TRAIN

On non-electrified lines, in particular, rail transport can be decarbonized with the help of fuel cells, thus dispensing with fossil fuels. At the same time, such routes no longer have to be equipped with expensive overhead lines.

40%

Around 40% of Germany's rail network has not yet been electrified.

Cell growth

The future belongs to hydrogen drive systems based on fuel cell technology. Both powerful and environmentally friendly, fuel cells can be used in a wide range of applications. Be it cars, buses, trains, ships, or airplanes: fuel cells can be deployed in all modes of transport and offer tremendous opportunities for growth. ElringKlinger has been active in this field for nearly 20 years, supplying components such as bipolar plates and media modules as well as stacks and complete systems.

Those who have read books by Jules Verne will be acquainted with the tremendous vision displayed by the French novelist as far back as the end of the 19 century. He predicted a technically mature submarine in "Twenty Thousand Leagues Under the Sea", conjured up images of global travel in "Around the World in Eighty Days", and wrote about the as yet unrealized "Journey to the Center of the Earth". In espousing such ideas through his novels, he proved to be well ahead of the times. This is also evident elsewhere, when he described the energy of the future in 1874: "Water is the coal of the future. The energy of tomorrow is water decomposed into its primitive elements by electricity. Hydrogen and oxygen, which constitute it, will furnish an inexhaustible source of heat and light for planet Earth."

What Jules Verne was describing 145 years ago – five years before the establishment of the company that was later to become ElringKlinger – is essentially a fuel cell. In a fuel cell, hydrogen and oxygen are brought to a chemical reaction, which then releases electricity. Those who paid attention in chemistry lessons will be well aware of the power of this reaction. The specific advantage here is that the conversion of energy during the chemical reaction in the fuel cell occurs with a higher efficiency than in the combustion process.

ElringKlinger recognized this potential when, around 20 years ago, the Group was asked to develop bipolar plates based on its expertise in the area of metalworking. Even when its development partner discontinued research into the fuel cell, ElringKlinger itself remained committed to the project. After all, it was evident that the fuel cell was a highly suitable drive system, particularly from an environmental perspective. If the hydrogen is produced from renewable energy, this technology even offers the benefit of being CO_2 neutral. The only exhaust gas produced is water vapor. This undoubtedly makes the fuel cell an energy solution tailored to the next generation of mobility.

Mobility has many dimensions. On the ground, the fuel cell offers enormous possibilities for the car. It is also suitable for deployment in trains. Fuel cells are the perfect solution for non-electrified routes that require locomotives with on-board electrical power supply. The same applies to the shipping industry, where energy is also provided on board.

However, this potential can be exploited not only on the ground but also in the air. Aircraft engines burn kerosene – often in large quantities, depending on the year of manufacture of the aircraft. The mere fact that emissions at high altitudes are more harmful to the climate than on the ground shows the great potential for savings when it comes to the environmental footprint of air transport. Fuel cells operate without such emissions – while still providing the power required for such areas of application. ElringKlinger's stacks are particularly well suited for this because they offer high power density.

Performance, however, is not the only argument in favor of the fuel cell. With hydrogen as an energy carrier, energy production and energy use can be separated from each other physically and in terms of timing. For example, it is possible to produce hydrogen today with wind energy along the coast of the North Sea and use it three months as fuel for a truck in southern Germany. Particularly in the case of commercial vehicles or regularly recurring, cyclical traffic, such as that attributable to bus transportation, purely battery-powered vehicles reach their limits relatively quickly and have to be recharged rapidly. However, stoppages due to recharging increase the vehicle's operating costs. This is where the fuel cell can demonstrate its true strengths and offer unparalleled advantages with much longer ranges and fast refueling times that are almost comparable with today's diesel vehicles.

Environmental compatibility is, of course, a major factor. After all, there are clear signs of climate change and a reduction in CO_2 emissions is inevitable. By issuing ever stricter regulations, policymakers have already set a framework for action. Now the aim is to implement it in order to be able to meet the various requirements and regulations. Hydrogen is a crucial component in this process. In this context, for example, CO_2-neutral mobility can be achieved if we switch to a hydrogen economy and combine it with renewable energies. The direction to be taken is known. After all, as Minister of Education and Research Anja Karliczek put it recently: "Hydrogen is the new oil." This clearly embraces the vision that Jules Verne formulated 145 years ago.

AIRPLANE

Aircraft have a substantial energy requirement. At the same time, however, they are faced with weight and volume restrictions for reasons of physics. Fuel cells can cover the energy needs of aircraft; they are comparatively compact and have a high power density. Batteries, by contrast, have a lower energy density and thus offer a shorter range.

230 g/Pkm

A domestic flight in Germany produces 230 g/Pkm in greenhouse gas emissions according to the Federal Environment Agency. A car emits 147 g/Pkm, while long-distance rail transport is responsible for 32 g/Pkm. (g/Pkm = grams per passenger kilometer).

87

There were around 87 hydrogen filling stations in Germany at the beginning of 2020. The existing fuel filling station infrastructure can be converted for use with hydrogen.

COMMERCIAL VEHICLES

The area of cyclical transport is particularly well suited for fuel cells. Prime example: buses that return to the depot on a regular basis. If this form of transport is to become environmentally friendly and, in a best-case scenario, CO_2 neutral, only the fuel cell is to be seen as a viable solution in economic terms. The same applies to trucks: frequent stoppages for recharging in the case of all-electric drives result in unfavorable costs.

FUNDED PROJECTS

ElringKlinger is involved in a number of funded projects aimed at advancing fuel cell technology for industrialization in various markets over the course of the 2020s.

VOLUMETRIQ

ElringKlinger successfully developed a fuel cell stack with very high power density as part of a project sponsored by the EU Commission and the Fuel Cell and Hydrogen Joint Undertaking (FCH JU). Together with its partners Johnson Matthey Fuel Cells, Solvay Specialty Polymers, and CNRS Montpellier, the Group was thus able to set new standards at an international level. The stacks are suitable for use in both passenger cars and commercial vehicles.

The project centered around the ElringKlinger fuel cell stack won the accolade of "Best Success Story" at the FCH JU Awards 2019. The honor is bestowed to recognize particularly successful and innovative projects in the field of fuel cell and hydrogen technology.

www.volumetriq.eu

H2HAUL

Together with the Dutch VDL Groep, three VDL vehicles will be equipped with fuel cell systems from ElringKlinger and tested in real-life operation by the Belgian retail group Colruyt Group as part of this FCH JU-sponsored project.

www.h2haul.eu

GIANTLEAP

In the multi-year EU-funded project, fuel-cell-powered range extenders for an electric bus from the Dutch manufacturer VDL Bus & Coach were developed and tested under real conditions. The final report concluded that ElringKlinger's fuel cell stacks were convincing: "The overall performance of the system exceeded expectations."

www.giantleap.eu