

## **HYDROGEN CARS: A NEW LEAP FOR A BETTER FUTURE**

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**Abstract.** *Hydrogen vehicles have been around for quite some time, but have recently been advertised as the future for passenger vehicles and civilian transportation. Hydrogen fuel cells run on pressurized hydrogen, that has a refill time equivalent to a gas filled vehicle and brags about things like zero emissions with literal water coming out of the exhaust. This sounds great, especially compared to electric vehicles which can sometimes take an hour to charge at a station. Hydrogen seems great in theory so what happened? Well, there are a few reasons why hydrogen cars lost traction and publicity, it all boils down to five factors: price, convenience, performance, the environment, and competition. Hydrogen cars tried to fix a problem that to be honest, didn't really need to be solved. And it didn't even succeed at fixing the problem in the first place. Hydrogen cars can run exceptionally long distance on hydrogen, but the factors like price, performance and convenience put the nail in the coffin for hydrogen fuel cell cars. Now you might be thinking: „Hey, the technology is super impressive, so if it's not gonna work for commercial vehicles where can we apply it? ”.*

**Keywords:** *price, environment, convenience, competition, performance*

### **Introduction**

Think of all the stuff you come into contact within one day. These objects didn't come out of nowhere. In most cases, it made a journey that crossed city limits or even country borders. Most of those goods have been transported from one location of the world to another by means of trucks. Those trucks you could call the backbone of commerce.

Unfortunately, the way they work right now is very unhealthy for the planet. Just look at Europe where trucks and buses barely make up any of the vehicles on the road, but they're responsible for the huge transport emissions, which continue to grow because more and more freight needs to be moved around. Our best solution is to achieve these zero emissions and that means electric motors. They can be powered with two options you already know from the car industry: Batteries and Hydrogen.

But trucks face a different set of challenges than passenger cars. They usually drive further and carry much heavier loads. So which system will win the race for the truck of the future, or do we need both? If this subject of zero-emission trucks was talked about just a few years ago, the ones who came up with this idea might have been “laughed out of the room”.

### **The advantages of Hydrogen Trucks**

Felipe Rodriguez works as “Heavy-Duty Vehicles Program Director” and his job is to reduce the climate impacts of heavy-duty vehicles. He mentions that there were many preconceived notions about what batteries could do and what batteries were: „...so batteries are too expensive, batteries are too heavy, batteries are too big.” [1]. The idea was that the massive batteries needed to power these big trucks, and that would compromise how much cargo they could carry.

Transporting heavy loads would make the batteries run out mid-journey. Freight operators often have tight profit margins. Time is money and they don't want to waste it on hours of charging,

so the focus shifted to fuel cells. These devices essentially work like batteries that run on stored hydrogen and oxygen from the air. They can produce enough electricity to power a truck, and their only byproducts are heat and water. Of course, it takes a lot of energy to produce pure hydrogen so that it can be used as fuel, but even then, a hydrogen truck produces up to 33% fewer emissions across its lifecycle than its diesel counterpart. The savings are much greater if the hydrogen is produced with renewable energy, but that's barely happening. Simply speaking: Hydrogen trucks can reduce emissions without compromising cargo capacity or requiring long breaks.

Volker Hasenberg manages the hydrogen strategy at Daimler Truck. In an interview that was playing live in a group call, he said: "Refueling a hydrogen truck is more or less the same as refueling your diesel truck. You have a station, you store your energy on board in the truck, and this takes a couple of minutes." [2]. So, at first sight, hydrogen fuel cells look like a great solution for trucks, but there's a catch. All these assumptions about batteries, that they are "too expensive, too heavy.", are already kind of outdated.

### **Batteries overtaking Hydrogen**

Batteries have become much cheaper very quickly, and their energy density has improved. That means a truck can get much more range from the same size battery pack. Researchers are also working on megawatt charging systems for heavy-duty trucks. The aim: To reduce the charging time from several hours to as little as 15 minutes. This would allow truck drivers to charge the vehicles during their mandated driving break, which of course varies around the world, though that's still a massive challenge in terms of infrastructure.

What swung the pendulum in favor of battery-electric motors was high-scale investment in EVs, because when it comes to greener passenger cars, most governments and producers are betting on batteries. "It's a whole automotive industry really, which is bringing down the cost of batteries." [3]. This was said by David Cebon, a professor who researches road transport engineering at the University of Cambridge. "But there's only a small industry, a relatively small number of players working on the engineering of fuel cells and hydrogen storage and hydrogen delivery." Battery-powered trucks also have the advantage that they're cheaper to operate than hydrogen trucks because they're more efficient.

To power a fuel cell with green hydrogen, there is a process that turns electricity into hydrogen, then that hydrogen is transported to refueling stations and pumped into a fuel cell which then turns it back into electricity. Roughly 60% of energy is lost on the way. Compare that to a fully electric truck. It needs energy to charge a battery, which then powers the motor. Only about 20% is lost.

David Cebon also made a comparison between those 2 sources of power: "When you compare those two strategies, the hydrogen fuel cell strategy uses three times more electricity, green electricity, to generate one "kW" per hour at the wheels of the vehicle. You have to have three times more wind turbines, three times more solar panels, or three times more nuclear power stations." The fact that battery electric trucks are cheaper to operate makes a huge difference. It compensates for the investment upfront to buy the vehicle, which is high, higher than for fuel cell trucks.

So, if we look at the total cost of ownership, the sum of all the expenses for a vehicle across its lifecycle, battery-powered trucks come out looking pretty good. More importantly, they could become even cheaper than diesel trucks before 2030. Looking at just how fast this is happening for long-distance tractor-trailers across Europe. Of course, battery-powered trucks have the added bonus of emitting way less than their diesel counterparts. They can be powered by an electricity mix of fossil fuels and renewables. That saves about 63% in emissions, and if they are powered with clean energy only, that saves 92% [4].

### **The battle between the Zero-Emission Competitors**

As battery technologies develop rapidly, this begs the question: Is the race between electric and hydrogen trucks already over, and what does that mean? In most countries, battery-powered trucks still represent less than 1% of sales, but projections say they will make up a vast majority of the European market by 2050 [5]. And manufacturers like Daimler and Volvo who

are betting on hydrogen are not betting on it instead of batteries, but in addition to batteries. Still apart from workplace banter, should truck makers be investing in hydrogen, after all that happened all these years?

Hydrogen truck producers basically want another leg to stand on. They are betting that battery-powered trucks will never develop enough to carry extremely heavy loads across several thousands of kilometers, that's because more cargo requires more energy.

Well, are there ways to make battery-powered trucks more viable for very heavy cargo on long journeys? Operators could swap out battery packs instead of waiting to recharge them. That would probably require industry-wide cooperation on battery-swap systems though. Another option would be to install electric road systems in some parts, they would allow trucks to collect electricity from overhead contact lines, just like how trains or trams do, and it could make it easier to drive through remote areas where there might not be charging stations.

### **Facing the Challenges**

That brings us to our next point: infrastructure. It needs to expand a lot, for either technology, if zero-emissions trucks are to take over. Hydrogen refueling stations are still extremely scarce, with entire regions in Europe not having any at all. When it comes to EV charging, there is more solid infrastructure in place for passenger cars, but the kind of high-power charging that trucks need is almost completely missing. In the European Union, that's where this law could come into play. It sets specific targets for member states to deploy more charging and refueling stations in the coming years. Regulations that signal to businesses that this is where the future of trucks is headed are vital. They take some risk out of this big transition, the same needs to happen to spur manufacturers into mass-producing zero-emissions trucks, because at the moment not enough are being produced for fleet operators to make the switch, so, the EU is looking to revise its CO2 standards for trucks. While it doesn't put an end to internal combustion engines, the proposal wants new heavy-duty vehicles to emit 90% less by 2040 [6]. Both battery and fuel cell trucks need to tackle their infrastructure and supply. But there is one challenge specific to hydrogen trucks. And that's the price of the fuel. This is where estimates diverge quite a bit. Some projections are optimistic, while others say it'll stay expensive for the next decades.

### **Conclusion**

In conclusion, the falling price of hydrogen is yet another thing to remember in a long list of uncertainties during this transition, that's because to get all the products to us that we use every day without all those emissions, some big questions still need answering. How much cheaper and smaller can batteries get? How fast can they be charged? And will there ever be enough green hydrogen? Either way, it looks like pure electric trucks are way ahead of hydrogen in the race to deliver our future products. But they are both bringing us closer to the same finish line: To reach our climate targets. Still, we might want to stay tuned because there could still be some surprises along the way.

### **References**

- [1] F. Rodriguez, „Zero-emission bus and truck market in China: A 2021 update.” Affiliation: International Council on Clean Transportation, January 2023, [Online]. Available: [https://www.researchgate.net/publication/369960607\\_Zero-emission\\_bus\\_and\\_truck\\_market\\_in\\_China\\_A\\_2021\\_update](https://www.researchgate.net/publication/369960607_Zero-emission_bus_and_truck_market_in_China_A_2021_update)
- [2] „Safe, Fast and Simple: Daimler Truck and Linde Set New Standard for Liquid Hydrogen Refueling Technology.” [Online]. Available: <https://www.daimlertruck.com/en/newsroom/pressrelease/safe-fast-and-simple-daimler-truck-and-linde-set-new-standard-for-liquid-hydrogen-refueling-technology-52581266?cHash=7758a92fe8add8fe15addfe02e5bacf7>

- [3] D. Cebone, „Is the UK's 'Clean' Hydrogen clean enough?” Director, Centre of Sustainable Road Freight and Professor of Mechanical Engineering at University of Cambridge, August 2022, [Online]. Available: [https://www.linkedin.com/pulse/uks-clean-hydrogen-enough-david-cebon?trk=public\\_profile\\_article\\_view](https://www.linkedin.com/pulse/uks-clean-hydrogen-enough-david-cebon?trk=public_profile_article_view)
- [4] A. O’Connell, N. Pavlenko, G. Bieker, and S. Searle, “A comparison of the Life-Cycle Greenhouse gas emissions of European Heavy-Duty vehicles and fuels.” February 2023, [Online]. Available: <https://theicct.org/publication/lca-ghg-emissions-hdv-fuels-europe-feb23/>
- [5] F. Rodriguez, „Europe’s electric truck market surges, while electric buses power ahead.”, August 2023, [Online]. Available: <https://theicct.org/europes-electric-truck-market-surges-aug23/>
- [6] S. G. Carroll, „EU Parliament agrees stance on reducing truck CO2 emissions”, November 2023, [Online]. Available: <https://www.euractiv.com/section/freight/news/eu-parliament-agrees-stance-on-reducing-truck-co2-emissions/>