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Ralph-Uwe Dietrich

German Aerospace Center (DLR), Germany

Synthetic jet fuel from renewable energy sources for sustainable aviation

Advanced technologies, optimized operation and infrastructure are not sufficient to achieve the CO_2 mitigation goals agreed for the aviation sector. Carbon neutral alternative liquid fuels are required to fill the gap towards a carbon-neutral growth from 2020. The Power-to-Liquid process is one option to produce synthetic jet fuels from renewable energy. The technical and economic performance of production processes based on renewable electricity and CO_2 was investigated and evaluated in this present study. Hydrogen can be generated by water electrolysis from fluctuating renewable power sources. Together with CO_2, e.g., sequestrated from industrial resources – the reverse water-gas-shift reaction forms syngas. The Fischer-Tropsch synthesis produces long chained hydrocarbons from syngas. Downstream product separation and upgrading generates gasoline, jet fuel and diesel. Another process concept is based on high temperature co-electrolysis of steam and CO_2 producing synthetic gas at high temperature and pressure. The process performance is evaluated via flowsheet simulation models and pinch point analysis comparing the Power-to-Fuel efficiency as well as carbon conversion into liquid fuels. A baseline Power-to-Fuel efficiency of 44% for the concept based on water electrolysis can be increased to 60% using the co-electrolysis concept. The baseline carbon conversion of 73% grows to 98%. The sensitivity of various operation conditions was analyzed. A cost analysis based on market data and equipment factors was performed for the investment year 2014. Employing stationary power input of 105 €/MWh, production costs of 3.38 €/kg were found for the water electrolysis concept. The production costs of the co-electrolysis concept was compared to 2.83 €/kg. The sensitivity of the electrolyze capital cost and electricity prices were analyzed and their effect on the production costs will be presented. Investment and operating costs to fill the gap towards carbon-neutral air transport growth from 2020 can be predicted based on 2014 costs and technology status. A comparison to other renewable jet fuels regarding land use, feedstock potential and economic measures will be provided.

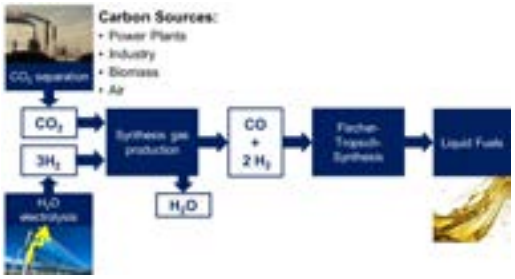

Figure : Baseline concept of the Power-to-Liquid process

Biography

Ralph-Uwe Dietrich leads the research area alternative fuels at the Institute of Engineering Thermodynamics in the German Aerospace Center (DLR) in Stuttgart. He is responsible for the research group on techno economic and ecologic evaluation of alternative fuels for aviation and global transport. He received his PhD in Engineering at the Clausthal University of Technology in 2013 and works as a Scientific Coworker at the Clausthaler Umwelttechnik-Institut (CUTEC-Institut GmbH). Before that, he has got 15 years of experience as Project Manager at different enterprises (SME and Fortune 500) of the process and automation industry.

ralph-uwe.dietrich@dlr.de