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Clean, Efficient, Expensive

Despite their prohibitive cost, fuel cells are turning up in cars, schools, and perhaps a 'green' megamall near you

July 28, 2002

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For more than five years, a fuel cell has kept the computers up and running at the Regional Information Center of Onondaga-Cortland-Madison BOCES.

Humming quietly outside the building, the Dumpster-sized unit makes electricity by capturing energy released when hydrogen and oxygen combine to make water. To operate, the fuel cell requires only a supply of natural gas from which to extract hydrogen.

Thanks to its fuel cell, the Regional Information Center, where mainframe computers process information for 52 school districts, is far less susceptible to power failures and fluctuations than it once was, facilities administrator Michael Fay said.

After the Labor Day storm of 1998, for example, when most of the BOCES campus on Thompson Road went dark along with the rest of Central New York, the RIC had power and its computers kept running, Fay said.

The fuel cell has other benefits.

Because it oxidizes hydrogen without burning it, the fuel cell emits small amounts of carbon dioxide but almost no other pollution. It uses fuel more efficiently than traditional power plants. And BOCES essentially doubles that efficiency by capturing the fuel cell's waste heat and using it to heat the RIC building.

Meanwhile, the fuel cell makes so little noise that it could be placed inside the building.

The environmental benefits of fuel cells have attracted widespread interest. The

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Pyramid Cos., developers of the proposed $2.2 billion Destiny USA megamall project, recently suggested they might incorporate as many as 60 fuel cells of the size BOCES uses in their development. They say Destiny USA will be the world's largest "green" building.

Yet there is a perfectly good reason fuel cells have not reached the mainstream: the price tag.

The 200-kilowatt unit at BOCES, far and away the most commonly used commercial fuel cell, costs about $900,000 to install. Without large government subsidies, few customers could afford them. BOCES got state and federal grants totaling more than $530,000 to help pay the bill.

Ronald Bonzagni, a project manager at Niagara Mohawk Energy who worked on the BOCES fuel cell and other fuel cell projects, said the price must come down about 80 percent before fuel cells are competitive with traditional sources of energy.

"The power quality is excellent. There are essentially no pollutants. It's very, very clean power. But the cost is up there," Bonzagni said. /su/111Research ramps up

The race is on to bring a cheaper fuel cell to market, but experts say it might take the better part of a decade.

Lured by the promise of cleaner, more efficient power, auto makers, manufacturers, utilities and others have joined the quest for affordable fuel cells. The car makers appear most eager. Both Honda and Toyota have vowed to put small numbers of fuel-cell cars on the road this year.

In addition to investments by private industry, the federal government and many state governments have programs to boost fuel-cell technology. Here's a sampling:

The federal Department of Energy recently launched a 10-year, $350 million program to develop a fuel cell that costs just $400 per kilowatt, less than one-tenth what BOCES paid. The Solid State Energy Conversion Alliance, a partnership with private industry, is developing small fuel cells (about 5 kilowatts) that could be combined like building blocks for various applications.

In April, Gov. John Engler unveiled Michigan's NextEnergy project, a comprehensive economic development plan aimed at keeping Detroit in the driver's seat as the automotive industry shifts toward fuel-cell technology. The initiative includes a 700-acre tax-free zone near Ann Arbor and a package of tax incentives aimed at companies that research or manufacture alternative energy technologies.

In February, Ohio Gov. Robert Taft unveiled his state's Third Frontier Project, a 10-year, $1.6 billion proposal to promote high-tech research. It includes a three-year, $100 million plan to make Ohio a national leader in fuel cell technology.

The New York State Energy Research and Development Authority spends about $13 million a year to support combined heat and power technology, which includes fuel cells. In December, the New York Power Authority bought eight fuel cells for installations in New York City.

/su/111The Destiny connection

The fuel cell still faces technological challenges to its commercial success. But simply increasing the volume of production might have a significant impact on prices, many supporters say.

If Pyramid orders 60 units, that would be unprecedented. UTC Fuel Cells, by far the leading manufacturer of commercial stationary fuel cells, typically sells 25 a year.

Along with fuel cells, Pyramid might incorporate solar, wind or geothermal energy at Destiny USA. Pyramid executive Michael Lorenz said the company has met with several fuel cell manufacturers, but the plans are still being evaluated.

Most analysts say competitively priced fuel cells are still years away.

In an analysis conducted last year for the Michigan Economic Development Council, Brett Smith of the Center for Automotive Research estimated it would be five to seven years before production of stationary fuel cells reaches high enough levels to bring prices down to the $400-per-kilowatt range sought by the Department of Energy. And it will probably be a decade or more before fuel cells are cheap and plentiful enough to significantly impact the auto industry.

"Fuel cells will definitely be competitive with the (utility) grid one day. Today, they are not competitive," said Kim Bergland, outreach director at the National Fuel Cell Research Center at the University of California, Irvine. "Where fuel cells make sense today are where there are issues other than just cost per kilowatt-hour." /su/111Space was the first frontier

The first practical use of fuel cells was in the U.S. space program, where they have been used since the early 1960s. UTC Fuel Cells of South Windsor, Conn., an 800-person sister company to Carrier Corp., has supplied fuel cells for the Apollo and Space Shuttle programs since 1966.

For most of the 1970s and early 1980s, the federal Department of Energy worked with fuel cell developers to create the first commercial version, a phosphoric acid fuel cell. Largely as a result of that effort, UTC Fuel Cells developed the 200-kilowatt model it sells. The company has sold more than 250 units to customers in 19 countries.

Other fuel cells are being developed for households, for vehicles, for utility power plants and other uses. Dozens of companies are working on some aspect of fuel cell development, according to Fuel Cells 2000, a nonprofit educational organization.

Fuel cells differ mainly according to what they use for an electrolyte, the material in the middle of a fuel cell that conducts current by allowing positively charged ions through and forcing electrons to go around. One of the more promising varieties in development, the proton exchange membrane (PEM) fuel cell, uses a thin plastic sheet. Another kind, more suitable to large stationary installations, uses a molten carbonate solution. Others use hard ceramic materials made of solid oxides.

BOCES was one of the first commercial customers to use a fuel cell to improve operations at a data center, said John Trocciola, regional manager at UTC Fuel Cells. Today, the "premium" quality of fuel-cell power for use with computers is one of its big selling points, he said.

Fuel cells not only stay on during blackouts and brownouts; they also eliminate the minor voltage and frequency fluctuations that sometimes occur on utility systems. Fay said BOCES has reduced the number of costly computer crashes at its Regional Information Center from perhaps 20 a year to no more than one or two. /su/111Energy from willow trees

Two other local educational institutions have bought fuel cells since BOCES

took the plunge.

Liverpool High School installed a 200-kilowatt unit similar to BOCES' in December 1999 as part of a multifaceted energy-efficiency project. In addition to reducing the amount of electricity the school buys from Niagara Mohawk, the fuel cell will serve as an educational resource for science teachers and eventually will allow the high school to become an emergency shelter during community disasters, said Joe Camerino, assistant superintendent for administrative services.

SUNY College of Environmental Science and Forestry announced plans in June to install the state's first molten carbonate fuel cell, a 250-kilowatt unit that will cost about $2.5 million to install.

The college has done fuel-cell research for more than a decade, said Cornelius Murphy, president. In addition to testing the fuel cell's commercial viability, ESF researchers will pursue an innovative attempt to extract hydrogen for the fuel cell from willow trees, Murphy said.

For years, state and federal subsidies have helped customers overcome the cost of fuel cells.

A federal program, jointly administered by the departments of Defense and Energy, reimburses buyers for $1,000 per kilowatt of capacity. New York has given grants to many buyers as well, often through the New York State Energy Research and Development Authority.

BOCES obtained $200,000 from the Department of Defense and $331,212 from NYSERDA. Liverpool school district got $200,000 from Defense and $250,000 from the state Petroleum Overcharge Restitution Fund.

The ESF project has been awarded a $1 million grant from NYSERDA and $100,000 from the Electric Power Research Institute. The school will seek $250,000 from the federal Department of Energy, and the New York Power Authority will supply a low-interest loan to finance the rest, Murphy said.

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