Influence of the COVID-19 pandemic on Flow-Based Market Coupling

Integrierte Netze der Zukunft / Integrated Future Networks
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Motivation and goal

The year 2020 caused a global economic downturn due to the COVID-19 pandemic. Thus, the electricity demand and markets in Europe were affected. The transmission grid usage changed and thereby the commercially interconnector capacities in the Single Day-Ahead Coupling (SDAC) were used differently. One advantage of the SDAC in Europe lies within the Flow-Based Market Coupling (FBMC) [1]. It enables higher commercial exchange capacities due to a more complex, but therefore more accurate approximation of physical flows. Against this background, this paper studies the influence of COVID-19 impacts on flow-based exchange capacities and resulting commercial flows in order to quantitatively assess the techno-economic advantages of FBMC.

Methodical approach

The analysis covers a comparison of the year 2019 and 2020 for the Central Western European (CWE) region which currently falls under the FBMC regime. One exemplary average domain is shown in the following figure 1 for the years 2019 and 2020. The graph was derived by calculating the average restrictions based on all FBMC restriction intersection points. The intersection points were calculated based on all hourly historical flow-based domains for flows from Germany to France and Austria. The used raw data is publicly available at the Joint Allocation Office. The differences between the year 2019 and 2020 indicate that in the COVID-19 year 2020 the exchange capacities were higher than in the year before. Further, the average exchange restriction shape occurs closer to bilateral maximum exchange capacities in 2020. The variability of restrictions for exchanges between Germany and Austria had a very low variance in 2020. In contrast, restrictions for exchanges between Germany and France occurred with a high variability in comparison to 2019.

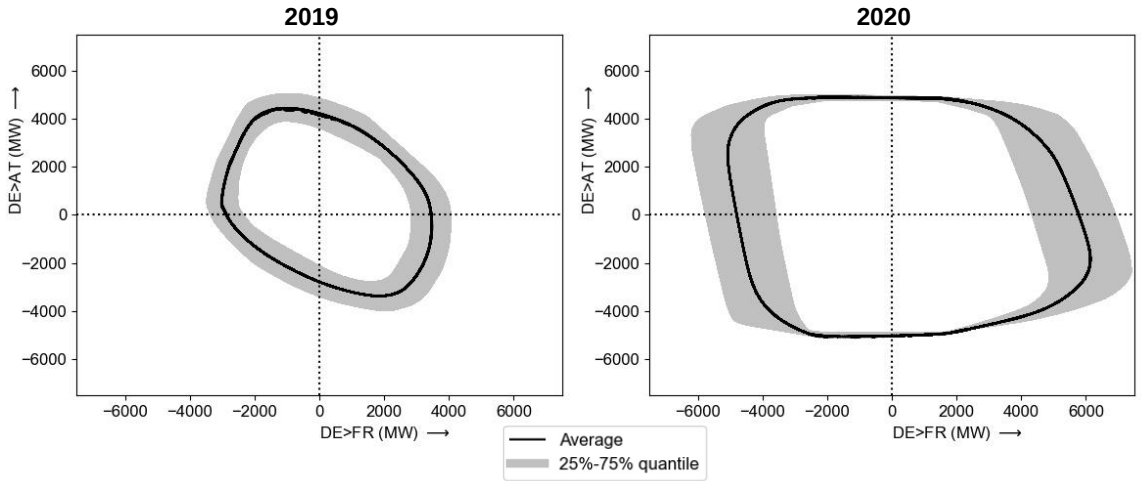

Figure 1: Average flow-based domains for bilateral flows from Germany to France and Austria

Based on such exchange capacity analysis in combination to demand and supply changes, a fundamental market simulation model is parameterized and applied [2]. The optimization-based electricity market simulation models the hybrid FBMC and Net Transfer Capacity (NTC) implementation for whole Europe. In an additional scenario the input data for the exchange capacities are switched from

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the flow-based model to maximum bilateral exchanges as NTC to deduce the market results based on a less accurate, but less complex market design [3]. Hourly NTC are derived from the historical flow-based domains such that the bilateral exchanges are maximized in accordance with the FBMC restrictions. In doing so the technical feasibility can be maintained since the NTC domain lies completely inside the flow-based domain. Simulation runs are compared for the years 2019 and 2020 in order to quantitatively assess the socio-economic benefit of the FBMC.

Results and discussion

The electricity market for the years 2019 and 2020 is simulated with hourly temporal resolution, covers the entire ENTSO-E area and models approximately 5000 generation, consumption and storage units. The historical FBMC restrictions were considered entirely for both years, which counted 1.29 million in 2019 and 1.36 million in 2020. One exemplary result lies within the total generation cost for both years displayed in figure 2. It depicts a comparison between the NTC and FBMC run as well as the change in total cost divided into the CWE and the ENTSO-E region excluding CWE.

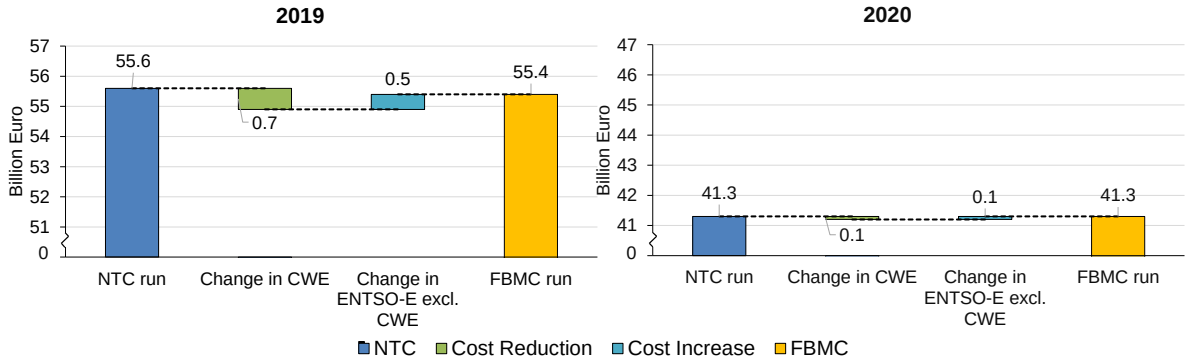

Figure 2: Derived total annual generation cost in the ENTSO-E region

In the year 2019 the generation cost in the FBMC run lies 200 million Euro per year below the NTC run due to higher degrees of freedom in exchange. FBMC leads to cost differences in opposite directions. The more flexible exchanges in CWE are used for reducing internal generation amounts and costs, resulting in less net exports to the region outside. The resulting lower net generation respectively net balance in CWE is compensated with higher electricity generation in the surrounding non-CWE region. In the year 2020 the generation cost changes between the NTC and the FBMC run followed the same structure. However, in 2020 the overall generation cost do no differ significantly between the two market coupling designs. This can be partly explained by the flow-based domain shape which occurred closer to NTC as displayed in figure 1.

Literature references

[1] European Network of Transmission Systems Operators for Electricity (ENTSO-E): Single Day-Ahead Coupling (SDAC), Brussels, 2021.

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[3] Van den Bergh, K., Boury, J., Delarue, E.: The Flow-Based Market Coupling in Central Western Europe: Concepts and Definitions, The Electricity Journal, volume 29, issue 1, Leuven, 2016.