Fuel cells and Intelligent Energy's Core

The Intelligent Energy **Core** is a PEM-type fuel cell – one of five different fuel cell types, all of which have different attributes in terms of size, robustness and ability to work at high temperatures.

The PEM (or Proton Exchange Membrane) fuel cell type is the most popular and appropriate type of fuel cell for automotive applications.

Simply put, each fuel cell is a multi-layered sandwich of plates and MEAs (Membrane Electrode Assemblies), in which the MEA acts as a catalyst during an electro-chemical reaction, producing water and electricity from hydrogen and oxygen.

The water by-product points to the usefulness of the technology in heat and power applications, such as the home.

The water by-product can be evaporated, drained or drunk, as it was, for example, by the astronauts of the Apollo missions. NASA were the first real users of fuel cell technology in the 1950s and 60s – a century after its first invention by Welsh lawyer Sir William Grove.

The Intelligent Energy **Core** fuel cell is a world beater, both in terms of volumetric power density and low parasitic loss. It is made from thin metal sheets, rather than the more common graphite plates, making it robust, compact and easier to manufacture.

This makes Intelligent Energy's fuel cell technology particularly attractive to the automotive industry, where space is always at a premium.

The design of the Core

'When it came to designing the casing for the Core', commented Seymourpowell's Nick Talbot, 'we decided to design it as a standalone project, giving this radical fuel cell its due as a beautiful, valuable and useful energy resource.

The **Core,** which can be detached completely from the bike, is therefore designed to create interest as an enigmatic object.

Although mostly encased in identical aluminium to the bike, of which it at first seems a completely integral part, the **Core** is also part-covered on one plane in a micro-etched, textured and durable shell, in a pattern derived from brain coral.

The pattern alludes to the fact that this is solid state technology – but is also functional, in that the intricate patterns also disperse heat. We wanted this to be a finer and more beautiful object than a diesel generator – and to make people look again at this new technology with a sense of wonder.'

env is a complete pre-production prototype motorbike, just as the 50kW powered light aircraft, developed by Intelligent Energy for partner Boeing was similarly a complete prototype in 2004.

Both vehicles demonstrate that Intelligent Energy's advanced fuel cells are completely ready for application to real vehicles in the here and now – as well as many exciting new vehicles in the future.

Two- and four-wheeled vehicles using 5kW and 10kW power are realistic next-step developments, for example, whilst Intelligent Energy's new 75kW fuel cell is the most compact cell around currently and the only one capable of starting in freezing conditions with no assistance.

env is lightweight, streamlined and aerodynamic. It boasts a performance that outreaches any existing electrical bike. In an urban or off-road environment, it can reach speeds of 50 mph. It is also virtually silent (with noise emissions equivalent to an everyday home computer) and its emissions are almost completely clean.

On a full tank, the **env** bike could be used continually for up to four hours without any need for re-fuelling. The bike can also be used by riders of any skill level with simple controls, via a throttle directly linked to the applied power.

The bike has no gears and is strictly defined as a motorbike, although it feels to riders more like a very quick and responsive mountain bike. '**env** is light, fast and fun', commented Seymourpowell director Nick Talbot.

'It has good ground clearance, great off-road suspension travel and a very carefully considered power to weight ratio. I have ridden motorbikes for years', he added, 'and, in the process of designing the bike, I have become a complete convert to fuel cell technology. The bike is usable, useful and great-looking. It was important on this project to demonstrate that new technologies don't have to be wrapped up in a dull product – engaging public imagination and enthusiasm is key.'

env has been produced in two monochromatic colourways: black supergloss and iridescent white. 'This was to express the bike's parallel natures', explained Nick Talbot. 'On the one hand, it expresses a utopian future vision of 'clean power, anywhere' - and on the other, it's an exciting, hard-edged bike and fun to ride.'

The bike's primary frame and swinging arm are made from hollow-cast aircraft grade aluminium. At the bike's heart is a fully–integrated 1kW fuel cell generator providing power on demand directly to the drive-train.

To enhance performance during peak power demand (ie when accelerating), the fuel cell is hybridised with a battery pack to provide a 6kW peak power to the motor.

The result is a balanced hybrid concept which combines the main advantages of Intelligent Energy's **Core** fuel cell, hydrogen storage and battery technology.

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Key components of the bike power system	
Motor	6kW, 48 VDC Brushed motor (model LEM-170, supplied by LMC ltd)
Motor controller	Brusa Direct Current (model MD 206)
Fuel cell	1kW Intelligent Energy air-cooled (2 x AC32-48)
Hydrogen storage	High pressure composite cylinder (Luxfer L65)
Hydrogen energy	2.4kWeh
Storage battery	4 x 12V Lead Acid (15Ahr) connected in series
Performance data	
Acceleration	0 – 20 mph in 4.3s (32kph)
	0 – 30 mph in 7.3s (48 kph)
	0 – 50 mph in 12.1s (80kph)
Top speed	50mph (80kph)
Range	At least 100 miles (160km)
Physical	
Bike mass	80 kg (Total mass including **Core**)
Fuel	
Hydrogen	99.9% purity
Oxygen	Taken from air
Hydrogen refuel time	Less than 5 minutes
Interface	
Electrical connection	Multi-core (Intelligent Energy specific)

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