

Pioneering the way to a
sustainable world

Fraunhofer UMSICHT

Four focus topics

Sustainable restructuring of economy and society: circular, climate-neutral, economical



Carbon Management

Sustainable use of carbon



Circular Economy

Materials and processes for the circular use of resources: from laboratory to industrial scale



Green Hydrogen

Materials and processes for the electrochemical production, utilization and storage of green hydrogen



Local Energy Systems

Concepts and technologies for transforming the energy supply of districts and industry

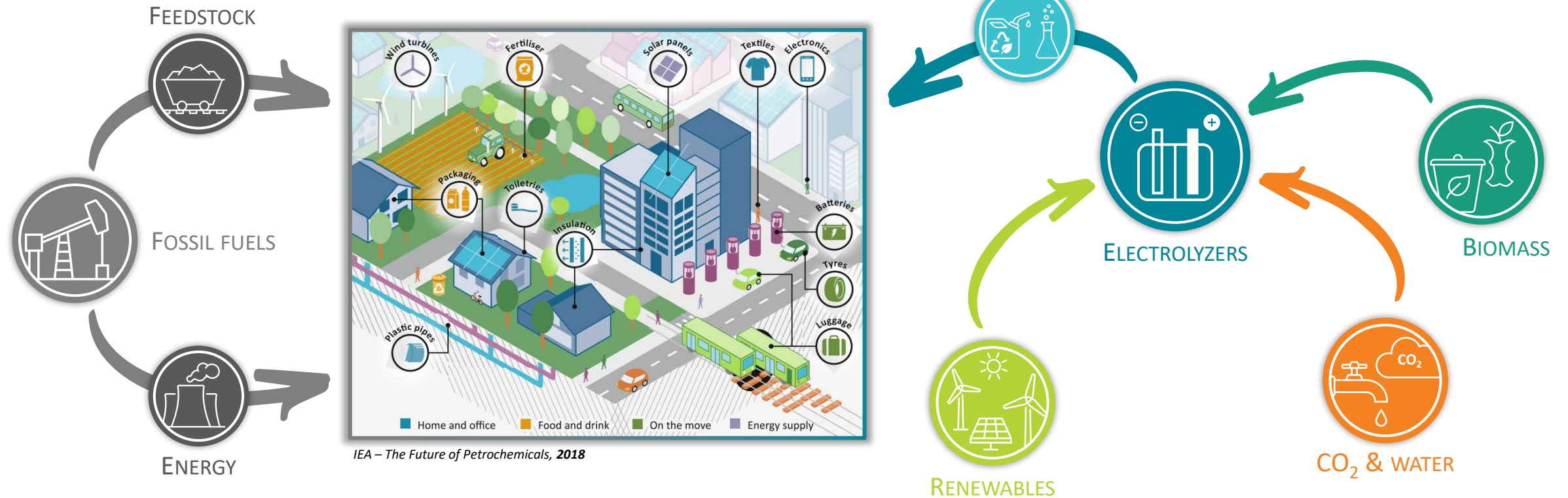


Department Electrosynthesis

Ulf-Peter Apfel, Julia Jökel, Kai Junge, Puring Daniel
Siegmond & Kevinjeorgios (Jorgo) Pellumbi

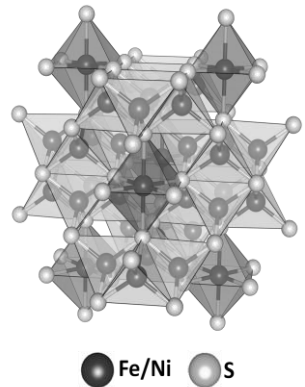
Defossilization of the chemical industry

Electrolyzers as key-enabling technologies



Competencies at Fraunhofer UMSICHT & Ruhr-University Bochum

Holistic approach from electrode development to electrolyzer scale-up



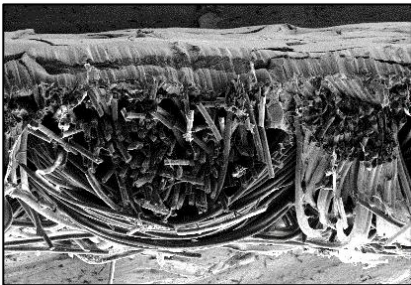
Catalyst development & synthesis to the kg-scale

Cell optimization

Scale-up to the demonstrator-scale

Novel electrode concepts

Stack development



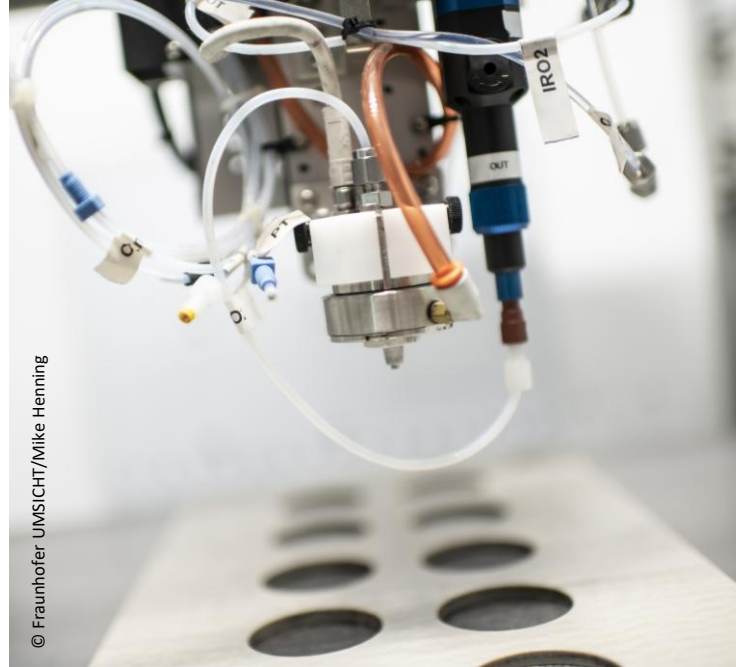
Electrolysis technology development

From catalysts to complete stacks



Catalyst Synthesis

performed in kg-scale, targeting transition metal compounds.



Electrode Manufacturing

using scalable techniques and tailored for specific electrolysis applications.

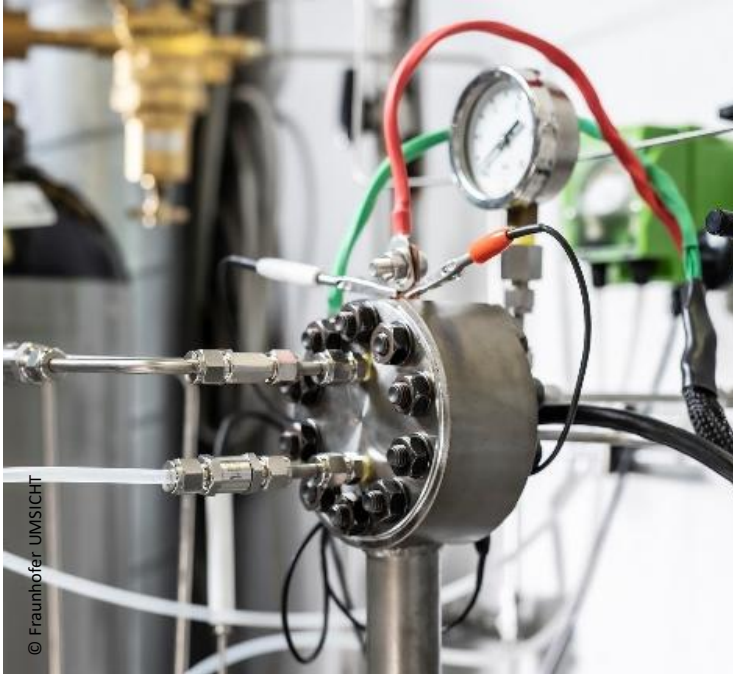


Catalyst Testing

directly within under industrially relevant conditions

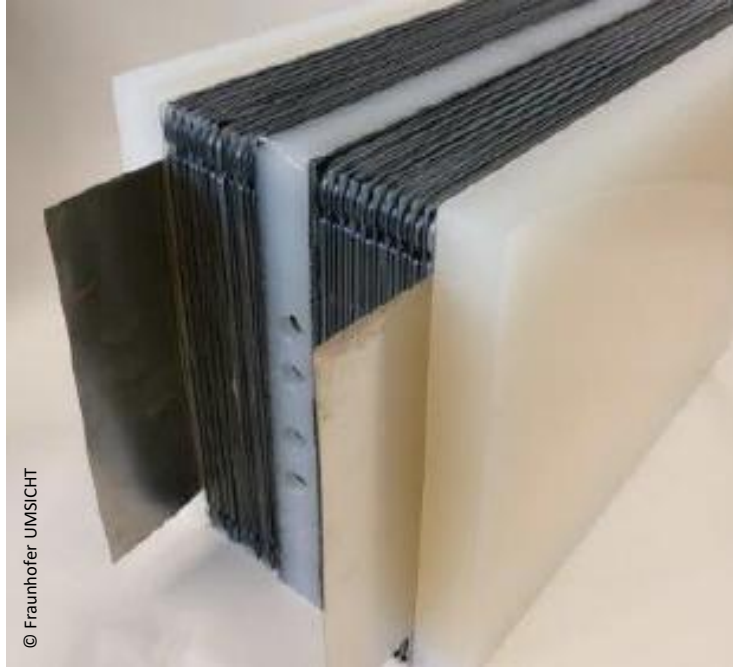
Electrolysis technology development

From catalysts to complete stacks



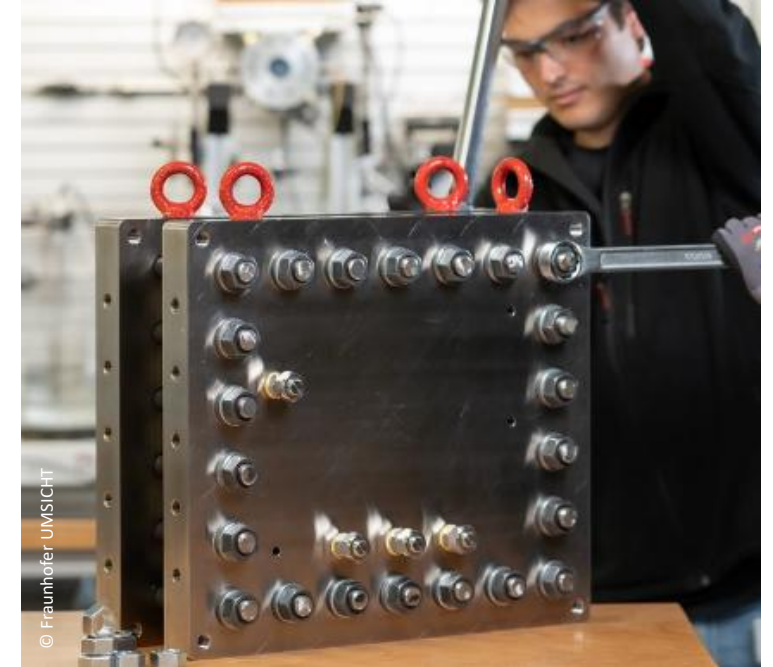
Cell and Stack testing

including lifetime evaluation, stress testing and corrosion analysis.



Innovative Electrolyzer Design

enabled e.g. by weldable thermoplastic cell components.

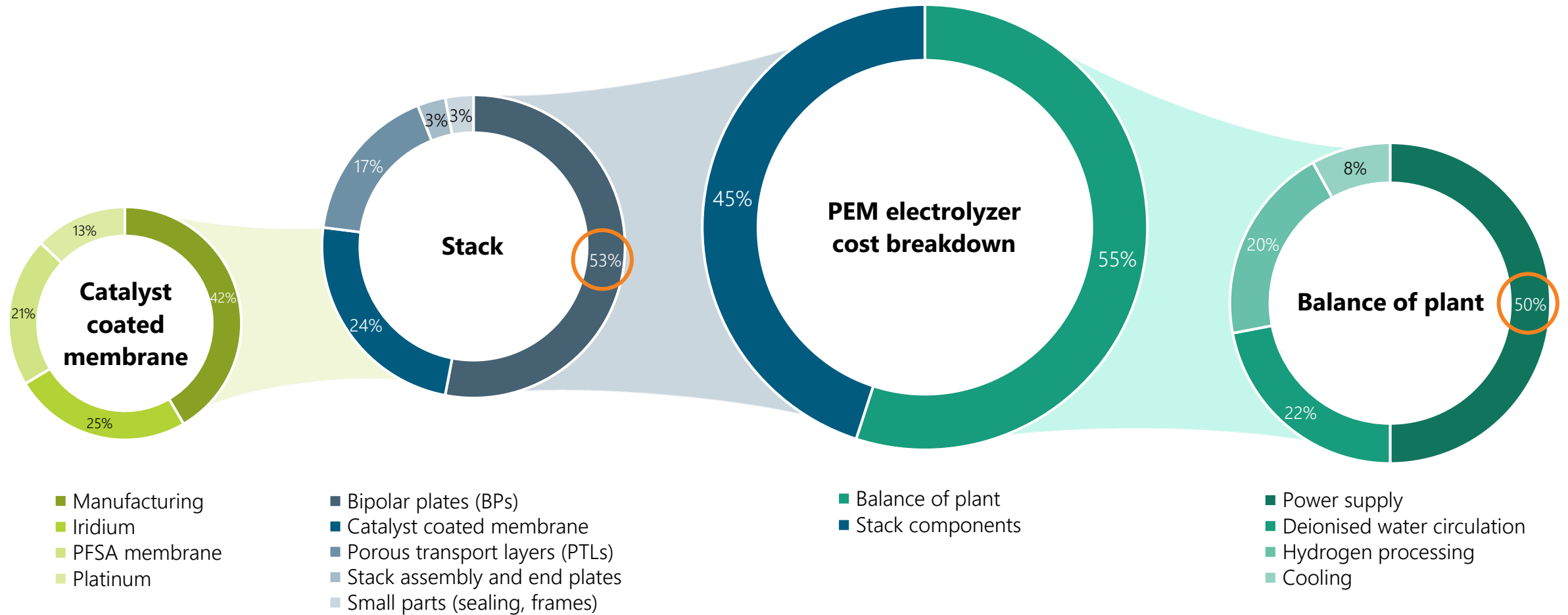


Stack Development

with electrolysis capacities of up to 50 kW depending on the application.

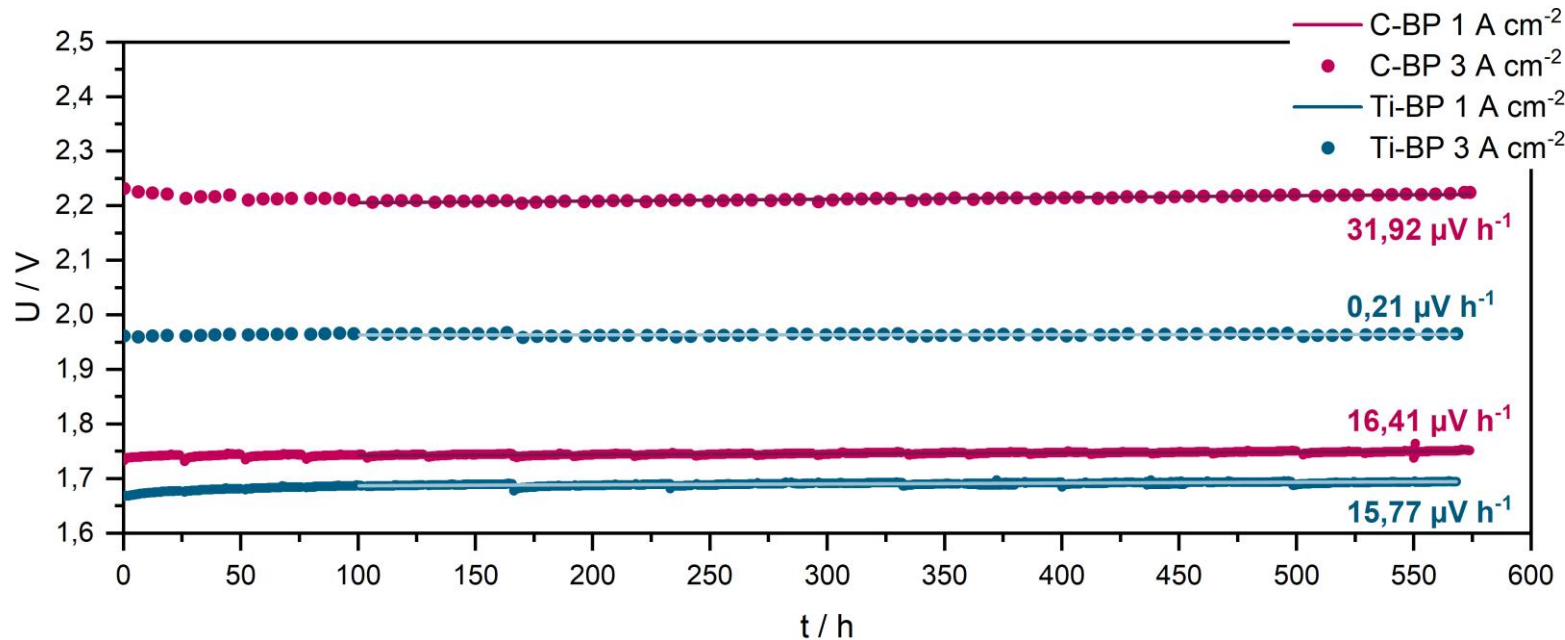
Proton exchange membrane electrolyzer

Key components and cost reduction



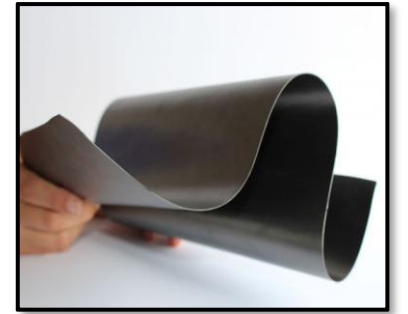
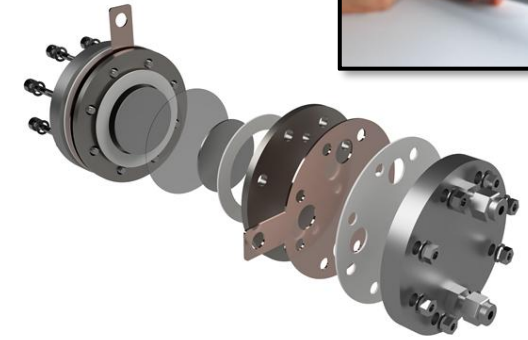
Project »H₂Giga PEP.IN«

Proof of concept

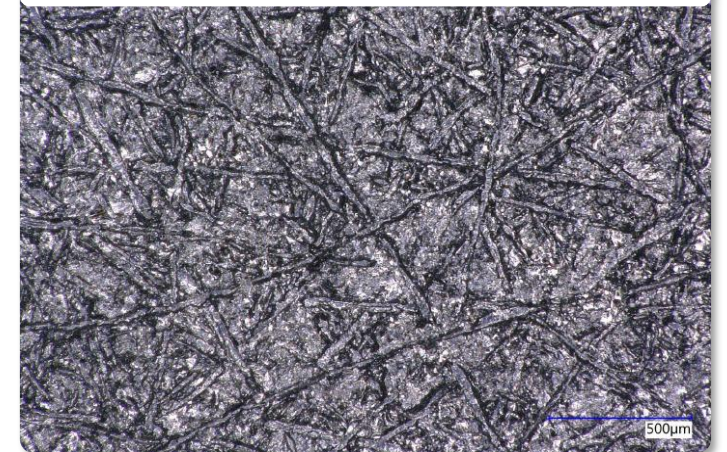


- Accelerated stress test: alternating between 1 and 3 A cm⁻² every 15 min
- Similar degradation behavior of carbon- vs. titanium-based BP at 1 A cm⁻²
- No pitholes in the BP: BP shows only the imprint of the Ti-felt

▪ <https://doi.org/10.1002/aenm.202402308>

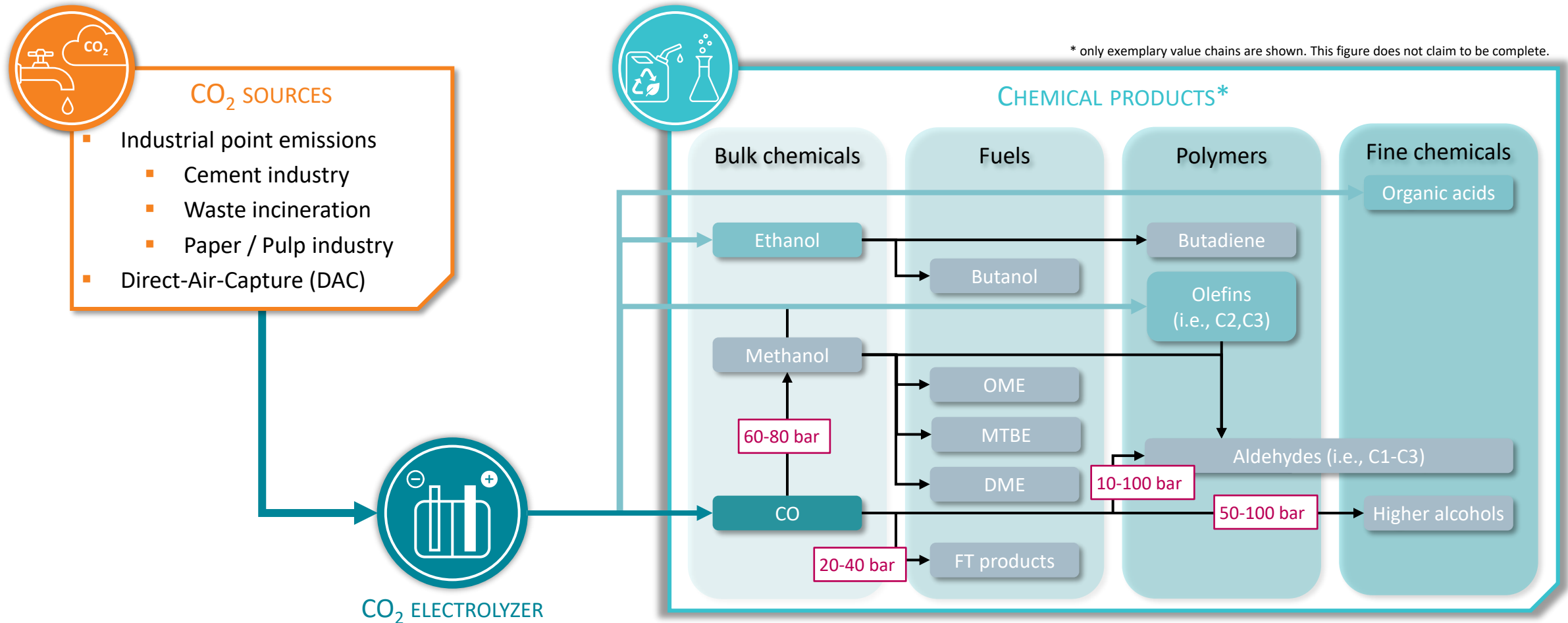


Anodic bipolar plate, 400 h @ 1 A cm⁻²



Defossilization of the chemical industry

Opportunities for CO₂ electrolysis along chemical value chains

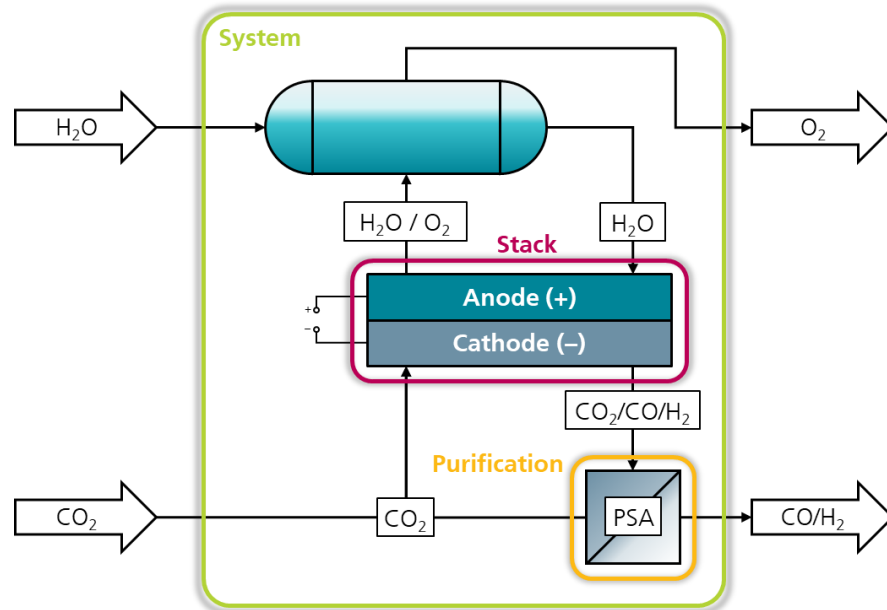


Project »Leuna100«

Piloting CO₂ electrolysis – scale-up to high pressure LTCE

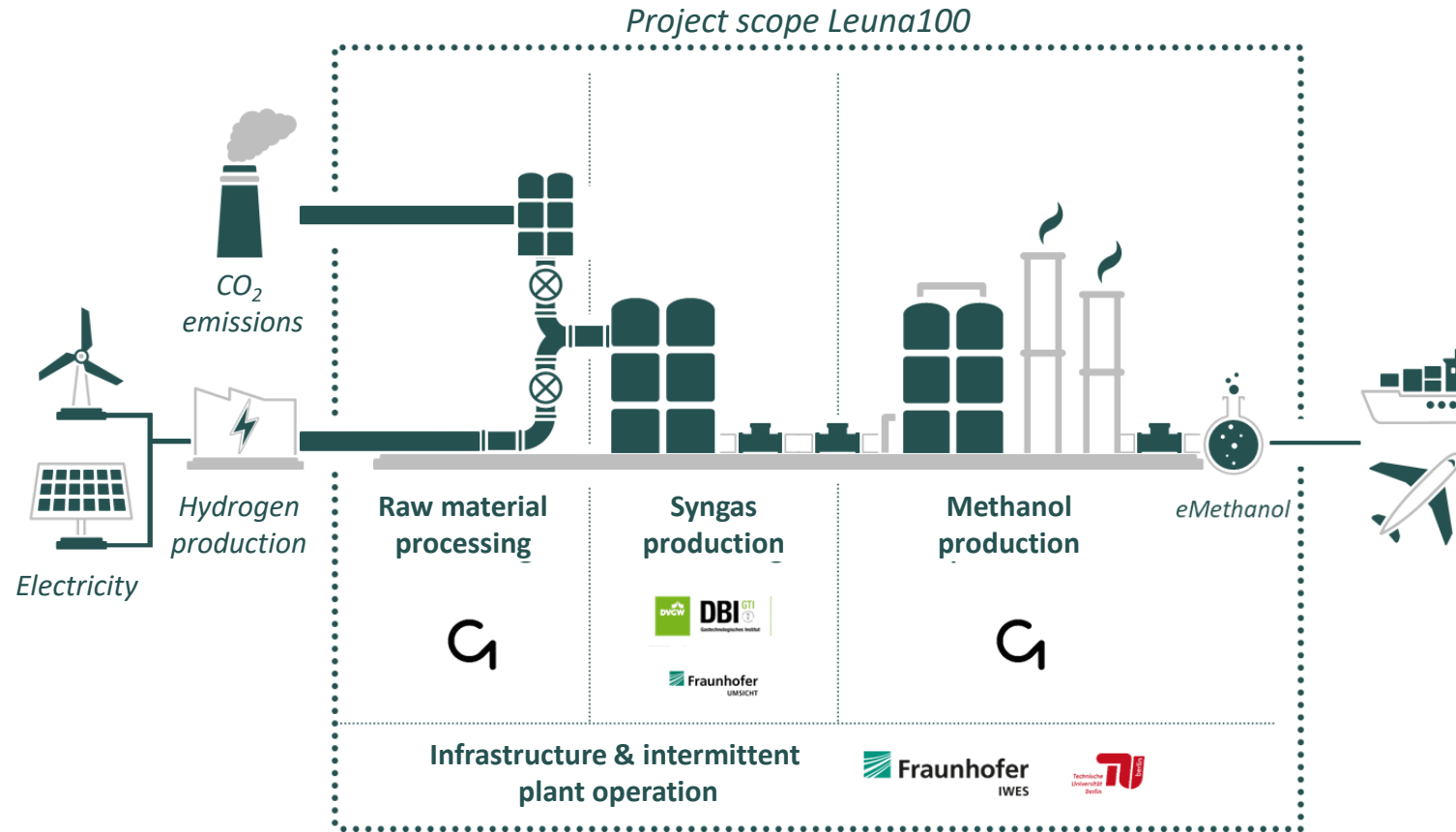
Role of Fraunhofer UMSICHT

- Development of a modular low temperature CO₂ electrolysis process for syngas production from CO₂ and H₂O for load-flexible methanol synthesis
- Commission at Hydrogen Lab Leuna from Q1/2026



Low-temperature CO₂-electrolysis (LTCE)

»Leuna100« - Pathway to green methanol



FUNDING PROGRAMME
**RENEWABLE
FUELS**

Funded by:



Federal Ministry
for Digital
and Transport

Coordinated by:



Project management agency:



on the basis of a decision
by the German Bundestag

Project Partners:

- C1 Green Chemicals AG
- Fraunhofer IWES
- DBI Gastechnologisches Institut Freiberg gGmbH
- TU Berlin
- Fraunhofer UMSICHT



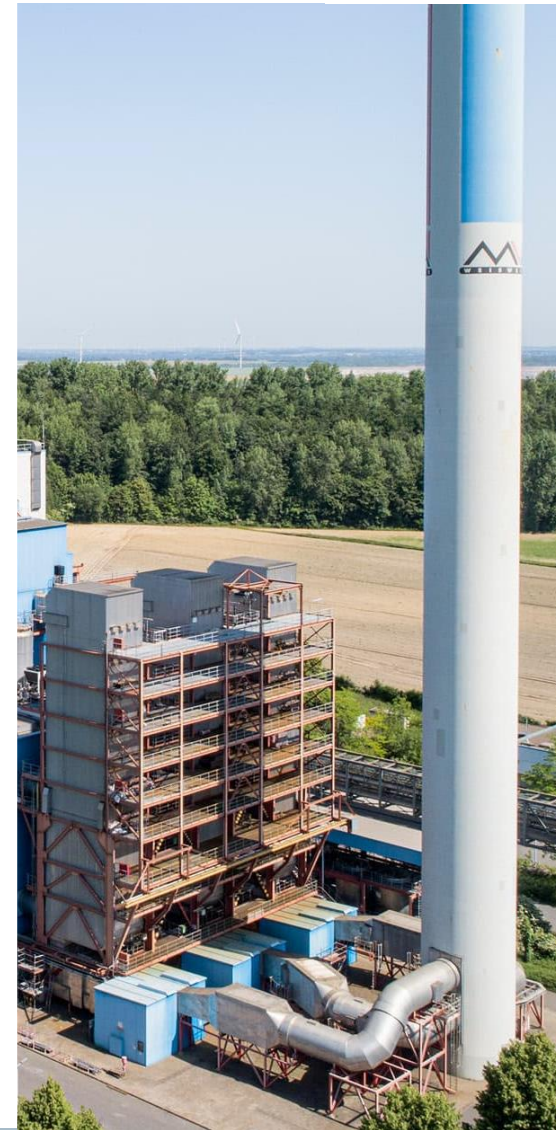
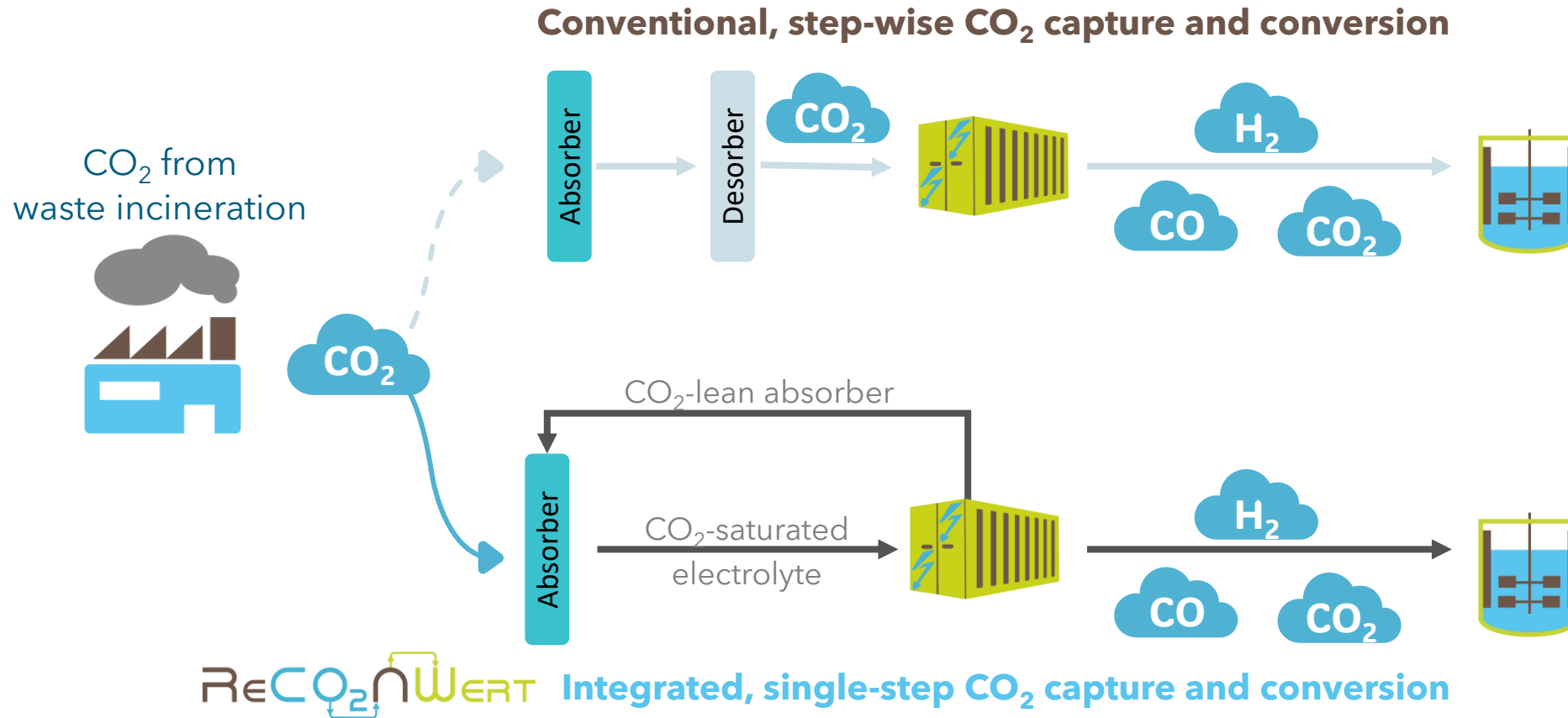
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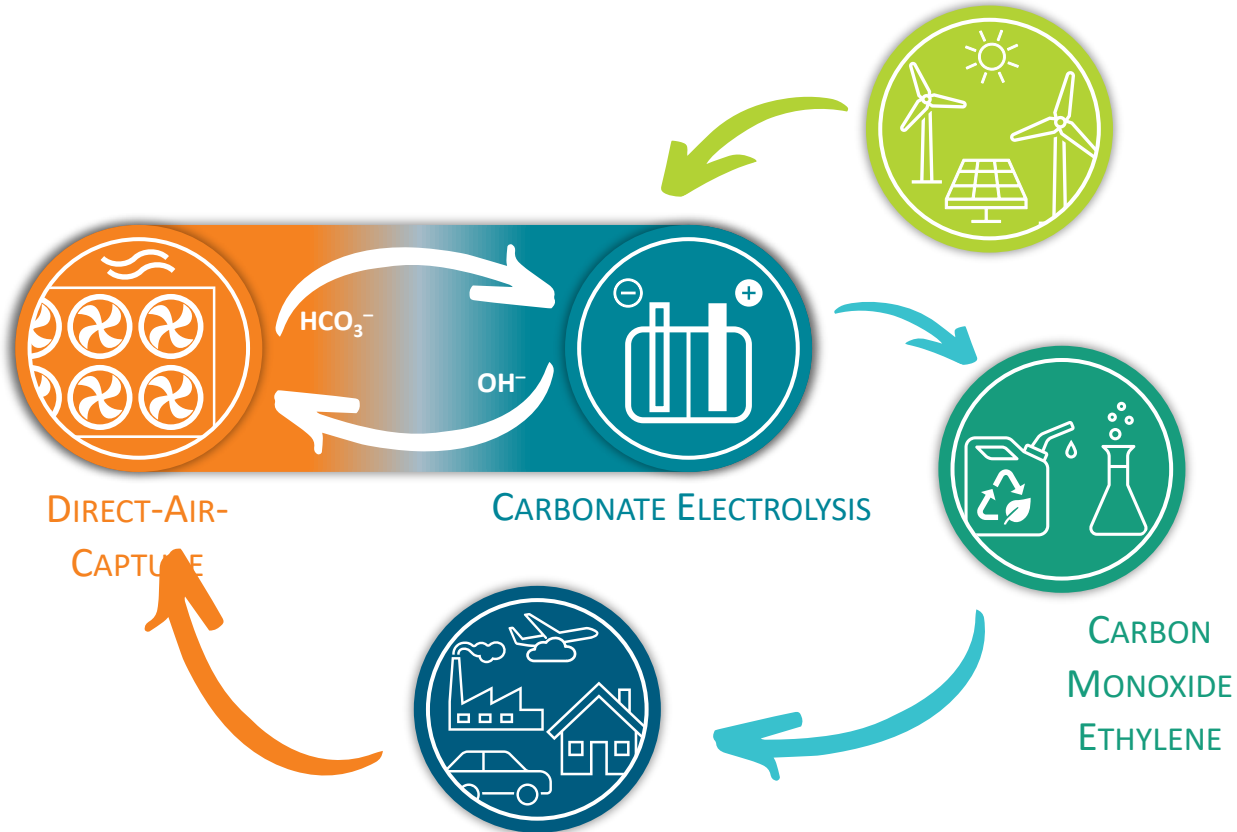
Integrated CO₂ capture and electrolytic conversion

»ReCO₂NWert« - CO₂ electrolyzers coupled with point sources



Integrated CO₂ capture and electrolytic conversion

»Air2Chem« - Combination of membrane gas absorption and electrolysis



Project »H₂Organic«

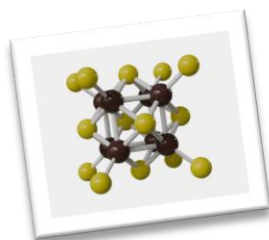
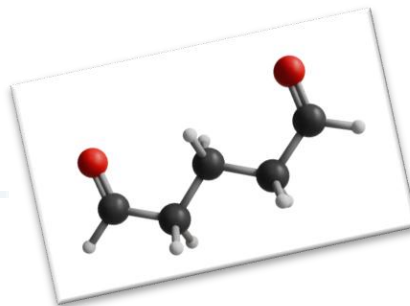
Electrification of industrial Hydrogenations

GEFÖRDERT VOM



BROAD SUBSTRATE SCOPE

- C-C: Alkynes, Alkenes
- C-O, C-N: Aldehydes, Ketones, Imines, Nitro
- Fatty acids, LOHC

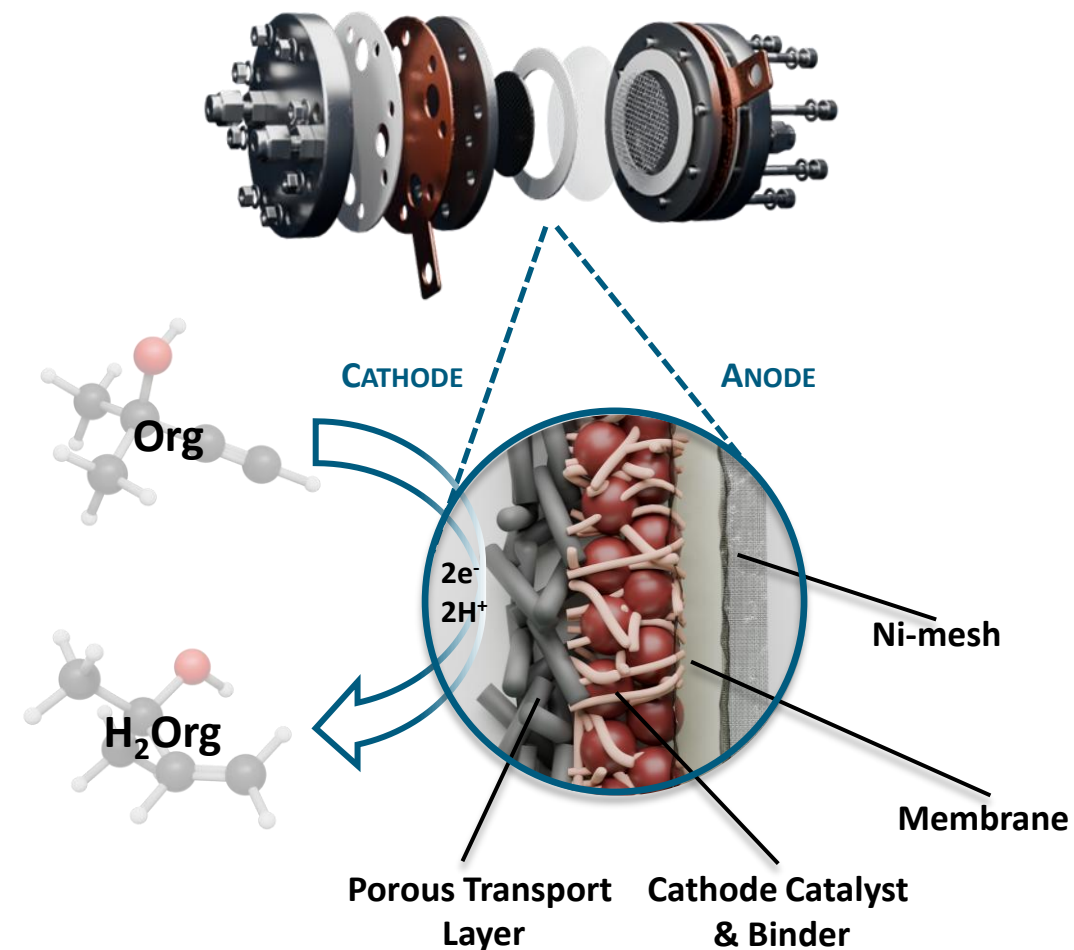
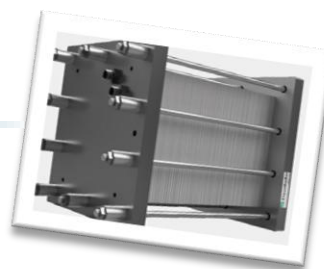


NON-NOBLE METAL CATALYSTS

- Conductive Metal Chalcogenides
- Innovative Mechanochemical Synthesis

ELECTRODE, CELL & STACK DEVELOPMENT

- Electrode Concepts for Neat Substrates
- Scaling up to Stack-level

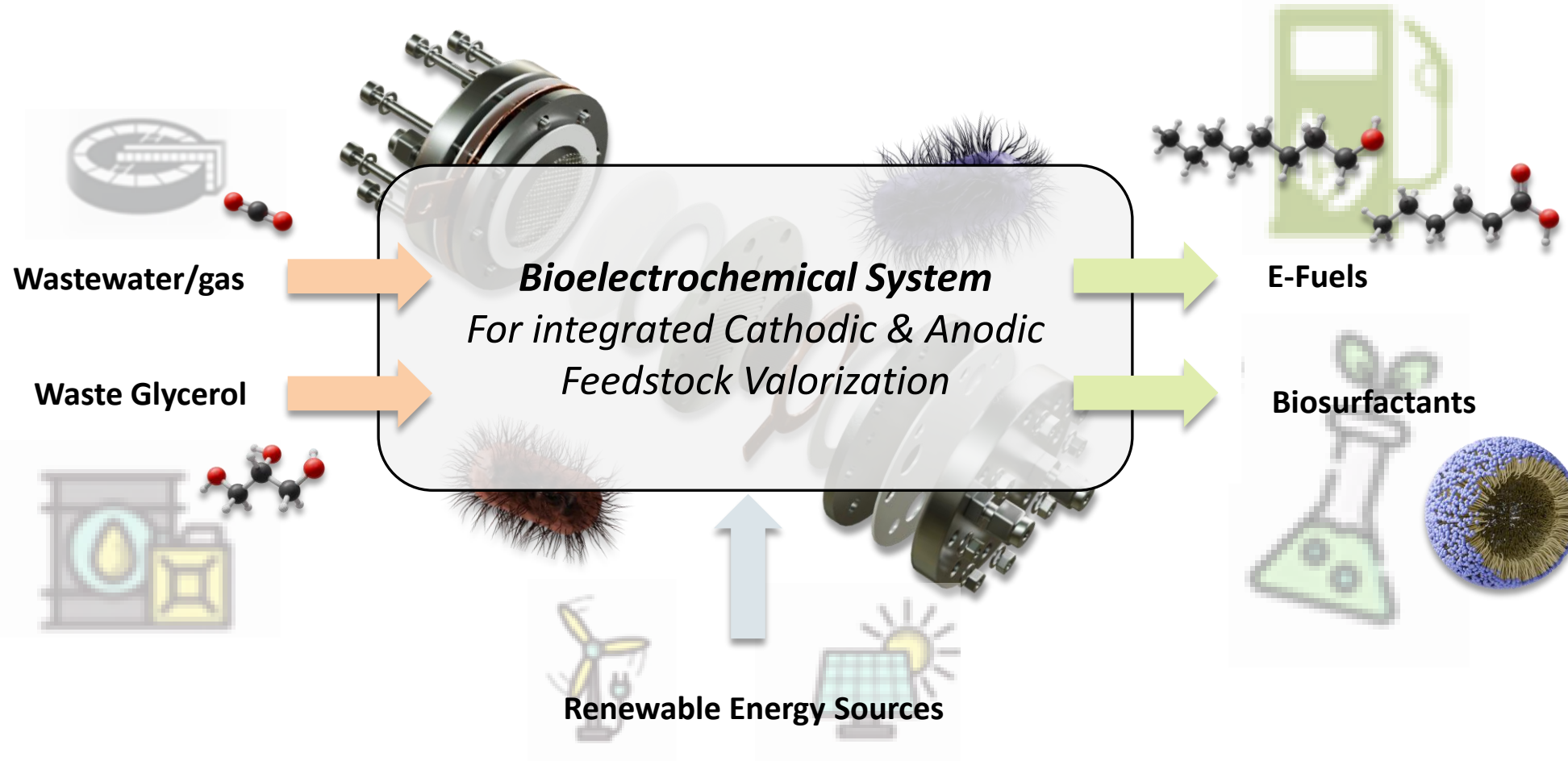


Project »BEFuel«

Bioelectrochemical Production of E-Fuels & High-Value Chemicals



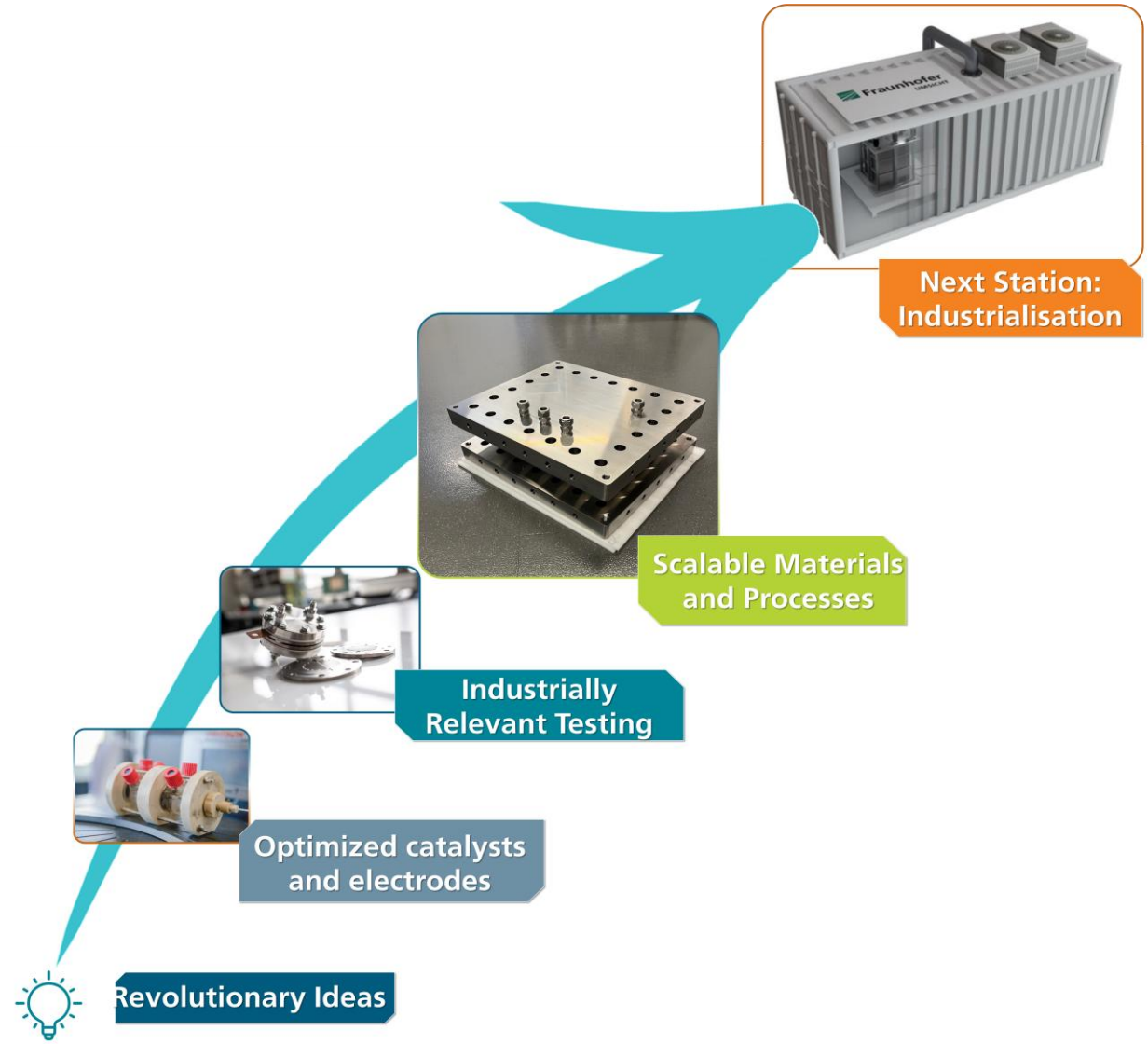
PARTNERS



Transfer research from lab to industry

From applied research to industrial solutions

- Our Focus is the transfer from lab scale to pre-industrial scale
- Typically our developments have TRL 5-6
- Through cooperation with industrial clients we achieve TRL 7-8
- We offer different capabilities on every development stage
 - Testing & evaluation
 - Material development
 - Stage design
 - Initial techno-economic analysis



Contact Department Electrosynthesis

Fraunhofer Institute for Environmental, Safety and Energy Technologies UMSICHT
Osterfelder Straße 3
46047 Oberhausen
www.umsicht.fraunhofer.de



Prof. Dr. Ulf-Peter Apfel
Head of Department Electrosynthesis & Professor of
Inorganic Chemistry @ Ruhr-Universität Bochum
Phone: +49 (0)208/8598-1571
E-Mail: ulf.apfel@rub.de or ulf-peter.apfel@umsicht.fraunhofer.de



Dr. Kai junge Puring
Group Manager Electrolysis Processes
Electrosynthesis
Phone: +49 (0)208/8598-1529
E-Mail: kai.junge.puring@umsicht.fraunhofer.de

Ruhr University Bochum, Activation of Small Molecules – Technical Electrochemistry
Universitätsstraße 150
44801 Bochum, Germany
www.rub.de/smallmolecules



Dr. Kevinjeorjios Pellumbi
Senior Scientist Electrosynthesis
Phone: +49 (0) 208 8598-1731
E-Mail: kevinjeorjios.pellumbi@umsicht.fraunhofer.de



Dr. Julia Jökel
Group Manager PEM & AEM Electrolysis
Electrosynthesis
Phone: +49 (0)208/8598-1620
E-Mail: julia.joekel@umsicht.fraunhofer.de

