

PRESS RELEASE

Projekt SAFari _08.03.20233

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Development of a pilot plant for the production of sustainable synthetic aviation fuels based on methanol

The harmful effects of air traffic on the climate will have to be greatly reduced in the future – this applies both to the carbon dioxide (CO₂) emissions from jet fuel and to the so-called non-CO₂ effects, such as the climate impact of the condensation trails caused by an aircraft. A consortium of research institutes and industrial partners, under the leadership of the Fraunhofer Institute for Solar Energy Systems ISE, is therefore researching the development of an innovative process: A sustainable synthetic liquid fuel (Sustainable Aviation Fuel, SAF) is to completely replace fossil jet fuel in the future. Innovations in the synthesis process should lead to an increase of the energy efficiency of this SAF production route. Partners along the entire value chain have joined forces with Fraunhofer ISE for the SAFari project: “Sustainable Aviation Fuels based on Advanced Reaction and Process Intensification”.

The consortium includes ASG Analytik-Service AG, BP Europa SE, Clariant AG, and the German Aerospace Center (DLR). Associated partners such as Südzucker AG and the German Aviation Association (BDL) are important stakeholders who provide the necessary raw materials or are potential off-takers. The SAFari project received funding from the Federal Ministry for Digital and Transport (BMDV) on 1 December 2022 for a duration of six years.

More than 23,000 large aircraft are in operation worldwide, consuming around 350 billion liters of fuel and emitting around 1 billion tons of CO₂ every year. According to calculations by the International Energy Agency (IEA), this corresponds to around 3% of global human-produced CO₂ emissions. Although long-haul flights (> 4,000 km) account for only 6.2% of flights in Europe, for example, they are responsible for more than half of aviation’s greenhouse gas emissions, according to calculations by Eurocontrol Data. Unfortunately, there is currently no alternative to liquid fuels: they are the only fuels that provide the high energy density necessary to cover such distances, and will thus remain indispensable for long-haul flights for the foreseeable future.

As part of the 77th Annual General Meeting of the International Air Transport Association (IATA) in 2021, the world’s airlines set themselves the goal of achieving net-zero carbon emissions by 2050. “Sustainable Aviation Fuel (SAF) must therefore achieve technological and economic market maturity as quickly as possible, so that – with industrial-scale production and global trade – it can make a significant contribution to reducing emissions from the aviation sector” explains Professor Christopher Hebling, Division Director of Hydrogen Technologies at Fraunhofer ISE. “What is encouraging is that SAF can be blended with conventional fuel without any further modifications to the engines or infrastructure,” Hebling added. European aviation fuel legislation mandates increasing use of SAF starting in 2025, while the US government has several incentives in place to increase SAF use.

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Tailor made pilot plant and use of green methanol-----
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In the SAFari project, the partners will produce and test sustainable aviation fuel from methanol in a pilot plant aiming to subsequently obtaining full market approval from the American Society for Testing and Materials (ASTM). With respect to the methanol pathway for producing SAF, there is not yet a fully integrated pilot or demonstration plant in operation that encompasses the entire process chain. The future SAFari pilot plant will be developed and operated by the Fraunhofer ISE and will combine all functionalities required for the later technical process in order to ensure the transfer of the gained know-how to industrial scale.

The conversion of carbon dioxide and hydrogen to methanol as a feedstock for the SAFari project is very advantageous for numerous reasons: "Green methanol can be produced worldwide at locations with a high availability of renewable energy sources and transported efficiently as a pure liquid to other locations using the existing infrastructure. There, it is converted into aviation fuels. Therefore, this methanol pathway offers a great opportunity to generate added value in Germany as well," explains Dr. Achim Schaadt, Head of Department Sustainable Synthesis Products at Fraunhofer ISE. "We also want to show that a higher blending rate can be achieved with methanol-based SAF." Currently, the various ASTM-approved SAFs allow a blending rate of up to 50%. The SAFari project is aiming for a rate of up to 100%.

Innovative reaction technologies and process integration

SAFari partners will take an innovative approach: "We want to demonstrate that synthesizing aviation fuel on the basis of methanol can reduce hydrogen demand and with that achieve high overall process efficiency on an industrially relevant scale. The focus will be on innovative reaction technologies throughout the various sub-processes and the intelligent integration of heat and mass flows. This should help to increase SAF yield and reduce production costs," explains Dr. Ouda Salem, SAFari project leader and Head of the Power-to-Liquids Group at Fraunhofer ISE. "The SAFari approach can become a disruptive technology that has the potential to completely replace the fossil process and significantly reduce the carbon footprint of aviation fuels in an economically viable manner," Salem continued.

ASG Analytik-Service AG | Dr. Thomas Wilharm

"ASG would like to intensify its activities in the field of jet fuels and anticipates a considerable increase in knowledge from the SAFari consortium. To this end, tailor-made analytical technologies are being provided for the characterization of the components, as well as extensive laboratory equipment for the determination of important fuel parameters. In addition, ASG is supporting the project partners in the development of distillation processes on a pilot plant scale and is providing synthetic feeds for the experimental setups, building on already robust experience in both areas."

BP Europa SE | Dr. Ulrich Balfanz

"BP intends to extensively expand its renewable energy and bioenergy portfolio. Our contributions to the SAFari project are important steps toward achieving our goal of advancing the production of sustainable fuels."

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Clariant Produkte (Deutschland) GmbH | Dr. Andreas Geisbauer

“We are pleased to be part of the SAFari research consortium and to be able to contribute to the development of future CO₂-neutral aviation based on our many years of expertise in the large-scale production of the zeolite catalysts required for the project.”

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German Aerospace Center DLR | Dr. Jens Melder

“The Institute of Combustion Technology (DLR-VT) has been active in the field of evaluating synthetic aviation fuels since 2006 and has developed a wide range of methods and international networks in this regard. Among other things, the institute was instrumental in the development of fuel prescreening, a tool for the early evaluation of SAF candidates. At SAFari, we contribute our expertise in the evaluation, qualification, and ASTM certification of fuels.”



The SAFari consortium, consisting of representatives from ASG Analytik-Service AG, BP Europa SE, Clariant AG, the German Aerospace Center (DLR), and Fraunhofer ISE © Fraunhofer ISE/Diana Bribach

Founded in 1992, **ASG Analytik-Service AG (ASG)** is a testing laboratory certified by the German Accreditation Body (DAkkS) and located in Neusäß, near Augsburg. With 45 employees and an annual turnover of approx. 5 million euros, ASG is an SME that, as a commercial service provider, is mainly involved in the analysis of fossil and regenerative fuel.

BP is an integrated energy corporation that operates in Europe, North and South America, Australia, Asia, and Africa, and aims to become a carbon-neutral company by 2050 or sooner. Headquartered in Hamburg, Germany, BP Europa SE employs about 10,500 people in Germany, Belgium, the Netherlands, Austria, Poland, Switzerland, and Hungary. BP operates one of Germany's largest refining and petrochemicals businesses and is the market leader in the service station sector with its Aral brand. Aral has been BP's service station brand in Germany since 2002.

Over the course of its 165-year history, **Clariant Produkte (Deutschland) GmbH** has established itself as a global and independent manufacturer of energy-efficient catalyst technologies and materials that advance sustainability efforts in the chemical industry. The company's work contributes

The Fraunhofer-Gesellschaft based in Germany is the world's leading applied research organization. Prioritizing key future-relevant technologies and commercializing its findings in business and industry, it plays a major role in the innovation process. A trailblazer and trendsetter in innovative developments and research excellence, it is helping shape our society and our future. Founded in 1949, the Fraunhofer-Gesellschaft currently operates 76 institutes and research units throughout Germany. Over 30,000 employees, predominantly scientists and engineers, work with an annual research budget of €2.9 billion. Fraunhofer generates €2.5 billion of this from contract research.

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to the defossilization of its customers' production processes and paves the way for the production of CO₂-neutral, emission-free basic chemicals and fuels.

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The **German Aerospace Center (DLR)** is the Federal Republic of Germany's research center for aeronautics and space. Here, research and development are advanced in the fields of aeronautics, space, energy and transport, security and digitization. A special feature of the Institute of Combustion Technology is the multi-scale observation and evaluation of fuel effects on combustion.



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