

event report

World Hydrogen Technologies Convention 2011
Glasgow, UK

14-16 SEPTEMBER 2011



*Honda's FCX Clarity FCEV making its Scottish debut outside the Glasgow SECC
(Source: Fuel Cell Today/Jonathan Wing)*

The biennial World Hydrogen Technologies Convention (WHTC), sister to the World Hydrogen Energy Conference (WHEC), took place from 14th to 16th September in Glasgow, the first time the conference has visited the UK. With Scotland's abundant renewable energy potential, the convention's primary theme 'Renewables to hydrogen' was a natural choice. Organised by the International Association for Hydrogen Energy (IAHE) and the local University of Strathclyde, the convention lasted three days and comprised three plenary sessions, six technical sessions (with parallel presentations) and an exhibition.

Fuel Cell Today manager Dan Carter, director Joe Stevenson and market analyst Jonathan Wing attended. Dan also launched the Fuel Cell Today 2011 Industry Review during the opening plenary.

Scottish governmental support for renewables is strong, and this is something that was reflected during the opening plenary. Fergus Ewing, the Scottish Minister for Energy, Enterprise & Tourism spoke of the country's ambitious aim to have 100% of its electrical demand met by

renewables by 2020. Scotland is famous for its seemingly perpetual winds and boasts the highest wind potential of anywhere in the EU though there is an increasingly strong drive towards marine sources such as wave, tidal and, of course, off-shore wind.

Dr Klaus Bonhoff, Managing Director of NOW GmbH, followed on from Mr Ewing by explaining the role of hydrogen and fuel cell technologies in meeting energy policy goals. Dr Bonhoff highlighted the importance of fuel cell technologies and hydrogen from renewables as key contributors to five goals: strong economy, cleaner environment, greater job creation, energy security and maintaining a competitive edge. He compared the merits of underground hydrogen storage with those of compressed air and pumped hydro, concluding that hydrogen is the best solution for long-term energy storage. Dr Bonhoff also spoke of the need for funding, and long-term commitments in particular, using the German National Innovation Program (NIP), Hydrogen and Fuel Cell Technology as the example. This project has committed funding for the entire length of the programme (2009 to 2016) which is key to enabling the implementation of longer-term visions.

Fuel Cell Today manager Dr Dan Carter closed the session with a review of the global fuel cell and hydrogen industries and an outlook to the future. The talk introduced findings from our 2011 Industry Review, which Dan officially launched during the presentation, and which is available for free download from fuelcelltoday.com.

Primary theme: Renewables to hydrogen

The talks and discussions within the opening plenary introduced several aspects of the convention's primary theme: renewables to hydrogen. Within this overarching theme, two main areas of interest emerged: hydrogen as an energy store for renewable energy, and hydrogen production directly from renewable resources.

Hydrogen as an energy store for renewable energy

During his plenary Dr Bonhoff spoke of the need for a clearer message about the role of hydrogen in future renewable energy systems. This is an issue that we have seen mentioned many times, and is an important one, as many stakeholders and decision makers still retain an idea of hydrogen as unsafe and fuel cells as an investment risk, after the false hype at the end of the 1990s. Energy storage for intermittent renewable electricity sources offers a new pathway for these technologies to be implemented and is likely to be of increasing importance in the coming years.

Dr Bonhoff drew attention to a benefit of hydrogen storage over alternative solutions, its potential to directly support future transportation systems. In Germany, transport represents a third of primary energy use. Hydrogen could be used both as an energy store and as a directly usable transport fuel. The German government has shown considerable interest in fuel cell bus demonstration programmes and hydrogen refuelling, so the use of hydrogen as an energy storage medium should be appealing. 'Windgas' projects are also underway in Germany looking at feeding renewably generated hydrogen into the natural gas grid for distribution.

In the UK, companies such as ITM Power are leading the way in demonstrating the viability of hydrogen energy storage. Speaking during the closing plenary, ITM CTO Dr Simon Bourne highlighted Britain's wind potential, the third greatest in the world, and how on-site hydrogen storage solutions, such as ITM's HFuel electrolyser, can help to balance variable renewables such

as Scottish wind turbines. This is an area that has already been considered by the Scottish government, with Alan Mortimer of ScottishPower Renewables explaining to Thursday's plenary audience the abandoned 'WindStor' project proposal. The proposal was to combine hydrogen storage and a fuel cell with a wind turbine in an area of weak grid coverage near Glasgow. The PEMFC implementation that had been considered provided an energy efficiency of just 28%, compared to efficiencies of over 70% achievable with pumped hydro or compressed air storage. This, combined with a lack of public confidence in the safety of the project, led to a denial of government funding. If an SOFC was to be used instead of the PEMFC efficiencies of over 60% could be achieved but the project is unlikely to be resumed.

Hydrogen production from non-renewable resources

Currently the majority of the world's hydrogen is manufactured using steam-methane reforming. The long term goal will be to produce hydrogen renewably to feed a hydrogen economy, but in the near future, transitional technologies must be exploited. In India, a comprehensive compressed natural gas (CNG) infrastructure is already in place, and plans are in place to introduce hydrogen into this distribution network. Indian Oil Company (IOC) introduced a direct natural gas to hydrogen-CNG (H-CNG) process which operates in a single step and produces 15 to 20% hydrogen in the H-CNG. This fuel improves nitrogen oxide emissions, but comes at a price as hydrogen is currently more expensive than pure CNG. IOC also shared its plans for the future which included using fuel cells for telecoms backup, buses and in conjunction with solar electrolyzers.

Hydrogen production directly from renewable resources

During her presentation in WHTC's closing plenary Dr Kerry-Ann Adamson, Research Director of Pike Research, spoke of the surge in demand for hydrogen that will occur as fuel cells continue to commercialise and the relatively low surplus that exists in current industrial hydrogen production. Industries may scale up existing production but ultimately innovative new ways to produce hydrogen will have to be explored.



Air Products' Orange County wastewater treatment plant (Source: Air Products)

Air Products, the world's largest hydrogen producer with a daily output of more than five million kilograms of hydrogen, plans to integrate renewables directly into its hydrogen production. A new plant in the US Orange County Sanitation District is the company's first foray

into biogas to hydrogen. Powered by a molten carbonate fuel cell (MCFC) from FuelCell Energy, the plant produces 175 kg hydrogen per day at an efficiency of 80% and is of a purity that satisfies all existing specifications for vehicle refuelling.

Lisa Jordan, Air Products' Business Manager for Bio-Energy, announced plans for the company's HESTON project – an upscaled biogas to hydrogen energy station in London that will mark Europe's first megawatt fuel cell deployment. Operating at 1.1 to 1.4 MW, the plant will produce 635 kg hydrogen per day at approximately €10 per kilo, providing a step change in European hydrogen production. Supported by the London Hydrogen Partnership and the EU JTI (Joint Technology Initiative), the project is pending approval from the European Union.

Education for the public on integrated renewables

During one of the parallel sessions, a Turkish project introducing renewable technologies in a novel way was presented. The H₂Ekokaravan is a custom-built mobile home which boasts 1.7 kW roof-mounted solar panels, a 1 kW wind turbine, 1.2 kW backup fuel cells. and is designed to operate autonomously from the grid for up to three days. Once the on-board batteries are charged to 90% capacity, the system automatically switches to hydrogen production mode. Hydrogen is not only used to power the fuel cells, but also to cook using a hydrogen cooker. The H₂Ekokaravan has toured eleven cities in Turkey, and also visited the 2011 World Future Energy Summit in Abu Dhabi and the Vienna Energy Forum 2011.

Marine: An expanding niche for fuel cells

With maritime emissions regulations tightening significantly in the EU and elsewhere, marine stakeholders, particularly the shipping industry, are looking for new ways to lower emissions without damaging their businesses. Fuel cells offer unique opportunities within this area.

A 2002 project, FC-SHIP, involving 21 EU partners and over 40 fuel cell partners looked at low megawatt range MCFC and SOFC running on liquid fuel with a reformer for marine auxiliary power unit (APU) purposes. This is likely to be how fuel cells will be implemented on ships to begin with, as the power needed for propulsion of such large and heavy vessels is not currently feasible or economical.

Propulsive power via fuel cells is possible on smaller boats, such as tugs or canal barges, with projects in Amsterdam, Germany and at the University of Birmingham validating this.

RCS: An ever-present obligation

As with any modern hydrogen and fuel cell event, there was an undertone of the necessity of, and trials of meeting, draft and existing regulations, codes and standards (RCS). An insightful presentation on the licensing of hydrogen stations for use in the HyFLEET:CUTE programme was given by consultant Klaus Stolzenburg. He explained how every station had to be licensed locally with authorities, many of whom had no prior experience with hydrogen. In the absence of any hydrogen-specific safety standards, a station would be subjected to CNG standards, hydrogen industrial plant standards, non-EU hydrogen refuelling standards, or a combination of all. This lack of consistent structure meant that there was a six- to eighteen-month delay between initial talks with authorities and obtaining permits.

With authorities so inexperienced in dealing with hydrogen technologies, the dissemination of accurate and publicly available information is crucial; the permit that took eighteen months to obtain was delayed because a local individual had managed to convince the authority that any hydrogen that may leak from the plant would infiltrate the land and poison the groundwater. This serves to show that even the most basic information surrounding hydrogen and fuel cell technologies is missing in some areas.

Randy Dey, Chair of the ISO/TC 197 board for standardisation of hydrogen technologies, summarised the unique challenge in developing hydrogen RCS: a single set of requirements is needed that would apply anywhere in the world – something that has never been done before for any fuel. The International Energy Association (IEA)'s Hydrogen Implementing Agreement (HIA) spans twenty three member countries and is working on several tasks to aid this effort: Task 23 – Small-Scale Reformers for On-Site Hydrogen Supply; Task 28 – Large Scale Hydrogen Delivery Infrastructure; and Task 31 – Hydrogen Safety.

Overall this event was a good stage for Scotland to promote itself as one of the most forward looking regions in terms of the intent to integrate hydrogen with its abundant renewables. Support could be seen from government, businesses and academia, all pushing towards the same goal. This type of concerted approach is necessary to overcome the inevitable legislative, technical and economic hurdles to the introduction of a new technology.

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A fuel cell electric vehicle (FCEV) and hydrogen infrastructure demonstration



Honda's FCX Clarity parked with ITM Power's HFuel (Source: Fuel Cell Today/Jonathan Wing)

Efforts in automotive fuel cell and hydrogen applications have been plagued by a chicken-and-egg conundrum implicit in establishing a refuelling infrastructure and reaching mass commercialisation: Consumers will not be willing to buy a FCEV if there are insufficient locations at which to refuel it, and investors will not want to fund the construction of hydrogen stations if there are no cars to drive onto the forecourt.

At WHTC Fuel Cell Today saw the future of low carbon transportation. Famous for being the world's first production FCEV, the Honda FCX Clarity was on display at the event. Also exhibiting was Sheffield-based ITM Power with its innovative HFuel mobile hydrogen refuelling station.

ITM's HFuel is a self-contained PEM-based electrolyser system, which includes all the water purification, pumps, control systems and safety devices needed to produce hydrogen safely and to meet current regulations. It also contains an uninterruptible power system which can safely shut down the system in the event of a power loss. The system delivers hydrogen at 350 bar.

Seeing the two products together provided a vision of a complete automotive solution. The automotive fuel cell industry has yet to mature, but Honda and ITM are leading the way by making their products commercially available. The Clarity is available to consumers on lease schemes in California and Japan, and the HFuel is available to order on request from ITM Power. ITM are also currently undertaking a field trial demonstration run of the HFuel, HOST, which sees the HFuel and two hydrogen internal combustion engine (HICE) vans operating at a given site for a week.

Mobile stations such as HFuel are cheaper and easier to deploy than conventional filling stations, and if deployed in clusters in areas can form the basis of a hydrogen infrastructure, helping to alleviate the chicken-and-egg conundrum. This is exactly what SunHydro, who sell similar refuelling stations, is aiming to achieve in the northeast of the USA.