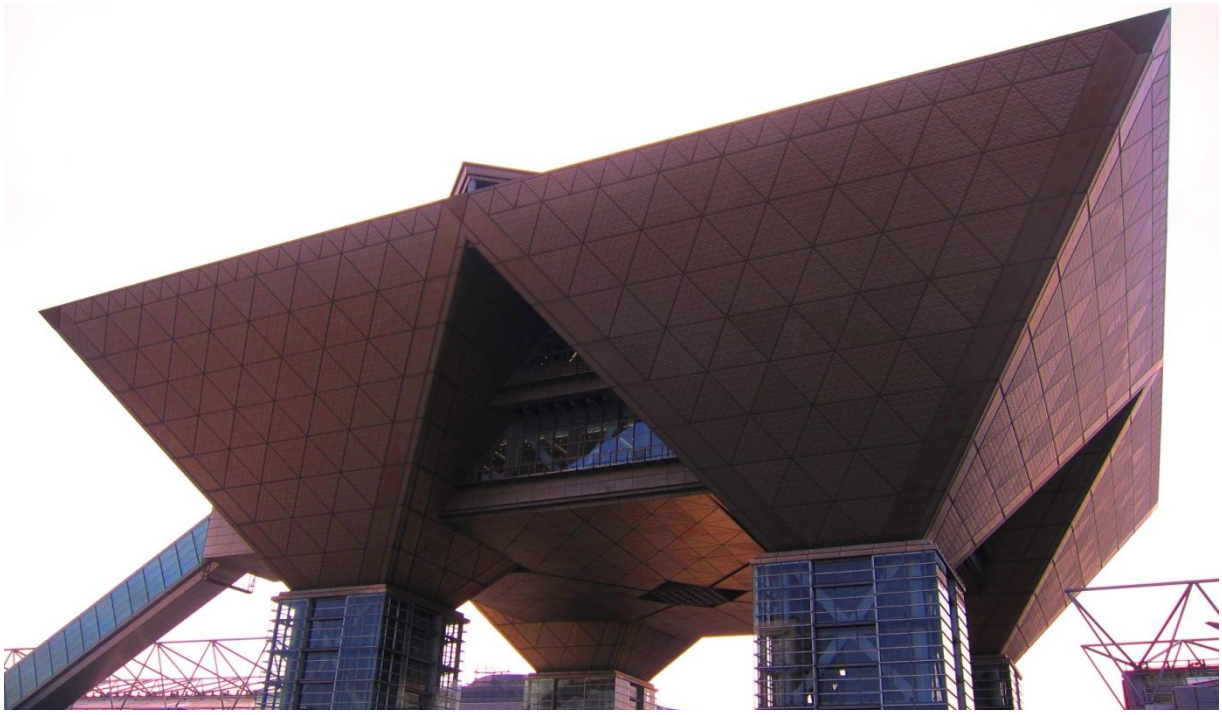
FuelCellToday
The leading authority on fuel cells

event report

FC Expo 2012, Tokyo, Japan

29TH FEBRUARY 2012



Tokyo Big Sight (Source: Jonathan Wing, Fuel Cell Today)

The annual FC Expo is one of the world's largest dedicated fuel cell trade fairs, attracting visitors and exhibitors from around the world. This year was no exception and we noted a high proportion of Korean attendees, underlining the country's interest in fuel cells. As always, entry to the FC Expo also allows visitors access to the other concurrent trade shows as part of World Smart Energy Week. This year they included: Eco House and Eco Building Expo, International Smart Grid Expo, Battery Japan, PV System Expo and Processing Technology Expo.

Day One

Fuel Cell Today has been attending the FC Expo in Japan for several years; this year as we walked the floor at the opening of the first day we noticed an increased presence of companies providing SOFC technology. Complete SOFC systems are on offer at the show ranging from small, low wattage tubular systems, up to kilowatt-scale planer stacks. Probably the most well-known Japanese SOFC is the new Ene-Farm product by Eneos Celltech distributed by JX Nippon Oil & Energy Corp. This 700 kW SOFC system was introduced in November 2011 and competes with its own established PEMFC system and those of Panasonic and Toshiba. Eneos' SOFC differs from its PEMFC competitors in that it is an electricity-led system, providing hot water as a secondary product. The higher operating

temperature of SOFC technology provides the integrated storage tank with hot water at 70° C, ten degrees Celsius higher than its PEMFC cousins. This hot water is mixed with cold water for household use, so the higher temperature enables the system to install a smaller hot water tank reducing the overall footprint. Since the system was introduced, around 300 units have been installed and Eneos is anticipating further growth as SOFC becomes more established in the scheme.

The successful release of an SOFC Ene-Farm is a firm indication of an increasing interest and demand for SOFC products in Japan. Sumitomo Precision products is showcasing a similar 1 kW SOFC stationary fuel cell that is in an advanced stage of development. It is interested in the Ene-Farm scheme, but will need to join forces with a system integrator to produce a suitable product to enter the scheme. Also under development is a larger version of the same system, with a rating of 5 kW, aimed at small factories and in the longer term, Sumitomo has plans to develop SOFC systems up to 100 kW.

Like many fuel cell technologies, SOFC is a scalable technology and is seeing strong adoption in the large stationary sector; Mitsubishi Heavy Industries is developing a large scale fuel cell combined cycle system industrial power plant under its Solidia brand. The company is planning three sizes of the plant: a 0.25-1.35 MW combined SOFC and gas turbine system; a 40 MW upscaled version of the same system; and an 80 MW combined SOFC, gas turbine and steam turbine system. The systems will be developed and commercialised from smallest to largest; they will be fed with natural gas and are expected to be 60-75% efficient. Mitsubishi plans to manufacture the whole product but initially it will buy in SOFC stacks.

As the SOFC market expands we expect to see an increasing number of companies that develop materials that can be used within SOFC diversifying into fuel cell development. Hitachi Materials Magic, a subsidiary of Hitachi Metals, Ltd., has been creating alloys for use in car engines for over twenty years; it is now adapting the Nickel-Chromium (Ni-Cr) alloys it developed for the automotive industry for use in SOFC.

SOFC technology is based on ceramics; it is only natural that we can see ceramics companies diversifying into SOFC development. NTK have developed proprietary ceramic technology that it is now looking to apply to SOFC – the company claims to have achieved a world leading 1.3 W/cm2 power density through optimisation of pore size and porosity of the electrodes. The company is hoping to commercialise the technology to system integrators by 2018 after several years of field testing and product optimisation.

Presidio Components, a 200 person strong San Diego-based multi-layer ceramic capacitor manufacturer, launched an SOFC subsidiary several years ago. Violet Fuel Cell Sticks is developing an innovative SOFC technology that combines the strengths of planer and tubular SOFC whilst addressing several of their shortcomings. Planer SOFC are prone to cracking if not carefully heated over a long period; tubular SOFC remove this shortcoming but are volume inefficient. A white paper, published in 2008, details Violet's solution: a flat 'stick' that contains many tiny tube-like fuel and air channels with multiple plate-like thin electrolyte layers between rows of tubes – together forming an SOFC that is small, efficient, and can be heated rapidly whilst withstanding cracking. Violet is independently funded and is quietly advancing its technology until it is ready for commercialisation.

Day Two

The FC Expo attracts companies from all over the world and today we have spent time visiting companies from outside Japan who team up to showcase their country's capabilities and exhibit on country pavilions.

Canada

On the Canada pavilion, Greenlight Innovation is introducing its fuel cell and battery test stations. Battery testing is a relatively new feature, but with the vast majority of commercial fuel cell systems hybridised with batteries in transport, stationary and portable applications we think this is a sensible move extending Greenlight's expertise in this field. In the future, test equipment for combined battery and fuel cell systems could evolve out of this technology. A review of Canada would not be complete without mentioning Ballard which is promoting its range of megawatt-scale stationary systems which can run using hydrogen from biogas, or a by-product of the chemical industry. Fuel cell modules for buses are also still a key product, and increasing interest in Europe is supporting this business.

United States

On the USA pavilion, Pdc Machines Inc is displaying its range of hydrogen compressors which can be used in a modular fashion and process hydrogen from both high and low pressure electrolysis. It has provided this technology to a range of hydrogen refuelling systems for the materials handling and transportation markets and recently assisted Boeing with compressors for a hydrogen station to refuel unmanned aerial vehicles. TDA Research has joined the USA pavilion for the first time this year, with its range of sulphur removal technologies for hydrogen purification. The technology changes colour when it has reached the end of its useful life and this can be used as a visual indicator to change the purification material before it is detrimental to the fuel cell's activity. Automated detection systems can also be installed for this, providing notification when the material needs exchanging. This can be especially useful in remote locations where access to the fuel cell installation is difficult. Sulphur can be removed down to levels of less than 4 ppb using the technology, and it can be used with a range of fuels from LPG, to biogas and fossil fuel methane.

Finland

The Finnish pavilion hosts SOFC manufacturers, research organisations and system integrators and activity in the country has been strong for many years. Current work is targeting a large scale demonstration project called Demo 2013, to be held in a Helsinki port facility from next year and will include fuel cells for materials handling, backup power and stationary power generation. Much more information about activity in Finland can be found in Fuel Cell Today's recent report Fuel Cells and Hydrogen in Finland, published earlier this week.

France

The energy mix in France is dominated by cheap, abundant nuclear power. Nearly 80% of the country's energy supply is nuclear and unlike Japan and Germany, there is no strong pressure to move away from this set up. As such the market for stationary fuel cells is limited, and fuel cell adoption of any kind has been slow – there are just two large fuel cell labs in the country; the majority of French fuel cell companies rely on the export market.

Despite this, the French government is interested in energy storage solutions. In 2009 it formed the HYPAC platform in partnership with an industry grouping and research bodies. The platform aimed to create a roadmap for hydrogen in France, published last year; the platform is now issuing calls for proposals and is spurring demonstration projects.

Formed four years ago and commercial for the last eighteen months, McPhy Energy provides hydrogen storage and low pressure electrolysis solutions. Its products are flexible and designed for both industrial and commercial use – the systems can adapt to defined limits on either energy price or energy demand. The company is now actively involved in a French government funded energy storage project that aims to valorise renewables and hydrogen. Another project on the French island of Corsica is combining a 500 kW photovoltaic system with a hydrogen storage and fuel cell system to balance and optimise its grid output.

Although fuel cells may not have a strong market in the French stationary sector, a French hydrogen mobility project is under development and there is strong interest in the use of hydrogen vehicles, particularly if they can be fuelled with hydrogen from energy storage systems. In education, Pragma Industries has seen some success in selling demonstrative products to French high schools and universities and also sells fuel cell test stations for the export market.

Taiwan

The Taiwan Fuel Cell Partnership is already more than fifty members strong; the Taiwanese market for hydrogen and fuel cells is focusing on backup power and scooters, with demonstration projects underway for both. The telecoms backup projects are using a mix of Ballard-powered systems and domestically produced systems; Yangtze was demonstrating its Taiwanese MEAs at the Expo. Young Green Energy is developing a compact 185 x 103 x 78 mm 20 W continuous (40 W maximum) output PEMFC system. Fuelled with 25 Wh solid state sodium borohydride cartridges, the system has one 20 W DC and two USB outputs. The product has been two years in development and Young Green are now looking for OEM partners to commercialise the product in either domestic or export markets; the company sees the product being used primarily for emergency personal and military use. The FC-20P01 product should cost about USD 400, with cartridges at USD 4 each.

Germany

Germany is a world leader in the adoption of hydrogen and fuel cell technologies. The German pavilion was the largest of the country pavilions and was receiving strong traffic, not least of all thanks to its afternoon business card for beer exchange. With a commitment to remove all nuclear power from Germany stringent targets have been set for the adoption of renewable energies: 35% by 2020, 55% by 2030, and 80% by 2050. The German grid supplies 600 TWh annually but at present there is only 0.7 TWh of energy storage – with the increasing amount of renewable energy grid balancing will become an increasingly important issue; with fast response times hydrogen storage and fuel cell electrification have potential to help mitigate this issue but will be competing against potentially cheaper gas turbines. The transition to non-nuclear would also require an additional 4,100 km of high voltage lines; this would be an expensive and difficult operation and distributed generation may be the best way to avoid this; once again fuel cells have great potential in this area as they can integrate into the low voltage grid. One company hoping larger stationary systems will flourish in Germany is Becker, which produces vacuum pumps and compressors for a number of industries, including fuel cells of 5 kW and above. A third driver for fuel cells in Germany comes from gas companies, who are seeking ways to stay relevant in the renewable electricity future.

Ceramic Fuel Cells Limited (CFCL) see Germany as a key market and with a BlueGen production factory located near Düsseldorf, the company was present on the German pavilion. CFCL began

commercial sales with its German partner sanevo blue energy recently and the initial shipment of 100 units sold out within four weeks. At present there is no government subsidy scheme in place but this is likely to change in the future.

The Fraunhofer Institute is the largest applied research organisation in Germany and its Future Foundation has financed several research branches including the ceramic-focused Fraunhofer IKTS. The company is non-profit and produces SOFC technology and solutions for those who want to make systems. One commercial partner of Fraunhofer IKTS is Ezelleron, which produces micro-tubular SOFC. The company serves as an integrator but is also developing its own products including the go::batt 125, a 25 W continuous output portable SOFC with one 12 V and four USB outputs; this unit is targeting similar applications to the Young Green Energy product.

Day Three

The third day of the FC Expo 2012 was equally as busy as the first two and we were visited by a number of companies keen to introduce themselves and their technologies. Ajusa is a family owned Spanish company which has a long history manufacturing head gaskets, camshafts and head bolts for the automotive sector. These types of components are very similar in performance to bipolar plates and other common fuel cell components, so it has been a simple evolution for the company to diversify into the fuel cell market. At its manufacturing facility in Spain, it has applied its technology to make fuel cell systems for both stationary and automotive applications. It has replaced the batteries in an electric vehicle with a PEM fuel cell, has its own hydrogen refuelling station and has a small house powered by a 10 kW hydrogen fuel cell – its own mini hydrogen economy.

Kaori is a major Taiwanese supplier of SOFC hotboxes and was exhibiting for the first time at the FC Expo. Similar to Ajusa, its origins lie in related technologies, in this case heat exchangers and heat treatment equipment. The company also has methane reforming technology and can produce hydrogen with less than 5 ppm CO. This reformer has been successfully tested using a Ballard PEM fuel cell, chosen because it is a widely used PEMFC across the industry.

We also took our chance to catch up on other developments inside Japan, specifically the transport related HySUT project, the Fukuoka hydrogen town and developments at Yamanashi University.

HySUT (The Research Association of **Hy**drogen **S**upply/**U**tilisation **T**echnology)

HySUT is charged with planning and developing the infrastructure necessary to enable the introduction of FCEV in Japan. Funded by a consortium of energy suppliers, engineering, and automotive companies the project has a roadmap for construction of 100 hydrogen stations by 2015; it is planned that this will facilitate domestic FCEV sales of a few thousand per year from that time. HySUT operates 12 hydrogen filling stations in Japan (ten permanent and two stationary) with a further four privately run stations making a total of 16 in the country. There is a lot of work needed to address the legislative aspects of hydrogen infrastructure in Japan, which it is hoped will allow hydrogen to be sited alongside conventional fuelling pumps, and this also forms part of HySUT's goals.

Fukuoka hydrogen town

The Fukuoka prefecture is located in northern Kyushu and has a population of over five million. In 2009, the Fukuoka HyLife project was launched as a four year demonstration to test the viability of hydrogen for residential use in the world's first 'hydrogen town'. It saw LPG-fuelled 1 kW Ene-Farm systems installed in 150 homes in Fukuoka town by Nippon Oil Corporation and Seibu Gas Energy Co.

Three years later the project is continuing to be successful and the feedback from users has been positive – they enjoy that they are helping to mitigate climate change without having to change their lifestyle. The project has attracted over 2,000 interested visitors from around the world and is to be extended until 2016 due to its success.

Japan has committed to build 100 hydrogen refuelling stations by 2015, when several global automakers will be commercialising FCEV. Fukuoka is one of four regions in which these stations will be concentrated (the others are Tokyo, Nagoya and Osaka) and the region is actively trying to attract FCEV; at present it is home to five FCEV, one scooter and two hydrogen refuelling stations – one of which is supplied with by-product hydrogen piped from a nearby steel plant. The region is home to several major automakers and its road infrastructure is well developed and not as crowded as in Tokyo, factors that should make it attractive for hydrogen infrastructure and FCEV deployment; it is unclear at the moment how the 100 stations will be split across the four regions.

Yamanashi University

The Yamanashi prefecture of the Chūbu region of Honshu island is home to Yamanashi University, which has been undertaking fuel cell research for more than forty years. The University was displaying several of its fuel cell projects at its pavilion and the area is now beginning to adopt fuel cell technology as well as research it. There are fifty Ene-Farm units installed in the region and this is increasing at a rate of around twenty per year. A 350 bar hydrogen refuelling station was constructed in August 2011 and a loaned Toyota FCEV is in use in the area; the University is working to increase the popularity of FCEV in the area. There are currently no plans for any large stationary projects in the area.

Dan Carter Manager

dancarter@fuelcelltoday.com

Jonathan Wing Market Analyst

jonathanwing@fuelcelltoday.com

www.fuelcelltoday.com