

Assessing the Impact and Quantifying the Value of Flexibility in Transactive Distribution Systems

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Distributed Flexibility (DF) is seen as a key tool in managing future distribution networks, but there are no comprehensive methods to quantify its value to stakeholders and impact on the network. Consequently, the potential costs and benefits of DF are uncertain, delaying the rollout of the concept onto real networks. This paper proposes a method to address that gap: a network-aware framework for modelling the interaction of DF with local and whole system markets to analyse the system performance in detail. The paper provides a set of mathematical models and algorithms to derive realistic supply and demand curves for flexibility in a distribution system, find the global equilibrium of multiple markets and services, model their impacts on networks, and perform cost-benefit analysis for stakeholders. The framework has been applied to a case study comprising a real network in England, forecast data of flexible demand and distributed generation, and the prices expected in the electricity system. The numerical study showed that DF can bring real value to all stakeholders when procured through markets; however, to maintain positive and consistent benefits to networks and stakeholders, appropriate price signals (i.e., tariffs and charges) must be designed for each network individually.