

Reduction of Curtailment by Residential Demand-side Management – Secondary Effects on Electricity Markets

(5) Energiemärkte

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Motivation and Research Question

The ongoing expansion of renewable energy in Europe leads to growing requirements for curtailment in order to ensure stable grid operation. Flexibility options like residential demand-side management provide means to reduce these curtailment measures by increasing their consumption in times of excess production of renewables [1]. Appropriate incentives for residential customers are necessary and can be implemented by variable electricity rates [2]. Since this approach naturally alters the total residual load within the considered area, it also affects wholesale prices for electric energy. These effects can be quantified by simulation of residential DSM based on measured load curves and real curtailment data.

Methods

The DSM potential for residential customers is calculated by a pattern recognition algorithm which allows identifying individual appliances within the measure load curve [3]. Based on that, shifting of the operation times of these appliances according to grid requirements, i.e. dependent on curtailment in the respective region, is simulated [4]. This yields adjusted time series of residential energy consumption for all regions.

The EPEX SPOT applies a double auction mechanism for day-ahead price formation. The effects on the resulting prices can be modelled by adjusting historical bid curves according to the changes in total consumption of the residential sector [5]. In general, increased consumption leads to additional demand, which can be inserted in the curve and therefore to higher prices, whereas decreased consumption has the opposite effect. Energy system modelling offers a second possibility to determine the impact on electricity markets. By adjusting the load curves according to simulated DSM measures on the input side, this allows evaluation of the differences between a defined standard scenario and the DSM case. In order to assess the described methods, the results are examined, validated and compared regarding their applicability to the described problem.

Results and Conclusions

The calculations show that both described methods yield plausible results, i.e. price changes correlate with load variation. Therefore, the methodology appears suitable to assess the market effects of variable electricity rates.

As expected, comparison of the methods evinces minor discrepancies in the results. This can be explained by the different approaches of using and adjusting historical data on the one hand and modelling the whole energy system based on representative load profiles on the other. Nevertheless, both approaches provide useful insight in the possible effects of the described measures and lead to the conclusion that only small changes of the resulting prices are to be expected.

References

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