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Alternative fuels from biomass and power (PBtL) – A case study on process options, technical potentials, fuel costs and ecological performance

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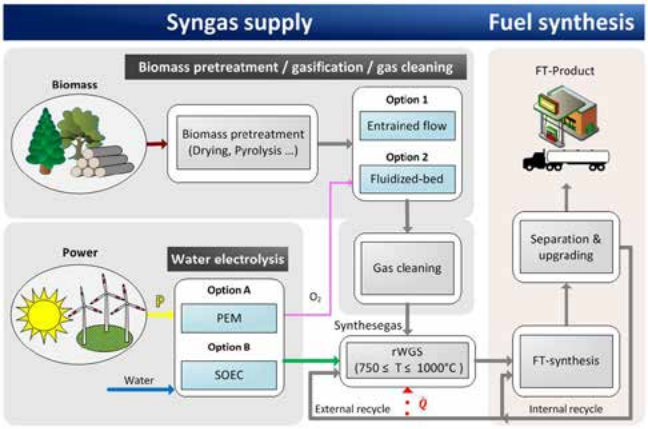
Greenhouse gas emissions in the transport sector shall be reduced to reach globally agreed COP21 goals. One option is to replace fossil based fuels with bio-based alternatives. The technical potential of biofuels made from energy crops (1st generation), biomass and waste wood (2nd generation) typically suffer from the limited technical potential of biomass resources in central Europe. Biofuel output can significantly be increased in the Power & Biomass-to-Liquid (PBtL) concept utilizing renewable electricity in modified BtL plants. The case study presents detailed results on promising process configurations of Fischer-Tropsch PBtL concepts based on different gasifiers and electrolyzers in terms of fuel production potentials, fuel costs and CO_2 footprint. Results from the study indicate that the biomass specific fuel output can be quadrupled when utilizing green electricity for hydrogen generation in the PBtL process. The increased fuel output results in lower fuel production costs due to the effects of the economy of scale. Fuel production costs below 1.3 €/l were estimated for a large PBtL plant (225 kt/year) assuming an electricity price of 31.4 €/MWh (average EEX-Phelix index of the year 2015). The exergy analysis reveals that the electrolysis and the gasification processes are characterized by the most significant thermodynamic optimization potentials. The PBtL concept is characterized by a lower CO_2 footprint, as high carbon conversion rates close to 100% can be achieved by using oxy-fuel technology and recycling the entire CO_2 within the system. Hence, largest CO_2 emissions arise from harvesting and transportation of the biomass feedstock.



Block flow diagram and system boundary of PBtL concepts

Biography

Ralph-Uwe Dietrich leads the research area Alternative Fuels at the Institute of Engineering Thermodynamics at 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 Technical University Clausthal in 2013 as a Scientific Coworker at the Clausthaler Umwelttechnik Institute (CUTEC-Institut GmbH). Before that, he got 15 years of project manager experience at different enterprises (SME and Fortune 500) of the process and automation industry.

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