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Optimal participation of prosumers in energy communities through a novel stochastic-robust day-ahead scheduling model

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Abstract-

With the advent of smart grids, novel businesses like energy communities are becoming more frequent, thus enabling alternative energy transactions for smart prosumers like peer-to-peer mechanisms, that may increment the efficiency of residential installations while reducing the electricity bill. However, the optimal participation in such frameworks is a formidable challenge because the multiple uncertainties involved and energy paths enabled, which increments the number of decision variables and pricing mechanisms. This paper addresses this issue by developing a novel day-ahead scheduling model for prosumers integrated in energy communities based on a stochastic-robust approach. The developed formulation contemplates energy transactions with the utility grid, the community and other peers, besides the intrinsic uncertainties that arise from these processes. The heterogeneity of the unknown parameters is effectively addressed by using different uncertainty models, thus, while the predictable parameters are modelled using robust formulation, the highly volatile uncertainties are treated via scenarios. A case study is presented with the aim of validating the new tool as well as analyse the different energy transactions and their monetary implications. The obtained results evidence the important role of storage assets in reducing the electricity bill by 86 %, which is achieved by incrementing the exportable capacity of the dwelling by 84 %. The impact of uncertainties is also studied, expecting more pessimistic profiles at expenses of incrementing the monetary cost in 0.37-$.

Index Terms- Energy communityPeer-to-peerProsumerSmart homeSmart grid

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