Modelling congestion management in the context of flow-based market coupling

Themenbereich (6) Modellierung
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Motivation and Research Question

Energy market modelling lacks an approach that tackles the implications of flow-based market coupling on congestion management in European electricity markets. Especially in the context of high shares of renewable energy, the topic is becoming even more important. Usually, congestion management is calculated on the basis of a simple load flow model incorporating available transfer capacities in terms of Net Transfer Capacities (NTCs), like in Grimm et al. (2017) or Nüßler (2012). Even ENTSO-E's mid-term adequacy report (ENTSO-E, 2018) does not consider flow-based market coupling yet. This paper suggests a modelling approach that incorporates flow-based market coupling in the calculation of zone-specific congestion.

Methodology

The modelling approach is based on the profound EDisOn (**E**lectricity **Dis**patch **O**ptimizatio**n**) model, as described and applied in Burgholzer and Auer (2016) and Dallinger et al. (2018). The European day-ahead market for electricity is simulated incorporating a detailed technical perspective on the generation, storage and load side on the one hand, and an application of flow-based market coupling on the other hand. Since flow-based market coupling demands a DC-load-flow model, loop flows are considered in the network structure. Dispatch on the electricity market is, if necessary, able to include demand for balancing energy as well as for heat in the context of power-to-heat. On the basis of this spot-market result, congestion management can be calculated zone-specific by minimizing congestion management cost. Flow-based market coupling provides a result for the European electricity market which already incorporates loop flows and physical line constraints. Nevertheless, congestion within a price zone can occur, if a more detailed network model is regarded for this zone. Possible extensions/variations to this model approach can be the consideration of technical ramp-limits, like in Vargas et al. (2015), or the (n-1)-Criterion that is neglected on the day-ahead market and enter the detailed load flow model on the zone-specific congestion stage.

Results and Conclusion

The calculation of congestion management in the face of flow-based market coupling is the major result to be taken from the model. This result can be used in many different real-world applications. Line bottlenecks within the control area of a TSO can therefore be identified and removed with the background of an up-to-date modelling approach. An alternative application would be the identification of line bottlenecks within (international) price zones in order to compare market designs. Thus, line expansion projects are one possibility to be evaluated.
In addition to that, the impact of different aspects of the electricity market on the determination of market prices can be considered. An example for this is the usage of storage devices. Projects regarding storage devices can therefore be analyzed by observing effects on domestic flows and market prices.
The adaptation of energy market modelling procedures to the quickly changing electricity market is a more than recent topic for Europe. The proposed modelling approach is able to incorporate recent electricity market structures and can be used for various applications of research projects.

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