IEK-3 Report 2015

Systems Research and Technology for a Sustainable Energy Supply

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

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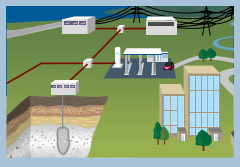
Institute of Energy and Climate Research – Electrochemical Process Engineering (IEK-3)

IEK-3 is one of the ten subinstitutes that currently constitute the Institute of Energy and Climate Research. Research work at IEK-3 focuses on providing technical solutions for a sustainable energy supply chain utilizing electrochemical energy conversion processes. Priority is given to electrochemistry and process engineering for solid oxide and polymer electrolyte 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 not only has laboratories for imaging, physicochemical and electrochemical investigations, but also facilities for preparation and sample pretreatment. In addition, universal and specialized test setups enable extensive operational testing and characterization of diverse converters with dimensions ranging from a square centimetre to square metres. 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. IEK-3 cooperates closely with universities and other educational establishments, providing an extensive range of further education and training opportunities.

The future energy demand will be covered predominantly by renewables like wind, water and the sun in decentralized units. The associated fluctuating provision of energy necessitates the construction of industrial-scale electrolyzers, storage solutions and reserve power plants.



Electrolysis is a primary conversion process which converts renewable excess power into hydrogen for compressed gas storage in large salt domes. A pipeline network for transporting and distributing large quantities of H_2 will ensure the economic and safe supply of H_2 to filling stations and other places of use such as refineries and reserve power plants.

In addition the direct use of H_2 in cars, buses and transporters with fuel cell drives, its indirect use as a biofuel is a promising option for avoiding CO_2 emissions in the aircraft, truck, rail and marine sectors. To produce the fuel on an industrial scale, biomass-based carbon is processed together with H_2 in a refinery to create a liquid biofuel, which is then transported by trailers to the various dispersers at bio- or airport filling stations.

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