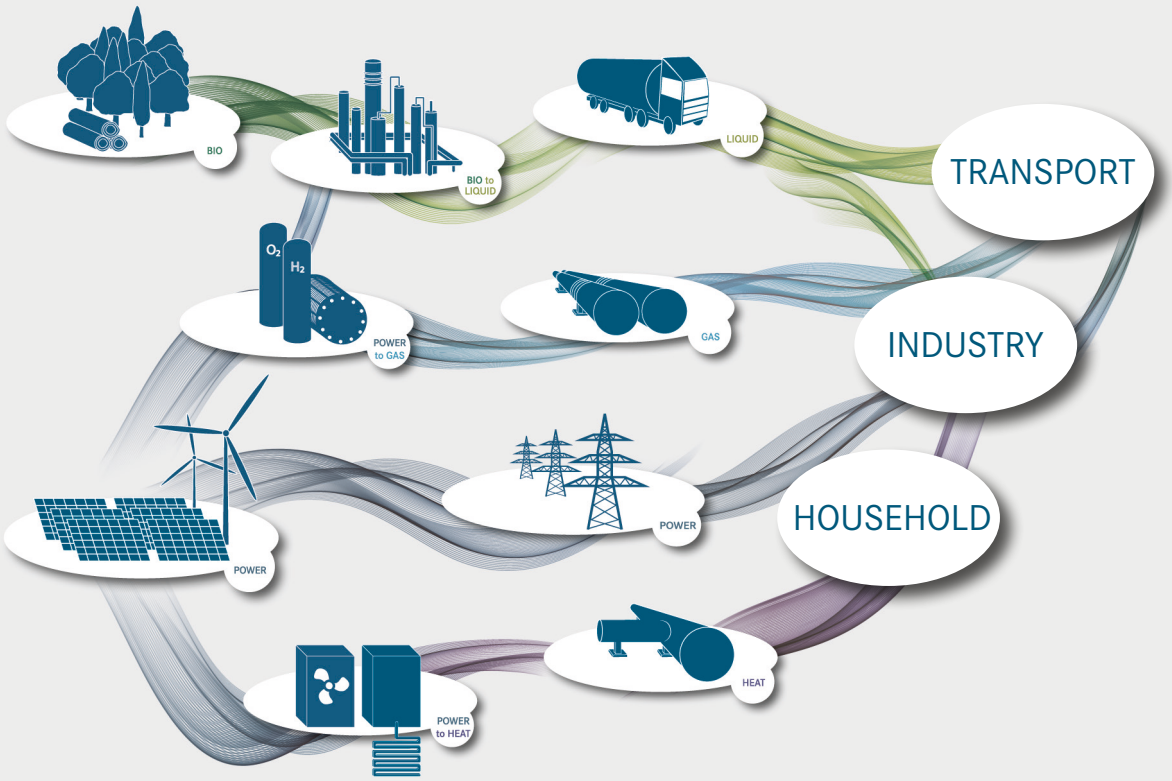
IEK-3 Report 2017

Sector Coupling –
Research for an Integrated Energy System



Energie & Umwelt / Energy & Environment
Band / Volume 386
ISBN 978-3-95806-258-0

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Member of the Helmholtz Association

Forschungszentrum Jülich GmbH
Institute of Energy and Climate Research
Electrochemical Process Engineering (IEK-3)

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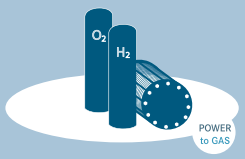
Schriften des Forschungszentrums Jülich
Reihe Energie & Umwelt / Energy & Environment Band / Volume 386

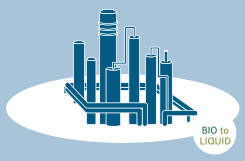
ISSN 1866-1793 ISBN 978-3-95806-258-0

Institute of Energy and Climate Research – Electrochemical Process Engineering (IEK-3)

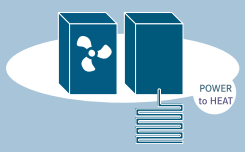
IEK-3 is one of the thirteen subinstitutes that currently constitute the Institute of Energy and Climate Research. Research work at IEK-3 focuses on technical solutions for a sustainable energy supply chain. Priority is given to electrochemistry and process engineering for fuel cells with and without reforming as well as for water electrolysis. These conversion technologies are investigated by an interdisciplinary team of scientists – from the underlying scientific principles to application in technical systems. IEK-3 has laboratories for imaging, physicochemical, and electrochemical investigations. In addition, universal test setups enable extensive operational testing and characterization of diverse converters with dimensions ranging from a square centimeter to square meters. In anticipation of technology transfer, IEK-3 has established a technical facility to concurrently fabricate functional layer systems, such as electrodes, gas diffusion layers and membrane-electrode assemblies, in a reproducible manner on an industrial scale. The facility also enables the precise assembly of multicomponent stacks. Process and systems analyses make it possible to identify and evaluate promising future R&D topics, to compare in-house technological developments with conventional technologies, to design energy pathways and energy supply networks, and to derive recommendations and provide guidance for interested sectors of society. In addition to its R&D services, IEK-3 cooperates closely with universities and other educational establishments, providing an extensive range of further education and training opportunities.



In a process called POWER-to-GAS, hydrogen is produced from electricity, which is in turn generated from fluctuating wind and photovoltaic power plants. Water electrolysis is used to transform electrical energy into chemical energy in the form of H_2 on an industrial scale. The energetically valuable gas is suitable for large-volume storage in salt caverns, can be transported over long distances via pipelines, and can be used directly as a fuel in the transport sector or as a chemical raw material in industry.



The BIO-to-LIQUID energy pathway makes use of biogenic raw materials to produce liquid fuels and chemicals without competing with crops. Synthesis based on H_2 and a carbon source is possible through various transformation processes. For this purpose, residual wood from logging is transformed into synthesis gas through gasification. In addition, CO_2 separated in biogas facilities in combination with electrolysis H_2 can be used for synthesis. Liquids produced in this way can complement or even substitute conventional fuels while simultaneously increasing the efficiency of vehicles and reducing pollutant emissions.



In a process termed POWER-to-HEAT, heating or cooling energy produced from electricity is another flexibilization option for an energy supply dominated by renewables. Renewable power is used in heat pumps and heating rods in order to provide heat or it is used in air conditioning units for cooling. Direct use in households is just as feasible as feeding heating/cooling energy into a grid for a user grid located further away.

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