

A risk-aware P2P platform involving distributed generators, energy communities and storage assets

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Abstract-

The decentralization of power systems and networks calls up for a more active participation of end users. In this context, new market and power trading models are arisen. Catalyzed by the evolution of communication infrastructures under the Smart Grid concept, new paradigms such as peer-to-peer (P2P) trading are becoming more common nowadays. This paper develops a P2P platform model, involving the participation of distributed generators (dispatchable and renewable), storage facilities and energy communities. Economic-oriented models are presented for each peer, considering arbitrage capability from storage, generation and flexibility provision. An original market structure is proposed seeking for equilibrium among agents. Moreover, risk-aware operating strategies are developed, which consider adaptive interval formulation of uncertainties. The new approach allows adopting risk-averse or risk-seeker strategies, thus allowing to consider the impact of uncertainties in a flexible fashion. The new platform is tested on a 5-peers case. The impact of demand and renewable penetration on local prices is assessed, concluding that cheap generation contributes to reducing prices and thus improving the economy of users, which can trade energy locally under low prices. Moreover, the impact of uncertainties is also analyzed, observing that the uncertainty level and the risk strategy adopted impact notably on the expected realization of uncertainties. It is also shown that the developed tool effectively seeks for improving the economy of users, even when pessimistic conditions of uncertainties are assumed. Results demonstrate that energy communities are more severely impacted for uncertainties, due to their reduced regulation capability. Finally, the developed tool is further validated in fifty P2P instances from an economic and computational point of view.

Index Terms- Distributed generation; Energy community; Peer-to-peer trading; Risk-aware optimization

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