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The German balancing energy market reform: Analyzing effects on prices, liquidity and competition

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The increasing share of renewable energy sources increases uncertainty in the power supply until shortly before the time of delivery. In addition to increased trading activity on the continuous intraday market, ancillary services have also gained importance as a critical tool for maintaining grid stability (Hirth et al., 2015). Complementary to the increasing RES share, new technologies such as large-scale battery energy storage systems (BESS) are entering the market at scale. BESS are well-suited to address short-term supply-demand imbalances and are increasingly positioned to play a pivotal role in the provision of balancing services (Figgener et al., 2022).

The German balancing market is divided into a capacity market and an energy market. Participation in the capacity market is possible until 9 am the previous day. Afterwards, participation in the energy market is required, with submission windows closing 25 minutes prior to delivery. In June 2022, the German Transmission System Operators (TSOs) joined the PICASSO platform, designed for the joint activation of aFRR of European TSOs (European Commission, 2017). The integration of the PICASSO platform requires additional changes to the aFRR energy market, which amounts to a reform. Before this reform, market participation required a preceding power bid in the capacity market. Following the reform, participants are permitted to place energy-only bids in the RAM, with submission windows closing 25 minutes prior to delivery. Furthermore, the market was changed from a pay-as-bid to a pay-as-cleared mechanism.

Therefore, we aim to analyze whether the reform has reached its goals by focusing on the analysis of balancing energy market prices, leading to the following research questions:

• Has the reform led to lower price levels in the German balancing energy market?

• What factors influence the price in the balancing energy market before and after the reform?

We hypothesize that the reform led to a decrease in positive balancing energy prices and an increase in negative prices due to the market reform.

The existing body of literature primarily focuses on short-term forecasting of imbalance prices, with only a few studies investigating the energy market of ancillary services. Narajewski (2022) evaluates short-term forecasting methods for the German imbalance price using various methods. The study finds that while advanced methods offer gains in empirical coverage, they do not substantially outperform the naïve benchmark. Dumas et al. (2019) develop probabilistic forecasting models for imbalance prices in the Belgian context. Their study highlights the importance of quantifying forecast uncertainty and demonstrates the added value of probabilistic approaches in operational planning for system operators and market participants. Merten et al. (2020) focus specifically on the automatic Frequency Restoration Reserve (aFRR) market and propose a methodology for forecasting aFRR market outcomes using various statistical and machine learning techniques. Their work compares different approaches to forecasting activation prices and volumes.

We investigate the achievement of the RAM reform in 2022 in the aFRR market, focusing on three key dimensions: price levels, market liquidity, and competition. Our empirical approach employs a counterfactual econometric analysis to assess whether the reform has achieved its intended objectives. Autoregressive effects of previous RAM prices, variables such as the connection of further countries to the PICASSO platform, intraday prices, commodity prices, residual load and renewable energy forecasts, power plant outages, and the increase in BESS are considered.

Results of the Chow test show a significant break at the time of the reform. Nevertheless, the result shows an increase in positive and a decrease in negative balancing energy prices. Switching from a pay-as-bid to a pay-as-cleared regime might increase overall price level and volatility after the reform. We conduct OLS regression analysis with varying specifications. Stationarity of the dependent and independent variables has been tested, followed by cointegration of the models. For both positive and negative prices, the inclusion of a reform dummy variable reveals coefficients that align with the results of the Chow test. However, we do

see that changing the pricing rule alone may be insufficient to reduce balancing energy prices, but market liquidity and participation likely exert a stronger influence. Nevertheless, the dummies for further countries are consistent with their hypothesis and decrease positive and increase negative prices. A time series method such as SARIMAX will be part of our future research.

References

Dumas, J., Boukas, I., de Villena, M. M., Mathieu, S., & Cornélusse, B. (2019, September). Probabilistic forecasting of imbalance prices in the Belgian context. In 2019 16th International Conference on the European Energy Market (EEM) (pp. 1-7). IEEE.

European Commission (2017): Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing. url: https://eur-lex.europa.eu/eli/reg/2017/2195/oj.

Figgener, J., Hecht, C., Haberschusz, D., Bors, J., Spreuer, K. G., Kairies, K.-P., Stenzel, P., and Sauer, D. U. (2022): The development of battery storage systems in Germany: A market review (status 2023). In: arXiv preprint arXiv:2203.06762. doi: 10.48550/arXiv.2203.06762.

Hirth, L. and Ziegenhagen, I. (2015): Balancing power and variable renewables: Three links. In: Renewable and Sustainable Energy Reviews, 50, pp. 1035–1051. doi: 10.1016/j.rser.2015.04.180.

Merten, M., Ruecker, F., Schoeneberger, I., & Sauer, D. U. (2020). Automatic frequency restoration reserve market prediction: Methodology and comparison of various approaches. Applied energy, 268, 114978.

Narajewski, M. (2022). Probabilistic forecasting of German electricity imbalance prices.
Energies, 15(14), 4976.

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