



CASE STUDY

Fuel Cell Zero-Emission Buses for Cologne Region, Germany

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Situation

In 2016, the German government adopted the Climate Action Plan 2050, making Germany one of the first countries to adopt the long-term low greenhouse gas emission reduction strategy as put forth by the Paris Agreement.



With a goal of becoming largely greenhouse gas neutral by 2050, this calls for prompt and far-reaching initiatives within a number of sectors, including the transportation. Over 95 percent of CO₂ emissions in Germany are caused by road traffic (source: Clean Energy Wire). Thus, the German Government has realized that a switch to alternative drives and fuels is necessary as the transport sector can and will make a sustainable contribution to achieving the climate targets.

Solution

The public transport operator RVK (Regionalverkehr Köln GmbH) has recognized its environmental responsibility as a community leader in Cologne.

Through the project “Zero Emission,” RVK has set an ambitious target to replace its entire diesel bus fleet with alternative powertrains. From 2030 and onwards, RVK aims to only procure zero-emission buses. In advance of this goal, a large fleet of

emission free buses and associated infrastructure is being deployed.

Beginning in 2010, RVK started to investigate alternative options which would allow the city to replace the fleet of diesel buses. All options for zero-emission transport were taken into consideration.

The buses in Cologne region travel in average 250-300 kilometres a day. Due to a tight operation schedule and an unstable electricity grid, it would not be possible to charge battery electric buses on route or return to the depot to recharge during the day.

To meet the requirements for range, flexibility and refueling time of the buses, it soon became clear that fuel cell electric buses (FCEBs) were the only zero-emission technology to offer one-to-one replacement of the city’s diesel buses.

Site	Cologne Region, North Rhine-Westphalia, Germany
Application	Currently the largest FCEB fleet in Europe
System	A mix of Ballard’s FCveloCity®-HD and FCmove™
Fuel	Hydrogen
Objectives	Replace the fleet of diesel buses with zero-emission alternatives

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Result

The first two prototype FCEBs were deployed in the cities of Hürth and Brühl by RVK in 2011. These were decommissioned by the end of 2016, as the project was finalized. In 2014 RVK purchased two Van Hool A330 FCEBs.

At the end of 2019 and the first half of 2020, 35 series-production vehicles of the type NEW A330 FC from Van Hool were commissioned.

As of 2021, RVK is operating the largest fleet of FCEBs in Europe with 38 buses in daily operation. In February 2021, the first Solaris Urbino 12 hydrogen bus was delivered, and an additional 14 FCEBs are expected to be in service by the end of 2021.

The FCEBs buses are equipped with Ballard Power Systems fuel cell technology and are powered by a mix of FCveloCity®-HD and FCmove™ fuel cell modules. Each bus carries 38.2kg of hydrogen on board and, thanks to a hybrid power source, these FCEBs are able to carry out a full day's operation of 350km.

Cologne's FCEB fleet benefits from the proximity of Ballard's European Customer Care Center which provides service, training, onsite support, diagnostics and spare parts in order to ensure availability of the buses.

The deployment of the FCEBs are co-financed by the Fuel Cells and Hydrogen Joint Undertaking (FCH-JU) and co-funded by the German NIP2 program, 30 buses in the framework of the JIVE project and 15 buses in the framework of the JIVE2 project.

Combined, the JIVE projects will deploy close to 300 FCEBs in 22 cities across Europe by the early 2020s.

Fueling

As the fleet of FCEBs in Cologne Region cover a large service area, several decentralized refueling options have been made available. Two hydrogen filling stations have been built at RVK depots in Meckenheim (near Bonn) and Wermelskirchen (Bergisch Gladbach district) near Cologne. Both stations have been designed to refuel 20 buses each day. A single refuelling (38.5 kg hydrogen) takes about 10 minutes and takes place under a pressure of 350 bar. The buses can also refuel at two public filling stations of "H2 Mobility Deutschland" at the Cologne/Bonn Airport and in Frechen.

Finally, the buses can drive to a chemical factory in Hürth, close to Cologne, and refuel. Here the hydrogen is a by-product of the production of chlorine and was simply wasted until RVK decided to test this as fuel for the FCEBs. It has proven to be extremely beneficial. There is significant potential to utilize by-product hydrogen as this region of Cologne is a center for chemical production.

Distance Travelled	Over 1,911,000 kms since December 2014
Refueling Time	10 minutes at 350 bar
Availability	92% bus fleet availability 97% fuel cell module availability

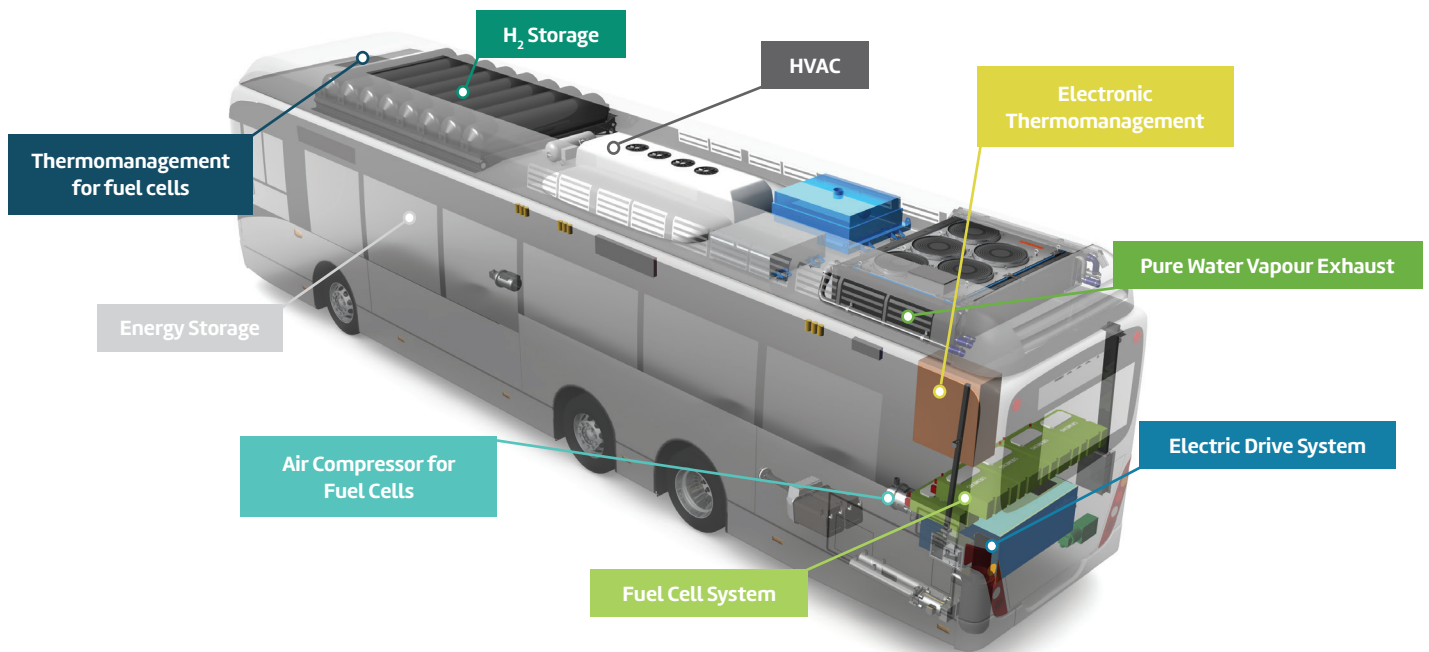
RVK has set an ambitious target to replace its entire diesel bus fleet with alternative powertrains



Zero Emission Bus Technology

A fuel cell bus is an electric vehicle that uses compressed hydrogen as the fuel, rather than storing energy in large batteries. Fuel cell power modules onboard the bus generate electricity through an electro-chemical process, producing only water and heat as byproducts. The electricity generated by the fuel cells powers the hybrid electric motors and charges the energy storage system. Regenerative braking on the buses increases the fuel economy. High pressure tanks located on the roof of the bus store hydrogen fuel, providing sufficient range for a full day of operation, over 16 to 18 hours. This compares well with the previous generation of fuel cell buses, whose range was less than 200 km, where buses were forced to operate in half day shifts before fuelling.

Fuel cell power modules onboard the bus generate electricity through an electro-chemical process



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