UK-France Power Spread Option Pricing

Valuing Transmission Rights via Kirk's Approximation & Monte Carlo Simulation
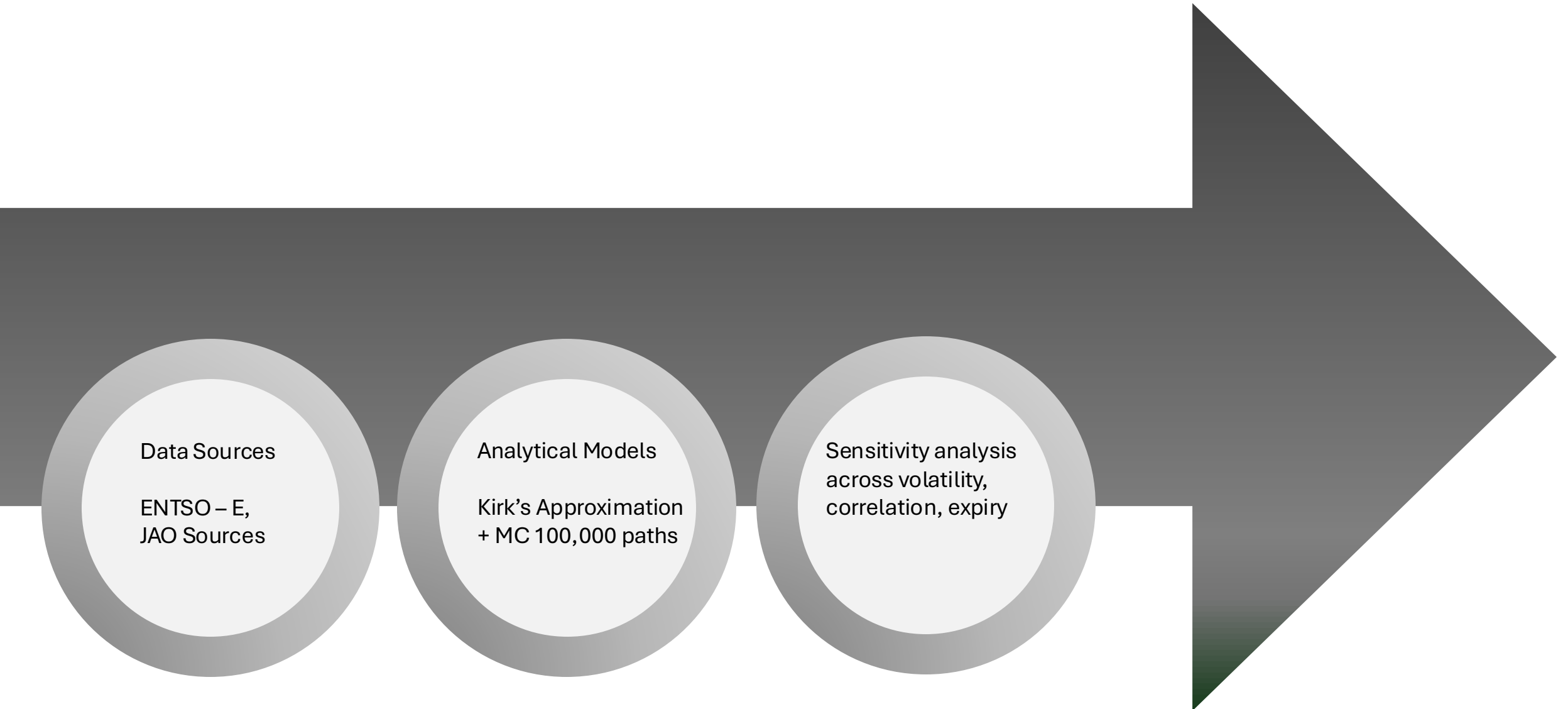
Author: Lyndon Odia | October 2025

Outline

Quantify the fair EUR/MWh value of optional transmission capacity between UK and France using spread option pricing methods (Kirk's Approximation and Monte Carlo Simulation).
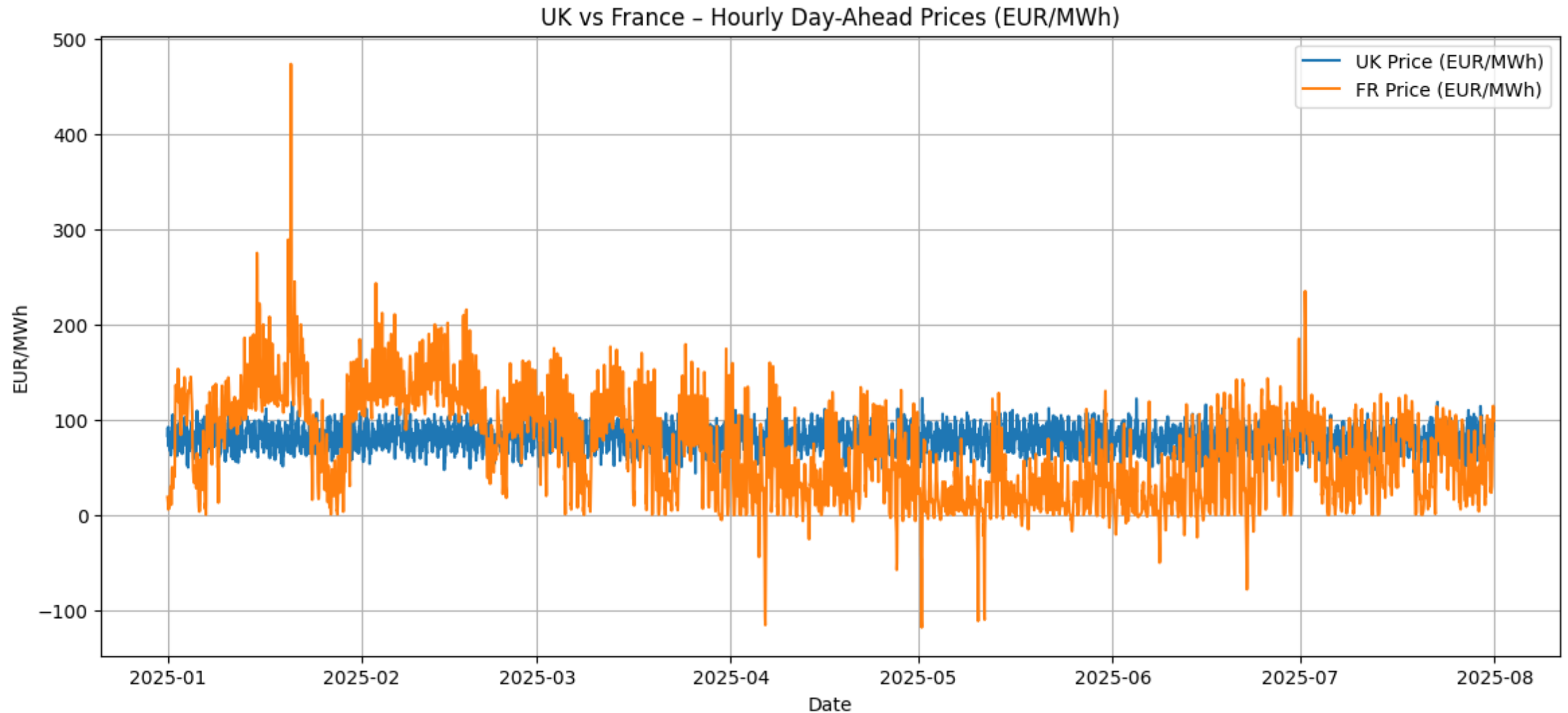
Author: Lyndon Odia | October 2025

Market Context

Interconnectors allow traders to arbitrage power spreads between coupled European markets. Valuing transmission rights as options captures the profit potential from volatility, correlation, and capacity costs.
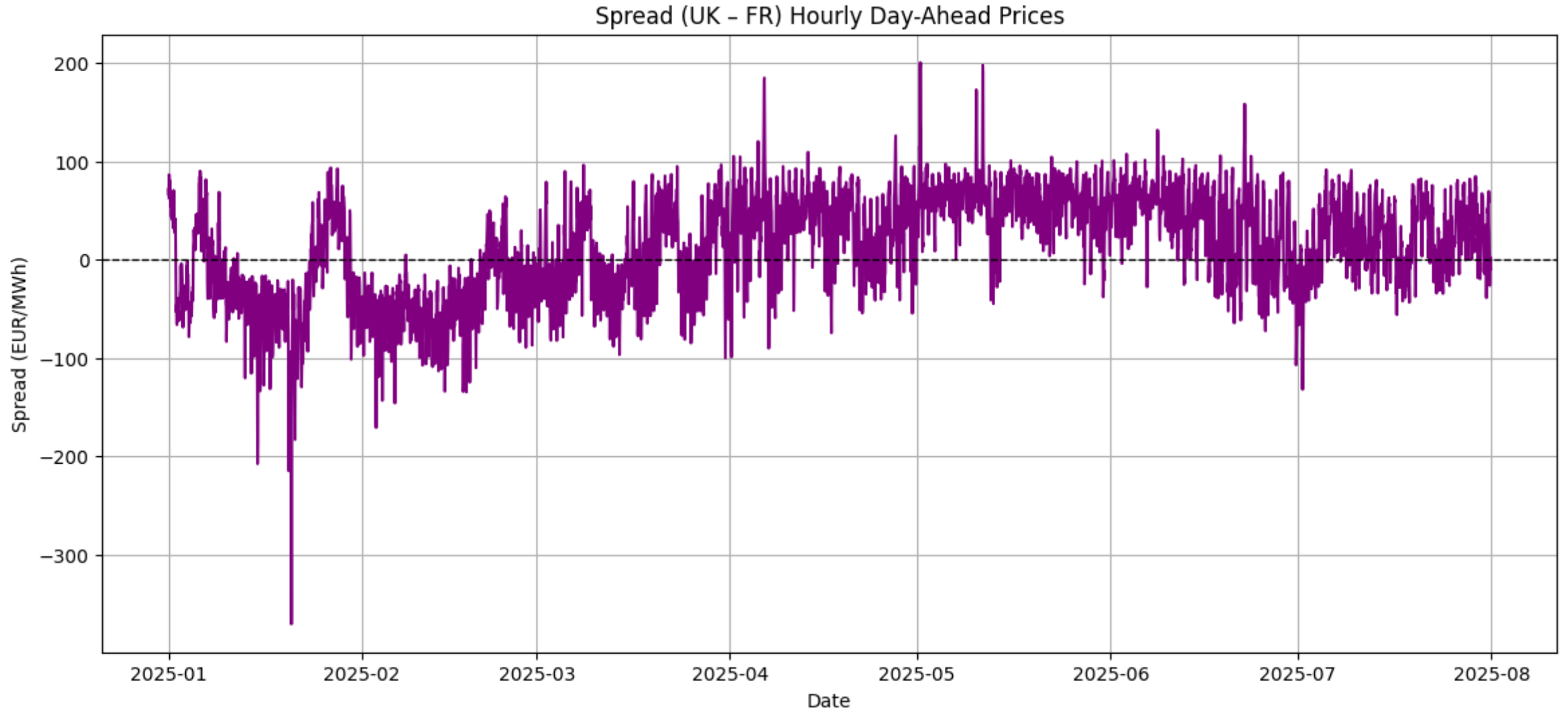
Author: Lyndon Odia | October 2025

Methodology

Data Sources

ENTSO – E,
JAO Sources

Analytical Models

Kirk's Approximation
+ MC 100,000 paths

Sensitivity analysis
across volatility,
correlation, expiry

Author: Lyndon Odia | October 2025

"UK vs FR Hourly Day-Ahead Prices (EUR/MWh)"

UK vs France – Hourly Day-Ahead Prices (EUR/MWh)

Author: Lyndon Odia | October 2025

"Spread (UK-FR) Hourly Prices"

Spread (UK – FR) Hourly Day-Ahead Prices

Author: Lyndon Odia | October 2025

"Distribution of Spread (UK-FR)"

Distribution of Spread (UK – FR)

Author: Lyndon Odia | October 2025
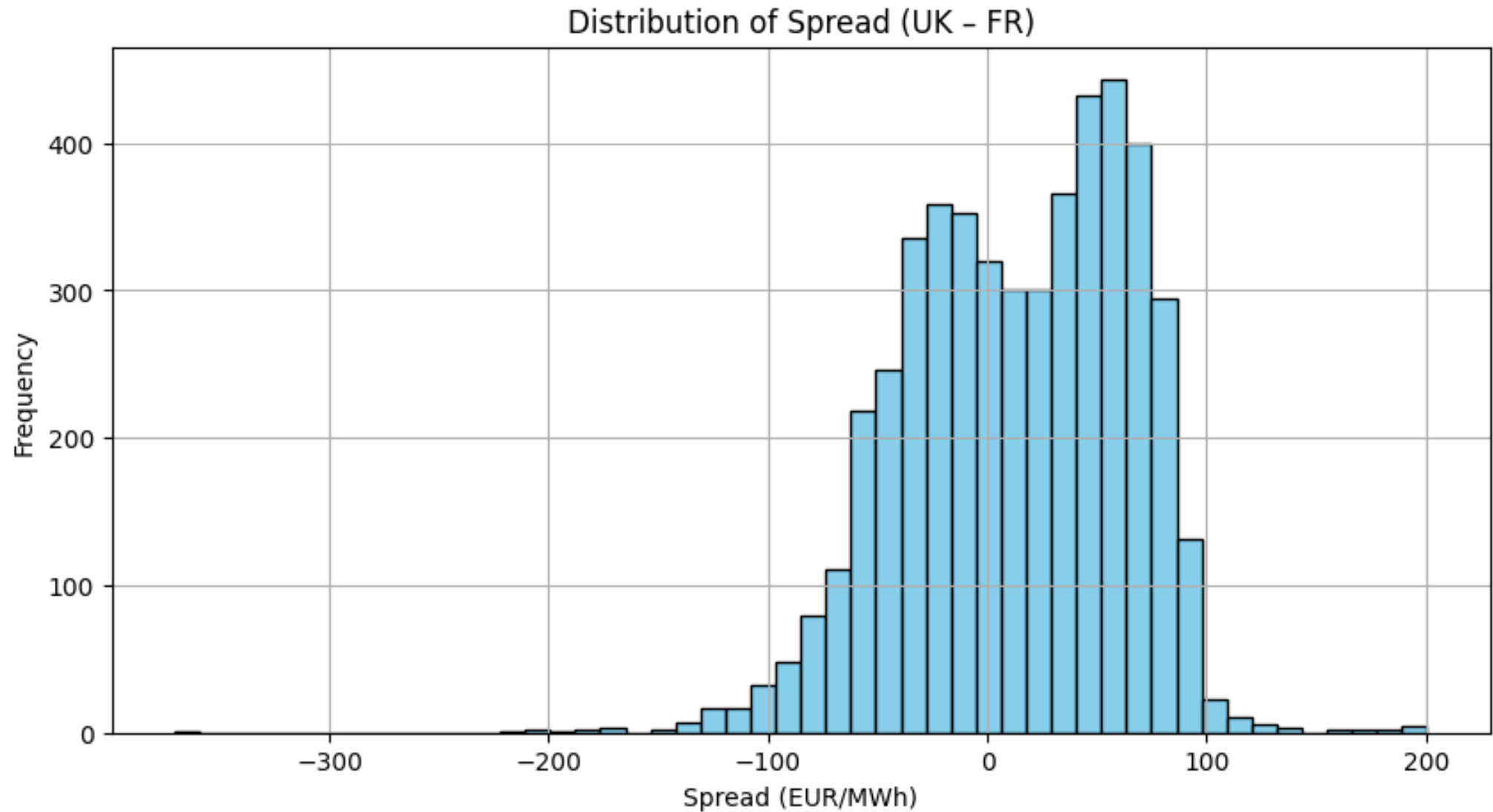
Base Inputs

Parameter	Description	Value
S_1	UK mean price (EUR/MWh)	81.10-
S_2	FR mean price (EUR/MWh)	68.06
Sigma_1	UK annualized volatility	0.198
Sigma_2	FR annualized volatility	1.008
rho	Correlation (UK-FR)	0.142
T	Time to expiry	1/12 (1 month)
K	Capacity cost (strike)	0.76 EUR/MWh
FX	GBP – EUR conversion	1.17

Author: Lyndon Odia | October 2025

Base Inputs

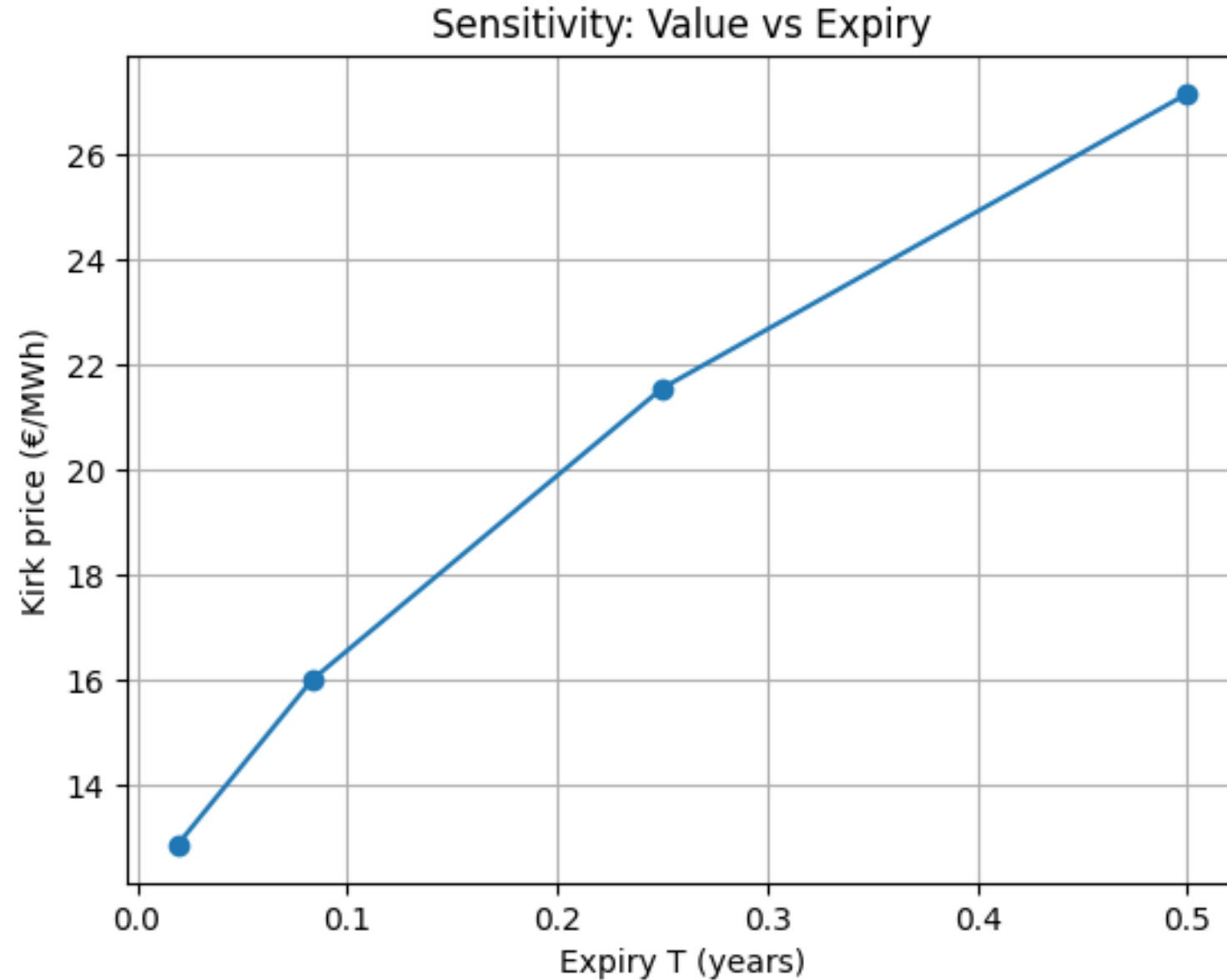| Model	Option Value (EUR/MWh)	Value
Kirk's Approximation	16.0	Analytical closed-form estimate
Monte Carlo (100k paths)	15.99	Numerical validation
Mean Spread	13.0	Average UK-FR spread
Capacity Cost	FR annualized volatility	From JAO GB-FR auctions
Fair Value	*= 16 EUR/MWh*	*Net of cost, for 1-month horizon*

Author: Lyndon Odia | October 2025

"Sensitivity: Value vs Correlation"

Sensitivity: Value vs Correlation

Author: Lyndon Odia | October 2025
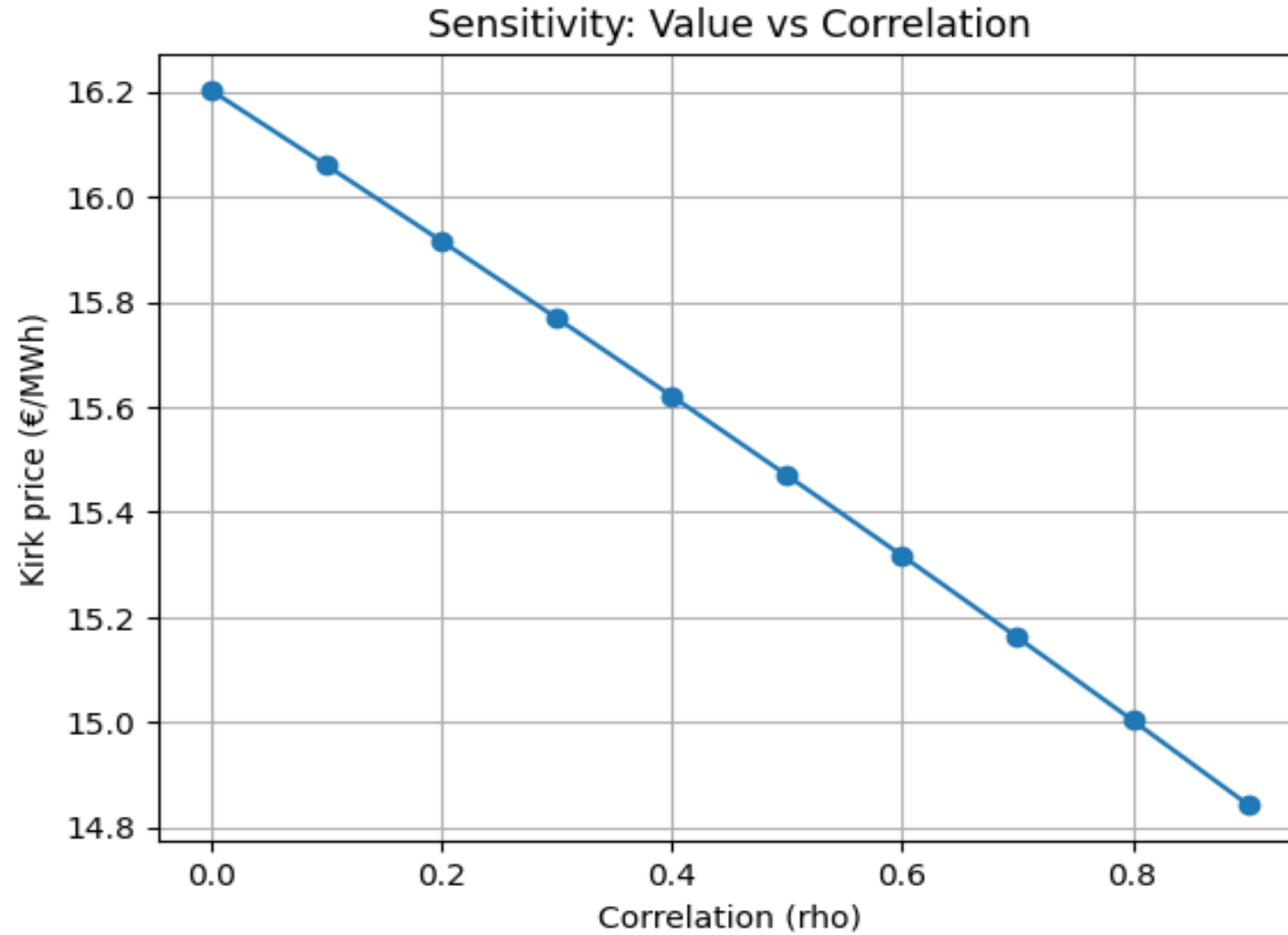
"Sensitivity: Value vs Volatility"

Author: Lyndon Odia | October 2025
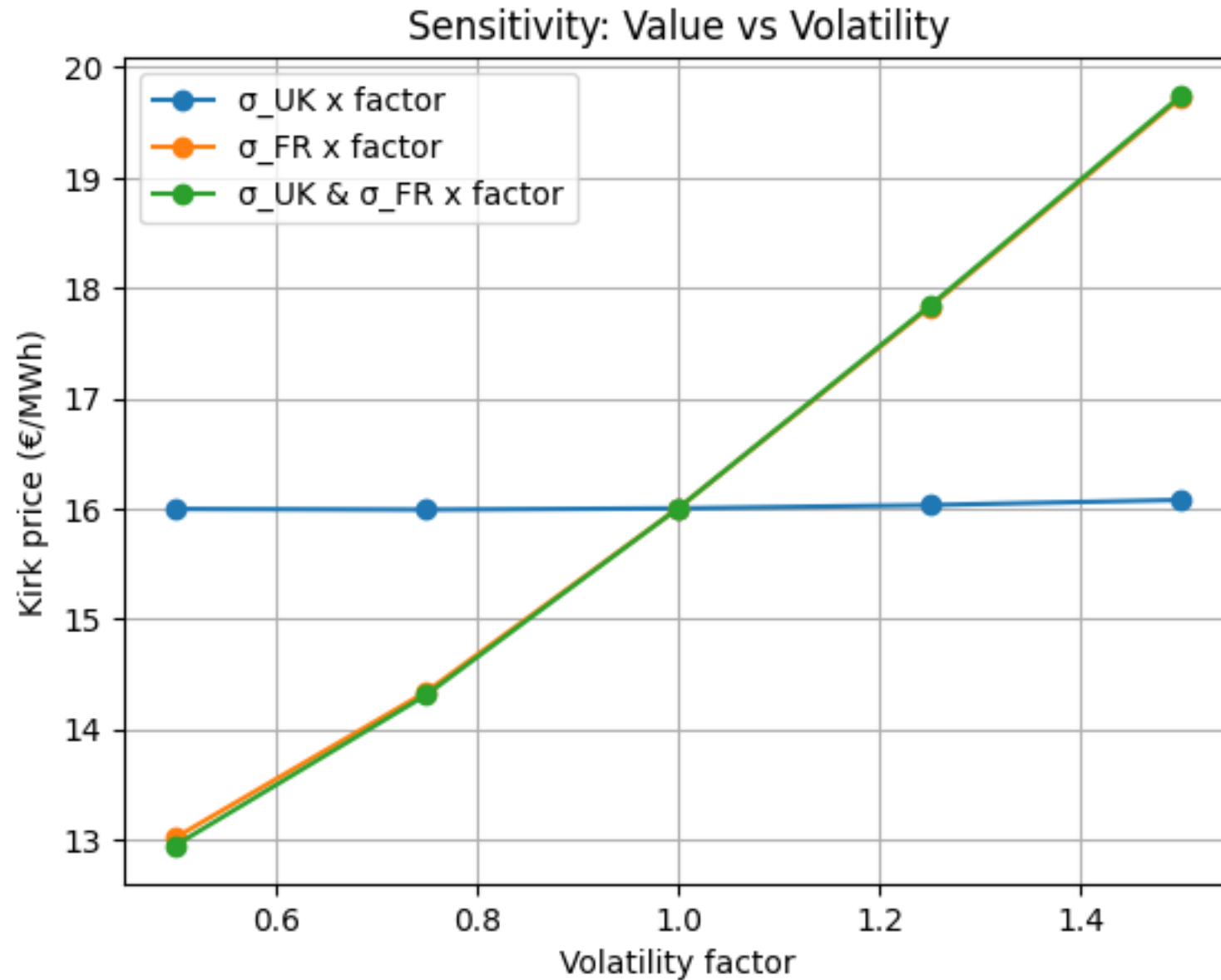
"Sensitivity: Value vs Expiry"

Author: Lyndon Odia | October 2025

Interpretation & Market Implications

1. Option value represents right (not obligation) to flow power when profitable.
2. Positive optionality driven by spread volatility and low correlation.
3. Capacity cost (0.76 EUR/MWh) = market - clearing price paid at JAO auctions.
4. 1GW for 1 month = EUR 11.5m notional value.

Author: Lyndon Odia | October 2025

Limitations

1. We use one set of S_1, S_2, sigma_1, sigma_2, rho from Jan–Jul 2025, which smooths monthly seasonality and regime shifts.
2. Capacity cost is included as a single average (€0.76/MWh) rather than the actual monthly JAO auction prices.
3. Kirk/MC are applied with a terminal-only exercise (European-style). Real transmission rights can be exercised daily/hourly.
4. rho and sigma are fixed; we do not model time-varying or regime-switching dynamics.
5. Losses, balancing fees, ramp/nomination constraints, curtailment risk, and gate-closure timing are not included.
6. We price one direction (IF2-GB → FR). The reverse direction (FR → GB) can have a different K, availability, and value.

Author: Lyndon Odia | October 2025

Next Steps

1. Monthly Re-estimation:
- ➢ Compute S_1, S_2, sigma_1, sigma_2, rho from hourly data within each month.
- ➢ Pull the JAO monthly auction K_m for the same month and direction.
- ➢ Price a 1-month option each month.
- ➢ This will capture seasonality, regime shifts, and the true cost of capacity.
- ➢ Pull 5+ years of real UK and France day-ahead prices so we can stress-test across different market regimes, especially 2022.

2. Two-direction view: Repeat for FR - GB to compare value asymmetry and assess netting/portfolio effects.

3. Time-varying dynamics: Explore GARCH (time varying correlation) or regime-switching volatility to better reflect stress periods.

4. Costs & frictions: Add losses, balancing/imbalance charges and nominations/gate closure constraints.

5. Interactive Visualisation & Forecasting: Develop a lightweight **Plotly Dash** dashboard to explore historical spreads, volatilities, and option values in real time, and to simulate forward-curve scenarios or policy-driven shifts in correlation.

Author: Lyndon Odia | October 2025