

A probabilistic merit order for electricity price forecasting

Paul Ghelasi, Florian Ziel

University of Duisburg-Essen, Essen, Germany

Extended Abstract

[Download file](#)

Abstract Summary

Probabilistic forecasting is crucial in domains where uncertainty itself changes over time. This is especially true for electricity prices, where the range of possible outcomes depends heavily on uncertain factors such as weather-driven renewable generation. We propose the first fully probabilistic fundamental model for electricity price forecasting which explicitly captures the individual sources of uncertainty in price formation by fitting probabilistic distributions to key drivers, including load, renewable generation, fuel prices, and available capacities. By sampling from these distributions and feeding them into a fast fundamental merit-order model, we generate a realistic set of price scenarios for the day-ahead market. The model is calibrated to historical data to maximize probabilistic forecast accuracy. The modelled price does not rely on any distributional assumptions and naturally produces complex predictive distributions that can be multimodal and reflect regime shifts between high- and low-renewable conditions. It retains all the advantages of a fundamental modelling framework such as interpretability and causal consistency while introducing a comprehensive treatment of uncertainty.

Presenting Author Biography

Paul Ghelasi is a PhD candidate in Econometrics and Data Science at the University of Duisburg-Essen, holding an M.Sc. in Business Administration (Energy and Finance, *with distinction*) from the same institution and a B.Sc. from the University of Mannheim. His research focuses on probabilistic **electricity price forecasting** and **bridging data-driven methods with fundamental energy market models**, advanced during his research stay at the University of Glasgow. Combining academic rigor with practical industry experience at RWE, he develops innovative forecasting frameworks for sustainable energy markets. His work is published in leading peer-reviewed journals, addresses critical challenges in short-to-long-term price prediction.