

## REFLEX PhD Candidate

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### PHD THESIS

#### Title

The influence of market design on diffusion and operation of flexibility options in the electricity market under consideration of technological learning

#### Abstract

With rising shares of fluctuating renewable electricity generation, flexibility options such as storage technologies, flexible power plants and load management will play a crucial role in the future. Currently, two opposing trends can be observed: On the one hand, European pumped storage plants are confronted with economic challenges. A profitable storage operation on the day-ahead market relies on price spreads to compensate for the efficiency losses occurring during the storage process. However, due to increased feed-in of solar and wind power, both the price spread between day and night and the midday price-peak on the wholesale market have been drastically decreasing over the past years. On the other hand, photovoltaic battery storage systems are on the edge of becoming profitable for many households, which is mainly driven by rising retail electricity prices and the declining photovoltaic feed-in remuneration.

These developments underline the influence of the current electricity market design (i.e. an energy-only-market) and incentive schemes (such as feed-in remuneration) on investment decisions and operation of flexibility options. Potential regulatory changes include the introduction of capacity remuneration mechanisms that compensate for the provision of secured generation and demand flexibility capacities or the limitation of the maximum feed-in power of photovoltaic systems. Another strong driver of investment decisions are learning effects and the associated cost degression, once new technologies are becoming established on the market.

The aim of the thesis is a comprehensive analysis of the effects of different electricity market designs and incentive schemes on the diffusion and the operation of various flexibility options. Cost degression through technological learning as well as competition and interactions between the different technologies on the electricity market are considered. The analyses aim to determine the impacts on the achievement of climate targets, security of supply and the long-term development of electricity prices.

## PROFESSIONAL EXPERIENCE

- since 05/2016    Research Associate at Karlsruhe Institute of Technology, Institute for Industrial Production, Chair of Energy Economics
- 06/2015 –  
04/2016        Research Assistant at Fraunhofer Institute for Systems and Innovation Research, Competence Center Energy Technology and Energy Systems
- 07/2010 –  
09/2013        Dual student at Siemens AG, Logistics and Airport Solutions

## EDUCATION

- 10/2013 –  
04/2016        Studies of Energy Science and Engineering at TU Darmstadt, Degree: Master of Science (M.Sc.)
- 10/2010 –  
09/2013        Studies of Mechanical Engineering and Business Administration at DHBW Ravensburg, Degree: Bachelor of Engineering (B.Eng.)

## RESEARCH INTERESTS

- Agent-based simulation
- Electricity market design
- Flexibility options

## PUBLICATIONS AND CONFERENCE PRESENTATIONS

Hladik, D.; Fraunholz, C.; Kunze, R. (2017). Zwei Preiszonen für Deutschland – Eine modellbasierte Analyse der langfristigen Auswirkungen. 12. Fachtagung Optimierung in der Energiewirtschaft: Würzburg, 8–9 November 2017, 145–157, VDI-Verlag, Düsseldorf.

Fraunholz, C.; Zimmermann, F.; Keles, D.; Fichtner, W. (2017). Price-based versus load-smoothing pumped storage operation: Long-term impacts on generation adequacy. 14th International Conference on the European Energy Market (EEM), 6–9 June 2017, Dresden, Germany, IEEE, Piscataway (NJ).

Fraunholz, C.; Keles, D.; Fichtner, W. (2017). Simulation von lastglättendem und preisbasiertem Einsatz der deutschen Pumpspeicherkraftwerke. 10. Internationale Energiewirtschaftstagung, Vienna, Austria, 15–17 February 2017.