Fraunhofer ISE

Fraunhofer Institute for Solar Energy Systems ISE

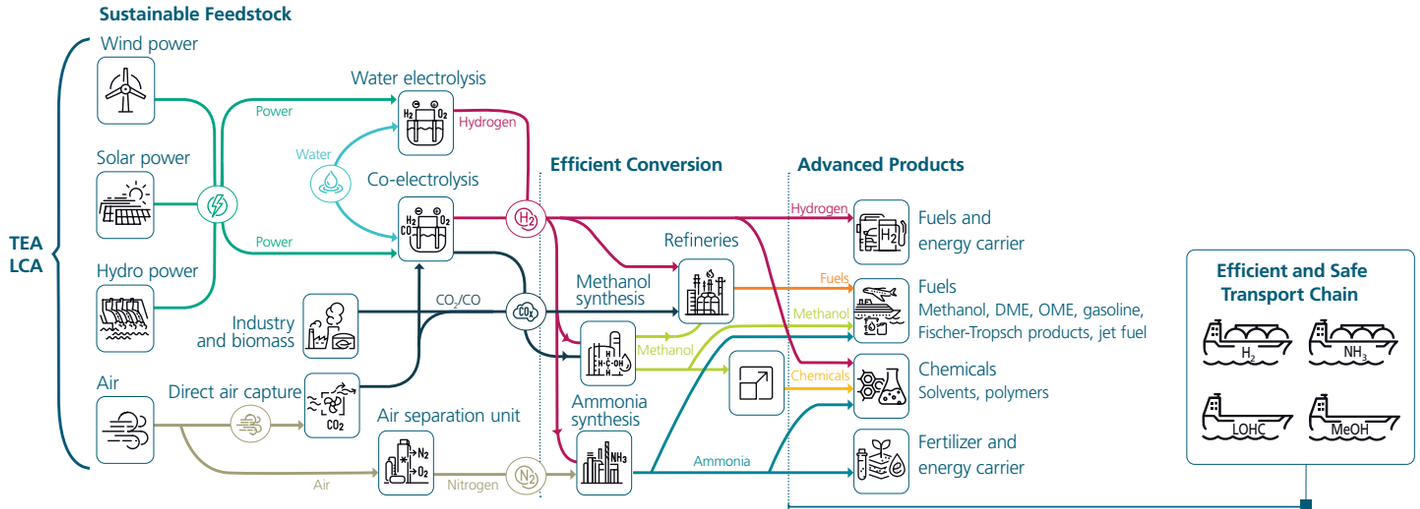
Hydrogen-Based Chemicals, Energy Carriers and Fuels

Production of Sustainable Synthesis Products

www.ise.fraunhofer.de/ptx

Production of Sustainable Synthesis Products

Power-to-X (PtX) denotes the conversion of sustainable hydrogen and CO_x/N_2 to energy carriers such as methanol, dimethyl ether and ammonia, which can also serve as sustainable chemicals or as clean fuels reducing CO_2 and local emissions. PtX contributes to defossilization of all energy economy sectors.



Power-to-X process chain.

Our Offer

- development and engineering of efficient, cost optimized processes for the production of sustainable synthesis products
- in-house design, construction, programming, and operation of fully automated, remote-operated mini and pilot plants for PtX production
- design, test and characterization of catalysts for PtX processes
- assessment of PtX process chains with state-of-the-art steady state and dynamic simulation platforms
- development of customized separation processes (adsorption, distillation)
- techno-economic feasibility studies assessing the potential of PtX processes for your business case
- analysis of catalyst deactivation, „time on stream“ effects and extraction of real-time process operating datas

For more than two decades, Fraunhofer ISE has been performing detailed investigations along the PtX process chain by developing, optimizing and evaluating chemical processes for the production of sustainable energy carriers and chemicals. We currently focus on methanol, oxymethylene ethers (OME), dimethyl ether (DME), sustainable aviation fuels (SAF) and ammonia.

Based on our unique chemical and engineering expertise, we can provide complete system solutions to the process, chemical, transport, finance and energy industries.

Our R&D aims to facilitate industrial deployments based on scientifically solid technologies that are transferable to industrial scale. Our developments help to bridge the gap between conceptual research and commercialization as demonstrated by our technologies such as π-COMET® and INDIGO.

Selected references:

- Tailor-made process intensification focusing on reactive distillation technologies based on experimentally validated simulation models. As a result, we obtained >99 % pure DME from raw methanol (INDIGO technology, patent pending).
- The π-COMET® reactive distillation technology (patent granted) was applied together with industrial partners to achieve the first European production of OME in an industrial environment. The product quality was standards compliant.
- Process material and energy integration, optimization, and conceptual engineering of PtX processes such as SAF (SAFari, BMDV-funded) or DME (Power-to-MEDME, BMBF-funded) are demonstrated in pilot plants.
- In the Carbon2Chem® project, our automated methanol miniplant ran for more than 5000 h using cleaned steel mill gases in an industrial environment.

Techno-Economic Analysis (TEA) and Life Cycle Analysis (LCA)

Fraunhofer ISE analyzes and optimizes complete PtX processes from the renewable source to the final application. In addition, we assess product logistics, determine ideal boundary conditions, and advise our customers by comparing different production routes.

From Plant Design to Operation

Using data from validated experiments, we design custom mini and pilot plants (~1 – 10 L/h), develop ISO 10628 compliant flowsheets, compile bills of materials, write control software and build plants for use in our own state-of-the-art labs or for remote operation at our partners' facilities.

Catalyst and Component Tests

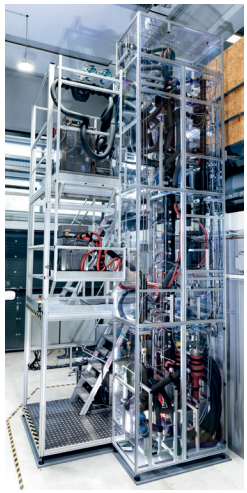
Having operated kinetic reactors for many years, we offer rapid and qualified catalyst screening and characterization. Kinetic models can be established based on experimental data, allowing robust process scale-up. Process equipment such as reactors, distillation, and absorption units can be tested in our plants and directly validated using our models.

Process Simulation and Modeling

Using state-of-the-art simulations, we offer reliable levelized cost estimations of PtX products. Our detailed scientific understanding of the different process steps is key for our economic models. We develop and benchmark new processes, also taking into consideration environmental impact assessments.

Our tools:

- ASPEN® Plus and CHEMCAD®
- X-Visual Plant Engineer
- Development of P&IDs according to DIN-EN-ISO 10628 and DIN-EN-ISO 62424
- MATLAB®/Simulink®
- Ansys Fluent®
- Umberto®



Unique structured-packing pressure distillation/absorption column at Fraunhofer ISE (DN50 up to 40 bar).

Further Information

Lab for Sustainable Synthesis Products

Contacts

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02-281330-25