

## Long Distance Relationships: The Secret for Fuel Cell Success?

Fuel cell developers and integrators form trans-oceanic partnerships to crash through cultural barriers

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Fuel Cell Magazine, April 2009

### ***The Global Fuel Cell Challenge:***

The multiplicity of viable fuel cell applications, breadth of developed and developing technologies and widely varying regional market conditions have created global partnerships among entities with complementary attributes. Although it may seem that domestic liaisons among culturally similar players spawned from fertile academia centric industry clusters should provide the clearest route to success in this struggling industry, it is the intercontinental groupings which are showing the most potential and creating the most buzz.

***Vertically Integrated Multi-National Partnerships Create Compelling Products:*** **Dantherm Power** is a global fuel-cell oriented creation of Denmark's largest HVAC manufacturer, **Dantherm A/S**, via its subsidiary, Dantherm Air Handling. Initially it had a set of domestic partners – **Danfoss**, **Grundfos**, and fuel cell stack developers **Topsoe** and **IRD** - with whom to develop complete fuel cell systems. A few lucky Danes were sent to the Fuel Cell Seminar in Honolulu in 2006 where they dutifully listened to my poster presentation on Successful Strategies in FC Markets. They made an impression on me due both to their exuberance and the presence of their pictures on their business cards...more about cultural differences later. That showing was followed by a complete Danish kiosk and contingent at the bi-annual HFC International Conference in Vancouver the next spring. The seeds of international cooperation were sown, helped in part by the presence in nearby Whistler of significantly more skiable, albeit dangerous, mountains as compared to gentle Denmark.

**Ballard Power** was already enjoying residential cogeneration success in its budding relationship with Japan giant balance of plant manufacturer, **Ebara**, and truly global visibility for its power plant use in the EC CUTE bus program. Clearly, Canadian integrators and marketers were not required nor relied on for Ballard's sales, and the international success allowed it to remain solvent while it divested its overwhelming commitment to the automotive power segment. While Dantherm Power carries pre-commercial demonstration installations with its domestic stack partners, it has chosen Ballard stacks as the basis for its entry into the most viable of all fuel cell markets, critical backup. Dantherm is not alone. **IdaTech**, while hidden away in the high desert of Bend Oregon, has shelved its own stack for Ballard's to secure an order for as many as 10,000 systems over the next few years. Internationally-oriented, India-based system integrator **ACME Tele Power Ltd.** has the clout and expertise in the Indian telco network market to make good on the potential if Ballard and IdaTech can produce. .

Ballard has not only survived but has risen to the brink of global credulity by focusing on its stacks alone, while forging relationships with successful manufacturers and system integrators catering to markets outside North America who are historically market savvy. It is not alone in this strategy (see fig.1).

### ***The current global stationary market in perspective:***

- The basic PEM fuel cell touted initially as the universal technology has finally been brought to reasonable reliability and cost levels for select markets. Early stack pioneers in the US and Canada who survived a millennial downturn have been joined by post millennial entrants forming global liaisons. They are bringing essentially mature PEM fuel cell technology to the critical backup power market long controlled by classic Pb-acid batteries and diesel generator sets.
- Connecticut-based **FuelCell Energy** and **UTC Power** have comparatively high profile mid-sized commercial and industrial CHP installations, ranging from 200 kW to 2.8 MW. The developers' domestic programs have enjoyed limited success: FCE securing subsidized sales in CT and CA and UTC receiving a 4.8 MW high profile order for the Freedom Tower in lower Manhattan. But Fuel Cell Energy has long held footholds in Japan and Germany, and now has guaranteed long-term profitable penetration into the Korean market via a ten-year sales commitment and licensing agreement with POSCO, Korea's largest steel manufacturer. Additionally, UTC has secured a multi-unit order from Samsung in Korea, but suffering from domestic price pressure, it is undergoing restructuring of its commercial fuel cell operations.

- Fuel cell mCHP (residential cogeneration) has gathered inertia through intense development and successful utility and government sponsored demonstrations of over 3600 home-based systems in Japan and Europe. There have been multiple announcements of 10,000+ unit manufacturing plans or integrator orders by 2010 and beyond contingent on incremental refinements, while the US market is essentially non-existent.
- Federal Governments including Japan, Korea, and Denmark, states including Ohio and Connecticut in the US, Baden-Wuerttemberg and North Rhine Westphalia Germany, Canadian provinces British Columbia and Ontario, and even cities like Hamburg and Columbia, SC have invested significant time and money into developing fuel cell clusters based on local University research, supply chain providers, developers, integrators, and end users. Although their programs continue, marked by anecdotal excitement and positive developments, **a more compelling creative synergy seems to arise from counter-intuitive cross cultural liaisons.**
- The €1 Billion (including 50% cost sharing) EC Joint Technology Initiative for Fuel Cells and Hydrogen to facilitate commercialization of fuel cells will elevate European awareness over the next six years. The German government-initiated Callux project unites German, Austrian, and Swiss stack developers, integrators, and major utilities to install 800 mCHP systems.

Figure 1: Some North American Dedicated Fuel Cell developers with their integrator partners

North American Developers	Location	International Integrators, Market Segment
Acumentrics	Westwood, MA, US	MTS (Merloni), <b>Italy</b> – mCHP
Altery Systems	Fremont, CA, US	EnerSys, <b>Global</b> – Critical backup
		Eaton Electric, <b>Global</b> – Critical backup
Ballard Power Systems	Vancouver, BC, Can	Dantherm Power, <b>Denmark</b> – Critical backup
		ACME via IdaTech, <b>India</b> – Telco, utility backup
		Ebara, <b>Japan</b> – mCHP
		Baxi INNOTECH, <b>Germany</b> – mCHP
Hydrogenics Corp.	Mississauga, ON, Can	APC by Schneider, <b>US+EU</b> – Data center backup
		Heliocentris, <b>Germany</b> – Mini Bus
		UPS Systems, <b>UK</b> – Data center backup
Intelligent Energy	CA, UK	Suzuki, <b>Japan</b> – Small motive
Nuvera Fuel Cells	Billerica, MA, US	Sacre-Davie, <b>Canada</b> : Generation
		Fiat, <b>Italy</b> – Motive
Plug Power Inc.	Latham, NY, US	Vaillant, <b>Germany</b> – mCHP
ReliOn, Inc.	Spokane, WA, US	Emerson, <b>Global</b> – Telco backup
UTC Power	Hartford, CT, US	Samsung, <b>Korea</b> – CHP
		Van Hool, <b>Belgium</b> – Bus power
FuelCell Energy	Danbury, CT, US	POSCO, <b>Korea</b> – CHP
		CFC Solutions, <b>Germany</b> – CHP

Source: Fuel Cell Intelligence

**Fuel cells represent disruptive technology:** Fuel cells require novel maintenance, support, and refueling including operator instruction and a new supply infrastructure. This can bring about concerted resistance by operators and managers afraid of disturbing the status quo, not to mention the conventional battery, diesel generator, and HVAC system suppliers who have not yet partnered with an upstart fuel cell developer. The primary logical argument lodged by this disparate group against adopting the new technology is that fuel cells are unable to deliver the equivalent power, response, and reliability at a cost competitive with the tried and true conventional technologies. It just seems that despite the inordinate number of entrepreneurial fuel cell developers in North America, many of them with products that offer the potential of a comparable value proposition with compelling environmental advantages, the industry struggles for visibility and wide-reaching support.

**Telecom Backup Status Report:** The US Federal Communications Commission (FCC) passed regulations in 2007 requiring 8 hours of power for telecommunications tower and transfer stations, an increase from the previous 4 hours. The new requirements (placed on hold by the Bush administration, but impending regardless) are referred to as the ‘Katrina’ regulations as they were promulgated in

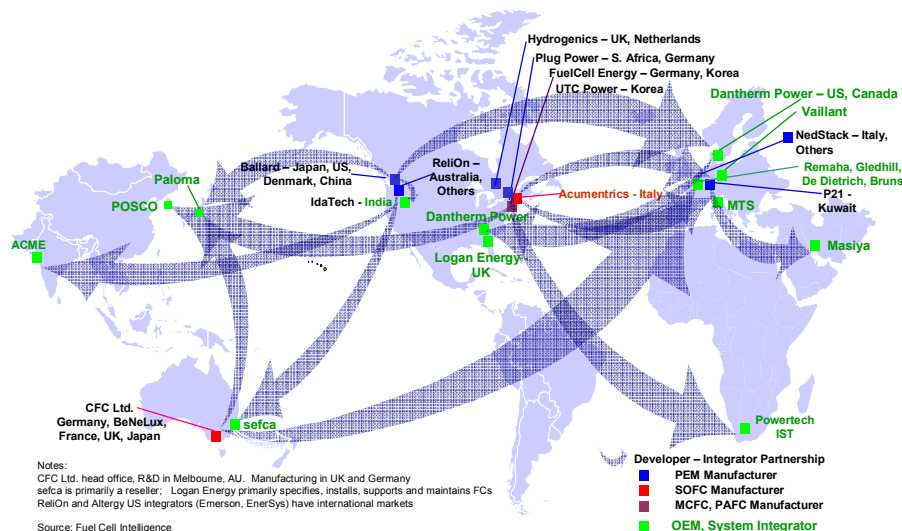
reaction to the failure of the communication infrastructure during 2005's devastating Hurricane Katrina. Recent EU mandates have also increased required backup run times, forcing providers to look at unconventional power systems.

Fuel cells have enjoyed anecdotal success as backup for remote telecom towers over the past decade, and recent incremental technological improvement increasing reliability and lowering cost have created a compelling value proposition particularly in the case of extended run times. Hydrogen-, and in 2009, methanol-fueled fuel cells are now a cost-effective alternative to doubling the back up time offered by the current technology VRLA (valve-regulated lead-acid) batteries, which can be a toxic waste nightmare both in manufacture and disposal. Although the upgrade will be a major expense for the telecoms industry, it is a golden opportunity for fuel cell developers as was in evidence at last fall's Intelec Conference and Exposition in San Diego. Rather than representing a technological oddity, **Dantherm Power**, **Plug Power**, **ReliOn**, and **Altery** were all actively courting the telecom giants with commercially viable indoor and outdoor configurations.

**Whither Standeth the US Market?** **Hydrogenics**, the 'other' Canadian PEM FC developer partnered in 2006 with **APC** of Kingston, RI with an eye toward 100's of unit sales to the major data center market. It seems now that perhaps 25 at most are in the field, primarily in Canada and the UK. Tom Sperrey's **UPS Systems**, the UK's largest data center backup distributor, has been promoting the systems tirelessly since he installed the first one to provide his own firm's backup. He has completed eight successful installations of the \$35k - \$100k systems at customer sites since then. He is critical of the lack of UK government support, but that's eight more than have been installed in the US. French electronics leader **Schneider Electric** purchased APC last year, and relaunched the product last fall. Although the fuel cell with its integrated ultra-capacitor is ideally fit for this application where instant response and environmental concerns are primary drivers, penetration has been minimal in the US.

**CommScope**, another leading complete power solution integrator with strong ties to AT&T, has designed a product around the Hydrogenics fuel cells, but AT&T remains mum about the technology. **Emerson Network Power**, the self-proclaimed "global leader in enabling Business-Critical Continuity™" has partnered with one of the earliest fuel cell telecom backup players, Spokane, Washington's own ReliOn, while Folsom, CA's Altery has agreements with global players **EnerSys** and **Eaton Electronics**. The developers are satisfied with the sales thus far and the integrators feature fuel cells in their marketing, but US network providers have yet to publicly embrace the technology.

Figure 2: International Integrator (OEM) – Stationary Fuel Cell Partnerships



**Developing Markets Beckon.** Although the marketplace appears unaware, reliability issues for pure hydrogen fueled PEM fuel cells have been settled. Altery has stressed its 'mass production' facilities and its low system cost making it an ideal partner for the VRLA-battery-oriented EnerSys. Altery, Hydrogenics, and **Intelligent Energy** all exhibited with Persian Gulf partners at the recent Abu Dhabi World Energy Conference. The emirate has committed €100 B to the 10-year Masdar Project, a carbon-neutral community of 100,000 people built from scratch with solar hydrogen production as a core energy technology. Mickey Oros, Altery's VP for Business Development, told me at least 50% of its

current sales are overseas. He says the *middle east countries, particularly the oil producers, are looking to the long term future, an attribute not exhibited in this country*, suggesting the US change tax structure to encourage long-term investment.

IdaTech, having struggled with the US market, now has hopes for long term success via 10,000 natural gas fueled systems in India. I submitted my thesis on the weak domestic market to Harol Koyama, President of IdaTech. He replied, *"I agree that historically the USA and similar countries have been slow to adopt these kind of new energy technologies. This is one reason why companies such as IdaTech have looked for and found partners elsewhere."* But hope is evident. He continued, "Very recently, though, the pendulum seems to be swinging back." The new stimulus legislation has provided grease for that pendulum with funds for development and tax credits for customers. Gary Simon, president of Westwood, MA based SOFC developer **Acumentrics** is confident of success for his 1 – 3 kW mCHP system developed with Italian leading boiler maker MTS. He showed me a working model of the system at their Boston-area facility, but he engenders no hope in the near future for a US market.

**Plug steps back.** Plug Power, despite a press release from October claiming **T-Mobile** as the first Connecticut telco provider to install a fuel cell back up system, has de-emphasized its hydrogen-fueled GenCore line to concentrate on international reformat-based products, its GenDrive forklift products and HT PEM mCHP. It seems odd that while Plug benefited from early government programs, now when back up systems should be an easy sell in the US they are leaving the space. The T-Mobile installation is one of the few times a US telco operator name has shown up in a press release in conjunction with a fuel cell developer. The US resistance to the clean, innovative though non-sexy technology most certainly played a role in Plug's move.

**Dantherm Initiative Shows Global Reach.** Dantherm Power did significant homework in packaging its own critical backup solution. They have worked with multiple domestic and foreign stack and other component makers, and think they now have an optimal package. They are integrating Ballard's outdoor backup designed model FCgen-1020ACS (air cooled stack) into a complete cabinet package. Dantherm's standard module includes enough ultracap capacity to provide transient bridging power, thus allowing the elimination of VRLA batteries. Optionally the module can be configured to enhance the run time performance of the existing batteries in customers' legacy systems.

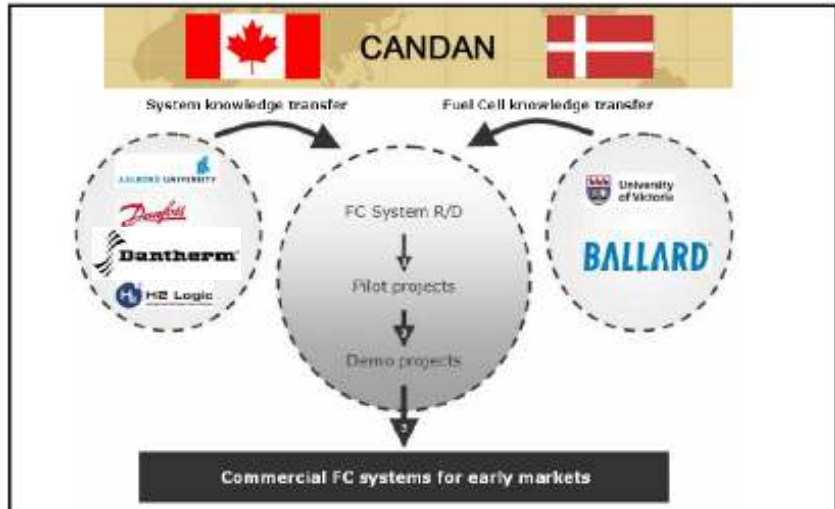
While the US domestic developers are concentrating on their international reach via their globally savvy partners, Dantherm has taken the plunge into the US market. Dantherm Power can leverage Dantherm Air Handling's high volume system manufacturing and integration capability as well as their long history as a trusted supplier to Telecom OEMs around the world to carve out a significant share of the North American market.

**Police Need Security, Too.** Dantherm Power, through its affiliate has received an order to supply backup power systems for Denmark's new TETRA national public safety network, SINE. The SINE network will consist of about 450 sites spread throughout Denmark. Dantherm AH will supply, install and support all 450 installations, installing fuel cell systems in about 150 where they can be optimally utilized. More than 50 fuel cell systems have been installed thus far.

Dantherm A/S has been a leader in cooling systems for battery-based backup systems on both sides of the Atlantic; conventional battery performance drops off drastically at temperatures over 25° C (77° F). In addition to its large manufacturing facility in Skive, Denmark, Dantherm has a manufacturing facility in Spartanburg, South Carolina. The convenience and cost benefits of domestic manufacturing will put Dantherm on equal footing with those 'established' developers. With the new administration in place, the timing may prove fortuitous for Dantherm.

Tom Ollila, the Plug Power alum chosen by Dantherm to get the US operation off the ground, is optimistic despite the hiccup in the 'Katrina' 8-hour regulation. He notes, "Worst case, even if no new rules are issued, this whole process has elevated the importance of backup power. To quote the CTIA; 'While we have the same goal as the FCC – to keep our networks running during times of emergency – we believe that having the flexibility to adapt to unique emergency situations will better serve American wireless consumers.' As we prove the economic and performance advantages of using fuel cells to provide vital backup power to telecom customers we can still continue to build a viable market here in North America. With over 200,000 cell towers in place and new network equipment being rolled out all the time, this is still an attractive Market."

**6,000 Mile Bedfellows.** Dantherm and Ballard are also lead members of the CanDan Initiative. With multiple complimentary stakeholders, the relationship among four Danish entities and Vancouver-based Ballard and the U. of Victoria will be developing motive FC applications, but the initial project involves major power producer BC Hydro. Dantherm Power will configure a bank of Ballard FCgen-1020ACS stacks into a shipping container-ready 100 kW module. The hydrogen fuel will be renewably produced by BC Hydro's Clayton Falls hydroelectric generation facility near Bella Coola, British Columbia. The CanDan cooperative agreement has just resulted in Dantherm Power's first Data Center installation.



McKesson Canada is a North American leader in health care and pharma information services, and therefore unusually reliant on its server array. A McKesson spokesman commented on the initial system, "The application of fuel cell technology in UPS solutions looks set to be a cost-effective way of providing for all of our needs at McKesson." Additionally, the system uses on-site hydrogen production rather than delivered canisters which will provide valuable benchmark data for the innovative fueling option.

**Solving the Hydrogen Dilemma.** Fuel cells may eventually capture a significant share of the worldwide backup market. And although the global gas giants such as **Air Products, Air Liquide, Linde, Praxair, and Airgas** can generally provide delivered bottled hydrogen to many global locations, extended run times, high delivery charges and hydrogen cylinder rental costs provide impetus to offer some fuel versatility. Developers looking for penetration in the broadest markets will be wise to have a hydrocarbon-fueled extended run time solution to offer in Asia, Latin America, and Africa. Such a configuration may even serve to catalyze the slow-on-the-uptake US market. Ballard will supply its newly developed model FCgen-1300, a liquid-cooled stack designed to work on reformat specifically for IdaTech and Dantherm. Although the 1300 will have considerably more balance of plant components than the 1020ACS, Ballard has integrated the reformer into the design employing the heat output of the stack to efficiently reform methanol or natural gas. Ballard has published 2010 price targets for the two integrated systems, providing guidelines for the industry. Ballard's 'econometric model' has the hydrogen fueled 1020ACS-based system at about \$2800/ kW and the reformate-fueled 1300 based system projected to be \$3200/kW. The figures provide a 1-3 year payback versus battery solutions. Although Ballard is counting on the quantity sales promised by ACME and the global potential of Dantherm, it is reasonable to expect that other integrators and even stack developers will opt for the solid Ballard stacks for their extended run-time solutions.

Ballard FCgen-1300



Source: Ballard Power Systems

**The DOE Understands.** A report published by the Department of Energy (DOE) in April 2007 states that "the DOE realizes that the pathway to direct hydrogen PEM fuel cells... in vehicles will likely include the introduction of PEM fuel cells in near-term markets with fewer technical challenges than automobiles. The DOE also recognizes that fuel cell companies and component developers need to increase fuel cell sales in the coming years in order to support the continued research and development (R&D) required for technological advancements in automotive applications, and to sustain the interest of investors in their companies. In order to facilitate growth of the PEM fuel cell industry, build a supplier base for future automotive markets, and develop robust products, the DOE is focused on identifying near-term market opportunities for PEM fuel cells in pre-automotive applications."

**Is Wide-spread Fuel Cell Critical Back Up, mCHP and CHP in America's Future?** I hope so. The US stimulus package provides rebates for CHP, and the fall bailout tripled the fuel cell subsidy. But like

telecom network providers, the US HVAC industry is reluctant to make waves. Education and some high profile installations garnering well-deserved publicity will help. Fuel cell power for the freedom tower would be a high-profile showcase, but ground zero remains a hole in the ground, seven years after 9/11. Still, small steps continue. Dantherm Power has just won a contract to install three fuel cell backup systems for the city of Columbia, SC emergency communications networks as part of the Greater Columbia Fuel Cell Challenge. Columbia and the National Hydrogen Association will be publicizing the Hydrogen Expo and Conference at the end of March as widely as possible to build industry awareness as well to boost the local economy which has committed to building a fuel cell cluster in a major way.

***The South Shall Rise Again.*** I just spoke with Sam Logan of Atlanta's **LOGANEnergy**. Employing a combination of foresight and sheer tenacity, Sam created his company in 1994 solely to install and maintain stationary fuel cell systems, long before any hope of fuel cells commercial viability. His firm has facilitated the installation of over 125 fuel cells from 5 kW to 600 kW, many technically challenging CHP systems. Now he has a UK subsidiary with utility giant Scottish and Southern Energy as a major partner, helping him cultivate business in the EU where the environment has been more welcoming. Sam finds optimism in the partnership, declaring "Europe is ten years ahead of the US in environmental issues."

***Multiple Markets Provide Unlimited Opportunity.*** Market projections, particularly in light of the global economic crisis are challenging at best. Although new construction in all markets is down significantly, the critical backup segment continues to grow and any market softening may be simply creating pent-up demand a year or two down the road. As for the justification for fuel cells being used in place of batteries or diesel generator sets, reliability, lifetime, start-stop cycles, start-up time, weight, power density, efficiency, fuel versatility, and of course cost all figure in the final equation, with varied requirements and importance. It turns out that fuel cells for many of these installations are the clearly superior choice. Geography, culture, and climate also play significant roles. Sadly, key decision makers often are just not ready to take a chance, even when the risks are mostly perceived and the payoffs comprehensive and compelling.

***Conclusion:*** After an inconsistent history, fuel cells have finally achieved viability in the real world. But being neither sexy nor violent (the Honda Clarity and 'Quantum of Solace' notwithstanding), there is significant cultural resistance to their implementation in the US. Partnerships among creative fuel cell entrepreneurs and visionary global system integrators can provide enough substance to provide the critical market push the industry so sorely requires. But in addition, the aura of hope ushered in by the new administration must be allowed to come to fruition in overall government policy. If the US fails to embrace its own technological advances, then only it is to blame.

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**Services:**

Global and regional market studies and forecast models  
Technical and statistical data analysis

**Resources:**

Comprehensive database built through over three years primary and other direct research including interviews with most important industry leaders on site visits, downloads of industry, utility, and world government data, and daily monitoring of critical news and skeptical analysis of press releases.

**Markets:**

- mCHP 500W – 4kW, mid-size 50 kW – 5 MW CHP, large scale generation 1MW+
- Vehicular power: automotive, motor bike & delivery, bus, mini-bus, river boat, large ship, aircraft
- Material handling vehicles: Fork lifts, airport tugs
- Auxiliary Power Units: Long-haul trucks 1 – 5 kW, marine 1 kW – 1 MW, aircraft 200kW – 1 kW
- Critical Backup: Telecom towers, telecom and power switching stations, data center, medical
- Mobile gen sets: 2 kW – 60 kW
- Micro, portable (soldier power) and consumer electronics
- Hybrid systems including renewable power generation and exotic energy storage media (including hydrogen)

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