Press release

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ENV – the world's first purpose–built fuel–cell motorbike comes to Monaco!

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ENV, the world's first purpose-built and fully-functioning hydrogen fuel cell motorbikes, are coming to Monaco! They're green, they're clean and they're utterly silent! The dynamic black and white prototype **ENV** bikes can be seen on the Intelligent Energy stand (number 204) at the EVS21 Symposium in Monaco from 2nd – 5th April 2005.

The **ENV** bike, designed by leading product designers Seymourpowell, was first launched by British energy know-how company Intelligent Energy at London's Design Museum on March 15th 2005. The bike has received a hugely positive response both from the British and the international media to date. Britain's leading motorbike publication, MotorCycleNews, said, for example *'this could be the most important new motorcycle ever'*, whilst national newspaper The Daily Telegraph called it *'the future of urban biking'* and The Daily Mirror added *'the only way to get more environmentally-friendly than this is to walk.'* The appearance of the bikes in Monaco is the first time they have been seen outside of the UK

The British government also heralded ENV's launch, with Tony Blair's Energy Minister, Mike O'Brien MP, sending this message:
'I congratulate Intelligent Energy on their fantastic achievement in building the world's first fuel cell motorbike. This is an important development in the designing and production of vehicles that do not emit carbon. This is truly a British success story of which Intelligent Energy and Seymourpowell can be justly proud and paves the way for further innovation in this exciting and important area.'

In the worldwide rush by the biggest names in the automotive and bike industry to bring hydrogen-powered vehicles to market, the hastily-assembled handful of prototypes and public launches to date have mostly (with the exception of Honda's recent fuel-cell scooter) paraded existing models, superficially adapted to fuel cell use.

The **ENV** bike is different. It offers an exhilarating glimpse of what can be achieved: a great-looking and exciting fuel-cell motorbike. *'In the none-too-distant future'*, commented **Intelligent Energy** CEO **Harry Bradbury**, '*people will be able to use a bike like ENV to leave work in an urban environment, drive to the countryside, detach the CORE and attach it to another vehicle, such as a motorboat, before going on to power a log cabin with the very same fuel cell, which could then be re-charged from a mini hydrogen creator, the size of a shoebox.'*

Intelligent Energy, with an expanding suite of technology platforms, is capable of producing every element of this scenario and is currently working on just such a hydrogen-creator, which will be able to produce hydrogen from future fuels such as bio-ethanol (derived, for example, from soya or sugar cane), offering consumers a tantalising vision of complete electrical self-sustainability. This vision is particularly compelling for remote communities and especially for the developing world, where large grids are simply not economically viable and where fuel cells offer both easy portability and power delivery at the point of consumption with no loss of efficiency.

The ENV bike

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 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 load 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.

'*With all the depressing news about climate change and geo-political unrest, many people look into the future with a sense of dread, or at best ambivalence,'* commented **Seymourpowell** co-founder **Richard Seymour** on the project*. 'Put simply, the future is painted by much of the media as a dark, dysfunctional place. But designers can't think like that. It's our job to face the future optimistically and projects like this point the way. Instead of being a 'worthy compromise', the ENV is a thrilling, handsome, ecologically-friendly slice of 'Optimistic Futurism'. I can't wait to own one myself*!

Fuel cell technology and the Intelligent Energy 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 uses metal rather than the more common graphite plates, making it easier to manufacture, more robust and, crucially, smaller as metal plates can be made more thinly than graphite plates. This makes the **CORE** 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 treated 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, say, 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.

'*The launch of ENV breaks new ground and opens up a whole new field of opportunities for low- and high-power fuel cell motorbikes*,' commented **Harry Bradbury**. '*ENV and its successors are good for the consumer and the environment. This is a fun vehicle with a realistic role to play in the leisure environment, as well as a role in emissions reduction from Boston to Bangkok. There has been much talk about low-carbon emission vehicles. Here is one at last.*'

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APPENDIX ONE: ENV technical specification and team credits

Key Components of the Bike Power System

Motor	6kW, 48 VDC Brush 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	50 mph (80kph)
	(note: **ENV** has been tested to 50mph – however, with further refinements and redevelopments, this top speed is expected to be exceeded)
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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Design and Supplier Team

Client	Intelligent Energy
Bike/Core Design	Seymourpowell
Bike/Core Identity	Pod Design
Frame & Swingarm	Caress Precision Products ltd
Engineering & Machining	D.B.C. Tools ltd
Body Work	Ogle Models and Prototypes ltd
Welding	GP Motorsports UK ltd
Motor	LMC ltd
Lighting	Marl International ltd
Machinings	JH Mays
Bicycle Parts	DMR / Upgrade
Batteries	PBQ Batteries

APPENDIX TWO: About Intelligent Energy

About Intelligent Energy:

Intelligent Energy is an energy solutions company, developing new energy technologies and creating and implementing power delivery services for its business partners, based on its world-leading PEM fuel cell technology.

The company has a proprietary suite of new energy technologies, focused on commercialising energy services in hydrogen generation, fuel storage and power generation using PEM fuel cells. **Intelligent Energy** is above all an intellectual property and know-how led business. Based in London and Loughborough (with subsidiaries in America and South Africa), the company is led by a world-class team, including: Sir John Jennings (Non-Exec Chairman), a former Chairman of Shell Transport and Trading ; Dr Harry Bradbury (CEO), a former global Energy Leader with Deloitte and Touche Solutions ; and Dr Paul Adcock (Head of Research and Development), who is the former Director of the Fuel Cell Group at Loughborough University.

Intelligent Energy is in fact made up from the entire team of experts of Loughborough University who specialised in fuel cell technology, giving it one of the largest and most experienced teams in the field throughout Europe, with collective intellectual property rights and know-how built up over a 12-year period. The company's many successes to date include a light aircraft, developed in partnership with **Boeing**, which is powered by a fuel cell. Boeing said that it had chosen the British fuel cell system because its performance, compared with weight and size, was better than that of its rivals. **Intelligent Energy** is now working on fuel cells which would provide ancillary power for commercial airliners.

The company's fuel cells are undergoing trials at more than a dozen sites, including schools and hospitals in South Africa, which plans to bring electricity to more than 4m homes that are currently without power.

Appendix THREE : About Seymourpowell

About Seymourpowell:

Seymourpowell celebrated its twentieth year in business in 2004 as one of the world's most celebrated product design consultancies. The company's client list features some of the most well-known brand names in the world, from Ford and Nokia to Jaguar, BMW, Minolta, Yamaha, Tefal, Hewlett-Packard and Casio.

The company's track record and longevity arises from its successful design of innovative consumer products for international markets. Clients can rely on a design approach based on 'out of the box' thinking, coupled with keenly commercial awareness of global market trends. The products the company has worked on - from cars, trains, mobile phones and bras to computers, irons, vibrators and helicopters - give it an unparalleled wealth of experience on which to draw.

Originally formed by Richard Seymour and Dick Powell, the company is now run by a 6-strong team of directors, with the founders joined by creative directors Nick Talbot, David Fisher and Adrian Caroen and financial director Russell Lloyd.

Seymourpowell has won many design awards over its 21-year history, from the BBC Design Awards to D&AD, ID, DBA and Minerva Awards. The company and its directors have also featured across a wide range of media from design and lifestyle magazines all over the world to national papers, radio and television, including the 1998 Channel 4 series 'Designs on your….', where Richard Seymour and Dick Powell worked with individual companies to produce innovative new products. The success of this short series led to a second Channel 4 six-part series in 2000 called 'Better by Design'.

APPENDIX FOUR: Fuel Cell Technology

Fuel cells provide point of consumption power generation, removing the costs and power losses associated with the transmission and distribution of electricity.

Fuel cells can be built incrementally to match demand and are equally efficient at both small and larger scale.

Fuel cells have higher energy conversion efficiencies than most other technologies: 45-55% of energy converted to electricity.

Fuel cells are capable of generating heat as well as power: in this combined heat and power mode (CHP mode), energy conversion efficiencies exceed 90%.

Fuel cells have dynamic load-following characteristics and can be built modularly for added reliability. They have none of the intermittency issues affecting wind and solar technologies.

Fuel cells are easy to maintain as they have no moving parts.

Fuel cells produce zero emissions if hydrogen is used as a feedstock, and significantly reduced emissions if hydrogen is produced from reformation of hydrocarbon feedstocks.

Fuel cells are modular. Effectively, you can keep adding to the sandwich up to an optimal configuration. At this point other stacks can simply be bolted on – and on and on! A fuel cell the size of a toaster could power a typical domestic UK home.

The USA wants to see hydrogen fuel cell cars on US roads by 2015 and has pledged to spend more than $1.5 bn (£900m) over five years to help develop the technology.

APPENDIX FIVE: The Hydrogen Economy

The real possibility of a hydrogen economy, as distinct from an oil economy, is getting ever closer.

Hydrogen is all around us – in air and water, for example, as well as being extractable from many other sources, such as bio-ethanol from sewage or sugar cane. However, hydrogen is not very easy to harness. Currently, hydrogen is most easily extracted from hydro-carbon fuels themselves, such as petrol, diesel, propane and natural gas. This is how hydrogen is currently produced for the **Intelligent Energy CORE.**

The future certainly lies in the use of omni fuel converters. However, even when using fossil fuels as a source, fuel cell technology achieves far higher utilisation levels than the internal combustion engine, where utilisation ratios are generally lower than 40% and can be as low as 20%, as large amounts of energy have to be used to create energy. As fuel cells have no moving parts and therefore do not need to use heat to create a reaction, they therefore have a much lower 'parasitic loss', with utilisation levels of 40-60% when producing electricity only and up to 90% when producing both heat and electricity. Crucially, fuel cells are also much cleaner. As fuel cells work according to an electro-chemical rather than combustion process, there are also much lower levels of emissions.

In the field of transportation, the real debate for the immediate future is whether or not to make vehicles with an on-board fuel supply or to create some kind of filling station plus on-board vehicle storage. There is currently a complete lack of fuel infrastructure for hydrogen-powered vehicles, which needs to be kick-started by public demand and/or political commitment to a cleaner future.

The real future success of the hydrogen economy will lie in achieving high performance at the lowest cost.

'*Oil reserves are forecast to be largely used up within 40 years and gas reserves within 80 years'*, commented **Intelligent Energy**'s **Harry Bradbury**. '*Hydrogen by comparison is the most plentiful element in the world, as well as being a clean, efficient fuel.'*

APPENDIX SIX: Quotes on fuel cell technology/sustainable energy

'*The problem of climate change means we must look to carbon-free technologies to meet our energy needs.'*
(Sir David King, UK Government's Chief Scientist, New Scientist, April 2004)

'*From factory-farmed chicken to old-growth lumber to gas-guzzling cars, many of the things we buy support destructive industries. But businesses, governments and concerned citizens can harness this same purchasing power to build markets for less-hazardous products, including fair-traded foods, green power and fuel-cell vehicles.'*
('State of the World 2004', Worldwatch Report)

'*When Thomas Edison set up his first heat-and-power co-generation plant near Wall Street more than 100 years ago, he thought the best way to meet customers' needs would be to set up networks of decentralised power plants in or near homes and offices…Now the wheel has come full circle*.'
(The Economist, 8th February 2004)

'Since the industrial revolution began in the 18th century, fossil fuels in the form of coal, oil and natural gas have powered the technology and transportation networks that drive society. But continuing to power the world from fossil fuels threatens our energy supply and puts enormous strains on the environment. The world's demand for energy is projected to double by 2050 in response to population growth and the industrialisa-tion of developing countries.'
(M I Hoffert et al, Nature 395, 891, 1988)

'If China and India rely heavily on antiquated technology to produce power from their plentiful local supplies of coal, they will surpass even the United States as the leading emitters of carbon dioxide within decades, negating any efforts by rich countries to curb global warming. Unless rich countries help poor ones leapfrog to greener technologies, the world could soon become a nastier place for everyone to live in.'
(The Economist, 8th Feburary 2001)

'The stone age did not end because the world ran out of stones, and the oil age will end long before the world runs out of oil.'
(Anon)