SEPTEMBER 2022

Fuel-cell hydrogen long-haul trucks in Europe: A total cost of ownership analysis

BACKGROUND

Road freight activity in Europe is expected to grow continuously through 2050, offsetting expected CO_2 reductions from mandated heavy-duty vehicle (HDV) CO_2 standards in the European Union (EU). To reach the EU's 2050 carbon neutrality goals, more ambitious CO_2 reduction targets are needed, which will require a shift from internal combustion engines to zero-emission HDV technologies. Fuel cell trucks are one option for achieving these goals. However, the economic viability of this technology is still uncertain.

This study evaluates the total cost of ownership (TCO) of fuel cell electric trucks (FCETs) in France, the United Kingdom, Germany, Italy, Spain, the Netherlands, and Poland, home to more than 75% of HDV registrations in the EU in 2020. The study focuses on long-haul tractor-trailers, the highest-emitting HDV segment in the EU. The TCO includes the costs of truck acquisition, renewable electrolysis hydrogen, diesel fuel, and maintenance, as well as road tolls and other country-specific taxes and levies.

KEY FINDINGS

» **FCETs won't achieve TCO parity with their diesel counterparts before 2030 in any of the seven countries**. Nonetheless, the TCO gap between the two technologies is significantly narrowed by 2030, ranging from €55,000 for trucks operating in the Netherlands to €180,000 for trucks operating in Germany and Italy. Table 1 summarizes the 5-year TCO gap between FCETs and diesel trucks, for trucks purchased in 2030.

icct
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Table 1. Five-year total cost of ownership gap between fuel cell and diesel tractor-trailers for trucks purchased in 2030 without policy intervention

Country	France	Germany	Italy	Netherlands	Poland	Spain	United Kingdom
TCO gap in 2030	+16% (€112,000)	+30% (€177,000)	+32% (€179,000)	+ 6% (€55,000)	+20% (€102,000)	+21% (€123,000)	+16% (€91,000)

» **Fuel cell long-haul trucks can reach TCO parity with their diesel counterparts by 2030 in Europe if the at-the-pump green hydrogen fuel price is around 4 €/kg**. The break-even hydrogen price varies, from 3.5 €/kg in Poland to 5 €/kg in the United Kingdom. This disparity is driven by the country-specific diesel fuel prices, road tolls, and other taxes and levies.

» **Hydrogen fuel subsidies will be needed to justify the business case for FCETs in Europe during this decade**. The expected hydrogen fuel price is higher than the break-even price required to achieve TCO parity by 2030. Subsidies needed vary from 1.2 €/kg in the Netherlands to more than 4 €/kg in Italy and Germany, as shown in Figure 1. The price of hydrogen fuel will be the primary driver of the technology's economic viability as the retail price gap between FCETs and diesel trucks is expected to narrow significantly by 2030.

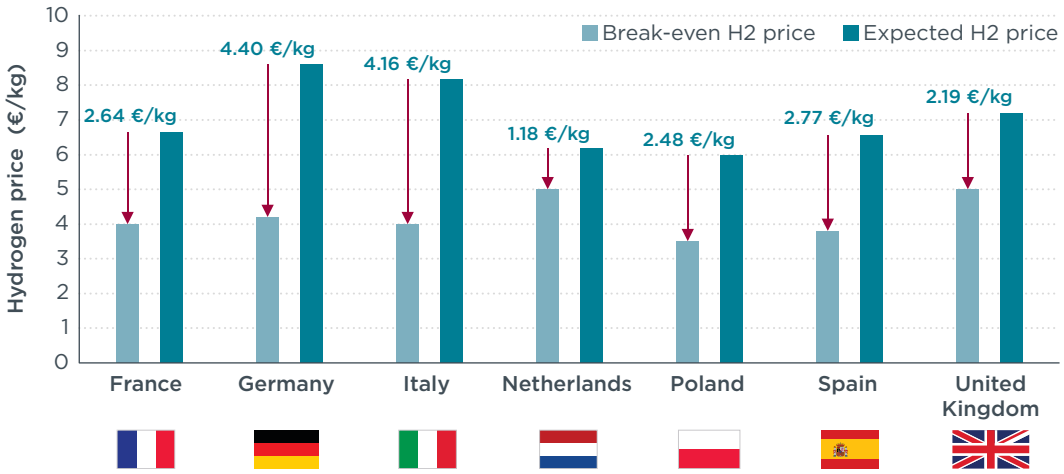

Figure 1. Hydrogen fuel subsidy needed to achieve TCO parity between FCETs and diesel trucks by 2030 considering onsite hydrogen production through renewable electrolysis

» **The price of hydrogen fuel is the primary determinant of the economic viability of fuel-cell electric trucks in Europe**. The fuel costs of FCETs are expected to be three times higher than those of equivalent diesel trucks today. This will fall by 2030 to 1.8 times higher, driven by expected improvements in FCET fuel economy and reductions in hydrogen fuel price. Meanwhile, the retail prices of FCETs and diesel trucks are expected to be within the same range by 2030.

» **Policy interventions can help narrowing the TCO gap between both truck technologies**. Providing purchase premiums reduces the retail price of a FCET but doesn't significantly cover the TCO gap. Exempting zero-emission HDVs from Road tolls or imposing CO_2 external costs on diesel trucks can have a significant impact on the TCO gap, especially given the high truck mileages. However, providing direct hydrogen fuel subsidies remains the most effective policy measure to reduce the TCO gap as shown in Figure 2.

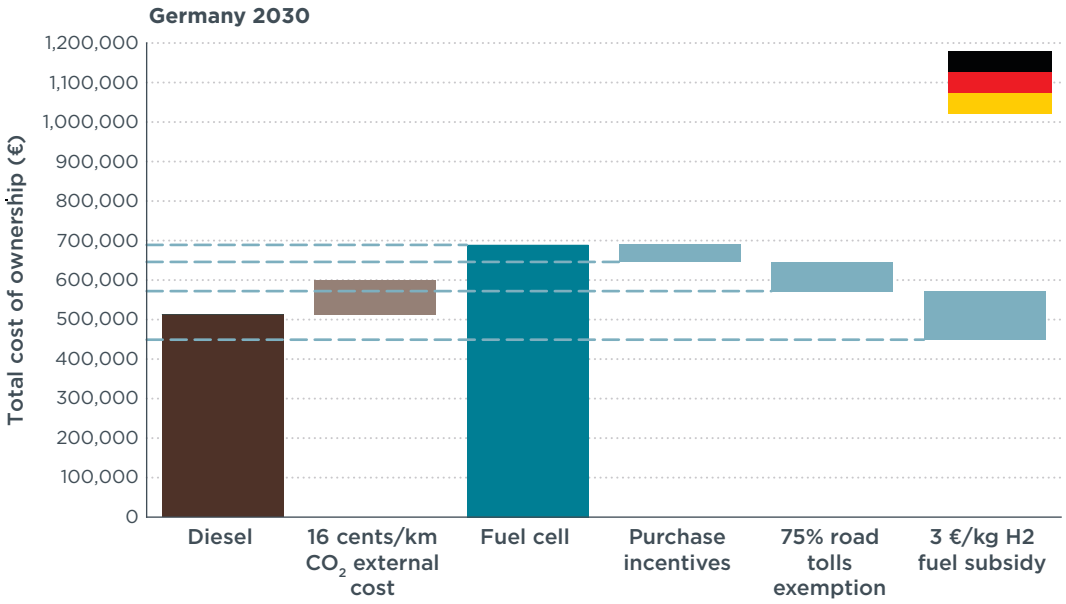

Figure 2. Impact of several policy measures on the total cost of ownership of fuel cell tractor-trailers, Germany, purchase year 2030

RECOMMENDATIONS

» **Increase the ambition of the heavy-duty vehicle CO_2 standards as early as 2030** to comply with the EU Climate Law. More stringent CO_2 standards can provide the certainty needed to invest in fuel cell trucks, which are capable of replacing the current diesel fleets and providing a significant reduction in CO_2 emissions. Stricter standards would also accelerate the technology improvement and ramp up its economies of scale, reducing the total deployment costs of the technology.

» **Expedite the implementation of the Eurovignette directive into national law and fully exempt zero-emission trucks from road tolls**. A 100% waiver on road tolls, similar to what is implemented in Germany, can reduce the TCO of fuel cell trucks by 14% to 25% by the end of the decade, helping fuel cell trucks to achieve TCO parity with diesel trucks in France and the Netherlands. This policy measure should be closely monitored so as not to jeopardize the road infrastructure funding in the future depending on the market share of zero-emission trucks that will be exempted from road tolls.

Tailpipe CO_2 emission charges are effective in penalizing polluting trucks. The proposed CO_2 charge of 0.08 €/km to 0.16 €/km can narrow the TCO gap between fuel cell and diesel trucks.

» **Incentivize the purchase of zero-emission trucks and limit these incentives to their early market uptake phase**. A differential purchase premium could be calculated as the difference in retail price between a zero-emission truck and its diesel equivalent, similar to what is currently implemented in Germany, France, and the Netherlands. Such premiums will decrease and eventually be phased out as the retail prices of zero-emission and diesel trucks become comparable, driven by the expected increase in economies of scale that may reduce the cost of some major components such as fuel cell units and hydrogen tanks.

While these purchase premiums cannot cover the entire TCO gap between fuel cell and diesel trucks, they can reduce the capital investment needed to ramp up market demand for the technology. Lack of capital is identified as a key barrier to the technology's deployment.

- **Provide fiscal incentives for renewable electricity used for hydrogen production**. Such incentives can reduce the at-the-pump green hydrogen price, narrowing the TCO gap between fuel cell and diesel trucks. Battery-electric trucks would also benefit from such incentives. Further, the at-the-pump hydrogen fuel price can be directly incentivized through policy measures such as grant support for capital costs and subsidies.
- **Extend the European Emissions Trading Systems (ETS) to cover transport as suggested by the "Fit for 55" package.** Proper carbon pricing can reduce the TCO gap between fuel cell and diesel trucks by penalizing polluting trucks. Germany already has a carbon pricing scheme and other member states are encouraged to implement a similar ETS for road transport.
- **Incentivize demonstration projects of fuel cell trucks in real-world applications**. Such demonstration projects can close existing knowledge gaps regarding the technology potential of fuel cell trucks such as truck fuel economy and refuelling time, and can demonstrate the technology's economic viability. This would help in identifying the real-world challenges hindering the technology's market deployment.

PUBLICATION DETAILS

Title: Fuel-cell hydrogen long-haul trucks in Europe: A total cost of ownership analysis

Author: Hussein Basma, Yuanrong Zhou, and Felipe Rodríguez

Download: theicct.org/publication/eu-hvs-fuels-evs-fuel-cell-hdvs-europe-sep22

Contact: Hussein Basma, hbasma@theicct.org

www.theicct.org

communications@theicct.org

twitter @theicct

icct
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION