

Prosumers with PV-Battery Systems in the electricity markets – a mixed complementarity approach

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Overview

Previous studies have shown that decentralised sector coupling and flexibility options play an important role in the integration of renewable energies into energy systems in the future. Recent developments include increased investments in PV battery systems underlining the increased importance of decentralised flexibility. At the same time, the present design of retail tariffs means that private households operate coupled PV battery systems primarily with the aim of increasing self-consumption, although the flexibility could be utilised to support the power system.

Methods

Our contribution examines in a stylised setting which adjustments to the regulatory framework can work towards a system-oriented operation of decentralised flexibilities with a focus on PV battery systems. We use the format of Mixed Complementarity Problems (MCP) to combine the optimisation calculus of decentralised actors at the retail level with cost minimisation at the wholesale market level. A special feature of our approach is the explicit and detailed modelling of a retailer. As a link between the two markets he covers the household's demand with quantities from the wholesale market facing time-variant prices. However, he charges households a time independent retail-price. The generation-portfolio at the wholesale level is characterised by a significant share of renewables resulting in volatile prices. When considering decentralised actors, we focus on prosumers, which in our simplified setting are depicted as representative households with a PV system and battery storage.

Results

In our present results, we see the impact of regulatory interventions on prosumage households' investment decisions and consumption behavior. The retailer plays an essential role in transmitting the market signals of the wholesale market to the prosumage households. We expect to gain further insights by analyzing additional variations in regulatory interventions and sensitivities regarding electricity market conditions.

Conclusions

Complementing previous work, we use MCP modeling to gain further insights into the investment decisions and consumption behavior of decentralized actors that do not directly participate in the electricity wholesale market. We conclude that regulatory interventions we consider can reduce barriers to system-serving behavior of prosumage households.

References

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