

An incentive-based framework for small-load flexibility providers

C. Valor Martínez; J.P. Chaves Ávila; V.K. Moreno

Abstract-

Integrating renewable energy sources into electricity systems is essential for achieving a sustainable, low-carbon future. Despite the benefits, the intermittent and variable nature of renewable power generation introduces significant challenges, highlighting the need for increased system flexibility. Although previous studies emphasize the importance of incentives to attract customer participation in flexibility provision and to ensure the viability of the aggregator business model, there remains a lack of a systematic, comprehensive, and integrated incentive model. This research introduces a comprehensive Incentive-Based Framework designed to harmonise the objectives of three key stakeholders: aggregators, small-load flexibility providers (customers), and system operators, including distribution and transmission system operators.

The development of this framework employs a dual-review approach. Initially, a literature review establishes the foundational principles critical for the viability of the aggregator business model. Subsequently, a review of existing projects examines flexibility initiatives across the United States, European Union, and the United Kingdom, identifying key components currently in use. This second phase exploits extensive, publicly accessible data from the mature U.S. market and enhances the model with insights from European projects. By integrating these analyses, the framework effectively aligns financial and operational aspects of flexibility provision with the perceived value from the customer's perspective, supporting the sustainability of aggregating flexibility from small customers. The findings and recommendations of this study offer valuable insights for policymakers, market operators, and stakeholders, fostering active customer engagement and facilitating the successful integration of renewable energy sources into electricity systems.

Index Terms- Explicit flexibility; Incentive-based flexibility; Aggregator; Small-load flexibility providers; Demand-response; Incentive-based framework

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