TradeRES
New Markets Design & Models for 100% Renewable Power Systems

Agent-based modeling of Demand Response in the German power sector

Johannes Kochems and Christoph Schimeczek

German Aerospace Center – Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Stuttgart, Germany

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Summary

Demand response can contribute to balancing variable renewable generation. In the paper, we present a novel approach to model demand response in the agent-based electricity market model AMIRIS. Load shedding, i.e. curtailment of loads, is modeled by decomposing the demand curve into demand segments. These segments each contain a planned demanded quantity and a price that expresses the willingness to pay. Load shifting, i.e. shifting energy consumption from one point in time to another, is modeled with dynamic programming and a two-dimensional state definition, consisting of the current shift duration and a discrete energy level. The advantages of the dynamic programming approach used within the agent-based simulation are its computational efficiency as well as the possibility to incorporate different dispatch strategies for marketing load shifting capacity and different retail prices. The approach is first applied to stylized test cases to demonstrate its basic functionality. Furthermore, a system cost minimizing and a profit maximizing strategy for marketing demand response are compared against each other. The differences in dispatch decisions between the strategies are shown to increase with increasing portfolio size. Using the profit-maximizing strategy, more frequent activations with lower capacities are made. As a result, realized profit and system costs increase.

Highlights

- A novel modelling approach for demand response, comprising both, load shifting and load shedding, is introduced.
- A system cost-minimising and a profit maximising strategy are compared against each other.
- It is found that the profit maximising strategy leads to withdrawing capacities in order to increase profits, thereby also increasing system costs.
- It is found that the differences between the dispatch strategies increase with increasing size of the load shifting portfolio, i.e. the amount of load that can be shifted.

Info

The TradeRES project will develop and test innovative electricity market designs that can meet society's needs of a (near) 100% renewable power system. The market design will be tested in a sophisticated simulation environment in which real-world characteristics such as actors' limited foresight into the future and risk aversion are included.

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info@TradeRES.eu

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