

Mitigating the impacts of community energy trading on distribution networks by considering contracted power network charges

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Abstract-

Driven by environmental and economic motives, different distributed energy resources (DERs) are being installed at a fast pace. The high penetration levels of DERs could result in technical issues at low voltage distribution networks (LVDNs) and lead to complex power system management. Therefore, many approaches were proposed in the literature to manage DERs to maximize their economic benefits while respecting the LVDNs's limits. One of the new approaches for managing DERs is community energy trading (CET). CET allows end users to exchange energy with each other besides energy exchange with retailers. Recent studies showed that CET could result in violations of the LVDNs limits if the grid constraints are not considered in the optimization model. These violations mainly happen due to the synchronized charging of electric vehicles and battery energy storage (i.e., flexible devices) connected to the LVDNs, which could require an infrastructure upgrade at LVDN. This paper proposes including contracted power cost in the CET objective function for energy cost minimization besides the energy cost to mitigate the impacts on LVDN. The proposed approach does not require the consideration of grid constraints in the CET model or interaction with the distribution system operator. The results showed that the proposed approach reduced the peak demand of the energy community (EC) by 34.3% without affecting its economic performance. Moreover, the proposed approach prevents violations of unbalanced LVDN limits in line loading, voltage unbalance, and voltage magnitude that occur in the CET scenario that does not consider contracted power cost.

Index Terms- Demand charges, energy community, energy community trading, grid tariff, local electricity market, network tariff, peer to peer energy trading, transactive energy.

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