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Topic: Sectorial Sessions / Implementing LCM in business

Session: Assessing sustainability of flexible energy systems transition / Approaching life-cycle sustainability as the actual driver of the energy / Application of Life Cycle Sustainability Assessment (LCSA) in the industry

Title: Decarbonizing maritime shipping: Life cycle sustainability assessment of a multi-fuel capable propulsion system based on Solid Oxide Fuel Cell technology for maritime shipping

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Abstract (max. 3000 Characters)

Maritime shipping is responsible for the emission of about 2.5% of global greenhouse gas (GHG) emissions worldwide. Most maritime vessels are operated with heavy diesel oil engines, emitting large quantities of GHG and air pollutants. Accordingly, a drastic reduction of GHG emissions from ships has become a key regulatory target on the European as well as global level. The maritime shipping industry, which is considered a hard-to-decarbonize sector, is therefore actively seeking for alternative technologies for a more sustainable operation of maritime vessels without compromising their current performance levels.

The Horizon Europe project FuelSOME focuses on developing a multi-fuel capable propulsion system based on Solid Oxide Fuel Cell (SOFC) technology for maritime shipping. The proposed fuel cell based propulsion system is specially catered for long-distance maritime shipping, and will be able to operate on ammonia, methanol and hydrogen. Regarding these fuels, short- and long-term sustainable supply chains are explored, and their life cycle sustainability impacts are explored.

In cooperation with project partners, foreground data on the life cycle of the multi-fuel energy generation system is collected, in order to perform a cradle-to-grave life cycle sustainability assessment (LCSA). In a first step, the environmental life cycle impacts of different supply chains for the green fuel components hydrogen, ammonia and methanol were analysed. Each of these fuels can be generated from various feedstock sources. For the analysis we selected and analysed electricity for synthetic fuels, agricultural energy crops and waste streams as well steam reforming from natural gas as feedstock sources. Once generated, the feedstock is then transported to the fuel production site and stored. Similarly to the feedstock sources, production methods for the green fuels are numerous. Regarding the production of hydrogen, methods include catalytic, thermochemical, electrolytic and biological processes. As for ammonia and methanol, production methods include thermochemical, catalytic and stripping processes. The different production methods were investigated through literature research and a selection of relevant supply chains for the FuelSOME

project was made. The environmental impacts of the selected supply chains of the green fuels were subsequently assessed and compared to conventional alternatives using a comprehensive set of environmental indicators following the recommendations for the Product Environmental Footprint as well as the FC-Hy guidelines for fuel cells including biodiversity impacts.

Ultimately, the results of the environmental LCA will be integrated with the results of the social LCA and the techno-economic assessment aiming to provide a comprehensive picture of the life cycle sustainability impacts of the fuel cell based FuelSOME propulsion system for maritime vessels.