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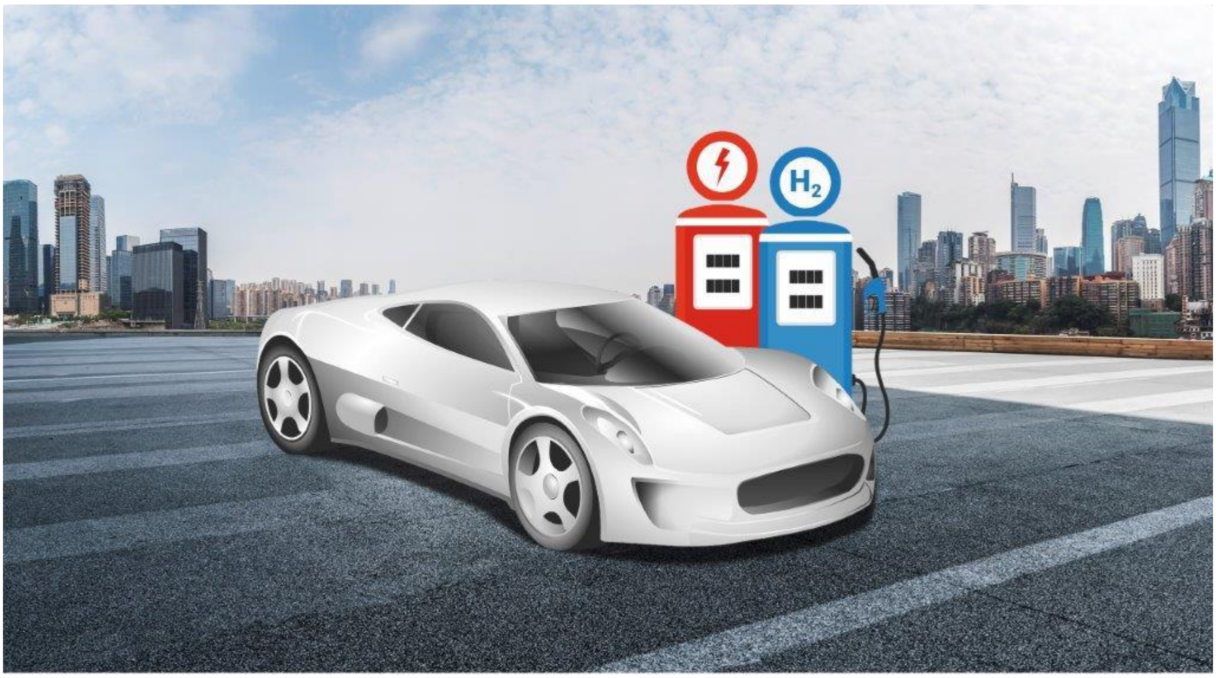
HYDROGEN AS A PROMISING ENERGY CARRIER: WHAT IS MISSING FOR A BREAKTHROUGH?

With the TAHYA project funded by FCHJU, a major step has been taken.

WITH TECHNOLOGICAL ADVANCES SUCH AS THE BATTERY ELECTRIC VEHICLE (BEV), HYDROGEN CAN ENABLE MOBILITY AT COMPARABLE COSTS.

"The fuel cell is the most consistent form of electric driving." *Peter Mertens, former head of development at Audi.*



Alternative drives for the mobility of the future dominate the day-to-day business of automotive OEMs in the development areas. Currently, the electrification of the drive for purely battery electric passenger cars (BEV) and hybrid systems plays the main role. In the last 5 years, significant technological leaps have been made in cell technology and battery module technology, which enable a BEV to achieve a mileage of between 70,000 and 140,000 km at the same cost as a corresponding diesel model.

Hydrogen in the FCEV (Fuel Cell Electrical Vehicles) is currently in a difficult state. Here, the availability of hydrogen can be argued with, as it is not a primary energy carrier. In addition, the vehicle variants are manageable with only a few models, and with about 400 registered vehicles this cannot really be called a market at present, but rather a technology project. Why is this so?

The cost drivers for hydrogen are the storage system and the fuel cell. Both units must compete with the battery module to be competitive. Moreover, the hydrogen is not directly available, but at least the same amount of energy has to be put into it first, which is later converted back into electrical energy in the fuel cell. This is where the real challenge lies.

With today's fuel cell development, compared to the first fuel cell generations, the expensive platinum content could be reduced by up to 80 % and there is also potential for further cost savings. The approx. 400 hydrogen vehicles in Germany do not yet represent a volume, so that current prices are more likely to be tied to the prototype. For the development of a cost-efficient hydrogen storage system, we have already been able to demonstrate a proof of concept for a COPV (Composite Overwrap Pressure Vessel) pressure tank with 700 bar pressure and 5.3 kg storage capacity as part of the TAHYA project. The costs can be below 400 € per kg hydrogen! This is sufficient for a range of 500-700 km.

In hydrogen production, a major innovative leap has been made in the development of dialyzers. In the case of the 30 megawatt formats, which directly use the overcapacities of wind farms, hydrogen can be produced at about 3.50 € / kg (700 bar compressed). In this way, the existing energy capacity can be used and transferred into a form that is easy to store. The hydrogen produced in this way can be transported via the existing gas pipelines and used in households for heat generation or directly compressed for mobile storage applications.

Currently, the main focus is on commercial vehicles and construction machinery. Here the first wave of system integration is underway, as the installation space for tanks is available and separate tank stations can be implemented quickly.

Within the next 10 years, hydrogen will be introduced as an energy storage medium in passenger cars.

Figure 1 shows schematically the cost curves over the mileage for the different drive concepts.

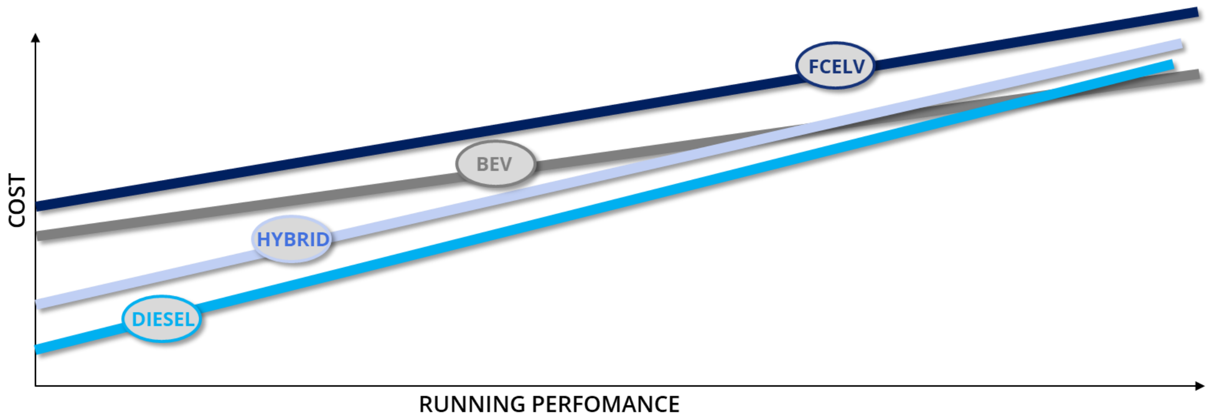


Fig.1: System comparison of total costs over mileage

The costs of the respective system are determined more by the application and the operational premises than by the pure system costs. In the long run, the BEV is the cheapest vehicle despite the higher initial investment, provided longer loading times can be accepted.

Hydrogen and fuel can be refueled in a few minutes. Currently the filling station system with 100 car stations for hydrogen is still quite thin, although oversized for the real existing 400 FCEVs with 4 vehicles per station!

Germany should nevertheless step on the gas in order not to be left behind again by developments on the Chinese market. The government and numerous companies are making broad-based efforts to develop this technology. A 20% share of the vehicle fleet is forecast by 2030.

OUTLOOK

The big advantage is the possibility to construct a purely electric drive with a supply interface consisting of battery module or hydrogen and battery module. This could be done on the same platform and the customer chooses the storage medium depending on the application: battery only or small battery and large hydrogen tank or medium size for battery and hydrogen tank. Because without a battery it is not possible. Conventional fuel cells have an output of between 70 and 150 kW. The battery is needed for peak performance and recuperation. Hydrogen technology can be seen as a range extender for the battery electric systems and thus represents a supplement and not a competition towards an emotion-free, electromobile world.

The essential advantages:

- *Abandonment of conventional drives with complex exhaust gas cleaning*
- *Fast refuelling in a few minutes*
- *High ranges if required*
- *Lower weight because batteries over 50 kWh are no longer needed*
- *Less raw material requirement for lithium and cobalt*

There is no way around hydrogen for an electromobile future!

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