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Breaking borders with JETRA: empowering long-term contracts and forward market coupling in Europe – Why nodal pricing reform is essential.

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Overview

Tapping the potential of renewable energy resource complementarity over large geographical areas with cross-border market creates a more optimized and lower cost energy system in Europe. In the wake of recent energy crisis, the importance of stable price from long-term markets for consumers and instruments to hedge against spot market volatility is greater still. At the same time, certain contractual arrangements in long-term market such as power purchase agreement in combination with the physical or financial transmission rights can generate stable cash flows for renewable investors. The establishment of long-term cross-border market with bilateral contracts and wholesale energy sales well in advance is of vital importance for the future. The design and allocation of cross-border transmission rights stand at the centre of the long-term market development.

In this research, joint energy and transmission right auction (JETRA) developed by O'Neil et al is proposed for long-term cross-border market development [1]. JETRA provides the possibility to auction energy, financial transmission rights and physical transmission rights simultaneously. The energy sale or purchase is brought into the forward market with implicit transmission access prior to the day-ahead market. The development of transmission rights as congestion hedging tools enables bilateral contracts at scale across borders such as cross-border PPAs. Market players can sign bilateral contracts to procure energy and hedge congestion cost risk by obtaining transmission rights in auctions.

The key characteristic that differentiates the proposed long-term auction from the priority long-term interconnection access is that the market clearing in JETRA is financial prior to the real time market. The market outcomes are liquidated after each round. Temporally, it does not give prioritised transmission capacity to the long-term market participants compared with the ones in spot market. Liquidated outcomes imply that auctions prior to real time do not interfere with physical dispatch to optimize the whole system according to real time constraints. In particular, the pricing and settlement rule is designed to link products in multiple timeframes and keep consistency between long-term and spot markets. This could enable the network users that procures energy or transmission rights to financially hedge the spot market price and congestion risk.

This research compares the implementation of JETRA under nodal pricing and compare its performance under zonal pricing. The compatibility of the current European zonal market design and governance with JETRA is investigated in terms of consistency between markets in different time frames and consistency between intra and inter bidding zone markets.

Method

Institutional setting, market rules and grid modelling of the JETRA implementation is compared between nodal pricing and zonal pricing. A case study based on a stylised network is used to illustrate the implementation of JETRA. The flow-based market coupling mechanism currently implemented in the day-ahead market is adapted for JETRA under zonal pricing. The institutional settings and market mechanisms for the long-term auction are envisioned to follow the

conventions of flow-based market coupling in day-ahead time frame, while taking JETRA requirements into account in grid modelling.

By examining and comparing the grid modelling process and auctioning outcomes between nodal and zonal markets, the bottlenecks of flow-based zonal market design in supporting the joint auction are identified. In the long-term time frame, important aspects to examine are the role of higher uncertainties and the information asymmetry between market players and the system operator. We examine how inefficiencies from current institutional setups and flow-based market coupling methodology are amplified in the long-term time frame.

Results

Under nodal pricing, independent system operator takes on the role of operating network and market simultaneously in the implementation of JETRA. The auction results are financial prior to the real-time market and a consistent nodal grid model is used across different timeframes. In the current European electricity market, governance of day-ahead market coupling revolving around zonal pricing determines the institution setups and their functions, which exert a fundamental impact on long-term market development. TSOs and power exchanges interact to clear the long-term and day-ahead market. In the implementation of JETRA, market clearing under zonal pricing can only be made financial in the time frames prior to the day-ahead, since dispatch from the day-ahead on is physical. The final payback to transmission right holders or energy contracts in forward markets are settled at the day-ahead price.

Compatibility of current European flow-based market coupling zonal design with JETRA is problematic when it comes to implementing JETRA to couple long-term market. Precondition of well-functioning hedging for cross-border trade is to keep the firmness of financial transmission rights. At the same time, increasing uncertainties in the long-term time frame and flexibility of products in JETRA further impedes TSOs to calculate efficient flow-based market coupling parameters. The grid modelling of flow-base market coupling assumes that the gap between the base case and the real-time operating point is filled by a set of generators changing their output with a predetermined share [2]. This assumption is challenged by the JETRA implementation. Prediction of transaction patterns is much more challenging for TSOs in the long-term time frame as the trade involves multiple hedging instruments and inter-temporal hedging strategies by market players.

To ensure the firmness of FTR in the forward market, a much more conservative grid modelling has to be made [3] [4]. This has profound implications for the effectiveness of the hedging instruments and long-term cross-border market development. From the system operator perspective, there is less interconnection capacity utilized for cross-border trade under zonal pricing, compared to nodal pricing. In the case study, revenue adequacy for the system operator is breached with both national based and integrated cross-border redispatch. From the grid user perspective, the hedging function of long-term cross-border transmission rights and energy contract is much weaker in the joint auction under zonal pricing compared to nodal pricing.

Conclusion

Incorporating energy and transmission rights in a joint auction ensures equal network utilization between long-term contracts and wholesale energy bids. However, the success of establishing an efficient long-term market through this joint auction of energy and transmission rights is contingent on the underlying market structure. The auction outcomes under zonal pricing, whether being physical or financial, can influence how multi-settlement rules can link up markets and thus affect revenue adequacy for the system operator. Importantly, our study highlights that a shift from zonal pricing to nodal pricing is a necessary condition for developing an efficient long-term market that incorporates the joint auction. To achieve this, TSOs and power exchanges need to be merged to enable simultaneous optimization of network and market conditions in different time frames.

References

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