

Probabilistic Electricity Price Forecasting for Storage Arbitrage in Central and Eastern Europe

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Abstract

The increasing share of electricity from renewable sources is reshaping the intraday market balance between supply and demand, with prices recurrently dipping midday and rising again in the evening. These swings create a natural time-arbitrage opportunity: store when prices are low and release when high. As flexible assets, Energy Storage Systems (ESS) offer a potential solution to enhance system stability. Our study focuses on four Central and Eastern European markets — Romania, Bulgaria, Hungary, and the Czech Republic — which have received limited attention in the literature on storage and arbitrage. While formally integrated into the European Target Model, these markets exhibit lower liquidity, weaker cross-border interconnections, and higher exposure to local shocks compared with larger Western European systems, making them particularly relevant for examining storage and arbitrage. We propose an innovative approach to quantify arbitrage opportunities in the electricity market using probabilistic price forecasting. In contrast to previous studies with ex-post assessments based on realized prices, we value arbitrage ex-ante using multivariate probabilistic forecasts. Using Distributional Random Forests, we estimate the joint distribution of day-ahead hourly prices, capturing temporal and cross-border dependencies. We further evaluate the economic value of these forecasts via scenario-based bidding strategies with ESS. Based on the comparative performance of lithium-ion and pumped-hydro storage, we provide recommendations for strategic planning and forecast-driven operations. Results indicate that even simple strategies deliver substantial gains when guided by probabilistic forecasts, contributing to the debate on the economic viability of ESS in improving electricity market efficiency.

Keywords: Day-Ahead Electricity Markets, Distributional Modeling, Energy Economics, Energy



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Storage Systems, Trading Strategies