

Sobhan Dorahaki, Masoud Rashidinejad, Seyed Farshad Fatemi Ardestani, Amir Abdollahi and Mohammad Reza Salehizadeh, 2023, Probabilistic/information gap decision theory-based bilevel optimal management for multi-carrier network by aggregating energy communities, *Renewable Power Generation, IET*, DOI: 10.1049/rpg2.12685

Abstract Energy communities are one of the vital puzzle pieces of future smart cities. This paper proposes a novel structure for a sustainable smart city by integrating energy communities in a multi-carrier energy network. Each energy community has a manager; the so-called Energy Community Managers (ECM), who trades energy with the upstream Multi-Carrier Network Operator (MCNO). On the other hand, MCNO participates in the upstream energy markets to satisfy the demands of energy communities by maximizing its own profit. Therefore, ECMs and MCNO should solve a bilevel optimization problem associated with some common variables at both levels such as: energy carrier price and the amount of energy carrier exchange. In fact, MCNO is the leader and ECMs are the followers of such a bilevel optimization problem. Strong duality is employed to convert the bilevel optimization into a single level, while uncertainties are modelled by information gap decision theory and a scenario-based approach. Sensitivity analysis shows that the thermal energy selling price and the gas buying price are the most crucial influencing on the profit of MCNO by 3.22% and -3.91% , respectively. Furthermore, the obtained results indicate that the risk attitude of the multi-carrier energy network operator has a critical role in the total profit.