

Lecture Series Summer semester 2022

Research Institute
for Supply Chain
Management

Monday, May 22, 2022, 5.30 pm.
The lecture will be held in hybrid mode.



DAVID WOZABAL

THE VALUE OF COORDINATION IN MULTI-MARKET BIDDING OF GRID ENERGY STORAGE:

Electricity storage is the key to a fully decarbonized energy system. Whether firms view investments in storage as profitable, is largely driven by their expectation of operating cash flows which are difficult to assess. We consider the problem of a storage owner who trades in a multi-settlement electricity market comprising an auction-based day-ahead market and a continuous intraday market. We show in a stylized model that a coordinated policy that reserves capacity for the intraday market is optimal and that the gap to a sequential policy increases with intraday price volatility and market liquidity. To assess the value of coordination in a realistic setting, we develop a multi-stage stochastic program for day-ahead bidding and hourly intraday trading along with a corresponding stochastic price model. We show how tight upper bounds can be obtained based on calculating optimal bi-linear penalties for a novel information relaxation scheme. To calculate lower bounds, we propose a scenario tree generation method that lends itself to deriving an implementable policy based on re-optimization. We use these methods to quantify the value of coordination by comparing our policy with a sequential policy that does not coordinate day-ahead and intraday bids. In a case study, we find that coordinated bidding is most valuable for flexible storage assets with high price impact, like pumped-hydro storage. For small assets with low price impact, like battery storage, participation in the day-ahead auction is less important and intraday trading appears to be sufficient. For less flexible assets, like large hydro reservoirs without pumps, intraday trading is hardly profitable as most profit is made in the day-ahead market. A comparison of lower and upper bounds demonstrates that our policy is near-optimal for all considered assets.

Prof. Dr. David Wozabal works at the interface of management, mathematics, economics, and computer science. His research is concerned with the study of the mathematical foundations and computational methods for decision making under uncertainty with a focus on applications in energy and climate.