

How VPPs Challenge Europe's Balancing Market Framework?

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Extended Abstract

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Abstract Summary

As electricity systems transition toward decarbonization, regulatory frameworks must adapt to the rise of Distributed Energy Resources (DERs) and their aggregation into Virtual Power Plants (VPPs). This paper examines how increased controllability from DERs within VPPs affects market participants' incentives to create imbalances. System imbalances—real-time mismatches between total generation and consumption—determine the need for corrective balancing actions and the associated settlement payments. Using a strategic bidding model adapted from prior literature and calibrated across five European markets (Germany, France, Spain, the Netherlands, and Denmark), we simulate VPP behavior under varying levels of portfolio controllability. Our findings suggest that while moderate control mitigates imbalances, excessive control exacerbates imbalances during periods of extreme market prices. These behaviors shift the source of VPP profits from unintentional imbalances to deliberate market arbitrage, challenging the regulatory assumption that imbalances are purely accidental. The results suggest that current imbalance settlement rules may need to be revised to address the strategic potential of increasingly controllable actors in future electricity systems.