**DEMAND RESPONSE OF INDUSTRIAL ENERGY CUSTOMERS – TWO CASE STUDIES**

Industrie

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### Motivation

The work presented here is part of the European Union’s Horizon 2020 project BestRES [1]. In the BestRES project we investigate current barriers for energy aggregators and aim to improve their role in future electricity market designs. In the first stage, the project is focusing on existing European aggregator business models (BM) taking into account technical, economic, environmental and social benefits. In the second stage, improved business models are developed considering different market designs in various European countries with a focus on competitiveness. A broad variety of improved BMs has been developed considering RES generation or demand flexibilzation of residential and industrial customers. In this work we present the results and lessons learned from two aggregator BMs focusing on medium- to large-scale energy consumers:

1. Activation of end users’ flexibility to reduce wholesale market cost or imbalances in Portugal
2. Using the flexibility of energy customers as third party in Belgium

### Methodology

For an in-depth analysis of the BMs we use the modeling and simulation library Femto, which is developed at the Energy Economics Group, TU Wien, and written in Julia [2] using the JuMP [3] toolbox. This library consists of mixed-integer linear optimization models simulating the operation and dispatch of an aggregator’s customer portfolio on reserve, day-ahead and intraday markets.

In general, three types of aggregator customers can be considered for models created with Femto: batteries, renewable energy producers and flexible loads. For the work presented here we focus on flexible loads. They are described by their load profiles and variables for load increase and decrease, respectively. Several flexibility characteristics, like e.g. the maximal number or the maximal duration of flexibility activations, are modeled via auxiliary binary variables.

Models that can be built using this framework generally consist of three stages. In the first stage the bid size and price for reserve market auctions is determined. Here, different degrees of foresight and information about underlying merit order curves or opportunity revenues on spot markets can be simulated via different objective functions. In the second stage, the portfolio’s operation is optimized in terms of spot market prices respecting possible reserve market constraints. Finally, reserve market activations are simulated and intraday market trades are used to balance shift-able loads.

### Results and Conclusions

The results in both case studies indicate that demand side flexibilization can provide economic benefits for medium- to large-scale energy consumers. One interesting finding in the first case study is that cost reduction on the day-ahead spot market does not automatically go hand in hand with a reduction of the average CO2 emissions in the purchased energy mix.

The second case study shows that the services of a third party aggregator could provide economic value for energy customers with flexible loads. However, in the current legal framework in Belgium this requires bilateral contracts with the respective energy supplier, which often constitutes a significant barrier for BM implementation.

# References

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