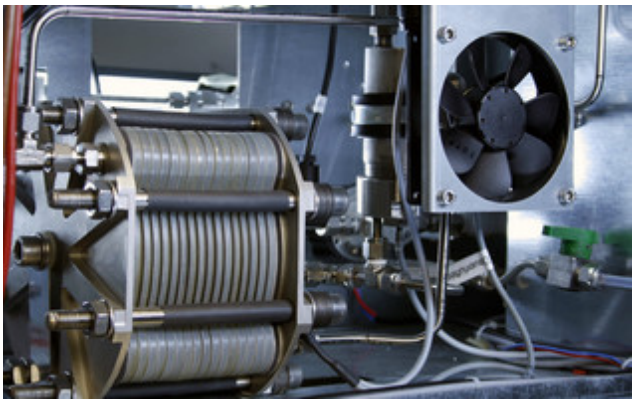
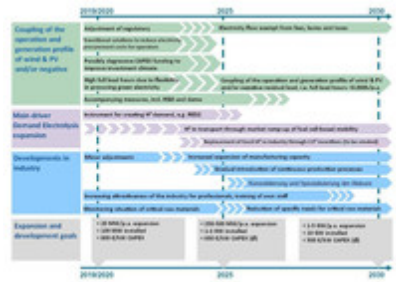


Membrane electrolysis cell stack in a prototype of a pressure electrolyser developed at Fraunhofer ISE



Roadmap for industrialising water electrolysis.

Energy transition needs water electrolysis on the gigawatt scale

The generation of hydrogen by means of water electrolysis makes it possible to store renewably generated electricity. In a new study, experts assume that by 2050 Germany will require an installed plant capacity in the three-digit gigawatt range in order to achieve the German government's climate protection goals.

This will enable the increasing proportion of intermittent wind and solar electricity to be stored seasonally in the form of hydrogen, reconverted back into electricity or further processed into fuels and basic chemicals.

Researchers at the Fraunhofer Institute for Solar Energy Systems ISE, the Fraunhofer Institute for Production Technology and Automation IPA and the E4tech consultancy firm investigated the possibilities for setting up the gigawatt industry required for water electrolysis in Germany. They developed a roadmap for establishing water electrolysis in Germany.

Roadmap for establishing water electrolysis

In their study entitled “Industrialisation of water electrolysis in Germany: Opportunities and challenges for sustainable hydrogen for transport, electricity and heating”, they demonstrate how the necessary industrial manufacturing capacities for electrolysers can be built up over the next few years. They investigated the challenges that need to be overcome in order to establish a gigawatt-sized electrolysis industry in Germany, in particular focussing on critical components. They discussed with industry and users as to which technological, manufacturing-based and actor-specific fields require action. From this they derived specific recommendations for action.

The researchers used a simulation tool for energy systems developed at Fraunhofer ISE to determine the future demand for electrolysis for the transport, heating and electricity sectors in Germany. They investigated six expansion scenarios, including the range of performance parameters determined in the industry survey.

The study assumes that energy-intensive industries will continue to be operated in Germany. All the scenarios considered presuppose that the climate goal of reducing energy-related CO_2 emissions by 80% without importing synthetic fuels on a large scale is achieved. In terms of the installed electrolysis capacity, this results in an

expansion corridor of more than 100 to well over 200 gigawatts in 2050 – depending on the respective underlying conditions.

The researchers note that the expansion rate would already have to exceed one gigawatt for new installations per year by the second half of the coming decade. The scenarios assume several gigawatts of new installations per year from 2030 onwards. This seems to be certainly feasible in technical and economic terms. “The two most important technologies, alkaline and PEM electrolysis, have already reached technical maturity. From a technological point of view, there's nothing preventing the large-scale use of electrolysis,” explains Dr Tom Smolinka, Head of Chemical Energy Storage at Fraunhofer ISE.

Launch of a market activation programme for water electrolysis

Some areas, however, still need further research. For example, high-temperature electrolysis is not yet competitive, but nevertheless offers considerable potential thanks to its lower electricity requirements and the industrial waste heat available in Germany. They were also able to identify only a few aspects that could provide obstacles from a production point of view. “The processes required to produce the components are already being used on a large industrial scale in other sectors. The production can be scaled up with a comparatively low use of machinery and capital,” says Steffen Kiemel, a research assistant at Fraunhofer IPA. For the potentially critical components it was shown that supply shortages are not expected in the short or long term.

“In particular there's a need for action by the legislator: the market ramp-up, which is the key lever for further technological development and cost reductions, needs to be supported by adjustments to the regulatory framework, especially with regard to electricity procurement, so that electrolysis applications can become economical,” emphasises Franz Lehner, Managing Consultant at the E4tech consultancy firm. The authors of the study therefore propose a market activation programme for water electrolysis which offers manufacturers and users planning security for investments.

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