

CARE-O-SENE

Catalyst Research for Sustainable Kerosene

CARE-O-SENE (Catalyst Research for Sustainable Kerosene) is a German-South African research project for the new and further development of catalysts in the Fischer-Tropsch (FT) process. These FT catalysts play a key role in the large-scale production of green kerosene. With the help of optimised catalysts, sustainable aviation fuels (SAF) can be produced more efficiently.

The international consortium has received funding of around 30 million euros from the Federal Ministry of Education and Research. Furthermore, CARE-O-SENE is the first project of the German National Hydrogen Strategy in which solutions for a worldwide challenge are being developed in global cooperation.

Key data of the research project:

- **By 2025**, CARE-O-SENE wants to set the course for large-scale production of green kerosene with a new generation of catalysts
- Goal: **More than 80 percent** process yield, significantly more fuel production with the same resource input
- **30 million euros in funding** from the Federal Ministry of Education and Research (BMBF)
- International consortium partners contribute an additional **10 million euros**
- Important component of the **National Hydrogen Strategy** of the Federal Republic of Germany

Seven German and South African project partners contribute their expertise:

- [Sasol Ltd.](#) and [Sasol Germany GmbH](#)
- [Helmholtz-Zentrum Berlin fuer Materialien und Energie \(Helmholtz Centre for Materials and Energy, HZB\)](#)
- [Fraunhofer Institute for Ceramic Technologies and Systems \(IKTS\)](#)
- [Karlsruhe Institute for Technology \(KIT\)](#)
- [University of Cape Town, Department of Chemical Engineering \(UCT\)](#)
- [INERATEC GmbH](#)

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Catalyst Research for Sustainable Kerosene

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About Sasol:

Sasol Germany GmbH is a manufacturer of high-quality chemical products with production sites in Brunsbuettel and Marl and its head office in Hamburg. Around 1,700 employees and almost 60 trainees produce innovative, sustainable products and develop solutions for the processing industry. The company offers a wide range of products, including substances for the production of detergents and cleaning agents, paints and coatings, cosmetics and pharmaceutical products. In addition, specialities such as high-purity and ultra-high-purity aluminas are used, for example, as catalyst carriers in catalytic converters for the automotive industry, industrial applications and high-performance abrasives.

Sasol Germany GmbH is part of the South African Sasol Group, a leading integrated chemical and energy company with almost 28,000 employees in 22 countries manufacturing and marketing first-class products. The Sasol Group includes the business divisions of Sasol Chemicals, Sasol Energy and Sasol ecoFT. The Sasol ecoFT division, newly founded in 2021, uses both Sasol's protected technology as well as expertise and experience to manufacture sustainable fuels and chemicals made of green hydrogen and sustainable carbon sources via the power-to-liquids process (PtL).

About HZB:

The Helmholtz-Zentrum Berlin fuer Materialien und Energie (HZB) is researching solutions for a climate-neutral society. Re-searchers are developing and optimising efficient and cost-effective energy materials for photovoltaic cells, batteries and catalysts. The HZB uses a research infrastructure with the accelerator-based x-ray source BESSY II which enables unique insights into materials and permits operando analyses. With around 1,200 employees, HZB is one of the largest non-academic research centres in Berlin in the field of energy research and is member of the Helmholtz Association. More information: www.helmholtz-berlin.de

Press release

International consortium to advance decarbonisation of aviation sector

In the CARE-O-SENE research project, partners from Germany and South Africa develop new catalysts for green aviation fuels

JOHANNESBURG, South Africa, 25 May 2022 – Sasol and Helmholtz-Zentrum Berlin (HZB) will lead a consortium to develop and optimise next-generation catalysts that will play a key role in decarbonising the aviation sector through sustainable aviation fuels (SAF).

At a ceremony at Sasol's global headquarters in Johannesburg yesterday, South African President Cyril Ramaphosa and German Chancellor Olaf Scholz attended the launch of CARE-O-SENE (Catalyst Research for Sustainable Kerosene) research project, to be funded by the German Federal Ministry of Education and Research (BMBF).

Sasol joins forces with five other world-leading organisations in Germany and South Africa to accelerate the development of catalysts that are essential to produce green kerosene on a commercial scale through Fischer-Tropsch (FT) technology.

“We are delighted to have been selected to lead this important project,” said Fleetwood Grobler, President and Chief Executive Officer of Sasol Limited. “Our expertise in FT technology and catalysts makes us the ideal partner to help Germany and the world decarbonise the aviation sector and make it sustainable over the long-term.”

Prof. Dr. Bernd Rech, Scientific Managing Director of HZB adds, “CARE-O-SENE will enable us to accelerate innovation in a crucial field of green energy. This can only be achieved in a global partnership by deeply integrating fundamental research and technology development on an industry relevant scale.”

Other CARE-O-SENE project partners include the Fraunhofer Institute for Ceramic Technologies and Systems (IKTS), the Karlsruhe Institute of Technology (KIT), the University of Cape Town,

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Geschäftsführung: Dr. Jens Straatmann Vorsitzender des Aufsichtsrats: Christian Schindler
Sitz der Gesellschaft: Hamburg Registergericht: Amtsgericht Hamburg HRB 78475

Department of Chemical Engineering (UCT) and INERATEC GmbH. The consortium expresses its sincere gratitude to the German Federal Ministry of Education and Research for supporting these important efforts.

CARE-O-SENE will run for three years and pursues the goal of setting the course for large-scale commercialisation of green kerosene production by 2025 with its research on catalysts. Catalysts are used to speed up chemical reactions, increase the yield and improve the quality of refined products. The new FT catalysts are expected to increase the fuel yield of the process to over 80 percent, thereby optimising use of resources.

Unlike conventional kerosene derived from fossil feedstocks, SAF can be made from green hydrogen and sustainable carbon dioxide sources. Developing SAF is key to a sustainable decarbonisation of the hard-to-abate aviation industry, and the main lever for net zero aviation. The underlying technology to developing SAF at scale from green hydrogen and sustainable carbon sources is FT technology, in which Sasol has been a global leader for more than 70 years.

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About Sasol:

Sasol Germany GmbH is a manufacturer of high-quality chemical products with production sites in Brunsbuettel and Marl and its head office in Hamburg. Around 1,700 employees and almost 60 trainees produce innovative, sustainable products and develop

solutions for the processing industry. The company offers a wide range of products, including substances for the production of detergents and cleaning agents, paints and coatings, cosmetics and pharmaceutical products. In addition, specialities such as high-purity and ultra-high-purity aluminas are used, for example, as catalyst carriers in catalytic converters for the automotive industry, industrial applications and high-performance abrasives.

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Press release

40-million-euro sustainable kerosene research project CARE-O-SENE receives funding

Hamburg/Berlin, 12 October 2022 – The international research project CARE-O-SENE (Catalyst Research for Sustainable Kerosene) was granted 30 million euros in funding by the German Federal Ministry of Education and Research (BMBF). Additionally, the industrial consortium partners contribute 10 million euros. The aim of the project is to develop novel, next-generation Fischer-Tropsch catalysts and thus to optimise the production of sustainable kerosene – or Sustainable Aviation Fuel (SAF) – on an industrial scale.

Sustainable kerosene is not based on fossil-based raw materials like conventional kerosene but on green hydrogen and carbon dioxide. The technology contributes significantly to sustainably decarbonising sectors such as aviation, since fossil fuels are particularly difficult to replace in this area.

Research partners for the next generation of Fischer-Tropsch catalysts in CARE-O-SENE include Sasol Germany GmbH, Sasol Limited and the Helmholtz-Zentrum Berlin fuer Materialien und Energie (Helmholtz Centre for Materials and Energy, HZB). Others are the Fraunhofer Institute for Ceramic Technologies and Systems (IKTS), the Karlsruhe Institute of Technology (KIT), The University of Cape Town (UCT) and INERATEC GmbH.

Dr Dirk Schaer, Lead Technical Marketing Catalyst at Sasol says: “Our work is an important building block of the German National Hydrogen Strategy. We are delighted that the BMBF has recognised the enormous potential in the CARE-O-SENE research project on the novel Fischer-Tropsch catalysts and supports the work.”

“We are absolutely delighted about the start of CARE-O-SENE,” adds Dr Tobias Sontheimer, Head of Strategy - Energy and Information at HZB. “The fact that each partner can contribute dedicated expertise in catalysis research and work so closely with successful companies on technological implementation makes the project very special.”

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German Chancellor Olaf Scholz and the South African President Cyril Ramaphosa gave the go-ahead for the CARE-O-SENE project at a ceremony at Sasol's headquarters in Johannesburg in May this year. Now that the positive funding decision has been taken, the research work can begin.

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Dr Dirk Schaer

Lead Technical Marketing Catalyst & Co-leader of the CARE-O-SENE project

Dirk is responsible for the marketing and sales of Sasol's high performance Cobalt Fischer-Tropsch catalysts enabling Sasol's own proven Fischer-Tropsch technology as well as alternative micro-channel and fixed bed technologies. Further to this, he is Co-leader of the CARE-O-SENE catalyst development consortium.

Dirk is fascinated by developing new markets and cooperating with groundbreaking companies and passionate start-ups specifically in sustainable markets.

Areas of expertise

Dirk has a long track record within Sasol Chemicals in different technical customer support, market development and marketing roles. He gained experience in a wide range of applications including plasticisers, lubricants, latent heat storage materials and homogeneous catalysts. Within all these roles, he demonstrated his high customer orientation and centrality.

Finding sustainable solutions together with his customer was always one of his major goals. This puts Dirk in the perfect position to further develop Sasol's highly specialised catalyst business and to drive the fuel and chemical industry's transition into a carbon free future from a catalyst point of view.

Dirk holds a Ph.D. in Chemistry from Georg-August University of Goettingen, Germany.





FAQ

What does SAF stand for?

SAF stands for **Sustainable Aviation Fuels**. SAF refers to all sustainably produced aviation fuels, such as biogenic and synthetic fuels.

SAFs are divided into different generations. The first generation includes plant-based SAFs that are produced from vegetable oils. The second generation consists of SAFs produced from biomass, for example from waste and wood residues. The third and fourth generations consist of synthetic fuels. This is where the power-to-liquids (PtL) process comes into play.

For a fuel to be considered an SAF – and thus sustainable – the raw materials used are evaluated according to certain sustainability criteria. Criteria include whether there is competition with food production, how much drinking water is used and whether there is any destruction of ecosystems, for example through additional agricultural cultivation.

How does the power-to-liquids process for the production of SAF work?

The key to decarbonising aviation is the technology to convert energy into liquid energy carriers (power-to-liquids; PtL) to produce SAF. One of the technologies used for this is the Fischer-Tropsch (FT) process for converting hydrogen and carbon dioxide from sustainable sources into SAF. The resulting SAFs are not based on fossil fuels like conventional kerosene but on renewably generated electricity and carbon dioxide.

What are Fischer-Tropsch catalysts?

The Fischer-Tropsch process converts green hydrogen and carbon dioxide into a synthetic fuel. New types of catalysts are being developed for this as part of the CARE-O-SENE project. Catalysts increase the efficiency of chemical conversion processes. This improves the process yield and significantly increases fuel production with the same amount of resources, which serves the goal of decarbonising the aviation sector.

The Fischer-Tropsch process, unlike alternative power-to-liquid processes, is already established in the market. Sasol brings over 70 years of experience on Fischer-Tropsch catalysts to the table and is the technology leader in this field.

Why is research into Fischer-Tropsch catalysts important for the production of SAF?

Due to global climate protection efforts and, in some cases, mandatory blending ratios for power-to-liquid kerosene, a strongly growing demand for sustainable aviation fuels is to be expected. Since green electricity and hydrogen will be relatively scarce commodities in the foreseeable future, it is essential to use these raw materials as efficiently as possible. CARE-O-SENE has, therefore, set itself the goal of increasing the process yield to more than 80 percent, thanks to new catalysts. This means that significantly more fuel can be rendered usable with the same amount of resources.

**Will an aircraft fly CO₂-free after the CARE-O-SENE project?**

The aircraft would no longer run on a fossil raw material but on a synthetic alternative – that is a great advantage. Nevertheless, a combustion process still takes place – with carbon dioxide as the residual product. However, this carbon dioxide is returned to the cycle and used as a raw material. Depending on the CO₂ source, it is possible to produce partially or completely CO₂-neutral kerosene. For example, this can be captured from industrial processes or waste incineration. With CO₂-neutral SAF, no additional CO₂ is released into the atmosphere.

Can aircraft use 100 percent SAF?

No changes to existing aircraft or the supporting infrastructure are necessary for the use of SAF. As so-called drop-in fuels, SAF can be used for standard passenger aircraft. SAFs are already being added to conventional fossil fuels in small quantities.

What do we mean by circular carbon dioxide (CO₂)?

By circular carbon dioxide we mean CO₂ that has a biogenic origin or was directly captured from the air ("direct air capture"), then further processed in chemical processes and released again through combustion processes, as in the case of sustainable fuels.

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CARE-O-SENE

Catalyst Research for Sustainable Kerosene

Research for a New Generation of Catalysts

The aviation industry pursues a global transformation using green kerosene. CARE-O-SENE can play a key role in making such green kerosene an attractive fuel alternative. Under the leadership of Sasol and HZB, several partners collaborate to realise this target.



CARE-O-SENE connects seven major German and South African project partners.

We set the course for large-scale commercialization of green kerosene production by 2025.

We develop and optimize next-generation catalysts. They will play a key role in decarbonizing the aviation sector through sustainable aviation fuels (SAF) by achieving higher SAF yields and significantly improving the green energy utilization.

We combine exceptional capabilities of leading research institutes in Germany and South Africa with 70 years of Sasol South Africa's know how on FT technology and FT catalyst and Germany's know-how on catalyst carriers.

We ensure the exchange of young talents between South Africa and Germany as well as institutes and industry.

Together, we develop optimized catalysts for the production of green kerosene.

What are Fischer-Tropsch catalysts?

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Due to global climate protection efforts and, in some cases, mandatory blending ratios for power-to-liquid kerosene, a strongly growing demand for sustainable aviation fuels is to be expected. Since green electricity and hydrogen will be relatively scarce commodities in the foreseeable future, it is essential to use these raw materials as efficiently as possible. CARE-O-SENE has, therefore, set itself the goal of increasing the process yield from 50 to 70 per cent to over 80 per cent, thanks to new catalysts. This means that significantly more fuel can be rendered usable with the same amount of resources.

How does the power-to-liquids process for the production of SAF work?

The key of this technology is converting electric energy into liquid energy carriers (power-to-liquids; PtL). Sustainable aviation fuels (SAFs) are accessible via the PtL approach. One of the technologies used for this is the Fischer-Tropsch (FT) process for converting hydrogen and carbon dioxide from sustainable sources into SAF. The resulting SAFs are not based on fossil fuels like conventional kerosene but on renewably generated electricity and carbon dioxide.

Sasol is a global chemicals and energy company.

We harness our knowledge and expertise to integrate sophisticated technologies and processes into world-scale operating facilities. We safely & sustainably source, produce and market a range of high-quality products in 22 countries, creating value for stakeholders.

Helmholtz-Zentrum Berlin für Materialien und Energie (HZB) researches solutions for a climate-

neutral society. Scientists are developing and optimising efficient and cost-effective energy materials for solar cells, batteries and catalysts. With 1200 employees, HZB is one of Germany's largest non-university research centers in the field of energy research and is a member of the Helmholtz Association.

Fraunhofer IKTS is a partner for power-to-X processes

based on high-temperature electrolysis and Fischer Tropsch synthesis. IKTS provides support from process engineering and the development of unique core components to modular, integrable overall systems.

KIT, the research university in the Helmholtz Association, creates and imparts knowledge for society and the environment. It makes significant contributions to global challenges in the fields of energy, mobility and information.

Established in 1829, the **University Cape Town** is

South Africa's oldest university with currently over 28 000 students. It has maintained a tradition of academic excellence, which today sees it ranked first in Africa and the only African university consistently ranked amongst the top universities in the world.

INERATEC produces sustainable e-fuels and chemicals

in modular chemical plants via the power-to-X or gas-to-X process. Renewable hydrogen and greenhouse gases such as CO₂ are converted into e-kerosene, CO₂-neutral diesel, gasoline or synthetic waxes.

Facts & Figures

40 M

Euro project volume

> 80 percent

process yield of green kerosene
thanks to new catalysts with the
same resource input

In 2025

we want to set the course for
large-scale production of green
kerosene with new catalysts.

7

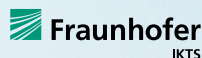
project partners from Germany
and South Africa combining
their expertise for developing new,
efficient catalysts.

We are committed to the enviroment

**CARE-O-SENE will play a key role
in sustainably transforming
industries such as aviation.**

**The goal is to make the
production of green kerosene as
a fuel alternative economically
more attractive.**

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