Hydrogen – Current Activities in Europe and Perspectives
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Deviating from historic developments hydrogen energy is more and more becoming part of an accepted strategy to fight global warming in combination with the advent of renewable energies. Here we will briefly describe major reasons and indicators for this paradigm change. More detailed informations can be found in recent publications [Bünger,00], in the internet (e.g. www.hynet.de) and in the transparencies of the accompanying speech.

In two separate steps L-B-Systemtechnik was given the task by WE-NET of Japan to summarize all German and later the European hydrogen energy related projects since 1988. Looking at the history of hydrogen energy 3 phases can be identified. The first began after the 1st and 2nd oil crises in 1973 and 1979 when especially in Germany and the U.S. programs were set up to develop various energy savings and renewable energy technologies. Prominent programs were the activities of DLR in Stuttgart /Germany and Los Alamos Nat'l Labs/USA on hydrogen production (HYSOLAR), vehicles and infrastructure (Mercedes Berlin fleet test).

With falling fossil energy prices the interest in and funding of energy alternatives diminished such that hydrogen projects were cancelled with the argument that all technologies were now ready for market-entry, but that only the demand could not be seen yet. Then, in 1989 another international program was started. The Euro-Quebec Hydro-Hydrogen Project (EQHHPP) was financed by EU's Joint Research Center in Ispra/Italy and the Government of Quebec involving a large number of industrial and institutional partners. In this activity the Government of Quebec was interested to acquire independance from other Canadian provinces and the U.S. to bring their remote hydro power potentials to market.

It was concluded that to initiate this energy vector on an industrial scale a step functional rise in hydrogen energy demand would be needed. Thus, only the hydrogen end use oriented work packages (LH2 city buses, hydrogen fuel cells) were transformed into hardware. This project resulted in two major achievements although failing to initialize a hydrogen energy market. Industrial and institutional hydrogen energy alliances and networks were established and a hydrogen technology basis was created concerning the whole range of hydrogen supply chains.

The other important phase for hydrogen energy started with the combined structural and technological changes in the energy market. Structurally, the drawbacks of strictly centrally organized nuclear energy were found, the effect of energy consumption on local and global climate were felt and the necessity of providing new decentralized structures in developing countries were realized. Beginning with the Public Utility Regulatory Policies Act of 1978 (PURPA) in the U.S., the Electricity Act 1983 and especially 1989 in England and stepwise energy market liberalization in the rest of the world in the 90ies decentral energy conversion solutions more or less suddenly became fashionable depending on the political situation and state-of-the-art energy market structure in each individual country.

Technologically, and not to be separated from the structural changes taking place, new decentrally relevant energy conversion technologies appeared on the scene, including fuel cells and renewable energy technologies, on- and only recently also offshore wind energy converters and biomass utilization but also efficient fossil energy converters and CHP units among others.

In defining a third hydrogen energy phase the EQHHPP (1989 – 2000) may be viewed as the major bridging activity for all hydrogen energy developments from the energy market turmoil after the oil-crises in the late 70ies and 80ies to the energy market liberalization in the late 80ies and 90ies.
As transport is the outstandingly fastest growing energy consumption sector both in the industrialized and developing world the automobile industry found itself standing with its back to the wall. Struggling intensively with the mineral oil industry on the quantitative and qualitative measures to fight this increase (i.e. in the AutoOil Program) they soon began understanding the necessity of measures being shortly effective. Examples are the shift from an alternative drive system orientation to alternative fuels within the U.S.’s Partnership for a New Generation of Vehicles (PNGV) program and the proclamation of the German Transport Energy Strategy (TES) initiative to find industrial consensus on one or two alternative fuels of the future in Germany and later also in the whole of Europe.

Whereas local pollution could already be reduced decisively by vehicle and fuel improvements the only measures to reduce greenhouse gas emissions is to reduce specific consumption and/or substitute fossil primary energy supply, only CO₂ sequestration offering a timely limited sidestep. Out of these measures alternative drive systems and fuels are the most benign measures for the automobile industry. On the fuel side hydrogen and other high hydrogen contents fuels such as natural gas and methanol are currently discussed intensively. On the drive side fuel cells are a well accepted high efficiency, multi-purpose and production friendly conversion technology.

Although hydrogen apparently is the ultimately accepted universal and clean fuel, the time of its introduction is intensively debated, costs being in the focus of all discussions. Thus, both the political availability (global distribution of fossil resources) as well as the economic availability (rising exploration costs after reaching the critical depletion midpoint) will be crucial for the time left to shift to hydrogen.

The large oil companies and governments of the industrialized countries are assisted by the IEA as the highest political and tactical organization to defend the oil price against the dependancy of OPEC. They want to make the world believe that we have plenty of time for this shift. However, other critical opinions are increasing spreading the word of an imminent fossil energy crisis with a local focus on the U.S. (e.g. C.J.Campbell, [www.oilcrisis.com](http://www.oilcrisis.com) and W. Zittel, [www.energiekrise.de](http://www.energiekrise.de)). A good indicator of the growing awareness within the oil industry are the alternative activities of the large companies (e.g. the new brand name of BP = Beyond Petroleum or the establishment of Shell Renewables/ Hydrogen and BP Hydrogen also at [www.h2interactive.net](http://www.h2interactive.net)).

Thus, it seems it will ultimately be both the threat of „too much“ (GHG emissions) and „too few“ (fossil resources) which will force us into hydrogen energy sooner than we have anticipated in consensus in the past.