

Andrea Biancardi, Carla Mendes, Iain Staffell

STORAGE BATTERIES AS BOTH COMPLEMENTS AND SUBSTITUTES TO CROSS-BORDER INTERCONNECTIONS

Andrea Biancardi: SDA Bocconi School of Management, Milan 20136, Italy and Centre for Environmental Policy, Imperial College London, London SW7 1NE, UK

Phone: +39 3287611831, e-mail: andrea.biancardi@sdabocconi.it

Carla Mendes: Centre for Environmental Policy, Imperial College London, London SW7 1NE, UK

e-mail: c.tavares-mendes@imperial.ac.uk

Iain Staffell: Centre for Environmental Policy, Imperial College London, London SW7 1NE, UK

e-mail: i.staffell@imperial.ac.uk

Overview

Cross-border interconnectors play a crucial role in decarbonizing power systems and increasing energy security, but high costs and risks hinder their implementation. At the same time, non-wire alternatives, such as electricity storage batteries, are becoming increasingly popular as a cost-effective solution to network limitations, reducing the need for costly network upgrades and reinforcements. The adoption of storage batteries may also erode the profitability of interconnectors, making these investments less justifiable, both for merchant investors and transmission system operators (TSOs). This paper uses a European electricity market model to quantify the impact of storage battery uptake on cross-border interconnector profitability. The study explores various scenarios of battery diffusion across Europe by 2030 and aims to inform policymakers about interconnection transmission capacity conservation under different adoption scenarios.

Methods

The study utilizes the Euromod model to evaluate the profitability associated with cross-border price arbitrage through interconnectors and to assess the impact of battery storage diffusion on interconnectors' profits across Europe. Euromod is an advanced tool that improves a classic linear dispatch model by replicating historical price time-series with greater precision. It covers a vast geographical region, including 27 European countries, and aims to minimize total system costs with respect to dispatch, storage, and interconnectors. To assess the impact of battery deployment on interconnector profitability, the study employs three different scenarios of battery storage deployment. The study also aims to determine the transmission quantity needed to achieve the same interconnectors' profit as in the base case scenario. This is achieved by simulating the total surplus across the European network under reduced transmission grid sizes and comparing it with the base case which is calculated according to ENTSO-E TYNDP (Ten-Year Network Development Plan). Additionally, the study analyzes the absolute reduction in the grid size needed to achieve the same total surplus and estimates the potential reduction in new planned capacity in TYNDP.

Results

A 4-year study evaluated Euromod's accuracy in depicting transmission flows and market prices across all European countries and assessing interconnector revenue simulation. It replicated most surplus estimation in Europe with justifiable variations, without compromising reliability. Most importantly, assessing the impact of battery capacity on transmission profitability, the study found that higher capacity and renewable energy's price volatility would increase transmission surplus, but higher battery penetration would result in a significant reduction. To achieve the same expected total surplus as projected by TYNDP in 2030 under the different battery uptake scenarios, the total grid size would have to be reduced on average by 6-7% compared to the TYNDP plan. This means that between 26-33% of new transmission capacity planned in TYNDP between 2020 and 2030 would not be built to achieve this reduction.

Conclusions

The study finds that batteries both complement and substitute interconnectors in the power grid. Batteries enhance energy security and stabilize market prices by reducing price volatility, but they can also pose a challenge to the profitability of interconnectors. The anticipated expansion of grid storage in the next seven years could eliminate the need for at least one fourth of the planned transmission infrastructure, based solely on the arbitrage generation perspective. However, this analysis does not account for line congestion and supply-demand imbalances. These factors could be considered in a more detailed model, but for now, the results of this study can inform regulators, policy makers, system planners, and investors about the potential impact of deploying batteries on the profitability of cross-border interconnectors.

References

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