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The Hydrogen Valley within the Ruhr Metropolis

Volker Lindner, Emanuel Grün, Frank Noczyk, Jens W. Kuhlmann,
h2-netzwerk-ruhr, Germany

1 The Ruhr Metropolis

The Ruhr Metropolis is due to the organically grown energy-technical and chemical structures from the past as a mining location the first address for fuel cells and hydrogen. And it is in demarcation of the mining past just the focus on the regenerative, the renewable, the lasting that characterizes this metropolitan area in Europe.

The region has about 5.2 million inhabitants and a population density of 1.220 inhabitants per km². About 60 million people are accessible in the vicinity of a three-hour driving time; in the vicinity of 500 kilometers 40 percent of the EU population are living. No other region in Germany is traffic-technically so systematically accessible like the Ruhr Metropolis.



Figure 1: The Ruhr Metropolis – central metropolitan area in Europe.

A large part of the electricity and heat consumed in Germany is generated in the Ruhr Metropolis. Due to the necessity to move the energy supply of the future towards climate friendly technologies, the Ruhr Metropolis is therefore in a forerunner position. Since the production of regenerative electricity is increasing and more and more included in the world's energy supply structure and so the electric energy changes from a secondary energy source to a primary energy source, one must also think about suitable storage procedures. One of the possibilities favored at present is the electrolysis of water and the storage of the produced hydrogen.

2 The Energy Carrier Hydrogen

Today hydrogen in the Ruhr Metropolis is produced primarily by steam reformation of natural gas (“brown hydrogen”), one of the biggest reformers in Europe is located in the chemical park Marl in the north of the Ruhr Metropolis. As actual sources for by-product hydrogen large-scale technical chlorakali electrolyses are available in the Ruhr Metropolis in Marl and Rheinberg.



Figure 2: Chemical park Marl – location of one of Europe's biggest reformers and starting point of 230 km pipeline network.

The discontinuation of hydrogen production from fossil energy sources by climate protection purposes and also the shortage of resources will make new sources for the entry into a hydrogen economy necessary, the first projects are already in place in the Ruhr Metropolis: So-called “green hydrogen” is won by the use of regenerative electricity in combination with water electrolysis, the gasification of biomass, the reformation of digester gas and the hydrogen production by algae.

There are projects in which green hydrogen is produced in Bottrop (waste water treatment plant of the Emschergenossenschaft) and Herten (wind power electrolysis in the Application Centre and biomass gasification in the Blue Tower) complemented with research in the areas of algae and chemical cyclic processes.

In the waste water treatment plant in Bottrop the originating digester gas which contains primarily methane is fed into a steam reformer after cleaning and the produced hydrogen is used in a nearby school in a hydrogen CHP unit.

The electrolysis which will be operated in the Application Centre H2Herten uses locally generated wind power for the splitting of water in hydrogen and oxygen. The so won very pure hydrogen is very well suitable for the application in fuel cells, as for example in the project HYCHAIN MINI-TRANS, a demonstration project of small vehicles in the northern Ruhr Metropolis.



Figure 3: Waste water treatment plant in Bottrop – source of green hydrogen.

The Blue Tower, presently under construction in Herten, is a gasification plant in which locally harvested biomass is converted to a hydrogen rich gas.

With hydrogen production through algae different research groups in the Ruhr Metropolis are dealing. At the university of Bochum a research department purely on this topic has lately been established, but also at the university Duisburg-Essen and the university of applied science in Bottrop academic groups are working on this topic.

In company research another way of regenerative hydrogen production is under development: AEI Europe in Herten deals with chemical cyclic processes which generate hydrogen from water by use of iron oxides.

Generally it is assumed that in 2030 "green hydrogen" will overtake "brown hydrogen" in production.

The Ruhr Metropolis already today has an exceptionally dense and variable regenerative hydrogen production structure and is worldwide competitive here.

3 Distribution of Hydrogen

Because of the grown structures between coal, steel and chemistry in the Ruhr Metropolis big experiences in dealing with technical gases like hydrogen are already present. All big gas providers like Air Liquide, Air Products and Linde are of course residents here.

The distribution of hydrogen is guaranteed in the complete Ruhr Metropolis. This happens with industrial customers by the use of a pipeline network which branches out from the northern Ruhr Metropolis on a total length of 230 km. The supply of smaller end users is done through hauling. There are hydrogen filling stations in the Ruhr Metropolis in Bottrop, Gladbeck and Herten.

The filling station in Bottrop will be able to deliver filling pressures of 200 and 350 bar and will be the first in Germany at which vehicles can be refueled with locally generated regenerative hydrogen.

4 Stationary Fuel Cell Applications

Stationary applications like UPS, storage and reconversion of regenerative energy and CHP-units are produced and operated in the Ruhr Metropolis.

b+w Electronic Systems from Oberhausen and Idatech from Herten are active for a long time already in the field for stationary UPS for mobile communication systems.

This is one of the areas which are looked at as "Early Market", so as an entrance market for the introduction to the mass market.

5 Mobile Fuel Cell Applications

"HYCHAIN-MINI TRANS" is one of the leading projects of the European Union in which 24 European partners take part. The purpose of the project is the introduction of hydrogen as an alternative fuel on the base of innovative fuel cell vehicles. The northern Ruhr Metropolis is as well as the regions of Rhône-Alpes (F), Emilia Romagna (I) and Castilla y León (E) to four European model regions in which the fuel cell technology is developed and tested in five vehicle types. Since May 2009 the first vehicles are already on the roads here.



Figure 4: Fuel cell midibus in the project HYCHAIN-MINI TRANS.

The northern Ruhr Metropolis serves not only as a region in which the hydrogen vehicles are tested, but also two vehicle suppliers as well as the hydrogen supplier for the whole project are seated here: In Gladbeck Hydrogenics which equips electric coaches with a modern fuel cell drivetrain has its seat, in Herten Masterflex Brennstoffzellentechnik develops and produces innovative load bicycles, so-called Cargobikes, and Air Liquide Deutschland has established a worldwide unique hydrogen-filling station in the chemical park in Marl for the high-pressure (up to 700 bar) cartouches with which a large part of the vehicles is equipped. Hydrogenics also equips forklift trucks and other carrier vehicles with fuel cell drivetrain. This is also one of the areas which are looked at as "Early Market".

6 Science and Research

Workgroups at the universities Bochum, Dortmund and Duisburg-Essen as well as at the universities of applied science of Bochum, Dortmund and Gelsenkirchen are active in the area of fuel cell and hydrogen technology in the Ruhr Metropolis. This research density is raised even further by the activities of renowned Fraunhofer-, Leibniz- and Max-Planck-Institutes. Apart of basic research this dense network also covers all adjoining subject fields - from hydrogen production to application.

With the centre for fuel cell technology (ZBT) in Duisburg another hotspot of the national research scenery is located in the Ruhr Metropolis. The Duisburg institute, settled directly on the university campus, is continuously developing since its foundation in 2001 and herewith documents its steady competence increase.

A technical center was opened in 2008 for production and inspection engineering at the ZBT. Currently more than 70 employees devote themselves comprehensively in all relevant fields of research to the subject fuel cell and hydrogen.

These fields of research are Gas process technology, Fuel cell and system technology, Electrochemistry and layer technology, Quality assurance and inspection, Microsystems and fluid mechanics, Hydrogen and batteries and Production engineering. The PBT at the ZBT is also the only German accredited testing laboratory for fuel cells and components.

Already in 2001 the energy institute of the university of applied science of Gelsenkirchen, which also deals with the future subject hydrogen, was founded. It serves as a partner and interchange for the collaboration between science and industry. The purpose of the work in Gelsenkirchen is the optimisation of modern energy systems taking into account a eco-friendly energy use. In this context the future technologies around hydrogen play of course a central role.

7 h2-netzwerk-ruhr

The Ruhr Metropolis wants to take a central role for the fuel cell and hydrogen technology for the future and distinguishes itself along the whole value added chain by enterprises and research.

The h2-netzwerk-ruhr is the umbrella which stretches over all these activities and represents the Ruhr Metropolis nationwide and internationally in strong partnership with North Rhine-Westphalia, Germany and the EU.

Feel invited to participate in our future!