Fakultät III Prozesswissenschaften
Institut für Energietechnik

Energieverfahrenstechnik und
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regenerativer Energien

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The chair of Energy Process Engineering and Conversion Technologies for Renewable Energies offers a Master thesis within the following topic:

Comparative study of waste collection vehicles drive technologies

The offered master thesis builds on two theses, which analyzed the technical and economic performance of diesel driven waste collection vehicles (DDV), battery-electric driven vehicles (BEV), and fuel-cell driven vehicles (FCV). An object-oriented power flow simulation in Python based on real-life routing data was implemented in order to identify and compare the energy demand between waste collection routes.

Within the offered master thesis, literature research on the state of the art of waste collection vehicles and the used powertrain configurations on the market shall be done. Consequently, the developed DDV; BEV, and FCV models shall be aggregated in an object-oriented model and enhanced by a natural gas vehicle (NGV). In addition, all technical, economic, and ecological model parameters need to be updated.

A comparative study of DDV, BEV, FCV, and NGV shall analyze the technical, economic, and ecological feasibility and influencing factors using the provided collection route profiles (vehicle speed and acceleration). The developed simulation model for DDV and BEV can be downloaded from github [1] and is described in detail in [2].

Possible factors to analyze are:
- Technical: Energy demand (fuel consumption and primary energy level) of four drive technologies.
- Economic: Total Costs of Ownership (TCO), is there a difference between the four drive technologies, what are the influencing factors?
- Ecological: CO_2 emissions per driving distance by the four drive technologies based on different hydrogen production and electricity scenarios.

The thesis is divided into the following steps:
- State of the Art of waste collection vehicles drive technologies
- Python: familiarization with object-oriented programming approach and DDV, BEV, FCV models
- Python: Model development of NGV drive technology and model aggregation
- Updating of technical, economic, and ecological model parameter
- Comparative study

Key requirements:
- High degree of independent and responsible work
- Very good knowledge of related energy technologies
- Experience in system modeling and simulation
- Experience in programming and object-oriented approaches

The thesis can be written in English or German.

[1] https://github.com/fabmid/Refuse-Collection-Vehicle-Energy-Demand-Simulation
[2] Schmid, Taube, Rieck, Behrendt: Electrification of waste collection vehicles: Techno-economic analysis based on an energy demand simulation using real-life operational data, IEEE Transactions on Transportation Electrification, 2020