TOPIC: Hydrogen production (decentralised, renewable-based)

DECENTRALISED PRODUCTION OF "GREEN" HYDROGEN USING WIND ENERGY

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The idea of a hydrogen economy based on renewable energy sources is continuously gaining importance, because of the increasing concern regarding growth of energy demand, depletion of fossil fuels, global warming and security of fuel supply. It is foreseen that in the long term renewable energy sources will provide the energy to produce the required amounts of Hydrogen for humanity's energy needs. In the medium term, Hydrogen technologies will help increase the penetration of renewables by acting as storage means of any surplus electricity, performing at the same time peak shaving and load leveling.

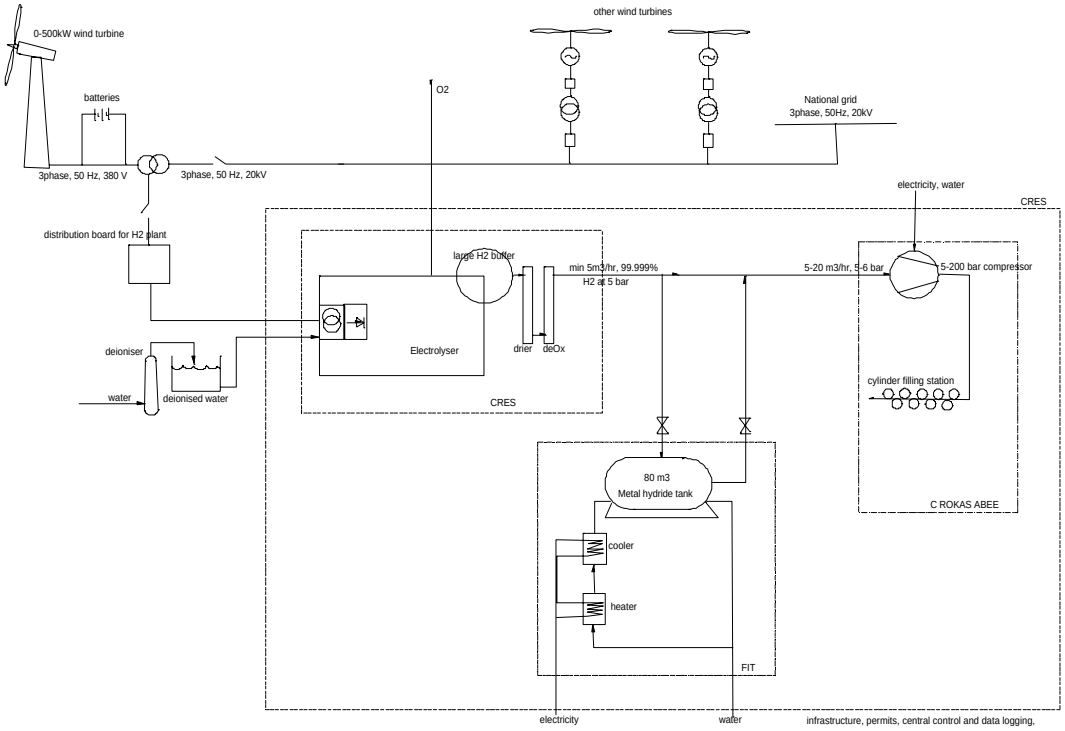
This paper presents the design of such a wind-hydrogen system. The system will be developed at the wind park of the Center for Renewable Energy Sources (CRES), near Athens, in Greece. Construction is planned to start in the second half of 2003. The paper also describes the different modes of operation of the system.

A 25 kW electrolysis unit will be connected to a 500 kW gearless, synchronous, multipole Enercon E40 wind turbine. The electrolysis unit will operate at variable power input, according to the available wind, in a "peak-shaving" mode. The electrolytic hydrogen will be purified prior to entering into a buffer tank. Part of the produced hydrogen will be stored in novel metal hydride tanks of approximately 50 Nm^3 H_2 capacity. The rest of the produced hydrogen will be compressed to approximately 220 bar and fed to cylinders at a filling station.

The wind-hydrogen system also includes a central control unit for automatic operation. This system will be developed so that any electrical energy that will flow into the Hydrogen plant will be solely from the wind turbine, by measuring the instantaneous power generated by the wind turbine. Thus, only "green" hydrogen will be produced that will initially be directed to the existing, non-energy related hydrogen market. The excess

wind power, which has not been used by the hydrogen plant, will be supplied to the electricity grid. Similarly the electricity grid will provide reactive power to the wind turbine.

A schematic of the plant is shown below:



It is foreseen that a buffer tank will be placed between the electrolyser, the metal hydride tank and the compressor. The operating pressure of the electrolyser will be a maximum of 20 bar, while the compressor will be specified to be able to operate for pressures from 10 to 20 bar at inlet. The quantity and quality of Hydrogen produced by a varying input power will be investigated along with the capacity of the electrolyser to cope with rapidly varying loads (20-100% of capacity in 1 sec). The regeneration of the single stage dryer section using Hydrogen stored in the metal hydride tanks will also be investigated.

This wind-hydrogen system in Greece and another one in Spain will be realised and tested in the framework of European Commission FP5 project titled "RES2H2" (Contract Nº ENK5-CT-2001-00536), in a joint effort of fourteen companies and institutions from different European countries. The project is co-ordinated by INABENSA (Ms. A. Castro) and ULPGC (Prof. A. Gotor).