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Benchmark-Based Risk Hedging for Battery Energy Storage via Financial CfDs

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Extended Abstract

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Abstract Summary

This study examines how financial contracts for difference (fCfDs) can be adapted from renewable generation to battery energy storage systems (BESS). Unlike wind and solar, BESS revenues depend on multi-market dispatch and trading strategy, so benchmark design is central to any fCfD scheme. Using Germany as the empirical reference market and Switzerland as the policy context, we compare three benchmark approaches for a 1 MW / 1 MWh battery in January 2025: (i) a perfect-foresight multi-market MILP across day-ahead, FCR, and aFRR capacity markets; (ii) the spot-oriented FlexIndex; and (iii) reported commercial performance from enspired.

The benchmarks differ substantially. The perfect-foresight model yields EUR 16,938, while FlexIndex reports EUR 5,170 and enspired EUR 6,250-8,330. In the MILP, aFRR+ accounts for 57% of allocated 4-hour blocks but about 69% of total revenue, showing that ancillary-service capacity payments dominate economics in the analyzed month. The figure-based decomposition also shows that revenues are concentrated in a limited number of high-price days rather than being evenly distributed over time.

These findings highlight a core policy trade-off. Simple and transparent benchmarks are easier to govern and communicate, but they can miss important value streams. Richer benchmarks can better reflect market opportunities, but they may overstate realizable outcomes and become harder to audit. At the current stage, FlexIndex appears more practical and closer to observed commercial performance, though likely conservative because ancillary-service value is only partly represented. Future work should incorporate ancillary-service value more realistically while keeping benchmark rules transparent and replicable, so fCfD auctions can discover efficient support levels with lower benchmark-induced bias.

Presenting Author Biography

David Holmer is a PhD student in energy economics at the Faculty of Economics, University of Basel, and a research assistant at the Zurich University of Applied Sciences (ZHAW). With a Master of Science in Computational Modeling and Simulation from the Technical University of Dresden and a Bachelor’s degree in Energy Economics, David has extensive experience in computational modeling within the energy sector. His work combines economics and computer science, leveraging machine learning, operations research, and advanced data visualization techniques for energy modeling. David's international experiences include semesters abroad at SeoulTech and CentraleSupélec in Paris.