Aggregator Operation in the Balancing Market Through Network-Constrained Transactive Energy

The future renewable-based power system will have an increased need for balancing power. Prosumers, having both generation and consumption capabilities, are expected to provide balancing power to the grid, if their flexibility can be appropriately managed. Meanwhile, undesirable line congestion and voltage violations may arise in the distribution network, when flexible resources respond to external control or price signals on a large scale. Hence, the development of an effective framework to coordinate flexibility at the distribution system level is of utmost importance. Such a framework should allow for an optimal provision of prosumer balancing power services within the boundaries of local network security constraints. In this study, a balancing market participation framework is proposed, adopting the concept of network-constrained transactive energy, to facilitate the interactions between the transmission system operator and aggregators who manage prosumer energy profiles. This framework retains user privacy and complies with the current market setup, where flexible energy is traded on the spot and balancing markets; however, it is ensured that the resulting energy profiles do not cause problems in the distribution network.