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Techno-economic Feasibility of A Trust and Grid-aware Coordination Scheme
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Abstract
The massive penetration of active customers throughout Home Energy Management Systems (HEMS) may cause adverse effects on the power grid, including rebound peaks, instabilities, and power congestion. The concept of coordination has arisen in literature to mitigate these effects and relieve power grid stress. Their advantages have been discussed for different market types as well as at different grid scales. However, it is imperative to develop proofs-of-concept and test not only the economic feasibility of such programs but also the technical one. This paper presents a cosimulation-based framework that facilitates economic and technical studies for coordination programs. A case study is presented, with eighteen residential users and a local coordinator within a Stackelberg game. At the customer level, flexibility is achieved through electric thermal storage (ETS). The program exploits salient features of blockchain algorithms to increase security at the demand aggregation level. The technical feasibility was evaluated through the Peak-to-average (PAR) ratio, active power losses, and the voltage profile using power flow methods over the IEEE 33-node feeder. This study's findings demonstrate the coordination programs' ability to bring economic benefits and reduce the PAR. Furthermore, they suggest that although coordination programs can assist in flattening the power profile, they could create adverse effects on the power grid in critical scenarios. © 2023 IEEE.

Index Keywords
Blockchain, Economic analysis, Electric load flow, Electric power system economics, Energy management systems, Heat storage, Smart power grids; Adverse effect, Block-chain, Demand response, Distributed energies, Distributed energy management, Electric thermal storage, Power flows, Power grids, Techno-economic feasibility, Thermal storage; Energy management

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