Energy
National Research Programmes 70 and 71

Project

Biochemically-catalytically produced biofuels

Climate-Neutral Propulsion of Aircraft and Trucks

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Despite ongoing tests with electrically powered aircraft and trucks, vehicles for the transportation of heavy goods will probably continue to depend on liquid fuels with high energy density for quite some time. However, the joint project presented here shows that these fuels could be produced from biomass in a climate-neutral way.

Although aircraft will probably continue to depend on kerosene for quite some time, this does not mean that they cannot become climate-neutral. Source: Pixabay/Holgi *Source:* Pixabay/Holgi

At a glance

- Air traffic and heavy goods vehicle traffic continue to depend on liquid fuels such as diesel and kerosene.
- However, these fuels can be produced not only from fossil fuels but also from biomass in a climate-neutral manner.
- In Switzerland, the amount of usable biomass is greater than assumed.
- However, its conversion into fuel is a complex and costly process.

In passenger cars, the conversion to electric engines is already in progress. Various alternative energy sources such as biodiesel or bioethanol are now available to replace fossil fuels. Trials with alternative energy sources and drive concepts for heavy goods vehicles (e.g. electrically or hydrogen-powered trucks) are also underway. Nevertheless, both trucks and aircraft will continue to depend on carbon-based liquid fuels for quite some time. Alternative sources of carbon for the production of carbon-based chemicals are also lacking.

Biomass is a solution, but a complex one

Although complex in its utilisation, there is one source that could kill two birds with one stone: biomass, a plant material which, when used for energy production, releases only the amount of CO2 fixed during its growth. Today's applications such as bioethanol or biodiesel are primarily based on vegetable oils (e.g. rapeseed oil), or starch from maize or sugar cane. However, such applications are controversial as they call for plants that are also food sources. So-called lignocellulosic biomass would be more suitable. Lignocellulose is present in the cell wall of woody plants. This type of biomass is the most commonly available raw material that is suitable for the production of biofuels, and it does not compete with food plant biomass.

However, the conversion of lignocellulosic biomass, such as straw or beechwood, into fuels and chemical precursors is highly challenging, which is why this joint project aimed to investigate the required biological and catalytic conversion processes and to evaluate their sustainability along the entire value chain.

A further goal was to first transform lignocellulose into carboxylic acid using a biotechnological process and, in a second step, to convert this acid into aircraft fuel.

The amount of usable dry matter in Switzerland is greater than assumed

All three included subprojects have produced results that contribute significantly to the research in their respective fields. For example, one of the teams has developed a so-called lactate platform for the production of carboxylic acids from lignocellulosic biomass. Thanks to this platform, it is possible to convert the different starting materials contained in the biomass first into lactic acid as a common intermediate product, and then into the required substances. In practice, this process has made it possible to extract, from one tonne of beechwood, approximately 200 kilograms of butyric acid, which can be used as a precursor for biofuels.

Furthermore, the analysis performed within another project indicated that the potentially available plant biomass in Switzerland is greater than previously assumed: namely 500 000 tonnes of dry matter per year. Half of this comes from so-called ecological compensation areas, i.e. extensively cultivated meadows. The other half consists of wood residues, plant material from unfertilised grassland with low livestock numbers, agricultural harvest residues and wood. However, the scientists believe that to ensure cost-effective conversion and processing of this material, the biorefineries would have to sell the resulting kerosene at twice the price of the fossil kerosene available today.

New pathways and optimised existing processes

The joint projects were aimed at enhancing energy efficiency in the chemical industry and improving the use of biomass. As a result, the researchers were able to identify novel ways of producing renewable and low-emission fuels and chemicals. They for example developed a simplified method to produce carboxylic acid from biomass. This involves pre-treating the biomass with steam, causing it to burst just like potatoes in a pressure cooker. Once the biomass is disrupted and defibred, enzymes break it down into sugar, and yeasts convert the sugar into alcohol which is then purified to almost 100 % by distillation.

This joint project points the way to a direct and indirect reduction of CO_2 emissions in Switzerland, thus contributing to several aspects of the implementation of the Energy Strategy 2050.

Produkte aus diesem Projekt

Contact & Team

Prof. Dr. Michael Hans-Peter Studer
Berner Fachhochschule
Hochschule für Agrar-, Forst- und Lebensmittelwissenschaften
Abteilung Agronomie
Länggasse 85
3052 Zollikofen

+41 31 910 29 36
michael.studer1@bfh.ch

Michael Hans-Peter Studer
Project direction

Doris Herrmann

Connected projects

Carboxylic acids for bio fuel

Straw and Beechwood for Environmentally Friendly Flights

Refinement of carboxylic acids

Organic acids could be turned into aircraft fuel

Sustainability of bio fuels

From Cultivation to Disposal: How to Optimise Biorefineries

All information provided on these pages corresponds to the status of knowledge as of 17.12.2018.