FUEL CELLS 2000
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The Business Case for Fuel Cells 2012

America's Partner in Power

Authors and Acknowledgements

This report was written and compiled by Sandra Curtin, Jennifer Gangi, and Ryan Skukowski of Fuel Cells 2000, an activity of Breakthrough Technologies Institute in Washington, D.C. Support was provided by the U.S. Department of Energy's Fuel Cell Technologies Program.

About This Report

This report profiles a select group of nationally recognizable companies and corporations that are deploying or demonstrating fuel cells. These businesses are taking advantage of a fuel cell's unique benefits, especially for powering lift trucks and providing combined heat and power to their stores and administrative offices.

This list is by no means exhaustive – tens of thousands of fuel cells have been installed around the world, for primary or backup power, for many years. There are many other companies in the United States and worldwide using fuel cells that we didn't profile. Outside of the business world, fuel cells are being used at wastewater treatment plants, government buildings, universities, military bases, homes and hospitals, to name just a few. There are many other applications for fuel cells, including portable power, vehicles, buses and consumer electronics, which are also being researched, demonstrated and deployed by numerous organizations around the world.

The information contained in this report has been obtained from public sources and via contact with fuel cell manufacturers and the companies profiled. Please contact Fuel Cells 2000 at info@fuelcells.org or 202-785-4222, ext. 17 with any corrections, updates or questions.

About Fuel Cells 2000

Fuel Cells 2000's mission is to promote the commercialization of fuel cells and hydrogen by supplying accurate, unbiased industry information and developing and disseminating summary materials accessible to a general audience. Our materials and information are available free of charge. Fuel Cells 2000 is independent and non-aligned, and supports fuel cells of all types for all applications.

Fuel Cells 2000 is an activity of the Breakthrough Technologies Institute (BTI), a non-profit [501(c)(3)] independent, educational organization that identifies and promotes environmental and energy technologies that can improve the human condition. BTI was established in 1993 to ensure that emerging technologies have a voice in environmental and energy policy debates. Our current focus is on air quality, climate change, energy efficiency, and energy independence. Our programs have won international recognition and numerous awards.

Logo Use

Company logos used in charts do not suggest sponsorship or association with the trademark owner's product or service and are being used solely for the purpose of description or identification.

Cover Photo Credits: Bloom Energy fuel cells installed at Walmart retail site, California (Top); Plug Power GenDrive™ fuel cell installed in Class 1 lift truck (Lower Left); ClearEdge Power fuel cells installed in the basement of Lafayette Hotel in San Diego, California (Lower Right).

Table of Contents

Acronyms Used in this Report

ARRA	American Recovery and Reinvestment Act
CEFIA	Clean Energy Finance and Investment Authority (Connecticut)
CO_2	Carbon dioxide
GHG	Greenhouse gases
IT	Information technology
ITC	Investment Tax Credit (federal)
kW	kilowatt
kWh	kilowatt-hour
LEED	Leadership in Energy and Environmental Design
MW	megawatt
NO_x	nitrogen oxides
NYSERDA	New York State Energy Research and Development Authority
PEM	proton exchange membrane fuel cell
PPA	power purchase agreement
PV	photovoltaic
SOFC	solid oxide fuel cell
SO_x	sulfur oxides
SGIP	Self-Generation Incentive Program (California)

I. Introduction

Fuel Cells for Corporate Sustainability

U.S. companies are finding that going green helps earn more green; more reliable and efficient sources of power help boost productivity as well as profits. As businesses turn to cleaner and more efficient technologies to help reduce their greenhouse gas emissions, many are turning to fuel cells to supplement their energy portfolios, including large, multi-megawatt (MW) orders in both ongoing and new end user markets.

Several recent studies reinforce the idea that sustainability can be good for the bottom line. A 2012 survey by research firm Verdantix indicates that many CFOs see sustainability as a key driver of financial performance, a similar result found in a 2011 MIT study, *Sustainability & Innovation Global Executive Study and Research Project.*[1]

Fuel cells are reliable, efficient, quiet, and significantly cut carbon emissions. In the age of distributed generation (power generated onsite), fuel cells also offer facilities a clean break from an electric grid plagued by violent weather disruptions and growing issues with cyber security. In addition, fuel cells are compatible with other energy technologies – whether renewable such as solar, wind or biogas, or traditional, such as natural gas or batteries. Fuel cells complement and improve energy technology performance and, in turn, help companies meet their sustainability goals while boosting their bottom line.

2012 Fuel Cell Customers

Repeat customers in blue

Adobe Systems	+ 0.4 MW
Americold	+ 0.6 MW
Apple	+ 5 MW
AT&T	+ 9.6 MW
CBS Studios	+ 4.8 MW
Coca-Cola	+0.5 MW; +56 forklifts
eBay	+ 6 MW
JMB Realty	+ 0.4 MW
Lowe's	+ 161 forklifts
Mercedes-Benz	+72 forklifts
News Corp.	+ 0.4 MW
Owens Corning	+ 0.4 MW
Procter & Gamble	+ 340 forklifts
Roger's Gardens	+ 0.015 MW
San Jose Sharks	+ 0.4 MW
Sysco	+ 524 forklifts
Walmart	+ 3.6 MW

+ 32.1 MW
+ 1,131 forklifts

A few of this year's big name fuel cell customers include Fortune 500 companies Apple, eBay, Coca-Cola, and Walmart, all of which trust fuel cells to provide reliable power to data centers, stores, and facilities. Some are purchasing huge, multi-megawatt (MW) systems, including three of the largest non-utility purchases of stationary fuel cells in the world by AT&T, Apple and eBay – 17 MW, 4.8 MW and 6 MW respectively. Others are replacing fleets of battery forklifts with fuel cells. Sysco, the food distributor, has more than 700 fuel cell-powered forklifts operating at seven facilities, with more on order. Walmart now has more than 500 fuel cell forklifts operating in three warehouses, including a freezer facility.

In our 2010 and 2011 Business Case reports, Fuel Cells 2000 profiled a total of 62 companies using fuel cells. The 2011 report also included second looks at 10 repeat customers from the previous report. This new 2012 report narrows the focus to a handful of companies either incorporating fuel cells with other technologies in order to better achieve their sustainability goals, and/or becoming repeat customers and installing large-scale systems at their facilities. The companies profiled are collectively saving millions of dollars in electricity costs while reducing carbon dioxide emissions by hundreds of thousands of metric tons per year.

II. New Markets, New Customers

The fuel cell industry is attracting customers from all areas of commerce – computing/software, television/media, real estate development, food/beverage processing, grocery stores, hotels, warehouse/distribution and much more. Many companies in these sectors are turning into repeat customers, coming back to purchase additional systems for their facilities.

Data Centers

Fuel cells are extremely reliable and generate high quality power, making them a valuable technology for data centers, hospitals, or other facilities where power outages are not an option. Banks, call centers, and prisons share this critical power need as well.

Two of the biggest names in computing, Apple and Microsoft, are each making a major investment in fuel cells for their respective data centers. Apple is in the process of installing a 4.8 MW Bloom Energy fuel cell system alongside 20 MW of solar panels at its new data center in Maiden, North Carolina. This historic installation is explained in greater detail in the following pages.

Microsoft recently announced a first-of-its-kind fuel cell installation at its Cheyenne, Wyoming, data facility that will come online in spring 2013. The 300-kW FuelCell Energy system will operate directly on biogas from a nearby wastewater treatment plant. Microsoft plans to scale up this system upon successful demonstration. Meanwhile, AT&T has become the largest fuel cell customer in the U.S., announcing an additional 9.6 MW to accompany the 7.5 MW from last year. This adds up to 17.1 MW of fuel cells helping to power 28 AT&T sites in California and Connecticut, including data centers.

Top Fuel Cell Power Customers

1	at&t	**17.1 MW** at 28 sites
2	Walmart	**10.4 MW** at 26 sites
3	ebay	**6.5 MW** at 2 sites
4	Apple	**5.3 MW** at 2 sites
5	KAISER PERMANENTE	**5.0 MW** at 7 sites
6	Coca-Cola	**3.1 MW** at 4 sites
7	COX	**3.0 MW** at 5 sites
8	CBS	**2.4 MW** at 2 sites
9	Sheraton HOTELS & RESORTS	**2.3 MW** at 5 sites
10	Adobe	**1.6 MW** at 2 sites

Media

Also reliant on continuous power - especially in the age of 24/7 cable news coverage - many media outlets are turning to fuel cells to power studios and communications networks. CBS Studios recently purchased 2.4 MW of UTC Power fuel cell systems for two California production locations housing 26 sound stages between them. News Corporation, based in New York City, installed a 400-kW fuel cell to generate electricity for the TV studio, with the waste heat being captured for hot water.

Time Warner Cable installed an Altergy Systems' 30-kW fuel cell system to provide backup electrical power to its Palm Springs, California, distribution hub that receives television, high-speed data, and phone signals from its primary distribution center in Palm Desert, and then distributes them to residential and business customers throughout Palm Springs.

Materials Handling

The U.S. is now the undisputed world leader in fuel cell lift truck deployments, and is also the leading manufacturer of them. There are now fuel cell lift trucks deployed at facilities in 19 states, with more on the way. In the year since our last report, there have been many new deployments and orders of fuel cell-powered lift trucks, including several from previous customers such as Coca-Cola and BMW. New customers include Procter & Gamble, Kroger, and Lowe's. Several U.S. based fuel cell developers are cornering the materials handling market, and lift truck manufacturers and integrators, such as Crown, Raymond and Yale, are boosting sales by offering fuel cells in their catalogues.

The benefits to businesses deploying fuel cell lift trucks are many. Longer run times, no voltage sag and faster refills mean more productivity from lift truck operators. No battery storage and changing room or dedicated employees manning it means more warehouse space for product, with some companies reporting recouping 6-7% of space upon switching to fuel cells. Zero-emission fuel cells are helping workers breathe easier around the warehouse as well.

Top Fuel Cell Lift Truck Customers

1	Sysco	**700+ forklifts** at 7 sites
2	Walmart	**509 forklifts** at 3 sites
3	P&G	**340 forklifts** at 4 sites
4	central grocers	**234 forklifts** at 1 site
5	BMW	**230+ forklifts** at 1 site
6	WinCo Foods	**200+ forklifts** at 1 site
7	Kroger	**161 forklifts** at 1 site
8	Lowe's	**161 forklifts** at 1 site
9	Wegmans	**140+ forklifts** at 1 site
10	Coca-Cola	**96 forklifts** at 2 sites

Real Estate/Hospitality

Fuel cells have been checking into hotels for years now, with the first installation in the early 1990s. Since then, there have been fuel cells installed in hotels and casinos around the country, and increasingly, in other real estate developments such as high rise office buildings, mixed-use apartment buildings and office parks. In February 2012, JMB Realty's Constellation Place (formerly MGM Tower) became the first Los Angeles skyscraper to be powered by fuel cells.

Fuel cells are inherently efficient, and when the heat is captured and used, that efficiency total more than 90%. This captured heat can be used in many capacities in the hospitality setting – hot water,

space heating, even for the pool or sauna. For some hotels, preserving historical buildings while upgrading energy systems can be a tricky situation. Fuel cells can be sited indoors or out, on roofs or in basements, and have a much smaller footprint than other technologies, so many developers are now designing them into the décor, including most recently at the historic Lafayette Hotel in San Diego.

III. Distributed Generation

The U.S. electric grid is 99.97% reliable, yet that 0.03% of unreliability is both troublesome and costly. In fact, the U.S. Department of Energy (DOE) reports that grid power outages and power quality issues cost American businesses on average over $100 billion each year.[2]

The threat of a cyber attack against critical infrastructure has emerged as yet another challenge to grid security in recent years, potentially impacting the information technology (IT) systems and networks used within the electric utility and delivery infrastructure, such as power lines, electricity control systems, and customer meters. A July 2012 Government Accountability (GAO) report[3] examined the growth of these threats to the electric power industry and states that this is one of the nation's high-risk vulnerabilities.

AVERAGE COST FOR ONE HOUR OF POWER INTERRUPTION

Cellular communications	$41,000
Telephone ticket sales	$72,000
Airline reservation system	$90,000
Semiconductor manufacturer	$2,000,000
Credit card operation	$2,580,000
Brokerage operation	$6,480,000

Source: U.S. Department of Energy [The Smart Grid: An Introduction.]

Fuel cell systems, whether grid-tied or grid-independent, provide premium power without voltage sags, surges, and frequency variations that can impact computer systems. In addition to power, byproduct heat from a fuel cell can be used at the end-user facility for space heating, water heating, and chilling. When supplementing grid power, fuel cells reduce peak demand and lower energy bills. In some areas, fuel cell power is even cheaper than grid electricity. Power purchase agreements, offered by many of the major fuel cell companies, can lock in the cost of fuel cell power for a specified period, generating cost savings over the term of the contract (more detail on page 10). On top of everything, fuel cells produce little to no polluting emissions – making fuel cells the cleanest energy generation technology available today.

IV. Partners in Power

Fuel cell systems can be scaled up to multi-megawatts and are capable of taking entire corporate campuses off the electric grid, but they do not have to work alone. In fact, many facilities now use fuel cells alongside other energy technologies to meet their power needs. Companies with critical power needs, ambitious sustainability goals, or both, have paired fuel cells with other renewable sources of energy such as solar, biogas, and wind to achieve serious emissions reductions and hardened grid independence. In other cases, fuel cells enhance conventional technologies and fuels such as batteries and natural gas, boosting the efficiency and extending the life, helping companies get more from less. The following section highlights the versatility of fuel cell technology and how it pairs with familiar energy sources and technology.

FUEL CELLS + NATURAL GAS

Of all the fuels fed into a fuel cell to generate electricity, natural gas is by far the most common fuel used today. Fuel cells provide an optimal pathway for natural gas, stripping hydrogen from methane (typically through steam reformation) and converting the hydrogen electrochemically into useful electric power. This process avoids combustion of fuel altogether, making fuel cells more efficient than combined cycle gas turbines.

Fuel cells running off natural gas also are much cleaner than conventional power plants, creating less than one ounce of greenhouse gases per 1,000 kilowatt-hours of electricity produced compared to 25 pounds for the same amount of electricity generated by conventional combustion technologies. Emissions from fuel cells are so low that some areas in the U.S. have even exempted natural gas-fueled fuel cells from air permitting requirements.

Fujitsu Sunnyvale Campus

Since August 2007, a 200-kW UTC Power fuel cell has provided 50% of the power needed to cool the data center and labs at IT giant Fujitsu's Sunnyvale, California campus. The system provides several advantages over an average fossil fuel power plant including:

- 35% less carbon dioxide (CO_2) emissions
- 4,000 lbs less nitrogen oxides (NO_X) per year
- 800,000 gallons of water saved per year
- 3.3-year payback period

There is already an existing infrastructure of natural gas pipelines that connect homes and businesses throughout the U.S. This is true for other countries, as well. In Japan, a natural gas-fueled residential fuel cell unit called the ENE-FARM has seen remarkable success in the wake of 2011's catastrophic tsunami and thanks to a generous subsidy from the national government. There are now more than 28,000 ENE-FARM units installed throughout Japan, generating electricity and hot water for average-sized households, and demand continues to grow.

Many fuel cell installations that utilize natural gas have achieved total independence from the electric grid. New York City's Central Park Police precinct building, for example, has been completely free of the electric grid since 1999 and generates all of its power onsite.

Abundance of natural gas, combined with new methods for heat capture dramatically improves the economics of producing hydrogen. If even the most modest estimates of natural gas availability in the United States hold up, fuel cells will certainly remain a key partner in the production and transmission of clean heat and power.

FUEL CELLS + BIOGAS

The decomposition of organic matter produces methane, a potent greenhouse gas but also a useful source of energy (biogas) for fuel cells. Landfills, farms, dairies, wastewater treatment plants, and food processing facilities are all places where biogas is produced, whether naturally over time or through a process called anaerobic digestion. At many facilities across the U.S., this energy-rich biogas is being flared or used in a combustion turbine. At others, it is being fed into high-temperature fuel cells to generate clean heat and power onsite.

Some facilities that do not generate biogas onsite opt to use "directed biogas," which refers to the injection of biogas into a natural gas pipeline. A facility that enters into a contract to use directed biogas may not actually consume that biogas in their fuel cell, but instead, the biogas becomes available to all locations along the pipeline once injected, offsetting a portion of natural gas regardless of the end-user.

California's Self Generation Incentive Program (SGIP) provides facilities in the state $4,500/kW for fuel cell systems that use a biogas feedstock, nearly double the subsidy for natural gas-powered fuel cells. The program has been particularly helpful to companies like Bloom Energy – based in Sunnyvale – that utilize directed biogas for their fuel cell systems across the state.

While directed biogas has yielded positive environmental effects, more facilities are making an effort to use the waste they generate onsite to power their fuel cell system. Sierra Nevada Brewing Company installed a 1.2-MW fuel cell system in 2005 that has provided the brewery with clean heat and power ever since. The company is now working to feed the biogas generated from beer production directly into their fuel cells.

Gills Onions

Since July 2009, Gills Onions in Oxnard, California has been putting close to 300,000 lbs. of their daily onion waste to good use. An Advanced Energy Recovery System (AERS) extracts juice from the onion waste, converts it to biogas via anaerobic digestion, and conditions it for use in two 300-kW FuelCell Energy units. This unique system saves Gills an estimated $700,000 in electricity costs and up to 14,500 tons of CO_2 equivalent emissions per year.

Farms and other producers of organic waste are increasingly looking to fuel cells to turn the waste into useful energy. The ongoing Farms to Fuel program in Sonoma County, California, aims to take manure from nearly 2 million egg-laying chickens from county farms and convert it into electricity via a 1.4 MW fuel cell located at the Sonoma County Water Agency. Meanwhile, Stone Edge Farm, an organic vineyard also in Sonoma County, is exploring the possibility of using waste from wine production directly in their 5-kW ClearEdge Power fuel cell, installed in 2011.

FUEL CELLS + SOLAR PV

Energy from the sun, though abundant and free, is variable. The variability of weather puts commercially available solar photovoltaic (PV) panels in an unfortunate position – generating power at just 20-25% efficiency. In urban settings, there also is the problem of finding enough roof space or land to site enough solar arrays to produce enough power. Fortunately, fuel cells can provide a stable, baseload supply of electricity to important loads on cloudy days, throughout the night, and in the autumn and winter months when the sun's energy is less intense. The use of fuel cells improves the overall efficiency of solar PV technology by a substantial margin and mitigates the variability of the sun's energy.

Facilities that pair solar PV panels with a fuel cell system onsite are typically those with a critical need for reliable, grid-independent power. For these facilities, even a few minutes of downtime from a power loss can translate to millions of dollars in lost revenue. Critical-needs facilities like data centers, hospitals, and grocery stores are just a few of the sites pursuing co-located renewable energy systems to harden grid independence in the U.S.

Earlier this year, Apple announced that its data center in Maiden, North Carolina, would use fuel cells and solar power to provide 100% of the site's electricity by the end of 2012. Construction is currently underway on a 20-MW solar PV array and 4.8-MW Bloom Energy fuel cell system that will take Apple's data center completely off-grid and make it one of the largest fuel cell installations in the U.S. When completed, the fuel cell system will run on biogas and deliver 40 GWh of baseload power per year. The solar panels will provide an additional 42 GWh over the same period of time.

The Hartford Life building in Windsor, Connecticut also takes advantage of a hybrid solar-fuel cell system. Completed in 2009, this installation features a 202-kW rooftop PV array as well as a 300-kW fuel cell from nearby manufacturer FuelCell Energy. The fuel cell helps offset 24/7 baseload power while the solar PV system provides power at daytime "peak" hours when grid electricity is most expensive.

Safeway Santa Cruz

Remodeled in 2010, this 60,000 sq. ft. grocery store now receives 100% of its power from two 100-kW Bloom Energy fuel cells and 896 solar PV panels installed on the roof. The fuel cell system provides between 60-70% of the store's daily electricity needs while the solar panels handle the remaining load.

FUEL CELLS + WIND

As with solar power, the variable nature of wind lowers the efficiency of wind turbines installed to handle the electrical loads at wind-powered sites. Fuel cells, being an ideal technology enhancer, can provide baseload power that ensures a facility stays powered during times of low or no wind. In areas with abundant wind and a wind-hydrogen hybrid plant, fuel cells also can convert the hydrogen generated from excess wind (through electrolysis) into electricity when demand is high. Examples of both are currently being demonstrated in the U.S. and around the world.

Wind energy, like solar energy, is considered one of the optimal pathways to creating clean hydrogen via water electrolysis. Several wind-to-hydrogen refueling stations have sprouted up in recent years, including one in Hempstead, New York, that generates hydrogen via wind-powered electrolysis and dispenses compressed hydrogen for fuel cell electric vehicles and hydrogen internal combustion engines. The station also produces blended hydrogen condensed natural gas (HCNG), a mixture of 20% hydrogen/80% natural gas by volume.

Adobe Systems has adopted a fuel cell-wind turbine configuration for their corporate headquarters in San Jose, California. The combination of both technologies provides roughly a third of the electricity needs of Adobe's campus. More on this installation can be found on Adobe's company profile on page 12.

According to the National Renewable Energy Laboratory (NREL), by the end of 2011, the U.S. had 46,916 MW of installed wind capacity; a huge number compared to the 2,472 MW installed in 1999 or the 25,410 MW installed by the end of 2008. This tremendous growth is expected to continue, drawing attention to how to store excess energy from this renewable resource – wind often blows strongest at night when demand for electricity is lowest. Fuel cells serve an important function in wind-to-hydrogen plants, converting stored hydrogen into electricity for stationary applications or even FCEVs.

Herten Wind-Hydrogen Plant

In late 2011, Canadian fuel cell company Hydrogenics won a contract to supply the city of Herten, Germany with a wind-hydrogen demonstration facility in 2012 that will convert excess wind into useful hydrogen for FCEVs or electricity production. The system will consist of a HySTAT 30 electrolyzer, a hydrogen storage mechanism, and a 50-kW fuel cell power system.

(Pictured above is a similar wind-hydrogen system in Prenzlau, Germany.)

FUEL CELLS + BATTERIES

Fuel cells and batteries are two technologies with much in common – they can even look quite similar on the surface. Fuel cells, like batteries, generate electricity through a chemical reaction, but where a battery requires recharging once its stored fuel is used up, a fuel cell maintains voltage and will keep producing electricity so long as it has fuel.

A common misconception is that fuel cells and batteries are competitors, particularly in the advanced vehicle industry where fuel cell electric vehicles (FCEVs) and plug-in electric vehicles (PEVs) are being introduced to consumers around the world. What many do not realize, however, is that fuel cells and batteries are used in tandem in many applications, including advanced vehicles.

In battery vehicles, fuel cells can serve as a range extender. The Ports of Los Angeles and Long Beach, California, are operating a fuel cell-battery hybrid Class-8 Tyrano truck in drayage service. Onboard this heavy duty vehicle, built by Vision Motor Corp., is a hydrogen fuel cell that charges a battery that drives the electric motor. The fuel cell enhances the battery's performance, extending its life over many cycles. This hybrid configuration saves over $390,000 in total ownership cost for the Ports of Los Angeles and Long Beach. Additional savings are anticipated in fueling and maintenance costs over the eight-year lifetime of each vehicle. The ports have had a positive experience with the rig and in May 2012 agreed to purchase 100 more units with the option for an additional 300.

In order to maximize the photovoltaic output of solar-powered communication and surveillance sites in the Arizona desert, ReliOn has deployed several hybrid solar-fuel cell-battery systems to provide the necessary power at these remote locations. Originally, these telecom sites relied on extended battery strings of 24-48V to backup a solar PV array. The batteries themselves were supported by 6.5-10 kW AC propane generators, which frequently failed to start properly. ReliOn provided the solution in the form of a T-1000® fuel cell system that provides a more reliable backup power supply to the battery string which in turn provided consistent power to the communications equipment until the sun returned.

Oorja Protonics Forklifts

Oorja Protonics has 500 of its fuel cell systems in the materials handling field today, with customers such as Martin-Brower, Unified Grocers, Nissan, and U.S. Foodservice. The OorjaPac fuel cell battery range extender increases the performance of the vehicle and the lifetime of the battery by continuously monitoring the battery and maintaining its state-of-charge. Refueling takes less than one minute and supplies enough power to run the vehicle 12 to 16 hours. The company estimates a payback period of less than two years and around $200,000 in savings a year in operating costs.

V. Financing Fuel Cells

Power Purchase Agreements

To encourage the installation of fuel cells for stationary power, the three largest fuel cell manufacturers – Bloom Energy, FuelCell Energy, and UTC Power – offer an innovative financing mechanism called a Power Purchase Agreement (PPA), a legal contract between an electricity generator and a consumer. Under a PPA, there is no upfront capital investment required by a consumer. Instead, a consumer purchases the electricity generated by a fuel cell system, while the manufacturer or third-party installer assumes the costs for operation and maintenance. In some cases, high grade heat generated from the fuel cell is also sold to the customer. A typical PPA allows customers to lock in favorable electricity rates for a period of 10-20 years, with added savings realized in improved efficiency and carbon reduction over time.

Since a PPA clearly defines the output of generating assets and the credit of its associated revenue streams, it can be used by the energy provider to raise nonrecourse (i.e. provider assumes the equipment performance risks) financing from a bank or other financing counterparty.

As more customers are opting to go the PPA route, fuel cell manufacturers are working with third-party integrators to create custom arrangements to tailor to location, electricity needs and rate period.

Federal Incentives

The Investment Tax Credit (ITC), created under the federal Energy Policy Act of 2005, helps to offset the cost of a fuel cell by providing tax incentives to residential and commercial customers. In 2008, the Emergency Economic Stabilization Act increased the incentive amount, and extended the credit through 2016. The ITC provides a 30% tax credit for qualified fuel cell property or $3,000/kW of the fuel cell nameplate capacity, whichever is less, on equipment installed before December 31, 2016. A credit of 10% is also available for combined heat and power (CHP) systems.

Federal Investment Tax Credit

- Business property owner: Credit of 30% of cost of fuel cell installation up to $3,000/kW
- Non-business property owner: Credit of 30% of cost of fuel cell installation up to $1,000/kW
- Minimum 0.5 kW in capacity
- Electricity-only efficiency of greater than 30%
- Eligibility extended to all utilities and telecommunications firms.
- Allowance of credit is permissible against Alternative Minimum Tax (AMT). This allows persons subject to AMT to take the credit against that portion of their tax liability.

The American Recovery and Reinvestment Act of 2009 (ARRA, or Recovery Act) in 2009 expanded these incentives by adding a grant in lieu of tax credit for fuel cell purchasers with insufficient tax liability (only entities that pay taxes are eligible for the credit). The ARRA also increases the cap on the 30% hydrogen fueling facility tax credit from $30,000 to $200,000.

State-level Policies

Many states have policies in place that support the installation and deployment of fuel cells, either via tax credits and incentives, or policies and legislation. The most prominent regulation at the state level is

the Renewable Portfolio Standard (RPS), a regulation that requires electric supply companies to increase the amount of energy produced from renewable energy sources. A number of states have moved to include fuel cells in their list of eligible renewable generation technologies.

Some states are actively funding installations. California's SGIP, funded by utility customers, provides $4,500 per kW for fuel cell systems utilizing renewable fuel, under which biogas and anaerobic digester gas (ADG) qualify. This program has helped propel California to the forefront of stationary fuel cell installations and arguably the state is now the world's leader in ADG-run fuel cells at wastewater treatment plants as well as food and beverage processing facilities.

Public benefit corporations and agencies such as the New York State Energy Research and Development Authority (NYSERDA) and Connecticut's Clean Energy Finance and Investment Authority (CEFIA) have been helping fund fuel cell installations in their states for many years now, and other states are catching on. The New Jersey Economic Development Authority (EDA) and the New Jersey Board of Public Utilities (BPU) recently launched a Large Scale Combined Heat and Power (CHP) and Fuel Cell Grant Program that will provide up to $55 million in grants for CHP and fuel cell installations.

To learn more about fuel cell-favorable policies in your state, please visit Fuel Cells 2000's State Fuel Cell and Hydrogen Database.

[1] Knut Haanaes, Martin Reeves, Ingrid von Streng Velken, Michael Audretsch, David Kiron and Nina Kruschwitz. *2011 Sustainability & Innovation Global Executive Study and Research Project*, MIT Sloan Management Review, 23 Jan. 2012, http://sloanreview.mit.edu/feature/sustainability-strategy.

[2] U.S. Department of Energy. *The Smart Grid: An Introduction*, http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_SG_Book_Single_Pages%281%29.pdf

[3] General Accountability Office, Statement of Gregory C. Wilshusen, Director Information Security Issues. *Challenges in Securing the Electricity Grid*, GAO-12-926T, 17 Jul. 2012, http://www.gao.gov/assets/600/592508.pdf.

VI. Spotlighted Companies

Adobe Systems

Software giant Adobe System's ambition is to achieve 'net zero' by 2015 in its United States owned facilities – buildings that can be independent from the grid and annually produce no carbon emissions. Adobe is the world's first corporation to achieve four Platinum certifications under the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) program. Adobe's Bloom Energy fuel cell installations build on the company's prior renewable energy initiatives, including 20 Windspire® wind turbines installed in 2009 at its corporate headquarters in San Jose, California.

Fuel Cell Customer Experience:

- 1.6 MW total fuel cell power at two locations
- Estimated 121.5 million lbs. of CO_2 avoided over 10 years

"Installing Bloom Energy fuel cells supports Adobe's efforts to remain at the forefront of utilizing impactful, clean technologies to reduce our environmental footprint. We hope to be an example to other companies considering cleaner, more affordable energy sources for their operations." - **Michael Bangs**, Director, Global Facilities, Adobe

New Installations

Adobe Office Building – San Francisco, California

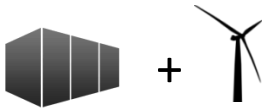
In January 2012, Adobe installed two 200-kW Bloom Energy Server solid oxide fuel cells (400 kW) at its San Francisco offices. Adobe expects the units will provide 35% of the offices' on-site power needs – the equivalent of powering 320 average-size homes.

400 kW SOFC system

35% of power needs

Earlier Installations

Adobe Headquarters – San Jose, California



1.2 MW SOFC system

24 kW wind turbines

30% of power needs

At Adobe's corporate headquarters in San Jose, California, fuel cells are working in tandem with wind turbines to provide about 30% of the electricity needed to power the site's three office towers and more than 90,000 m^2 of office space. With 12 100-kW Bloom Energy fuel cell units, as well as 20 1.2-kW Windspire turbines in the building's central courtyard, Adobe is able to significantly reduce its dependency on the grid for power. The fuel cells, installed on Adobe's 5th floor patio of the West Tower, convert natural gas into electricity at a rate of 9.5 GWh per year. Adobe purchases renewable biogas from a Pennsylvania landfill to offset the natural gas being converted in the fuel cells on site, making the system virtually carbon neutral.

Adobe's 400-kW fuel cell installation at its San Francisco office

AT&T

AT&T wants to minimize its environmental impact and dependency on fossil fuels through the purchase or commission of alternative energy sources, when costs are comparable. The company has already installed 3.9 MW of solar and fuel cell power at its sites in the U.S. and has set a goal of adding a minimum 5 MW of new clean energy technology to its portfolio in 2012. After the company's first experience with the technology back in the 1990s – a 200-kW fuel cell demonstration at its New Jersey research laboratory – AT&T is reaping the benefits of fuel cells. Today, the company operates hundreds of ReliOn fuel cells that provide backup power to cell phone towers, and will use Bloom Energy fuel cells to generate primary power for 28 sites.

Fuel Cell Customer Experience:

- 17.1 MW (7.5 installed, 9.6 planned) at 28 sites in California and Connecticut
- 149 million kWh of electricity per year – enough to power 13,680 homes
- 50% reduction in CO_2 compared to grid power

"We have high-tech centers that run around the clock, and the Bloom Boxes have worked perfectly. We haven't had any outages, and this allows us to have onsite generation with high reliability. A key differentiator for fuel cells compared to other forms of alternative power is that fuel cell electricity production is virtually constant. They provide steady recurring electricity production at a relatively predictable cost, replacing the traditional electricity bill, which can be volatile." – **John Schinter**, Senior Energy Director, AT&T

New Installations

AT&T sites – California and Connecticut

In October 2012, AT&T announced it had signed a contract with Bloom Energy for an additional 9.6 MW of fuel cell power – a follow-on order after the 2011 deployment of 7.5 MW of Bloom Energy servers. AT&T will not own the fuel cells, but will instead purchase the energy generated by the onsite fuel cells via a "Bloom Electrons" power PPA. Once installed, AT&T will have Bloom Energy fuel cells generating power at 28 sites in California and Connecticut.

9.6 MW total SOFC

17 sites in California and Connecticut

Earlier Installations

AT&T Sites – California

In 2011, AT&T began installing 7.5 MW of Bloom Energy's fuel cells to power administration offices, data centers and facilities housing network equipment at 11 California sites. The fuel cells will produce 63 million kilowatt-hours (kWh) per year, enough to power more than 5,331 homes annually. All systems were online by the end of June 2012.

7.5 MW SOFC

11 sites in California

AT&T Telecom Stations – Nationwide

During 2010 and 2011, AT&T deployed 431 ReliOn fuel cells, each with a new refillable 72-hour hydrogen fuel system, at 180 locations across the AT&T Mobility Network. Funding for the fuel cells was provided through the 2009 ARRA. The deployments include AT&T sites in Arizona, California, Colorado, Florida, Illinois, Indiana, Kentucky, Michigan, New Mexico, and Utah. Data compiled by DOE determined that the fuel cells exhibited 99.9% reliability and ReliOn reports that the fuel cells have provided reliable backup power during grid outages ranging between 20 minutes and 73 continuous hours.

2-6 kW PEM

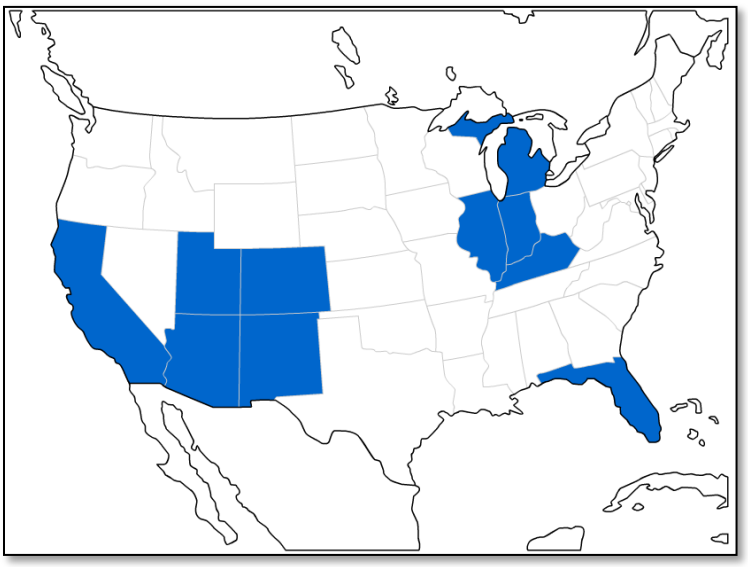
431 units at 180 sites

AT&T Research Laboratory – Holmdel, New Jersey

In 1995, Jersey Central Power and Light Company (JCP&L) installed a 200-kW natural gas-powered UTC Power fuel cell on the site of one of its customers, AT&T Research Center at Holmdel, New Jersey. The fuel cell provided base load electric service and heat to AT&T. The system has since been decommissioned.

200 kW PAFC

Combined heat & power



Locations of AT&T's Current and Planned Fuel Cells

BMW

BMW's goal is to reduce the environmental footprint of its Spartanburg, South Carolina plant, a worldwide manufacturing facility for the company's X-3, X-5, and X-6 vehicles. The facility first deployed fuel cell-powered forklifts in 2010. After operating the vehicles for a year, BMW became convinced of their benefits – BMW is now converting the entire forklift fleet to fuel cell power. By the end of 2012, BMW expects to have 400 fuel cell forklifts in use and 14 hydrogen fueling dispensers. Currently, the hydrogen is a by-product of a sodium chlorate plant that is purified, compressed and liquefied by using electricity produced from renewable hydropower and trucked to the site. In November 2011, the plant launched a new project to determine the feasibility of converting landfill methane to hydrogen fuel for its fuel cell forklift fleet. The BMW plant presently burns the methane, which is transported 9.5 miles via a pipeline from the landfill, in turbines to provide about 50% of the plant's power.

Fuel Cell Customer Experience:

- 1.8 million kWh of electricity saved annually that would have been needed to charge forklift batteries
- 1,200 tons of CO_2 emissions per year avoided

New Deployments

BMW Manufacturing Plant – Spartanburg, South Carolina

In 2012, BMW placed a follow-on order for more than 230 Plug Power fuel cell units for forklifts, converting the factory's forklift fleet entirely to fuel cell power. The units should be operational by the end of 2012, with 400 fuel cell lift trucks. The site will dispense 500 kilograms of hydrogen daily using 14 refueling dispensers.

2.6-10.1 kW PEM

230+ units

Earlier Deployments

BMW Manufacturing Plant – Spartanburg, South Carolina

In October 2010, BMW purchased its first 86 fuel cell-powered forklifts, tuggers and stackers for use at its new Spartanburg, South Carolina, manufacturing plant that produces the new BMW X3 Sports Activity Vehicle®. Prior to purchasing the fuel cells, an evaluation of fuel cell, lead-acid battery and fast charge battery technologies determined that fuel cells would be the best power source for BMW's materials handling fleet.

2.6-10.1 kW PEM

86 units

CBS Corp.

CBS is making the corporation, and all of its business units, more energy efficient, conservation-minded and less wasteful in all areas. It is the only major media company to voluntarily report through the Climate Registry carbon management program. CBS's energy-related efforts include the installation of solar panels on some sound stages, buildings and production vehicles; the use of highly efficient new air conditioning technology and practices; and "Cool Roof" technology and energy efficient green roof practices that significantly cut building energy consumption. In July 2012, CBS announced that it would add 2.4 MW of fuel cells to two of its California production facilities.

"Fuel cells are a great fit for our business and sustainability goals. With the installation of these PureCell systems, we will substantially increase our energy security by being able to continue operations in the event of a grid outage and, equally important, the installation is projected to reduce our impact on the environment and provide significant energy cost savings for our business." – **Michael Klausman**, President, CBS Studio Center & Senior VP Operations, CBS Television City

Fuel Cell Customer Experience:

- 2,370 metric tons of CO_2 emissions avoided per year
- 2.8 million gallons of water saved annually
- Low NO_X emissions – equal to removing 357 cars from the road

Planned Installations

CBS Television City and CBS Studio Center – Los Angeles, California

CBS Studios will install six UTC Power PureCell® fuel cell systems (2.4 MW) at two production locations in California – three at CBS Studio Center, a production facility with 18 sound stages and office space in Studio City, California, with three at CBS Television City in Los Angeles, housing eight sound stages and office space. The studios produce shows such as Entertainment Tonight, The Price is Right, CSI: NY, NCIS, American Idol and Dancing with the Stars. Four of the fuel cell systems will be configured to operate independent of the grid to provide energy security for the studios, and to serve as critical power backups during blackouts and other emergencies. Thermal energy from the systems will provide cooling for both studios and space heating and hot water at Television City. The installations are supported by funding from California's SGIP.

2.4 MW SOFC CHP

411-kw Solar PV (Television City)

60% of power (Television City)
40% of power (Studio Center)

Coca-Cola

The Coca-Cola Company's goal is to grow its business, but not the carbon dioxide emissions from its manufacturing operations, as compared to a 2004 baseline. To help accomplish this goal, the Company is working to incorporate more fuel-efficient modes of product delivery and to reduce fleet and transportation emissions. "Efficiency and Climate Protection" is one of seven focus areas that make up Coca-Cola's Live Positively platform, the Company's commitment to making a positive difference in the world by growing business in economically, environmentally and socially sustainable ways.

Fuel Cell Customer Experience:

- 3 MW total fuel cell power
- 95 fuel cell forklifts in two facilities

New Installations

Bottling Facility – San Leandro, California

Coca-Cola Refreshments USA purchased Plug Power GenDrive™ fuel cells for 37 fuel cell forklifts and 19 fuel cell pallet jacks at Coca-Cola's 500,000 sq. ft. bottling and distribution center in San Leandro, California. With this conversion, Coca-Cola will be able to eliminate their battery room and open up more than 2,000 sq. ft. of floor space for storing and moving product. According to Coca-Cola, fuel cells increase productivity by 15% on average, and lower operational costs by up to 30%. Electrical consumption will be reduced by an estimated 1.6 million kWh/year. Air Liquide provides the hydrogen.

1.8-3.2 kW PEM

56 units

Bottling Facility – American Canyon, California

In April 2012, Coca-Cola placed five Bloom Energy fuel cells in service at its 360,000 square-foot beverage bottling plant in American Canyon, California. The fuel cells run on natural gas.

1 MW SOFC

Earlier Installations

Production Center – Charlotte, North Carolina

In June 2011, the Coca-Cola Bottling Co. Consolidated (CCBCC) production center in Charlotte, North Carolina began operating a fleet of 35 Crown and five Yale counterbalanced class one lift trucks powered by Plug Power fuel cells. The forklifts are refueled at three indoor fueling stations with hydrogen from Linde North America.

8.7-10.1 kW PEM

40 units

Bottling Facility – East Hartford, Connecticut

In June 2011, Coca-Cola installed two UTC Power 400-kW fuel cells that generate 100% of the power and 50% of the heat used at its East Hartford, Connecticut bottling facility.

800 kW PAFC

100% of power, 50% of heat

Production Facility – Elmsford, New York

In October 2010, CCR installed two UTC Power PureCell® Model 400 fuel cell systems at its Elmsford, New York, production facility. The fuel cell systems provide 35% of the electricity and heat required by the facility and prevent the release of more than 2,635 metric tons of carbon dioxide (CO_2) and more than four metric tons of nitrogen oxide emissions by using fuel cells instead of non-base load utility power plants. NYSERDA provided funding to support the project.

800 kW PAFC

35% of power and heat

Odwalla Juice Packaging Facility – Dinuba, California

In March 2011, Coca-Cola subsidiary, Odwalla, announced the installation of a 500-kW Bloom Energy fuel cell system at its juice packaging facility in Dinuba, California. The fuel cell system generates 30% of the plant's power and operates using directed biogas, reducing over 5 million pounds of CO_2 annually.

500 kW SOFC

Directed biogas

30% of power

5 million lbs. CO_2 avoided per year

Cox Enterprises

Cox Enterprises is working to reduce its annual company-wide carbon dioxide footprint 20% by 2017. The company's national sustainability program, Cox Conserves, Cox Enterprises' national sustainability program, aims to conserve resources, embrace renewable energy and reduce the company's greenhouse gas emissions. Cox Conserves also encourages the company's employees and their families to engage in eco-friendly practices.

Fuel Cell Customer Experience:

- 3 MW total fuel cell power
- 15,500 tons of carbon emissions avoided

"Twenty-five percent of Cox Communications' electricity in California is now being generated through our alternative energy projects. These projects yield positive results for the environment and the bottom line." – **Steve Bradley**, Cox Enterprises' Director of Energy, alternative energy and business continuity

New Installations

Cox Communications – San Diego, California

In March 2012, Cox Enterprises installed five 200-kW Bloom Energy fuel cells at its Cox Communications subsidiary in San Diego. The fuel cells, powered by renewable biogas, include two 200-kW units powering 100% of one facility and three 200-kW units powering 90% of another building.

1 MW SOFC

Directed biogas

100% and 90% of power needs

Earlier Installations

Cox Headquarters – San Diego, California

In February 2011, two 400-kW UTC Power PureCell® fuel cell systems were installed at Cox's San Diego, California headquarters. One fuel cell provides 100% of the electrical load for one building, and the other generates nearly 60% of the electrical requirement for the main building. The fuel cells are powered by a blend of natural gas and biogas from San Diego Gas & Electric Co.'s pipeline. This enabled Cox to qualify for $3.6 million from California's SGIP program, by purchasing the equivalent of at least 75% of their gas consumption from a biogas producer that injects cleaned biogas into the system.

800 kW PAFC

Directed biogas

60% and 100% of electrical needs

Rancho Santa Margarita Facility – Orange County, California

In February 2011, two 400-kW UTC Power PureCell® fuel cell systems were installed at Cox's Rancho Santa Margarita Facility to provide nearly 60% of the 300,000 sq. ft. building's electricity requirement. The site also uses a 100-kW rooftop solar PV system. These fuel cells also use a combination of natural gas and biogas, preventing about 3,000 tons of garbage a year from going into a landfill.

800 kW PAFC

100 kW solar PV

~4,600 tons of carbon emissions avoided

KTVU Television Station – Oakland, California

In January 2010, Cox installed four 100-kW Bloom Energy fuel cells (400 kW total) at its KTVU television station in Oakland, California. The fuel cells run off biogas and provide 69% of the main building's energy requirements, generating power at a lower cost than the local utility.

400 kW SOFC

69% of power

~2,000 tons of carbon emissions avoided

Cox's 400 kW Bloom Energy installation in Oakland, California

Sysco

Sysco's 90 Broadline distribution facilities are a major focus of the company's sustainability efforts. The warehouse energy efficiency initiative, started in 2006, generates energy savings by focusing on operational efficiencies and equipment upgrades. Since this project's inception, the Broadline organization has achieved a 19% reduction in kilowatt hour usage while increasing warehouse storage volume by approximately 14%. The company's warehouses also experienced improvements in equipment life and operation and were able to eliminate environmental issues associated with lead battery use and disposal. Sysco's Houston warehouse operates using a 100% fuel cell-powered fleet of pallet trucks and forklifts, and the company is replacing approximately 1,444 lead-acid batteries with 722 fuel cells at seven additional Broadline distribution centers.

Fuel Cell Customer Experience:

- 19% reduction in warehouse energy use
- Approximately 14% increase in warehouse storage volume
- Nearly $100,000 saved per year at Houston warehouse in man-hours spent on refueling fuel cells versus swapping batteries

New Deployments

Sysco Warehouses – Nationwide

Sysco has deployed new fuel cell forklifts at its facilities in Boston, Massachusetts (170), Front Royal, Virginia (102), Long Island, New York (50), and San Antonio, Texas (110). The company has also purchased 92 fuel cell forklifts for its Riverside, California warehouse which will be operational by April 2013. The company has plans to convert additional faciltiies to fuel cells in the near future.

1.8-3.2 kW fuel cell

524 units

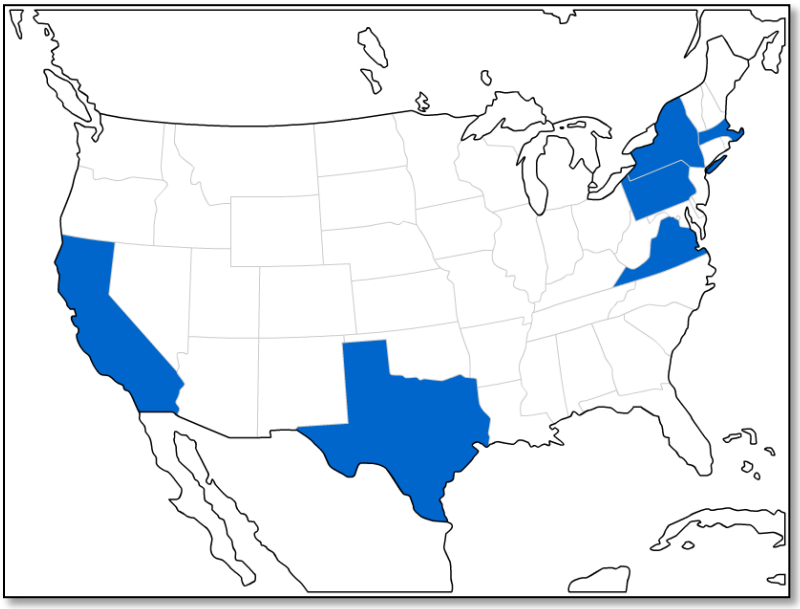
Earlier Deployments

Sysco Distribution Center – Houston, Texas

Through the ARRA, Sysco converted the entire class-2 and class-3 lift truck fleet to fuel cell power at its Houston site in order to demonstrate the economic benefits of large fleet conversions of lift trucks from lead-acid batteries to fuel cell power. Sysco reports that the performance of fuel cells is much better than lead-acid batteries, and that the current cost of hydrogen fuel is approximately the same as the cost of electricity to charge lead-acid batteries. In addition, Sysco operates 25 of its Class-3 fuel cell forklifts in sub-zero temperatures.

1.8-3.2 kW fuel cell

98 units



Locations of Sysco's Current & Planned Fuel Cell Forklifts

Walmart

Retail giant Walmart is working toward 100% renewable electricity for its stores and facilities, no small task considering the nearly 4,000 retail locations in the U.S. and more than 10,000 stores worldwide. In pursuit of this goal, the company has installed fuel cells at 26 Walmart and Sam's Club locations in California. These fuel cell systems, manufactured by Bloom Energy, produce 65 million kWh of electricity each year, and have been configured by Walmart to provide between 40-70% of each store's annual electricity needs. Walmart has also been an enthusiastic first-adopter of fuel cell-powered forklifts for their warehouse operations in the U.S. and Canada, with over 500 currently in service.

Fuel Cell Customer Experience:

- 26 fuel cell-powered stores in the U.S.
- 65 million kWh of electricity per year
- 509 fuel cell forklifts in North America

New Installations

Walmart Stores – Multiple Sites, California

In the Business Case for Fuel Cells 2011, we reported 17 Wal-Mart stores in California being powered by fuel cells. Today, that number stands at 26 stores, a gain of nine that underscores the company's seriousness to making their operations more sustainable. In Walmart and Sam's Club locations, Bloom Energy fuel cell systems are handling between 40-70% of the site's power needs.

400 kW SOFC system

40-70% of power needs

Food Distribution Centers – U.S. and Canada

Since our last report, Walmart has added over 400 fuel cell forklifts to three of their warehouses – Cornwall, Ontario; Balzac, Alberta; Washington Court House, Ohio – bringing the total number of forklifts to 509. These PC4500 units made by Crown Equipment Corp utilize a Plug Power GenDrive fuel cell system that help Walmart warehouses reclaim valuable space and cut down on refueling time. Walmart's Balzac warehouse reports expected operational savings of $269,000 per year, and total energy cost savings could reach $4.8 million by 2015 as a result of these hydrogen-fueled forklifts.

1.8-3.2 kW fuel cell

$269,000/year savings (Balzac facility)

Expected GHG reduction up to 72% compared to batteries charged from grid

Earlier Installations

Walmart Stores – Hemet and Lancaster, California

400 kW SOFC system

50% of power needs

Walmart's two retail stores in Hemet and Lancaster, California (included in under "multiple sites" above), were the company's first fuel cell installations and are still in operation today. The company's 200,000 sq. ft. Lancaster store receives about half of its power from the Bloom Energy fuel cell system, which was sold to Walmart under a PPA in 2010. Under this arrangement, Bloom installs and maintains the fuel cell system while Walmart reaps the benefits. The fuel cells generate electricity very quietly and occupy a small, discreet plot of land behind the store.

VII. Recent Fuel Cell Installations and Purchases

Americold

Americold, which owns and operates temperature-controlled space for its customers, is investing in clean energy projects to lower emissions of the power they use, and the company has identified energy cost and consumption as an opportunity for savings. In the past two years, Americold's conservation projects, which include lighting and refrigeration improvements and employee awareness, have resulted in savings of over 101.7 million kilowatt hours. In February 2012, Americold installed three Bloom Energy fuel cells (totaling 600 kW) at its Salinas, California warehouse.

600 kW SOFC

5.3 million kWh/year

"We are excited to have this [fuel cell] technology added to our portfolio to further our commitment to reduce the impact of our operations on the environment. The performance and reliability has proven to be everything promised." – **Fred Walker**, Vice President Engineering and Facilities

Apple

Apple's goal is to achieve net zero energy use for its corporate facilities worldwide. The first step is to ensure energy efficient facilities, while the second tier focuses on generating clean, renewable energy onsite. To date, Apple's renewable energy generation has focused on using solar PV, fuel cells, and other technologies. The third tier of the strategy is to meet remaining energy needs with renewable energy generated offsite.

4.8 MW SOFC

Directed biogas

20-MW solar PV

124 million kWh/yr

Apple is building a new data center in Maiden, North Carolina, that will draw about 20 MW of power at full capacity, producing 60% of this power onsite using one of the largest non-utility fuel cell installations – a biogas-powered 4.8-MW fuel cell installation will provide more than 40 million kWh of renewable energy annually - and the nation's largest private installation of solar arrays. Apple will be producing enough onsite renewable energy (124 million kWh) to power the equivalent of 10,874 homes. The remaining 40% of energy needs will be met by directly purchasing renewable energy generated by local and regional sources. By the end of 2012, Apple will meet the energy needs of its Maiden data center using entirely renewable sources. This installation makes Apple a repeat fuel cell customer - its corporate headquarters in Cupertino, California, uses a 500-kW fuel cell to generate more than 50% of the needed energy onsite.

Baldor Specialty Foods

In mid-2012, Baldor Specialty Foods, one of the largest importers and distributors of fresh produce and specialty foods in the Northeast, installed 50 Oorja Protonics OorjaPac™ fuel cell systems that are used to power the company's fleet of battery-operated forklifts at its Bronx, New York facility. OorjaPac™ is a methanol-fueled fuel cell that operates as an on-board battery charger for a variety of Class 3 materials handling vehicles.

1.5-kW DMFC

5.3 million kWh/year

101.7 million kWh in energy savings

"Baldor Foods is excited to be working with Oorja to help us achieve our corporate sustainability goals. We are very impressed by the technology, as it is environmentally-friendly and will also help us save costs and improve productivity." – **Mike Muzyk**, Baldor President

eBay

In 2009, eBay committed to reduce its corporate greenhouse gas emissions by 15% by 2012 over a 2008 baseline. The company's first fuel cell was installed in 2009 – a biogas-powered 500-kW Bloom fuel cell system co-located along with a 650-kW solar array at its San Jose headquarters.

6 MW SOFC

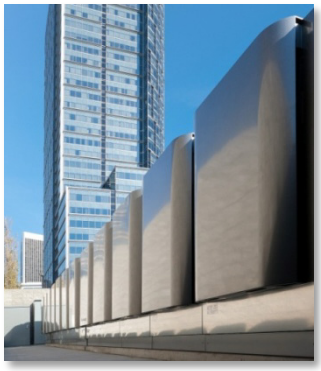
Directed biogas

The new fuel cell installation, announced in June 2012, will feature 30 Bloom Energy servers (6 MW) located at the next phase of eBay's flagship data center in South Jordan, Utah. The fuel cells will produce onsite energy to power millions of transactions by eBay's more than 102 million active users, who generate more than $69 billion in merchandise volume annually. The new data facility (dubbed the Quicksilver data center) will also power activity across eBay's other global commerce platforms, including PayPal and StubHub. The fuel cell system will eliminate the need for an uninterrupted power supply (UPS) system since grid power will serve as the backup. A microgrid at the Utah site will enable excess fuel cell power generation to be diverted from the Quicksilver data center over to the larger, neighboring Topaz data center. The 6-MW fuel cell system will be operational by mid-2013.

"We believe the future of commerce can be greener. Technology-led innovation is changing retail and revolutionizing how people shop and pay. We also want to revolutionize how shopping is powered. We are embracing disruptive energy technology and designing it into our core data center energy architecture. Running our data centers primarily on reliable, renewable energy, we intend to shape a future for commerce that is more environmentally sustainable at its core." – **John Donahoe**, President and CEO, eBay Inc.

JMB Realty / Constellation Place

JMB Realty is committed to making the 35-story Constellation Place (formerly MGM Tower) high rise building a standout "green" workplace in Los Angeles. In 2008 and 2010, two acres of solar PV panels were added to the roof of the parking structure, and in December 2011 the building installed four 100-kW Bloom Energy fuel cells. The 35-story building is currently LEED®EB O&M Gold certified, and the two Bloom Energy Servers generate about a third of the building's power.



400 kW SOFC

~33% of power

30% reduction in GHG emissions

"JMB is excited to be Bloom's first high-rise, Class A office installation in Los Angeles. Bloom's compact footprint produces 400 kW of power in less than 900 square feet, helping us provide our tenants high quality, premium space with minimal environmental impact." – **Sarah Shaw**, Vice President Development and Operations

Lafayette Hotel

Lafayette Hotel's renewable goals were to find an alternative energy solution that would work within strict historic preservation guidelines, keeping the City of San Diego landmark listed on the National Register of Historic Places. In 2012, the San Diego hotel installed a 40-kW ClearEdge Power fuel cell system (eight fuel cell units combined) in the basement of the hotel's main building. The fuel cells generate 45% of the building's electricity and produce enough heat to help keep the pool's temperature between 76 and 79 degrees year-round. The ClearEdge system serves as one of the supporting measures for the hotel's application for the New Market Tax Credit and Historic Rehabilitation Tax Credit programs that partially financed the hotel's renovation project. The fuel cell installation also qualified for California's SGIP funding. The Lafayette also became the first Energy Star historic hotel in the region.

40 kW PEM

45% of power

~$30,000 reduction in energy costs

Avoids 100 tons of greenhouse gas (GHG) emissions/year

"One of the key challenges in this renovation was finding an alternative energy solution that would preserve the building's historic value. With ClearEdge Power's fuel cell system, we were able to comply with strict guidelines and qualify for energy upgrade rebates and tax credit incentives that helped make this renovation a reality in one of the toughest real estate and hospitality recessions." – **Tara J. Hamacher**, President, Historic Consultants Inc., the sustainable energy and tax consultancy that structured the project financing

Life Technologies Corp.

Since 2008, Life Technologies Corp., a global biotechnology tools company, has reduced carbon dioxide emissions by 16%; energy consumption by 20%, water usage by 43%, and hazardous waste by 41%. In July 2012, the company debuted its Bloom Energy fuel cell system that generates about 60% of the power needed for its Carlsbad, California headquarters and the manufacturing and distribution center. The new fuel cell system fits within 1,500 square feet and provides 1 MW of power that is generated onsite.

1 MW SOFC

60% of power

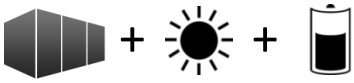
30% CO_2 reduction

4-year return on investment (ROI)

"Moving 'off the grid' using innovative sources of alternative energy helps reduce our carbon footprint and continues to demonstrate our commitment to ongoing sustainability initiatives." – **Cristina Amorim**, Chief Sustainability Officer for Life Technologies

Mesa del Sol Smart Grid

Real estate development firm, Forest City Covington, has established a smart grid energy system to power the 78,000 sq. ft. retail and business Aperture Center in the new Mesa del Sol community in Albuquerque, New Mexico. The system generates power onsite via integrated resources that include an 80-kW fuel cell, an onsite 50-kW solar PV system, a 240-kW natural gas powered generator and a 160-kW/hour battery storage system. An automated building management system manages the electric supply and distribution between onsite generation sources, energy storage, and the local electric utility's power grid.



80-kW fuel cell

50-kW solar PV

240-kW natural gas generator

160-kW/hr battery storage system

Project partners include Japan's New Energy and Industrial Technology Development Organization (NEDO), nine Japanese technology companies, University of New Mexico School of Engineering, New Mexico state government, County of Los Alamos, Sandia National Laboratories, and Mesa del Sol. NEDO is investing $22 million in the microgrid and will turn over to project the University of New Mexico's Center for Emerging Energy Technologies for continued research and smart grid development.

News Corp.

400 kW PAFC

675 metric tons of CO_2 avoided/year

4.2 million gallons of water saved/year

News Corporation's long-term vision includes growing the business without growing the carbon dioxide footprint, and powering operations with clean electricity. In December 2010, News Corp. achieved its target to become carbon neutral, with net zero carbon emissions, through a combination of energy efficiency, renewable energy and carbon offset projects around the world. In 2012, the company started up a natural gas-powered UTC Power PureCell stationary fuel cell system at the 1211 Avenue of the Americas building in New York City that provides News Corp. (parent company of Fox and the Wall Street Journal), the building's major tenant, a significant portion of its electricity for TV studios and its hot water needs. The fuel cell is located three levels below ground and can operate independent of the electric grid, providing energy security for the building and making it a critical power backup during blackouts, natural disasters and man-made emergencies. The project is a joint venture between News Corp., UTC Power, Beacon Capital Partners and NYSERDA.

Owens Corning

400 kW SOFC

65% of power

Owens Corning wants to reduce greenhouse gas emissions 20% by 2020, and is developing opportunities for expansion of fuel cell applications, CHP, and renewables. In December 2011, the company installed two 200-kW Bloom Energy Servers at the company's Compton, California roofing and asphalt plant to provide approximately 65% of the plant's power over the course of a year. The power reliability of fuel cells helps avoid overloaded infrastructure – the plant used to contend with an average of one to two power outages per week.

"Our roofing and asphalt plant now operates with energy that is more sustainable, cheaper, as well as more reliable with the deployment of Bloom Energy Servers. The 24/7 uninterruptible, high quality power from the Bloom Energy servers has greatly improved the reliability of critical manufacturing processes at the facility." – **Frank O'Brien-Bernini**, Vice President, Chief Sustainability Officer

The Palace apartments

In August 2011, ClearEdge Power installed two ClearEdge5 fuel cells at The Palace apartments, a renovation project that will provide apartments for foster youth aging out of the system. The ClearEdge5 system will enable LINC Housing, a Long Beach-based nonprofit that builds and manages affordable housing throughout California, to save money and reduce the impact of its apartment building on the environment. The fuel cell system is discreetly located on the roof of the Palace, allowing LINC Housing to maintain the historic character of the building, which was built in 1929. The building has also installed photovoltaic solar panels on the roof. The combination of fuel cells and solar panels will generate nearly all of the site's electricity and produces enough heat to meet the hot water needs of the building.

10 kW PEM

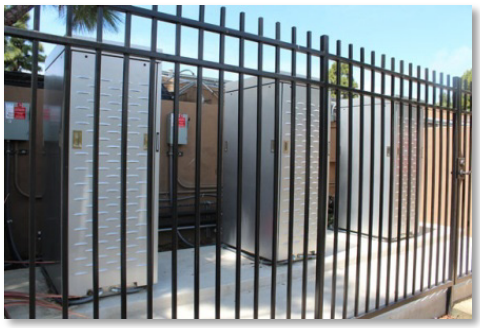
Solar PV

35-40% CO_2 reduction compared to the grid

"Six years ago, LINC Housing made a commitment to building sustainable housing, and these fuel cells are certainly one of the highlights of that effort. People think it's not possible to bring new technology to the homes we build; as a nonprofit developer we are pleased to demonstrate that with partnerships and perseverance it can be done." - **Hunter L. Johnson**, LINC's President and CEO

Roger's Gardens

Roger's Gardens, an Orange County, California home and garden center, has implemented a sustainability program that covers every aspect of their operations. In 2012, the company installed a 15-kW ClearEdge Power fuel cell system – choosing the fuel cell since it would efficiently deliver clean and cost-effective power and its compact design would not detract from the facility's landscaping. Because the fuel cells operate at up to 90% efficiency, Roger's Gardens is able to reduce the amount of fuel required to power their facility while reducing carbon dioxide emissions by 41%. Byproduct heat is used for the nursery's orchid area, creating further savings. The fuel cell system qualifies Roger's Gardens for substantial tax credits and rebates for energy upgrades.



15 kW PEM

Up to 90% efficiency

41% CO_2 reduction

17.2 ton GHG reduction

Saves $13,000/year in energy costs

"The ClearEdge system delivers cost-effective clean energy that helps us increase efficiencies and reduce our environmental footprint. In addition, its compact design means it does not impact the consumer experience that has made our store a destination for home and garden enthusiasts for more than 35 years." - **Gavin Herbert, Jr.**, co-owner of Roger's Gardens

Sharks Sports & Entertainment

The San Jose Sharks, part of the National Hockey League (NHL), are now one of the "greenest" sports franchises in the U.S. thanks to two Bloom Energy fuel cell installations. Last year, the Sharks announced a 500 kW fuel cell system would be installed at Sharks Ice, the team's practice arena in San Jose, California. That system is now operational, and will generate 85% of the building's energy needs on average. Recently, the Sharks announced a second fuel cell installation at HP Pavilion in downtown San Jose, which means that the team can remain cleanly powered come game time. This most recent installation is 400 kW and will replace 90% of the 450,000 sq. ft. arena's power during non-event hours and 25% on game days. The fuel cell system will save 4.8 million lbs. of CO_2 over a 10-year period.

900 kW SOFC

85% of power (at practice facility)

90% of power (at arena – non-event hours)

Toyota Motor Sales U.S.A.

In October 2012, Toyota Motor Sales U.S.A. commissioned a 1.1 MW Ballard Power Systems ClearGen™ fuel cell system at the company's sales and marketing headquarters campus in Torrance, California. Toyota can now meet peak and mid-peak power needs using electricity from either the clean energy fuel cell system or from the power grid. Hydrogen fuel is delivered to the fuel cell system via an existing hydrogen pipeline, which also supplies a local fuel cell vehicle fueling station, and is offset with the purchase of landfill biogas. The installation received funding from Sustainable Development Technology Canada (SDTC), a non-profit corporation funded by the Government of Canada, and through California's SGIP.

1.1 MW PEM

Directed biogas

"Reducing our demand for electricity from the utility will create an estimated savings of one hundred thousand dollars each summer, while at the same time reducing our environmental footprint." - **Doug Beebe**, Toyota Administrative Services Corporate Manager

VIII. Planned Forklift Deployments

Lowe's

Lowe's has signed a five-year contract with Plug Power to set product pricing and service terms for 161 GenDrive® fuel cells for lift trucks for its new distribution center in Rome, Georgia.

Mercedes-Benz U.S. International

Mercedes Benz has purchased 72 Plug Power GenDrive® fuel cell units to operate its Hyster electric lift truck fleet in its Tuscaloosa, Alabama, production facility. With this conversion, Mercedes-Benz is able to eliminate its battery room and open valuable floor space for storing and moving product. This is not Mercedes' first fuel cell purchase – in 2000, the site installed a 250-kW, natural-gas fed FuelCell Energy power plant that fed the facility's power distribution system.

Procter & Gamble

Procter & Gamble is converting its battery-operated forklift fleets to fuel cell power at four of its facilities – one each in California, North Carolina, Pennsylvania and Louisiana. 340 forklifts will be powered by Plug Power GenDrive® fuel cells. Other sites are being studied for future conversions.

> *"Fuel cell forklifts can be a financially attractive proposition that increase productivity while helping us reach our sustainability vision. Our internal analysis shows that we can not only achieve the sustainability benefits, but can also achieve an attractive rate of return on our investment at the same time. This is just another step on our environmental sustainability journey. Two additional sites are in the advanced study phase for conversion, and we'll continue to look for opportunities like this where innovation has made going green a win for our shareholders as much as it has the environment."* – **Stefano Zenezini**, Vice President, Global Family Care Product Supply and Global Product Supply Sustainability

Stihl, Inc.

German power tool manufacturer Stihl has ordered Plug Power GenDrive® fuel cells to be used in 75 forklifts at its Norfolk, Virginia, warehouse. The order from Stihl is important since the company uses its North American deployment as a benchmark for future European facility conversions.

Appendix A – Fuel Cells Benefit Local Government and Services

Businesses aren't the only ones to benefit from fuel cells. Local governments, universities, utilities and hospitals are finding that fuel cells can meet their needs, too. These organizations are assessing the business case – which must be justified to taxpayers, ratepayers or board members – and have found that fuel cells can deliver cost-savings, energy efficiency improvements, and greenhouse gas emission reductions that go a long way toward meeting their sustainability goals. Below we profile several recent sites that made plans for fuel cells during the past year.

California State University, East Bay – Hayward, California

In June 2010, Pacific Gas and Electric Company (PG&E) ordered a 1.4 MW FuelCell Energy DFC1500 fuel cell power plant to install as utility-owned fuel cells at the campus of California State University East Bay – Hayward Hills (CSU – East Bay). Installed in 2012, the fuel cell power plant is configured to utilize the fuel cells' waste heat for heating a swimming pool and utilize the waste water for landscape irrigation.

California State University, San Bernardino and Long Beach Campuses

Two 1.4 MW FuelCell Energy combined heat and power fuel cell systems, one each at CSU-San Bernardino and CSU-Long Beach, are being installed under the Southern California Edison Fuel Cell Project. The fuel cells will interconnect and operate in parallel with Edison's distribution system. The first fuel cell system was recently installed at CSU-San Bernardino.

City Hall – New York City, New York

Community Board 1 had approved the installation of 158 rooftop solar panels at New York's City Hall, but later these were determined to be more costly than a fuel cell. The solar array would also have also generated only enough power for one-half of one floor in the building. Plans were changed in 2011 in favor of a 100-kW SOFC, using natural gas as its feedstock. Once installed, the fuel cell is expected to save the city $45,000 in annual energy expenses.

City Hall and Hall of Records – New Haven, Connecticut

A 400-kW UTC Power fuel cell system, located behind City Hall, began operating in July 2012. It generates all the needed power and a portion of the heating and cooling required by both the City Hall and the Hall of Records. This is New Haven's fifth fuel cell – others include: Roberto Clemente Leadership Academy and Hill Central School; Yale University's Environmental Science Center and Peabody Museum; the New Haven Water Pollution Control Authority's treatment plant; and 360 State Street, a residential and retail high-rise building. The fuel cell system is expected to save the City of New Haven $2 million over 10 years.

CTTransit - Hartford, Connecticut

CTTransit will install a 400-kW UTC Power PureCell® stationary fuel cell system to generate power for its headquarters facility in Hartford, Connecticut. Thermal energy from the fuel cell will pre-heat two boilers that support the building's primary heating system. The system will prevent the release of more than 827 metric tons of CO2 annually and will save 3.6 million gallons of water per year. The project is supported by a grant from the Transit Investments for Greenhouse Gas and Energy Reduction Program (TIGGER-run by the Federal Transit Administration and a part of the ARRA of 2009). CTTransit also operates a fleet of five fuel cell-powered buses in regular transit service.

Delmarva Power – Newark, Delaware

Bloom Energy has installed a 3-MW fuel cell system at Delmarva Power's Brookside Substation that feeds power into the electric grid. In total, Delmarva Power will deploy 30 MW of Bloom Energy Servers – the largest utility-scale fuel cell deployment in the U.S. – which is enough to power about 22,000 homes. The fuel cells will help Delmarva Power meet the state's Renewable Portfolio Standard requirement for clean energy. Bloom Energy is also building a fuel cell manufacturing plant on the University of Delaware's Science, Technology and Advanced Research (STAR) Campus. The installation is expected to decrease CO2 emissions by about 50% compared to Delaware's electric grid and virtually eliminate NOX and sulfur oxide (SOX) emissions. Additionally, the fuel cell system will use less than 0.002% of the water required by conventional power plants.

Eastern Connecticut State University – Willimantic, Connecticut

In September 2012, under a 10-year Energy Services Agreement, the university started up its UTC Power 400-kW PureCell fuel cell system. Located outside of the University's LEED-certified Science Building, the fuel cell will provide a majority of the building's power and will provide supplemental heat. The system prevents the release of more than 1,356 metric tons of CO_2 annually and saves nearly 3.8 million gallons of water per year. The project is supported by a federal ARRA grant through Connecticut's CEFIA.

Inland Empire Utilities Agency – Chino, California

Inland Empire Utilities Agency (IEUA) installed a 2.8 MW FuelCell Energy fuel cell system in 2012 at its water recycling facility in Chino, California, following an evaluation of alternatives to their existing biogas fueled internal combustion engines. IEUA reported that increasingly stringent emission permitting requirements by the South Coast Air Quality Management District (SCAQMD) influenced the switch to fuel cells. The agency signed a 20-year PPA with UTS BioEnergy to install, operate and maintain the fuel cell system, which is fueled primarily with renewable biogas, and will purchase the power generated from the fuel cell plant at the agreed upon price over the 20 year period. Heat generated by the fuel cells will heat the facility's anaerobic digesters.

San Jose/Santa Clara Water Pollution Control Plant – San Jose, California

A 1.4-MW FuelCell Energy DFC1500 power plant was installed in 2012 at the San Jose/Santa Clara Water Pollution Control Plant. The fuel cell is owned by UTS BioEnergy, which sells energy produced by the fuel cell to the Water Pollution Control Plant under a long-term purchase agreement. About two-thirds of the energy used at the facility comes from methane produced in the site's anaerobic digester and from landfill processes.

St. Francis Hospital – Hartford, Connecticut

St. Francis Hospital installed its second fuel cell in 2012, a UTC Power PureCell 400 fuel cell system that will provide power to the Mount Sinai Rehabilitation Hospital campus. The 400-kW system will provide almost half of the building's electrical needs and thermal energy. The hospital installed its first fuel cell in 2003, a 200-kW UTC Power fuel cell that provides power security to the operating room and is interconnected with hospital's distribution and air conditioning system. St. Francis Hospital's new fuel cell will prevent the release of more than 383 metric tons of CO_2 annually.

University of Connecticut, Depot Campus – Mansfield, Connecticut

In April 2012, the University of Connecticut (UConn) began using a fuel cell power plant to supply energy, heat, and cooling to buildings at the Depot campus. The 400-kW UTC Power PureCell fuel cell system provides energy to all buildings on the Depot campus, including important research laboratories and offices at UConn's Center for Clean Energy and Engineering and the Longley Building. Using the fuel cell to generate power onsite will prevent the release of more than 831 metric tons of CO_2 annually.

Washington Gas – Springfield, Virginia

In April 2012, WGL Holdings announced a 200-kW natural gas-powered Bloom Energy SOFC had been installed at the new, LEED certified Washington Gas Springfield Center. The fuel cell runs round-the-clock and meets approximately 35% of the site's baseload power needs. By using the fuel cell, CO_2 will be reduced by approximately 50% compared to the grid.

Western Connecticut State University – Danbury, Connecticut

WCSU's new science building will be completely powered by a natural gas-powered UTC Power fuel cell that is scheduled to begin operation in December 2012. The fuel cell will provide 100% of the building's needed power and byproduct heat for heat and hot water. In the summer the fuel cell will dehumidify the building. The university anticipates annual savings of $30,000 as a result of using the fuel cell system.

Appendix B – Fuel Cell Customers

Companies

Ace Hardware
Adobe
Albertsons Supermarket
Apple
ASHTA Chemicals
AT&T
Baldor Specialty Foods
Bank of America
Becton Dickinson (BD)
BMW
Bridgestone-Firestone
Cabela's Sporting Goods
Carla's Pasta
Cache Creek Casino Resort
CBS
Cellcom
Central Grocers
Chevron
Coca-Cola
Cox Communications
CVS
Diversey
EARP Distribution
East Penn Manufacturing Co.
eBay
FedEx
Fireman's Fund
First National Bank of Omaha
Fresh & Easy
Fujitsu
Gills Onions
Golden State Foods
Google
Guaranty Savings & Loan
Hartford Life
H-E-B
Hilton Hotels
Inland Cold Storage
Kaiser Permanente
Kimberly-Clark
Kroger
Lafayette Hotel
Lowe's
Martin-Brower
Mercedes-Benz
MetroPCS
Napa Wine Company
NBCUniversal
Nestlé Waters
News Corp.
Nissan North America
NTT Communications
Odwalla
Owens Corning
Pepperidge Farm
Pratt & Whitney
Price Chopper
Procter & Gamble
Safeway
Sierra Nevada
Shark's Ice
Sheraton
Sprint Nextel
Staples
Star Market
Stone Edge Farm
Stop & Shop
Super Store Industries (SSI)
Sutter Home Family Vineyards
Sysco
Testa Produce
The Palace apartments
Time-Warner Cable
T-Mobile
Union Pacific Railroad
United Natural Foods Inc. (UNFI)
United Parcel Service (UPS)
Universal Studios Hollywood
U.S. Foodservice
Verizon
Wakefern Food Corp.
WalMart
Wegmans
Westin Hotels
Whole Foods Market
WinCo

State and Local Governments

City of Columbia Radio Network (SC)
Dublin San Ramon Services District Regional Wastewater Treatment Facility (CA)
East Anaheim Police Department/Community Center (CA)
Eastern Municipal Water District – Moreno Valley & Perris Valley Regional Water Reclamation Facilities (CA)
Fairfield Water Pollution Control Authority (CT)
Hartford Public Safety Complex (CT)
Inland Empire Utilities Agency (CA)
New Haven City Hall and Hall of Records (CT)
New Haven Water Pollution Control Authority (CT)
New York City – Central Park Police Precinct (NY
New York City – City Hall (NY)
New York Power Authority Office Building (NY)
New York Power Authority – 26th Street, Hunt's Point, Oakwood Beach, & Red Hook Water Pollution Control Plants (NY)

Schools

California Institute of Technology
California State University
Central Connecticut State University
East Rochester Elementary School (NY)
Hamden High School (CT)
Liverpool High School (NY)
Middletown High School (CT)
Pasadena City College (CA)
Portland Community College (OR)
Roberto Clemente Leadership Academy & Hill Central School (CT)
San Diego State University (CA)
San Francisco State University (CA)
South Windsor High School (CT)
State University of New York (NY)
Union College (NY)
University of California – Santa Barbara
University of Connecticut
University of Delaware
University of South Carolina
Western Connecticut State University
Woodbridge High School (CA)
Yale University (CT)

Utilities / Power Generation

American Electric Power (OH)
Delmarva Power (DE)
Dominion Power (VA)
Edgecombe-Martin Electric Membership Cooperative (NC)
Electric Power Board (TN)
FirstEnergy Corp. (OH)
NextEra Energy Resources (CA)
Pepco (MD)
Pacific Gas & Electric (PG&E) (CA)
Piedmont Electric Membership Cooperative (NC)
Southern California Gas (CA)
Washington Gas (VA)

Hospitals

Stamford Hospital (CT)
St. Francis Hospital (CT)
St. Helena Hospital (CA)
Waterbury Hospital (CT)

Museums / Zoos / Conservatories / Science Centers

Bronx Zoo (NY)
Chewonki Center for Environmental Education (ME)
Connecticut Science Center
Henry Doorly Zoo (NE)
New York Aquarium
Phipps Conservatory and Botanical Garden (PA)
Yale Peabody Museum (CT)

Federal Agencies

Argonne National Laboratory / U.S. Department of Energy
Defense Logistics Agency/U.S. Department of Defense
Federal Aviation Administration / U.S. Department of Transportation
NASA
National Park Service / U.S. Department of the Interior
U.S. Air Force
U.S. Army
U.S. Marine Corps
U.S. Navy

Transit Agencies / Shuttle Operators

AC Transit (CA)
Birmingham-Jefferson County Transit Authority (AL)
BurbankBus (CA)
Capital Metro (TX)
Chicago Transit Authority (IL)
CTTransit (CT)
Greater Cleveland Regional Transit Authority (OH)
Marin Transit (CA)
Massachusetts Port Authority
Ohio State University
Santa Clara Valley Transportation Authority (CA)
SunLine Transit (CA)
University of Delaware

Appendix C – Additional Resources

Fuel Cells 2000

For newcomers to the fuel cell world, Fuelcells.org explains the basics such as how a fuel cell works, applications, benefits, and offers an abundance of free resources such as original articles, presentations, the Fuel Cell Library, and a free monthly Technology Update. In addition, the website includes:

- Reports, including State of the States: Fuel Cells in America 2012 and the 2011 Fuel Cell Technologies Market Report
- Industry & Markets section, featuring the Fuel Cell Top 200, a searchable directory of the most active fuel cell companies around the world.
- State Fuel Cell and Hydrogen Database, which includes all US fuel cell installations, vehicle demonstrations, hydrogen fueling stations and state legislation and policies, including tax credits and grants: www.fuelcells.org/fuel-cell-databases/
- Worldwide Stationary Installation Database: www.fuelcells.org/fuel-cell-databases/
- Comprehensive charts, including Fuel Cell Vehicles, Specialty Vehicles, Fuel Cell Buses, Hydrogen Fueling Stations (U.S. and World) and Fuel Cell Equity and Investment: www.fuelcells.org/resources/charts/

Seeing is Believing: Fuelcells.org has many tools to help visualize the progress of the fuel cell industry

U.S. Department of Energy's Fuel Cell Technologies Program
www1.eere.energy.gov/hydrogenandfuelcells
The U.S. Department of Energy Fuel Cell Technologies Program within the Office of Energy Efficiency and Renewable Energy supports research addressing the technological, economic, and institutional obstacles to the widespread commercialization of fuel cells and related technologies.

The site has information on the program and industry in general, including technical and educational reports, presentations, fact sheets and links.

Fuel Cell and Hydrogen Energy Association
www.fchea.org
Trade association for the hydrogen and fuel cell industry. Members include fuel cell manufacturers, component suppliers, fuel providers, universities and other companies involved in the industry.

U.S. Fuel Cell Manufacturers

Altergy Systems	www.altergy.com
Bloom Energy	www.bloomenergy.com
ClearEdge Power	www.clearedgepower.com
FuelCell Energy	www.fuelcellenergy.com
IdaTech	www.idatech.com
Oorja Protonics	www.oorjaprotonics.com
Plug Power	www.plugpower.com
ReliOn	www.relion-inc.com
UTC Power	www.utcpower.com

Many other fuel cell companies are offering products and services. For list of the most active, visit http://www.fuelcells.org/top-200/.

Hydrogen Infrastructure Companies Listed In This Report

Air Liquide	www.us.airliquide.com
Air Products and Chemicals, Inc.	www.airproducts.com
Linde North America LLC	www.linde.com

For more information about any of the information included in this report, please contact Fuel Cells 2000 at info@fuelcells.org.

Appendix D – Fuel Cell-Powered Forklifts in North America

Company	Location	Site	Year Deployed	Fuel Cell Manufacturer	No. of Forklifts
Ace Hardware	Sacramento, CA	Warehouse	2008	Plug Power	6
Baldor Specialty Foods	Bronx, NY	Facility	2012	Oorja Protonics	50
BMW Manufacturing Co.	Spartanburg, SC	Manufacturing plant	2010, additional units purchased in 2012	Plug Power	230+
Bridgestone-Firestone	Aiken County, SC	Manufacturing plant	2008, more added 2009	Plug Power	43
	Warren County, TN	Manufacturing plant	N/A	Plug Power	N/A
Central Grocers	Joliet, IL	New distribution center	2009, more added 2011	Plug Power	234
Coca-Cola	San Leandro, CA	Bottling and distribution center	2011	Plug Power	56
	Charlotte, NC	Bottling facility	2011	Plug Power	40
CVS Caremark	Chemung, NY	Distribution facility	Under construction	N/A	N/A
	North Smithfield, RI	Distribution facility	N/A	N/A	N/A
Defense Logistics Agency, U.S. Department of Defense	San Joaquin, CA	Distribution depot	Planned	Plug Power	20
	Fort Lewis, WA	Distribution depot	Planned	Plug Power	19
	Warner Robins, GA	Distribution depot	2010	Hydrogenics	20
	Susquehanna, PA	Distribution depot	2009, 2010	Nuvera, Plug Power	55
EARP Distribution	Kansas City, KS	Distribution center	2011	Oorja Protonics	24
East Penn Manufacturing	Topton, PA	Manufacturing facility	N/A	Nuvera	10
FedEx	Springfield, MO	Service center	2010, ARRA funding awarded to FedEx Freight East for 35; 5 more purchased without DOE funding	Plug Power	40
	Toronto, ON, Canada	Logistics hub	N/A	Hydrogenics	N/A
GM	Oshawa, ON, Canada	Car assembly plant	N/A	Hydrogenics	19

	Oshawa, ON, Canada	Car assembly plant	2005	Hydrogenics	2
Golden State Foods	Lemont, IL	Distribution facility	2011	Oorja Protonics	20
H-E-B	San Antonio, TX	Perishables distribution center	2009, ARRA funding	Nuvera	14
ISOLA Laminates	Ridgeway, SC	Warehouse	2007, 2-week demonstration	Hydrogenics	2*
Kimberly-Clark/GENCO	Graniteville, SC	Distribution center	2010, ARRA funding awarded to GENCO	Plug Power	25
	Graniteville, SC	Distribution center	GENCO operating a fuel cell forklift pilot program	N/A	2*
Kroger Co.	Compton, CA	Distribution Center	Purchased 2011	Plug Power	161
Leigh Fibers	Spartanburg, SC	Warehouse	2007, 2-week demonstration	Hydrogenics	2*
Lowe's	Rome, GA	Distribution Center	Planned for 2013	Plug Power	161
LPC	Lodi, CA	Warehouse	2009	Oorja Protonics	N/A
Martin-Brower	Stockton, CA	Food distribution center	2010, 2011 add-on order converted entire Stockton pallet jack fleet	Oorja Protonics	15, 2nd order - N/A
Mercedes-Benz	Tuscaloosa, AL		2012	Plug Power	72
Michelin	Columbia, SC	Manufacturing plant	2007, 2-week demonstration	Hydrogenics	2*
Nestlé Waters	Dallas, TX	Bottling facility	2009	Plug Power	32
New United Motor Manufacturing, Inc. (NUMMI)	Fremont, CA	Manufacturing plant	2007	Oorja Protonics	N/A
Nissan North America	Smyrna, TN	Assembly plant	Purchase in 2009, 18-month field trial beforehand	Oorja Protonics	60
	Smyrna, TN	Assembly plant	2007, 5-month demonstration	Plug Power	N/A
Ozburn-Hessey Logistics	Smyrna, TN	Warehouse	2004	Ballard Power Systems	4

PBR	West Columbia, SC	Warehouse	2007, 2-week demonstration	Hydrogenics	2*
Procter & Gamble	CA, LA, NC, PA	Facilities	Purchased 2011	Plug Power	340
The Raymond Corp.	Greene, NY	Manufacturing facility	2007	Plug Power	N/A
Stihl Inc.	Norfolk, VA	Facility	Order announced in 2012	Plug Power	75
Super Store Industries	Lathrop, CA	Warehouse freezer	2009	Oorja Protonics	75
Sysco	Riverside, CA	Distribution center	Purchased 2011	Plug Power	80
	Boston, MA	Distribution center	Purchased 2011	Plug Power	160
	Long Island, NY	Distribution center	Purchased 2011	Plug Power	42
	San Antonio, TX	Distribution center	Purchased 2011	Plug Power	113
	Front Royal, VA	Redistribution facility	2011	Plug Power	100
	Philadelphia, PA	Distribution center	2010, ARRA funding awarded to GENCO	Plug Power	95
	Houston, TX	Distribution center	2010, ARRA funding awarded to Sysco Houston	Plug Power	98
	Vancouver, BC, Canada	Distribution center	N/A	Plug Power	N/A
	Canton, MI	Distribution center	2010, trial completed	Plug Power	45
	Grand Rapids, MI	Distribution center	2009, trial completed	Plug Power	30
Testa Produce	Chicago, IL	Distribution center	Order placed Nov. 2010	Oorja Protonics	20
Unified Grocers	N/A	Refrigerated food distribution facility	2011	Oorja Protonics	200
United Natural Foods, Inc. (UNFI)	Sarasota, FL	Distribution center	2010	Plug Power	65
U.S. Foodservice	Livermore, CA	Distribution facility	2010	Oorja Protonics	40
Wakefern Food Corp./Newark Farmer's Market	Newark, NJ	Distribution center	2011	Plug Power	193
Walmart	Balzac, AL, Canada	Refrigerated	2010	Plug Power	81

		distribution center			
	Cornwall, ON, Canada	Distribution center	Planned	Plug Power	174
	Washington Court House, OH	Food distribution center	2007	Plug Power	254
	OH	Two distribution centers	2006	Plug Power	14
	MO	Distribution center	2005	Plug Power	4
Wegmans	Pottsville, PA	Warehouse	2010, ARRA funding awarded to GENCO	Plug Power	136
Whole Foods Market	Landover, MD	Distribution center	2010, ARRA funding awarded to GENCO	Plug Power	61
WinCo Foods, LLC	Modesto, CA	Distribution center	Purchased in 2011 – 82 operational, a total of 184 to be deployed in 2013	Plug Power	184

*2 forklifts were deployed in 2-week trials at several companies in the Charlotte, SC area
In 2008, Plug Power entered into an agreement with Ballard Power Systems to purchase fuel cell stacks for its electric lift truck applications
ARRA = American Recovery and Reinvestment Act