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Hydrogen bike

Hydrogen for electric bicycles ?

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Already discovered in the 18th century, the use of hydrogen as a chemical began some 150 years ago. Prior to the usage of natural gas, so called Town Gas was used in order to heat homes, cook meals or light streets. Town Gas contained up to 70% hydrogen. Today, the bulk of world-wide hydrogen is used by the chemical and petro-chemical industry, while other applications are marginal in comparison.

Hydrogen has received growing attention in recent years as a clean fuel in transportation.

The main reason for this development is the problem of storing renewable electric energy in large quantities for longer periods. Converting solar, wind or hydro electric power into hydrogen and back in terms of cost and efficiency has been improving steadily. Today the gain from storing renewable power in hydrogen outweighs its disadvantages. In northern Europe for example, wind power is increasingly converted to hydrogen using electrolyzers.

In transportation, the storage of energy is a major ingredient. Seeking means to make a better environment, we want to get away

from burning hydrocarbons. Battery-electric vehicles would be a solution if there would not be some ifs. Batteries do not hold power for ever (self-discharge) and they are of heavy weight (adding to fuel consumption). With widespread use, the price of the raw materials will increase, and their recycling will have to be arranged (considerable processing). Thus, hydrogen would be the fuel of choice for trains and boats, trucks and buses if it was more readily available. In an efficient distribution system, hydrogen would come to the consumer at €10 or less per kilogram or €0.50 or less to run the bicycle a whopping 100 km.

However, so far use of hydrogen has been restricted to the industrial or institutional user. The general public is far from getting their hands on this technology, except for a few educational toys. Even the better known hydrogen powered cars and the less well known hydrogen bicycles are not really available to the broad public. These vehicles are produced in batches to be given to selected users who are granted access to some rare refuelling stations. Price quotations for hydrogen cars and bicycles exist, but trying to get one – not to mention its fuelling, is not possible.

We have been thinking about how to bring hydrogen, and the related technology,

to the general public. Kits for converting someone's bicycle into a battery-electric bicycle exist. The conversion takes merely an afternoon and everybody can do it. So what is more obvious than replacing the approximately 500 Wh battery of a standard kit with an equivalent, even better, hydrogen storage and fuel cell system?

The advantages are readily at hand:

- The hydrogen bicycle can have larger autonomy because more energy per weight can be stored with hydrogen than with batteries.
- The refuelling is really fast, either refilling a pressurized bottle or changing a metal-hydride cartridge.
- Since the user only pays for the components, and does the assembly work himself, the hydrogen bicycle will come with an interesting price tag.

A nice idea, but how would one realize it? Our thoughts were further elaborated within the Pangloss Labs association, as well as in public events, hackathons at the 2019 Open Geneva Innovation Festival, the 2018 and 2019 Fête de la Science at Ferney-Voltaire in France, and a dedicated hackathon organized by Pangloss Labs.



From left to right: Klaus, Olivier and Harald during the visit at Ataway, Chambéry.

The outcome was the following:

- All necessary components are available on the market. A prototype will serve for the demonstration of the feasibility.
- Components list and assembly manual will be distributed under an open license to attract other people and groups engaging in the making of hydrogen bikes and exchanging the improvements.
- A user community will have some purchasing power which might lead to lower component prices because of larger orders.

Hydrogen supply, however, remains a challenge, not so much in terms of technology or availability, but rather in cost of the hydrogen. Small devices for refilling metal-hydride cartridges exist, but come with a heavy price tag. Small electrolyzer stations, capable of supporting a fleet of say 10 to 20 bicycles,

cost in the order of a quarter million euros. Our idea is to equip the bicycles with returnable hydrogen storage that is distributed and collected like for example camping gas cylinders or in vending machines, a concept promoted by the Paris and Geneva based company Aaqius.

As of today, we have acquired various components and have started experimenting with a fuel cell which eventually will power our bicycle. Our hydrogen storage is a standard pressurized bottle not at all adapted for the purpose. Nevertheless, we hope to cycle on hydrogen rather soon.

We look forward to participation and input of a larger community, and invite interested people to come and join us at Pangloss labs.

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