

FUEL CELL POWER

The magazine for the power source of the future



HEADLINE NEWS

The hydrogen mini-grid, incorporating a wind turbine, electrolyser, hydrogen storage and a fuel cell, will supply entirely renewable energy to the Environmental Energy Technology Centre in Yorkshire. This building will spearhead the development of the hydrogen infrastructure in the UK and Europe.

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BUILDING THE HYDROGEN INFRASTRUCTURE IN YORKSHIRE

Yorkshire, UK

The first commercial building in Europe fuelled solely by wind and “green” hydrogen power will have its own hydrogen mini-grid, incorporating an electrolyser and a fuel cell, and will present a vision of how buildings could be powered in the future. Rising energy costs, concerns over security of supply and the challenging target of 15% of all UK energy being delivered from renewable sources by 2020 highlight the pressure the renewable energy industry is under to develop innovative solutions for sustainable energy generation. Generating energy close to where it is needed and the intelligent management of that energy is critical to the UK’s energy mix.

The building will house the Environmental Energy Technology Centre (EETC) on the Advanced Manufacturing Park in Rotherham, South Yorkshire and will provide a base for businesses specialising in renewable or emerging energy industries. Energy consultants, TNEI, in partnership with the Pure Energy Centre, were appointed to create this pioneering energy development on behalf of the regional development agency, Yorkshire Forward, with funding from the European Union.

At the heart of the building’s design is its innovative power system which is currently under construction. The hydrogen mini-grid, based on a hydrogen fuel cell, will be the most technically advanced commercial fusion of renewable energy and state of the art hydrogen technology in Europe.

The energy generated by this installation will make the EETC one of the first truly carbon negative, fully operational commercial developments in the world and demonstrate the important role hydrogen has to play in providing a secure, reliable and renewable energy

supply for the UK. It is estimated that the hydrogen mini-grid system will generate over 500MWh of electrical energy per annum from an onsite VESTAS wind turbine. This electrical energy will be used to provide power to the EETC building and displace the use of electricity supplied by the local network operator. This will potentially save around 130 tonnes of CO2 every year.

SURPLUS ELECTRICITY STORED AS HYDROGEN

The excess electricity generated during periods of low demand will be used to produce hydrogen and will be made available for a range of uses, including transport fuel, or for use in research and development by companies occupying the centre. The hydrogen will be produced by a state-of-the-art high pressure alkaline electrolyser. This element of the design has been created by Pure Energy Centre specifically for use with renewably generated electricity and has a significantly longer lifespan than alternative, commercially available electrolysers. This is due to the innovative electrolyser construction that minimises electrode degradation caused by the high fluctuations in power supplied by a renewable energy device.

UK’S LARGEST STORE OF “GREEN” HYDROGEN

Once generated, the hydrogen from the electrolyser will be compressed from 30 bar to 420 bar for storage at high pressure in composite cylinders. This high pressure storage will allow the hydrogen to be used on site or easily sold or transported for use elsewhere.

Another commercial first will be the storage of significant quantities of high

pressure hydrogen on site, with over 200kg stored in purpose built cylinders, creating the biggest single store of "Green" hydrogen in the UK. Once the storage capacity is full any further excess electricity generated will be fed directly to the existing distribution network as "green" electricity.

The building is scheduled for completion early in 2009. In the next stage, TNEI and the Pure Energy Centre hope to enlist the help of the Department of Mechanical Engineering at the University of Leeds, to carry out a structured and comprehensive knowledge transfer programme, designed to build expertise within the Yorkshire region.

The focus of this knowledge transfer is the development of a pioneering control system that will optimise efficiency and enable Yorkshire Forward to derive maximum benefit from the renewable energy being generated on site.

All round control and simulation skills will be acquired through monitoring and controlling all energy input and output. This will enable the system to be used to its maximum potential whilst minimising energy losses.

BUILDING UP THE HYDROGEN INFRASTRUCTURE

The team will then explore the development potential and strategic opportunities for business partnerships in the hydrogen economy. The wider opportunities for hydrogen power are vast, but they have yet to be realized. Currently the development of the hydrogen economy is being held back because no hydrogen infrastructure exists within the UK to support pioneering developments like the Yorkshire Forward project.

TNEI and the Pure Energy Centre are hopeful that when the Yorkshire Forward project is up and running, visionaries in Government and industry will recognise its ground breaking potential and start to invest and

champion the developments that are so much needed to support what could be a burgeoning Hydrogen Economy.

Hydrogen production is scheduled to start in January 2009 and there will be open days for the public throughout the year. Operational data will become available in spring 2009 free of charge to those registering at www.hydrogen-yorkshire.co.uk

TESCO POWERS AHEAD WITH TNEI



Energy consultants, TNEI, have assessed the suitability of Tesco's network of 2,000 supermarkets and depots in the UK for wind turbines ranging from 6 kW upwards. Several units have already been deployed and the roll out of small vertical axis wind turbines is starting with an installation at Tesco in Newton Aycliffe, North East England. The turbine, supplied by Ropatec of Italy, is only about 30 ft high, a similar height to other street furniture, such as lamp posts, and is therefore less visually obtrusive. It is quieter and more responsive to the turbulent wind conditions experienced in urban areas. In the right conditions it has an energy output of 6kW, enough to power four houses. www.tnei.co.uk

UPS SYSTEMS SUPPLYING FUEL CELLS FOR A VARIETY OF APPLICATIONS

Berkshire, UK



"The Environmental Energy Technology Centre (EETC) in Yorkshire demonstrates how businesses can potentially be self-sufficient by using renewable energy" said Tom Sperrey, Managing Director of UPS Systems, which provided the hydrogen fuel cells for the Centre. "This project will prove to be important in the progression of hydrogen and fuel cell technology as viable alternative sources of energy" he added.

UPS Systems, based in Hungerford UK, already supplies total turnkey projects and standby power solutions for large-scale IT infrastructures. They provide a full range of fuel cell power solutions, including natural gas fuel cells delivering multi-megawatts of prime power. They implemented the UK's first two fuel cell based standby power systems at their offices in Hungerford and at Winton Capital Management in London. UPS is now installing a hydrogen fuel cell for the EETC which was commissioned by Yorkshire Forward. It is located on the Rotherham-Sheffield border and is designed to be an iconic zero-carbon building, with the aim of encouraging the development and commercialization of environmental energy technologies.

UPS Systems is providing the EETC with a 30kW power system comprising nine inverters, three 10kW PEM fuel cells, 240Ah batteries and supervisory software to control the system. These components will be installed and integrated with a Hydrogen Mini-Grid System that will then form an end-to-end renewable energy process to power the EETC's facilities. With sufficient wind, the Centre's turbine will generate enough electricity to power both the onsite facilities and an electrolyser that will, in turn, create hydrogen. The hydrogen will then be compressed and stored for later use, and any excess power will be fed back into the National Grid. During periods of low wind speed, the fuel cell will automatically activate, converting the stored hydrogen into electricity and ensuring a continuous supply of power to the EETC.

STORING HYDROGEN FOR VEHICLE REFUELLING AND ELECTRICITY GENERATION

Dr. Jason Stoyel, Technical Manager at energy consultants TNEI said "This will be the largest wind-to-hydrogen installation in the UK and the first to incorporate both the ability to dispense high pressure hydrogen for vehicle refuelling, as well as a fuel cell to generate electricity. UPS Systems' expertise in fuel cells is vital to the success of the project and will help make the EETC a truly carbon neutral facility." UPS Systems' experience of implementing hydrogen fuel cells covers sizing initial requirements and designing the most appropriate solution, including the fuel cell, fuel storage and matched uninterrupted power supply (UPS). They take responsibility for the planning, installation and support of the eventual solution. As the costs of air

pollution and emitting global warming gases rise, fuel cells, with their significantly lower maintenance costs are increasingly becoming economically viable alternatives.

The Government commissioned Stern Review pointed out that the decision to buy low-carbon products may mean slightly higher up-front capital costs (though these are falling rapidly) but lower expenditure over time.

UPS SYSTEMS JOINS LONDON HYDROGEN PARTNERSHIP

UPS Systems has joined the London Hydrogen Partnership and will help to promote hydrogen technology to improve energy security and air quality, reduce greenhouse gases and noise, and support London's green economy. Collaborative research published by fuel cell manufacturers shows that replacing a diesel generator with a 10kW fuel cell powered by renewable hydrogen could reduce CO2 emissions by approximately eight tonnes per 1,000 hours of operation.

The company will actively participate in the Partnership's working group for stationary applications, a sector in which it has considerable experience, having provided standby power solutions for IT, telecommunications and data centres in commercial and public sector organizations throughout London and elsewhere in the UK. "UPS Systems brings further real-world expertise in the commercial deployment of fuel cells to the Partnership," said Paul Medlicott, Director of the Westminster Consortium and vice chairman of the London Hydrogen Partnership. "Practical fuel cell applications like standby power are available today, and they help to create valuable awareness and increase public acceptance of hydrogen as an energy source. We look forward to working with UPS Systems to advance the deployment of fuel cell technology in the Capital."

Tom Sperrey, Managing Director of UPS, added "It's not just being a zero-emission energy source that makes fuel cells an attractive proposition. Their very small footprint, almost silent operation and potentially unlimited runtime mean that they have much to offer city-centre companies with limited office space, restrictions on noise and difficulties in obtaining planning permission for alternative standby power systems."

UPS SYSTEMS INSTALLS ITS FIRST METHANOL FUEL CELL

Until now UPS Systems' fuel cell deployments have mainly centred on the provision of standby power for IT or demonstrator projects where fuel cells have been integrated within renewable energy systems. In their latest project, fuel cells are the prime power in a remote monitoring application, which demonstrates the versatile nature of the technology. UPS Systems is supplying two methanol fuel cells to npower renewables for a portable wind monitoring application. Continuous power to the anemometry equipment is provided by two 12 volt gelled-electrolyte batteries and to ensure they are constantly re-charged, the system also comprises solar PV and two EFOY Pro 1600 methanol fuel cell modules. The fuel cells are lightweight and compact and require little maintenance. The batteries, fuel cells and methanol fuel for the project are all integrated within a secure, weatherproof casing and monitored by the company's proprietary remote monitoring system.

Stewart Kirby, Anemometry Analyst at npower renewables commented: "We chose to integrate fuel cells into the project because of their flexibility which allows the whole remote monitoring and power system to be portable. We need to be able to move the wind monitoring equipment quickly and easily between locations and the fuel cells allow us to do this." www.upssystems.uk.com

LONDON AND HYDROGEN FUEL CELLS

London, UK

CROYDON AND CAMDEN COUNCILS

In a bid to tackle pollution in London, a new zero-emission hydrogen fuel cell is providing clean temporary power at council events in Camden and Croydon, replacing traditional generators, which can be both dirty and noisy.



The hydrogen fuel cell powered a roadside vehicle emissions testing unit at its launch in London's City Hall.

The fuel is obtained from Camden's new hydrogen fuelling depot - the first local authority-owned hydrogen fuelling facility in the country. The project is funded by Transport for London and the two councils, and was the first ever competitive tender for a fuel cell system in the UK. The launch was part of the London Hydrogen Partnership (LHP) Hydrogen and Fuel Cells Showcase.

Camden Council's Executive Member for Environment, Cllr Chris Knight, said: "Camden Council is absolutely committed to taking our share of the responsibility for tackling climate change, improving air quality and improving the environment both globally and locally for future generations. We are really excited about this new technology which is a zero emission alternative to many of today's generators which can be dirtier and noisier than vehicles."

CHANCERY LANE AND THE BACON FUEL CELL

The theme for Camden's Car Free Day 2008 was Air Quality and Carbon Emissions. The event was held in conjunction with Westminster Council and the Chancery Lane Association Business Group, with support from Transport for London. Chancery Lane, a busy street for central London commuters, was closed to cars for a day to make way for a range of exhibits promoting alternative means of travel. The initiative was actively supported by the Colville Estate, which manages land in Chancery Lane.

Dr F T Bacon OBE, FRS, who developed the first practical hydrogen-oxygen fuel cell, was a direct descendant of Sir Nicholas Bacon, father of Sir Francis Bacon, the essayist and philosopher of science. In gratitude for his services to the State, Elizabeth I gave Sir Nicholas Bacon two fields in Chancery Lane which have remained in the family ever since. The land is now under present day office blocks and is managed by the Colville Estate.

F T Bacon began his work on the fuel cell in 1932, although the principle had been demonstrated by Sir William Grove in 1839 and other investigators subsequently experimented with various forms of fuel cell. Bacon initially experimented with Grove's use of activated platinum gauze with a sulphuric acid electrolyte, but quickly moved on to use activated nickel electrodes with an aqueous potassium hydroxide electrolyte. In January 1940, he moved to a laboratory at King's College London and there developed a double cell, with one unit for generating the hydrogen and oxygen gases and the other for the fuel cell proper. This could be reversed so that it acted as both an electrolyser and a fuel cell. Bacon undertook further development after the war at

Cambridge University. There the team developed electrodes with a much more stable interface and overcame problems of corrosion of the oxygen electrode by soaking the new nickel electrodes in lithium hydroxide solution. In 1959, with support from Marshall of Cambridge Ltd. (later Marshall Aerospace) a 5 kW forty-cell battery,

with an operating efficiency of 60%, was demonstrated publicly. The patents for the fuel cell were licensed by Pratt and Whitney as part of a successful bid to provide electrical power for the NASA Apollo Project to land a man on the Moon by the end of the 1960s

EMERGING CLEAN ENERGY MARKETS

Loughborough, UK



Intelligent Energy's hydrogen fuel cell motorcycle, the ENV, was the first vehicle to be refueled at the new hydrogen station at Loughborough University. Intelligent Energy will use the station as a refuelling point for its development programmes, as it looks to build and test fleets of hydrogen fuel cell vehicles. Loughborough University's ultimate goal is to transfer its own fleet of service vehicles over to hydrogen,

Other partners in the project include Cenex, Bryte Energy, Air Products and the East Midlands Development Agency (EMDA). The facility is one of a number of hydrogen refuelling stations being set up across the region by the British Midlands Hydrogen Forum.

Known as the 'Midlands Hydrogen Ring', the stations will be at the heart of the hydrogen fuelling infrastructure planned for the UK. Initially an external supplier will supply the hydrogen, but Loughborough University is investigating ways of creating its own renewable hydrogen on site.

GROWING OVERSEAS MARKETS

In accordance with Intelligent Energy's ongoing strategy of transition from technology to product development, the focus of its US operations will now centre on fuel cell based clean power systems for the portable, backup and combined heat and power (CHP) markets. Murali Arikara, head of US operations, said: "We believe that hydrogen fuel cells for distributed power generation will be good for customers, good for the environment and an enabler to increased energy security and that the US market will be amongst the first to adopt these game changing products." Intelligent Energy is also taking part in the World Future Energy Summit in Abu Dhabi, which is organised and hosted by Masdar, the Abu Dhabi Future Energy Company. www.intelligent-energy.com

BRITISH FIRM OFFERS LORDS AN ENERGY SOLUTION

The House of Lords' Select Committee on Economic Affairs has called on the Government to urgently encourage more research and development into energy storage technologies. "Cost-effective storage of electricity from renewable sources is a critical stumbling block to the wider use of clean power in the future," says the report entitled *The Economics of Renewable Energy*.

ITM Power says that it has already developed the solution – their hydrogen fuel cell systems store intermittent energy from renewable sources, and they have invited members of the committee to visit their Sheffield factory for a demonstration of the new technology. ITM Power converts electricity produced by wind, wave or solar power into hydrogen using their patented electrolyser technology and then stores the hydrogen. Once stored, in the same way as natural gas, the hydrogen can be used as a CO₂ - free fuel to power generators or to burn in internal combustion engines. Alternatively the hydrogen can be converted back again into electricity using fuel cell technology.

SPOTLIGHT ON ENERGY STORAGE

Jim Heathcote, CEO of ITM Power, said: "This report puts the spotlight on the urgent need for energy storage, an area where ITM Power has developed skills and expertise, particularly in the use of hydrogen to form a 'buffer' storage facility for fuel. This incisive report is also welcome because it explodes several myths – mainly that wind farms alone can be the salvation of our energy problems and that biofuels are the 'green' way forward for transport."

The House of Lords report examines the viability of increasing the UK's use of renewable energy from the current 1.8% to 15% by 2020. One of the main conclusions is that wind power is intermittent and inefficient, even though it is likely to become Britain's largest source of renewable energy. The report says: "Matching electricity supply to demand is challenging as it is not presently economic, or technically feasible, to store electricity on a large scale. Electricity can be stored in batteries for portable applications but their costs are too high for use in the national electricity grid. Electricity generation must be matched to demand on a minute-by-minute basis or power cuts result. Some power plants are therefore kept running at less than full load to respond rapidly to a sudden increase in demand or to make up for a power plant failure elsewhere in the system."

The Select Committee's report concludes: "A breakthrough in cost-effective electricity storage technology would help solve the problem of intermittency and remove a major stumbling block to wider use of renewable energy in the longer term. However, no evidence we received persuaded us that advances in storage technology would become available in time materially to affect the UK's generating requirements up to 2020. We recommend that the Government should as a matter of urgency encourage more research, development and demonstration in energy storage technologies. We call on the Government to look afresh at the UK's research effort into renewables and to consider what more might be done, in a global context, to promote more, and more focused research across a range of technologies leading to new, effective and economical ways to reduce carbon emissions."

LIB DEM LEADERS SEE ITM'S HYDROGEN STORAGE SOLUTION

Sheffield, UK



Liberal Democrat leader Nick Clegg MP viewed ITM's hydrogen powered car along with (left to right) Party Shadow Chancellor Vince Cable MP, Sheffield City Council leader Paul Scriven and Jim Heathcote, CEO of ITM Power.

At ITM Power's Sheffield factory they drove a Ford Focus converted to run on hydrogen and toured a home demonstration suite where everything from a cooker to a television runs on power produced cleanly from hydrogen.

The MPs also saw ITM Power's Home Refuelling Station which allows householders to produce hydrogen, which in turn can be used to produce clean electricity, and be self-sufficient and independent of the national grid.

Hydrogen produces no harmful emissions when burnt and ITM Power has recently started pilot production of the home refuelling stations at its factory in Sheffield. Nick Clegg MP said: "We have seen some remarkable technology today, and it's great that a British company is doing it. ITM Power would appear to have some of the answers to help us address both climate change and our dependence on fossil fuels." Vince Cable was equally impressed. He added: "What we have seen demonstrated today is a vision of what could become a

reality for millions of householders and drivers."

Jim Heathcote, ITM Power's CEO, said: "We are pleased that these very busy politicians took the time to see what we are doing and they showed a genuine interest. Only a few days ago the Government announced higher targets to cut greenhouse gases by 2050. What we have developed is a series of practical products that will significantly help to reduce greenhouse emissions and could help the Government realise these tougher targets." www.itm-power.com

FUEL CELL POWER MEMBERS VISIT THE FUTURE IN ITM'S HYDROGEN HOME!

Daphne Vivian-Neal and Jean Aldous of Fuel Cell Power were struck by the sight of the solar panels when they visited ITM's apartment, where everything, even the cooker, is powered by hydrogen. The words 'fuel cells' have been familiar to Daphne for most of her life, as she is the daughter of the late Dr F. T. Bacon, who started his development of the first practical working fuel cell in the north of England in 1932.

ITM Power believes that in the current energy crisis, individuals as well as governments will have to seek secure energy supplies from sustainable sources. Solar photovoltaic systems are becoming increasingly economic and ITM's technology will enable solar energy to be stored as hydrogen, so that electricity can be generated when required to power the home or vehicles.

FUEL CELLS COULD REDUCE CO₂ EMISSIONS AND ENHANCE ENERGY SECURITY

The Climate Change Act 2008 commits the UK to reducing carbon dioxide emissions by 80% by 2050, compared with 1990 levels. The widespread deployment of fuel cells could conserve energy and reduce CO₂ emissions but they have to compete with established technologies which are not covering their full costs. Any new technology costs more until technical maturity is achieved and economies of scale apply. The EU Emissions Trading Scheme (ETS) is meant to 'make the polluter pay' so that low carbon technologies would be more competitive, but in the current employment crisis, energy users are being allocated most of their entitlement to emit CO₂ free, in case existing production and jobs move outside Europe. If governments cannot charge polluters, the alternative is to make an allowance for non polluting technologies, such as fuel cells. In Germany the government contributes up to €1550 per kilowatt (kW) and in America the Investment Tax Credit has been increased to \$3,000/kW.

FORESIGHT REPORT ON POWERING OUR LIVES

Moves towards sustainable energy in the UK are being hampered by old ways of thinking, according to a major new report by Foresight, the Government's futures think tank. The UK is entering a period of energy transition. The main forces driving change are a growing consensus about the scale and importance of climate change, and the need to ensure secure energy supplies for the UK in the face of rising global demand. The Foresight report concludes that key strategic challenges include overcoming the "lock-in" to current centralised systems and enabling

greater activity at a wider range of scales.

Purposeful and strong action from government is required to overcome lock-in and open up the energy system to experimentation and new ideas. Investment in information and communications technologies (ICT) and data management could revolutionise current perceptions of the kinds of energy systems which are considered to be desirable and feasible, especially if coupled with breakthroughs in energy storage technology. Targets for large reductions in carbon emissions, coupled with other specific goals, such as the expansion of renewable energy, are likely to require the deployment of energy systems at a range of more decentralised scales - from urban Combined Heat and Power systems to renewable heating systems in households.

The costs of decentralised options can appear to be prohibitive, because economic appraisal techniques do not consider how these options might 'measure up' in a radically different future energy system; the long term costs and risks associated with incremental change to the current centralised system are not assessed for comparison.

Professor John Beddington, the Government's Chief Scientific Adviser and Director of the Foresight Programme, said that urgent action needs to be taken if we are going to meet the 80% emissions target specified in the Climate Change Act. www.foresight.gov.uk

CBI'S ACTION PLAN

According to the Confederation of British Industry (CBI), the next two or three years will be critical. A much greater sense of urgency is required if the UK is to meet its targets for reducing greenhouse gas emissions at an affordable cost, and to establish an international leadership role in the low carbon economy of the future. Many of the technologies and solutions that will be required already exist but are not yet commercially viable. The pace and scale of implementation must now be accelerated. The UK has a unique opportunity to prosper in key markets of the future by taking a lead in the development of low carbon technologies and services in power, buildings, transport and industry.

The CBI has set up a task force which is working with Government to co-ordinate and manage the implementation of emission saving projects and to improve the effectiveness of spending on R&D of new technologies. There are five key areas in which small companies could be involved, commercial buildings, renewable electricity, renewable road transport fuels, domestic energy efficiency and housing.

The task force is pledged to develop new products and services that will enable all households in the UK to cut their emissions in half by 2020. Many people do not invest in cost effective ways of saving energy and reducing emissions because for them the payback time is too long, so it is important that we look for creative ways to bridge this timing gap. We need a new policy framework in which government, business and consumers can work together towards a shared national objective. www.cbi.org

US FEDERAL INVESTMENT TAX CREDIT EXTENSION

Fuel Cell Energy Inc. expects that the extension of the federal Investment Tax Credit (ITC) through 2016 and its increase to \$3,000 per kilowatt (kW) will

spur the sales of its highly efficient, ultra clean fuel cell power plants.

The ITC was originally part of the U.S. Energy Policy Act of 2005, enacted to encourage the installation of non-traditional energy sources in the U.S. to increase the amount of green electricity the country produces. The ITC extension was signed into law by the President on October 3, 2008. Customers purchasing fuel cells can now receive a credit of either \$3,000 per kilowatt or 30% of the capital cost, whichever is lower, an increase from the prior ITC of \$1,000 per kilowatt or 30% of the capital cost. Additionally, utilities are now entitled to utilize the ITC when purchasing fuel cells.

FuelCell Energy power plants are an ideal part of the clean energy solution because they provide reliable, baseload power 24 hours a day, with near-zero emissions and low CO₂. Because of their quiet operation, low profile and siting flexibility, fuel cells can be located in grid constrained areas. Distributed generation fuel cells can be economical compared to the cost of building new large central generation power plants and associated transmission and distribution.

FuelCell Energy's Direct FuelCells (DFC)[®] are powered by a variety of fuels, including renewable wastewater gas, biogas from beer and food processing as well as natural gas and other hydrocarbon fuels. DFC power plants stretch existing fuel supplies with their highly efficient operation - creating more clean power from the same amount of fuel than any other source of distributed generation in their size range. DFC convert fuel electrochemically into electricity, water and heat with an electrical efficiency of 47 percent compared to 30-35 percent for legacy combustion systems. Combined heat and power applications, where the heat is captured and used, result in an overall energy efficiency of up to 80 percent. www.fce.com

FUEL CELL COMPANY GROWTH ACCELERATES

Karlskoga, Sweden

HELPING LONDON TO BEAT AIR POLLUTION

Morphic Technologies AB and its subsidiary companies, Helbio, Exergy Fuel Cells and Cell Impact AB are making rapid progress in a variety of markets for fuel cells and renewable energy technologies. Exergy Fuel Cells has been chosen as one of two companies that will be delivering fuel cells to an ongoing infrastructure project in London. The project is aimed at equipping temporary power installations in street environments with fuel cells, thus helping to cut pollution and noise levels. London, like many large global cities, has a problem with air quality. Levels of air pollution have exceeded the limits laid down by the EU for many years, and the capital now faces the prospect of penalties unless something is done.

A large number of projects have been initiated to improve London's air quality and achieve long-term environmental improvements. In the boroughs of Camden and Croydon, the local authorities have been conducting projects since 2006 aimed at equipping temporary power installations with fuel cells. A fuel cell system was also used to power mobile vehicle emissions monitoring equipment outside London City Hall last October. The hydrogen for the fuel cell is obtained from a local transport depot in Camden, near the new Kings Cross international Eurostar terminal. The first fuel cell generator is powered by a 5 kW PEM fuel cell, from the US manufacturer Plug Power, and the second will be equipped with two 1 kW PEM fuel cell systems from Exergy Fuel Cells.

Omoniyi Giwa, Program Manager at Transport for London, said "The projects have several objectives. One is to completely eliminate pollution

and noise from this type of generator. Another is to raise awareness about alternative sources of energy in general, and particularly hydrogen. We will also be actively sharing our knowledge with other authorities that want to introduce similar technology." Jonas Eklind, of Morphic Technologies, added: "We are very pleased to be delivering fuel cells to this project. It points to the acceptance of the technology and shows that hydrogen can be used as an energy carrier in urban environments."

METHANE FROM SEWAGE POWERS FUEL CELL

The system developed by Morphic Technologies and its subsidiary companies, Helbio and Exergy Fuel Cells, for converting biogas from sewage into electricity and heat has been successfully installed, calibrated and tested. It was delivered last summer to Patras Municipal Corporation for Water Supply and Waste Water Management.

Purified biogas is extracted directly from sewage, and converted into hydrogen by Helbio's unique reformer. It is then fed to a fuel cell manufactured by Exergy Fuel Cells in Bologna.

The system produces 20 kW of electrical energy and 25 kW of heat. The unique feature of the concept, which was verified in the pilot system, is that the hydrogen generated is sufficiently pure to run a fuel cell, without contaminating the membranes and catalyst. The carbon monoxide content of the hydrogen must be less than 50 ppm (parts per million) and Helbio's biogas reformer has been shown to achieve a purity of 1.5 ppm, which is exceptionally good.



"These impressive test results open up the possibility of offering these types of energy systems to the global market," said Martin Valfridsson, CEO of Morphic Technologies. "I am very pleased that we are already seeing the fruits of the partnerships among our specialized subsidiaries. Sewage treatment is just one area where the reformer-fuel cell system combination can be put to direct use. Incineration plants, refuse stations, industries and agriculture are other prioritized areas.

Professor Xenophon Verykios, CEO of Helbio, was very pleased with the system's performance. "As far as we know" he said, "this is the first time a biogas system with a reformer and fuel cell has been demonstrated in practice. The next step will be to offer products with higher outputs – 125 kW and 250 kW fuel cells – in partnership with Exergy Fuel Cells."

INCREASING FUEL CELL EFFICIENCY

Morphic has developed a patented technology for manufacturing key fuel cell components that are significantly less expensive, faster and more efficient than has previously been possible. The test centre of their subsidiary company, Morphic Impact in Tokyo, has received a further order for test and verification platforms from one of the world's largest automotive manufacturers. The platforms will be used to test and optimize nine types of

fuel cell flow plates for use in the fuel cell systems of different end products. Morphic's patented technology enables more efficient forming of metals than with conventional production methods and can increase the efficiency of the fuel cell without increasing its external measurements.

Morphic has also received its first test order from a European supplier to the automotive and aircraft industries in a major fuel cell project. With virtually no impact on the environment and superior energy efficiency, fuel cells have the potential to replace many currently existing energy systems. Potential application areas for fuel cells include propulsion systems for cars and buses, laptops, cameras and other portable electronics, electrical generators, and military applications.

AGREEMENT WITH SAAB

Saab is seeking to offer industrial expansion in the fields of environmental and energy technology in connection with its worldwide sales activities. Morphic is currently embarking on a broad commercialization of its products in wind power, biogas systems and fuel cells, and is looking to conclude partnerships with major industrial players in order to rapidly increase sales of its new products. Saab and Morphic see good opportunities for synergies in several countries, and have therefore initiated a partnership to evaluate these.

ONE OF FASTEST GROWING TECHNOLOGY COMPANIES!

In view of the speed and diversity of successful developments undertaken by Morphic and its subsidiaries, it is not surprising that the Company received first prize in Deloitte's ranking of the fastest growing technology companies in Sweden! Morphic was also named Number 4 in the 2008 Deloitte ranking of the 500 fastest growing technology companies in Europe, the Middle East and Africa. www.morphic.se

NEWS

4.8 MEGAWATT POWER PLANT FOR KOREA

Anyang, Korea

UTC Power, a United Technologies company, has supplied 12 of their 400 kW fuel cell systems to Samsung Everland for installation at a GS Power plant in the Town of Anyang, just outside Seoul. GS Power will use the electricity from the fuel cells to provide power for about 5 percent of Anyang's population, with 40,000 megawatt hours total annual power output expected. The 4.8-megawatt plant will be operational in September of 2009 and will be one of the largest fuel cell installations in the world. Robin Park, Samsung Everland President and Chief Executive Officer said: "With the prolonged effects of high and unstable oil prices on businesses and heightened environmental concerns and regulations worldwide, I am certain more businesses will show interest in renewable energy and other clean energy initiatives such as fuel cells." Earlier this year, UTC Power was selected by the New York Power Authority to provide 12 of the same PureCell® Model 400 units for the Freedom Tower and three other new towers under construction at the World Trade Center site in New York. www.utcpower.com

10,000TH PORTABLE FUEL CELL DELIVERED!

Germany

SFC Smart Fuel Cell, a world leading supplier of portable fuel cells based on direct methanol fuel cell technology (DMFC) has celebrated the delivery of its 10,000th EFOY fuel cell to a motor

home owner in France. SFC also supplies the EFOY Pro fuel cell series for professional industrial users. This series has models with charging capacity ranging from 600 to 1600Wh per day and meets the demanding requirements of many off-grid industrial systems, including security cameras, measuring and early warning sensors and traffic systems.

The EFOY Pro fuel cell kit can also be retrofitted into an electric vehicle. Two fuel cells fuelled by two cartridges continuously and automatically charge the batteries when required, giving extended driving range. SFC has created a convenient fuel cartridge supply infrastructure.

SFC and their U.S. technology partner, Dupont, won the first prize of \$1 million in the U.S. Defense Department's Wearable Power Prize Competition.



From Left: Dennis Kountz, DuPont; Christian Böhm and Dr. Peter Podesser, SFC; Undersecretary of Defense John J. Young-Jr.; Sevilay Kaya, SFC; Mark S. Baunchalk, DuPont; Christoph Sonntag, SFC.

A portable hybrid battery/fuel cell system integrating SFC technology was also awarded third prize. Under rigorous test conditions, and with 170 competitors, four of the top five winners employed fuel cells. www.sfc.com

UK'S FIRST RENEWABLE HYDROGEN RESEARCH CENTRE IN WALES

South Wales, UK

A Renewable Hydrogen Research and Demonstration Centre has been opened by Wales' First Minister, Rhodri Morgan, at the University of Glamorgan, Baglan Energy Park, South Wales. The Centre will demonstrate the viability of producing hydrogen from a range of indigenous, renewable energy sources and evaluate the benefits of using hydrogen as an energy storage medium. UPS Systems plc designed and installed a 10 kW PEM fuel cell system, including inverters, an electrolyser and a controller unit, with supervisory software that manages the system. The electrolyser will produce hydrogen using power from the different renewable sources and, when it has been compressed and stored, the hydrogen will supply the fuel cell to power parts of the Centre.

HYDROGEN VIABLE TODAY

Professor Dennis Hawkes, one of the team developing the project on behalf of the University, said "Until now, many have seen hydrogen fuel cells as 'technology of the future'. In reality it is a viable solution for many applications today, offering clean power - the only emissions being water and heat - and a genuine alternative to diesel generators." The fuel cell will be demonstrating an alternative energy source, providing a solution that is quiet, clean, low-maintenance and reliable, whilst helping to reduce the Centre's overall carbon footprint. UPS Systems Managing Director, Tom Sperrey, commented, "The Renewable Hydrogen Research and Demonstration Centre will bring together technology and expertise, demonstrating hydrogen fuel cells as a reliable and effective medium of both prime and backup power."

PRODUCING THE HYDROGEN

The University of Glamorgan is examining a range of large and small scale processes whereby hydrogen can be produced from renewable energy sources. Electrolysis of water to hydrogen is a mature technology, which could be coupled to hydrogen storage to help overcome the intermittency of solar, marine and wind power. Hydrogen can also be produced from dry biomass by combustion technologies, or from wet biomass by fermentation, but these technologies are currently at the development stage.

There is world-wide interest in developing the process for dark fermentation of food industry co-products and crops rich in carbohydrates, in order to produce hydrogen. This process uses well-known reactor technology, but the biological aspects must first be studied in order to establish the conditions which allow stable operation of the hydrogen reactor and maximise hydrogen yield. The University is also investigating biohydrogen production from sewage sludge, in collaboration with a major utility company, RWE Thames Water. Pilot scale work is commencing to investigate the feasibility of sustainable hydrogen production from starch industry co-products, in collaboration with Rank Hovis and Hydrogen Solar. As part of the UK Engineering and Physical Sciences Research Council's SUPERGEN programme they are investigating the fermentative production of hydrogen from energy crops, such as perennial rye grass, sugar beets and fodder maize. In conjunction with other UK Research Councils, they are evaluating the potential for biomass supply chains in the UK for such technology.

AWARENESS RAISING EVENTS



The first in a series of awareness-raising events to be held at the University of Glamorgan's newly opened Hydrogen Centre was a demonstration of hydrogen powered fork lift trucks. Fork lift trucks are either diesel or, when used in an enclosed space, are usually

battery powered. The replacement of the battery by a hydrogen fuel cell gives several advantages, charging time is reduced, there is no need for a battery room hence more space in the warehouse, there is no need for specialist staff for refuelling, and there are longer periods at full power. The payback time for such a machine can be around two and a half years. Delegates gathered to hear speakers from the University of Glamorgan, the fuel cell manufacturers Ballard and Hydrogenics, Air Liquide and International Business Wales, who part-sponsored the event. Other events in the future may include themes relating to hydrogen powered uninterrupted power supplies, hydrogen powered remote equipment and hydrogen vehicles. www.glam.ac.uk

EVENTS

25th March 2009, Building the Hydrogen & Fuel Cells Future, International Conference, Birmingham. The conference outlines strategies to achieve the Hydrogen Fuel Cell economy. www.climate-change-solutions.co.uk

21st - 24th April 2009, Hannover Fair, Germany International exhibition including fuel cells and World Energy Dialogue. www.hannovermesse.de

20th - 21st May 2009, ALL-ENERGY 2009, Aberdeen, Scotland International conference and exhibition on renewable energy, hydrogen and fuel cells. www.all-energy.co.uk

31st May - 3rd June 2009, HFC2009, International Conference and Exhibition Canada. www.hfc2009.com

22nd - 24th September 2009, 11th Grove Fuel Cell Symposium, Building on Fuel Cells, Queen Elizabeth II Conference Centre, London, UK. In order to meet their carbon emission commitments, governments are now beginning to introduce legislation in order to stimulate a market for clean and renewable technologies. This has the potential to dramatically change the nature of fuel cell markets. The Symposium will address this changing world and its potential impact upon the fuel cell industry. www.grovesfuelcell.com

Fuel Cell Power provides information about all types of fuel cells. It has been set up by the family and friends of the late Dr. F. T. Bacon, OBE, FRS, the fuel cell pioneer who was concerned about the effects of discharging the by-products of combustion into the atmosphere.

Information can be obtained from:
Fuel Cell Power, The Gallery, The Street, Woolpit, Suffolk, IP30 9QG.
Telephone : 01359 245073

www.hydrogen.co.uk www.futureenergies.com www.fuelcellpower.co.uk