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event report

8th Smart Hydrogen and Fuel Cell Power, Birmingham NEC, UK, 29th March 2012

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The 8th International Conference, Exhibition and Partnering, entitled Smart Hydrogen and Fuel Cell Power, boasted more than 200 delegates and attracted speakers from as far afield as California and Shanghai. The show also had a poster display area and exhibition which included representatives from E.ON and the UK Hydrogen and Fuel Cell Association.

The conference began with an address from Sandy Taylor, Head of Climate Change & Sustainability for Birmingham City Council. He discussed the increasing pressure on shared resources, touching on peak oil, and spoke of the need for resource conservation. Birmingham City is committed to a 60% cut in its carbon footprint by 2026 and has already achieved a 17% cut in emissions since 2005. Schemes in place which have helped with this include the installation of almost 2,000 solar panels in social housing, fitting efficient LED bulbs for street lighting and plans to introduce an electric car charging infrastructure as part of the CABLED (Coventry and Birmingham Low Emissions Demonstration) project. The city is also applying for funding to build a second hydrogen refuelling station and attract fuel cell electric vehicles. Taylor arrived at the NEC in one of the council's fleet of electric vehicles, but lamented the lack of charging infrastructure at the venue.

Professor Kevin Kendall then introduced the schedule for the morning's talks which included E.ON's collaboration with Ceramic Fuel Cells Limited on commercialising its BlueGen® fuel cell unit in the UK, as seen on the Channel 4 show Home of the Future, and updates on fuel cell developments in China and the European Commission's Horizon 2020 project.

The first plenary speaker of the day was unable to attend the conference, but his presentation covering fuel cells in China was given by Dr Shangfeng Du of the University of Birmingham. Starting with the history of fuel cell developments in China, the talk went on to discuss the long-term financial support for fuel cell technology from the Chinese Government and the success of high-profile demonstration projects such as the Beijing Olympics. Dr Du went on to highlight the extent of fuel cell related research being conducted in China, not only in PEMFC and DMFC, but also in SOFC development. The country currently has 25 national fuel cell standards, including fifteen domestically written ones (all relating to PEMFC) and a further ten which it has adopted from the international community relating to a variety of technologies and applications.

Nick Rolf from BOC Linde then discussed the steps necessary to introduce hydrogen infrastructure and began by warning against the 'burning platform' mentality, in which constant change and improvement is expected. While complacency can be just as damaging, new technologies take time to introduce properly, especially when supply chain development, after-market infrastructure and retail development all need addressing as part of the plan. The introduction of complex infrastructure is not an alien concept however and Rolf compared the hydrogen infrastructure model to those of electricity, water and gasoline supply; all of which incorporate a number of complex processes in a staged manner to deliver the final product. Rolf went on to discuss the pre-requisites of hydrogen as a fuel, which included:

- RCS (Regulations, Codes and Standards)
- Public perception
- Government support and funding
- Production, distribution and storage
- Collaborations

The early markets to be served by the fledgling hydrogen infrastructure include fleet operators and the materials handling sector, with automotive OEMs following on from those. Key points to focus on as enablers for hydrogen include:

- Miniaturisation – reducing the footprint of refuelling apparatus
- Purity standards – relaxing standards will lower the cost of H_2 at the pump
- Vehicle choice – don't dismiss hydrogen ICE as a stepping stone to FCEV
- Collaborations – UKH2Mobility is a good forum to engage the government on key issues

Stationary micro combined heat and power (micro-CHP) systems were the topic of the next presentation from Jeremy Harrison of E.ON. He stated that the smart home of the future has to be part of a smart energy network, which must incorporate heat and power management. This will mean different things in different countries; for example with Denmark may utilise its existing district heating infrastructure and the UK may make use of its natural gas infrastructure. In the UK around 85% of domestic energy is used for heating (space and water) and conventional boilers compete with stirling engines for a share of the approximately 1.5 million gas-fired units installed annually. Fuel cell micro-CHP units are being tested in the UK with Ceramic Fuel Cells Limited's BlueGen SOFC system undergoing testing. Micro-CHP has the potential to add value in terms of carbon displacement and also in minimising the wider network costs as distributed generation can support the national

grid. Harrison closed by adding that more information on micro-CHP products can be found at www.microchap.info.

No conference on hydrogen fuel cell power would be complete without including the automotive sector and Thomas Brachmann from Honda R&D provided an update on Honda's fuel cell programme. The company's latest iteration of the iconic FCX Clarity has a 40% improvement in range when compared to the 2005 model. It also has twice the fuel economy of its gasoline and diesel counterparts. Two other recent announcements of note from Honda are the unveiling of a solar hydrogen station on the grounds of the Saitama Prefectural Office in Japan and the option to include a power outlet allowing the FCX Clarity to function as an independent power source.
The solar hydrogen station is the first installation in Japan of a system that can produce, store and dispense hydrogen with zero carbon dioxide emissions. The hydrogen is produced by Honda's own water electrolysis system and the system is capable of producing 1.5 kg of hydrogen per day; sufficient for an FCX Clarity to run approximately 150 km or 90 miles, making it ideal for personal use.
The option to install an inverter inside the FCX Clarity means the car can generate and output power; Honda claims the vehicle can supply up to 9 kW electricity for more than seven hours on a full tank of hydrogen – an option that could prove useful for emergency power needs when grid electricity is not available.

The final contribution to the morning session came from Bert de Colvenaer, executive director of the FCH JU (Fuel Cells and Hydrogen Joint Undertaking) who discussed progress towards the European Union's new framework programme for research and innovation, Horizon 2020.
The FCH JU is a public–private partnership which brings together its members from a range of diverse backgrounds to address European policy challenges, sustainable development and ensure security of supply. Its current roadmap, agreed in 2009 and to run until 2013, has received around €940 million in funding. Horizon 2020 is the successor to this programme, due to begin from 2014 and to run for six years.
De Colvenaer touched on a number of European fuel cell projects, including the CHIC fuel cell bus project; FITUP, a field test of portable generators, backup and UPS; and the HyLIFT-DEMO demonstration of fuel cell fork lift trucks. More details about these and other projects can be found on the FCH JU projects website.

The final session before lunch began with Professor Jack Brouwer from the University of California, Irvine who presented details about the Orange County Sanitation District molten carbonate fuel cell installation in California. The fuel cell has three main purposes, to generate heat, electricity and also to produce fuel for hydrogen fuel cell vehicles. The use of the fuel cell to generate hydrogen as a transport fuel actually increased the efficiency of the overall system, through a number of synergistic effects. Simply by putting in more fuel than was necessary for heat and electricity generation, the scientists found the additional endothermic fuel reforming process actually minimised the need for additional air cooling, lowering the parasitic load on the fuel cell. Therefore by producing a useful and saleable by-product, the electrical output of the facility could be increased. The facility runs on digester gas and can store 120 kg hydrogen at the generator site and a further 50 kg near to the freeway at the fuel dispenser.

Simon Bourne from ITM Power picked up the theme of hydrogen as a transport fuel and tied it into the current challenges of storing grid electricity. By using distributed electrolysis tied to sources of renewable electricity, 'triple zero' hydrogen could be produced: zero carbon in its production, zero carbon in its transportation and zero carbon when it is used. To date ITM Power has completed sixteen out of its planned 21 Hydrogen On-Site Trials (HOST), has recently joined the EcoIsland and UKH2Mobility projects and has completed its hydrogen fuel cell materials handling trial with Marks and Spencer. ITM will be fuelling FCEV from its electrolyser units at the 2012 Group Exhibit, Hydrogen + Fuel Cells event in Hannover Messe this April.

The use of fuel cells in transport featured in all of the remaining morning presentations with David Yorke, future vehicle technical manager at First, providing an update on the hydrogen bus fleet in London. The project is part of the CHIC programme and is run by Transport for London with five fuel cell buses currently running on the Route 1 bus route in the city. A further three buses are slated for delivery by summer 2012, from which point there will be enough fuel cell buses to service the entire bus route. Air Products is involved in refuelling the buses through a contractor, Bluways. Fitted with Ballard Power Systems' HD6 FCVelocity fuel cells, the buses can run for a whole day using 30 kg of stored hydrogen and taking advantage of regenerative braking and supercapacitors for additional energy storage. Safety has been paramount for this project, with high pressures, high voltages and the close proximity to the public all needing to be considered.

Dr Ben Todd, managing director at Arcola Energy, then introduced his company and its links to Horizon Fuel Cell Technologies. Arcola Energy is a UK based retailer of hydrogen fuel cell systems, with close ties to BOC, Horizon Fuel Cell Technologies and Riversimple. A range of fuel cell products are available to buy through Arcola Energy's website, including BOC's Hymera portable fuel cell, Horizon's range of portable devices and you can email for a quote on the Riversimple fuel cell city car.

In the final talk of the morning, John Price, head of energy and propulsion at EADS Innovation Works, spoke about his company's SOFC development project. Microtubular SOFC with an output of 100–200 W are being developed for inclusion in unmanned aerial vehicles. The goal is to run the SOFC on propane and replace the batteries in conventional UAV, allowing for longer runtimes. Current challenges include weight reduction and optimising the interconnectivity of individual SOFC cells to provide sufficient power.

After lunch, Torquil Ross-Martin from Tata Motors shared his thoughts on the competition between battery electric and fuel cell electric vehicles. The need for greenhouse gas reduction is clear and both technologies will feature as part of the solution. Ross-Martin's view was BEV would tend to fit with low-mileage vehicles whereas FCEV would be more suited to vehicles with a higher annual mileage. Challenges still remain for hydrogen storage and the development of suitable infrastructure, but to achieve the required CO_2 targets, green hydrogen is necessary. This is likely to come at a price however, as low cost hydrogen tends to have a high carbon footprint and does not meet the purity requirements of most vehicles. The prices quoted for commercial hydrogen sale may also leave little or no room for profit margins or fuel duty, especially in countries like the UK.

The next two speakers introduced a shift in conventional thinking regarding vehicles, coming from Microcab and Riversimple respectively. John Jostins from Microcab is working with Arcola Energy and Horizon Fuel Cell Technologies on its H2EV; a multi-purpose vehicle platform which is road legal in the UK. The vehicle can either take the form of a four-seater car, a minivan or a flat-floored car (for ease of access). It carries 1.8 kg of hydrogen at 350 bar, which is enough for a range of around 100 miles at a top speed of 55 mph using its 3 kW fuel cell. The vehicle does however require a Vehicle Special Order (VSO) which must be renewed each year to allow it to carry hydrogen.

Nicolas Sergent from Riversimple presented a similarly styled micro-car, which is a two-seater fuel cell city vehicle. The Riversimple business model is to sell a service, not a car, with a fixed cost per month plus a variable surcharge for the fuel used. It initially plans to introduce its vehicles to Leicester and Hereford in 2013 and then rollout to other regions after that. The Riversimple contains 6 kW of fuel cells from Horizon Fuel Cell Technologies and the company also works closely with Arcola Energy on this project. With a range of 200 miles per kilogram of hydrogen and emissions of only 31 g of CO_2 per kilometre (calculated using fossil fuel derived hydrogen) national emissions targets can be met without the need for green hydrogen, although using hydrogen from renewables improves these figures.

The penultimate speaker of the day diverted from fuel cell technologies, and introduced another way to reduce emissions and save fuel, especially for managers of large vehicle fleets. Steve Perham from Airmax, a remote diagnostics company, showed how companies are mapping the world, in a similar manner to Google Streetview, in order to enable 'smart vehicles' to read the road. Fuel savings can be derived from allowing the vehicle to choose the optimum driving mode for different topographies and environments. Airmax is working with engineering technology consultancy Ricardo to develop electronic control units for smart cars.

The final talk of the day was from Professor Robert Steinberger with the title "100 HFC Car Swarm in the Midlands". Steinberger discussed the problems of transportation, accounting for 30% of EU energy consumption and growing. The mindset of vehicle use, with single occupancy and stop-start traffic are not helping to reverse this trend. The Swarm project is seeking to address this, providing mid-range (up to 250 miles) FCEV which can also run in a 'city mode' as plug-in hybrids. The goal of the project is to provide 100 vehicles; in the Midlands, Belgium and North-West Germany currently 95 are being used. The vehicles cost £35,000–£80,000 and Air Liquide is assisting the project, providing containerised hydrogen filling stations selling fuel at less than €10/kg.

After the main programme of presentations, there was an award ceremony and drinks reception, at which Jeremy Harrison from E.ON was presented with the 2012 Hydrogen and Fuel Cells Award; an additional award was also presented to Professor Kevin Kendall from the University of Birmingham for his contribution to the event during the past eight years. My congratulations go to both of the winners!

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