SPECIAL REPORT BY NICK GIBBS

Hydrogen can still help slash vehicle emissions

WILL HYDROGEN EVER BECOME an important part of the vehicle refuelling mix? Or is it, either used in a fuel cell or as a combustion fuel, doomed to remain on the sidelines?

Last year, fuel cell vehicle (FCEV) sales reached 15,538 globally according to data from IDTechX, compared to 6.6 million for plug-in vehicles, and the Toyota Mirai and Hyundai Nexo accounted for over 12,000 of those. And those sales were heavily subsidised, IDTechX pointed out.

Annual sales of fuel cell cars are expected to reach 126,000 annually by 2030, according to research from GlobalData Energy, but that would represent just 0.2% of predicted total car sales.

Guessing what will happen is hard. In 2013, the UK government figured that annual UK sales of FCEVs would be around 25,000 by 2022. From January to August, Toyota sold four Mirais and Hyundai two Nexos in the UK.

But there are some powerful forces working to make fuel cells a success, and the advantage of hydrogen for current manufacturers and suppliers is that its use in combustion engines or even fuel cells maintains a supply chain that doesn't need to change much.

For example Bosch, the world's largest automotive supplier, is strongly pushing the use of hydrogen as it expands its fuel cell business, but also as an alternative fuel for combustion engines.

Britain's Johnson Matthey (JM), meanwhile, is turning to production of the fuel cell's polymer electrolyte membrane, or PEM, the thin layer through which positively charged ions pass, to replace its catalytic converter business.

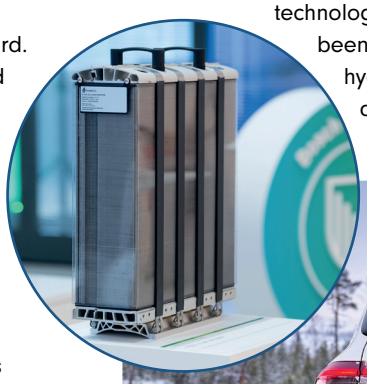
JM then sells it to fuel cell suppliers or direct to vehicle makers. The PEM, along with the two platinum-coated catalyst layers either side, forms the heart of the fuel cell and requires specialist metals chemistry knowledge. The rest isn't very tricky. "The natural habitat for our customers is, by and large, mechanical engineering and manufacturing. They make the other 997 pieces," said Eugene McKenna, commercial and strategy director for JM's Hydrogen Technologies business.

The best argument for the hydrogen fuel cells as an alternative to battery-electric technology has always been that filling up with hydrogen can be as quick as refuelling a petrol or diesel tank. For trucks, that means much less idle time.

Hydrogen also makes for a good alternative energy store, especially if it can be made using renewable electricity that might otherwise be wasted, for example at night.

These benefits have long been understood. But other arguments are coming to the fore as the shortage and subsequent price increases of battery materials become more acute with legislation pushing sales of electric vehicles.

If Russia's wider energy war shows us anything, it's that we should avoid relying on one energy source or technology, Markus Heyn, head of mobility services for Bosch, argued. "In the automotive industry, we should use this occasion to ask ourselves what we can do if there should ever be too few battery cells," he



BMW and Bosch are among most vocal FCEV proponents

told the Stuttgarter Zeitung newspaper in September.

Similar arguments were made by BMW CEO Oliver Zipse, who brought up both scarcity of raw materials for batteries and the lack of charging infrastructure as the reasons behind his company's push into hydrogen fuel cells. "If we run into an emission-free world, we have to have an offering of hydrogen, otherwise you will lose market share," he said on the company's second quarter earnings results call.

BMW has started making fuel cell versions of the X5 SUV using stacks from partner Toyota. The production run will be small initially, but Zipse said the company was planning a possible next-gen version and is also investigating making a fuel cell version of its Neue Klasse new generation of cars from 2025.

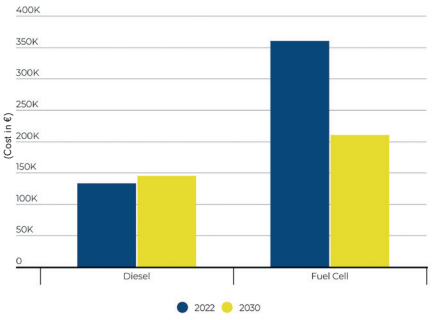
Premium brands such as BMW and Land Rover who make good money selling big SUVs are running over the numbers for fuel cells and weighing the advantages compared to a whopping great battery pack.

However, fuel cell SUVs will still need a battery. In BMW's iX5 the fuel cell imparts just 167bhp compared to almost 200bhp from an electric motor mated to a battery pack.

A similar set-up can be found in Land Rover's Zeus project that mates a fuel cell with a plug-in hybrid drivetrain in a heavily modified Defender. "In a premium SUV you don't want to put your foot down to find lag. That's what the battery's for," said Mo Mani, hydrogen fuel cell lead engineer at JLR.

The comparatively sluggish reaction time of a fuel cell is less of an issue in vans, another vehicle that's seeing some investment on the fuel cell side. Stellantis is already selling fuel cell versions of its mid-sized vans in limited numbers on mainland Europe, including the Citroën Jumpy and Opel Vivaro. A fleet could then invest in refuelling back at base.

Renault is also rolling out a hydrogen van, a version of the Master with a 40bhp fuel cell. But like the Stellantis vans it also has a battery, here 33kWh in size, to help with acceleration. This is great for parts makers, given it offers a range



Cost of fuel cell HGVs much higher than diesel now, but expected to fall quickly

of powertrain areas to supply into, but it also makes it much harder to achieve price parity even with battery-electric counterparts (pricing hasn't been revealed for the Renault or Stellantis vans).

The cost of the stack, together with the cost of hydrogen, means FCEVs won't see price parity with electric cars until "later this decade or in the 2030s" according to even the Hydrogen Council, a global organisation of hydrogen-interested

COSTS NEED TO DROP

HGVs stand to gain from fuel cell tech

Fuel cell tractor-trailers consume around 9kg of hydrogen per 100km today, potentially decreasing to 6.6kg/100km by 2030.
Pump hydrogen costs will fall to an expected €5-8/kg in 2035. However a break-even hydrogen price of around €3-5/kg is needed for fuel cell trucks to reach cost of ownership parity with diesels by 2030.
Fuel cell HGVs are 10-12% more energy-efficient than diesels, but battery-electric trucks remain the most efficient powertrain.

Source: ICCT

companies that tends to err on the side of optimism.

That optimism is growing however. The push from established suppliers, as well as longtime hydrogen flag-waver Toyota (representing the goals of the Japanese government) are keeping the conversation alive. As is the accelerated need to find not just zero emission solutions but also energy independence.

The European Union's Fit for 55 goal within its European Green Deal, calling for cuts in emissions by at least 55% by 2030, included the Hydrogen Accelerator. This has the target of using 20 million tonnes of renewable hydrogen in the EU by 2030, of which 10m would be produced in Europe. This would replace a quarter of Russian natural gas imports, the EU believes, and also help drive down costs of the greenest (and therefore most expensive to produce) hydrogen.

It will still need significant incentives applied before it reaches current diesel levels, a recent study by the International Council on Clean Transportation found. "The price of hydrogen fuel is the primary driver of the economic viability of fuel cell electric trucks," it concluded.

The other big accelerator is China's first long-term plan for hydrogen vehicles, unveiled in May, that calls for 50,000 FCEVs on the road by 2025, up from 8000 in 2020. When the Chinese state starts throwing its weight behind a technology, growth seems inevitable.

But then China is also leading the charge on swappable batteries and that right now is looking like the closest rival to hydrogen fuel cells, particularly in the taxi market, local buses, and municipal vehicles. It could even become a niche alternative for larger SUVs, following the lead of Chinese Tesla rival Nio. Then there's the pace of development of batteries themselves. More energy-dense batteries supporting more rapid charging could render fuel cells obsolete as the pace of electric vehicle and battery cell investment continues to far outpace that of fuel cells.

In the vehicle industry right now, where the rapid pace of development is being measured in dog years rather than human, it's difficult to call. But hydrogen is definitely going to be in the mix.