Master thesis proposal

Environmental assessment and circularity of hydrogen storage tanks for trucks

Background

Many countries of the world have ambitious goals for climate change mitigation and protection of the environment. For the transport sector, electric propulsion is a way to reduce energy use and emissions. Among feasible technologies, fuels cells can produce electricity from hydrogen on-board vehicles, with water vapor as the only emission. Storage of hydrogen on the vehicles is however a challenge in order to reach long driving distances without refueling. For fulfilling requirement for distance between refueling the hydrogen is either compressed to 700 bar, cooled to cryo-temperatures or liquefied to increase the density of the hydrogen. The knowledge of how hydrogen tanks are reused and recirculated is still very limited, and more research is needed.

Volvo AB is a global leading truck, off-road, bus and marine company, with research center based in Gothenburg. The company is in a transition phase and will produce large scale fuel cell vehicles for meeting the Paris agreement for heavily reduce the CO_2 emissions from the vehicles in operation.

Project description

The purpose of this project is to evaluate environmental impact of different hydrogen tanks operating in a heavy-duty truck using life cycle assessment (LCA), in collaboration with Volvo Global Truck Technology (VGTT). The task is to compare 700 bar, cryo-compressed and liquid storage tanks. The study will investigate two research questions:

- What is the difference in environmental impact, including all life cycle stages, between 700 bar, cryo-compressed and liquid storage tanks?
- How can circular material flows be improved for the different tanks?

The project will include an overviewing literature review of existing LCA studies of hydrogen tanks, tanks manufacturing, and tanks end-of-life procedures. It will also cover how a shift of the tank mass alters the vehicle operation energy use. The tanks design and manufacturing assembly description will be gathered during visits to VGTT. The LCA modeling will be conducted using OpenLCA.

The project will be conducted partly at Environmental Systems Analysis (ESA), Chalmers, and partly at VGTT, during the spring 2022.

Qualification

The project requires a collaboration between two students with good ability to work independently and multidisciplinary. Students are expected belong to master's programs in Industrial Ecology, Sustainable Energy Systems, Mobility Engineering or Applied Mechanics. However, prior experience of life cycle assessment is a strict requirement (e.g., Chalmers course on master's level VTM081). Experience of vehicle modeling, for example using Matlab/Simulink, is a plus.

Contact

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