Hydrogen mobility from renewable energy

January 10 2019, by Robin Vivian

FaHyence hydrogene filling station in action. Credit: McPhy

A reliable energy transition requires the implication of a range of scientific domains: physical, human, social, economic, as well as earth and life sciences, with the particular concern to put the end user in the centre of technology development. As part of the ULHyS project (Université de Lorraine Hydrogène Sciences et Technologies), the

University of Lorraine brings together about ten laboratories around five research topics, from hydrogen production to territorial deployment. In this context, several ULHys members were invited to visit the hydrogen filling station FaHyence at Sarreguemines.

Inaugurated in April 2017, FaHyence is the first fuel station in Europe that produces hydrogen by electrolysis on site using green electricity from renewable energies delivered by Electricity of France (EDF). The site has a capacity of 40 kg of hydrogen per day, representing the need of about 20 to 25 vehicles per day for charging pressures between 350 to 420 bar.

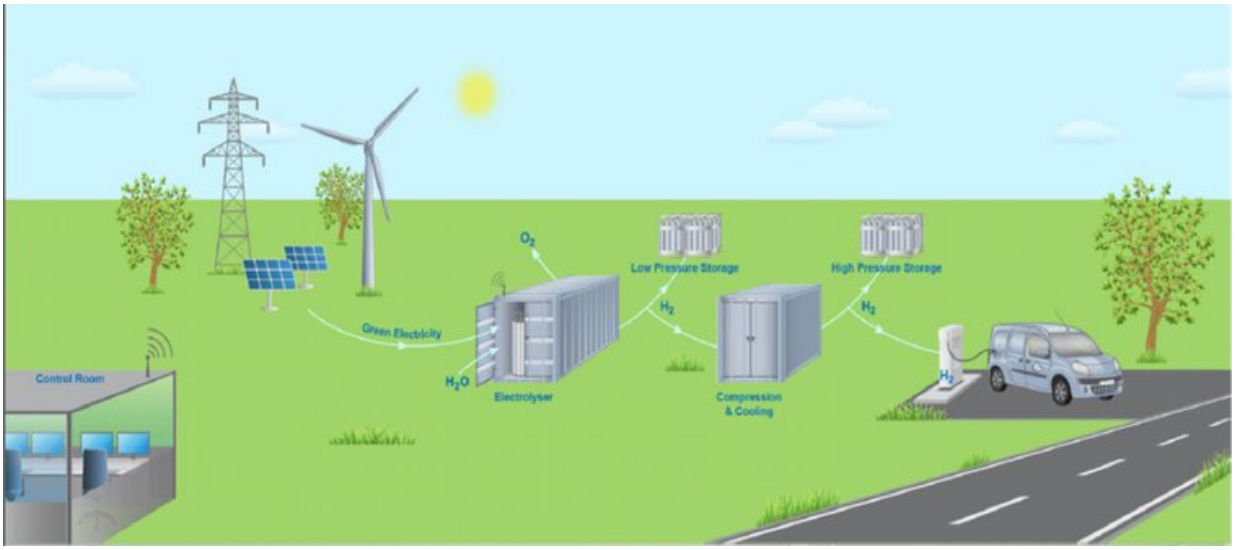
Ranges of about 350km, without any greenhouse gas emission

Other hydrogen fuel stations in France include the HyWay project, which has been operational since summer 2018 on the CEA (French Alternative Energies and Atomic Energy Commission) site at Grenoble, and two others are under construction at Rodez and Nantes. FaHyence is the result of a collaboration between EDF, EIFER, McPhy, Symbio Fcell and the Urban Conglomeration of Sarreguemines Confluences (CASC). In order to ensure a regular operation of the gas station, about ten hydrogen vehicles run in the urban conglomeration: Electric Kangoo ZE (Renault) equipped by Symbio Fcell with a fuel cell acting as range extender. The PEM (polymer electrolyte membrane) type fuel cells run with pure hydrogen and consequently without any greenhouse gas emission with ranges up to 350 km, thereof 200 km thanks to a 33kWh Li-ion battery and 150 km thanks to a 5kWh PEMFC connected to a 1.8 kg hydrogen tank pressurized at 350 bar.

Even if the filling station is not at free access, any vehicle – French, European or international – running on hydrogen can make a recharge

after simple authorization apply at the CASC with one evident advantage: the hydrogen filling is completely free. As a consequence, nine additional utility vehicles have been bought in between by other professional partners in the conglomeration and several private German and Belgian users have already filled their reservoirs at Sarreguemines.

FaHyence makes part of the H2ME (Hydrogen Mobility Europe) project funded by the European program FCH JU (Fuel Cells and Hydrogen Joint Undertaking) which aims at deploying 49 hydrogen filling stations and 1,400 vehicles over the EU by 2020. Hydrogen is the third chapter of the sustainable mobility project of FaHyence besides electricity and bio-methane. It is an ambitious living laboratory and an evident application example of hydrogen technology.



Sketch of the filling station published with kind authorization of the society. Credit: EIFER. Author provided

A full tank in four minutes flat

Users learning how to take advantage of the filling devices has gone smoothly. The interface is classical and the procedure similar to conventional systems using fossil fuel allowed to minimise the adaptation period. Improvements are still needed in terms of ergonomics and interactions, but the operation principle remains quite simple. Compared to hours of charging necessary for conventional battery-based electric vehicles, the four minutes to fill a vehicle's tank with hydrogen seem to be more than acceptable.

The station contains an alkaline electrolyser with a production capacity of 1.8 kg/h which requires 50 litres of water per kilogram of produce hydrogen. In addition, there is a two-level compressor, the first reaching pressures of about 30 bar, and the second equipped with a cooling circuit down to -20°C allows to reach pressures up to 420 bar. This compression device provides two major advantages: The first is that it allows to fill not only hydrogen vehicles at 350 bar (case of FC-EV such as the Kangoo ZE), but as well, for sure with some volume limitations, electric vehicles operating with hydrogen requiring filling pressures of 700 bar and reaching ranges of about 450 km (case of FCV such as the Toyota Mirai, the Honda Clarity Fuel Cell and the Hyundai Nexo…). The second advantage is that the cooling system reduces the filling time to four minutes compared to seven minutes for systems operating at ambient temperature.

An under-exploited gas station which could easily become competitive

"Hydrogen technology itself is not the limiting factor", says Christian Hector, head of the technical service of Cofluences and initiator of the FaHyence project. "The most constraining element is the electrolyser". With an average of 2.2 fuelings per day, representing barely 5% of its nominal capacity, the station is clearly under-exploited. As a

consequence, the per-filling cost remains too high to be competitive with classical systems. While the per-kilogram cost of hydrogen depends on local conditions; at Sarreguemines it is 10€ per kg, and the national average is of about 6€ per kg. Note that it takes about 1 kg of hydrogen to travel 100km.

For the station to be cost-efficient, a minimum of 30 vehicles daily filling their tank would be required. "But the economic profit was not the motivation of this project," says Hector. "The purpose was to test electric mobility in a cross-border context, as well as to validate the technical reliability of a hydrogen gas station in combination with an electrolyser on-site". Even if the future of this station, whose financial support ends in 2020 remains uncertain, the objectives have been reached and this thanks to the tenacity of Hector and his green mobility team at the CASC.

Provided by The Conversation

Citation: Hydrogen mobility from renewable energy (2019, January 10) retrieved 19 September 2024 from https://phys.org/news/2019-01-hydrogen-mobility-renewable-energy.html