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Co-optimizing energy and reserve interconnection capacity in coupled EU electricity markets

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Abstract-

The European Union Internal Electricity Market is undergoing major reforms to support the transition to a fully decarbonized energy system by 2050, where non-dispatchable renewable energy sources play a central role. To enhance market efficiency, renewable energy sources integration, and power system balancing, the European Union promotes increased cross-border interconnection and cooperation among Member States. This paper reviews existing literature and market models addressing multi-zone interconnection capacity allocation and proposes a novel inter-zonal co-optimization mechanism for the joint allocation of energy and automatic balancing reserve capacity based on system cost minimization. Unlike previous approaches that treat energy and reserve coordination separately or sequentially, this study introduces a unified optimization framework that captures the interdependencies of intra- and inter-zonal dispatch. The proposed mechanism is implemented within the CEVESA market model and applied to a realistic Iberian case study, assessing its economic and operational impacts under varying interconnection capacity scenarios. Results show that while energy coordination alone achieves significant cost reductions, joint coordination of energy and reserves delivers further efficiency gains, reduces reserve price volatility, and enhances cross-border system flexibility.

Index Terms- Electricity market; Interconnections capacity allocation; Market coupling; Balancing reserves coordination

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