

**D**ubbed the 'diesel dupe' news that Volkswagen had been found cheating on emissions tests, by the US Environmental Protection Agency, has highlighted the struggle vehicle manufacturers face when it comes to meeting ever more stringent emissions targets.

Volkswagen is among a number of leading car manufacturers that had made a significant push in looking to sell diesel powered cars on the back of low emissions. In the UK, for example, lower vehicle tax for diesel cars was introduced in 2001 on the grounds that such vehicles were less polluting – a tax break that is still in place.

VW's admission that around 11million cars worldwide have been fitted with a 'defeat device' – software that appears to run the diesel engine at less than normal power and performance, then revert back to normal once back on the road – has placed automotive manufacturers in a difficult position and some analysts are talking about the 'death' of diesel.

### Abusing the rules?

Traditionally, diesel engines were valued for their dependability and limited consumption. Over the past 10 years, they have become significantly more powerful and efficient, or so it seemed.

A report from the Brussels based transport lobby group Transport and Environment has suggested that carmakers are 'abusing' testing rules, 'enabling cars to swallow more than 50% more fuel than is claimed'.

More damagingly, the report also suggests that nearly two thirds of the gains said to have been made on CO<sub>2</sub> emissions and fuel consumption since 2008 have been entirely 'theoretical'.

'Customers,' according to Dr Henri Winand, CEO of hydrogen fuel cell supplier Intelligent Energy, "no longer want to be attached to brands that are bad for the environment. Secondly, on a purely economic level, the status quo is not viable either."

# Honest energy

Will hybrid and electric vehicle manufacturers be able to benefit from the crisis engulfing Volkswagen? By Neil Tyler



**"The use of hydrogen in vehicles is becoming more popular, we have seen a remarkable acceleration of commercial traction over the last 12 to 18 months"**

Dr Henri Winand

Could the crisis around VW provide manufacturers of hybrid and electric vehicles with an opportunity to change the way in which the market operates?

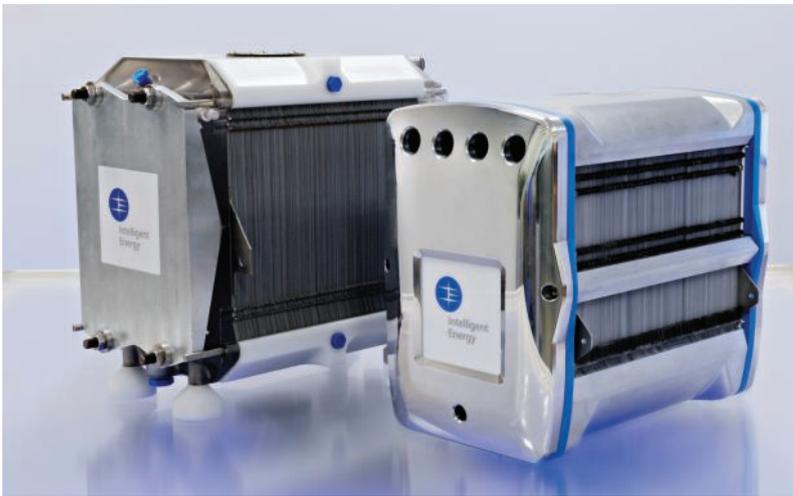
Dr Winand believes so. "This fresh motivation for an emissions reducing energy source may see the transition to hydrogen happening quicker than previously expected," he suggests. "At Intelligent Energy (IE), we have spent more than 20 years creating a portfolio of patents for zero tailpipe emission hydrogen fuel cells. Our business model is intended to help vehicle manufacturers access the technology they need to transition their vehicles into true zero tailpipe emission vehicles in a rapid and cost effective manner."

He suggests the recent trend of fuel cell electric vehicle products from mass market OEMs hitting the consumer market, such as those from Honda and Toyota, show many in the industry are working to see

the transition to true zero tailpipe emission mobility occur as quickly as possible.

"IE already works with nearly 25% of the large OEMs. They understand the importance of making these changes and investing in new technologies. We have the knowledge and expertise to help them bring fuel cell electric vehicles to market quicker and faster than if they worked on their own."

There are several types of fuel cells, including: polymer exchange membrane (PEMFC); solid oxide (SOFC); alkaline (AFC); molten-carbonate (MCFC); phosphoric acid (PAFC) and direct methanol (DMFC). But, when it comes to automotive fuel cells, the most popular is PEMFC – it has a high power density and a relatively low operating temperature (ranging from 60 to 80°C). A low operating temperature means the cell doesn't take so long to warm up and begin generating electricity.



Proponents of fuel cell technology argue that it is capable of converting chemical energy cleanly and efficiently from hydrogen rich fuels into electrical power and usable high quality heat in an electrochemical process.

However, it is a technology that is not without its critics. Elon Musk, CEO and product architect of Tesla motors, describes it as 'extremely silly' technology.

His concerns are primarily focused on the manufacture and storage of the gas, which he says is very inefficient.

Commenting at the Detroit Auto show earlier this year, Musk suggested 'the best case hydrogen fuel cell doesn't win against the current case battery' and that hydrogen's failings would become more obvious in the next few years.

According to Dr Winand, treating batteries and fuel cells as competing technologies is the wrong starting point.

### Think about the mix

"When we think about the future of energy, we need to really think about the mix – we do not need to favour one technology at the expense of others. Where does the power that goes into the batteries come from? Fuel cells and batteries are incredibly complementary, particularly when it comes to vehicles."

By attaching a hydrogen fuel cell

to a battery electric vehicle it is possible to nearly double its range – one of the greatest issues facing electric vehicle adoption.

"A fuel cell can charge a battery on the move and refuelling a hydrogen tank only takes a matter of minutes," says Dr Winand. "Hydrogen fuel cell technology could unlock the potential of electric vehicles, similar to, but much cleaner than, the hybrid revolution which brought electric/petrol vehicles to the market."

### Beyond automotive

While only a handful of automakers are unveiling models using fuel cells they have been providing power to a number of industrial sectors for several years.

The use of renewable sources of energy has resulted in growing demand for more energy storage, in order to overcome fluctuations in supply. The use of hydrogen as a storage solution is becoming a more practical solution as it is capable of bulk energy storage at the GWh level and smaller power modules can be scaled up to meet the power requirements of a very diverse range of products.

Fuel cell power systems which have been designed to be both modular and scalable are being used in a variety of off-grid applications such as wireless base stations, emergency communication systems, flight guidance systems as well as for surveillance and security.

Intelligent Energy recently announced that it is to supply energy-management services to more than 27,000 telecoms towers in India.

According to Dr Henri Winand, IE's CEO, "Our technology will help to bring a more stable, reliable power supply to these towers and will help to demonstrate the full power of hydrogen fuel."

Diesel generators are currently the main back-up power source, but tend to be costly, inefficient and emit high levels of CO<sub>2</sub>, NO<sub>x</sub> and a host of other harmful carcinogenic particulate emissions.

Over the term of the agreement, 70% of the managed telecom towers are expected to move from diesel power to hydrogen fuel cells.

The hydrogen fuel cell is much like a battery, comprised of a number of cells forming a stack. Each cell contains an anode, a cathode and an electrolyte layer. When a hydrogen-rich fuel – for example, clean natural gas or renewable biogas – is pumped into the fuel cell stack, it reacts with oxygen to produce electric current, heat and water. These fuel cells can work continuously, so long as fuel is supplied.

"The use of hydrogen in vehicles is becoming more popular," suggests Dr Winand. "With Hyundai and Toyota bringing vehicles to market, we have seen a remarkable acceleration of commercial traction over the last 12 to 18 months. We are seeing increased demand for access to best in class fuel cell technology."

### A long time coming

Electric vehicles have been a long time in the making, prompted by the wave of hybrid vehicles which have captured large swathes of the market.

Fuel cell electric vehicles have longer range than battery electric vehicles on their own and, unlike batteries, take just minutes to refuel. Many see hydrogen fuel cell electric vehicles as the answer to air quality and carbon emission conundrums that boggle policy makers worldwide.

Last year, the UK's hydrogen community was given a significant boost when business minister Matthew Hancock announced a fund consisting of up to £11m for the development of a hydrogen fuelling station infrastructure. The money was earmarked to help establish an initial network of up to 15 hydrogen refuelling stations, as well as to serve public sector hydrogen vehicles.

According to Dr Winand, this is just the start. "Toyota has set its sights on even greener electric vehicles – not a battery electric vehicle hybridised with a combustion engine, but an electric drive train combined with a hydrogen fuel cell.

"The result is a silent car of the future with zero-emissions at the tailpipe – but that future has already arrived."