

FUEL CELL POWER

The magazine for the power source of the future



HEADLINE NEWS

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REDUCING ENERGY COSTS

Sierra Nevada, USA

BEER POWER!

FuelCell Energy has upgraded its one megawatt (MW) Direct FuelCell power plant located at Sierra Nevada Brewing Co. to use fuel created from a waste by-product of the brewing process. The fuel cell power plant began running last summer and initially ran on natural gas. To boost the brewery's energy efficiency and ecologically friendly profile, Sierra Nevada co-founder, Ken Grossman, sought to convert the ultra-clean fuel cells from operating solely on natural gas to a gas mixture that the brewery produced as a by-product. Two of the plant's four fuel cell stacks can now operate in dual fuel mode - using any combination of natural gas and anaerobic digester gas (ADG). As the plant increases production, the other two fuel cells will also operate on ADG.

The system is now capable of producing 250 to 400 kilowatts of electricity from biogas, reducing the company's fuel costs by 25 to 40 percent. Regardless of the fuel blend used, the high efficiency of DFC power plants require less fuel than conventional power plants, resulting in lower operating costs and an overall reduction in the amount of carbon dioxide emitted into the atmosphere per unit of power output.

Bruce Ludemann, Senior Vice President of Sales and Marketing, FuelCell Energy, explained that because fuel cells generate energy by chemical conversion rather than combustion, they can convert virtually any biomass, or hydrocarbon, power source into ultra-clean electricity. Sierra Nevada is reducing its energy costs and eliminating a manufacturing by-product that would otherwise add to its disposal and waste water expenditures.

DAIRY PROCESSING WASTE

In spring 2007 Tulare City, California, will take delivery of three 250kW Direct FuelCells (DFC) to power a municipal wastewater treatment plant with fuel from dairy-processing waste. Surplus heat generated from the operation will also be used in the production of the gas to be used as fuel, thereby substantially boosting the facility's overall energy efficiency.

Wastewater treatment facilities are an ideal application for DFC power plants because of their ability to operate on anaerobic digester gas, which is classified as a renewable fuel and eligible for government incentive funding at installations around the world. As an added benefit, FuelCell Energy's ultra-clean DFC power plant does not require Tulare to purchase \$600,000 of Emission Reduction Credits, which they would have to do if the city had employed traditional on-site power equipment. "Our selection of the DFC power plant was based on it being less costly than alternative products, while helping us reduce harmful emissions," said Lew Nelson, Tulare's Director of Public Works.

ONIONS POWER FUEL CELLS

In California, Gills Onions, the largest year-round grower and processor of fresh-cut onions, has purchased two of Fuel Cell Energy's DFC power plants, which will reduce the company's energy costs by using biogas created from onion juice and cut onion solid waste by-products to generate electricity, while also lowering its waste disposal expenses. Steven and David Gill are farmers and owners of Gills Onions. They are boosting the company's energy reliability and efficiency, while decreasing energy costs, by installing two 250kW DFC units that are expected to be operational in mid-2007.

"Gills Onions and FuelCell Energy are providing a truly innovative solution for the fresh-cut industry's waste disposal headache," said Steven Gill. "The raw vegetable waste can be converted into electricity, thereby reducing greenhouse emissions, eliminating costly offsite waste disposal, reducing our energy needs, and making a new model for sustaining California agriculture." Bruce Ludemann of FuelCell Energy said: "The recent heat wave that triggered record electric demand and caused brownouts or voluntary reduction in power use has accelerated Gills Onions decision to install onsite power generation to ensure its critical business applications have access to reliable power."

INCREASING POWER, LOWERING COSTS

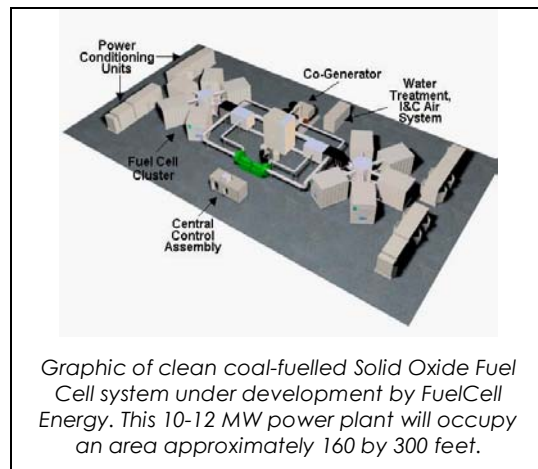
Fuel Cell Energy has announced an advanced cell stack design that boosts the power output of its DFC power plants by 20 percent. This enhancement will be incorporated across its entire line of power plants. From the second quarter of 2007 the 250kW unit will increase in power to 300kW, the 1 MW to 1.2 MW and the 2MW power plant to 2.4MW. The full potential power increase in electric power output inherent in their technology is up to 50%. The 20% increase has been achieved by improving thermal management of electrochemical activity within the fuel cell stack and, combined with progress in value engineering and ongoing cost-reduction programs, is integral to achieving FuelCell Energy's \$3,200-3,500/kilowatt cost target at the end of 2006 for its larger power plant.

R. Daniel Brdar, FuelCell Energy President and CEO said: "Now that we've successfully captured the first 20 percent, we're focused on achieving the balance in our ongoing product development plans. With additional technology-driven improvements we have under development, value engineering, supply chain development, and economies from volume production, we are positioned to meet the power needs of the broad

market. This milestone demonstrates the ability of our people to execute our product development and cost reduction plans and is a major step in realizing the commercial potential of our products."

CARBON CAPTURE FROM COAL

Coal supplies half of the USA's electricity and is a major contributor to CO2 emissions worldwide. FuelCell Energy's efficient technology reduces CO2 emissions and they are continually making further improvements.



Graphic of clean coal-fueled Solid Oxide Fuel Cell system under development by FuelCell Energy. This 10-12 MW power plant will occupy an area approximately 160 by 300 feet.

FuelCell Energy has been awarded \$36 million by the US Department of Energy for Phase 1 of the development of a solid oxide fuel cell based hybrid system which will be about 40% more efficient than today's conventional coal based plant. It is expected to capture at least 90% of the system's CO2 emissions for environmentally safe disposal while being cost competitive with other base load power generating technologies.

REDUCING EMISSIONS

The State of California is encouraging the introduction of local power generation under its Self Generation Incentive Programme. This covers efficient and renewable energy technologies, including solar panels, wind turbines and fuel cells. FuelCell Energy recently sold a DFC power plant to a California hotel and entertainment resort, which will use the electricity generated by three 250 kW

units to provide base load power around the clock and will transform the plant's heat by-product into hot water for the guests, adding to the system's overall operating efficiency.

In California, Direct FuelCells are classified as ultra-clean under the stringent emissions standards of the California Air Resources Board. Because DFC power plants generate electricity without combustion, they dramatically reduce harmful emissions of gas and particulates, while generating reliable power right where it is needed.

EMISSION CREDITS OFFSET GREENHOUSE GASES

FuelCell Energy transformed the 29th annual World Energy Engineering Congress in Washington into a pollution-free event by donating more than 2,600 megawatt hours of renewable energy certificates, making the gathering a certified 'Cleaner and Greener Event®'.

FuelCell Energy's emission credits offset more than 300 tons of various greenhouse gases, heavy metals, particulates and other pollutants that were discharged into the atmosphere from energy related to the conference.

The offset included energy to run the Congress itself, as well as the travel, meal preparation, lodging and other show-connected activities by attendees. Emissions reduction credits are created by employing cleaner fuels, increasing the use of renewable energy sources and utilizing highly efficient power generation systems, such as FuelCell Energy's Direct FuelCell power plants.

www.fce.com

NEWS

HONDA PLANS LIMITED MARKETING FOR 2008

Tokyo, Japan

The next generation FCX Concept fuel cell vehicle incorporates Honda's newly developed, compact, high-efficiency fuel cell stack.



Limited marketing in the US and Japan is planned for 2008. www.honda.com

JUST LIKE PLUGGING INTO THE WALL

Hampshire, UK



Voller Energy's Fuel Cell ABC™ automatic battery charger is designed to recharge a variety of batteries. An MP3 player or Apple iPod® can be connected to the inbuilt USB charging port. The Fuel Cell ABC can simultaneously charge an iPod, a laptop via the standard wall outlet socket and mobile phone via the standard 'cigar lighter' outlet. www.voller.com

€5 BILLION INVESTMENT IN HYDROGEN ECONOMY

Brussels, Belgium



European Science and Research Commissioner Janez Potočnik, seen here riding on a hydrogen utility truck, officially opened the European Hydrogen and Fuel Cell Technology Platform's Annual Assembly and Exhibition in Brussels.

Commissioner Potočnik said: " We can identify and overcome obstacles to the implementation of this technology in all its very many applications, raise public awareness, address safety issues and develop standards that ensure that technology developed in Europe is used not just here but around the world."

On the eve of the European Hydrogen and Fuel Cell Technology's (HFP) annual assembly and exhibition, 48 leading industrial stakeholders signed a declaration for the creation of a Joint Technology Initiative (JTI) on hydrogen and fuel cells.

This signifies a major and accelerated step forward in the development and deployment of hydrogen and fuel cell technologies within Europe, which will benefit energy security, the environment and European competitiveness. This industrial backing could result in more than €5 billion being invested in the next ten years.
www.hfpeurope.org

"HOTMODULE" HEATING PARIS APARTMENTS

Ottobrunn, Germany

The Hotmodule, a molten carbonate fuel cell from MTU CFC Solutions of Ottobrunn, Germany, will contribute heat to 283 apartments in Paris during the winter months, in accordance with French CHP regulations.

The electricity generated will be supplied to the grid and will be paid for by Electricité de France. The advantages for residential use are that the electrochemical converter makes virtually no noise and emissions are so low that the technicians refer to exhaust air rather than exhaust gas.



The long life and reliability of the Hot-Module was proven over nearly four years operation at the University Clinic in Magdeburg.

The fuel cell achieved a remarkable 98% availability over 30,000 hours in operation and there were no measurable signs of ageing at the scheduled end of the project.

www.mtu-friedrichshafen.com

CFCL DEVELOPS MORE POWERFUL FUEL CELLS

Victoria, Australia

Ceramic Fuel Cells Ltd (CFCL) has announced a further major step towards commercialisation with the development of its next generation of solid oxide fuel cells. These cells have demonstrated significant performance improvements, particularly in power density, and will be incorporated into micro - CHP units to provide clean power for homes. The new cells are more than twice as powerful as CFCL's current cells. Early versions of CFCL's cells achieved a power density of 200 milliwatts per square centimetre (200 mW/cm²). The new cells have doubled that, bringing power density to more than 400 mW/cm², and further improvements are expected. Higher power density means that CFCL can produce the same amount of electricity from a much smaller fuel cell stack, which is cheaper and easier to integrate into commercial appliances.



Ceramic electrolyte is cast in the form of a green tape. The cells use 'thin film' technology, comprising extremely thin electrolytes, which are better at conducting oxygen ions. This increases the amount of electricity that each cell can generate.

The new cell technology is designed to be highly efficient, with electrical efficiency of 50% and significantly better fuel utilisation of up to 85%. The total efficiency of the integrated micro-CHP unit will be higher still, as 'waste' heat is captured and re-used. The new fuel cell stacks are designed to produce 1kW of electricity and significantly less than 1kW of heat.

Reducing the amount of heat produced by the fuel cell stack means the micro-CHP unit can generate electricity efficiently all year round providing base load power. It is silent in operation and can be fuelled by natural gas, LPG, ethanol or other biofuels. There are low to zero emissions which can be monetised via emissions trading. www.cfcl.com.au

SOFC VOLUME MANUFACTURING PLANNED

West Sussex, UK

Ceres Power has secured a new product facility to design, build and test complete products. The Company is already working closely with partners providing key routes to market, and is now establishing an assembly capability for both large scale trials with partners, as well as direct sales into niche markets. The new facility is anticipated to be operational by mid-2007 and will take output from the cell 'pilot plant' already commissioned and integrate these into complete systems. The facility will accommodate an expanded design engineering capability for their targeted range of market applications, which include residential combined heat and power (CHP), off-grid generation and auxiliary power units (APU) for transport. It will enable Ceres Power to validate manufacturing processes and assembly methods ahead of transfer to volume manufacture. Ceres is also planning a much larger facility for the volume production of its core fuel cell components in preparation for mass market uptake.

The South East England Development Agency (SEEDA) has contributed one third of a £600,000 programme to support the scale-up of key processes for the manufacturing of Ceres unique fuel cells. Ceres has been joined by a new Finance Director, Rex Vevers, who will help the Company to capitalize on its technology leadership in the alternative energy sector. www.cerespower.com

INTELLIGENT ENERGY PREPARES FOR COMMERCIALISATION

London, UK



Intelligent Energy has announced the appointment of Dr Henri Winand as the company's new Chief Executive.

He was formerly Vice President of Corporate Venturing at Rolls-Royce plc, the power systems provider for land, sea and air. Intelligent Energy's Chairman, Flavio Guidotti commented "I am delighted to welcome Henri to his new role. This testifies to our commitment to be a major player in the energy field through the further commercialisation of our fuel cell technologies."

FUEL CELL BIKES IN NORWAY AND BRUSSELS

Stavanger, Norway



Intelligent Energy exhibited its multi-award-winning ENV fuel cell powered bike at the Hydrogen Planet exhibition in Norway.

At the exhibition, hydrogen was supplied by Norway's first hydrogen filling station, which will form a part of Norway's hydrogen highway 'HyNor'.

This autumn, the ENV was also demonstrated at the European Hydrogen and Fuel Cell Platform's exhibition in Brussels. The UK based fuel cell power systems company, Intelligent Energy, was both a sponsor and exhibitor at the event in Brussels during October.

Intelligent Energy showed a range of technologies, including a number of its proprietary PEM fuel cell stacks and systems, which have achieved both increased performance and lower costs compared with conventional fuel cells and have been selected for development projects by both PSA Peugeot Citroën and Boeing.

FIRST FUEL CELL-POWERED MANNED FLIGHT

London, UK



Boeing and Intelligent Energy are developing a prototype two seater light aircraft which will be powered by fuel cells from Intelligent Energy. Some 100 years after the first powered flight by the Wright brothers, the first ever fuel cell powered manned flight is planned for the coming year.

www.intelligent-energy.com

CENERGIE PIONEERS AGRICULTURAL WASTE-TO-ENERGY IN FRANCE

St. Alvere, France

Agrilec's principal business is the production and marketing of systems for generating electricity from agricultural waste using bio and electro chemistry and gasification techniques. Agrilec SARL is a wholly owned subsidiary of fuel cell manufacturers, Cenergie Plc. Its mission is to produce environmentally clean and sustainable electricity from waste, utilizing a resource that would otherwise be an environmental hazard and incur disposal costs.

A LIVING FROM THE LAND

Agrilec advises the farming and rural community on how to achieve energy self-sufficiency, create new revenue streams through the conversion of most types of agricultural waste into electricity, and obtain financial assistance for the installation of state-of-the-art equipment.

Agrilec will draw on the expertise in fuel cell technology and waste-to-energy solutions of its parent company Cenergie and its technical partners in associated technologies and processes. These include biogas production via anaerobic digestion of organic waste, gasification to produce hydrogen, hydrogen production from renewables, hydrogen storage, and the building of zero-emission electrical generating systems driven by fuel cells.

The company is initially launching a 35 kilowatt pilot agricultural waste-to-energy project in rural Dordogne, south west France, an area with a high level of agricultural activity including poultry/dairy farming, crop production and viticulture. These activities produce a large volume of organic waste, in some cases subject to strict disposal regulations to avert environmental pollution.

This initial project will demonstrate the feasibility, profitability and

environmental benefits of such a venture.

Agrilec's CEO, Alexandra Abson, is establishing the first project in Europe but plans to set up similar projects further afield, the USA being the next target. "Agrilec can provide reliable on-site power and back up systems to the grid" she said. "I look forward to spending winter in the Dordogne, but have learned to expect post-storm power cuts of up to 48 hours. If Electricité de France (EdF) co-operates with Agrilec, this situation, frequently experienced by remote rural communities with implications for their enterprises as well as homes, will be a thing of the past."

WASTE TO INCOME STREAM

When Agrilec unveils its pilot installation in early 2007 Alexandra will benefit from green energy generated using waste from her nearest neighbour's duck and cattle rearing farm. The joint project aims to supply the farmer's operation and two dwellings. If there is any excess electricity, the producers will be able to sell it to EdF for up to 14 euro cents per kilowatt-hour under new legislation. In a deregulated market such as the UK the farmer would be able to sell it on to private subscribers in a local network as well as to the grid.

Agrilec's Project Engineer James Galloway will build the demonstration waste-to-energy system including an anaerobic digester for duck droppings to create biogas, using "superbugs" provided by US bioengineering partner Onsite Power Systems Inc. Hydrogen is then extracted from the biogas using reformer technology provided by strategic partners such as Air Products.

James Galloway will conduct feasibility studies for each Agrilec project and give technical advice and support to

client farmers. "Hydrogen produced from organic sources such as animal and crop waste, or electrolysis of water using renewables like wind and solar is an inexhaustible source of fuel – a well that will never go dry" he said. "Hydrogen is the most plentiful element in the universe and the second most plentiful on earth.

Using technologies developed by Cenergie's technical partners to extract it in a clean, economical and efficient way, hydrogen can be harnessed and used immediately in fuel cells to generate electricity or stored for later consumption".

Agrilec is currently negotiating to operate and enter into joint ventures throughout France with farmers and growers, food processors and other entities creating waste from agricultural activities. Agrilec will thus stimulate a market for Cenergie's fuel cell technology and the related technologies of its partners. Agrilec will also design and manufacture its own range of waste-to-energy equipment, such as anaerobic digesters suitable for small or large-scale use.

A UNIVERSAL MODEL

James Galloway and Katy O'Rorke, Project Promoter, are pictured in Dordogne, south west France, with some 'fuel producers' in the background.

Katy O'Rorke commented: "Agrilec's waste-to-energy demonstration here in the Dordogne is a grass roots project in the true sense, but its part of a grander plan. France is the second largest agricultural producer in the world and the responsible disposal of farm waste is an economic and public health issue.



Agrilec's installations will allow farmers and rural communities to comply with waste disposal legislation, produce their own electricity, and turn a profit from their excess energy. Agrilec's model is universally applicable and is particularly effective in a deregulated energy market".

Agrilec will demonstrate that Cenergie's alkaline fuel cells (AFCs) are ideal for use in agricultural applications because of their robust and reliable nature and scalability. However the principles of this project can be applied to large-scale scenarios and different environments at community level.

Cenergie's Total Utility Solution (TUS) programme is based on the remediation of all types of municipal waste from industry, commerce, public sector and domestic sources, using cutting edge technology to create hydrogen as fuel for its systems and generate power on a decentralised basis. The process will not add to global warming gases, in fact it will reduce the emissions of methane which would otherwise be released into the atmosphere from agricultural waste.

This technology brings great potential for developed and developing worlds alike and an added benefit is that the process produces nutrient rich water for irrigation and also pure water as by-products. www.cenergie.com

UK-DEVELOPED POLYMER CUTS THE COST OF FUEL CELLS

Southampton, UK

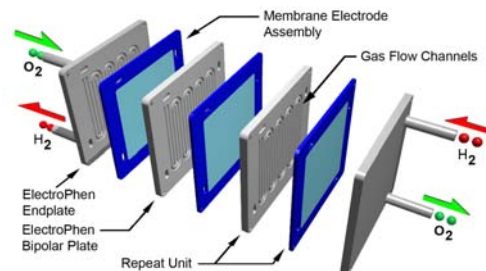
Hydrogen fuel cells provide efficient energy without damaging emissions and, with heavy backing from major governments, they look set to provide an answer to the environmental problems of fossil fuels, and concerns over oil and gas supplies. Already in use in London buses and Japanese homes, fuel cells combine hydrogen with oxygen from the air to generate electricity and heat, with the only waste product being clean water.

The successful use of fuel cells as a power source by NASA in over 100 space missions proved the effectiveness of the technology, and led to a large array of prototype and development applications in transport, portable and stationary power applications. The first commercial applications were as auxiliary generators and as industrial power back-up. As sales volumes increase in these niche sectors and corresponding manufacturing costs come down, so other commercial markets will open up, leading ultimately to the mass volume markets of consumer electronics goods and automotive transport.

COST REDUCTIONS

The widespread adoption of fuel cells is currently limited by the cost of key components. In particular, up to 30% of the cost, and 75% of the weight, of the popular Polymer Electrolyte Membrane (PEM) fuel cell stack is due to components called the bipolar plates and end plates. A UK start-up company called Bac2 has developed a new material called ElectroPhen, which will reduce the weight of the bipolar plates and end plates, which represent 75% of the weight of the PEM stack.

ElectroPhen will therefore reduce the overall cost and weight of fuel cell stacks and help their mass adoption. It should also enable the use of cheaper catalyst materials and cheaper methods of volume production.

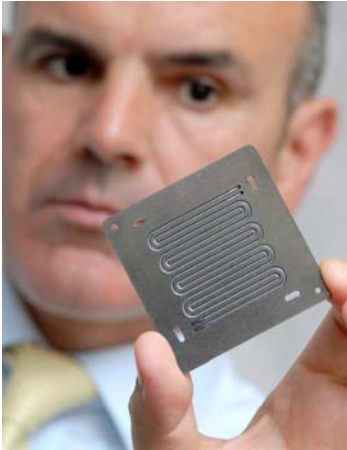


This simplified representation of a polymer electrolyte fuel cell stack illustrates how the bipolar plates and end plates interconnect individual cells and provide connections to the outside world. The bipolar plates conduct electricity, keep the reaction gases separated and channel away waste water and heat from the reaction.

Bac2's patent pending ElectroPhen material is better suited to the easy and low cost production of conductive composite bipolar plates, rather than the non-electrically conducting polymers used in existing composite plates.

ElectroPhen was first seen as a low cost electrode material for potential use in advanced electrochemical water treatments and has since been optimised for fuel cells and a range of other applications.

A NEW MATERIAL



Dr Graham Murray, CTO of Bac2 shows an ElectroPhen bipolar plate, which has the potential to reduce the cost and complexity of fuel cells. ElectroPhen has conductive properties, which dramatically expand its potential uses. In its raw state it is about a billion times more conductive than most common plastics, which means that less conductive filler needs to be added to bring it to an acceptable conductivity for bipolar plates. The strength of the ElectroPhen resin therefore makes for a tougher plate, and further modifications with plasticisers, reinforcers, and conductive fillers enable the composition of ElectroPhen to be 'fine-tuned' for specific applications and customer requirements.

STRUCTURAL INTEGRITY

Other important physical characteristics of ElectroPhen are its thermal stability and resilience to temperature. Metal bipolar plates may suffer degradation from reaction with the catalysts but ElectroPhen is inert towards the catalyst. This means that fuel cell stack manufacturers can safely explore the use of different, cheaper catalyst materials that may require higher temperatures at the reaction surface. Compressed graphite granules held in resin are sometimes adopted for bipolar plates, but the softness of the graphite particles makes the structure weak and the use of resin must be minimized because it is an insulator.

The manufacturing process usually involves curing by heat, which presents problems for scaling up to high volume manufacture.

Mobile electronics products and automotive applications are harsh environments, where long-term reliability is essential. This means that the ideal bipolar plate needs to be constructed from a material that has sufficient structural integrity so that the intricate features of the gas channels can be moulded into it. It must also be robust, have minimal electrical resistance to the flow of current generated within the fuel cell stack and be very low cost. The basic raw materials for ElectroPhen are widely available from major chemical suppliers and it is cheap to manufacture. As a result, bulk quantities of raw materials, or better still, pre-mixes containing conductive fillers to Bac2's specification, can be supplied directly to moulding companies.

SCALING FOR HIGH-VOLUME PRODUCTION

Today, a number of fuel cell stack manufacturers produce their own bipolar plates, having largely been forced to undertake their own R&D on the most suitable available materials. The volumes produced are only small, so manufacturing techniques appropriate to these volumes may be applied and this is reflected in the high cost of stacks available on the market. However, when the cost/efficiency barriers of fuel cells are overcome, PEM fuel cells will realise widespread adoption in automotive and electronic equipment applications and the volumes required will grow dramatically.

At the point where it becomes viable for car manufacturers to introduce a fuel cell powered vehicle to the mass market, the manufacturing requirement for bipolar plates will rise rapidly, although the number of cars built will not need to be particularly high. Manufacturability on this scale needs to be considered by stack

manufacturers currently pioneering the lower volume commercial markets.

ElectroPhen's room-temperature cure makes for easy scalability, from rapid-prototyping through to high volume compression or injection moulding. Trials with hardener formulae have yielded cure times from as little as a few seconds up to tens of minutes, so it is easy to adapt the mix to suit the type of moulding, size of the item, and operating cycle of the moulding machine. The moulding techniques are readily available, presenting the opportunity for low-cost manufacture in developing countries where under-developed fossil fuel infrastructure reduces the entry barriers to adoption of a fuel cell based hydrogen economy.

A new material or technique often creates the opportunity for a radical rethink on the technology itself. Early-stage experimentation at Bac2 has revealed that using ElectroPhen conductive polymers and composites may make it possible to reduce the number of fuel cell stack components, or simplify assemblies. The opportunities for significant cost reduction that lead to earlier adoption of fuel cell technologies are therefore tantalisingly close. www.bac2.co.uk

NEWS

FUEL CELL BUSES FOR CONNECTICUT AND BELGIUM

Connecticut, USA

The US Federal Transit Administration has awarded UTC Power and research partners several grants for fuel cell bus technology developments. The Company has supplied fuel cell power plants for buses in Washington DC, California, Spain and Italy and recently announced orders for Connecticut and Belgium.



UTC Power will provide four of its Puremotion™ fuel cell power systems to power zero-emission hybrid electric buses that will operate in Washington DC. The bus in Hartford, Connecticut, will be used in revenue service by CTRANSIT. The grant from the Federal Transit Administration will pay for the bus and infrastructure to support future fuel cell transportation projects in Greater Hartford. www.utcpower.com

100 FUEL CELL CHEVYS!

Detroit, USA

The Chevrolet Equinox Fuel Cell vehicle is seen here in front of the Capitol in Washington DC. General Motors is building the world's largest fuel cell vehicle fleet with a hundred of these next generation fuel cell vehicles. Larry Burns, GM Vice President, Research & Development, said that the Equinox Fuel Cell demonstrates an



important milestone on GM's pathway to automotive-competitive fuel cell propulsion technology. The vehicles will be fuelled with hydrogen and will be operated in California, New York and Washington.

www.gm.com

DAIMLER CHRYSLER

Stuttgart, Germany

PARADIGM SHIFT TO SUSTAINABLE MOBILITY

DaimlerChrysler supports a paradigm shift towards sustainable mobility. Lawmakers around the world must summon the political will to initiate changes which will help to prevent supply bottlenecks and dependency on supplier countries, while also leading to further reductions of CO₂ and other emissions. This paradigm shift must be marked by the use of various primary energy sources to replace the current overwhelming dominance of so few energy sources. Our concept focuses on hydrogen produced from renewable sources as a vehicle fuel, with the ultimate goal of establishing a system of mobility that is sustainable because it is emission-free and optimized to achieve the highest levels of efficiency.

CUSTOMER ACCEPTANCE

DaimlerChrysler and its partners in worldwide testing programs for fuel cell vehicles are paying close attention to customer acceptance of the new technology.



It's very important for motorists to be able to fill up with pressurized hydrogen as quickly and conveniently as they can with gasoline or diesel. Experience gained with the best filling stations from the current testing projects shows that this is already possible. Motorists who have never used a hydrogen pump before have been able to fill their pressurized tanks

in less than three minutes without any problems.

HYDROGEN FILLING STATION NETWORKS

Automakers will have to work with energy companies to develop a hydrogen filling station network. Individual filling stations have already been built in the areas where fuel cell vehicles are currently being tested. The goal now is to establish clusters or mini-networks in the testing regions between 2010 and 2015, and then link them along highways in the years that follow. It will be important not only to achieve a sufficient density of filling stations but also to ensure that all of them have the required technical performance capabilities.

REDUCING OVERALL COST OF RENEWABLES

The current cost disadvantage for fuels produced from renewable sources is likely to remain a problem for many years, which is why governments must create political conditions conducive to the production and use of such fuels. In the future, supplies of crude oil will continue to dwindle, and the need to exploit lower-yielding sources of crude oil, such as oil shale and oil sand (considered too costly in the past), will by itself lead to higher prices. At the same time, there are several factors in favour of techniques for producing fuels from renewable sources.

Solar energy and wind power, at least, are essentially inexhaustible resources, which means that scarcity can never play a role in their prices. In general, fuels obtained from fossil energy sources will become more expensive in the future, while prices for fuels from renewable sources will tend to fall and the greater efficiency of fuel cell drives will help to reduce overall vehicle operating costs.

WHY HYDROGEN?

DaimlerChrysler's top priority is to develop concepts for sustainable mobility, which means:

- Maximum energy efficiency and thus minimal energy consumption by vehicle drive systems. When hydrogen is used to power fuel cell vehicles, it leads to energy efficiency in the resulting drive system that is nearly twice as high as that achieved by the most modern gasoline and diesel engines.
- Diversification of primary energy sources used for transport applications and a greater share of fuels from renewable sources in the energy mix.
- The long term goal of zero emissions and complete CO₂ neutrality.



Three Daimler Chrysler Sprinter vans provide daily delivery services

www.daimlerchrysler.com

News

ITM FUEL CELL COST REDUCTION PROGRAMME

Essex, UK

ITM Power has been awarded an honourable mention in The Sustainable Business.com 20 Companies Changing the World (for the better!) list.

They have just announced that they have achieved one of the milestones set out in their programme to develop cheaper fuel cells and electrolyzers. In parallel with the development of their low cost electrolyser programme, the Company is applying its technology to reduce the capital cost of fuel cells operating using hydrogen.

The Company has reduced the cost of fuel cells to \$900/kW by increasing the power output of its cells to 360mW/cm². ITM materials have now been successfully operated at powers in excess of this level.

Consistent and repeatable performance at these power densities has been achieved.

Jim Heathcote, CEO, ITM Power Plc, said: "One of our strategies is to be able to provide a low-cost electrolyser and a low-cost fuel cell that could provide the essential technology necessary to convert intermittent low-value renewable energy (wind, solar) into a reliable non-fossil energy supply.

ITM have identified multiple applications for this technology and have entered into early stage discussions with third parties about possible collaboration in order to bring these products to market."

www.itm-power.com

FUEL CELL MARKETS AT WESTMINSTER

London, UK



At an exhibition in the House of Commons, Toddington Harper and colleagues from Fuel Cell Markets explained to Gordon Brown, MPs and members of the House of Lords, the wide variety of applications that fuel cells address. Gordon Brown now plans to visit the first operational fuel cell in the UK, a 200 kW Phosphoric Acid Fuel Cell from United Technologies Corporation, which provides electricity and heat at the leisure centre in Woking, Surrey.

The House of Commons Trade and Industry Select Committee is following this up with a fact-finding paper. Alastair Darling, Secretary of State for Trade and Industry, invited Fuel Cell Markets to advise them on precisely what the Government could do to assist the implementation of fuel cell technologies.

www.fuelcellmarkets.com

FUEL CELL POWER'S RECOMMENDATIONS

Fuel Cell Power has recommended that a UK energy agency should be set up which would take on the scientific role of the former Department of Energy. Since it was abolished twenty years ago, energy R & D has been fragmented and it has been increasingly difficult for so called 'disruptive' energy technologies to break into established energy markets.

A cost should be attached to polluting technologies, which would make clean and efficient fuel cells more competitive. The regulations which

control the UK electricity supply industry should be altered to ensure a level playing field for small combined heat and power systems, including hydrogen fuel cells. The introduction of low voltage appliances which can be powered directly from micro wind or solar panels should be encouraged, both for the UK and overseas markets.

In the transport field, higher priority should be given to efficiency and the reduction of greenhouse gas emissions. Considerably more support is needed for prototype development. Engineering capacity will have to be rebuilt if we are to contribute to the growing world markets for efficient and renewable energy technologies.

UK HOOKED ON OIL

A report by the New Economics Foundation and WWF finds that nearly half the UK economy depends in one way or another on petroleum-based products in order to function. The report examines the Government's ability to meet the twin challenges of tackling climate change and responding to the coming economic shocks related to the peak and decline of global oil production.

Norway currently has set aside about \$45,000 for every one living in the country. Several other countries have established funds and Sweden is committed to becoming oil-free by 2020. The report concludes that the time has come for the UK to set up an Oil Legacy Fund designed to invest in the urgent, wide-scale transition to a sustainable energy system.
www.neweconomics.org

GREATEST MARKET FAILURE

London, UK

Sir Nicholas Stern's report on the Economics of Climate Change points out that climate change is the greatest market failure the world has seen. All countries will be affected by climate change, but it is the poorest that will suffer earliest and most. Based upon the assessment of the science carried out by the Intergovernmental Panel on Climate Change in 2001, it is estimated that the dangers of unabated climate change would be equivalent to at least 5% of the world's GDP each year. Taking into account recent scientific evidence and the full economic impacts on human life and the environment, it is estimated that the dangers could be equivalent to 20% of global GDP or more.

In contrast, the costs of action to reduce greenhouse gas emissions to avoid the worst impacts of climate change can be limited to around 1% of global GDP each year. Although people would pay a little more for carbon-intensive goods, our economies could continue to grow strongly.

GREEN GROWTH

Each tonne of carbon dioxide (CO₂) that we emit now is causing damage worth at least \$85, but these costs are not included when people spend their money. There are many opportunities that would enable us to cut emissions that would cost less than \$25 a tonne.

In other words, reducing emissions will make us better off. The annual benefits of shifting the world on to a low carbon path could be in the order of \$2.5trillion.

The level of greenhouse gases in the atmosphere should be limited to somewhere between 450 and 550 parts per million CO₂ equivalent (CO₂e). The current concentration of greenhouse gases is already 430 ppm CO₂e, so anything lower would impose very high adjustment costs. Anything higher would substantially increase the risks of very harmful impacts but would only reduce the expected costs of mitigation by comparatively little.

THREE POLICY ELEMENTS

To address the market failure, three elements of policy are required. The first is carbon pricing so that people are faced with the full social costs of their actions. The second is to drive the development and deployment of a range of low-carbon and high efficiency products. Globally, support for energy R & D should at least double and support for deployment should increase up to five-fold. The third is to remove barriers and inform individuals. There is still time to avoid the worst impacts of climate change. Governments, businesses and individuals all need to work together to respond to the challenge.
www.sternreview.org.uk

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, Lyndhurst, The Street, Woolpit, Suffolk, IP30 9QG.
Tel. & Fax 01359 245073

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