
# Fuel Cells - An Onsite Power Generation Option

**IN RECENT YEARS** the pace of fuel cell commercialization has picked up and more choices are available to customers. Manufacturers have developed an array of products, mostly fueled by natural gas, that are accumulating hundreds of thousands of hours of successful operation in a wide range of applications. The technology is beginning to blossom.

Fuel cells convert energy from fuel and an oxidizing agent reaction directly into DC electric power without a mechanical conversion, using one of several electrolyte agents. Most fuel cells use hydrogen as a fuel source and air as the oxidant. Most often, natural gas is the economical source of the hydrogen stream. The DC power is easily converted to AC for factory or commercial use.


One of two 400 kW fuel cells serving a Coca Cola manufacturing facility in Elmsford NY.

## Natural Gas - The Source for Hydrogen

The process for producing hydrogen from natural gas is called 'reforming' and this has been one of the key building blocks to viable commercial operation in a fuel cell package. Today reformer technology has greatly improved and natural gas is an economical and widely available fuel. In addition, certain technologies such as the molten carbonate system eliminate the need for an external reformer as they can reform natural gas directly in the cells.

Individual cells in a fuel cell array produce relatively low voltages and amperages, but by stacking cells and operating parallel stacks, unit packages are now available in hundreds of kilowatt capacity. The DC power output is converted to AC for application in standard power circuits.

All fuel cells also have the ability to produce byproduct heat, and in some types this can be very high quality steam. Whether in the form of hot water or steam the recovered energy can often be utilized

At Left: A UTC Power PureCell® Model 400 fuel cell being unloaded to serve St. Helena Hospital in California's Napa Valley. The unit now provides 60 percent of the hospital's electricity needs and 50 percent of its space heating and domestic hot water requirements.
All Photos courtesy UTC Power.

in manufacturing processes, for boiler feedwater heat, for space heating or for absorption cooling. Effective utilization of the heat is one of the keys to an economically successful fuel cell installation.

## Various Technologies

The U.S. Department of Energy (DOE) has been participating with the private sector in a large scale molten carbonate fuel cell development program beginning in the 1970s. Today one of those private companies, FuelCell Energy, has demonstration and commercial units operating at over 50 installations worldwide. Most of the units are about 250 kW, but in some cases multiple units have been combined for even larger operations.

An interesting FuelCell Energy molten carbonate fuel cell operation is in Renton, Washington, where a 1 MW power plant using wastewater digester gas is operating at the wastewater treatment plant. Other units have successfully operated on coal mine methane gas and are supplying electricity for the mining operation.

## UTC Power

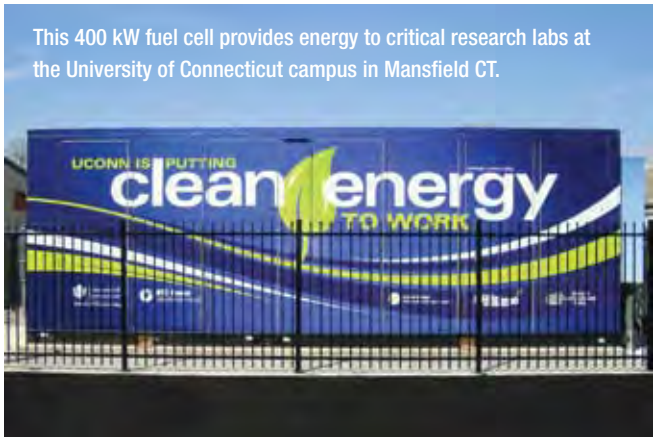
Another leader in commercialization of fuel cells is UTC Power. Its PureCell® system uses a phosphoric acid fuel cell (PAFC) product for distributed generation and combined heat and power applications. According to Jennifer Sager from UTC Power, the PAFC offers an attractive blend of system performance, durability and value for stationary power applications. She says, "The PureCell system produces 400 kW of continuous, reliable electric power while generating 1.5 million Btu/hour of useable heat byproduct."

She notes that the system is well-suited for applications requiring anywhere from 400kW to 5 MW of baseload power. "Typical market sectors fitting this profile include supermarkets, hospitals, hotels, data centers, bottling plants, pharmaceutical plants, prisons and many other load types." According to Sager, the largest multi-unit to date consists of 12 PureCell systems in South Korea that produce 4.8 MW of power. This installation provides more than 12% of the town's power supply. The New York Power Authority also selected UTC Power to provide 12 systems for the new World Trade Center, "The Freedom Tower."

## Attractive Project Paybacks

Each PureCell system that produces 400 kW of electric power also produces enough "high-grade" heat to drive a 50-ton single-effect absorption chiller. Sager indicates that a facility that is a strong fit for the electric and thermal output from a PureCell system can often achieve a financial payback of 3-4 years with current federal tax credits and state incentives. "Because our system is designed to operate for ten years on its initial fuel cell stack, the customer is able to reap significant savings over the life of the system."

In April 2012, the University of Connecticut commissioned a 400 kW PureCell system on its Depot Campus in Mansfield, CT. The unit provides energy to critical UConn research labs and offices, including those working on advancing fuel cell and microgrid technology at UConn's Center for Clean Energy Engineering. By generating and using power on-site with a PureCell system, UConn will prevent the release of more than 831 metric tons of carbon dioxide annually – the equivalent of planting more than 192 acres of trees.



This 400 kW fuel cell provides energy to critical research labs at the University of Connecticut campus in Mansfield CT.

MORE info

**CLEAREDGE POWER**
www.clearedgepower.com

**DOE TYPES OF FUEL CELLS**
www1.eere.energy.gov/hydrogenandfuelcells/fuelcells/fc_types.html

**FUELCELL ENERGY**
www.fuelcellenergy.com

**PLUG POWER**
www.plugpower.com

**UTC POWER**
www.utcpower.com

## Mobile Fuel Cell Power

Another interesting approach to integration of fuel cell technology into industrial and warehouse operations is Plug Power's GenDrive® hydrogen fuel cells with on-board hydrogen storage to power lift trucks and pallet jacks. The units typically operate an entire shift on a hydrogen charge. The fuel cell unit fits into the existing battery space of standard electric lift truck equipment.

According to Plug Power, units can be refueled in approximately two minutes. Use of fuel cells eliminates the need for large battery-charging areas, and the fuel cells operate at temperatures down to -22°F in freezer spaces, eliminating the problem of "battery fade" at low temperatures. Hydrogen for refueling is supplied by outdoor liquid hydrogen storage facilities. The fuel cells use the PEM (proton exchange membrane) system, one of the most widely used fuel cell technologies.

Plug Power equipped lift trucks can refuel in less than two minutes, a clear advantage over electric battery units. Using this technology, a lift truck can support continuous service on three shifts.

## Taking the Step

If your need is for an alternative, clean source of electric power and thermal energy, or for a niche application such as replacing lift truck electric batteries with a modern hydrogen solution, fuel cells can be your answer. **GT**