



JAMES MAY'S PUB GUIDE TO POPULAR TECHNOLOGY

FREQUENTLY ASKED QUESTIONS DOWN THE RACK AND PINION REVEAL THE WONDERS OF THE MODERN WORLD

This month: the hydrogen fuel cell

1 I keep hearing about this thing. What is it?

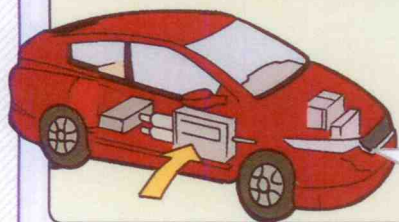


The hydrogen fuel cell is an electricity-generating device, powered by hydrogen (from a tank of some sort) and oxygen (taken from the atmosphere, unless you're on a spaceship, then that comes from a tank as well). It produces electricity on demand; i.e. when you press the accelerator in a fuel-cell car. As long as there is a supply of hydrogen and oxygen, it will operate. It won't go 'flat'.

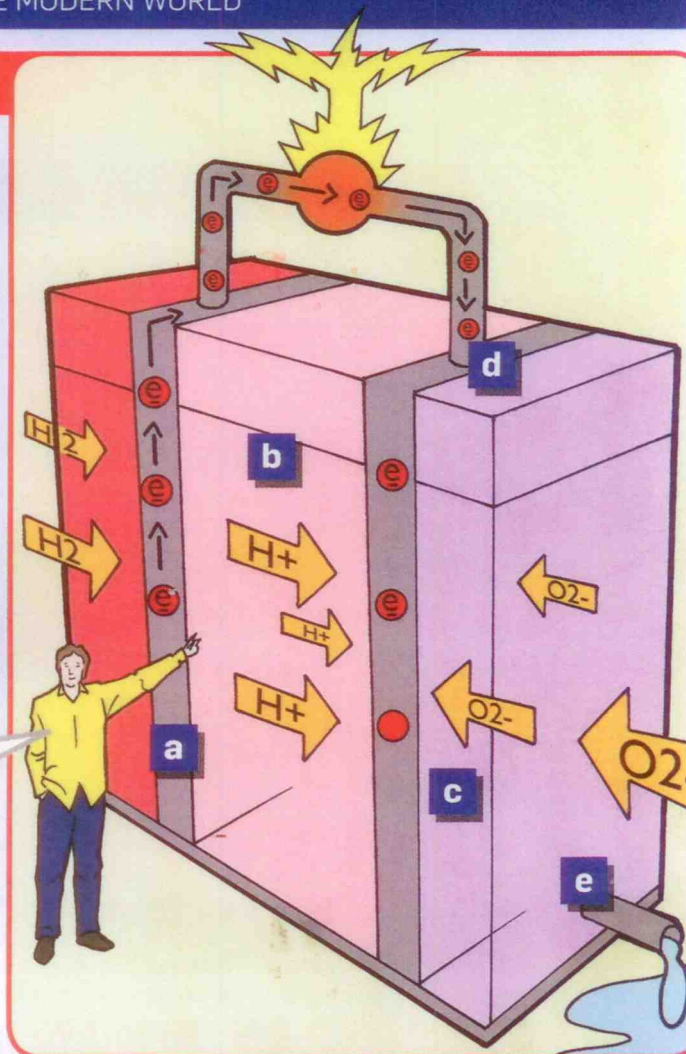
2 How does it work, then? Briefly, please...

- This is a bit like school chemistry lessons, but here goes. In the middle of the cell is something called a 'proton exchange membrane'. Hydrogen gas (H_2) is forced through the cell from one side, and a catalyst splits it into two hydrogen ions (positively charged) and two electrons (negative).
- The membrane is designed in such a way that the ions can pass through it, but the electrons can't.
- On the other side of the membrane, atmospheric oxygen (O_2) is split into two oxygen atoms, which have a negative charge. These attract the positive hydrogen ions, which come gambolling through the membrane in search of atomic intercourse.
- Meanwhile, the two negative hydrogen electrons need to find another way to the other side of the membrane. A wire is provided for this, and the flow of electrons through it produces a current.
- Once the work is done and everyone is at the party, they all pile in to produce water, which you will remember is H_2O . That's the 'exhaust'.

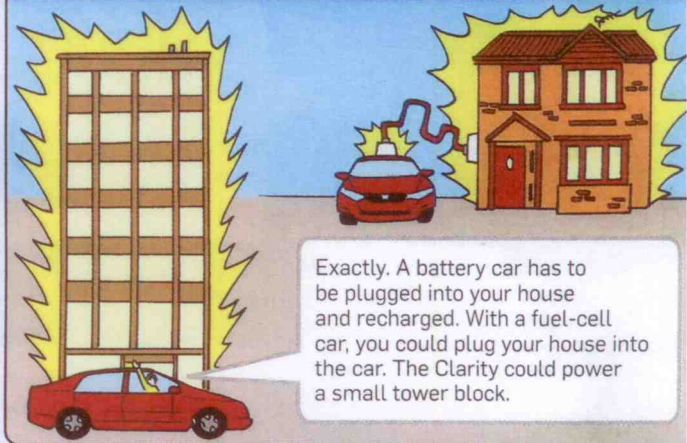
3 How much electricity do I get from all this?



Only a tiny bit, so cells are combined in what's properly called a *fuel-cell stack*. That's the weird-looking metal box you find in the Honda FCX Clarity. It produces 100 kilowatts.



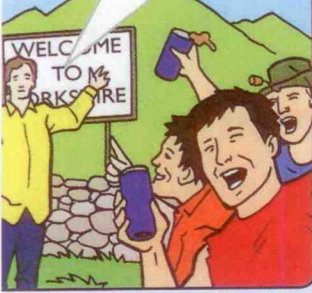
4 Wow! That's a lot of fan heaters. Mine's 2kW



Exactly. A battery car has to be plugged into your house and recharged. With a fuel-cell car, you could plug your house into the car. The Clarity could power a small tower block.

5 This all sounds a bit too good to be true

In a way it is. You don't get something for nothing with physics unfortunately. Hydrogen is the simplest and most abundant element in the universe, but, as with teenage gatecrashers, it always turns up with its mates. In water with oxygen, for example, or in oil with carbon. The fuel cell works because hydrogen doesn't like being left on its own. Extracting hydrogen, or 'cracking' it as the boffins say, is very energy-intensive.



6 Doesn't that defeat the point?



Proponents say not. Take natural energy, such as waterfalls or the wind or the tide or sunshine. They are quite difficult to exploit as they are, but if the energy of those were used to crack hydrogen, then that energy could be stored and used at will and anywhere in the world – in your car, on a space station, in the desert. This is why boffins refer to the fuel cell as an 'electrochemical energy conversion device'. Sorry.

7 What about hydrogen storage?

This is a bit tricky. As with the gas in your car's air-con, it likes to leak out. It also affects some metals and makes them brittle. It can be stored under pressure, as in the Clarity, or in special unpressurised canisters with complex internal sponges giving them massive surface areas. The latter may be the long-term solution.



8 Isn't hydrogen used to make atomic bombs?



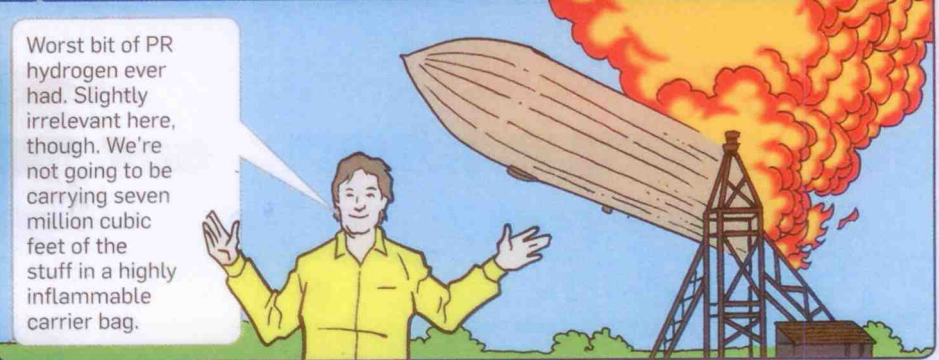
Yes, but only through the highly complicated process of nuclear fusion. Don't panic, that can't happen in a fuel cell.

9 It does go up with a bit of a bang though...



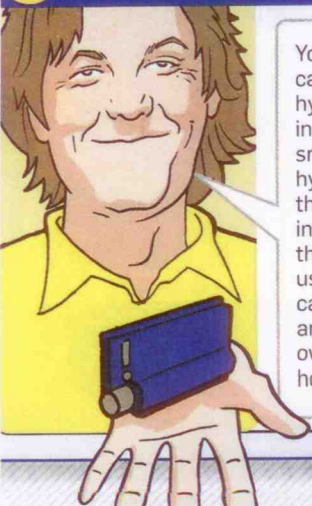
So does petrol, and you don't spend time worrying about that.

10 Is this the point where I mention the Hindenburg?



Worst bit of PR hydrogen ever had. Slightly irrelevant here, though. We're not going to be carrying seven million cubic feet of the stuff in a highly inflammable carrier bag.

11 When will I have a fuel cell in my life?



You could have one now. You can buy a solar-powered hydrogen extractor that sits in your garden. This produces small unpressurised canisters of hydrogen about the size of your thumb. These can be plugged into your pocket fuel cell (about the size of a paperback) and used to recharge your phone/camera/iPod/laptop. It works anywhere on the planet. It's your own little power station. See horizonfuelcell.com.

Is it cost-effective?

Not yet – to power a house, the set-up cost will be prohibitive. But, over time, costs will lower.

Has James earned a pint for this explanation?

YES

NO