More Than "Just Backup"

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Fuel cells provide reliable electricity across a broad spectrum of facilities.

By Paul Hull

Stop thinking of distributed power as simply backup systems. As the public becomes disenchanted with power outages and dependence on the power grid is perceived with less enthusiasm, solutions like wind farms and solar arrays are contributing to peace of mind for industrial, commercial, and residential users. Of the power sources offered today, fuel cells are one of the cleanest and most efficient form of distributed power generation available. The technologies developed so far have enabled us to use fuel cells for baseload power solutions—every hour, every day, and every week.

"Traditional forms of power generation, primarily made up of centralized fossil fuel plants, are becoming less favored in lieu of clean, distributed power generation technologies," is how Anthony Leo, vice president of OEM and application engineering at FuelCell Energy Inc., states the situation.

Stop thinking of fuel cells as simply the latest gimmick. UTC Power began its life more than 50 years ago when engineers at Pratt & Whitney Aircraft convinced decision-makers that fuel cells held the key to powering manned spacecraft. Since 1966, UTC fuel cells have provided electric power and drinking water on all US-manned space flights. The latest gimmick? Hardly. UTC Power has been issued 746 US patents and has 313 pending US applications. The company has also been issued 1,805 foreign patents and has 655 pending foreign applications. UTC Power has installed more than 260 stationary fuel cell systems for customers in 19 countries. The company's PureCell systems have proven to be especially suitable for hospitals, data centers, hotels, education institutions, and supermarkets.

At the Hilton New York, with almost 2,000 rooms, the PureCell system provides a portion of the hotel's power and hot water, while reducing its carbon footprint, minimizing the release of harmful pollutants, and conserving both energy and water.

"The fuel cell at the Hilton New York is one of the more significant ways we can have an impact on energy consumption in one of the largest cities in the world," comments George Neeson, vice president of engineering and housekeeping at the Hilton Hotels Corporation. "With a global vision to be the first choice of the world's travelers, we are concentrating on eco-friendly initiatives that our Hilton Family of Hotels can adopt to help improve and sustain the environment for future generations of travelers."

This hotel application is an excellent example of how fuel cell power can do more with less. More than half the energy potential in traditional power generation goes up the stack as waste heat. In contrast, the UTC Power fuel cell converts heat exhaust into

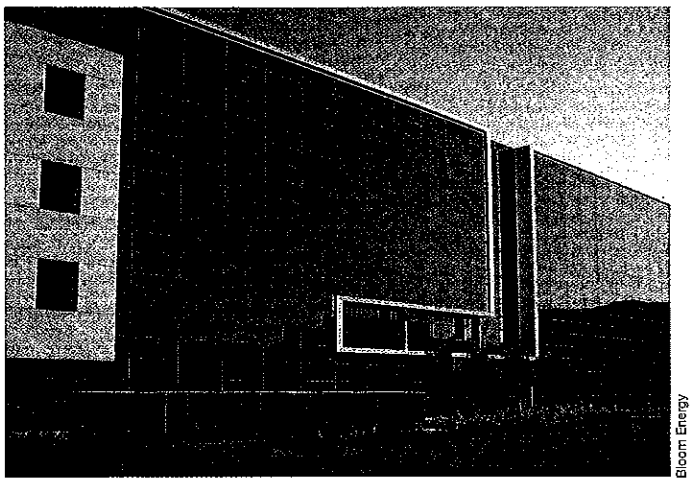
Why Fuel Cells?

How and why do current users of fuel cell technologies approach their decisions? A variety of voices highlight the reasoning behind the decision to go with fuel cells:

"eBay believes in the power of our business model to make a real difference in the world," advises **John Donahoe, eBay CEO**. "That includes how we embrace innovation to reduce our carbon footprint."

"Installing low-carbon technologies—like Bloom's Energy Servers—at our facilities is not only the right thing to do for our planet, but it's also a smart business decision," comments **Mark Nicholls**, senior vice president, corporate workplace executive, **Bank of America**.

"This new fuel technology represents an important step for Coca-Cola, in continuing to grow our business without growing the carbon footprint," says **Brian Kelley**, president and general manager, **Coca-Cola North America** Still Beverages and SupplyChain.



Bloom Energy

Fuel cells reflect the dual nature of onsite power: backup and reliability.

Bloom Energy

These fuel cells can work at 800°F inside, yet they remain cool to the touch.

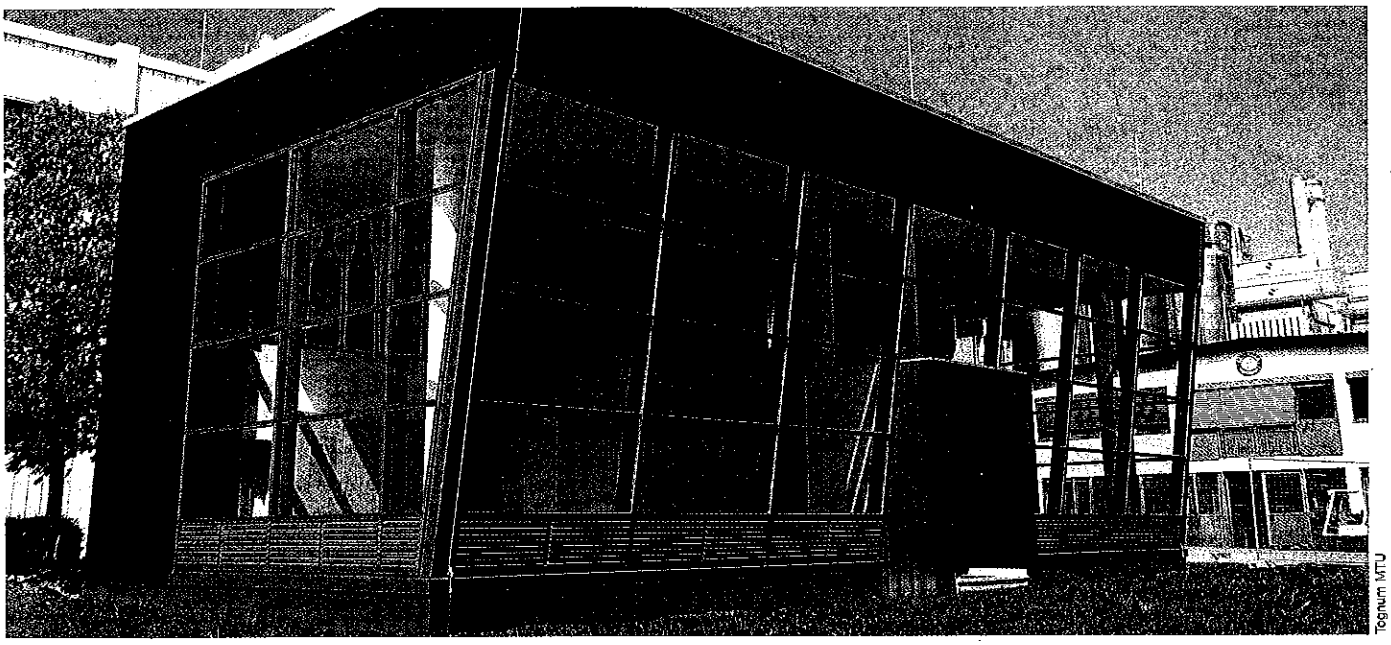
heating and cooling, thus turning potential waste into useable energy. While central power plants achieve conversion percentages in the lower 30s, UTC Power solutions can attain energy conversion efficiencies up to 90%. It's not gimmicks at work; it's efficiency getting the job done in the best way for the customer (and, by extension, for the health of the public who must breathe the air daily in cities like New York).

Sometimes or Always

Onsite power has gained its deserved momentum in recent years from the fact that it is always there, a claim that other sources of power have been unable to match as the demand for electricity, from residential, industrial, and commercial customers, has increased. We are using more electricity for a range of tools and toys, machines and methods, entertainments, and efficiency, but there has been obvious evidence that traditional sources of power cannot supply what is needed. Onsite power has, therefore, matured with two roles—that of the backup system when "normal" sources fail, but also as the permanent, always-on solution for our power needs. Fuel cell applications reflect those dual roles. IdaTech, based in Bend, OR, shows us two examples of fuel cells as backup systems.

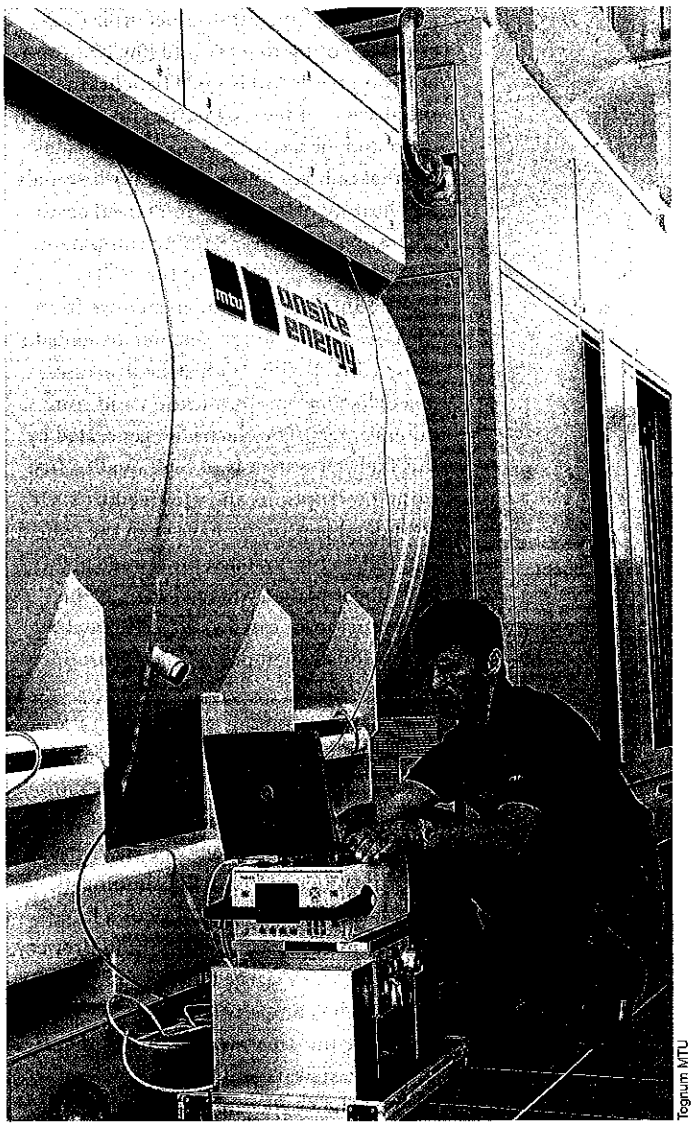
The leading wireless services provider in the Philippines is Smart Communications Inc. (SMART), and it required a reliable, low-maintenance, environmentally friendly operation for its 36.9 million customers. The traditional backup power for SMART cellular sites with critical equipment (that requires backup power with more than four to six hours of autonomy) was a battery bank and a diesel-powered generator. The company tested an IdaTech Electra-Gen XTi Fuel Cell System at a cell site near Manila. It was installed in place of a diesel generator outside the shelter on a concrete pad. Operating on HydroPlus (a methanol and water liquid fuel), the system generates its own hydrogen onsite and on demand, eliminating the need for the delivery and storage of hydrogen bottles. IdaTech's fuel cell system supported SMART at the cell tower site reliably for more than four days, without interruption for 86, with no faults. It passed the Smartcom Test and will be used for the "Alternative Power for Cell Sites" program.

At another site, similar demands required a system both energy efficient (specifically by offering reduced carbon emission), and virtually maintenance-free. Why these conditions? Telstra's base station sites are in remote areas, and they require backup power for the company's critical telecommunications equipment that provides more than eight hours of autonomy.



Tognum MTU

When it comes to fuel cells, "Narrow Application" does not apply: They can be used for small residential applications and larger industrial sites like the Erdinger Brewery.



Tognum MTU

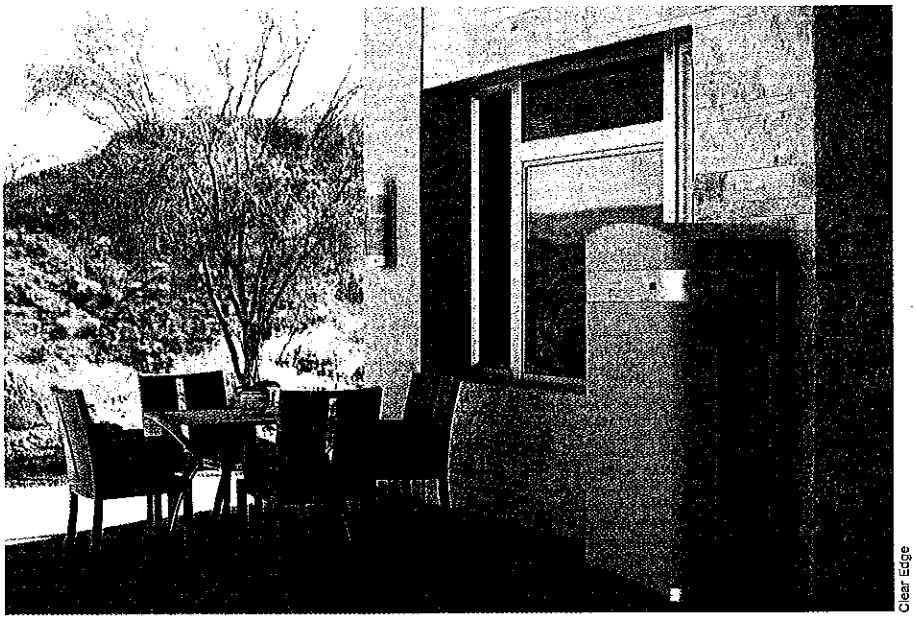
Reliability and low-maintenance upkeep make fuel cells the right choice for many commercial facilities.

Telstra is Australia's leading telecommunications company with over 9 million fixed lien services and 9.7 million mobile services for their 5.2 million 3G customers. Standard backup power used to comprise five strings of batteries and a diesel-powered generator in case of extended power failure. Both could be unreliable and costly to maintain. This company chose IdaTech's ElectraGen XTi System. Initial testing was performed in Melbourne, Australia, over several days before the unit was moved to Dixons Creek, Victoria, Australia, for installation. Ironically, within 24 hours of the installation at the test site, a power failure occurred and the fuel cell system responded, generating 1.5 hours of backup power. Telstra reports that the system has been working flawlessly since its installation at its permanent site.

That reliability is the essence of the success of fuel cell systems for heating and cooling facilities may be most obvious in places like supermarkets. We expect our food to be fresh; we expect our supermarkets to carry on regardless of outside influences; and we don't expect anything to stop the high level of service to which we have become accustomed to. I can remember a few years ago—during a power outage—that a neighbor said he'd solve his problems by going to the local supermarket for reinforcements, as if the supermarket was somehow immune from the power outage.

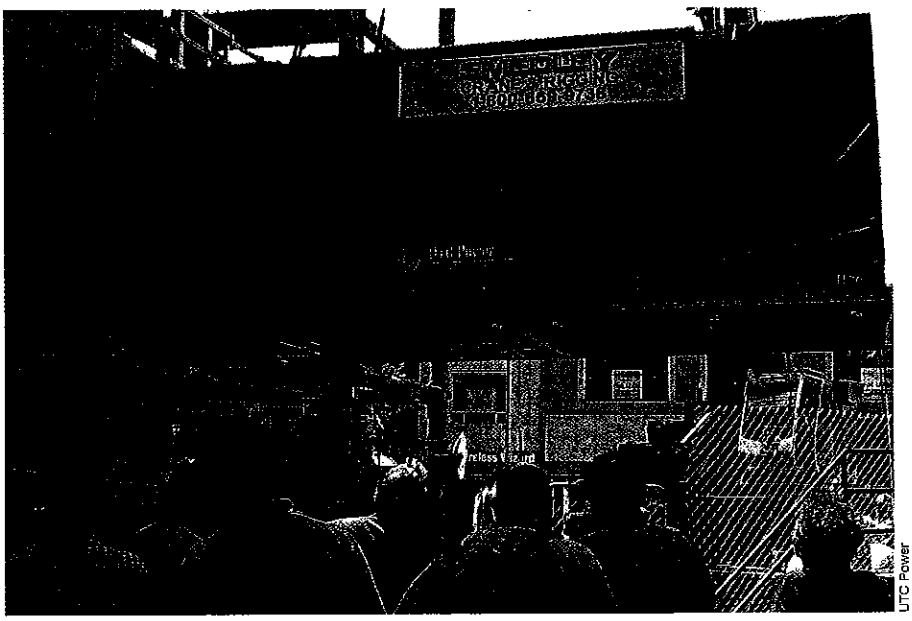
And yet immunity from power outages is exactly what reliable backup power supplies—which is why Whole Foods Market (a leading retailer of natural and organic foods with 300 stores in North America and the United Kingdom) has decided to use a PureCell Model 200 (from UTC Power) for its 46,000 square-foot store in Glastonbury, CT.

"We're well aware, here in Connecticut, of electricity grid constraints," observes Kathy Loftus, Global Energy Coordinator for Whole Foods Market. "To be able to mitigate those constraints ensures reliability for all consumers of electricity and to be able to do that with clean, alternative onsite generation is the best option. Together with UTC Power and the Connecticut Clean Energy Fund, we've designed a combined cooling, heating, and power system for our new Glastonbury store, using a quiet, highly energy-efficient fuel cell that will also reduce our carbon footprint dramatically."



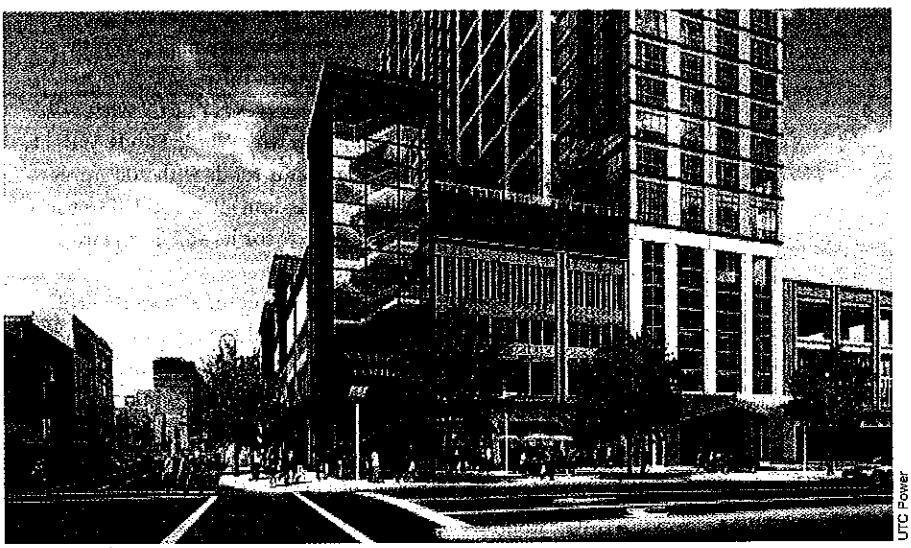
Clear Edge

Fuel cell system installed on the patio of a single residence



UTC Power

A fuel cell power system goes onsite for 400-kW power at a New Haven residential development.



UTC Power

At 360 State, a UTC Power fuel cell system gives 400 kW of onsite power.

More Than Just Backup

The proven and recorded success of fuel cell technology as an alternative, onsite power source for so many different applications has caused several industries to view fuel cells as long-term, reliable (rather than an "aren't-we-lucky-we-have-it-standing-by?") solutions to industry-specific energy problems. The HotModule HM400 from MTU Onsite Energy, of the Tognum Group, for example, is a fuel cell plant that provides about 345-kW of electricity and 250-kW of thermal energy that offers versatility; it is especially suitable for operation with natural gas, biogas, sewage gas, and several other special fuels. The MTU Onsite Energy systems can also produce power for up to 430,000 hours of operations. (That's about 50 years in total).

The choice to go with fuel cells has a lot to do with their capabilities: high rate of efficiency (almost 50% during partial-load and full-load operation), fuel utilization efficiency of up to 90%, and low pollution emission levels. Additional benefits include the absence of moving parts, and extremely quiet and vibration-free operation—making fuel cells a popular choice for hospitals and heating plants. You won't need costly enclosures or noise-damping equipment.

The fuel flexibility of the MTU's HotModule—and its independence from the power grid—offer welcome benefits to those with sensitive industrial processes, places like telecommunication and computer centers. The electricity generated by this fuel cell system is of high quality, free from interruptions and grid feedback. Of considerable promise have been the hybrid fuel cell/engine systems for sewage plants and biogas plants, where electricity and heat generation can be aligned virtually continuously with prevailing pas production levels.

When technologies are new to us, we tend to think their range of applications as narrow: Fine for those large, multi-billion places, but not necessarily suitable for us. But "narrow application" does not apply when it comes to fuel cell technologies. A fuel cell can run one house or a large factory. At the Erdinger Weißbräu Brewery, for example, the large amounts of water requires the company's to operate its own anaerobic pre-treatment plant before releasing wastewater into the public drainage system. The wastewater treatment process produces biogas with an 85% methane content that—since 2009—has been used

to run a HotModule from MTU Onsite Energy. As the "in house" biogas is available only on days when production running, the system was extended by introducing a second gas train, making it possible to operate the fuel cell with biomethane as well. Even if biogas production is inadequate on days when the brewery is working, the plant can operate on biogas and biomethane in a mixed mode. As an added bonus, the system installed at the brewery can cut carbon dioxide production by up to 1,200 tons a year.

higher efficiency than grid electricity.

Additionally, if the application consumes all the heat and power produced by the system it will generate electricity as low as 6 cents per kilowatt-hour (while some utility rates are as high as 50 cents per kilowatt-hour). The system produces consistent base load power, 24 hours a day, seven days a week with excess power fed back into the grid for credit through a net metering program.

From a single residence to a development with 500 residential units, **fuel cell power shows its capability.**

Residential and Residential

Onsite fuel cell systems, like vehicles, come in many sizes. The ClearEdge5 system can be suitable for an individual residence or a small business facility. The company says the ideal customer would require some 43,000 kWh of base load power a year with a heat requirement that mirrors the unit's production capacity of about 20,000 BTUs an hour.

The ClearEdge5 fuel system comprises three core technology components integrated to offer greater efficiency. Its fuel processor reforms natural gas into ultra-clean hydrogen through a catalytic process, and then electricity is created, as opposed to burning the natural gas as in a traditional power plant production process. The appliance dramatically reduces criteria pollutants and greenhouse gases. Once the hydrogen is processed through a fuel cell stack, it creates direct current (DC) power and heat. The Power Conditioning unit converts that DC electricity into alternating current (AC), which ties directly to a facility's main electrical panel, providing locally produced, steady, continuous power for electricity's needs.

The ClearEdge5 also comes with the ability to reduce a facility's carbon footprint significantly by operating with much

fuel cell power shows its capability. For example, 360 State Street is a mixed-use, 700,000-square-foot development in the downtown of New Haven, CT, that utilizes a combustion-free power for the development comes from a 400-kW fuel cell.

"360 State Street is the first large-scale residential installation of a fuel cell in the world," boasts Jennifer Gangi, program director, Fuel Cells 2000, a nonprofit environmental organization. She reminds us that, until now, residential usage has been more likely to be a 5-kW cell in individual homes.

"Onsite fuel cell technology represents the future of electricity generation in this country," adds Bruce Becker, president of Becker + Becker, the New Haven building's developer and architect. "Traditionally, large fuel cells have been used at schools, hospitals, and other energy-intensive facilities, but multi-family residential buildings represent a perfect [heretofore uncultivated] opportunity for fuel cell technology, because of their ability to utilize continually the fuel cell's process heat in the form of hot water and space heating demand."

The Mayor of New Haven, John DeStefano Jr., comments: "360 will serve as a model for new application for fuel cells, with the potential to grow fuel cell manufacturing jobs in the state, while also having a positive environmental impact."

Sometimes, the initial cost of fuel cell systems can deter potential users—even if they can see the good savings of ownership, which means that the first adopters tend to be big, high-tech companies (and the US military arms, which are virtual big companies). Bloom Energy, for example, can count some impressive customers among its initial clientele, but the founder, K. R. Sridhar, emphasizes that he expects Bloom Energy to produce a system affordable for single residence owners, somewhere in the $3,000 range, within the next decade. While some observers believe the claim is a little optimistic, Bloom Energy's purchase options can put fuel cell systems within reach. By offering two purchase options, potential users can install Bloom Energy Servers as capital purchases funded by an anticipated a three- to six-year payback (when factoring in the capital cost of the servers and the fuel, operations, and maintenance expenses). Users can lease a Bloom system with no initial outlay and up-front incentives to generate a positive cash flow in the first year.

Fad or Future?

It's clear from my research into fuel cells as onsite power sources, that the current beneficiaries are mostly large corporations with large facilities—which could include public authorities, hospitals, universities, and government agencies. It's certainly people with good funding, or who can access good funding, who are reaping the first harvests from these technological marvels (which were "discovered" almost 200 years ago), but there is a healthy undercurrent of activity to make fuel cells less expensive and, therefore, available to more customers. They could be small businesses and single residences. As a solution that can work day in, day out, regardless of grid outages and interruptions, fuel cells show enormous promise. They could be the most important energy development . . . ever. DE

Paul Hull *writes on construction topics for several magazines.*

Online extras

When it comes to onsite power, sometimes one size can "fit all."
www.distributedenergy.com/fuel-cells