

# POPULAR SCIENTIFIC ABSTRACT

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The Role and Feasibility of Electrofuels in the Future Renewable Energy System

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Many parts of the world's energy systems are dependent on energy dense liquid or gaseous fuels such as natural gas, gasoline, diesel, and jet fuel. Today, these fuels are mainly fossil based, which is a problem in relation to the climate challenge that we are facing. Some of the fossil fuels that are used today can be substituted with renewable electricity production or with biofuels. However, there is a technical limit on the applicability of electricity and the amount of sustainable biomass is limited.

By turning renewable electricity, water, and carbon dioxide into gaseous or liquid fuels, these limitations can be loosened, and this is how electrofuels are produced. Electrofuels can be almost chemically identical to the fossil-based fuels that is used today, but the carbon dioxide emissions from burning electrofuels will equal the carbon dioxide sequestered in the production. The "electro" in electrofuels refers, not to a specific chemical composition of the fuel, but to the origin of the energy; here electricity. It is therefore possible to produce renewable gasoline, diesel, jet fuel, etc. without using fossil fuels and without violating the sustainable biomass potential.

In this thesis, a technical solution space for future fully renewable energy systems that stays within the sustainable biomass potential has been quantified in relations to electrification, biomass demand, and hydrogen integration in the form of electrofuels. An investigation of how system integration aspects and co-optimization of biomass utilization affects the biomass demand of future fully renewable energy systems has also been conducted. Furthermore, technological pathways, processes and their economic feasibility for producing sustainable aviation fuels from the following feedstocks has been analyzed; biogas, bio-methane, electro-methane, hydrogen, and CO<sub>2</sub>. Lastly, the thesis consists of a quantification of the amount of energy and consequently land area it would take to substitute all fossil fuels with electrofuels in 2060 under a current policy scenario.

The role of electrofuels in the future renewable energy system is mainly in keeping the biomass demand at a sustainable level while supplying the future demand for energy dense gaseous and liquid fuel needed in sectors that are hard to electrify such as aviation, shipping, and high temperature process heat. The technical components and building blocks for producing electrofuels already exist, but they must be put together in an upscaled green supply chain. The issue is that the price of electrofuels is and will be higher than those of fossil fuels if no regulation is enforced.