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Future Day-Ahead Electricity Price Spreads in Germany: Drivers, Forecasting, and Flexibility Scenarios

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Large and volatile within-day spreads in the day-ahead electricity market, defined as the daily maximum minus the minimum of hourly day-ahead prices, shape arbitrage revenues and therefore investment incentives for flexibility resources such as batteries, demand response, and vehicle-to-grid (V2G). They also provide a market-based signal of scarcity and surplus in power systems with rising shares of variable renewables. Yet most related work focuses on average prices or broad volatility measures, so evidence on within-day spreads as a flexibility-relevant metric and on their short-horizon predictability is comparatively limited. This study asks (i) which observable day-ahead fundamentals are most associated with German within-day spreads and (ii) how predictable spreads are at short horizons. We contribute by documenting daily spread dynamics for Germany over 2015–2025, linking spreads to the day-ahead information set, and translating estimated relationships into stylized flexibility scenarios relevant for the pathway to climate neutrality.

We compile a daily dataset for Germany spanning 05 Jan 2015 to 30 Apr 2025, combining day-ahead prices and forecasts from SMARD (Bundesnetzagentur) with a TTF natural gas price proxy. The dependent variable is the within-day spread of hourly day-ahead prices (EUR/MWh). Explanatory variables are observable ex ante at the day-ahead stage, including forecasts of solar share, wind offshore share, wind onshore share, and load, plus lagged TTF gas prices. Net exports are jointly determined within the coupled day-ahead auction and are therefore treated as potentially endogenous. Baseline specifications exclude net exports and robustness checks include lagged net exports. We estimate predictive regressions with HAC (Newey–West) inference and evaluate out-of-sample performance on 2023–2024 (731 days) after training on 2015–2022 (2,918 days). We benchmark against historical mean, random walk, and an AR(1) spread model, while Elastic Net and ARIMAX serve as additional robustness checks.

Day-ahead fundamentals exhibit meaningful associations with spreads. Coefficients are positive for renewable shares and gas prices, with a strong gas-price association of about +1.3 EUR/MWh in spread per +1 EUR/MWh higher gas price in-sample. Net exports add little incremental explanatory power once fundamentals are controlled for. In forecasting, however, persistence dominates. On 2023–2024, a fundamentals-only OLS model yields RMSE of about 77 and MAE of about 46.7, while AR(1) and lag-augmented dynamic specifications reduce errors materially, with RMSE of about 64–65 and MAE of about 36.9.

Finally, we translate the estimated mapping into a stylized 2050 scenario analysis that combines projected renewable shares with low versus high gas-price regimes and low versus high flexibility motivated by V2G and second-life battery integration. Flexibility is implemented as an illustrative spread-compression sensitivity and is not a causal estimate. The scenario matrix suggests that higher flexibility can substantially compress spreads even under high gas prices, for example from roughly 142 EUR/MWh to roughly 79 EUR/MWh. This underscores the potential economic value of scalable flexibility for moderating price dispersion in high-renewables systems. Overall, fundamentals are most useful for structural interpretation and scenario translation, whereas short-horizon spread forecasting is primarily time-series driven. This implies a division of labor between investment-oriented stress testing and trading-oriented prediction.

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