Sustainability Requirements Analysis of Power-to-X-Fuels in the Aviation Sector

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Referent

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Kurzbeschreibung

According to the national hydrogen strategy of the German government, the introduction of Power-to-X (PtX) fuels is planned to support the decarbonization in those sectors in which a direct electrification is not likely to be feasible in the near future, e.g. the aviation sector. PtX fuels require a relatively high amount of electricity, water and CO2 to be produced and can then be used in existing infrastructure and vehicles. With a very high sensitivity to the electricity source, several studies point out the economic advantages of producing the fuels in other countries than Germany due to a usually higher amount of full load hours for photovoltaics and wind power. However, the potential social and ecological (positive and negative) impacts are rarely addressed in this context.

Aspects of dynamic and consequential Life Cycle Assesssment (LCA) and Social-LCA (S-LCA) are integrated into the here developed approach. While the impacts of different process constellations and locations for interna-tional supply chains on the Global Warming Potential (GWP) are analyzed in this work with regard to their potential to contribute to the CO2 goals of the aviation sector in Europe, other ecological and social impacts are addressed with a benchmarking approach. The underlying idea is that the transition to alternative fuels for a reduction in CO2 emissions should at least not worsen sustainability aspects within other important areas. Fossil and biobased jet fuels are integrated as benchmarks with the Sustainable Development Goals (SDGs) as normative framework. The SDGs are globally accepted and cover the most important aspects of sustainability around the world, which is especially important with regard to many different assessed locations on a global scale. Every SDG is connected to an indicator of the S-LCA or Environmental-LCA (E-LCA) or additional calcula-tions and then addressed individually within this approach. For example, the S-LCA indicator fair salary is con-nected to the SDG no poverty. The SDG no poverty does cover many more aspects than just fair salaries, how-ever it can be assumed that a lower risk of unfair salaries contributes to a positive development of this SDG. Therefore, it is not the aim of this approach to analyze how the SDGs can be reached in total, but how they can be affected in a positive direction. If the benchmark of one SDG cannot be reached

with any of the assessed alternatives, additional measures are elaborated qualitatively. Eventually, the constellations will be discussed with regard to their technical, economic and political feasibility.

The electricity generation for the PtX process is assumed to be additional, which means that it is not directly affected by current shares of renewables in electricity mixes. However, with the assessment of the entire life cycles, the share still has an effect on other life cycle stages of the PtX fuel production and also on the bench-marks. For the consideration of this changing share of renewables on a global basis, a dynamic global energy system model has been developed for this work as wel. It is used to assess the dynamic potential environmen-tal impacts of electricity generation from 2020 to 2050. The Social-LCA data is static due to the lack of dynamic data.

The focus is set on the methodological development, while the different involved locations and processes are used as case studies. Preliminary results of the benchmarks and the potential of PtX to.