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Operation of energy hubs with storage systems, solar, wind and biomass units connected to demand response aggregators

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Abstract-

Energy Hubs (EHs) play an important role in sustainable cities; they are multi-carrier energy systems that can satisfy different energy needs of consumers by relying on the conversion and storage of energy sources as well as renewable energy sources. With efficient and reliable energy supply, EHs may significantly contribute in developments of sustainable cities. In this paper, day-ahead scheduling of EHs is done, while they are connected to demand response aggregators. The studied EH includes photovoltaic and wind renewable sources, biomass, hydrogen electrolyzer, combined heat and power unit, solar heater, boiler, electric, thermal and hydrogen storage systems. Besides electric grid and gas network as input sources, EH may purchase electricity from demand response aggregators. Information gap decision theory (IGDT) is employed as a risk-aware method to handle uncertainties of electric, thermal and hydrogen demands, photovoltaic and wind power, solar heat and electricity prices. The scheduling is carried out from the perspective of the uncertainty free, risk-averse and risk-seeking decision-makers. The problem is formulated as a mixed-integer model and is solved using CPLEX solver in General algebraic modeling system (GAMS). The impact of risk awareness and deviation factors of critical and target costs on day-ahead scheduling and EH operation costs is investigated. The results show that the transaction with demand response aggregator decreases EH operation cost by 20.1%. The results also show that electric, thermal and hydron storage systems respectively decrease the operation cost by 3, 1.7 and 2.1%.

Index Terms- Energy hubs; Storage; Information gap decision theory; Risk; Uncertainty

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