Master Thesis Project for Master Students at Chalmers University of Technology

Electrified vessels - charging solutions

Background
Electrification of transports is increasing. Different transport segments have different specific needs when it comes to electrification. For land transport there are several charging possibilities emerging such as combinations of nightly charging and fast charging, battery swapping, electric roads, etc.

For water transports (shipping and ferries) these needs are also dependent on the harbor charging infrastructure as well as the different technical requirements connected to trip lengths and possible limits on the waiting time flexibility when combined with commercial usage of the vessels.

So far shipping has in general been electrified to a very small extent with vessels operating on short routes with many stops being the best electrification candidates. Some charging solutions, such as battery swapping, may alleviate waiting times in the harbor and reduce electrical grid loads, but might require more battery usage on a system level than pure electric vessels.

It is therefore of high interest to investigate how different charging solutions (cable charging and battery swapping) compare to each other for different cases and scenarios. This master thesis is expected to contribute to such knowledge.

Goal
- Description of known functioning charging solutions for water transport or studies relevant to the Swedish context.
- Develop and apply a method to evaluate the need of battery capacity for one or several electrified vessels in operating scenarios (e.g., a ferry fleet) with or without battery swapping.
- For the studied cases discuss effects on environmental aspects such as battery lifetimes and use of resources for energy storage.

Work outline
1. Literature study for vessels charging concepts relevant to the Swedish context. Amongst gathered data, select cases to investigate.
2. For the selected cases capture the energy consumption estimation during operations, and the route-dependent charging possibilities and make a comparison between charging batteries onboard or utilizing battery swapping.
3. Discuss what pros and cons are there for the different options, both from a technical and environmental perspective.

Application
Ability to work independently and to take initiatives is required, as well as completed relevant electrical engineering courses at Chalmers and experience in simulations (e.g. Matlab/Simulink). The application should include cover letter, CV and transcripts and be addressed to Svetla Käck at VTI with a copy to Emma Grunditz at Chalmers.

Time plan and Contact
- Start: January 2024. End: June 2024; 1 or 2 students.
- Svetla Käck, svetla.kack@vti.se, Swedish National Road and Transport Research Institute
- Emma Grunditz, emma.grunditz@chalmers.se, Chalmers University of Technology, Electric Power Engineering

VTI, Statens väg- och transportforskningsinstitut, är ett oberoende forskningsinstitut inom transportsektorn.

www.vti.se