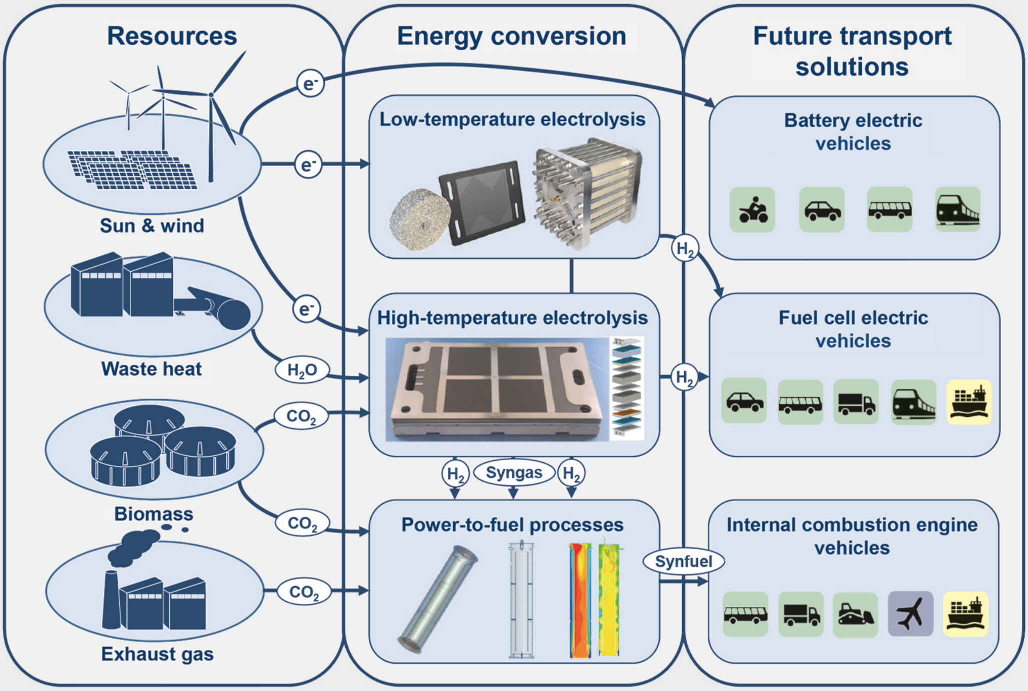

IEK-3 Report 2019

Tailor-Made Energy Conversion for Sustainable Fuels

Detlef Stolten, Bernd Emonts (Editors)

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JÜLICH Forschungszentrum

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Elektrochemische Verfahrenstechnik (IEK-3)

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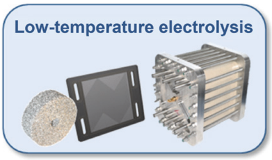
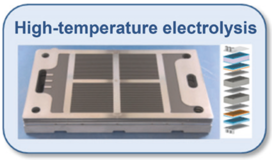
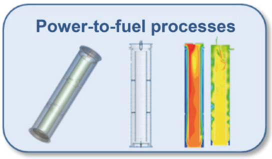
There is an urgent need to reduce carbon dioxide emissions from the burning of fossil fuels in the transport sector. Through its focused efforts in technology research on water electrolysis and in the technoeconomic evaluation of future transport solutions in the period under review, IEK-3 succeeded in improving the technological maturity of advanced water electrolysis and gaining ground-breaking insights into process engineering for the production of synthetic fuels from H_2 and CO_2.



Water electrolysis at temperatures of roughly 70 °C permits highly dynamic operation with fast start-up and shut-down procedures. Electrolyzers with polymer electrolyte membranes or potassium hydroxide solution have reached a sufficient degree of maturity to facilitate the construction of large plants on the megawatt scale, with current and future R&D activities focusing on improving performance, increasing lifetimes, and reducing investment and operating costs. Rolling out large-scale plants for electrochemical H_2 production serves as a test for their integration in the energy system



Steam electrolysis at temperatures of up to approximately 800 °C permits the use of surplus high-temperature heat produced in many industrial processes. The maturity of electrolyzers based on solid oxide cells depends on that of the relevant fuel cells and is now sufficiently high to enable plants to be constructed on the kilowatt scale. Current and future R&D activities focus on resolving issues related to material changes that reduce performance and lifetime; other priorities include designing a reversible system for electrolysis and fuel cell operation and achieving application-relevant cost targets.



The targeted processing of hydrogen from renewable sources and carbon dioxide from climate-neutral sources produces a synthetic, liquid fuel that in its ideal form substitutes today's kerosene or diesel and at the same time burns without harmful residues. Dimensioning tools and methods are being used to design a synthesis reactor – comprising an autothermal reformer, WGS reactor, and catalytic burner – which will synthesize the two source gases, H_2 and CO_2, into a synfuel with high selectivity and low conversion losses.

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