

## UKH<sub>2</sub>Mobility sees 1.6m FCEVs in UK by 2030

**The UKH<sub>2</sub>Mobility project has released the results of its Phase 1 interim report, evaluating the benefits of hydrogen fuel cell electric vehicles (FCEVs) and paving the way for commercial rollout in the UK.**

The UKH<sub>2</sub>Mobility project – launched a year ago [*FCB*, January 2012, p1] – brings together leading businesses from the automotive, energy, infrastructure, and retail sectors with government to provide a roadmap for the introduction of FCEVs and hydrogen refuelling infrastructure in the UK. This will push well beyond the recently announced London Hydrogen Network Expansion (LHNE) project, the UK's first integrated hydrogen transport system in London and the South East [*see page 8*].

Key findings from the interim report include:

- Up to 10% of new car customers will be receptive to fuel cell cars when they are first introduced, attracted by the newness of the technology and environmental benefits.
- Once mass production of FCEVs is established, bringing costs down, there is the potential for 1.6 million vehicles on UK roads by 2030, with annual sales of more than 300 000 FCEVs.
- An initial rollout of just 65 hydrogen refuelling stations would provide sufficient coverage in line with early vehicle sales, with the network growing in line with the number of FCEVs on the road, to provide 1150 sites by 2030.
- In the market conditions assumed in the roadmap, the hydrogen refuelling network will be able to cover its operating costs by the early 2020s, and reach breakeven in the late 2020s. The total financing needed up to the breakeven point is £418 million (US\$655 million), with a relatively modest £62 million (\$97 million) of this required before 2020.
- For the first time, the benefits that hydrogen production by water electrolysis can have on the UK electricity grid were quantified, particularly with respect to the integration of generating capacity for renewable electricity.

There are currently 11 industry participants in UKH<sub>2</sub>Mobility: Air Liquide, BOC, Daimler,

Hyundai, Intelligent Energy, ITM Power, Johnson Matthey, the Morrisons supermarket chain, Nissan Motor Manufacturing (UK) Ltd, Scottish & Southern Energy (SSE), and Toyota. Three UK government departments are also participating, together with the European Fuel Cells & Hydrogen Joint Undertaking (FCH JU). Two of these partners – Daimler and Nissan – have just announced they are collaborating with Ford to deliver affordable FCEVs by 2017 [*see page 2*].

'Phase 1 sows a seed for the adoption and development of a new transport system which will allow society to decarbonise road transport and clean up emissions, without disrupting its business and social routine,' says Dr Graham Cooley, CEO of ITM Power. 'Phase 2 will show how that seed can proliferate, enabling the UK to be a world leader in the deployment and manufacturing of the necessary electrolyser refuelling technology and fuel cell vehicles.'

The final report of Phase 1 is due to be published in March. During 2013 Phase 2 of UKH<sub>2</sub>Mobility will then use the information and roadmap produced in Phase 1 to develop a detailed business case and specific actions to which the participants can commit.

Synopsis of UKH<sub>2</sub>Mobility Phase 1 results:  
<http://tinyurl.com/ukh2mobility-phase1>

Air Liquide, Hydrogen Energy: [www.planete-hydrogene.com/en/hydrogen-energy-1.html](http://www.planete-hydrogene.com/en/hydrogen-energy-1.html)

BOC, Hydrogen Refuelling: <http://tinyurl.com/8z5cxhd>

Daimler, Fuel Cell Drive Technology:  
<http://tinyurl.com/daimler-fcevs>

Hyundai, Zero-Emission Vehicles:  
<http://tinyurl.com/hyundai-zevs>

Intelligent Energy: [www.intelligent-energy.com](http://www.intelligent-energy.com)

ITM Power: [www.itm-power.com](http://www.itm-power.com)

Johnson Matthey Fuel Cells: [www.jmfuelcells.com](http://www.jmfuelcells.com)

Nissan Motor Company: <http://tinyurl.com/nissan-fcevs>

Toyota, Fuel Cell Tech: <http://tinyurl.com/toyota-fcevs>

European Fuel Cells & Hydrogen Joint Undertaking:  
[www.fch-ju.eu](http://www.fch-ju.eu)

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## ROAD VEHICLES

## Daimler, Nissan, Ford join forces to develop affordable FCEVs

**Three of the world's leading automakers – Ford, Nissan, and Daimler – have signed a hydrogen fuel cell development agreement in an effort to bring affordable fuel cell electric vehicles (FCEVs) to market by 2017.**

The companies – which have so far been working on the technology separately in North America, Asia, and Europe – plan to jointly develop a common FCEV system while reducing investment costs associated with the engineering of the technology. If this work is successful, the partners believe that it will significantly reduce the cost and make it more widely available.

The strategy will be to develop a common PEM fuel cell stack and system design which can be used in a wide range of vehicles. The partners are also studying the joint development of other FCEV components to generate even further synergies. Economies of scale will be harnessed by manufacturing the result across all three companies. Each partner will make an equal investment in the project, and launch a highly differentiated, separately branded FCEV in due course.

The collaboration aims to send a clear signal to suppliers, policymakers and industry to encourage the further development of hydrogen refuelling stations and other infrastructure necessary to allow the vehicles to go to the mass market. The 2017 target is two or three years later than Daimler had – until recently – been aiming for [*FCB*, July 2012, p7], and appears to at least partly blame the slow buildup of hydrogen refuelling infrastructure [*see page 1, and also the Air Products feature in this issue*]. Toyota and BMW are also collaborating to develop a number of advanced vehicle technologies, including a fuel cell system [*see item below*].

Daimler, Fuel Cell Drive Technology:  
<http://tinyurl.com/daimler-fcevs>

Nissan Motor Company: <http://tinyurl.com/nissan-fcevs>

Ford, Hydrogen Fuel Cell Vehicles:  
<http://tinyurl.com/ford-fcevs>

**expanding their successful strategic long-term cooperation in sustainable mobility, including collaboration on developing a fuel cell system for their vehicles.**

The partners have signed binding agreements on long-term collaboration for the joint development of a fuel cell system, architecture and components for a mid-size sports vehicle, and joint R&D of lightweight technologies. The newly signed agreements follow a memorandum of understanding signed last June [*FCB*, July 2012, p5].

BMW and Toyota also signed a binding agreement to commence collaborative research on lithium-air batteries, with the aim of developing a lithium-air battery with an energy density greatly exceeding that of current lithium-ion batteries. This agreement marks the second phase of collaborative research into next-generation lithium-ion battery cells that began last March.

The companies will share their fuel cell technologies and jointly develop a complete system for fuel cell electric vehicles (FCEVs), including the stack and system packaging, as well as a hydrogen storage tank, motor and battery, aiming for completion in 2020. They will also collaborate on jointly assessing the development of the required hydrogen infrastructure, and on creating the codes and standards necessary for FCEV commercialisation.

According to a *Nikkei* report, this is the first time that Toyota – which has been developing fuel cell technology since 1992 – will share it with another company. The automaker will license its drivetrain and hydrogen storage technology to BMW this year, which BMW will use to build a prototype vehicle by 2015 ahead of plans for a market release around 2020. The report added that Toyota will launch a fuel cell powered sedan as early as 2015 in Japan, the US, and Europe, priced at around ¥5 million (US\$4 000).

The spirit of collaboration seems to be in the air – Ford, Nissan, and Daimler have just signed a hydrogen fuel cell development agreement in an effort to bring affordable FCEVs to market by 2017 [*see item above*].

Toyota, Fuel Cell Technology: <http://tinyurl.com/toyota-fcevs>

BMW Efficient Dynamics, Hydrogen:  
<http://tinyurl.com/bmw-hydrogen7>

## MOBILE APPLICATIONS

## BMW, Toyota deepen collaboration on fuel cells, sustainable tech

**German-based BMW Group and Toyota Motor Corporation (TMC) in Japan are**

## Nuvera unveils Orion stacks for materials handling at ProMat

**Massachusetts-based Nuvera Fuel Cells introduced its new**

**Orion® PEM fuel cell stack at the recent ProMat 2013 materials handling show in Chicago. Nuvera says that Orion delivers higher productivity, lower cost of ownership, and reduced emissions in materials handling applications.**

Orion is Nuvera's eighth-generation PEMFC stack, designed for industrial mobility, aerospace, and automotive applications. It is designed to be easily integrated by forklift manufacturers and other industrial vehicle OEMs into their products. Nuvera says that the compact new stack provides the performance, serviceability, versatility, and ruggedness needed for heavy-duty industrial operations. Using Orion to power their products will allow OEMs to provide their customers with the most advanced fuel cell technology to cut operating costs, increase productivity, and reduce their facilities' greenhouse gas emissions.

Nuvera says that its unique stack architecture provides industry-leading current density that reduces the capital cost for a given amount of power produced, higher efficiency leading to lower operating cost, and an independently verified high-durability design that delivers performance from 8 kW to 300 kW. Orion is supplied with SmartStack™, Nuvera's proprietary stack control logic that enables rapid and reliable integration by OEMs into their products. SmartStack can be supplied as a software download into the OEM control unit, or embedded into an optional Nuvera electronic control unit.

Nuvera also launched at ProMat the PowerTap+ service, which eliminates most of the upfront costs associated with creating a reliable hydrogen source for fuel cell electric vehicles or other applications. Nuvera assumes full responsibility for installation of the equipment, and undertakes regular maintenance checks to ensure efficient, uninterrupted hydrogen delivery. The company also promoted the new design of the PowerTap hydrogen dispenser, which makes forklift refuelling fast, easy, and safe.

Nuvera's hydrogen supply systems and fuel cell technology are transforming markets such as logistics, automotive, and aerospace. The company's hydrogen generation technology is ideally suited to provide a cost-effective source of hydrogen for applications in the 25–250 kg/day range.

Nuvera Fuel Cells, Billerica, Massachusetts, USA.

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[www.nuvera.com](http://www.nuvera.com) or

<http://tinyurl.com/nuvera-orion>

## ITM wins CE mark for materials handling fuel cell unit, adds IP

**UK-based ITM Power has been awarded CE certification for the Infintium Fuel Cell System for materials handling vehicles. ITM is the exclusive European importer of the Infintium system, and can now offer customers an integrated fuel cell and refuelling solution, both with the CE mark – a mandatory conformance mark for products marketed in the European Economic Area. The company has also announced important extensions to its patent portfolio, following a recent major intellectual property review.**

Last summer ITM Power announced that it had signed an agreement with Infintium Fuel Cell Systems (IFCS) in Texas to distribute its fuel cell systems for materials handling equipment [*FCB*, July 2012, p8]. The deal facilitates the development of a European customer base in the rapidly expanding materials handling market, where traditional battery and engine technology is being replaced by fuel cells powered by hydrogen. Under the agreement, IFCS committed to gaining – with ITM Power's assistance – CE marking for its systems that can be fitted to all classes of pallet and forklift trucks, as well as airport baggage handling and utility vehicles.

ITM Power can now offer a full turnkey solution to the materials handling sector, including onsite hydrogen generation, refuelling, and fuel cell systems. The successful trials of the company's HFuel product platform, together with measured operational benefits of fuel cell powered materials handling vehicles, has seen ITM Power engage with a growing number of potential retail, distribution, and logistics customers [*FCB*, January 2012, p6]. The company can provide a tailored, integrated solution that includes modelling, onsite trials, supply of equipment, and maintenance contracts. HFuel is capable of generating up to 400 kg of hydrogen per day, onsite, from renewable power.

'IFCS and ITM Power will now be able to tender for extensive commercial contacts in Europe,' comments Ross Oliver, VP of operations for IFCS. 'The market for hydrogen in the materials handling space is the fastest growing hydrogen sector, and it's great to be able to make a new entrant offering with our partner ITM Power.'

Meanwhile, ITM Power has reviewed and extended its patent portfolio, covering its suite

## EDITORIAL

Delays are appearing in the previously agreed timescale for the initial market introduction of fuel cell electric vehicles (FCEVs), with some of the automakers involved blaming the slow rollout of hydrogen fuelling infrastructure – just as the hydrogen supply sector seems to be getting to grips with building enough fuelling stations to meet the early demand.

As we report in this issue, technology trailblazer Daimler is linking up with Nissan and Ford [*see page 2*] to jointly develop fuel cell technology that will lead to affordable FCEVs – but by 2017, rather than the 2014–15 timeframe we all thought we were aiming for [*FCB*, October 2009, p2 and numerous reports since]. And long-time FCEV developer Toyota is deepening its collaboration with BMW in Germany, aiming for vehicle completion in 2020 [*also on page 2*].

This seems at odds with the numerous items we have published in the last couple of years on the construction of hydrogen fuelling stations, to build regional and even national networks of hydrogen infrastructure. Europe seems to be particularly enthusiastic, perhaps because of the extensive funding support from the Fuel Cells and Hydrogen Joint Undertaking [*see page 11*]. While Germany is a long-time proponent of building a hydrogen fuelling network [*FCB*, June 2012, p1], Scandinavia is also making a significant effort [*FCB*, April 2012, p12 and June 2012, p9], and even in the UK [*see pages 1 and 8 in this issue*].

The rollout of hydrogen fuelling infrastructure in the US is more piecemeal, not surprising considering its size and large areas with minimal population. California has long been working to build up an extensive network of hydrogen stations – even if budgetary constraints seem to have completely stalled the 'Hydrogen Highway' that former Governor Arnold Schwarzenegger wanted. But the California Fuel Cell Partnership ([www.cafcp.org](http://www.cafcp.org)) is still supporting the opening of new hydrogen fuelling stations [*FCB*, August 2012, p7], and the Department of Energy's Hydrogen and Fuel Cells Program is funding numerous projects to validate the technology being developed for hydrogen fuelling [*see page 11*].

As it happens, the feature article in this issue [*pages 12–14*] reports on the role that Air Products is playing in pushing Europe closer to the creation of a hydrogen transport infrastructure. The company is building on its long experience in hydrogen production and distribution to form a clear strategy on how a hydrogen transport infrastructure can be rolled out across Europe and beyond. A timely thought indeed...

**Steve Barrett**



of unique materials and processes in many countries. Since the start of 2010, a further 21 patents have been granted across 10 patent families, covering technologies, materials, or processes relevant to ITM Power's activities. An additional seven new patent applications have been submitted, which are now progressing through the patent system. ITM Power now has 94 separately granted patents and 64 pending patent applications across 31 patent families. In addition, the patent position has been extended to include protection for applications outside the scope of ITM's current core activities.

ITM Power, Sheffield, UK. Tel: +44 114 244 5111, [www.itm-power.com](http://www.itm-power.com)

Infintium Fuel Cell Systems, Carrollton, Texas, USA.  
Tel: 1 800 864 2547 (tollfree in US), [www.ifcsglobal.com](http://www.ifcsglobal.com)

## SFC improves EFOY installation flexibility, availability in yachts

**G**erman-based SFC Energy has unveiled a further product development to improve flexibility when installing the popular EFOY Comfort fuel cell in small vans or sailing boats. The company is now also supplying Dutch boatbuilder Leonardo Yachts, which offers the EFOY fuel cell for independent onboard power supply on two of its luxury daysailers.

SFC Energy has responded to calls for more flexibility when installing the popular EFOY Comfort direct methanol fuel cell, and presented a product development at the recent CMT 'holiday' exhibition in Stuttgart. A longer cartridge connection will in future enable users to position the M5 or M10 fuel cartridge at a different level to the device itself, allowing the cartridge to be fitted above or below the fuel cell. This is very useful in particular where installation space is limited, for example in small vans or sailboats.

'The longer cartridge connection is our response to the ideas and wishes of our customers in the caravanning and sailing fields,' says Dr Peter Podesser, CEO of SFC Energy. A number of vehicle manufacturers presented at the CMT expo a fitted fuel cell with longer cartridge connection, with caravans a growing market sector for the EFOY Comfort as a proven year-round onboard power supply for leisure applications.

The Knaus Tabbert Group showcased its Eurostar caravan at CMT, with the EFOY Comfort 140 now factory-fitted as a standard component of the Eurostar self-sufficiency

package. This makes the Knaus Tabbert Group the world's first vehicle manufacturer to offer a fuel cell as a factory-fitted option in a caravan, although it has been available for some time in its motorhomes [*FCB*, October 2010, p2].

The marine leisure sector is another key market for SFC's fuel cell based energy solutions [*see the feature on SFC Energy in FCB, January 2013*]. Leonardo Yachts in the Netherlands is now offering the EFOY for independent onboard power on its *Eagle 36* and *Eagle 44* luxury daysailers. The boatbuilder sees the greatest benefit for its international clientele in the most powerful fuel cell model, the EFOY Comfort 210, with its charging capacity of up to 2.6 kWh per day.

SFC Energy AG, Brunnthal, Munich, Germany. Tel: +49 89 673 5920, [www.sfc.com](http://www.sfc.com) or [www.efoy-comfort.com](http://www.efoy-comfort.com)

Leonardo Yachts: [www.leonardoyachts.com](http://www.leonardoyachts.com)

## Nilfisk-Advance intros industrial floor cleaner, Plug fuel cell power

**I**n the US, the Nilfisk-Advance Group – a leading manufacturer and distributor of professional floor cleaning equipment – has introduced the first fuel cell-powered industrial combination sweeper-scrubber. The Advance CS7000™ Combination Sweeper-Scrubber Fuel Cell unit was unveiled at the recent ProMat 2013 materials handling expo in Chicago, to meet growing industrial demand for cost-effective, alternative fuel solutions.

'This first-of-its-kind, fuel cell-powered unit provides a sweeper-scrubber solution for customers who have already invested in fuel cell technology, allowing them to further leverage their fuel cell investment and infrastructure,' says Jeff Barna, president and general manager for Nilfisk-Advance in the US. 'Fuel cell technology users can now meet their industrial cleaning needs, while utilising their own hydrogen fuel cell infrastructure.'

Operating solely on hydrogen, the fuel cell-powered Advance CS7000 provides enhanced efficiency, productivity, reliability, simplified maintenance, and 100% indoor emission-free operation – making it an ideal solution for sustainable-driven applications. Additional benefits include rapid refuelling capabilities with no recharge cycle, for 24/7 operation, and simple, two-connection setup for easy fuel cell installation.

Plug Power manufactures the GenDrive® PEM fuel cell used in the Advance CS7000

sweeper-scrubber. The GenDrive power solution is seeing growing deployment in material handling applications for a variety of customers across North America [*see the Plug Power feature in FCB, December 2011*].

Nilfisk-Advance Group: [www.advance-us.com](http://www.advance-us.com) or [www.nilfisk-advance.com](http://www.nilfisk-advance.com)

Plug Power: [www.plugpower.com](http://www.plugpower.com)

### SMALL STATIONARY

## CFCL signs deal with iPower to install units in UK social housing

**A**ustralian-based Ceramic Fuel Cells Ltd has signed a distribution agreement with iPower Energy Ltd in the UK, which will see fully funded installations of the solid oxide fuel cell BlueGen system for social landlords.

CFCL has granted limited exclusivity to energy services company (ESCO) iPower on the basis of minimum deliveries of 200 BlueGen units during 2013, and a further 200 BlueGen units during 2014. The exclusivity is limited to the use of BlueGen to provide ESCO services within the social housing sector in the UK.

Social enterprise iPower develops low-carbon projects, working with a range of technologies to reduce energy bills and carbon emissions. iPower will be able to offer guaranteed discounts on electricity tariffs to social housing tenants where BlueGen is installed. Installations are offered on a turnkey basis and can be fully funded by iPower, which will also supply power and heat to tenants in place of existing suppliers. iPower's aim is to make clean energy affordable to all and return maximum benefits to property owners and tenants, with most of its profits used to help combat fuel poverty and climate change.

The agreement with iPower reflects an increased emphasis for CFCL on BlueGen deployment in the social housing market, a sector where the cost savings associated with BlueGen's high electrical efficiency can have most effect – particularly in apartment blocks, where the electrical output from one system can be shared between up to four apartments. iPower will use a number of regional installation, sales and service partners approved by CFCL in the deployment of BlueGen systems across the UK.

'The use of BlueGen in social housing offers real scope to bring down fuel bills for the least well off in society,' says Jon Cape, CEO of iPower. 'We are already at the detailed design

stage with the first large project under this agreement, and are attracting expressions of interest from a number of councils and housing associations across the UK.'

Ceramic Fuel Cells has sold its BlueGen generator to major utilities and other foundation customers in Germany, the UK, Switzerland, the Netherlands, Italy, Japan, Australia, and the US. The company is also developing fully integrated power and heating products with E.ON UK [*FCB*, December 2011, p3], GdF Suez in France, and EWE in Germany [*FCB*, August 2011, p5].

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Tel: +61 3 9554 2300, [www.cfcl.com.au](http://www.cfcl.com.au)

European Sales Office: Ceramic Fuel Cells BV, Heerlen, The Netherlands. Tel: +31 88 5445 070.

iPower Energy Ltd: [www.ipoweruk.com](http://www.ipoweruk.com)

## Cascadian wins two clean energy telecom contracts in Indonesia

**S**ingapore-based Cascadian, a leading Asian specialist in the integration and deployment of clean energy telecom solutions, has been awarded a contract to deploy methanol-based fuel cells on the island of Kalimantan by Indonesian operator XL Axiata. Cascadian has also signed a multi-year agreement with another Indonesian operator, Telkom International, to deploy and manage prime and backup power to a newly deployed wireless network.

The XL deployment on Kalimantan – the Indonesian part of the island of Borneo – utilises ElectraGen™ ME backup power systems utilising a PEM fuel cell with methanol fuel processor. The fuel cells will ensure backup power to some of XL's most critical sites.

The XL agreement means that Cascadian is now working with more than 10 operators around the world to deploy its Managed Energy Solution (MES™), which is built around the advanced ElectraGen fuel cell technology originally developed by IdaTech in the US, itself now part of Canadian-based Ballard Power Systems [*FCB*, August 2012, p10]. As part of the XL deal, Cascadian will integrate its IntelSite™ monitoring platform to fully manage all aspects of the fuel cell network on a 24/7 basis via its Network Operations Center in the Indonesian capital, Jakarta.

'Operators are beginning to realise that there is no longer a reason to continue to deploy outdated and environmentally harmful

diesel generators for backup power,' says Marshall Towe, CEO of Cascadian. 'Our MES eliminates the risks operators face when deploying new green technologies. Our fixed-price, long-term energy contract provides the very highest level of performance at a total cost of ownership well below that of the outdated and polluting alternatives.'

Meanwhile, Cascadian has signed a multi-year agreement with Indonesian operator Telkom International (Telin), a subsidiary of PT Telkom Indonesia, to deploy and manage its nationwide energy network providing prime and backup power to the newly deployed Timor Leste 3G wireless network. The agreement sees Cascadian deploy a solution that includes methanol-based fuel cells and integrates solar and wind into a full turnkey power solution. Cascadian also will take full responsibility for the management of all aspects of the Telin power solution across multiple vendors under its Managed Energy Solution.

Cascadian says that its solution is far more reliable than conventional power sources, providing wireless operators with much greater network availability, and most importantly increased revenue generation opportunities. The company is already working with operators across Asia who are aggressively adopting various forms of clean energy. It recently signed an agreement to expand the network of hydrogen fuel cells in Indonesia for wireless operator Hutchison CP Telecommunications [*FCB*, November 2012, p4].

Italian-based Acta SpA is also looking to develop the market for telecoms backup power systems in South East Asia, including Indonesia, Malaysia, and Singapore, through the recent appointment of a commercial sales partner, M-Business Resourcing Sdn Bhd (MBR) in Malaysia [*see page 7*].

Cascadian: [www.cascadian.com](http://www.cascadian.com)

XL Axiata: [www.xl.co.id](http://www.xl.co.id)

Telkom International: [www.telin.co.id](http://www.telin.co.id)

Ballard Power Systems: [www.ballard.com/backup\\_power](http://www.ballard.com/backup_power)

## Hy9 partners to grow telecom markets in Asia and Africa

**U**S-based Hy9 Corporation, which provides high-purity hydrogen generation products for use with fuel cells, has announced strategic partnerships with Sankosha Corporation in Japan and Clean Energy Investments in South Africa to develop

## IN BRIEF

### DOE fuel cell bus analysis finds fuel economy up to twice that of diesel buses

A recent report written by the National Renewable Energy Laboratory for the US Department of Energy shows that the fuel economy of fuel cell buses is 1.8–2 times higher than conventional diesel buses (4 mpg) and compressed natural gas buses (3 mpg). This shows significant fuel economy improvement towards the DOE and Federal Transit Administration (FTA) target of 8 mpg (diesel equivalent).

The report – *Fuel Cell Buses in US Transit Fleets: Current Status 2012* – includes data collected from 18 fuel cell buses at three transit agencies: AC Transit and SunLine Transit in California, and Connecticut Transit (CTTRANSIT). In one year, the fleet of fuel cell buses in the study traveled nearly 250 000 miles (400 000 km), and saw almost 25 000 h of fuel cell system operation. One fuel cell power plant has been in operation for more than 12 000 h; this is an advance towards the DOE-FTA interim target of 18 000 h by 2016, and the ultimate target of 25 000 h (equivalent to 4–6 years in service).

Availability varied from site to site, with a low of 53% up to a high of 71%, with the overall average at 57%. Although this is much lower than the target of 90%, it is not unexpected for technology at this stage of development. The reasons for unavailability are mostly attributed to bus-related and battery issues rather than the fuel cell system. While bus performance and fuel cell system durability have continued to improve, there are still challenges to overcome to move fuel cell bus technology to a commercial product.

Access to hydrogen continues to be one of the biggest hurdles to adoption of any fuel cell electric vehicle. Several demonstration projects have been delayed because of fuel access issues. For example, an incident last May at AC Transit's hydrogen station in Emeryville [*FCB*, May 2012, p13] resulted in a temporary suspension of the demonstration while the cause was investigated [*FCB*, June 2012, p13]. The investigation team comprised AC Transit, Linde, the California Air Resources Board (CARB), Sandia National Laboratories, and the Alameda County Fire Department. The incident was attributed to a failed pressure relief device; analysis showed that the nozzle sub-assembly was made of a material that was a poor choice for use with hydrogen.

Report: <http://tinyurl.com/us-fcbus-2012> (PDF)

DOE Fuel Cell Technologies Program:  
[www1.eere.energy.gov/hydrogenandfuelcells](http://www1.eere.energy.gov/hydrogenandfuelcells)

## telecom markets for its products in Asia and Africa, respectively.

Hy9 will work with Sankosha – a leading provider of communications systems and enclosures for the telecom industry, and a global leader in lightning protection systems – to develop the Asian market for reformer-based fuel cell power systems which operate on readily available methanol.

‘Our partnership with Hy9 Corporation creates a strong team in Asia, where hydrogen generation systems are quickly becoming the preferred option to onsite hydrogen storage tanks,’ says Sankosha president Masayoshi Ito. Hy9 and Sankosha will collaborate on integrating fuel cell stationary power systems with Hy9’s HGS onsite hydrogen generators and enclosures for turnkey backup power systems suitable for Asian markets, including dense urban areas and rooftop installations.

‘Sankosha has been serving the telecom and railway markets in Japan, Taiwan, and Korea for over 80 years,’ says Gary Clarke, president and CEO of Hy9. ‘Their knowledge of telecommunication customer requirements and their product and service offerings are an excellent complement to Hy9’s HGS-M™ series hydrogen generator, in providing a solution to carriers’ need for backup power systems other than a diesel generator.’

Meanwhile, Hy9 has also announced a strategic partnership with Clean Energy Investments in South Africa, to facilitate the rollout of stand-alone power systems to enable the deployment of wireless communication systems in sub-Saharan Africa. Clean Energy Investments is already collaborating with California-based Altery Systems to develop and market an integrated methanol fuel processor for use in Altery’s Freedom Power™ PEM fuel cell systems [*FCB*, December 2012, p10].

‘The unique conditions in South Africa and Africa have created a market ready for the adoption of hydrogen fuels. As compressed hydrogen is not always readily available in the majority of African countries, we have partnered with Hy9 to produce hydrogen onsite for our Altery fuel cells,’ says Gavin Coetzer, CEO of Clean Energy Investments. ‘The integrated solution will allow us to promote fuel cells beyond the reach of the present compressed hydrogen distribution network.’

Hy9 and Clean Energy Investments will work to integrate fuel cell systems with Hy9’s HGS onsite hydrogen generators for turnkey backup power systems suitable for African markets, including locations with no grid power. The Hy9 fuel processor converts methanol/water into hydrogen for use with fuel cell systems, eliminating the need for frequent

resupply of hydrogen cylinders required for off-grid locations.

Hy9 also recently signed an agreement with the Dutch fuel cell manufacturer Nedstack to collaborate on developing the market for reformer-based PEMFC power systems [*FCB*, January 2013, p10].

Hy9 Corporation, Hopkinton, Massachusetts, USA.  
Tel: +1 508 435 3789, [www.hy9.com](http://www.hy9.com)

Sankosha Corporation: [www.sankosha.co.jp/en](http://www.sankosha.co.jp/en)

Clean Energy Investments: [www.cleanenergyinvest.co.za](http://www.cleanenergyinvest.co.za)

Altery Systems: [www.altery.com](http://www.altery.com)

## ElectroPS partners with VP Energy in US to boost global reach

**Italian/Singapore-based Electro Power Systems SpA has entered into an exclusive manufacturing, operations, and distribution agreement for the US, Canada, and Mexico with Michigan-based VP Energy LLC. The deal sees EPS expand its reach into the North American market for clean energy storage.**

The decision to partner with an alternative energy solutions provider in the US was fuelled by increasing global use of EPS’s autonomous, self-recharging fuel cell technology to provide clean and efficient energy storage, including grids and renewables extension and optimisation. With its comprehensive coverage of the territory, and expertise in supplying and integrating the Premier UPS fuel cell generators to North America, VP Energy can effectively expand the use of the CSA-certified ElectroSelf™, the world’s only stand-alone, self-recharging energy storage system based on fuel cell technology [*FCB*, March 2012, p3]. VP Energy is also well positioned to integrate EPS technology into comprehensive energy storage and mission-critical support solutions.

ElectroPS is a market leader of fuel cell energy storage solutions based on hydrogen technology, and offers the only autonomous, self-recharging fuel cell system that can effectively and efficiently guarantee always-on power for virtually any application. ElectroSelf is an enabling technology for distributed generation that is optimised for use with renewables. It efficiently stores energy when grid or renewable sources are plentiful, and instantaneously releases energy whenever there is a power outage or when renewable sources are insufficient. Key markets for ElectroSelf include Asia-Pacific, North America, and the EMEA (Europe, Middle East, and Africa) territories that are increasingly focused on

cleantech solutions to fuel growth expectations in a sustainable yet cost-effective manner.

Electro Power Systems supplies fuel cell-based energy storage solutions to some of the world’s largest players in the telecom, utility, system integration, security, and business continuity sectors, as well as organisations requiring power protection for mission-critical applications. EPS recently moved its strategic headquarters to Asia, with R&D and operations being managed from its Italian engineering facilities [*FCB*, November 2012, p10]. The company also has branches in the UK and India, and expects to have its own presence in China shortly.

Electro Power Systems SpA, Torino, Italy.  
Tel: +39 011 225 8211, [www.electrops.it](http://www.electrops.it)

Electro Power Systems Group, Singapore.  
Tel: +65 6557 2609, [www.electropowersystems.com](http://www.electropowersystems.com)

VP Energy LLC, Brighton, Michigan, USA.  
Tel: +1 810 588 4800, [www.vpenergy.com](http://www.vpenergy.com)

## Ballard sees rising orders for fuel cell telecom backup power

**Canadian-based Ballard Power Systems is seeing positive indicators of momentum in the fuel cell backup power market, with increasing new and repeat orders from telecom network operators. In December and early January the company received orders for more than 400 ElectraGen™ fuel cell systems from distribution partners that deliver systems for deployment in African and Asian telecom networks [see *Cascadian* item on page 5].**

These orders represent growing traction for Ballard’s ElectraGen family of fuel cell backup power systems, both direct hydrogen- and methanol-fuelled, driven by the recognition of inherent value offered at an attractive life-cycle cost. The addition of a methanol-fuelled product line is already paying dividends.

Ballard’s ElectraGen-ME methanol-fuelled systems are particularly well suited for extended-runtime backup power requirements. These systems are designed for high reliability, long life, and minimal ongoing maintenance. They represent a majority of the systems ordered since Ballard acquired key assets – including the methanol-fuelled product line – from IdaTech last summer [*FCB*, August 2012, p10]. ElectraGen-ME systems include a fuel reformer that converts HydroPlus™ fuel – a methanol-water liquid mixture – into hydrogen gas to power the fuel cell system.



During the recent difficult circumstances presented by Hurricane Sandy, 17 Ballard ElectraGen-ME methanol fuel cell systems were put to the test in the Bahamas mobile telephone network when the storm downed power lines and cut off grid power [*FCB*, December 2012, p5]. Each of the 5 kW systems operated flawlessly for the three days it took for Hurricane Sandy to pass over the Bahamas. To date, more than 2000 Ballard backup power systems have been shipped for deployment in telecom networks around the globe.

Ballard Power Systems, Burnaby, BC, Canada.  
Tel: +1 604 454 0900, [www.ballard.com](http://www.ballard.com)

## Acta partnership and order in Indonesia, adds production space

**I**talian-based Acta SpA has appointed a commercial sales partner, M-Business Resourcing Sdn Bhd (MBR) in Malaysia, to address the market for telecom backup power systems in South East Asia, including Indonesia, Malaysia, and Singapore. Acta has also increased its manufacturing capacity by renting extra production space adjacent to its current facility.

MBR is a business development agency specialising in the South East Asia telecom market. Acta has been working with MBR to develop opportunities in the Asian backup power sector, and has now engaged MBR as its commercial partner for this regional telecoms market. Acta recently signed a deal with MVS Engineering Ltd to distribute Acta's electrolyser in India [*FCB*, January 2013, p9].

In addition, Acta says that the partnership with MBR has brought in its first purchase order, for an electrolyser to be shipped for evaluation for telecom backup power applications in Indonesia. The order, for a rack-mounted 300 litre/h electrolyser unit, has been received from PT Cascadian Indonesia, a 'green' energy solutions integrator with offices throughout Asia, the Middle East, and Africa. Cascadian recently won contracts to deploy methanol-based fuel cell backup power systems – supplied by Ballard Power Systems – with Indonesian telecoms operator XL Axiata [*see page 5*] and PT Hutchison CP Telecommunications [*FCB*, November 2012, p4].

Indonesia is a leading market for fuel cell backup power systems for the telecom sector, both grid-based and off-grid, driven by the sector's rapid development and a fragile grid infrastructure. Its largest mobile operator, Telkomsel, was operating

more than 51 000 base stations at the end of 2012, which it expects to grow to 66 000 during 2013. Grid outages in the capital Jakarta occur on average for 50 hours per month.

'The ability to self-recharge hydrogen onsite provides significant advantages over the logistics of hydrogen delivery, particularly to the many remote locations found in Indonesia,' says Mark Shiels, managing director of MBR. 'As there are over 500 deployments of fuel cells already in place, Acta's electrolyser provides significant savings and advantages to anyone using or considering adopting fuel cells. In addition, Acta's AES electrolyser stack technology and system efficiencies meet the requirements of the growing demand for off-grid solar and renewable powered sites.'

Meanwhile, Acta has increased its production capacity by signing an agreement for an extra 600 m<sup>2</sup> of rented production space adjacent to its current facility near Pisa. By December the company's order rate had exceeded its current production capacity, which has created a need for more production space to enable the reorganisation and expansion of production processes [*see the feature on Acta in FCB*, September 2012].

An additional advantage of the new production facility contract is that it also allows for further capacity expansion in the future. The warehouse has an additional 600 m<sup>2</sup> of production space available under an option arrangement.

Acta SpA, Crespina, Pisa, Italy. Tel: +39 050 644281, [www.actagroup.it](http://www.actagroup.it)

M-Business Resourcing: [www.mbrglobal.com](http://www.mbrglobal.com)

### LARGE STATIONARY

## FuelCell Energy in power plant service deal with Swiss utility

**G**erman-based FuelCell Energy Solutions GmbH (FCES) has entered into a multi-year service agreement for a stationary fuel cell power plant owned by Elektrizitätswerk der Stadt Zürich (ewz), the municipal electric utility company for Zürich in Switzerland. FCES will operate and maintain the power plant in close collaboration with ewz, and will supervise the plant from its European operations centre in Dresden.

The ewz project team is closely involved in the operation and assessment of its stationary fuel cell power plant, to study the minimal

emissions, high electrical efficiency, and operational flexibility. ewz is among the largest energy utility companies in Switzerland, supplying electricity for the city of Zürich as well as parts of the Graubünden canton.

'This fuel cell power plant, operating since November 2010, is the first carbonate fuel cell installation utilised in Switzerland,' says ewz director Marcel Frei. 'We are performing an assessment of this carbonate fuel cell power plant to evaluate the electricity and heat output, the operating costs, and the integration with the gas network for the fuel supply.'

The existing plant will be serviced by FCES, including the scheduled replacement of the molten carbonate fuel cell stack, during the 10-year term of the service agreement. FCES, with its German manufacturing base, is the sales, manufacturing and service business for the European Served Area for Connecticut-based FuelCell Energy Inc.

FCES offers a comprehensive portfolio of services for stationary fuel cell power plants with multi-year service agreements. Highly trained technicians and engineers remotely operate and maintain the fuel cell power plants 24/7, with field service technicians providing onsite servicing. These service offerings transfer the plant performance responsibilities to FCES, providing customers with certainty of costs and power supply.

FCES recently sold a DFC300-EU molten carbonate fuel cell power plant for installation at the 20 Fenchurch office development in central London, UK [*FCB*, December 2012, p4]. The 300 kW Direct FuelCell® power plant will be installed in 2013, and commissioned for the building completion in 2014.

FuelCell Energy Solutions GmbH, Dresden, Germany. Tel: +800 100 5060 (international tollfree), [www.fc-es.de/en](http://www.fc-es.de/en)

FuelCell Energy Inc, Danbury, Connecticut, USA.  
Tel: +1 203 825 6000, [www.fuelcellenergy.com](http://www.fuelcellenergy.com)

ewz: [www.stadt-zuerich.ch/ewz](http://www.stadt-zuerich.ch/ewz) (in German)

## UTC Power PureCell systems for Lotte World Tower in Seoul

**S**amsung Everland in South Korea has purchased two PureCell® Model 400 fuel cell systems from US-based UTC Power, to be installed at the Lotte World Tower, Korea's first super-tall skyscraper. The fuel cell power plants will be installed in the basement of the tower, and provide 800 kW of clean, efficient power to the building's Lotte World Mall.

On completion in 2015, the Lotte World Tower will be one of the tallest skyscrapers in the world, and house the tallest observation deck on its 123rd floor at 498 m above the ground. The mixed-use building will include retail outlets, offices, residences, a luxury hotel, and public access floors.

The PureCell system is a proven solution to today's energy challenges [see the feature on the UTC Power Model 400 in *FCB*, February 2012]. The power plant is already in use with Korean utilities – last autumn Samsung Everland purchased seven PureCell Model 400 phosphoric acid fuel cell power plants from UTC Power for installation at the Korean South East Power Co (KOSEP) facility in Bundang, south of Seoul [*FCB*, December 2012, p4]. This installation is UTC Power's first building application in the country, and the first indoor fuel cell installation in Korea.

'This first building application in Korea is an important milestone for the PureCell system, and is a testament to the proven performance of our other fuel cell installations in the country,' says Eric Strayer, general manager of international sales at UTC Power.

In addition to providing power to help meet Korea's Renewable Portfolio Standard (RPS), the PureCell systems will be supported locally by its Korean subsidiary, UTC Power International Services – Korea. This Seoul-based fuel cell services company is staffed with dedicated PureCell system technicians, to serve UTC Power's growing installed capacity in Korea.

UTC Power is in the process of being acquired by Oregon-based ClearEdge Power [*FCB*, January 2013, p8].

UTC Power, South Windsor, Connecticut, USA.  
Tel: +1 860 727 2200, [www.utcpower.com](http://www.utcpower.com)

Samsung Everland: [www.samsungeverland.com/eng](http://www.samsungeverland.com/eng)

## PORTABLE & MICRO

### Lilliputian Systems, Brookstone launch Nectar mobile power

**M**assachusetts-based Lilliputian Systems and its partner Brookstone, a lifestyle specialty retailer, launched the Nectar™ Mobile Power System at the recent Consumer Electronics Show (CES) in Las Vegas. This micro fuel cell portable power solution provides two weeks or more of energy for consumer electronics devices, to overcome the modern curse of battery anxiety.

The Nectar system is a compact, lightweight, and highly portable device that powers and charges almost all consumer electronic devices – smartphones, tablets, mp3 players, eReaders, Bluetooth headsets, digital cameras etc. – that comply with the USB 2.0 power standard. This is achieved by inserting a single Nectar Pod™ butane cartridge into the mobile power system, which Lilliputian says will give consumers 10 times the runtime compared with traditional chargers. The pods are convenient and easy-to-use; once a pod has been depleted, the user simply attaches a new pod, for another fortnight of power.

The Nectar Mobile Power System was awarded the prestigious CES Innovations Award for Design and Engineering in the Portable Power category. Both the Nectar Mobile Power System and Nectar Pod cartridges have been approved for carry-on and use onboard regular commercial aircraft by the UN International Civil Aviation Organization (ICAO) and the US Department of Transportation.

The Nectar system is currently undergoing advanced testing prior to its commercial availability this summer. It will initially be exclusively available at Brookstone stores and via [Brookstone.com](http://Brookstone.com), retailing for \$300 with cartridges costing \$10 each. Last June Lilliputian announced a strategic partnership with Brookstone, as the first Nectar retail launch partner to commercialise and accelerate widespread distribution [*FCB*, June 2012, p9].

In other news, Lilliputian has elevated longtime CEO Ken Lazarus to chairman of the board. Pete Simone – who has been involved with the company for many years, including serving on its consumer electronics advisory board – has taken over as interim CEO. The company plans to recruit a permanent CEO with experience of high-growth technology companies, as well as in consumer electronics and retail.

The company's patented Silicon Power Cell™ technology is based on highly efficient solid oxide fuel cells and microelectromechanical system (MEMS) wafer fabrication methods, including key nanotechnology elements, and is fuelled by recyclable, high-energy butane cartridges.

Lilliputian Systems Inc, Wilmington, Massachusetts, USA. Tel: +1 978 203 1700, [www.nectarpower.com](http://www.nectarpower.com)

Brookstone: [www.brookstone.com](http://www.brookstone.com)

## FUELLING

### First UK integrated hydrogen transport system in London, SE

**A** consortium of companies in the UK with expertise in hydrogen

### transport infrastructure is launching the London Hydrogen Network Expansion (LHNE) project, to roll out the UK's first hydrogen powered transport system across London and the South East.

The consortium, led by Air Products, will deliver a publicly accessible, state-of-the-art, fast-fill 700 bar (10 000 psi) renewable hydrogen fuelling station network. The three-year LHNE project – co-funded by the Technology Strategy Board – will also deploy new hydrogen vehicles in London, including a number of Hyundai hydrogen fuel cell electric vehicles (FCEVs) as well as hydrogen internal combustion engine (HICE) vans from Revolve Technologies.

Creating this network is particularly important because the major automakers have confirmed that the hydrogen vehicles available for purchase in the UK from 2014–15 will require 700 bar fuelling systems. The LHNE project will upgrade the existing fuelling station located at Heathrow Airport to 700 bar [*FCB*, August 2012, p7], and deliver a new hydrogen station to this specification in London. In addition, the project will increase accessibility to the dual-pressure hydrogen fuelling station at Millbrook Proving Ground in Bedfordshire [*FCB*, September 2012, p6], and at the Transport for London hydrogen station in Stratford in east London.

These developments will create the first network of 700 bar hydrogen stations in the UK, ready to meet increasing demand for hydrogen fuelling. The functionality of this network will then be proved by a fleet of HICE vans which will be operated by Commercial Group as part of its delivery network.

'The LHNE project will bring together all the components necessary to make hydrogen transport possible across London and the South East,' explains Diana Raine, European business manager for hydrogen energy at Air Products. 'We hope that this project will act as an exciting demonstration model to be replicated across the UK and Europe in years to come.'

The LHNE consortium comprises Air Products, Cenex – Centre of Excellence for low carbon and fuel cell technologies, Commercial Group, Element Energy, Heathrow Airport, and Revolve Technologies (which provided the HICE vans for the Hydrogen On Site Trial project run by ITM Power [*FCB*, March 2011, p8]).

The project is co-funded by a grant from the UK's innovation agency, the Technology Strategy Board. It is one of five R&D projects selected by the Technology Strategy Board last July to help accelerate the adoption of energy systems using hydrogen and fuel cell technologies, bringing them into everyday use [*FCB*, July 2012, p1]. The Mayor of London and the Greater London Authority will play a supporting role in the project.



The UK<sub>H<sub>2</sub></sub>Mobility project [see page 1] was launched a year ago to ensure the UK is well placed to handle the commercial rollout of hydrogen FCEVs to consumers by 2015 [FCB, January 2012, p1]. This initiative brings together government departments and 13 industrial partners from the utility, gas, infrastructure, and global car manufacturing sectors.

Air Products, Hydrogen Energy:  
www.airproducts.co.uk/h2energy

Cenex, Centre of Excellence for low carbon and fuel cell technologies: www.cenex.co.uk

Commercial Group: www.commercial.co.uk

Element Energy: www.element-energy.co.uk

Greater London Authority: www.london.gov.uk/hydrogen

Heathrow Airport, Sustainability:  
http://tinyurl.com/d8ym6ub

Revolve Technologies: www.revolve.co.uk

Technology Strategy Board: www.innovateuk.org

Hyundai, Zero-Emission Vehicles:  
http://tinyurl.com/hyundai-zevs

## Quantum partners with Linde to supply hydrogen dispensers

**I**n the US, California-based Quantum Fuel Systems Technologies Worldwide – which develops and supplies natural gas, alternative fuel systems, and clean propulsion vehicle technologies – has received an initial purchase order from Linde LLC for gaseous hydrogen refuelling systems.

This is the first order for Quantum Technologies under a three-year partnership agreement with the gases and engineering company, the US affiliate of The Linde Group, covering the supply and commissioning of compressed hydrogen refuelling dispensers.

The hydrogen systems will be specially designed, built, and commissioned in support of Linde's US-based hydrogen refuelling station projects. The systems will support refuelling at both 5000 and 10 000 psi (350 and 700 bar) service pressures, and will come integrated with a remote gas management system, authentication, and point-of-sale systems. Quantum holds multiple patents related to hydrogen fuelling systems, and has designed and built 13 systems for General Motors, Shell Oil, the US Army, AeroVironment/NASA, and others in support of hydrogen fuel cell programmes.

Linde is spending millions of dollars on California-based companies in the deployment of hydrogen fuelling stations [FCB, May 2012,

p13 and July 2010, p8], and this expands that investment in the state via the design and build of a critical component of the station – the hydrogen fuelling dispenser,' says Steve Eckhardt, Linde's head of business development for alternative energy. 'The Linde-Quantum partnership agreement will create jobs and expand technology development in California.'

Quantum Technologies' portfolio includes natural gas and hydrogen storage and metering systems, electronic and software controls, hybrid electric drive systems, and other alternative fuel technologies and solutions for natural gas and hybrid, plug-in hybrid electric and fuel cell electric vehicles. Its powertrain engineering, system integration, vehicle manufacturing, and assembly capabilities support the development of natural gas, plug-in hybrid, hydrogen-powered hybrid, fuel cell, and specialty vehicles, as well as modular, transportable hydrogen refuelling stations.

Quantum Fuel Systems Technologies Worldwide, Lake Forest, California, USA. Tel: +1 949 930 3400, www.qftw.com

Linde US Industrial Gases, Hydrogen Energy:  
http://tinyurl.com/linde-us-h2energy

## McPhy acquires Italian electrolysis firm PIEL, wins €10m investment

**T**he French solid-state hydrogen storage developer McPhy Energy has acquired PIEL, an Italian pioneer in hydrogen generators based on electrolysis of water. The acquisition enables McPhy to couple the production and solid-state storage of hydrogen. McPhy has also received a further €10 million (US\$13.4 million) increase in its capital base, half of it coming from the Ecotechnologies fund, managed by CDC Entreprises on behalf of the French government.

McPhy's acquisition of PIEL – a division of the ILT Technology Group, based near Pisa – is an important milestone in the deployment and accessibility of its magnesium hydride-based technologies, enabling the company to uniquely pair the production and solid-state storage of hydrogen.

PIEL brings its know-how in alkaline hydrogen generators, connected directly to the grid or to renewable energy sources, with more than 3000 installations in service at more than 1000 customers worldwide. The integration of these technologies makes 'green' hydrogen generation accessible to clients at the point of

use and/or the storage of renewable energy, with modular systems adaptable to users' demands and needs.

The integration of PIEL into McPhy Italia represents an enormous growth opportunity for both companies. PIEL brings generators and industrial clients to McPhy, while gaining access to McPhy's storage technology and customers in the energy markets. PIEL will also benefit from additional financing that will enable the company to accelerate projects under development.

'The integration of these two systems enables us to put an ultra-flexible offer on the market for our clients,' says Adamo Screni, executive VP of sales, and president of McPhy Energy's new Italian subsidiary. 'We can hereby facilitate access to hydrogen onsite for industrial hydrogen users, by creating a very clean, straightforward, and economical offer that is much more attractive than current solutions. For the energy storage market, this is an 'all-in-one' solution, which optimises an installation's global yield.'

In other news, the Ecotechnologies fund has made its second investment in McPhy, worth €5 million, to support its commercial development following the PIEL acquisition. This investment is part of a €10 million capital increase completed by existing investors Emertec Gestion, Sofinnova Partners, Gimv, Arevadelfi, and Clipperton Finance.

McPhy has already made initial commercial deliveries to leading industrial and energy players and universities, such as Enel in Italy [FCB, March 2011, p9], Iwatani in Japan [FCB, April 2011, p7], E.ON, and the University of Nottingham in the UK [FCB, October 2011, p8]. McPhy is also supplying its hydrogen storage technology to a Total hydrogen fuelling station at the new BER international airport in Berlin [FCB, January 2013, p6]. Last summer the company expanded its European operations with a new subsidiary in Germany [FCB, June 2012, p12].

McPhy Energy, La Motte-Fanjas, France.  
Tel: +33 4 7571 1505, www.mcphy.com

PIEL, Ponsacco, Pisa, Italy. Tel: +39 0587 73741, www.piel.it

Ecotechnologies fund: http://tinyurl.com/aurskxx (in French)

## COMMERCIALISATION

### Connecticut invests in Advent Technologies to move from Greece

**C**onnecticut Innovations (CI), the state's quasi-public authority responsible for growing Connecticut

**businesses through innovative financing and strategic assistance, has made a \$1 million investment in Advent Technologies, to encourage the high-temperature PEM fuel cell developer to relocate its headquarters from Greece to Connecticut, while maintaining R&D operations overseas.**

CI is investing in Advent Technologies Inc of East Hartford, Connecticut, the parent company of Advent Technologies SA, through its Eli Whitney Fund. This investment is part of a \$2.3 million funding round also involving Piraeus Capital Management, Systems Sunlight, Velti, and individual investors.

Advent Technologies will relocate its headquarters to Connecticut, where it will establish R&D and manufacturing operations, while maintaining R&D operations overseas. Advent was founded in Greece in 2005 by researchers from the Foundation for Research & Technology – Hellas and the University of Patras. Russell Tweeddale, CI managing director of investments, joins Advent's board of directors as chairman.

Advent develops and produces materials, components, and systems for renewable energy applications. Its current focus is the development and production of high-temperature proton-exchange membranes (HTPEMs), high-temperature membrane-electrode assemblies (HTMEAs), and other HTPEM fuel cell products and systems. Its products are designed for use in electricity generation and hydrogen cleanup.

Many of Advent's products incorporate its proprietary HTPEM, Advent TPS®, which uses a unique pyridine-based polymer electrolyte. Advent TPS is used as a building block for the company's HTMEAs and fuel cell stacks, which operate in a temperature range that enables their use with traditional fuels such as natural gas, propane, biofuels, and military fuels.

Current and potential applications for Advent's components and HTPEM fuel cells include combined heat and power (CHP) applications for residential and small business use, anti-idling applications (e.g. powering truck radios and charging phones in parked trucks), and military applications (e.g. charging and powering portable electronic devices, such as radios, computers, and night-vision goggles).

Advent Technologies Inc, East Hartford, Connecticut, USA. Tel: +1 860 291 8832, [www.advent-energy.com](http://www.advent-energy.com)

Advent Technologies SA, Marousi, Athens, Greece. Tel: +30 210 637 8820.

Connecticut Innovations: [www.ctinnovations.com](http://www.ctinnovations.com)

## Ballard sells Material Products Division to newly formed AvCarb

**Canadian-based Ballard Power Systems has announced the completion of an agreement to sell its Material Products division in Lowell, Massachusetts, raising up to US\$12 million. The division's assets were purchased by investment group ALY Holdings LLC, in partnership with the unit's senior management, through a new company, AvCarb LLC.**

Ballard says that the sale will fortify its balance sheet. The company received \$10.5 million in cash on completion, with the remainder payable on the basis of 2013 financial results associated with the Material Products division.

Substantially all the assets of the Material Products division were purchased by Boston-based ALY Holdings in partnership with the division's senior management. A new company, AvCarb, has been established as a result of the transaction, at the same location.

'The Material Products division is a non-core asset, with the majority of its sales generated in industrial sectors not related to fuel cells,' explains Ballard's CFO, Tony Guglielmin. 'We believe this transaction represents the best outcome in terms of sale proceeds and continuity of supply, with no shareholder dilution. As well, the sale enables a singular focus on our higher-growth fuel cell product markets.'

Ballard's fuel cell product revenue has experienced significant growth in recent years, led by applications in telecom backup power and materials handling [see page 6]. Sales in these markets have led to a 30% annual revenue growth rate over the past three-year period for the company's fuel cell products.

In addition to the manufacture of carbon friction materials for various industrial applications, AvCarb also manufactures gas diffusion layer (GDL) materials used in the production of hydrogen fuel cells. Under a supply agreement, AvCarb will continue to make GDL materials available to Ballard for use in its PEM fuel cell products.

'We will focus on serving our customers' evolving needs for engineered carbon materials, while continuing to support fuel cell customers, including Ballard, with advanced GDL material,' says Roger Masse, president of AvCarb. 'The experience and philosophy of the ALY Holdings team is also a great fit with our management group and with the business.'

Ballard Power Systems, Burnaby, BC, Canada.  
Tel: +1 604 454 0900, [www.ballard.com](http://www.ballard.com)

AvCarb Material Solutions, Lowell, Massachusetts, USA. Tel: +1 978 934 7500, [www.avcarb.com](http://www.avcarb.com)

## Cummins makes strategic investment in ReliOn

**US engine giant Cummins Inc has made a strategic investment in Spokane-based ReliOn, which provides high-reliability fuel cell solutions for backup power and grid-support applications. As part of this investment, Cummins will be represented on the ReliOn board of directors.**

ReliOn is a leading developer of modular, fault-tolerant PEM fuel cell technology utilised in a range of stationary fuel cell systems for emergency and backup power, uninterruptible power supplies, digital power, and off-grid power for customers such as major telecom providers, government communication sites, and utilities.

Last summer, Alpha Energy integrated a ReliOn E-2500™ hydrogen PEM fuel cell system into its Hybrid Power System Test Facility in Bellingham, Washington, in anticipation of evaluating the system for implementation in future Alpha Energy projects [FCB, September 2012, p4]. That followed the launch of ReliOn's E-1000x and E-2200x products, which address the need for high duty cycle grid-support where alternative power products support a less reliable or non-existent electrical grid [FCB, August 2012, p5].

'Cummins is a global leader in power generation and, as such, will be an excellent partner to work with ReliOn as we continue our global market expansion,' says Gary Flood, CEO of ReliOn. 'Additionally, Cummins will use its broad capabilities in engineering and manufacturing to accelerate ReliOn's efforts to drive costs down and increase the distribution reach of our fuel cell products around the world.'

Cummins comprises a number of business units that design, manufacture, distribute, and service engines and related technologies. In 2010, working with Protonex Technology, Cummins Power Generation demonstrated a tubular solid oxide fuel cell in a hybridised auxiliary power unit configured to power the 'hotel loads' on a truck, running on commercial diesel [FCB, May 2010, p1].

ReliOn, Spokane, Washington, USA.  
Tel: +1 509 228 6500, [www.relion-inc.com](http://www.relion-inc.com)

Cummins Inc: [www.cummins.com](http://www.cummins.com) or [www.cumminspower.com](http://www.cumminspower.com)

## RESEARCH

## AFC Energy extends electrode life, research tie-up with Lancaster

**I**n the UK, AFC Energy reports that it has extended the longevity of its alkaline fuel cell electrodes to more than six months of continuous operation at its laboratory. The company has also established a new research relationship with the engineering department at Lancaster University, as well as expanding fuel cell test capabilities at its base in Surrey.

The milestone six months' longevity was achieved using a generation of electrodes developed a year ago, and is significant since AFC Energy believes that the first industrial applications will require a minimum of three months' electrode life to be economic [*FCB*, June 2012, p7]. This depends on the level of subsidy available in key markets, particularly in the Far East – such as in South Korea – where the company is pursuing a strategy with industrial partners.

'We have made innovative use of commercially available materials to make advances in this regard,' says technical director Dr Gene Lewis. 'We are continually working on additional performance improvements to longevity, power output, and overall system lifetime cost.'

This longevity means that these applications have the potential to generate significant revenues for AFC Energy, while also opening up new commercial opportunities in additional territories such as Germany, where the company is already carrying out trials with AkzoNobel [*FCB*, January 2012, p4]. And last summer AFC announced that it will build a 1 MW alkaline fuel cell facility – the largest in the UK – at the Industrial Chemicals Ltd chlor-alkali plant in Essex [*FCB*, June 2012, p1].

The link-up with Lancaster University will allow AFC Energy to draw on the expertise of one of the UK's leading research universities, and re-establish its relationship with former AFC employee and fuel cell expert Dr Richard Dawson. A team led by Dawson, who is still retained as an AFC consultant, will be asked to undertake research and testing to help the company better understand how alkaline fuel cells operate using different hydrogen feedstocks.

AFC Energy has also undertaken a further expansion of its fuel cell test capability, since each electrode is now likely to spend longer on test. The increased capability will support the company's product development programme as it continues its work on extending the longevity and

power output of its proprietary electrodes [see the feature on AFC Energy in *FCB*, November 2011].

AFC Energy, Cranleigh, Surrey, UK.  
Tel: +44 1483 276726, [www.afcenergy.com](http://www.afcenergy.com)

Lancaster University, Engineering Department:  
[www.engineering.lancs.ac.uk](http://www.engineering.lancs.ac.uk)

## European FCH Joint Undertaking launches €68m proposals call

**T**he European Fuel Cells and Hydrogen Joint Undertaking (FCH JU) has published its 6th annual call for proposals, which has a budget of €68.5 million (US\$92 million) according to its Annual Implementation Plan 2013.

The Annual Implementation Plan is the result of a joint effort by the three major FCH JU stakeholders – the Industry Grouping (NEW-IG), Research Grouping (N.ERGHY), and European Commission.

The overall programme of the FCH JU is divided into four major horizontal application areas: transportation & refuelling infrastructure; hydrogen production, storage & distribution; stationary power generation & CHP; and early markets. Cross-cutting activities have also been established as a fifth area, to make their relevance more visible.

The estimated distribution to the key topics in the 2013 call for proposals is €23 million for transportation & refuelling infrastructure, €7.5 million for hydrogen production & distribution, €24 million for stationary power generation & CHP, €9 million for early markets, and €5 million for cross-cutting issues.

The deadline for applications is 22 May. Evaluation is expected to take place in June, and applicants will be informed of the results in July. Projects selected for contract negotiations will be announced in September.

In other news, a report has been published on the public consultation on the preparation of the FCH JU under the European Commission's Horizon 2020 framework for R&D for the period 2014–2020. The public consultation was conducted between July and October 2012.

European Fuel Cells and Hydrogen Joint Undertaking:  
[www.fch-ju.eu](http://www.fch-ju.eu)

FCH JU 2013 call for proposals:  
<http://tinyurl.com/fch-ju-call-2013>

FCH JU Annual Implementation Plan 2013:  
<http://tinyurl.com/fch-ju-plan-2013> (PDF)

Consultation report:  
<http://tinyurl.com/fch-ju-consultation> (PDF)

## IN BRIEF

### DOE Hydrogen, Fuel Cells 2012 progress

The US Department of Energy's Hydrogen and Fuel Cells Program has recently published its 2012 Annual Progress Report (<http://tinyurl.com/bca7ntv>), which contains reports from projects funded by the programme.

The Program engages in research, development, and demonstration (RD&D) of critical improvements in hydrogen and fuel cell technologies, as well as diverse activities to overcome economic and institutional obstacles to commercialisation. In Fiscal Year 2012, Congress appropriated \$136 million for the Program, which is organised into distinct sub-programmes focused on specific areas of RD&D.

### PATH report sees global hydrogen, fuel cell sector growing 26% annually to 2023

The global fuel cell and hydrogen energy market is projected to be worth over US\$180 billion in 2050, and revenues in the fuel cell sector will grow at 26% per annum over the next decade, according to the Partnership for Advancing the Transition to Hydrogen ([www.hpath.org](http://www.hpath.org)). The 2011–2012 Annual Report on World Progress in Hydrogen is PATH's second report covering the fuel cell market.

Data contributed by members of PATH – the international coalition of national hydrogen associations – forecast that worldwide employment in the sector will rise to 700 000 by 2019, and FCEVs on US roads are anticipated to rise from 430 in 2010 to more than 53 000 by 2017.

The report (\$200 download, \$250 CD-ROM, \$300 hard copy) examines the status of current and planned hydrogen and fuel cell projects, government funding and legislation for the industry, existing educational programmes, and events that showcase hydrogen and fuel cell products. It also provides an analysis of the challenges the community still faces, and offers strategies for best practices for industry development.

### Call for abstracts for SOFC-XIII in Japan

The 13th International Symposium on Solid Oxide Fuel Cells (SOFC-XIII) will be held 6–11 October 2013 at the Okinawa Convention Center in Okinawa, Japan. The Symposium will provide an international forum for the presentation and discussion of the latest R&D on SOFCs and related topics.

Papers are solicited on all aspects of SOFCs, including materials, fabrication methods, cell and stack designs, electrochemical performance, modelling, utilisation of different fuels with or without reformation, stationary power generation, transportation, military applications, prototype SOFC systems, field test experience, cost, commercialisation plans, and high-temperature electrolysis.

Abstracts should be submitted online ([www.sofc-xiii.com](http://www.sofc-xiii.com)) by 1 April.



# Hydrogen transport infrastructure: How industry is preparing for the arrival of affordable fuel cell vehicles

By Diana Raine – European Business Manager for Hydrogen Energy Systems, Air Products, UK

**Europe is getting closer to the creation of a hydrogen transport infrastructure, as the car industry looks to introduce affordable hydrogen fuel cell electric vehicles (FCEVs) on our roads from 2014–15. This article looks at how Air Products is building on its long experience in the hydrogen industry to form a clear strategy on how a hydrogen transport infrastructure can be rolled out across Europe.**

The creation of a hydrogen transport infrastructure in Europe is closer than ever. The car industry is confident that affordable hydrogen fuel cell electric vehicles (FCEVs) will begin appearing on our roads from 2014–15, and the hydrogen infrastructure industry has demonstrated – across the globe – that fuelling technology is already being rolled out.

Air Products is the leading global supplier of hydrogen to refineries that assists in producing cleaner-burning transportation fuels, and has vast experience in the hydrogen fuelling industry. As such, Air Products has been building infrastructure, proving technology, and developing a strategy to support the

rollout of hydrogen-powered transport. To date, Air Products has built more than 150 fuelling stations in 19 countries worldwide, undertaking over 500 000 safe fuellings every year.

Building on many years of experience in the hydrogen industry, we have formed a view of how hydrogen transport infrastructure will develop across Europe. Hydrogen infrastructure needs to be rolled out in a way that will allow fuel cell electric vehicles, when they are deployed en masse, to be put immediately into practical use. Stations are being deployed in strategic sites in line with committed vehicle deployment, creating clusters of stations and

vehicles. As more and more vehicles roll out, these clusters can, in the longer term, be connected up to provide national infrastructure coverage.

## London and the cluster approach

Air Products has been working in this way, as demonstrated by the network of hydrogen fuelling stations we are establishing in London.

In Stratford in east London, Air Products supplies the hydrogen and a dedicated fuelling station that currently fuels five hydrogen fuel cell buses (increasing to eight in 2013). This is one of the largest and most successful bus trials of this kind in Europe. In July 2012, the hydrogen buses – operated by FirstGroup – were fuelled for the 1000th time at the Air Products fuelling station. The hydrogen buses are now an established fixture of the Transport for London bus network, running on the scenic RV1 route – the first fully hydrogen bus route – which takes them past major London landmarks including Tower Bridge, the London Eye, and Covent Garden.

***'This is one of the largest and most successful bus trials of this kind in Europe'***

Also in London, working alongside the Greater London Authority, Air Products has been coordinating the HyTEC (Hydrogen Transport in European Cities) project, supported by the Fuel Cells and Hydrogen Joint Undertaking (FCH JU). This project saw Air Products install a new fuelling station at Heathrow Airport [Figure 1], the first phase of which was to fuel hydrogen fuel cell taxis that



Figure 1. The Air Products hydrogen fuelling station at Heathrow Airport – part of the HyTEC project – was used to fill up fuel cell taxis that transported VIPs around London during the 2012 Olympic Games.

transported VIPs around London during the 2012 Olympic Games. Further fuelling of taxis and passenger vehicles is expected throughout 2013 and 2014.

Air Products will continue to support the expansion of a hydrogen fuelling network in London, and plans to deploy a further station in 2013 [see the news item on the *London Hydrogen Network Expansion* on page 8]. With the beginnings of this network in place, it will be possible for a number of fleets of buses, cars, and other vehicles to build a real presence for hydrogen transport in London.

By providing stations that can fuel a variety of different fuel cell electric vehicles, Air Products has assisted vehicle users in reducing carbon emissions, as well as nitrous oxide (NO<sub>x</sub>) emissions, a major contributor to poor air quality in London. As well as continuing to invest in the research and development that keeps improving hydrogen infrastructure technology, we are looking forward to the ultimate transition to the use of renewably produced 'green' hydrogen, thereby creating zero-emissions, well-to-wheel transport in the capital.

As well as its work in London and the UK, Air Products is committed to expanding the hydrogen fuelling network in Germany. Together with industry partners of the Clean Energy Partnership, Air Products has signed a letter of intent in Berlin to provide state-of-the-art SmartFuel™ hydrogen fuelling stations to a planned network of stations supported by the German Federal Ministry of Transport, Building and Urban Development (BMVBS). The plan aims to extend the existing infrastructure up to 50 fuelling stations by 2015. The hydrogen stations are to be built in metropolitan regions and along corridors connecting these regions, thereby supporting the initial rollout of FCEVs.

## The HyTEC project

The first phase of the HyTEC project was designed to showcase hydrogen transport technology during the London 2012 Olympics. The HyTEC consortium delivered a new hydrogen fuelling station, the second in London, near Heathrow Airport, and five hydrogen fuel cell powered London black cabs for use by VIP guests of the Greater London Authority.

During the Games, the taxis travelled a total of 2500 miles (4000 km) while transporting 40 visiting dignitaries. High-profile individuals taking a trip in the cabs included Arnold Schwarzenegger – a keen hydrogen advocate as the former Governor of California – and actress Barbara Windsor, as well as members of the GLA including Mayor Boris Johnson and Deputy Mayor Kit Malthouse.



Figure 2. The Air Products HyCO4 hydrogen production plant in Rotterdam, the Netherlands is much more efficient than the previous plant, increasing hydrogen production capacity by around 50%.

## 'Greening' hydrogen production

Existing hydrogen production levels are adequate to supply the evolving hydrogen transport sector in the short term. But as the market evolves, the production of hydrogen using greener methods will become increasingly important. The first step in this transition is to make the current hydrogen production methods more energy-efficient. Air Products has made great strides in Europe with its new HyCO4 hydrogen production plant in Rotterdam, the Netherlands [Figure 2].

HyCO4 came on-stream in the second half of 2011, and serves ExxonMobil's (Esso) Rotterdam refinery in the Netherlands and other additional customers in Europe.

### HyCO4 plant

This highly efficient plant replaced an old, less efficient plant (HyCO3), while at the same time increasing hydrogen production capacity by around 50%. The use of the most advanced processes and technology, together with the synergy in the production processes between HyCO4 and the refinery, improved overall energy efficiency by more than 15%.

Another significant benefit of the integration is that it has reduced related CO<sub>2</sub> emissions by 200 000 tonnes per annum, which is the equivalent to taking around 90 000 cars off the road. This is achieved by employing Air Products' proprietary process to utilise low-value refinery fuel gases and recycling them back into the process to reduce the use of natural gas,

thereby further lowering the carbon footprint. Capacity at HyCO4 is in the region of 300 metric tonnes of hydrogen per day, making it one of the largest hydrogen production plants in the world.

## Renewably produced hydrogen

As the market develops for hydrogen transport, the next step will be the production of hydrogen from renewable feedstocks. Air Products is making great strides in this area as well.

In Orange County in California, Air Products is producing hydrogen from a municipal wastewater treatment plant. In addition to generating hydrogen, the project also creates electricity and heat from this renewable source. This technology application was the first of its kind in the world, and opens significant opportunities for other biogas feedstock streams. Air Products intends to produce hydrogen from renewable sources around the world, and is planning to bring this technology to Europe – with a first plant for London in the early stages of planning.

### OCSD treatment facility in California

- The Orange County Sanitation District (OCSD) station in Fountain Valley, California produces enough hydrogen for 25–50 FCEV fuellings per day [Figure 3].
- It assists in improving the air quality of the region.
- The station generates 250 kW of electricity.
- The station also produces heat that can be directed to several uses onsite.





Figure 3. The Air Products hydrogen fuelling station at the Orange County Sanitation District municipal wastewater treatment facility in California can refuel 25–50 fuel cell electric vehicles a day.

## Hamburg-Bramfeld station in Germany

Air Products' commitment to being at the forefront of hydrogen transport infrastructure is also demonstrated its hydrogen fuelling station at an existing Shell fuel station in Hamburg-Bramfeld, Germany [Figure 4].

The station is open 24 hours a day, can refuel hydrogen vehicles in just 3 minutes, and can deliver enough hydrogen to refuel a fleet of 50 vehicles per day. The station's modular design also facilitates easy expansion, capable of meeting increased future demand. The retrofit of an existing conventional petrol and diesel fuelling station is an important step in widening the availability of hydrogen to consumers, and the effortless integration with existing infrastructure is an example of the flexibility of Air Products' state-of-the-art technology.

## Preparing for hydrogen fuel cell electric vehicles

From 2014–15 hydrogen cars will start to become commercially available, and there will be a demand for hydrogen transport infrastructure. Leading hydrogen industry players such as Air Products are already delivering new and innovative stations in line with a clear strategy on how a hydrogen transport infrastructure can be rolled out across Europe. Hydrogen vehicles are already being demonstrated on the roads of London, the hydrogen fuel is being produced with ever fewer emissions, and fuelling technology is at a stage where it can match conventional fuelling in terms of speed. In other words, when affordable hydrogen vehicles do arrive on the forecourts, the hydrogen infrastructure sector will be ready.

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HyTEC, Hydrogen Transport in European Cities project: [www.hy-tec.eu](http://www.hy-tec.eu)

European Fuel Cells and Hydrogen Joint Undertaking (FCH JU): [www.fch-ju.eu](http://www.fch-ju.eu)

Clean Energy Partnership (CEP): [www.cleanenergypartnership.de/en](http://www.cleanenergypartnership.de/en)

## Energy from waste

In addition, Air Products is building an energy-from-waste (EfW) plant, using state-of-the-art advanced gasification technology, on Teesside in the North of England. The plant is expected to produce enough reliable, controllable, and renewable electricity to power up to 50 000 homes. Situated in a location with good access and connectivity to the local and national electrical distribution infrastructure, and in close proximity to landfill disposal facilities, it will divert up to 350 000 metric tonnes of non-recyclable waste from landfill per year – helping to meet the UK's waste diversion targets.

In the longer term, however, this plant has the potential to generate a renewable source of hydrogen for hydrogen energy applications. Having secured the necessary environmental and planning approvals, the renewable energy facility is scheduled to enter commercial operation in 2014.

## Research and development

Air Products is committed to ongoing research and development, which is crucial if we are to keep hydrogen technology moving forward. For example, this year we have worked with the Fraunhofer Institute for Solar Energy Systems ISE in Germany to build a public solar-powered hydrogen fuelling station in Freiburg. Solar photovoltaic arrays, installed on the roof of the station and a neighbouring building, power the electrolysis, which in turn generates hydrogen. The hydrogen is then compressed, stored, and dispensed using Air Products technology. The station is a landmark in developing the link between renewable energy and hydrogen-fuelled mobility, and illustrates the benefit of continued innovation and investment in hydrogen technologies.



Figure 4. Air Products technology features in the hydrogen fuelling station at an existing Shell fuel station in Hamburg-Bramfeld, Germany.



## Research Trends

### Efficient Ag–phosphonium ionomer interface for hydroxide-exchange membrane fuel cells

S. Gu et al.: *Chemical Communications* **49**(2) 131–133 (7 January 2013).  
<http://dx.doi.org/10.1039/c2cc34862d>

### Performance evaluation of direct-biogas SOFC-micro gas turbine hybrid CHP system

S. Wongchanapai et al.: *J. Power Sources* **223** 9–17 (1 February 2013).  
<http://dx.doi.org/10.1016/j.jpowsour.2012.09.037>

### Preparation of dense silicate electrolyte coating for IT-SOFC by low pressure plasma spraying

F. Sun et al.: *J. Power Sources* **223** 36–41 (1 February 2013).  
<http://dx.doi.org/10.1016/j.jpowsour.2012.09.034>

### Performance degradation of passive direct formic acid fuel cell, improved by hydrophobic filter

T. Tsujiguchi et al.: *J. Power Sources* **223** 42–49 (1 February 2013).  
<http://dx.doi.org/10.1016/j.jpowsour.2012.09.030>

### Pt–Ti alloy catalysts on Magnéli-phase TiO<sub>x</sub> support for improved PEMFC durability

T. Ioroi et al.: *J. Power Sources* **223** 183–189 (1 February 2013).  
<http://dx.doi.org/10.1016/j.jpowsour.2012.09.063>

### Synthesis and application of core-shell Co@Pt/C PEMFC catalysts

R. Lin et al.: *J. Power Sources* **223** 190–198 (1 February 2013).  
<http://dx.doi.org/10.1016/j.jpowsour.2012.09.073>

### Preparation and properties of crosslinked sulfonated poly(imide-siloxane) for PEMFC

C.-C. Lin et al.: *J. Power Sources* **223** 277–283 (1 February 2013).  
<http://dx.doi.org/10.1016/j.jpowsour.2012.09.068>

### Performance and stability of LSFerCr-based SOFC anodes in hydrogen and CO

D.M. Bierschenk et al.: *J. Electrochem. Soc.* **160**(2) F90–93 (February 2013).  
<http://dx.doi.org/10.1149/2.032302jes>

### Sulfur poisoning of WGS reaction on anode-supported SOFCs

A. Hagen: *J. Electrochem. Soc.* **160**(2) F111–118 (February 2013).  
<http://dx.doi.org/10.1149/2.060302jes>

### Size-controlled Nafion/ZrO<sub>2</sub> nanocomposite electrolyte in pores for high Pt utilisation in PEMFCs

T. Nakajima et al.: *J. Electrochem. Soc.* **160**(2) F129–134 (February 2013).  
<http://dx.doi.org/10.1149/2.065302jes>

### Activity and evolution of vapour-deposited Pt–Pd catalysts for solid acid fuel cell cathodes

A.B. Papandrew et al.: *J. Electrochem. Soc.* **160**(2) F175–182 (February 2013).  
<http://dx.doi.org/10.1149/2.002303jes>

### Crosslinked SPES-SPPSU membranes for HTPEMFCs

J.-D. Kim et al.: *Int. J. Hydrogen Energy* **38**(3) 1517–1523 (6 February 2013).  
<http://dx.doi.org/10.1016/j.ijhydene.2012.10.110>

### Sulfonated MWNT and imidazole functionalised MWNT/PBI composite membranes for HTPEM

L.-C. Jheng et al.: *Int. J. Hydrogen Energy* **38**(3) 1524–1534 (6 February 2013).  
<http://dx.doi.org/10.1016/j.ijhydene.2012.10.111>

### Synthesis methods for aliovalent-doped ceria, electrical properties for IT-SOFC electrolytes

G. Kim et al.: *Int. J. Hydrogen Energy* **38**(3) 1571–1587 (6 February 2013).  
<http://dx.doi.org/10.1016/j.ijhydene.2012.11.044>

### Current status of PEM and anion-exchange membrane DEFCs

A. Brouzgou et al.: *J. Applied Electrochem.* **43**(2) 119–136 (February 2013).  
<http://dx.doi.org/10.1007/s10800-012-0513-2>

### Ethanol oxidation on PBI-based high-temperature DEFC using Pt/C, PtRu/C, Pt<sub>3</sub>Sn/C catalysts

J.J. Linares et al.: *J. Applied Electrochem.* **43**(2) 147–158 (February 2013).  
<http://dx.doi.org/10.1007/s10800-012-0496-z>

### Mesoporous carbon supported non-noble metal Fe–N<sub>x</sub> catalysts for PEMFC cathode

A.H.A. Monteverde Videla et al.: *J. Applied Electrochem.* **43**(2) 159–169 (February 2013).  
<http://dx.doi.org/10.1007/s10800-012-0497-y>

### IrO<sub>2</sub>–SnO<sub>2</sub> mixtures as (DMFC) cathode catalyst in alkaline media

C. Locatelli et al.: *J. Applied Electrochem.* **43**(2) 171–179 (February 2013).  
<http://dx.doi.org/10.1007/s10800-012-0520-3>

### Pulsed electron beam pretreatment of magnetron sputtered ZrO<sub>2</sub>:Y<sub>2</sub>O<sub>3</sub> films for IT-SOFCs

N.S. Sochugov et al.: *Solid State Ionics* **231** 11–17 (4 February 2013).  
<http://dx.doi.org/10.1016/j.ssi.2012.11.001>

### Durability of carbon nanofibre and carbon nanotube as PEMFC catalyst support

S.M. Andersen et al.: *Solid State Ionics* **231** 94–101 (4 February 2013).  
<http://dx.doi.org/10.1016/j.ssi.2012.11.020>

### Optimisation of lanthanum tungstate/Pr<sub>2</sub>NiO<sub>4</sub> half-cell for proton-conducting SOFCs

E. Quarez et al.: *Fuel Cells* **13**(1) 34–41 (February 2013).  
<http://dx.doi.org/10.1002/fuce.201200091>

### Annealing of Nafion 1100 with annealing agent, to raise ionomer working temperature in PEMFCs

G. Alberti et al.: *Fuel Cells* **13**(1) 42–47 (February 2013).  
<http://dx.doi.org/10.1002/fuce.201200126>

### Nafion-1,2,3-triazole blend membranes for HTPEMFCs

J.-D. Kim et al.: *Fuel Cells* **13**(1) 65–71 (February 2013).  
<http://dx.doi.org/10.1002/fuce.201200090>

### Imidazolium-functionalised SiO<sub>2</sub> nanoparticle doped membranes for anhydrous HTPEMFCs

B. Lin et al.: *Fuel Cells* **13**(1) 72–78 (February 2013).  
<http://dx.doi.org/10.1002/fuce.201200096>

# Patents

## Reversible metal-supported SOFC with barrier material throughout cell layers to resist corrosion

*Assignee:* Technical University of Denmark, Denmark

*Inventor:* P.H. Larsen

*Patent number:* US 8298721

*Published:* 30 Oct. 2012 (Filed: 27 Aug. 2008)

## SOFC fabrication with integrally formed, co-fired substrate layers for improved strength and reliability

*Assignee:* National Taiwan University of Science & Technology, Taiwan

*Inventors:* C.-C. Chou et al.

*Patent number:* US 8298722

*Published:* 30 Oct. 2012 (Filed: 7 Jan. 2009)

## Transition metal nitride coating on PEMFC separator, and use in automotive fuel cell system

*Assignee:* Nissan Motor Co, Japan

*Inventors:* N. Uchiyama et al.

*Patent number:* US 8298724

*Published:* 30 Oct. 2012 (Filed: 6 Mar. 2008)

*(PCT filed as JP 2008/054561, 6 Mar. 2008)*

## Fabrication of electrode substrate from carbon and crosslinkable resin fibres, for PEM, DMFC or PAFC

*Assignee:* UTC Power, USA

*Inventor:* R.D. Breault

*Patent number:* US 8298725

*Published:* 30 Oct. 2012 (Filed: 29 Mar. 2007)

*(PCT filed as US 2007/007554, 29 Mar. 2007)*

## SOFC systems with hot zones for improved reactant distribution via centre cathode air feed tube

*Assignee:* Protonex Technology, USA

*Inventors:* J.C. Poshusta et al.

*Patent number:* US 8304122

*Published:* 6 Nov. 2012 (Filed: 6 Feb. 2009)

## Ambient pressure PEMFC system using partial air humidification to maintain adequate water balance

*Assignees:*

Daimler, Germany and Ford, USA

*Inventors:* R.A. Sederquist et al.

*Patent number:* US 8304123

*Published:* 6 Nov. 2012 (Filed: 28 Apr. 2008)

## SOFC stack with enhanced reactant distribution between cells, for higher power generation efficiency

*Assignee:* Nissan Motor Co, Japan

*Inventors:* T. Yaguchi et al.

*Patent number:* US 8304126

*Published:* 6 Nov. 2012 (Filed: 31 Jan. 2008)

*(PCT filed as JP 2008/052001, 31 Jan. 2008)*

## Automotive PEMFC stack with water guide member for gravity-aided removal of condensed water

*Assignee:* Honda Motor Co, Japan

*Inventors:* K. Nunokawa et al.

*Patent number:* US 8304127

*Published:* 6 Nov. 2012 (Filed: 17 Feb. 2010)

## SOFC or SOEC stack with Mn-impregnated sintered LSM cathode layers to inhibit degradation

*Assignee:* Topsoe Fuel Cell, Denmark

*Inventors:* P.V. Hendriksen et al.

*Patent number:* US 8304128

*Published:* 6 Nov. 2012 (Filed: 30 Nov. 2009)

## SOFC with island-shaped first and higher-porosity second cathode layers, for enhanced durability

*Assignee:* Shinko Electric Industries, Japan

*Inventors:* F. Katagiri et al.

*Patent number:* US 8304129

*Published:* 6 Nov. 2012 (Filed: 27 Mar. 2007)

## PEMFC MEA manufacturing for low proton conduction resistance at electrolyte/catalyst layer boundary

*Assignee:* Toyota Motor Corporation, Japan

*Inventor:* T. Morita

*Patent number:* US 8304130

*Published:* 6 Nov. 2012 (Filed: 1 Aug. 2008)

## DMFC structure and fabrication method, with holes in border layers to avoid assembly misalignments

*Assignee:* Nan Ya PCB Corporation, Taiwan

*Inventors:* J.-M. Chen et al.

*Patent number:* US 8304131

*Published:* 6 Nov. 2012 (Filed: 2 Apr. 2010)

## DMFC electrode catalyst structures for use with high-concentration or pure methanol

*Assignee:* Toshiba, Japan

*Inventors:* H. Chigusa et al.

*Patent number:* US 8304132

*Published:* 6 Nov. 2012 (Filed: 21 June 2011)

## Producing very thin, uniform PEM with improved mechanical strength and suppressed H<sub>2</sub> permeation

*Assignee:* Toyo Boseki, Japan (Toyo Cotton)

*Inventors:* K. Sasai et al.

*Patent number:* US 8304133

*Published:* 6 Nov. 2012 (Filed: 26 Dec. 2007)

*(PCT filed as JP 2007/074915, 26 Dec. 2007)*

## PEM composition with thioether group and azole ring compounds, for high chemical stability at 100°C

*Assignee:* Asahi Kasei

E-materials Corporation, Japan

*Inventors:* N. Miyake et al.

*Patent number:* US 8304134

*Published:* 6 Nov. 2012 (Filed: 21 Feb. 2008)

*(PCT filed as JP 2008/052982, 21 Feb. 2008)*

## Manufacture of proton-conductive polymer electrolyte membrane based on PVA, and use in DMFC

*Assignee:* Nitto Denko Corporation, Japan

*Inventors:* T. Sugitani et al.

*Patent number:* US 8304135

*Published:* 6 Nov. 2012 (Filed: 3 Mar. 2009)

*(PCT filed as JP 2009/053989, 3 Mar. 2009)*

## SOFC bundle with polygonal tubular supports, for excellent performance and power density

*Assignee:*

Samsung Electro-Mechanics Co, Korea

*Inventors:* E.S. Lee et al.

*Patent number:* US 8304136

*Published:* 6 Nov. 2012 (Filed: 3 Nov. 2009)

## Automotive PEMFC with two hydrogen sources to mitigate anode hydrogen depletion before restart

*Assignee:* Ford Global Technologies, USA

*Inventors:* S.A. Janarthanam et al.

*Patent number:* US 8304138

*Published:* 6 Nov. 2012 (Filed: 26 May 2010)

## High-flow PEMFC bipolar plates with interdigitated comb channels and continuous serpentine channels

*Assignee:* Intelligent Energy, UK

*Inventors:* P.D. Hood et al.

*Patent number:* US 8304139

*Published:* 6 Nov. 2012 (Filed: 3 Oct. 2002)

*(PCT filed as GB 02/04483, 3 Oct. 2002)*

## PEMFC metal separator with overlapping bosses and guide ridges for smooth fluid flow

**Assignee:** Honda Motor Co, Japan  
**Inventors:** S. Sugiura *et al.*  
**Patent number:** US 8304140  
**Published:** 6 Nov. 2012 (Filed: 11 June 2010)

### PEMFC separator comprising stainless steel, titanium or Ti alloy, and evaluation of warp and twist

**Assignee:** Sintokogio Ltd, Japan  
**Inventors:** H. Kihira *et al.*  
**Patent number:** US 8304141  
**Published:** 6 Nov. 2012 (Filed: 20 Aug. 2010)

### Thin, simplified DMFC structure without impairing diffusibility of reactants and by-products

**Assignee:** Sanyo Electric Co, Japan  
**Inventor:** S. Imura  
**Patent number:** US 8304142  
**Published:** 6 Nov. 2012 (Filed: 14 June 2011)

### Conductive and hydrophilic coating for PEMFC bipolar plate, including residues of silane coupling agent

**Assignee:** General Motors, USA  
**Inventors:** R.H. Blunk *et al.*  
**Patent number:** US 8304143  
**Published:** 6 Nov. 2012 (Filed: 23 Nov. 2009)

### Micro fuel cell fabrication process for semicells formed in single layer of conductive monocrystalline Si, operable on hydrogen or methanol

**Assignee:** STMicroelectronics, Italy  
**Inventors:** G. D'Arrigo *et al.*  
**Patent number:** US 8304144  
**Published:** 6 Nov. 2012 (Filed: 4 May 2010)

### High tortuosity diffusion medium with porous spacer layer to enhance water management in PEMFC

**Assignee:** General Motors, USA  
**Inventors:** C. Wieser *et al.*  
**Patent number:** US 8304145  
**Published:** 6 Nov. 2012 (Filed: 19 Feb. 2010)

### Core/shell PEMFC cathode catalyst comprising base and/or precious metal core with Pt or PtRu shell

**Assignee:** Umicore AG, Germany  
**Inventors:** M. Lopez *et al.*  
**Patent number:** US 8304362  
**Published:** 6 Nov. 2012 (Filed: 27 Aug. 2007)  
(PCT filed as EP 2007/058889, 27 Aug. 2007)

### Stabilised PEMFC cathode catalyst by combining Pt nanoparticles with metal salt in solution

**Assignee:** UTC Power, USA  
**Inventors:** M. Shao *et al.*  
**Patent number:** US 8304365  
**Published:** 6 Nov. 2012 (Filed: 16 May 2008)  
(PCT filed as US 2008/006318, 16 May 2008)

### Catalyst-coated membrane and Ag (or Ag alloy) catalyst film/layer for alkaline membrane fuel cells

**Assignee:** CellEra Inc, USA  
**Inventors:** S. Gottesfeld *et al.*  
**Patent number:** US 8304368  
**Published:** 6 Nov. 2012 (Filed: 23 Feb. 2010)

### Three-way diverter assembly to regulate temperature and humidity of automotive PEMFC stack

**Assignee:** General Motors, USA  
**Inventors:** B. Andreas-Schott *et al.*  
**Patent number:** US 8308938  
**Published:** 13 Nov. 2012 (Filed: 18 June 2008)

### Hollow fibre membrane humidification module for use with automotive PEMFC system

**Assignees:** Toyota Motor Corp, Japan  
and NOK Corporation, Japan  
**Inventors:** H. Kanazawa *et al.*  
**Patent number:** US 8308943  
**Published:** 13 Nov. 2012 (Filed: 22 Oct. 2007)  
(PCT filed as JP 2007/070967, 22 Oct. 2007)

### Pt-metal oxide composite PEMFC cathode catalyst with reduced Pt oxidation and dissolution rates

**Assignee:** Brookhaven Science Associates, USA (Brookhaven National Lab)  
**Inventors:** R. Adzic *et al.*  
**Patent number:** US 8308989  
**Published:** 13 Nov. 2012 (Filed: 24 Feb. 2011)

### PEMFC with fuel recirculation control for even water distribution without lowering fuel gas pressure

**Assignee:** Toyota Motor Corporation, Japan  
**Inventors:** T. Hashimoto *et al.*  
**Patent number:** US 8309261  
**Published:** 13 Nov. 2012 (Filed: 30 June 2008)  
(PCT filed as JP 2008/062242, 30 June 2008)

### Improved compact SOFC assembly with lower direct heat dissipation, efficient utilisation of waste heat

**Assignee:** Kyocera Corporation, Japan  
**Inventors:** T. Ono *et al.*  
**Patent number:** US 8309263  
**Published:** 13 Nov. 2012 (Filed: 6 Jan. 2009)

### PEMFC flow-field with strong, chemically stable two-layer metal bipolar plates

**Assignee:** UTC Fuel Cells, USA  
(now UTC Power)  
**Inventors:** S.F. Burlatsky *et al.*  
**Patent number:** US 8309264  
**Published:** 13 Nov. 2012 (Filed: 8 Dec. 2006)  
(PCT filed as US 2006/046833, 8 Dec. 2006)

### Electrolyte membrane for PEM or DMFC with tiny projection cluster on side(s), produced by moulding

**Assignee:** Hitachi Ltd, Japan  
**Inventors:** A. Miyauchi *et al.*  
**Patent number:** US 8309265  
**Published:** 13 Nov. 2012 (Filed: 31 Aug. 2004)

### SOFC with neck-down point in passages in elongated substrate of monolithic Fuel Cell Stick™

**Assignees/Inventors:** A. Devoe and L. Devoe, USA [Violet Fuel Cell Sticks]  
**Patent number:** US 8309266  
**Published:** 13 Nov. 2012 (Filed: 19 Sep. 2011)

### PEMFC with porous electrode for lower pressure loss in gas diffusion path, for high output power

**Assignee:** Nissan Motor Co, Japan  
**Inventor:** S. Tanaka  
**Patent number:** US 8309267  
**Published:** 13 Nov. 2012 (Filed: 23 Oct. 2009)  
(PCT filed as JP 2009/068238, 23 Oct. 2009)

### Sealed, reinforced PEMFC MEA with encapsulation films on gas diffusion substrate edges, adhesive layers impregnating substrate

**Assignee:** Johnson Matthey Fuel Cells, UK  
**Inventors:** S. Buche *et al.*  
**Patent number:** US 8309268  
**Published:** 13 Nov. 2012 (Filed: 2 Aug. 2004)  
(PCT filed as GB 2004/003334, 2 Aug. 2004)

### PEMFC MEA with multilayer anode catalyst, including layer to adsorb sulfur compounds for better low-humidification operation

**Assignee:** Panasonic Corporation, Japan  
**Inventors:** H. Shintani *et al.*



*Patent number:* US 8309269  
*Published:* 13 Nov. 2012 (Filed: 25 June 2008)  
*(PCT filed as JP 2008/001659, 25 June 2008)*

**SOFC systems with improved gas channelling and heat exchange to protect thermally sensitive elements**

*Assignee:* CP SOFC IP LLC, USA  
*Inventors:* C. Finnerty et al.  
*Patent number:* US 8309270  
*Published:* 13 Nov. 2012 (Filed: 3 Aug. 2007)

**Low-cost tubular PEMFC module in which current collector electrode functions as spacer between cells**

*Assignee:* Toyota Motor Corporation, Japan  
*Inventors:* M. Terada et al.  
*Patent number:* US 8309271  
*Published:* 13 Nov. 2012 (Filed: 3 Aug. 2006)  
*(PCT filed as JP 2006/315776, 3 Aug. 2006)*

**SOFC with higher power density and utilisation of solid carbon deposited onto anode on activation**

*Assignees:* Tokyo Inst. of Technology, Japan  
 and Mitsubishi Chemical Corp, Japan  
*Inventors:* M. Ihara et al.  
*Patent number:* US 8309272  
*Published:* 13 Nov. 2012 (Filed: 27 Feb. 2007)  
*(PCT filed as JP 2007/053685, 27 Feb. 2007)*

**PEMFC with suppressed water flooding and membrane drying, for less deterioration when driven at high temperature and low humidity**

*Assignee:* Panasonic Corporation, Japan  
*Inventors:* M. Gemba et al.  
*Patent number:* US 8309273  
*Published:* 13 Nov. 2012 (Filed: 17 Mar. 2008)  
*(PCT filed as JP 2008/000613, 17 Mar. 2008)*

**PEMFC separator plate with radiation-cured flow-field layer on substrate, by photopolymerisation**

*Assignee:* General Motors, USA  
*Inventors:* J.A. Rock et al.  
*Patent number:* US 8309274  
*Published:* 13 Nov. 2012 (Filed: 15 May 2009)

**Control of membrane water content during hot pressing, for optimised interface in PEM or DMFC MEA**

*Assignee:* Paul Scherrer Institut, Switzerland  
*Inventors:* H.-P. Brack et al.  
*Patent number:* US 8309275

*Published:* 13 Nov. 2012 (Filed: 14 Sep. 2004)  
*(PCT filed as EP 2004/010252, 14 Sep. 2004)*

**Preparing catalyst ink dispersions with enhanced yield and coating control, and use in PEMFC MEA**

*Assignee:* Hanwha Chemical Corp, Korea  
*Inventors:* B. Jang et al.  
*Patent number:* US 8309276  
*Published:* 13 Nov. 2012 (Filed: 6 Nov. 2007)  
*(PCT filed as KR 2007/005565, 6 Nov. 2007)*

**Copolymer with aromatic sulfonic acid group, for heat-resistant PEM with high proton conductivity**

*Assignee:* JSR Corporation, Japan  
*Inventors:* T. Kadota et al.  
*Patent number:* US 8309678  
*Published:* 13 Nov. 2012 (Filed: 16 May 2008)  
*(PCT filed as JP 2008/059053, 16 May 2008)*

**NMR apparatus for in situ analysis of PEMFCs**

*Assignee:* Department of Energy, USA  
 (Argonne National Lab)  
*Inventors:* R.E. Gerald et al.  
*Patent number:* US 8310235  
*Published:* 13 Nov. 2012 (Filed: 16 Nov. 2007)

**Low-cost PEMFC manufacture by single-step injection moulding of rubber seals on metal separators**

*Assignee:* Honda Motor Co, Japan  
*Inventors:* T. Mitsuoka et al.  
*Patent number:* US 8313680  
*Published:* 20 Nov. 2012 (Filed: 2 Feb. 2010)

**Reformer-HTPEMFC system with stack exhaust heat used to generate steam in evaporation channels**

*Assignee:* WS Reformer GmbH, Germany  
*Inventors:* J.A. Wunning et al.  
*Patent number:* US 8313867  
*Published:* 20 Nov. 2012 (Filed: 31 Mar. 2009)

**Oxygen enrichment device with molecular sieves to boost PEMFC power output onboard aircraft**

*Assignee:*  
 Airbus Operations GmbH, Germany  
*Inventors:* H. Gruendel et al.  
*Patent number:* US 8313868  
*Published:* 20 Nov. 2012 (Filed: 13 May 2008)

**Residential PEMFC system with adsorptive desulfurisation of natural gas feed to reformer**

*Assignee:* Panasonic Corporation, Japan  
*Inventors:* Y. Kani et al.  
*Patent number:* US 8313869  
*Published:* 20 Nov. 2012 (Filed: 25 Aug. 2008)  
*(PCT filed as JP 2008/002290, 25 Aug. 2008)*

**Integrated flow-field structure for effective removal of reaction products in PEMFC or electrolyser**

*Assignee:* ElectroChem Inc, USA  
*Inventors:* S.M. Pien et al.  
*Patent number:* US 8313870  
*Published:* 20 Nov. 2012 (Filed: 31 Oct. 2008)

**PEMFC system with heater(s) in coolant header(s) to provide more even heating throughout stack**

*Assignee:* General Motors, USA  
*Inventors:* D. Wexel et al.  
*Patent number:* US 8313871  
*Published:* 20 Nov. 2012 (Filed: 22 Nov. 2006)

**PEM with metal-bound inorganic ion-conductive salt, ion-conductive cation exchange resin, for use in high-temperature DMFC (120°C)**

*Assignee:* Samsung SDI Co, Korea  
*Inventors:* M.-K. Song et al.  
*Patent number:* US 8313873  
*Published:* 20 Nov. 2012 (Filed: 14 July 2009)

**SOFC on porous tubular anode support, to eliminate external fuel and air flow, minimising oxidation**

*Assignee:*  
 Samsung Electro-Mechanics Co, Korea  
*Inventors:* J.H. Gil et al.  
*Patent number:* US 8313874  
*Published:* 20 Nov. 2012 (Filed: 30 Oct. 2009)

**High-performance cermet SOFC cathode with controlled operating temperature, to 600°C as IT-SOFC**

*Assignee:* Versa Power Systems, Canada  
*Inventors:* A. Wood et al.  
*Patent number:* US 8313875  
*Published:* 20 Nov. 2012 (Filed: 2 Oct. 2006)

**Cellphone with software control of heat radiation from micro PEMFC, to avoid water vapour affecting camera or screen**

*Assignee:* Casio Hitachi Mobile Communications Co, Japan  
*Inventor:* K. Suzuki  
*Patent number:* US 8315747  
*Published:* 20 Nov. 2012 (Filed: 4 Apr. 2008)

### Apparatus and method for non-destructive measurement of bending stiffness of PEMFC GDL

*Assignee: Hyundai Motor Company, Korea*  
*Inventors: B.K. Hong et al.*  
*Patent number: US 8316721*  
*Published: 27 Nov. 2012 (Filed: 25 Oct. 2010)*

### PEMFC humidifier with hollow fibre membranes to control flow direction of dry air into humidifier

*Assignees: Hyundai Motor Company, Korea and Kia Motor Corporation, Korea*  
*Inventor: H.Y. Kim*  
*Patent number: US 8317167*  
*Published: 27 Nov. 2012 (Filed: 1 Apr. 2010)*

### SOFC electrode manufacture using electroless plating solution with Pd catalyst, no sintering or reduction

*Assignee: Edinburgh Napier University, UK*  
*Inventors: W.J. Waugh et al.*  
*Patent number: US 8318241*  
*Published: 27 Nov. 2012 (Filed: 3 Oct. 2008)*  
*(PCT filed as GB 2008/003342, 3 Oct. 2008)*

### PAFC or HTPEMFC with better acid electrolyte condensation zone, to minimise edge seal degradation

*Assignee: UTC Power, USA*  
*Inventors: R.D. Breault et al.*  
*Patent number: US 8318362*  
*Published: 27 Nov. 2012 (Filed: 16 May 2007)*

### PEM or DMFC system with control unit to remove water remaining in stack before startup

*Assignee: Panasonic Corporation, Japan*  
*Inventors: H. Matsuda et al.*  
*Patent number: US 8318364*  
*Published: 27 Nov. 2012 (Filed: 7 July 2009)*

### PEMFC-reformer system with bypass control to reduce partial combustion and CO in exhaust

*Assignee: Panasonic Corporation, Japan*  
*Inventors: A. Yukimasa et al.*  
*Patent number: US 8318365*

*Published: 27 Nov. 2012 (Filed: 14 Mar. 2008)*  
*(PCT filed as JP 2008/000597, 14 Mar. 2008)*

### Micro DMFC with reference electrode for optimised operation and crossover, for portable devices

*Assignee: Sony Corporation, Japan*  
*Inventors: K. Makita et al.*  
*Patent number: US 8318367*  
*Published: 27 Nov. 2012 (Filed: 2 Nov. 2006)*  
*(PCT filed as JP 2006/321970, 2 Nov. 2006)*

### Operation of reformed methanol HTPEMFC (up to 200°C) or PAFC with fuel processor, for portables

*Assignee: UltraCell, USA*  
*Inventors: I.W. Kaye et al.*  
*Patent number: US 8318368*  
*Published: 27 Nov. 2012 (Filed: 6 Aug. 2007)*

### Reducing radiator size and using antifreeze loop to operate PEMFC in cold weather transportation

*Assignee: UTC Power, USA*  
*Inventor: L.L. VanDine*  
*Patent number: US 8318369*  
*Published: 27 Nov. 2012 (Filed: 2 May 2012)*

### DMFC separator for improved performance by reducing deviation in cell performance and dead space

*Assignee: Samsung SDI Co, Korea*  
*Inventors: Y.-S. Na et al.*  
*Patent number: US 8318371*  
*Published: 27 Nov. 2012 (Filed: 14 May 2009)*

### Automotive PEMFC stack with displacement preventing member, for rigid but lighter structure

*Assignee: Toyota Motor Corporation, Japan*  
*Inventor: N. Saito*  
*Patent number: US 8318372*  
*Published: 27 Nov. 2012 (Filed: 25 Apr. 2008)*  
*(PCT filed as JP 2008/058459, 25 Apr. 2008)*

### MEA with fewer components, for PEM or DMFC stack with higher efficiency but lower size, cost

*Assignee: Johnson Matthey Fuel Cells, UK*  
*Inventors: H.K. Rajantie et al.*  
*Patent number: US 8318373*  
*Published: 27 Nov. 2012 (Filed: 11 Sep. 2007)*  
*(PCT filed as GB 2007/050534, 11 Sep. 2007)*

### PEMFC cathode with surface nanostructure for catalysis and Pt/C nanocatalyst immobilisation

*Assignee: Panasonic Corporation, Japan*  
*Inventors: D. Ino et al.*  
*Patent number: US 8318374*  
*Published: 27 Nov. 2012 (Filed: 4 June 2010)*

### PEMFC cathode by direct liquid MOVPE of bi- or multimetallic nanoparticles on diffusion layer

*Assignee: CEA, France*  
*Inventors: S. Mailley et al.*  
*Patent number: US 8318375*  
*Published: 27 Nov. 2012 (Filed: 25 July 2008)*

### Electrolyte membrane with coating layer of anion binding agent to prevent acid elution, for PEMFC

*Assignee: Hyundai Motor Company, Korea*  
*Inventors: K.Y. Cho et al.*  
*Patent number: US 8318376*  
*Published: 27 Nov. 2012 (Filed: 11 Dec. 2007)*


### Membrane-electrode junction agent to enhance joint strength between membrane and electrodes in DMFC

*Assignee: Sekisui Chemical Co, Japan*  
*Inventors: T. Miyami et al.*  
*Patent number: US 8318377*  
*Published: 27 Nov. 2012 (Filed: 12 Mar. 2008)*  
*(PCT filed as JP 2008/054527, 12 Mar. 2008)*


### MEA for mixed reactant fuel cell, in particular for compact DMFC, for even fuel and oxidant supply

*Assignee: Samsung SDI Co, Korea*  
*Inventors: C. Kwak et al.*  
*Patent number: US 8318379*  
*Published: 27 Nov. 2012 (Filed: 15 Feb. 2007)*

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## EVENTS CALENDAR

4 March 2013

**Sustainable Hydrogen Breakfast, with UK's SUPERGEN DoSH2 Consortium**

City Hall, London, UK

More information: <http://tinyurl.com/arrgm5x>

11 March 2013

**Launch of the Greater Manchester Hydrogen Partnership**

Manchester Metropolitan University, UK

More information: <http://tinyurl.com/b3a9m7t>

12–13 March 2013

**International Workshop on Durability & Degradation Issues in PEM Electrolysis Cells and its Components**

Fraunhofer ISE, Freiburg, Germany

More information: <http://pem-workshop.pse.de>

18–19 March 2013

**Energy Storage, International Summit for the Storage of Renewable Energies**

Düsseldorf, Germany

More information: [www.energy-storage-online.com](http://www.energy-storage-online.com)

19–20 March 2013

**10th Symposium for Fuel Cell and Battery Modelling and Experimental Validation, ModVal 10**

Bad Boll/Stuttgart, Germany

More information: <http://modval10.hs-offenburg.de>

7–10 April 2013

**13th Topical Meeting of the International Society of Electrochemistry: Advances in Electrochemical Materials Science and Manufacturing**

Pretoria, South Africa

More information: <http://topical13.ise-online.org>

Abstract deadline: 21 March 2013

8–12 April 2013

**19th Group Exhibit Hydrogen+Fuel Cells, within Hannover Messe 2013**

Hannover, Germany

More information: [www.h2fc-fair.com](http://www.h2fc-fair.com)

16–18 April 2013

**5th International Conference on Fundamentals & Development of Fuel Cells, FDFC 2013**

Karlsruhe, Germany

More information: <http://fdfc2013.eifer.org>

16–19 April 2013

**WBZU Fuel Cells & Hydrogen Course**

Ulm, Germany

More information: <http://tinyurl.com/bgv5tfq>

18–19 April 2013

**COGEN Europe Annual Conference**

Brussels, Belgium

More information: [www.cogeneurope.eu](http://www.cogeneurope.eu)

23–25 April 2013

**6th Energy Storage World Forum**

Berlin, Germany

More information: [www.energystorageforum.com](http://www.energystorageforum.com)

1–2 May 2013

**2013 Ohio Fuel Cell Symposium**

Elyria, Ohio, USA

More information: [www.fuelcellcorridor.com](http://www.fuelcellcorridor.com)

12–17 May 2013

**223rd Meeting of The Electrochemical Society**

Toronto, Ontario, Canada

More information:

[www.electrochem.org/meetings/biannual/223/](http://www.electrochem.org/meetings/biannual/223/)

28–29 May 2013

**20th Fuel Cell Symposium 2013: Fuel Cell Development Information Center**

Edogawa-ku, Tokyo, Japan

More information: [www.fcdic.com/eng/info.html](http://www.fcdic.com/eng/info.html)

29–30 May 2013

**3rd Israeli Power Sources & EV Conference**

Herzliya, Israel

More information:

[www.sdle.co.il/Default.asp?sType=0&PageId=70548](http://www.sdle.co.il/Default.asp?sType=0&PageId=70548)

3–7 June 2013

**6th International Conference on Polymer Batteries and Fuel Cells, PBFC**

Ulm, Germany

More information: [www.zsw-bw.de](http://www.zsw-bw.de)

11–12 June 2013

**10th Hypothesis Conference on Hydrogen & Fuel Cells 2013**

Edinburgh, Scotland, UK

More information: [www.hypothesis.ws](http://www.hypothesis.ws)

16–19 June 2013

**HFC 2013, 6th Hydrogen + Fuel Cells International Conference & Exhibition**

Vancouver, BC, Canada

More information: [www.hfc2013.com](http://www.hfc2013.com)

17–18 June 2013

**2013 General Assembly of the German National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP, in German)**

Berlin, Germany

More information: [www.now-gmbh.de/de/aktuelles/](http://www.now-gmbh.de/de/aktuelles/)[now-vollversammlung-2013.html](http://now-vollversammlung-2013.html)

19 June 2013

**2. Symposium Elektromobilität (in German)**

Ostfildern/Stuttgart, Germany

More information: <http://tinyurl.com/czq453p>

24–27 June 2013

**ACT Expo 2013, Alternative Clean Transportation (including presentation by winner of the 9th Annual Hydrogen Student Design Contest)**

Washington, DC, USA

More information: [www.actexpo.com](http://www.actexpo.com)

2–5 July 2013

**4th European PEFC and H<sub>2</sub> Forum, International Technical Conference**

Lucerne, Switzerland

More information: [www.efcf.com](http://www.efcf.com)

12–15 July 2013

**Hydrogen and Fuel Cells Conference 2013**

Napa Valley, California, USA

More information: [www.zingconferences.com/index.cfm?page=conference&intConferenceID=109](http://www.zingconferences.com/index.cfm?page=conference&intConferenceID=109)

Abstract deadline: 12 March 2013

4–5 September 2013

**6th Annual Cenex Low Carbon Vehicle Event, LCV2013**

Millbrook Proving Ground,

Bedfordshire, UK

More information: [www.cenex-lcv.co.uk](http://www.cenex-lcv.co.uk)

8–13 September 2013

**64th Annual Meeting of the International Society of Electrochemistry: Electrochemistry for a New Era**

Santiago de Queretaro, Mexico

More information: <http://annual64.ise-online.org>

9–11 September 2013

**5th International Conference on Hydrogen Safety, ICHS 2013**

Brussels, Belgium

More information: [www.ichs2013.com](http://www.ichs2013.com)

25–28 September 2013

**5th World Hydrogen Technology Convention, WHTC 2013**

Shanghai, China

More information: [www.whtc2013.com](http://www.whtc2013.com)

26–28 September 2013

**3rd New Energy Forum 2013, with Forum 5: Hydrogen Energy (including fuel cells)**

Xi'an, China

More information:

[www.bitcongress.com/nef2013](http://www.bitcongress.com/nef2013)

30 September–2 October 2013

**World of Energy Solutions: f-cell conference & trade fair, Battery + Storage, and e-mobil BW Technologietag 2013**

Stuttgart, Germany

More information: [www.f-cell.de/englisch/home/](http://www.f-cell.de/englisch/home/)

6–11 October 2013

**13th International Symposium on Solid Oxide Fuel Cells, SOFC-XIII**

Ginowan, Okinawa, Japan

More information: [www.sofc-xiii.com](http://www.sofc-xiii.com)

Abstract deadline: 1 April 2013

21–24 October 2013

**2013 Fuel Cell Seminar & Energy Exposition, Featuring Hydrogen Fuel**

Columbus, Ohio, USA

More information: [www.fuelcellseminar.com](http://www.fuelcellseminar.com)

17–20 November 2013

**EVS 27, Electric Vehicle Symposium & Exhibition**

Barcelona, Spain

More information: [www.evs27.org](http://www.evs27.org)

Abstract deadline extended: 21 March 2013

18–20 November 2013

**8th International Renewable Energy Storage Conference & Exhibition, IRES 2013**

Berlin, Germany

More information: [www.euro-solar.de/en](http://www.euro-solar.de/en)

Abstract deadline: 15 May 2013