GENERATION ADEQUACY IN THE GERMAN ELECTRICITY MARKET: THE EFFICIENCY OF MARKET SPLITTING AND A STRATEGIC RESERVE

Christoph Fraunholz, Karlsruhe Institute of Technology, Chair of Energy Economics, +49721-60844668, christoph.fraunholz@kit.edu
Dirk Hladik, TU Dresden, Chair of Energy Economics, +49351-46339762, dirk.hladik@tu-dresden.de
Dogan Keles, Karlsruhe Institute of Technology, Chair of Energy Economics, +49721-60844566, dogan.keles@kit.edu

Overview

With increasing shares of electricity generation from renewable energy sources, questions related to a secure supply of electricity – and generation adequacy in particular – gain in importance for European policy makers. In this contribution, the focus lies on Germany, which is currently confronted with multiple potential threats to maintaining long-term generation adequacy, especially in the southern part of the country: Firstly, the ongoing phase-out of nuclear power leads to decommissioning of large generation capacities, which are mainly located in Southern Germany. Secondly, decreasing electricity prices provide poor investment incentives and might lead to economic decommissioning of other thermal power plants. Thirdly, wind power generation in Northern Germany increases faster than transmission capacities of the electrical grid, frequently resulting in a day-ahead market dispatch that is physically infeasible and has to be redispatched. Thus, congestion management volumes have risen tremendously in the past years [1].

As a consequence, Germany is planning to implement a strategic reserve in order to incentivize investments in generation capacity and avoid economic decommissioning of power plants [2]. However, without a regional component, this measure might not lead to a reduced need for congestion management and thus secure generation adequacy in Southern Germany. Therefore, a splitting of the German electricity market in a northern and a southern zone could be an economically more efficient solution providing regional investment signals and maintaining generation adequacy throughout the country. In this contribution, the long-term efficiency of both instruments – a strategic reserve and market splitting – is analysed and compared for the German electricity market with a focus on the development of the dispatchable generation capacities, system costs and generation adequacy.

Methods

In order to address this research question, short-term dispatch decisions, long-term capacity expansion planning and transmission grid restrictions have to be considered at the same time. Since a single model is not capable of including all three aspects in a reasonable level of detail, a coupling of the agent-based spot market model PowerACE and the optimising power flow model ELMOD is applied. Both models use an identical set of power plants in the base year and hourly profiles for demand and feed-in of renewable energies. ELMOD further takes into account the grid topology in the base year and the expected grid expansion according to the power grid development plan [3], while a list of investment options with associated techno-economic power plant parameters is used in PowerACE. Although the focus lies on Germany, all neighboring countries are also modelled to account for cross-border effects.

In a first step, ELMOD is used to determine an optimal division of the German price zone derived from the most congested transmission lines in the base year. The resulting zonal configuration and the maximum trading capacities between the two zones are then transferred to PowerACE. This step is only required for the market splitting scenario. Subsequently, PowerACE is applied to simulate the hourly dispatch of the power plants and the future development of the power plant portfolio and returns these information to ELMOD. Finally, ELMOD can be used to determine the necessary congestion management measures, i.e. curtailment of renewable energies and redispatching.

Results

In this contribution, three different scenarios are considered. While the market design in the German neighboring countries is the same in all scenarios, the German market design is varied: Firstly, an energy-only market is considered as a reference. Secondly, a split of the German market in a northern and a southern zone is investigated. Thirdly, an energy-only market with an additional strategic reserve is analysed. The different settings are then compared in terms of the system costs – consisting of the costs for both electricity generation and congestion management – and the development of the conventional generation capacities. Further, some indicators to evaluate generation adequacy in Nothern and Southern Germany are applied.

Conclusions

In this contribution, the long-term efficiency of two different instruments aiming to secure generation adequacy in Germany – namely the implementation of a strategic reserve and a split of the German market in a southern and a northern zone – are analysed and compared with each other as well as with the current situation of an energy-only market in Germany. Implications drawn from this analysis can be used by policy makers when trying to find a suitable design of the German electricity market, which maintains generation adequacy in a efficient manner.

References

[1] Bundesnetzagentur and Bundeskartellamt: Monitoring report 2016. Bonn 2016. URL: https://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/BNetzA/PressSection/ReportsPublications/2016/MonitoringReport_2016.pdf

[2] European Commission: State aid – Commission opens in-depth investigation into German plans for electricity capacity reserve. Brussels 2017. URL: http://europa.eu/rapid/press-release_IP-17-903_en.htm

[3] ENTSO-E: Ten Year Network Development Plan 2016. Market Modeling Data, 2016. URL: https://www.entsoe.eu/Documents/TYNDP%20documents/TYNDP%202016/rgips/TYNDP2016%20market%20modelling%20data.xlsx