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Structural Persistence and Evolution of the Sawtooth Pattern in the European 15-Minute Day-Ahead Market: Empirical Insights and potential Drivers

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On October 1, 2025, European Day-Ahead (DA) trading underwent a fundamental structural reform with the conversion to 15-minute trading products across all participating Member States. This transition aimed to enhance the integration of renewable energy sources and improve overall market efficiency by harmonizing the DA timeframe ever more closely with the physical reality.
Historically, the so-called 'sawtooth pattern'—characterized by systematic intra-hour price jumps resulting from load over- and under-estimations—was a dominant feature of the Intraday auction 1 (IDA1), driven by the granularity mismatch between hourly DA products and first quarter-hourly adjustments. Contrary to some expectation that introducing quarter-hourly DA products would smoothen the IDA sawtooth prices, empirical data reveals that the sawtooth pattern persists and has migrated into the DA market. While the magnitude of price deviations has declined compared with 'sawtooth'patterns prior to the 15-minute transition, the phenomenon remains a structural component of price formation. We attribute this to specific market frictions: procurement strategies that still rely heavily on block and hourly products, and 'bidding inertia' where participants optimize against hourly schedules. Furthermore, we highlight the potential amplifying role of cross-border constraints, where rigid hourly Flow-Based Market Coupling (FBMC) capacities may restrict physical exchange during intra-hour ramps, forcing sharp internal price adjustments when local merit orders are stretched. We conduct a descriptive analysis to identify the potential drivers of the continued "sawtooth pattern", i.e., the intra-hour spreads on the DA market. We examine the relationship between 60-minute volume shares and price volatility, indicating that high concentrations of hourly block orders necessitate a more 'active'smoothing of sub-hourly ramps. Additionally, we analyse Merit Order Curve regimes to show how potential non-linear supply elasticity amplifies intra- hour spreads during periods of steep residual load gradients. Additionally, we quantify the historic impact on renewable capture prices, illustrating the 'value destruction'for solar assets where generation peaks coincide with systematic price dips within the hour, when moving from an hourly to a quarter-hourly DA price. Finally, we discuss the integration of these findings into our fundamental modelling framework. To capture these dynamics, we implement a structural post-processing logic that superimposes a 'sawtooth pattern'—derived from residual load gradients and thermal inflexibility constraints—onto our hourly forecasts. Looking ahead, we utilize this framework to assess the future trajectory of the sawtooth in light of the projected 215 GW solar capacity in Germany by 2030. Our approach suggests that despite improvements in algorithmic bidding, the pattern will likely persist for some time due to the fundamental collision between growing solar ramps and the structural dominance of thermal block bids.

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