

“STUDY ON COOPERATION BETWEEN TRANSMISSION SYSTEM OPERATORS PSE S.A. AND 50HERTZ TRANSMISSION GMBH”

Executive summary

The two Transmission System Operators - 50Hertz Transmission GmbH (50Hertz) and Polskie Sieci Elektroenergetyczne S.A. (PSE), in cooperation with the German and Polish Ministries responsible for energy finalized a common „German-Polish Study on cooperation between Transmission System Operators PSE and 50Hertz in long-term and mid-term perspectives”.

The Cooperation Study was divided into two main parts – mid-term and long-term analysis.

The **first part of the Study** - the mid-term investigation - aimed at improving coordination of operational planning processes of both Parties.

The following issues and tasks were identified as important for both Parties:

- (1) improving the quality of prediction of power flows on the German-Polish border for the D-3 and D-2 time horizons,
- (2) coordinated use of cross-border remedial actions in the region (phase shifting transformers and bilateral and multilateral redispatch) including their cost sharing,
- (3) improving coordination of mid-term (up to 3 years) planning processes.

As for the first subject the TSOs jointly came to the conclusion that results of the current weekly planning process in Germany cannot be used for improving capacity calculation and allocation processes in Poland. PSE and 50 Hertz agreed to support development of flow based methodology in the region in order to achieve a higher quality of cross-border power flow prediction.

Coordinated use of cross-border remedial actions in the region requires advanced software solutions that are currently not available. Having developed an IT tool for supporting optimized use of remedial measures at the German-Polish border, the TSOs concluded that advanced coordination as well as cost sharing is possible in a region-wide mechanism only.

Discussing possible improvements of planning processes up to 3 years and better coordination, PSE and 50Hertz agreed on regular exchanges every half a year.

In the **second part of the Study** the TSOs conducted the investigation regarding the long-term prospects of transmission systems operation in the region from the perspective of future market outcomes.

The key findings were achieved as a result of the modeling process performed by the National Centre for Nuclear Research (NCBJ) in Warsaw, consulted and supervised by the experts of both TSOs'. Market data were based on the Pan-European Market Modeling Database, used among others for preparation of the ENTSO-E Ten-Year Network Development Plans, with certain adaptations for Germany and Poland in terms of installed power and line capacities. Data were processed in an innovative way by a Flow Based Market Coupling algorithm (designed especially for the Study).

In order to perform the task, NCBJ was to tackle two major issues:

1. Constructing, testing and understanding the model of European market using a Flow-Based Market Coupling mechanism,
2. Exploring sensitivity of market's and power systems' response to different scenarios.

The modeling framework developed for this investigation proved to be a valuable tool for testing policies and infrastructural enhancements. Furthermore, the study exemplified the first cooperation of German and Polish TSOs with practical use of the Flow Based Market Coupling. The import and export position of each country,

wholesale power prices, German-Polish electricity trades and transmission line congestions were central elements of this investigation.

Two target years were selected for simulations: 2025 and 2030. Geographical coverage of the study was Europe, however different regions were treated with their individualized resolutions. For each target year, a reference scenario was established in accordance to the Pan-European Market Modeling Database adapted for Poland and for Germany¹ to the best knowledge of the TSOs. Intertemporal constraints, minimum run-times and maintenance periods were integrated. A full run covered every hour of one year. Alternative scenarios were based on the reference ones, but with infrastructural or policy-based modifications, hence facilitating a sensitivity test of the simulated systems' reaction for alternative scenarios that were as follows:

1. delayed procurement of German internal HVDC lines in 2025,
2. enhanced interconnectors' capacities by introducing a "minimum Remaining Available Margin" (minimum RAM) in 2025 according to the Clean Energy Package,
3. adjustment of demand, generation and transmission infrastructure in Poland in 2030,
4. introduction of enhanced interconnectors' capacities in accordance with the Clean Energy Package combined with reduced Polish demand for electricity in 2030.

Market simulations were followed by a power flow analysis.

The cooperation of PSE and 50Hertz together with the team of academic researchers of NCBJ led to the identification of future challenges regarding regional markets and networks.

Key messages received from analysis based on reference scenarios 2025 and 2030 and assumptions regarding the input data are as follows:

- The Polish wholesale market clearing price turns from the lowest ones in 2025 to the highest ones in 2030².
- While balanced in 2025, Poland's electricity imports make up to 15% of its total demand in 2030.
- Germany is a major electricity exporter in both 2025 and 2030.
- More than half of Polish electricity imports are transferred through the German-Polish border and that makes up to 8% of the total Polish demand.
- Future internal grid enhancements in Germany and Poland and flow-based market coupling support the growth of German-Polish electricity trade by a factor of five.

Key messages derived from the alternative scenarios are as follows:

1. Delayed commissioning of inner-German HVDC lines (not yet there in 2025)
 - additional congestions occur mainly in the northern German grid;
 - social welfare losses in Europe and higher curtailment of renewable energy.
2. Increased interconnector transmission capacity as required by Clean Energy Package in 2025
 - application of 70% minimum RAM on interconnector capacities increases Polish-German electricity exchange by one fifth in both directions;
 - no new grid congestions occur in Poland although a few congested lines appear close to the Polish-German border. Higher congestions appear in the German grid.
3. Postponed modernization of Polish units beyond 2030
 - postponed modernization of old fossil fuel plants and a lower increase in renewable generation further increases the Polish wholesale market clearing prices in 2030;

¹ Before decision about coal phase-out.

² The resulting market clearing prices are calculated with efficiency factors per power plant type including the cost of CO₂. -Subsidies for RES are naturally not part of the market clearing price.

- cross-border grid constraints at the southern and western Polish border hinder full usage of economically electricity from other countries to balance Polish power prices in 2030.
4. Increased interconnector capacities required by the Clean Energy Package combined with decreased Polish power demand in 2030
 - assuming 70% minimum RAM on interconnectors following the Clean Energy Package and lower Polish demand in 2030, both the Polish wholesale electricity price and import dependence decrease compared to the reference scenario.

The outcomes presented above provide a selection of major trends regarding the German-Polish electricity exchange. Both qualitative and quantitative analyses contribute to the ongoing discussion on the future challenges of electricity trades and system operation.

Simulations of electricity trades and subsequent analyses of regional power flows for different scenarios have led to the following observations:

1. The wholesale market clearing price spread between Germany and Poland is expected to rise in the long-run due to peaking Polish prices.
2. The utilization of German-Polish interconnectors is growing. This originates from expected growth of demand for imported energy in Poland. Both, price differences between the neighbors and the capacity of their interconnectors make German-Polish transmission lines crucial for satisfying Polish consumption. Up to 50% of total electricity imports are expected to be delivered to Poland from its western neighbor.

In the future, some grid congestions are identified in northern Germany while the Polish grid faces fewer congestions assuming the reference grid development. The scenarios display noticeable differences in congestion pattern in close proximity to cross-border transmission lines in Poland and Germany. An Advisory Group – a group of eight German and Polish experts from the energy field – representatives of ministries, regulators, universities, research institutes and consulting companies facilitated discussions over the assumptions of the Study, the quality of the models adopted and the executed calculations. Two meetings of the Advisory Group and the project team were held in July 2018 and June 2019 to discuss the study's proceedings and results.