

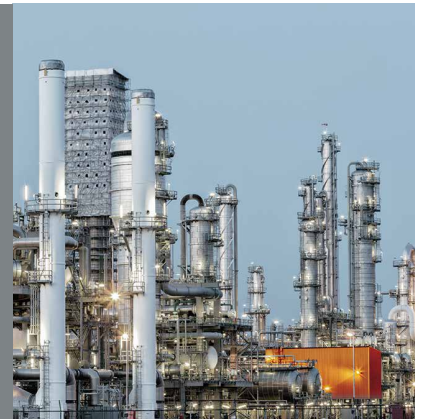


CLEAN SYNGAS FOR SECTOR INTEGRATION

SUNFIRE-SYNLINK



RENEWABLE
ON-SITE SYNGAS
PRODUCTION TO
BRIDGE THE GAP
BETWEEN POWER,
MOBILITY AND
CHEMICAL SECTOR



PRODUCT

Sunfire-SynLink is a so called co-electrolyser based on solid oxide cell (SOC) technology. Renewable electricity, water and CO₂ is used to produce clean syngas consisting of hydrogen and carbon monoxide.

Syngas is a feedstock for various chemical processes and can further be processed to e-Crude, a substitute for crude oil. E-Crude can be used in the existing infrastructure to provide CO₂ neutral e-Fuels, e-Chemicals and e-Waxes.

APPLICATIONS

Syngas is essential for a variety of industrial applications.

Industry:

- + Chemicals
- + Plastics
- + Cosmetics

Mobility:

- + Refineries
- + Power-to-Liquids

DEVELOPMENT ROADMAP

Power-to-X

- + Proof of concept for **Power-to-Liquids** process based on successful demonstration (e-Diesel, e-Naphta and e-Wax production) with reverse water-gas shift reaction (RWGS), operational since end of 2014
- + Proof of concept for **Power-to-Syngas** process with co-electrolysis ongoing, initial prototype operation by Q2 2018
- + Target: Commercial **Power-to-Syngas** prototype operation in 2019

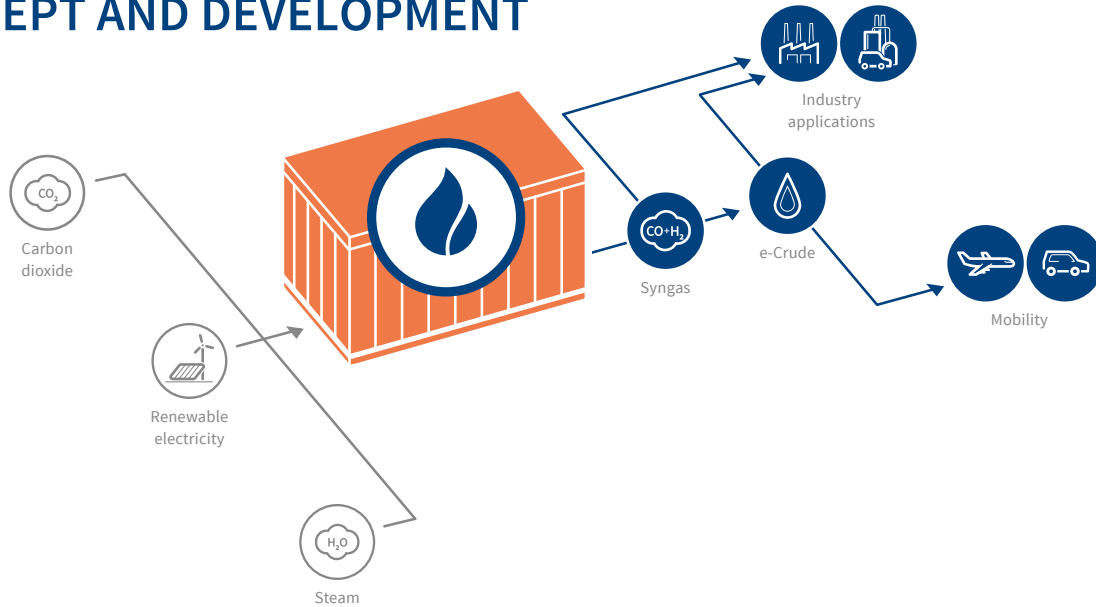
CORE ADVANTAGES

- + **Galvanic process** for syngas production
- + **Highest efficiency** in syngas production (> 80 %_{LHV})
- + **Modular design** to meet customer demand up to megawatt scale
- + **Flexible syngas production** with customised output (between 30 % and 100 %) and adjustable syngas composition (ratio between hydrogen and carbon monoxide)
- + **No contamination or residues** based on sole utilisation of water and CO₂





CLEAN SYNGAS FOR SECTOR INTEGRATION CONCEPT AND DEVELOPMENT



CONCEPT

- + Using renewable electricity, water and CO₂ a Power-to-Fuel efficiency of 60 %_{LHV} can be reached by using Sunfire-SynLink Technology
- + Total CO₂ mitigation potential of 85 % (LCA)

DEVELOPMENT PHASE I

- + Successful demonstration: Power-to-Liquids process with RWGS
- + Production of more than three tons of synthetic e-Crude
- + Industrial-scale endurance test: continuous operation > 2,000 hours
- + Project partners: EIFER, Fraunhofer, GETEC, HGM, FZ Jülich, Kerafol, Lufthansa, Universität Bayreuth, Universität Stuttgart
- + Supported by the Federal Ministry for Economic Affairs and Energy (sunfire project, 033RC1110 A – H)

DEVELOPMENT PHASE II

- + Target: Demonstration of Power-to-Syngas process with initial 10 kW_{DC} co-electrolyser to achieve reductions of OPEX and CAPEX
- + Proof of concept for integrated production of e-Crude by combining CO₂-Air Capture + syngas production + e-Fuel production
- + Project partners: KIT, Climeworks, Ineratec, ZSW
- + Supported by the Federal Ministry of Education and Research (Kopernikus project, 03SFK2Q0)

NEXT STEP: UPSCALING

- + First commercial plant for the production of e-Crude planned in Norway in the industrial park of Herøya
- + Electric input of 20 megawatts to produce 8,000 tons of e-Crude per year
- + Utilizing cost-efficient renewable energy from hydropower
- + Annual production volume sufficient to supply e.g. 13,000 cars with synthetic fuel avoiding 28,600 tons of CO₂ emissions p.a. from fossil fuels
- + Partners: Nordic Blue Crude AS, Climeworks, EDL Anlagenbau and others

