

Seminar Thesis or Master's Thesis

Multi-Agent Modeling of Sequential Bidding by Bidirectional Truck Depots on Sequential Electricity Markets

Motivation

During standstill, bidirectional truck fleets can offer flexibility on several electricity markets. These markets close at different times. Balancing capacity is auctioned the day before delivery, the day-ahead market closes at noon and intraday trading continues until shortly before delivery. Every early commitment restricts later decisions, while vehicle arrivals, state of charge and prices are still uncertain.

Depots also differ strongly in fleet size, schedules and standstill patterns, and they influence each other via the shared markets. With the new 15-minute balancing products under decision BK6-25-212 of the German Federal Network Agency, the question arises for which depots sequential multi-market operation pays off.

Thesis topic

The aim of this master's thesis is to develop a multi-agent model in which each depot acts as an agent with its own charging infrastructure, schedules and information. The agents bid sequentially on the balancing, day-ahead and intraday markets, and commitments from earlier stages are binding for later ones.

Different depot types, e.g., long-haul, regional distribution or shift-based operation, are simulated and compared with an idealized simultaneous optimization. The goal is to identify the depot characteristics for which multi-market operation pays off. If desired, AI methods such as reinforcement learning can be integrated for the bidding strategies of the agents.

What you get

- Contribute to applied research on bidirectional charging and multi-market operation during an ongoing balancing market reform
- Creative freedom at the interface of electric mobility, energy markets, multi-agent modeling and AI
- In case of excellent working performance: opportunity for co-authorship in a scientific paper
- Close supervision with regular meetings

Work packages

- Literature research on multi-market bidding and multi-agent models
- Definition of representative depot types with different fleets and schedules
- Modeling of depot agents with sequential bidding, gate closure times and binding commitments
- Implementation of the multi-agent simulation in Python and comparison with a simultaneous reference optimization
- Quantification of the benefit of 15-minute balancing products compared to four-hour blocks in terms of revenues, offered capacity and fleet availability
- Optional integration of AI methods, e.g., reinforcement learning for the bidding strategies of the agents
- Identification of the depot characteristics for which operation pays off

Requirements

- Advanced proficiency in Python
- Solid knowledge of mathematical optimization or agent-based modeling
- Interest in energy markets and their regulation, independent and structured way of working
- Experience in machine learning, especially reinforcement learning, is a plus
- Very good German or English language skills

I am looking forward to receiving your complete application with a CV, current overview of grades, brief motivation, and any other documents. **The thesis can be written either in German or English.**

Contact

Philipp Bergmann, M.Sc.
E-Mail: p.bergmann@tum.de

Start date

From now

Workplace

FTM (Garching Forschungszentrum) or remote