FuelCellToday
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analyst view

Methanol – Clean Fuel for the Future?

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The QBEAK on display at the Group Exhibit Hydrogen + Fuel Cells in Hannover, April 2013 (Fuel Cell Today)

As a fuel for fuel cells, methanol is showing good form lately. Last month, Ballard Power Systems announced that it had shipped 500 methanol-fuelled ElectraGen-ME telecom backup power systems since the company acquired the product line from IdaTech in August 2012, including deployments in 16 Caribbean and Latin American telecommunications networks. In fact, the methanol-fuelled product appears to be more popular than the hydrogen version: in the five months to the end of 2012, Ballard sold 160 hydrogen-fuelled ElectraGen versus 240 methanol-fuelled systems (which use PEMFC with an integrated reformer).

DMFC specialist SFC Energy has launched new versions of its EFOY Pro portable generators for demanding industrial applications; lifetime has increased by 50% to 4,500 hours, while operating costs have been cut by as much as 40%. Having acquired PBF Group, a customised power solutions developer, SFC Energy is using this expertise to open up new markets for its products. It is targeting the market for an off-grid system with extended runtime and is developing a cabinet product using the EFOY Pro that can operate for many months on the methanol stored on site, requiring minimal fuel deliveries. For the leisure market, its EFOY COMFORT product line is now also available in the US and Canada. SFC Energy continues to work with the US Air Force to optimise its 50 W JENNY fuel cell generator for military needs and received $1 million in December to bring it to production readiness.

Oorja Protonics has also been busy, signing up UniPro Foodservice Inc. as a potential customer for Oorja's DMFC range-extender technology for materials handling vehicles (MHV). It has also signed an agreement with Lawrence Berkeley National Laboratory to cooperate on further technology

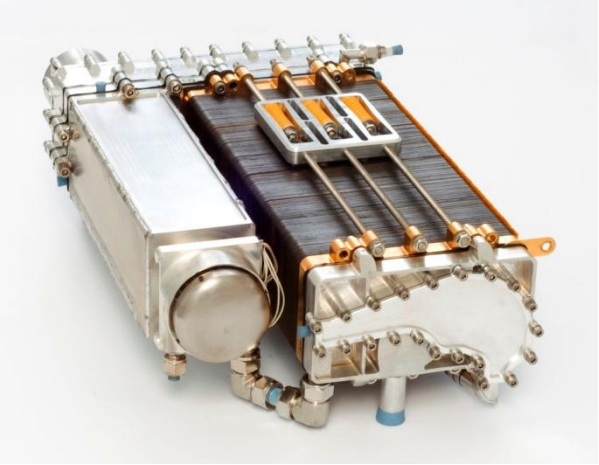
development for improved DMFC and liquid-fed fuel cell systems. Outside the USA, it is working with HySA Catalysis in South Africa, which has the marketing and distribution rights to Oorja's products in the African market; the target applications are telecommunications backup power, MHV, and auxiliary power units for refrigerated trucks. In April it started shipping its products to HySA for demonstration in MHV in South Africa.

But if there is one fuel cell application that surely must be considered beyond the reach of methanol, it is its use as an automotive fuel. It was tried, after all, notably in Daimler's NECAR 3 and Toyota's FCHV-2 demonstration fuel cell vehicles in the late 1990s, and then set aside in the next decade when the automotive OEMs collectively agreed to focus on compressed hydrogen because of the advantage of zero tailpipe emissions. So that was that for methanol and fuel cell vehicles – or was it? Fuel Cell Today has spoken to one fuel cell company that thinks not: Denmark's Serenergy.

Serenergy was established in 2006 as a specialist designer and manufacturer of high-temperature PEMFC integrated with methanol reforming. Methanol was its fuel of choice from the beginning and the first question to address is why it decided on the HT-PEMFC + reformer route rather than DMFC. Serenergy's Commercial Manager Mads Friis Jensen says the company is not looking to compete in the range where DMFC technology is well-established and effective, but he believes that at power outputs above about 300 W PEMFC-based products make better sense as they allow for more compactness and efficiency than DMFC equivalents.

HT-PEMFC tolerate impurities in reformed fuel better than low-temperature PEMFC and the waste heat can be reused in the reforming process, allowing for simpler balance of plant, but HT-PEMFC technology has been plagued by reports of poor lifetimes. Jensen says this is in the past: the company's MEA supplier has been delivering consistent product quality at volume for some time now and Serenergy has demonstrated 5,000 operating hours at the system level, allowing it to offer a warranty to that effect – although Jensen says the technology is expected to have a lifetime of 20,000+ hours as 30,000 hours has been demonstrated at the MEA level. This is still insufficient for applications such as micro-CHP, but enables certain markets where the aim is to deliver 'reasonable lifetime at reasonable cost'. To this end, the product has been developed with the intention that most of it can be easily recycled: Serenergy recovers most of the platinum, for instance, and bipolar plates are simply reused.

So what are Serenergy's target markets? With the launch of its new 5 kW product platform (*right*) at this year's Group Exhibit Hydrogen + Fuel Cells at Hannover in April, it is now ready to tackle immediate commercial opportunities. Telecommunications backup power is a focus point: Jensen says the Serenergy product should be cost-competitive with a smaller footprint than LT-PEMFC + reformer products and will be designed as a straight replacement for diesel generators. Echoing the trend in Ballard's sales mentioned above, he believes methanol-fuelled systems offer a superior alternative in many cases where longer runtimes are required.



The next step for Serenergy is selling fuel cell range extenders for small electric vehicles: the EcoMotion landscape maintenance vehicle demonstrated in 2011 was a prequel to this, and a Nilfisk Advance hybrid floor sweeper which will use a Serenergy range extender was on display at the Group Exhibit this year; Jensen also notes the "proven potential" in the MHV market. But, he says, this is a stepping stone to the ultimate mass market, and it is here that we begin to discuss methanol fuel cells for cars.

If methanol has been tried once for fuel cell cars and discarded, why does Serenergy think it will succeed now? Jensen makes the point that both fuel cell technology and methanol production (specifically from renewable sources) have come a long way in the last decade. Serenergy's concept is also very specific in its ambition: as a serial range extender for hybrid vehicles where the battery caters to peak load and the fuel cell is sized to the average load. So rather than a power output of 80–100 kW, as is typical in FCEV, the fuel cell is only 5–20 kW so stack density can be lower (reducing cost per kilowatt but without increasing the system to an unmanageable size). In a well-designed car, the battery will cater for normal drive cycles with the range extender only there to top-up the battery charge. The battery also covers start-up so that the slight lag in fuel reforming and fuel cell output is not an issue.

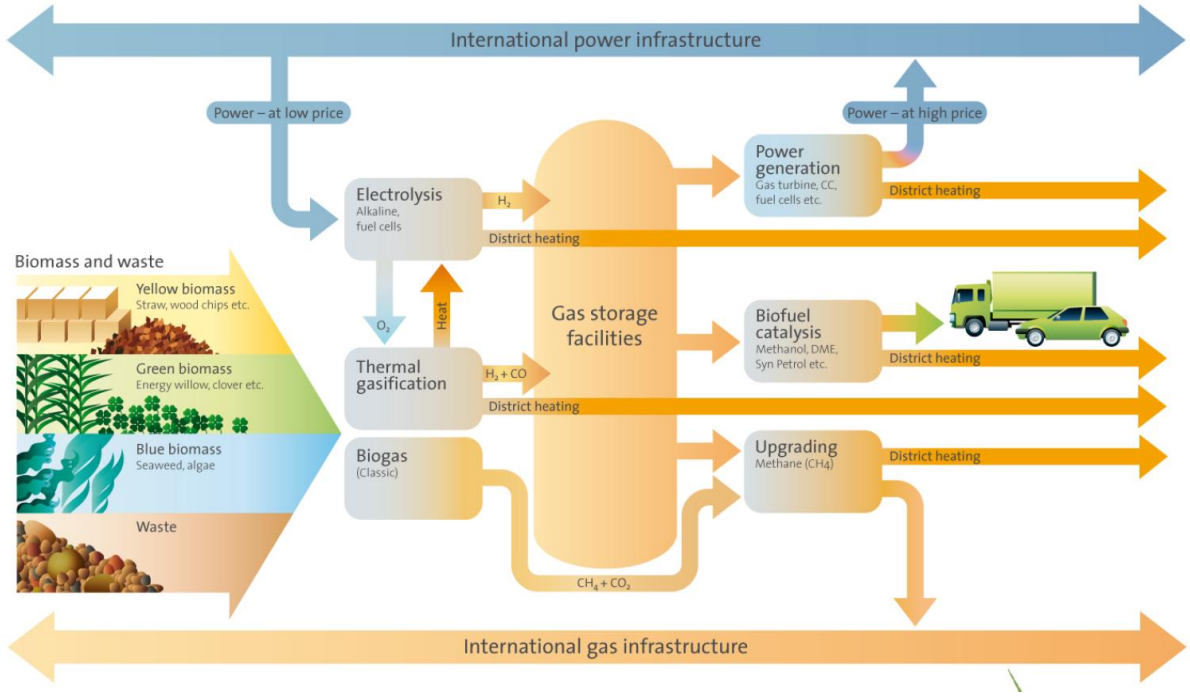
Serenergy is working with Danish electric vehicle developer ECOmove to crystallise this concept in the form of the QBEAK concept car. The car, which we have reported on before, was also on display at Hannover and showed how the range extender and the battery simply slot into a central channel in the vehicle's floor that can be easily pulled out for addition or replacement of any component. QBEAK is currently a prototype but is intended to be on Danish roads within the next few years. For this, it needs fuel.

Serenergy is in the planning phase with Denmark's largest fuel distributor (OK a.m.b.a.) to adapt existing filling stations to dispense the cheap methanol-water mix used by QBEAK (the distributor is already delivering the methanol fuel being used in MHV trials in Denmark). Annual fuel consumption in the country has dropped by 6% in the last few years and as a result spare pumps are available. Some components must be replaced to tolerate methanol and existing underground tanks can be used if fitted with a new lining. Jensen says the question of methanol's toxicity has been raised but is simply an engineering issue, methanol being no more hazardous than conventional fuels. For the fuel distributor, methanol may well offer a way to increase sales so that the creation of a methanol refuelling infrastructure – in Denmark at least – could be accomplished at no net cost to the consumer. This circumvents one of the chief objections to new vehicle drivetrains.

But what about carbon dioxide emissions? A vehicle fuelled with methanol will emit CO_2 at the tailpipe but in Denmark, where the aim is to use domestic energy resources as efficiently as possible, this may not be the deciding factor. Jensen points to a Danish study that indicates, under the stated conditions, well-to-wheel fossil CO_2 emissions can be lower than hydrogen because methanol can be derived from a variety of renewable resources with good yield and high efficiency and because it is relatively easy to store and distribute. Is renewable methanol available? This was addressed in a previous Analyst View but in a major development since then, the European Commission has awarded €199 million in co-funding to a consortium that will construct a large-scale biomass refinery in the Netherlands. The Woodspirit refinery will gasify forestry and wood processing residue to produce syngas that is then converted to biomethanol. Of course, biomass is subject to limited availability and Jensen sees promise in the approach adopted by Carbon Recycling International (CRI), where hydrogen from electrolysis is combined with captured CO_2 to produce methanol (whether this is fully renewable depends on the source of carbon, but that is a subject for another discussion).

CRI's methanol production plant in Iceland, which draws on a geothermal plant for its power and CO_2, has received the first ISCC PLUS certificate for renewable fuel of non-biological origin.

To underline the fact that Denmark really is serious about methanol, the Coherent Energy and Environmental System Analysis (CEESA) project, which is partially financed by the Danish Council for Strategic Research, has identified methanol as a key fuel for cars within a fossil free energy system for the country by 2050, and it is also included in broad energy planning by Energinet.dk – illustrated below (*courtesy of Energinet.dk*):



So Serenergy and ECOmove may well succeed in getting methanol fuel cell vehicles on the road again – to the benefit of the fuel cell industry as a whole, which is strengthened by having a variety of solutions available for each application. This may not be limited to Denmark: Jensen believes there is wider interest and says Serenergy is planning for and discussing the possibility of employing its technology in concept cars with a number of international OEMs. But for the moment, the company is focusing on generating revenue by exploiting existing niches while keeping a cash-neutral operation. This is of course aided by access to a good support structure in Denmark, within which dedicated technology research and development is co-funded by government programmes such as the EUDP under the Danish Ministry of Climate and Energy.

As for methanol, its use in telecommunications backup and portable power, small electric vehicles and MHV already makes a lot of sense and we expect to see growing success for the fuel in fuel cell applications worldwide. Its relevance as an alternative fuel that could make a substantial contribution to carbon reduction is also becoming apparent.

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