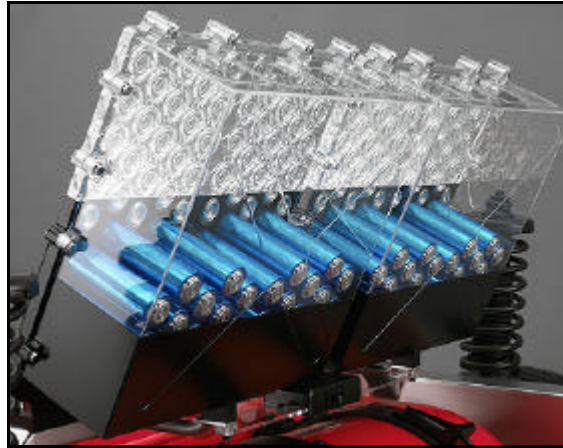


FUEL CELL POWER

The magazine for the power source of the future



HEADLINE NEWS

The use of fuel cells for micro-generation could halve demand for fossil fuels used for heat and power in buildings. Hydrogen fuel cell systems would also add value to micro wind and solar generators by storing surplus energy and providing power when required in buildings or for transport. Fuel cell micro-generation systems could provide a cost effective means for governments to ensure future energy security and to reduce CO₂ emissions

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SCOTLAND'S HYDROGEN FUTURE

Aberdeen, UK

WHERE WILL HYDROGEN COME FROM?

Representatives from Scotland and overseas gave a variety of presentations on the future of hydrogen and fuel cells at the H208 conference. Some speakers envisaged that hydrogen will be produced locally from small scale wind, solar or biomass sources and others saw a future with large scale transmission of hydrogen around the globe. Marco Rossetti of Air Products explained that at present most hydrogen is produced from natural gas for industrial applications, but it will in future be produced increasingly from greener feedstocks or else the CO₂ will be sequestered.

Air Products is participating in the development of many greener hydrogen activities and Scotland has a wealth of resources which will enable it to be at the forefront of a renewable hydrogen economy. His company has more than 60 hydrogen production and processing facilities in several countries and they have built over 70 hydrogen refuelling stations. They are obtaining hydrogen from the Hercules photovoltaic project in Spain and from wind farms, as well as biogas from a variety of sources, such as landfill gas, waste materials including plastics, agricultural wastes and vegetable oils. In the UK, Air Products is providing a green hydrogen supply for five micro-cabs at Birmingham University and will supply it for ten new buses in London. In Scotland, they will supply hydrogen storage, a hydrogen fuelling station and cylinder filling capability for Phase 2 of the Hebridean Hydrogen Park in Stornoway, Isle of Lewis.

SCOTTISH HYDROGEN AND FUEL CELL PROJECTS

The objective of the Hebridean Hydrogen Park is to encourage the development of a hydrogen economy

with local and export hydrogen markets. They will store surplus renewable electricity as hydrogen to power i.c. engine or fuel cell vehicles, and build up by 2012 to provide heat and power for homes, industry and marine vessels.

In Fife Energy Park, an 11,000 sq ft energy efficient building, with a hydrogen fuel cell CHP system, is being constructed to house the Hydrogen Office. The objective of the Hydrogen Office is to facilitate the development of renewable, hydrogen and fuel cell technologies as a hedge against future energy cost increases and in order to lower CO₂ emissions and reduce dependence on imported energy.

Berwickshire Housing Association is installing an innovative prototype fuel cell CHP system designed by ReGenTech in one of its houses. Power will be supplied by 5.76kWp (kilowatts peak) solar panels and a 6kW wind turbine on a 9 metre tower. The hydrogen will be stored at 18.5 bar pressure in two 4600 litre underground vessels, which will provide 250kWh (kilowatt hours) total storage.

REPLICATING PROJECTS

Dr Mary Gillie of ea technology outlined the project she is undertaking on behalf of the International Energy Agency, the IEA Hydrogen Implementing Agreement Task 18. They are collating information about hydrogen projects and plan to replicate them globally. Of the ten leading industrial nations, Germany has the most companies developing hydrogen projects, followed by Spain, Japan, Canada and Denmark. The UK, with little Government support, has relatively few companies involved.

FRONT COVER *fuel cell stack photo courtesy of Honda*

The efficiency and effectiveness of various methods of Government support are assessed. The economics are not yet sufficient to justify H2 but other benefits may tip the balance. The objective of Task 18 is to move hydrogen from a few niche areas into the mainstream. A simple model assesses renewable output and energy demand and uses basic assumptions of fuel cell, electrolyser and battery efficiencies in order to help plan the

implementation of further hydrogen projects.

LARGE SCALE PRODUCTION AND DISTRIBUTION

In a scenario where hydrogen is used for transportation on a large scale (2020-2030) Christoph Stiller of NorWays showed how it could be produced in Norway and carried by pipeline, high voltage grid or ship to other European countries. www.all-energy.co.uk

FUEL CELLS – CLEAN ENERGY HERE AND NOW

London, UK

An interesting group of speakers and exhibitors was assembled at a meeting in London organised by the Low Carbon and Fuel Cell Technology Knowledge Transfer Network (LCFC KTN). The purpose of the event was to advise upon investment and consolidate expertise in fuel cell technologies. Several different fuel cells were exhibited, including alkaline, proton exchange membrane and solid oxide systems. Cheaper catalysts and novel materials were displayed, which will reduce fuel cell costs and hasten commercialisation. Presentations were given by three of the fuel cell manufacturers, as well as a developer of cheaper catalysts. Comprehensive assessments of these companies were prepared by Equity Development.

UK AND EUROPEAN MICRO-GENERATION

The CEO of Ceres Power, Peter Bance, said that they are aiming at the CHP market, to provide small-scale power systems in the built environment. The logic behind CHP products is that centralised generation is only about 35% efficient in its use of primary energy while distributed generation, where the heat is utilised, is 80 – 90%

efficient. Ceres Power's solid oxide fuel cell (SOFC) has been incorporated in a wall mounted CHP unit to meet customer requirements in the UK and Europe. The company has an alliance with Centrica, trading as British Gas, to deliver mass market uptake of CHP in the UK residential market. Centrica has invested in Ceres Power and is placing a forward order for 37,000 units. British Gas is the largest UK utility with 16 million customers and with 9,000 engineers to carry out installations. This will provide an excellent platform for sales of micro-generation systems to residential markets in other European countries. The SOFC is also suited for portable applications and to provide auxiliary power in transport sectors, including automotive, marine and aerospace.

10,000 FUEL CELLS PER YEAR

Brendan Bilton gave a presentation on behalf of Ceramic Fuel Cells Ltd (CFCL). They are moving towards commercialisation of their solid oxide fuel cell with a major order from Nuon NV to supply 50,000 micro-CHP units over five years, based upon an agreed specification. 10,000 fuel cell systems per annum will be produced at CFCL's

factory in Heinsberg, Germany, which will meet this requirement.

CFCL's European partners, including E.ON, Gaz de France and EWE, have over 20 million customers who could utilise their micro CHP (m-CHP) units. The next market is Asia, where CFCL are delivering one of their NetGenPlus™ fuel cell systems to the Paloma Group. They will work together to develop an m-CHP system which would be suitable for Paloma's 10 million domestic customers in Japan. The Japanese Government is giving massive support to the introduction of fuel cells and Mr Bilton strongly recommends that the UK should take similar action. CFCL has increased the electrical output from their fuel cell stacks to 2kW, which will provide ample power for the average household and according to Equity Development, will significantly reduce the cost per kW and increase the unit's CO₂ savings.

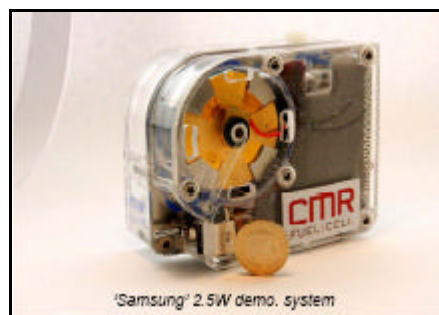
REDUCING FUEL CELL AND HYDROGEN COSTS

The Chief Operating Officer of Acta SpA, Toby Woolrych, said that the price of platinum has quadrupled in the past five years, so it is essential to replace it as a catalyst in proton exchange membrane (PEM) and direct methanol (DMFC) fuel cells. Acta SpA, has developed a new type of fuel cell, the Alkaline Membrane Fuel Cell (AMFC), which operates in an alkaline rather than an acid environment and does not require expensive catalysts. There is expected to be a large global market for the AMFC to meet consumers' increasing demands for portable power. Acta has also developed a range of catalysts which generate hydrogen from ammonia, water or biofuels. Ammonia carries far more hydrogen by volume than a high pressure hydrogen cylinder and the catalyst generates hydrogen from ammonia at room temperature, so it could be used for refuelling future

fuel cell powered cars. The exhaust is benign, unlike that of gasoline or diesel. Ammonia can be made from renewable energy sources and Acta's catalysts can be utilised to obtain this from the waste streams of industry and agriculture. Acta has a strategic alliance with the Sumitomo Corporation to develop Asian markets and they are collaborating with CMR Fuel Cells to accelerate the launch of their fuel cell catalysts in portable electronic applications.

FILLING THE 'RUN-TIME GAP'

John Halfpenny, CEO of CMR Fuel Cells, explained that the limits of battery technology for portable applications have been reached and fuel cells are the future. More power is needed for mobile TV and wireless systems and fuel cells will be able to fill the 'run-time gap'. The original equipment manufacturers (OEMs) are looking for new solutions. They want cheap and price-stable materials for high-volume applications



CMR has supplied Samsung with a fuel cell stack which operates at 40 – 50°C. CMR aims to provide fuel cells to OEMs to power battery chargers, laptops, power tools, and eventually scooters. Their notebook computer was the only functioning demonstrator at the recent FC Expo. CMR is starting with direct methanol fuel cells, leading to second generation alkaline fuel cells for mass-market applications.

For further information on this and future events organised by the Low Carbon and Fuel Cell Technology KTN visit www.lowcarbonfuelcellktn.org.uk

INTELLIGENT ENERGY AND PEUGEOT DEVELOP ZERO EMISSIONS URBAN DELIVERY DEMONSTRATOR

Loughborough, UK

ELECTRIC VEHICLE RANGE EXTENDED TO 300 KMS



Intelligent Energy and PSA Peugeot Citroën have presented the results of their collaborative research project. This has culminated in the delivery of a demonstrator vehicle powered by an electric battery with a highly successful hydrogen fuel cell range extender. The H2Origin demonstrator is based on one of PSA Peugeot Citroën's van range, the Peugeot Partner Origin.



The Intelligent Energy 10kW fuel cell system is compact and was specifically designed to fit under the bonnet of the H2Origin. The addition of the fuel cell trebles the range of the battery electric vehicle from 100 kms to 300kms. The fuel cell contributes basic power to the drive train and ensures that the battery state of charge is maintained so that it operates continuously at maximum efficiency.

Intelligent Energy's fuel cell stacks and systems are designed from first principles, combining novel fluid and thermal management techniques with metal plate architecture. This reduces the requirement for much of the conventional auxiliary components, resulting in fuel cell power generation systems that are more reliable, compact and less costly to manufacture. The complete integration of the fuel cell system in the engine compartment enables the retention of payload similar to that of a production vehicle.



PSA Peugeot Citroën's novel hydrogen storage system offers many advantages. Compressed hydrogen is securely stored in an exchangeable rack, which provides a practical alternative to refuelling at a traditional fuel station, thus overcoming a major hurdle.

Intelligent Energy's fuel cell power system has a clear path towards automotive cost targets, but at low volume they are not cost competitive with mass produced internal combustion engines. More work is needed to meet the requirements for mass manufacture. We must ensure the durability required for high volume production and reduce the size and weight of hydrogen storage systems.

Jean Pierre Goedgebuer, Scientific Director of PSA Peugeot Citroën, said : "The Intelligent Energy fuel cell in the H2Origin extends its range from approximately 100kms to three times that distance. This sort of range increases the attractiveness of electric vehicles for urban delivery, which is one of the most promising future markets for electric vehicles."

BLACK CABS GO GREEN!

New plans will put hydrogen taxis on the streets of London in time for the 2012 Olympics. A collaboration led by the hydrogen fuel cell developer Intelligent Energy and including Lotus Engineering Ltd, LTI (London Taxis International Ltd) and TRW Conekt, will see a fleet of classic London cabs fitted out with zero emission hydrogen fuel cell power systems. The programme is part of the UK government's Technology Strategy Board recent allocation of funding of £23 million for 16 innovative low carbon vehicle development programmes.

The taxis will be powered by fuel cells and batteries configured into an electric hybrid, so the vehicles will be able to operate for a full day without refuelling. They will be capable of achieving speeds of up to 75 mph, with the fuel cell power train providing better acceleration than standard taxis. The fuel cell system will be able to function at temperatures as low as minus 20°C, and will fit in the space allotted to the engine in the current LTI taxi design. The vehicles will top up their hydrogen tanks at central depots in a refuelling process which will take only a few minutes.

Chief executive officer at Intelligent Energy, Henri Winand, said, "With the price of oil continuing to rise and CO2 emissions increasing, we need to introduce alternatives to the petrol and diesel engine. Fuel cell vehicles offer considerable well-to-wheel emissions savings, and produce no pollution at the tail-pipe.



The black cab is an internationally recognised and iconic symbol of London and this partnership is an important part of making low carbon transport a practical and

near-term reality. This project is central to our plans to supply zero emissions power systems to the automotive market."

"Energy security and the environment remain major global issues, and people around the world are coming to see that hydrogen is a viable solution to our growing energy needs" added Winand. Iain Gray, chief executive of the Technology Strategy Board, said: "We are delighted to support this important project. Tackling the growth of carbon emissions from road transport and meeting demanding new EU carbon emission standards for new cars are major challenges for the UK's automotive industry."

Mike Kimberley, chief executive officer of Group Lotus Plc said: "We are committed to driving forward with high technology, global advancements into areas such as hybrid and electric vehicles and are delighted to be major contributors to this low carbon vehicle development project. There is a global drive to reduce CO2 emission levels and this is something we are dedicated to, for both our Lotus cars and engineering clients." Peter Shillcock, Managing Director of LTI Ltd said: "As a responsible automotive manufacturer we are committed to exploring all possible technological solutions to help reduce emissions from our world famous taxi. We are delighted to be involved in the project that will see a fleet of the iconic London taxis operating on the streets of London." www.intelligent-energy.com

UTC POWER ON WAY TO COMMERCIALISATION

Austin, Texas

LARGEST US PROCUREMENT OF FUEL CELL BUSES

The largest ever procurement in the United States of fuel cell power systems for public transport buses was announced at the American Public Transportation Association's annual bus conference in Austin, Texas. AC Transit of Oakland, California, is purchasing a minimum of eight 120 kW PureMotion® fuel cell systems from UTC Power, with options for an additional 13 units, to power AC Transit's hybrid-electric, fuel cell buses, scheduled for delivery in 2009 and 2010.

"Our experience with UTC Power and their fuel cell design has been extraordinarily good," commented Rick Fernandez, AC Transit's General Manager. "Not only have we realized significantly better fuel economy, but their unique design operates at near-ambient pressure resulting in a very quiet vehicle. UTC Power has been a strong partner of ours, sparing no resources to provide us with excellent service and support, leading, in part, to our elected Board of Directors unanimously approving their contract."

In addition to fuel efficiency, the benefits of fuel cell buses include zero harmful tailpipe emissions and smooth, quiet operation. The clean operation means these buses have an immediate, positive impact on street-level emissions.

Jan van Dokkum, UTC Power president, said, "We are on a path to fuel cell commercialization with power plants that have zero emissions, offer high efficiency and quiet operation, and we appreciate the positive ongoing relationship with our partners."

52,000 HOURS AND GOING STRONG!

The PureCell® Model 200 stationary fuel cell system, which was installed at St. Agnes Hospital in Bocholt, Germany in 2000, has so far generated more than 10 million kilowatt-hours of power and operated for more than 52,000 hours with its original fuel cell stack. The stack is the heart of any fuel cell power unit and key to its durability. The fuel cell provides the hospital with base load electric power, heating in winter and air conditioning in summer as well as domestic hot water. The availability of the fuel cell has been as high as 97 percent in most years.

UTC Power has installed more than 260 stationary fuel cell power plants for customers in 19 countries on five continents and its fleet has accumulated more than 8 million hours of field operation. The company is now finalizing development of its next-generation phosphoric acid fuel cell system for commercial on-site power applications. It will have a 20-year operating life and provide 400 kilowatts of power and more than 1.6 million Btu/hr of thermal output – twice the power and heat output of the company's current model.

SUPERMARKET TO USE FUEL CELL TECHNOLOGY AT STORE

The new Whole Foods Market in Connecticut, USA, will be the first supermarket to generate most of its power on-site with an ultra-clean fuel cell from UTC Power. This will enable them to reduce their carbon footprint.

"We are always looking to reduce our impact on the environment," said Kathy Loftus, Global Leader, Sustainable Engineering, Maintenance and Energy for Whole Foods Market. "Together with UTC Power and the Connecticut Clean Energy Fund, we've designed a combined cooling, heating and power system for our new Glastonbury store using a quiet, highly energy-efficient fuel cell that will reduce our carbon footprint dramatically."

The new 46,000 square-foot store will generate 50 percent of the electricity and heat and nearly 100 percent of the hot water needed to operate the store on-site. This allows Whole Foods Market to reduce its burden on the power grid and its impact on the environment.

The UTC Power fuel cell system captures its exhaust energy for local cooling and heating. The harnessed exhaust energy at the store will cool refrigeration cases year-round and heat the store in the winter months. In contrast, more than half of the energy potential in traditional power plants is lost to the atmosphere as waste heat or in transmission line losses.

The fuel cell at the Glastonbury Whole Foods Market will be configured for grid-independent operation and is capable of providing 200 kW of standby power if there's a grid failure, which will enable the store to operate without disruption. "Our UTC Power PureCell® system provides Whole Foods Market with enhanced energy security and will ensure a reliable food supply for customers and protect against costly food spoilage if the

power grid goes down," said Jan van Dokkum, UTC Power president. Fuel cells are one of the cleanest and quietest power-generating technologies in the world today. The store's fuel cell is eligible for an Onsite Renewable Energy grant from the Connecticut Clean Energy Fund (CCEF). The CCEF promotes, develops and invests in clean energy sources for sustainable energy for the benefit of Connecticut ratepayers.

FUEL CELLS PROVIDE ELECTRICITY FOR ORBITER

Every U.S. manned space mission during the past four decades has used fuel cell power plants built by UTC Power. The fuel cells, which generate all of the Space Shuttle's electrical power, surpassed 100,000 hours of flight operation during the recently completed mission by the Orbiter Endeavour. There are three fuel cells per Orbiter, each capable of producing up to 12kW. They are more than 70 percent efficient, which is two to three times better than a typical combustion engine. Water produced as a by-product provides drinking water for the astronauts.

UTC Power is a full-service provider of environmentally responsible power solutions. With 50 years of experience, it is the world leader in developing and producing fuel cells for on-site power, transportation, space and defence applications, as well as a leader in innovative, renewable energy solutions and combined cooling, heating and power solutions for the distributed energy market. www.utcpower.com

NEWS

CNBC RANKS ITM AMONGST THE WORLD'S BEST

Saffron Walden, UK

ITM Power emerged ahead of many of the world's largest companies in CNBC's report on industries developing low-carbon technologies. The European Business report states: "ITM Power is working towards the development of low-cost, more efficient fuel cells and electrolyzers, which can be used in a whole host of applications." ITM Power's CEO, Jim Heathcote, said: "We are delighted to be in such a prestigious report and cannot overstate the impact our work will have on the critical challenges of reducing the use of fossil fuels and tackling climate change."
www.itm-power.com

MIT CREATES NEW MATERIAL FOR FUEL CELL

Massachusetts, New England

Engineers at the Massachusetts Institute of Technology (MIT) have developed a new membrane which increases the power output of direct methanol fuel cells (DMFC) by 50%. At present nafion is used, which is expensive and is not very efficient on its own. The structure of the new material is built up a few nanometres at a time and has been found to improve the efficiency and power output of the DMFC by more than 50%. The use of the new material in photovoltaics is also being explored.

MIT MEETING ENDORSES MASSIVE INVESTMENT IN GREEN TECHNOLOGIES

The keynote speaker at the MIT Energy Conference, venture capitalist, John

Doerr, said that the pace of innovation in green technologies, although breathtaking in the past five years, is far from fast enough to address the scale of the world's energy problems. We need the right technologies to avoid polluting the planet to the point of dangerous greenhouse gas levels. We have to find answers that are economic for all people everywhere and use policy to harness innovation to make sure the right thing to do is the profitable thing to do, so that it becomes the probable thing to happen. Many people are calling for something like an Apollo project to solve the problem, but single government agency projects fail miserably to convey the size of the challenge. More money flows through markets in a day than all the world's governments in a year. The global energy market is \$6 trillion and going green will be the largest transformation on the planet. The entire world needs to "reindustrialize" to adopt less polluting forms of energy.
www.mit.edu

MORE ORDERS FOR FUEL CELL ENERGY

Seoul, South Korea

POSCO Power, South Korea's leading independent power producer, has ordered 25.6 MW of FuelCell Energy's power plants and fuel cell modules, bringing to 38MW the total of FuelCell Energy products ordered by POSCO to date. Mr. Seung-Woo Lee, President and CEO of POSCO Power, said that the demand for clean energy continues to grow and they expect FuelCell Energy's products will continue to generate substantial orders from their customer base, both utilities and independent power producers. www.fce.com

EUROPEAN PARLIAMENT SUPPORT FOR FUEL CELLS AND HYDROGEN

Brussels, Belgium

The proposal by the European Commission to set up a European Fuel Cell and Hydrogen Joint Technology Initiative (FCH JTI) to expedite the development and commercialisation of fuel cell and hydrogen technologies has been approved by the European Parliament. An overwhelming majority of MEPs (590 out of the 619 who voted) were in favour of creating this initiative. The EU's Competitiveness Council has also adopted the Regulation creating the new body.

The European industrial grouping which will work with the European Commission to forward the aims of the JTI is entitled the New Energy World Industry Grouping (NEW IG). The NEW IG is a voluntary not-for-profit association established under Belgian law and is open to all industrial companies with fuel cell and hydrogen R & D activities in Europe. The Chairman of NEW IG is Mr Van Breda Vreisman, who advised the European Parliament and other key stakeholders on the governance of the JTI and the technical advances that are foreseen with fuel cells and hydrogen.

ACCELERATING MARKET ENTRY OF FUEL CELLS AND HYDROGEN

The FCH JTI will run until 2017 and will have a budget of €1 billion, with investment shared by its two founding members, the European Commission and NEW IG. The aim is to create well funded and integrated development and demonstration programmes, accelerating the market entry of fuel cell and hydrogen technologies under the EU's Seventh Framework Programme. NEW IG membership incorporates companies of all sizes, from micro to large, representing a major part of Europe's hydrogen and fuel cell industries. The present

membership stands at 64 companies and new applications are welcomed. Members are developing products for the transport, stationary, hydrogen production, components and portable fuel cell fields.

GENERAL ASSEMBLY IN BRUSSELS, OCTOBER 2008

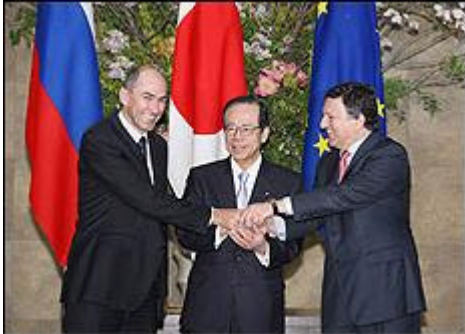
The General Stakeholders Assembly will take place at Autoworld in Brussels on 13th to 15th October. There will be industry workshops on the 13th October and the Exhibition and Drive and Ride will be opened. At the official launch of the FCH JTI on the 14th October, speakers will show how fuel cell and hydrogen technologies can play a major role in Europe's future energy systems and show the commitment of stakeholders to take concrete action in order to make this a reality. This will be followed by the Conference on 14th and 15th October. The Assembly is set to become a major event in the European hydrogen and fuel cell calendar. In future the siting of the Assembly will rotate round the major centres of Europe, stimulating cohesive action with fuel cells and hydrogen.

The objectives of the 2008 event are:

- To officially launch the Joint Technology Initiative for fuel cells and hydrogen and position it in a European context as well as in a global emerging industry.
- To demonstrate the commitment of stakeholders towards mobilising high public and private investment to deploy hydrogen and fuel cell technologies in Europe.
- To present the objectives and governance of the Joint Technology Initiative to the stakeholders. www.fchindustry-jti.eu

EU AND JAPAN PROPOSE INVESTMENT IN LOW CARBON TECHNOLOGIES

Tokyo, Japan



At the EU-Japan Summit in Tokyo it was agreed that unprecedented investment is needed in low carbon technologies in the power generation, transport and industrial sectors. Mr Janez Janša, President of the European Council (left) and Mr José Manuel Barroso, President of the European Commission (right) issued a joint statement with Mr Yasuo Fukuda, Prime Minister of Japan.

Japan and the EU share the view that strong leadership by industrialised countries is required to deal with the scale and the urgency of climate change and to promote a low carbon,

high growth global economy. Mr Fukuda is the current President of the G8 and will host the annual meeting in Hokkaido Toyako this summer. Their joint statement referred to last year's report by the Intergovernmental Panel on Climate Change which stated that in order to limit the projected damage, industrialized countries would have to reduce their greenhouse gas emissions in a range of 25 - 40% below 1990 levels by 2020. Emerging economies should also make contributions. Japan and the EU will work closely to explore the potential for reductions in key sectors like power, transport and industry, which may encourage these sectors in developing countries to become more efficient in the coming decade. Mr Fukuda has already committed Japan to investing \$30 billion in low carbon technology over the next five years, as well as a contribution of \$10 billion to the Cool Earth Partnership which will assist with measures to be taken in developing countries. www.kantei.go.jp

FUEL CELLS REDUCE CO2

Burnaby, Canada



Two major fuel cell companies, Ballard and Plug Power, have jointly published the results of a survey which shows the contribution fuel cells could make to

reducing greenhouse gases in four key areas:

Materials handling: The illustration shows a Plug Power Lift Truck being refuelled. Hydrogen refuelling is fast and safe for fuel cell lift truck operators. Lift trucks using hydrogen from natural gas reduced greenhouse gas emissions by 25 to 50% compared with trucks fuelled by propane or diesel. In 26 US States, they were found to emit less CO₂ than electric trucks powered by the grid.

Residential CHP applications: Compared with conventional systems, for each kW powered by natural gas,

the fuel cell would reduce carbon dioxide emissions by one tonne per annum, that is 5 tonnes for a 5kW unit. If the 5kW unit were powered by hydrogen from renewable energy, it could displace about 30 tonnes of CO₂ per year.

Back-up power: Based on 1000 hours of operation, a 5 kW fuel cell powered by renewable hydrogen replacing a diesel generator could reduce CO₂ emissions by approximately 4 tonnes and a 10kW unit by about 8 tonnes.

Heavy duty Transit buses: Emissions from a conventional urban diesel bus are about 150 tonnes CO₂/year. If the bus were powered by hydrogen from reformed natural gas, emissions would be reduced by about 25%. If the hydrogen were obtained from renewable sources, a fuel cell bus would have zero emissions and displace up to 150 tonnes CO₂/year.

BALLARD AND SYSTEM INTEGRATORS

Burnaby, Canada

RAYMOND CORP DEVELOPING FUEL CELL LIFT TRUCK

Several manufacturers are preparing to integrate fuel cells into their products, which will include fork lift trucks, buses, auxiliary power units and various specialist applications. The Raymond Corporation has signed an agreement with Ballard Power Systems to develop a prototype using the next-generation of Ballard's Mark9 SSL™ fuel cell to power Raymond® lift trucks. Raymond Corporation, the leading North American provider of materials handling solutions, began a three-year research program last year, using hydrogen fuel cell-powered Raymond® lift trucks in real applications, including an indoor, fast-fill hydrogen refuelling system. "Raymond is committed to demonstrating the advantages that hydrogen fuel cells can offer the materials handling industry," said James Malvaso, president and CEO for The Raymond Corporation. "This partnership will further enhance our research into fuel cell-powered lift trucks and help uncover additional value related to the merging of these technologies."

Advantages of a fuel cell solution over batteries have been shown to include: increased uptime; consistent power; longer runtime; and elimination of battery storage. These advantages

create tangible economic and operational benefits. In addition, fuel cells are a clean technology, producing zero emissions while removing the need to handle and dispose of lead acid batteries. "We are pleased to partner with an important materials handling equipment manufacturer of Raymond's calibre," said John Sheridan, president and CEO of Ballard. "Raymond has a deep understanding of end-user needs, and we believe that a successful prototype could represent the first important step toward purpose-built fuel cell lift trucks."

SPECIALIST APPLICATIONS

Ballard will supply Mark1020 ACS™ air-cooled fuel cell products for integration by Heliocentris into demonstration and teaching systems for sale to educational institutions as well as for specialized commercial and industrial use. "Ballard's technology has proven itself in terms of performance, reliability and ease of integration," said Dr. Henrik Colell, Chief Executive Officer of Heliocentris. William Foulds, Ballard's Vice President of Sales, added "Heliocentris' experience in systems integration, combined with their significant exposure to the education market, will help ensure a high-profile and successful presence for Ballard among the next generation of highly capable scientists and engineers."

HYDROGEN FUEL CELL BUSES

Ballard has signed a five-year agreement with New Flyer Industries Inc., the leading manufacturer of heavy-duty transit vehicles in Canada and the United States, to supply fuel cell modules for use in New Flyer shuttle buses. Shuttle buses are smaller and lighter than full-size buses and are intended for use in a range of growing applications, such as community feeder routes, where their reduced noise profile and emission-free operation is highly valued.

Last year, New Flyer was awarded a contract by BC Transit for the world's largest fleet of hydrogen fuel cell buses, totalling twenty 40-foot heavy duty vehicles. John Marinucci, President and Chief Executive Officer of New Flyer said: "The market demands that we find and utilize innovative technology to advance the development of zero-emission buses that are both environmentally-friendly and fuel efficient. Ballard is the leader in fuel cells so we look forward to a very productive relationship." www.newflyer.com

BACK-UP POWER MARKET

IdaTech plc has signed an agreement under which Ballard will provide PEM fuel cells for integration into their next generation 250 watt iGen™ power supply, which is designed as an auxiliary power unit for a number of applications, potentially including recreational vehicles and telecommunications backup power. Fuel cell auxiliary and backup power solutions deliver a number of advantages over conventional batteries and diesel generators, including higher reliability over a wide range of operating conditions, lower maintenance costs, longer operating life, reduced size and weight, and reduced installation footprint and environmental impact. The use of an alternative fuelling solution based on methanol will favourably position fuel cells for applications where a liquid fuel is more desirable. IdaTech has extensive capability and experience in reforming fuels, such as methanol, and in systems integration. www.ballard.com

CALIFORNIA LEADS THE WORLD!

Sacramento, California



California is leading the world with targets for the introduction of electric

vehicles. The major motor manufacturers have to ensure that a percentage of the cars they produce are zero emission vehicles (ZEVs), powered by batteries or hydrogen fuel cells. The obligation may be partly met by Part Zero Emission Vehicles, (PZEVs) such as plug in hybrids or hydrogen engine vehicles. Governor Schwarzenegger is seen here with a fuel cell powered car in Vancouver last year. www.arb.ca.gov

HYDROGEN CORPORATION STARTS UP FIRST COMMERCIAL POWER PLANT

Ashtabula, Ohio

HydroGen Corporation has successfully started up its first full-scale commercial demonstration fuel cell power plant at ASHTA Chemicals' chlor-alkali facility in Ashtabula, Ohio. The 400 kW Phosphoric Acid Fuel Cell (PAFC) plant uses by-product hydrogen to generate electrical power. The plant has performed well during initial testing and has demonstrated expected performance during various start-up, operational, and shut-down modes at differing power levels. This has prepared HydroGen for near term commercial deployment of its multi-megawatt PAFC plants for the chemical industry.

HydroGen and its project partners have also successfully started up a pilot coke oven gas treatment plant to process gas into hydrogen of sufficient purity to support PAFC power plant requirements. Preliminary results indicate that the plant is effectively removing contaminants and is producing a hydrogen fuel stream meeting their PAFC plant requirements.

MULTI-MEGAWATT PAFC PLANT DESIGN FOR SAMSUNG

HydroGen has entered into a distribution and marketing agreement with Samsung Corporation, which will act as HydroGen's exclusive agent to market, distribute and sell its phosphoric acid fuel cell power plants in Asia and the Middle East. HydroGen will sell Samsung its fuel cell power plants and will cooperate with Samsung with regard to training, technology development and support and the procurement of balance of plant. Marketing will be focussed upon industries which already have surplus hydrogen, which can be used to power the fuel cells.

HydroGen and Samsung are negotiating a purchase agreement for an initial hydrogen-based 5 MW fuel cell power plant and HydroGen is working with an architectural engineering firm to complete the engineering and design. The design package includes process flow diagrams, process and instrumentation drawings, equipment specifications and data sheets, a preliminary hazardous operations study, and development of cost reduction strategies.

Additionally, HydroGen is producing a design for multi-megawatt PAFC power plants operating on natural gas. Upon satisfactory completion of the design, the parties plan to enter into an exclusive distribution and marketing agreement for multi-megawatt PAFC power plants fuelled by natural gas.

Mr. Sung-Ha Chi, President and CEO, Samsung Trading Group, stated: "This strategic cooperation between Samsung and HydroGen is based on the strong synergies between Samsung's brand value and the outstanding fuel cell technology of HydroGen, and we believe that these synergies will help to create a world-leading partnership in large-scale fuel cell systems. Samsung Corporation's strategic plan is to initiate its fuel cell business in Korea, where market conditions are very strong, and using the know-how developed, to expand the business to the Asian and Middle Eastern markets. Samsung Corporation plans not only to sell fuel cell power plants using HydroGen's technology, but also to operate fuel cell plants in the role of an independent power producer."

John Freeh, CEO of HydroGen added "With this series of agreements, Samsung and HydroGen have formed a partnership that positions our

companies for market leadership in the multi-megawatt fuel cell arena. This partnership will accelerate our program of commercialization by providing unique access to the rapidly growing Asian and Middle Eastern markets for clean energy technology. Samsung's global reach and world class capabilities will effectively open the global market place for our fuel cell product.

NEXT GENERATION PAFC PRODUCTS

Lower cost, high volume manufacturing approaches will be implemented in HydroGen's advanced manufacturing plant that is scheduled to come on line in late 2009. Initial design and sourcing strategies have identified an achievable reduction of 50% in fuel cell costs and work is underway to make similar improvements with the balance of plant. A prototype of an automated

stack assembly line has been developed and successfully tested. Advanced electrodes based on nano-materials are expected to play an important role in cost reductions and lifetime performance improvements in their longer range design and manufacturing plans. However, HydroGen has stated that due to insufficient funding, work may have to be scaled down as engineers are being laid off. John Freeh, HydroGen's CEO, said: "While we have made significant strides in advancing our technology to the commercialization stage, we must face the reality of the difficult equity market we find ourselves in. We believe we have in place a strong foundation to become a global player in the growing distributed generation market for electricity and in the movement towards clean, hydrogen and natural gas based power generation." www.hydrogenllc.net

NEWS

HYDROGEN FUEL CELL FACILITY

Teesside, UK

The Centre for Process Innovation (CPI) on Teesside has announced that technologists from around the country are taking advantage of their new Fuel Cell Application Facility (FCAF). They are focussing on hydrogen as a fuel source and have already demonstrated the world's first hydrogen powered lighthouse.

Next is a mobile hydrogen fuel station and developments planned for the future include fuel production from biomass. The aim of the FCAF is to establish fuel cells as a commercially viable low carbon technology. It is equipped with advanced fuel cell test stations and its experienced team can offer technical support to product and project developers, OEM systems integrators and manufacturers. www.uk-cpi.com

SMALL SCALE CAR PRODUCTION

Okinawa, Japan



Honda has built a new assembly line dedicated to fuel cell vehicles. It includes unique processes, such as the installation of the fuel cell stack and hydrogen tank. This is a step towards Honda's goal of achieving widespread use of fuel cell vehicles. The FCX Clarity is being exhibited at the G8 Hokkaido Toyako Summit in July. The first customers will be in California where hydrogen refuelling stations are available. www.world.honda.com

10,000 FUEL CELL CHP UNITS IN JAPAN

Tokyo, Japan

The Japanese Government is backing the installation of 10,000 fuel cell combined heat and power units in 2008, leading towards planned mass production in 2012. The 1kW PEM fuel cell systems will be powered by natural gas, kerosene or LPG. When mass marketing begins with government incentives, the system will cost US\$10,000. The fuel cell stack life has already passed 20,000 hours and latest targets have increased to 80,000 hours.

ROYAL SOCIETY PRIZE

London, UK

The President of the Royal Society, Lord Martin Rees, presented the Royal Society Prize for Science Books to Mark Lynas for *Six Degrees: our future on a hotter planet*. The judges said that this gives a good overview of the latest science and provides a compelling view of how climate change could affect our world. The book encourages positive action and everyone should read it. www.royalsoc.org

EVENTS

8th-9th October 2008, Fuel Cells Science & Technology 2008, Copenhagen: The conference themes will reflect technical progress with fuel cells and their fuels. Organized by Elsevier. www.fuelcelladvances.com

13th - 15th October 2008, European Fuel Cell and Hydrogen (FCH) General Stakeholder Assembly, Brussels: On the

SUN, HYDROGEN AND FUEL CELLS POWER HYBIRD

Savoie, France

During summer 2008, LISA Airplanes' Hy-Bird will become the first plane to fly around the world using only renewable energies, solar energy and hydrogen.



Photovoltaic cells affixed on the wing and tail will supply sufficient energy for the take off and for on-board power supply. A fuel cell will power the aircraft for cruise flight. The world tour will be in stages and Hy-Bird will promote sustainable development at each stopover. The Hy-Bird was featured in Leonardo DiCaprio's movie, *The 11th Hour*. LISA Airplanes, based in Savoie, is undertaking its R&D program in conjunction with the industries and laboratories of the Rhône-Alpes region of France. www.lisa-airplanes.com

13th October there will be industry workshops and the Exhibition and Drive and Ride will be opened. The FCH JTI will be officially launched on the 14th October and this will be followed by the Conference on 14th and 15th October. (see page 10) www.hfpeurope.org

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