Technical University of Munich
TUM School of Engineering and Design
Chair of Automotive Technology

Semester‘s Thesis or IDP

Modeling of Electricity Markets to Trade Battery Electric Truck Flexibility via Bidirectional Charging

Motivation:

In the realm of European road transport, commercial vehicles stand as substantial contributors to greenhouse gas emissions. The transition to battery-powered commercial vehicles presents the most promising way for achieving sustainable decreases in emissions. This shift is in line with the European Commission's ambitious target to slash CO2 emissions from heavy-duty vehicles by 90 percent by 2040. In addition, many companies will demand a green supply chain in future.

Especially electric truck depots will require high charging power and smart integration into the electricity system. Due to limited grid connection capacities and the slow roll-out of public charging facilities, more and more transport companies are likely to set up private charging stations on their property. Beyond cost-efficient charging, depot flexibility can be commercialized by participating in electricity markets such as balancing services and other flexibility products. In this context, the truck batteries can become an economic asset: electricity can be purchased when prices are low, stored in the vehicles, and later used or sold when prices are high, turning the depot into an active participant in the energy system.

Thesis topic:

The aim of this thesis is to extend an existing open-source optimization framework that enables the commercialization of flexibility from electric truck depots. While the model already supports flexibility trading, only a limited set of electricity markets is currently represented. Therefore, you will analyze additional markets (e.g., balancing services / frequency regulation) and investigate how they can be integrated into the existing modeling environment in a consistent and scalable way. Based on this analysis, you will implement the required model extensions as a prototype in the open-source codebase. Finally, you will validate the extended framework using a simple case study scenario.

What you get:

- Contribute to scientific research in a highly future-oriented field of in the intersection of commercial transport mobility and the energy sector
- In case of excellent working performance: Opportunity for a follow-up thesis work (master’s thesis) and co-authorship in a scientific paper

Work packages:

- Literature research on modeling and optimization of electricity markets
- Familiarization with an open-source flexibility commercialization framework
- Comparison of different modeling approaches
- Implementation of one approach
- Validation based on simple operating scenarios

Requirements:

- Passion for e-mobility and energy-transition-accelerating technologies
- Programming experience in Python
- Ideally initial experience in mathematical optimization
- Independent and strategic way of working
- Very good German or English language skills

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

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Start date:
From now

Workplace:
FTM, Garching Forschungszentrum. The thesis can also be done in home office.