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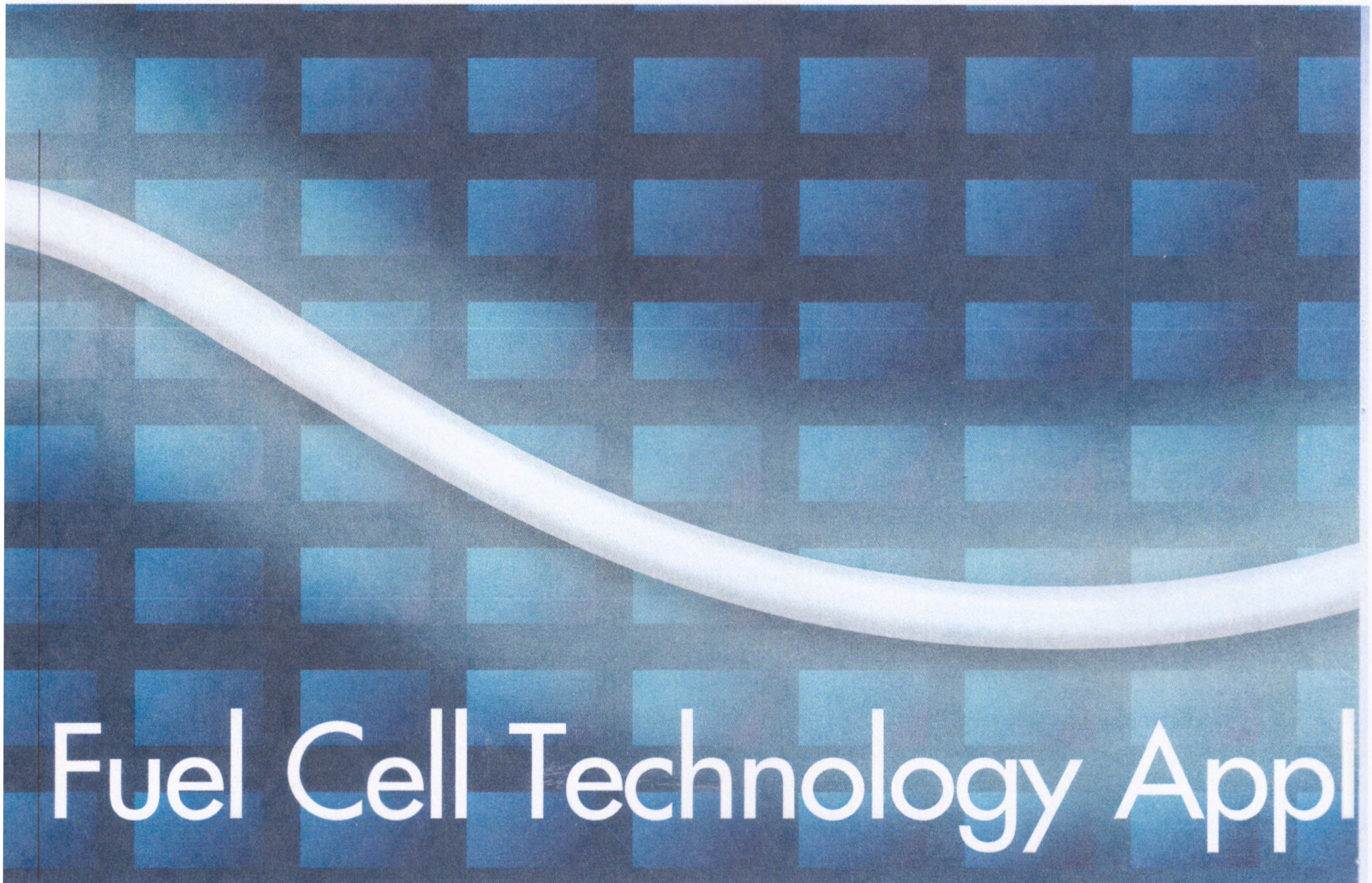
# 2014 BUYER'S GUIDE ISSUE

*Our annual directory of manufacturers, suppliers and service providers specializing in housing and community development*



# Fuel Cell Technology Appl

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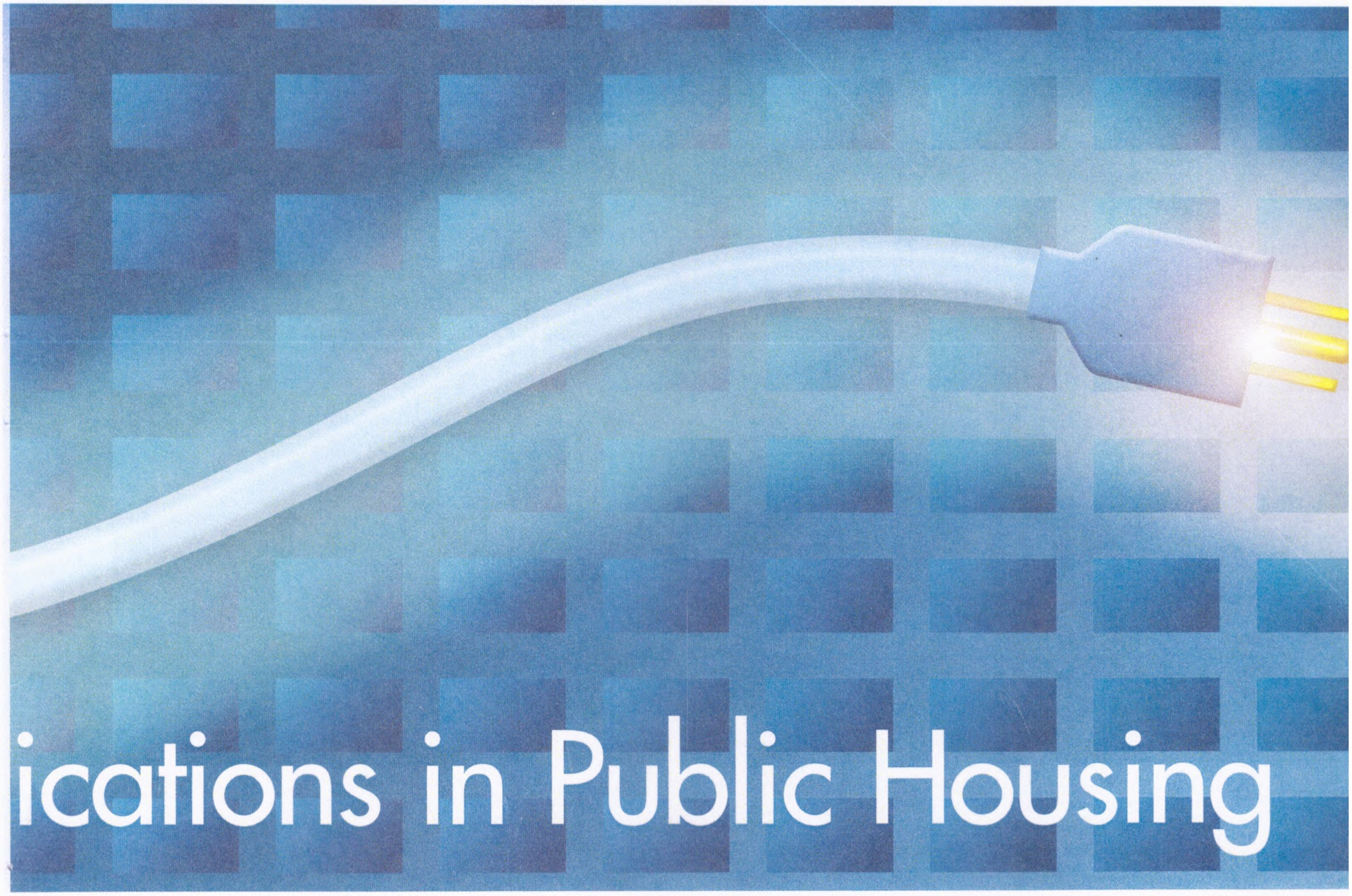
ENERGY EFFICIENCY and alternative power generation are critical to sustainability and resiliency. In HUD's 2012 Report to Congress, Secretary Shaun Donavan said that "Energy efficiency, and more broadly green building, continues to be a top priority at HUD. We know that energy-efficient homes can be more affordable, durable, comfortable, and often healthier than less efficient homes, and I am especially concerned about the burden of energy costs on low- and moderate-income renters and homeowners." One sustainable energy technology attracting increased attention for its efficiency and environmental performance is the fuel cell.

## What Is a Fuel Cell?

A fuel cell is an electrochemical device that converts chemical energy from a fuel (e.g., natural gas) into electricity with water and heat as a by-product. Unlike previous electrical generators/engines, which combusted (burned) the fuel and produced significant emissions, the electrochemical process in today's fuel cells produces heat, water, and low to negligible levels of $CO_2$, NOx and SOx compared to utility fossil fuel generation.

A fuel cell has a structure similar to a battery, with an anode, a cathode, and a catalyst. However, battery stores electricity, while a fuel cell generates electricity from fuel. Fuel cells are designed to run continuously, providing a consistent, stable power supply without requiring recharging, like a battery. Some fuel cells provide only electricity, while others produce electricity and heat for applications including heat and hot water.



# ications in Public Housing

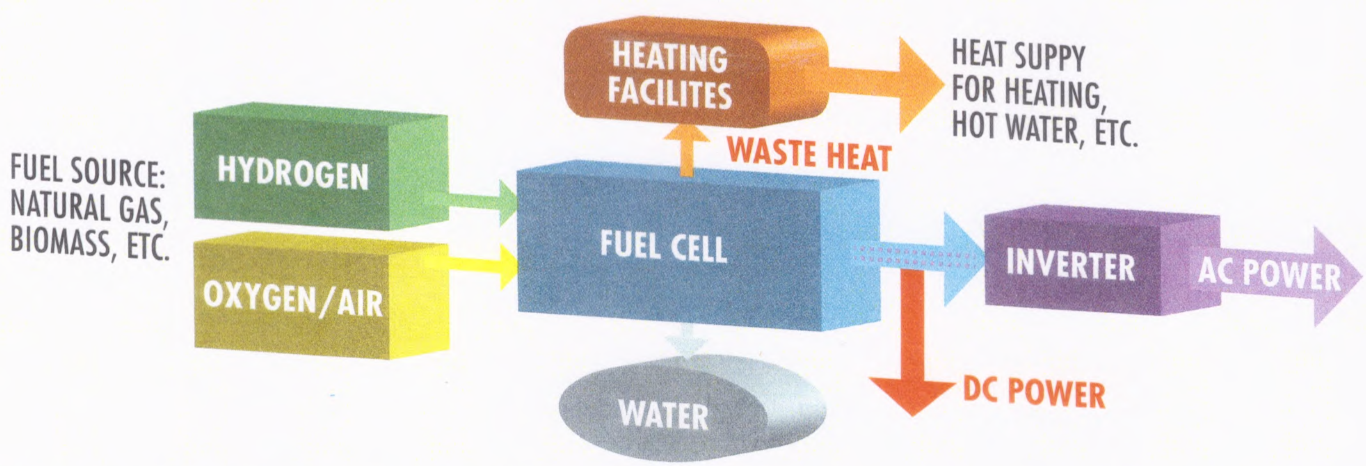



Figure 1. Fuel Cell Used in CHP Applications

Fuel cells producing both electricity and heat (Figure 1) are commonly referred to as Cogeneration or Combined Heat and Power (CHP). As long as a constant source of fuel and oxygen/air to sustain the chemical reaction is supplied, a fuel cell can run without interruption.

Individual fuel cells can be *stacked*, or placed in series, to increase the energy generated and meet customer demand requirements. The electrical efficiency of a fuel cell is between 40–60 percent, or up to 85 percent efficient in cogeneration or CHP mode if waste heat is captured for use. Because fuel cells have few moving parts and do not involve combustion, in ideal conditions with proper operations and maintenance they can achieve up to 99.9 percent reliability.

**Because fuel cells have few moving parts and do not involve combustion, in ideal conditions with proper operations and maintenance they can achieve up to 99.9 percent reliability.**

Fuel cells offer dense energy production. From a space comparison standpoint, a solar power plant of similar capacity (200 kilowatt (kW), 400k watt (W), and 1.4 megawatt (MW)) would occupy approximately 1.6 acres, 3.2 acres and 12 acres respectively, providing fuel cells a distinct advantage for power density in urban environments.

Fuel cells generate electricity with low harmful emissions compared to today's grid, which utilizes a combination of nuclear, coal, gas-fired and renewable generation. Fuel cells can cut 40 percent–100 percent of emissions vs. the grid depending on what fuel source is utilized.

In addition to the environmental savings, PHAs will also experience productivity improvements, to include: time, cost and manpower savings. No other energy generating technology offers the

| Fuel Cell Type | Module/ System Size | Rated Baseload System Size for comparison (in kW) | Output kWh for electricity and Btu/hr for heat | Physical Space Required (including service area) |
|---|---|---|---|---|
| **ELECTRICITY ONLY** | | | | |
| Solid Oxide | 200kW System; 100kW increments | 200kW | 1,660 MWh/yr<br>No heat | 27′ x 9′ |
| **ELECTRICITY AND HEAT (CHP)** | | | | |
| Combined Heat and Power (CHP) | 1. 1,400 kW System<br>2. 2,800 kW System | 1,400 kW<br>2,800 kW | 11,600 MWh/yr and 3,730,000 Btu/hr heat @ 120º<br>23,200 MWh/yr and 7,460,000 Btu/hr heat @ 120º | 58′ x 42′ (may require added access space)<br>60′ x 55′ (may require added access space) |

Table 1. Typical System Size, Output and Required Space Used in Residential Buildings

**One hundred percent reduction can be achieved through directed bio gas, but on average, utilizing natural gas as the feed-stock, today's fuel cells emit the following representative emissions:**

$CO_2$: Range from 495 lbs (w/heat recovery) to 1,049 lbs (w/o heat recovery for CHP) per megawatt hour (MWh)

NOx: Range from < .01 to .02 lbs per MWh

SOx: Range from negligible < to .0001 lbs per MWh

**Fuel cells are quiet compared to traditional generator technologies. They include the following representative noise levels:**

| | | |
|---|---|---|
| Solid Oxide Fuel Cell: | 200 kW: | < 70 A-weighted decibels (dBA) at 6 ft. |
| CHP Fuel Cell: | 1,400 kW: | 65 dBA at 10 ft. (w/option) or 72 dBA at 10 ft. |

**For comparison and context, here are some common noise levels:**

| | |
|---|---|
| Normal conversation: | 60 dBA at 3 ft. |
| Highway: | 70 dBA at 100 ft. |
| Generator: | up to 89 dBA from 50 ft. (without silencers). |

product range and combination of benefits produced by fuel cells.

## How Long Have Fuel Cells Been Around?

The first fuel cell was invented in 1838. The first commercial use of fuel cells came more than a century later in space programs to generate power for probes, satellites and space capsules. For the last 20 years, fuel cells have been used for primary and backup power for commercial, industrial, and residential buildings and in remote or inaccessible areas.

Fuel Cells 2000, a non-profit education and outreach program, estimates that at year-end 2013, there were at least 170MW of fuel cells installed in facilities throughout the U.S providing primary or backup power. It is estimated that the global fuel cell market revenue will reach $2.5 billion by 2018. The unit shipments of fuel cells across all sectors/applications are expected to increase from 24,500 units in 2012 to 1,127,560 units by 2018. Where the cost of primary energy, and the need for backup supply are of paramount importance, the flexibility of fuel cells for size, power and applications make them worth considering.


SOURCE: FUEL CELL TODAY - INDUSTRY REVIEW 2012

Figure 2. Pictured above, projected increase in Megawatts growth generated by fuel cells in the areas of portable use (auxiliary power units), stationary (fixed locations-buildings), and transport (vehicles).

> Fuel cells generate high quality electricity power quietly with reduced emissions, which is extremely important for mission-critical applications such as banking and hospitality operations, and data centers.

## Weathering the Storm with Fuel Cell Technology

Recent powerful storms in the United States underscored the need for resilient and reliable power sources. The ability of weather-related disasters to knock out power lines and cripple communities became abundantly clear during 2013's Super Storm Sandy. Resiliency has jumped to the top of the wish list for companies when it comes to technology purchases. Fuel cells can be configured to be grid-independent, which is invaluable when the power goes out in a city or town. The following cases exemplify the resilient and reliable backup capability of fuel cells:

- **Delmarva Power** operates 30 MW of natural gas-powered fuel cell servers at two substations, enough to power about 22,000 homes, for its Delaware customers. This is the largest utility-scale deployment of fuel cell technology in the U.S. The solid oxide fuel cell units performed without trouble during Super Storm Sandy, delivering continuous and reliable power to the grid. Recently, the CEO of Delmarva Power's parent company, Pepco Holdings, spoke about the possibility of placing more solid oxide fuel cells in the regional grid to shore up reliability during natural disasters.
- The **Sheraton New York Hotel and Tower** has a 250 kW fuel cell that has provided electricity and heat since 2005. Power from the system can be diverted to emergency lights on 20 floors of the hotel if a blackout occurs.
- The **Central Park Police Station** was not aware there was a widespread power outage in New York City, during the 2003 Northeast blackout. The building was the only place with power, thanks to the station's 200-kW fuel cell that operates independent from the grid.
- During Hurricane Irene, back-up power fuel cells owned by **Sprint** and installed at select locations provided continuous backup power, keeping communications lines open. A **Whole Foods** location impacted by the hurricane's path prevented major food spoilage thanks to the fuel cell that kept its coolers operating during that storm.



## Fuel Cell Applications for PHAs

Fuel cells generate high quality electricity power quietly with reduced emissions, which is extremely important for mission-critical applications such as banking and hospitality operations, and data centers. These businesses require a power supply free of the surges, spikes, and outages that can disrupt transaction processing and can cost a company millions of dollars per hour. Until recently, fuel cells have been primarily marketed commercially to retail sites, distribution centers, data centers, and defense and intelligence centers. However, fuel cells can deliver this same level of continuous power, safety and security to public housing residents. Initial discussions with the New York City Housing Authority and other area housing authorities have generated interest due to the high cost of electricity in and the need for reliable backup power. The examples above show how fuel cells performed in recent storm situations.

Fuel cells can provide primary power (base load), backup power and combined heat and power (CHP) to a PHA. Since they can be installed as either grid-independent or in grid-parallel mode, fuel cells can provide reliable power without disruption due to grid failure or blackouts, leveraging the reliability and stability of the natural gas pipeline infrastructure for a consistent feed-stock. When fuel cells are operated in grid-independent mode, the PHA can continue its basic operations by providing its residents electricity to maintain essential services such as refrigerators, elevators, pumps and lighting.

For PHAs looking for heat besides resilient power, CHP offers an added financial return for housing authorities, particularly regarding heat, hot water, and/or space heating. The byproducts

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CHP System.

200 million lbs. of $CO_2$ (as compared to the grid) over the 20-year PPA term. [1]

of CHP fuel cells include either useful low-heat value (LHV) or high-heat value (HHV) that can be harnessed to provide hot water or space heating to a facility, or run air conditioning systems and refrigeration units when integrated to such systems. This greatly increases overall energy efficiency, as a fuel cell operating in CHP mode can harness up to 90 percent of the energy in a fuel, while the electricity grid averages approximately a 33-40 percent efficiency factor for fossil-fuel fired generation. PHAs may generate almost 100 percent of their hot water needs from an on-site fuel cell while enjoying base load power at costs lower than utility/grid rates.

With hurricanes and other natural disasters causing power outages and network interruptions, plus the ever-growing demand for power, there is an increasing need for more reliable power than is available from the current electric grid, battery backup or diesel generator systems. Fuel cells designed and implemented in a multi-purpose fashion can serve both the base-load power needs and backup power needs for PHAs.

Fuel cell flexibility also encourages tandem arrangements with renewable energy systems. For example, 2.8MWs of fuel cells and 1.4 MWs of Solar photovoltaics were integrated into a single Power Purchase Agreement (PPA) solution for the County of Santa Clara by developer Alternative Energy Development Group (AEDG). The energy system will power all county operations, including the 911 communications center, numerous detention facilities, county offices, parks and airports for a 20-year term. The project, entering the construction phase in Q2 of 2014, includes nine county sites, over 25,000 MWh per year of electricity produced, projected cost savings of over $15,000,000, and projected carbon emission savings of over 200 million lbs. of $CO_2$ (as compared to the grid) over the 20-year PPA term. [1]

## How Do I Pay for Fuel Cell Technology?

### Fuel Cell Financing

How much does a fuel cell cost? That depends on capacity, application, installation requirements, available incentives and other factors. Most installations are not direct off-the-shelf purchases; many projects take advantage of financing mechanisms that use state and federal tax incentives. For public-sector entities, a Power Purchase Agreement (PPA) is a mainstay of the energy industry for securing financing for alternative and renewable energy projects. PPAs are not new to PHAs that rely on solar power as a supplement to their grid requirements. They provide the following major benefits to a PHA:

- Pre-defined price of electricity (dollars per kilowatt hour (kWh)) with a pre-defined price escalator is specified for a term of 10-20 years (providing budget certainty);
- On-site use of the system's waste heat (when applicable in need for a CHP solution);
- Systems are installed with no upfront capital (no capital expense for the PHA);
- System design, engineering, permitting, installation and utility interconnection are provided by the PPA owner;
- Operation and maintenance (O&M) costs are included for the duration of the contract; and
- Certain performance guarantees can provide a minimum kWh

[1] More information on this project is available at www.aedgonline.com/case-studies/santa-clara-county

performance threshold.

For decades, utility companies, as buyers, have led the way in the utilization of PPAs to buy energy from independent producers who own large-scale generation projects (i.e., fuel cell, wind, solar PV, microturbines, etc.). The availability of this form of energy procurement, under long-term contracts, has evolved to now include commercial, non-profit, public-sector and residential buyers. Third party financing vehicles, including PPAs, account for over 60 percent of renewable and alternative energy projects in the United States. An agreement (the PPA) unique to the specific project is established between the producer/seller and the PHA. *The producer is the entity that owns the system asset and generates the electricity sold to the PHA, which is paid for on a price per kWh delivered to the PHA.*

PPAs are inclusive of all costs and monitoring/management services, to include the ongoing Operations and Maintenance (O&M) costs for the full term of the agreement. It has become standard practice for the producer to contract directly with the manufacturer or the project developer to provide the O&M services for the term of the PPA. As a great result, all parties involved in a project have a vested interest in the quality of the product, its timely installation, and ongoing uptime and support. The producer (often the owner and operator) is financially incentivized to ensure the system delivers the maximum possible kWhs each year of the term. Meanwhile, the PHA, who has contracted for up to 100 percent of their annual electricity requirements at a known price during the full term of the PPA, has a financial incentive to select the best possible solution and PPA provider.

Many states offer tax credits and funding.

The net is PPAs are often a win-win for the PHA and producer and frequently ensure that viable generation projects get built. They are often seen as the key document in developing independent generating assets. This has the added benefit of producing affordability and stability to projects of all sizes and types.

Leasing is a second viable financing alternative for PHAs. However, advanced leasing expertise, structures, and providers are typically required to monetize tax benefits in the structure, to deliver the strongest economic value to the PHA.

## HUD Energy Incentives

HUD has stated its commitment to the Climate Action Plan and more specifically the Better Building's Challenge by initiating a range of new steps geared towards achieving President Obama's goal of doubling energy productivity by 2030 relative to 2010 levels. Among the goals of the President's recent Climate Action Plan for 2020 is to begin *with cutting carbon pollution by changing the way we use energy—using less dirty energy, using more clean energy, wasting less energy throughout our economy.*

Fuel cell technology can be part of the solution that supports this goal—and, more the Better Buildings Challenge, which aims to help American commercial and industrial buildings become at least 20 percent more energy efficient by 2020. Fuel cells can support the federal government's mandate for clean energy. While Federal agencies have reduced greenhouse gas emissions by over 15 percent, fuel cell technology can assist in the Administration's goal to consume 20 percent of its electricity from renewable sources by 2020—more than double the current goal of 7.5 percent, while reducing greenhouse gas emissions and saving taxpayer dollars.

HUD energy incentives available to fuel cells include both the operating fund incentive (based upon reduced consumption) and the rate reduction (based upon reducing the electric rate). For PHAs with an existing energy performance contract (EPC), the rate reduction incentive often associated with a PPA could adversely affect the cash flow as part of an EPC. Alternate financing vehicles may be required as a solution to the rate dilemma for PHAs with an EPC. Besides the Federal goals for renewable/clean energy, PHAs must look to their state mandates and classifications that define the status of fuel cells regarding low-emission and/or renewable technology.

As part of HUD's commitment to the President's Climate Action Plan, fuel cells can play an important role in meeting the Department's Climate Change goals. Opportunities exist for working with HUD on meeting mutual goals through cooperation and flexible financing approaches with existing EPC incentives. Most important, HUD has demonstrated precedence and a willingness to explore and develop policy that incorporates new technology and innovative financing as demonstrated by the Multi-family Energy Innovation Grant Program.

### State Incentives

Many states also offer tax credits and funding. Some do this through state policy and legislation, such as California's its Self-Generation Incentive Program (SGIP), others via development agencies and public benefit funds, like the New York State Energy Research and Development Authority (NYSERDA), Massachusetts Green Energy Fund, the Connecticut Clean Energy Fund (CCEF) and the Pennsylvania PA Fuel Cell Incentive. New Jersey is the most recent state to offer fuel cell incentives. Most recently, the State of New Jersey joined this list of states to offer incentives. The following boxes provide a summary of these states' incentives. For more information, please see www.dsireusa.org.

## California

Initiated in 2001, the Self-Generation Incentive Program (SGIP) offers incentives to customers who produce electricity with wind turbines, fuel cells, various forms of combined heat and power (CHP) and advanced energy storage. For 2013, the incentive payments range from \$0.48/W–\$2.03/W depending on the type of system. Retail electric and gas customers of San Diego Gas & Electric (SDG&E), Pacific Gas & Electric (PG&E), Southern California Edison (SCE) or Southern California Gas (SoCal Gas) are eligible for the SGIP. Beginning in May 2012, all technologies previously eligible for the expired Emerging Renewables Program are now eligible for the SGIP program. Originally set to expire at the end of 2011, SB 412 of 2009 amended the Public Utilities Code to allow incentives to be available through January 1, 2016. Any program funding remaining after January 1, 2016 must be returned to the utilities to reduce ratepayer costs.

Systems less than 30 kW will receive their full incentive upfront. Systems with a capacity of 30 kilowatts (kW) or greater will receive half the incentive upfront, and the other half will be paid over the following five years based on the actual performance. The following technologies will receive the corresponding upfront incentive (or half of this figure if the system is 30 kW or larger):

- Emerging Technologies
- Fuel Cell - CHP or Electric Only - \$2.03/W

There is no minimum or maximum eligible system size, although the incentive payment is capped at 3 MW. Further, the first megawatt (MW) in capacity will receive 100 percent of the calculated incentive, the second MW will receive 50 percent of the calculated incentive, and the third MW will receive 25 percent of the calculated amount. Applicants must pay a minimum of 40 percent of eligible project costs (the biogas adder is not included in calculating the limit). Projects using the Federal Investment Tax Credit (ITC) must pay 40 percent of the eligible project costs after the ITC is subtracted from the project costs (i.e., the SGIP credit is limited to 30 percent of project costs).

PG&E, SCE, and SoCal Gas administer the SGIP program in their service territories, and the California Center for Sustainable Energy administers the program in SDG&E's territory. Customers of PG&E, SDG&E, SCE, and SoCal Gas should contact their program administrator for an application, program handbook, and additional eligibility information.

## Connecticut

In July 2011, Connecticut enacted legislation amending the state's Renewables Portfolio Standard and creating two new classes of renewable energy credits (RECs): Zero Emission Renewable Energy Credits (ZRECs) and Low Emission Renewable Energy Credits (LRECs).

The state's two investor-owned electric utilities, United Illuminating (UI) and Connecticut Light & Power (CL&P) must enter into 15-year contracts for RECs from low-emission Class I renewable energy facilities (on the customer side of the meter) up to 2 MW. The law establishes the emission criteria required to achieve low-emission facility status, but this category could include facilities that generate electricity using fuel cells, biomass or landfill gas. Resulting low-emission RECs (LRECs) may be used for RPS compliance during the year of generation or the subsequent year. Utilities are required to spend up to \$4 million on LREC contracts annually. The price cap of one LREC was \$200 in 2012 and 2013. The utilities jointly submitted their six-year solicitation plan in December 2011 and issued their first request for proposals (RFP) in May 2012. Winning bids are evaluated based on project quality, proposed ZREC or LREC price, and compliance with the RFP process. Bids are submitted online. Projects must be located in CL&P's or UI's service territory.

## Why PHAs Should Consider Fuel Cells

### Utility Cost Savings

Fuel cells can generate power at a cost competitive with grid electricity rates in states that offer Fuel

## New Jersey

The New Jersey Clean Energy Program (NJCEP) offers incentives for several types of small combined heat and power (CHP) and fuel cell systems that have a generating capacity of 1 MW or less and are located behind the meter of an existing electric or natural gas customer that pays the Societal Benefits Charge (SBC). This includes customers of the states' investor-owned electric and natural gas utilities, but does not include customers of municipal utilities. A variety of equipment and installation requirements exist for determining eligibility (details on the program website), but in addition to these limitations the program guidance specifically notes that the following types of systems are not eligible for incentives: renewable source-fueled systems; portable and emergency backup power systems; used, refurbished, temporary, pilot, or demonstration equipment; systems that use diesel fuel, other types of oil or coal for continuous operation. However, systems that use Class I renewable fuels (as defined under the New Jersey Renewable Portfolio Standard) are eligible under the separate Renewable Energy Incentive Program (REIP). The New Jersey Economic Development Authority (EDA) administers New Jersey's Large CHP and Fuel Cell Program, which offers incentives for systems sized greater than 1 megawatt (MW). The EDA also offers low-interest financing for the small CHP program through the Energy Efficiency Revolving Loan Fund.

## New York

Under a Program Opportunity Notice (PON) 2157 The New York State Energy Research and Development Authority (NYSERDA) offers incentives for the purchase, installation, and operation of customer sited tier (CST, also called behind the meter) fuel cell systems used for electricity production. Because such systems will help fulfill the CST component of the state RPS requirement, eligibility for incentives is generally limited to customers who pay the RPS surcharge on their electricity bills. Exceptions to this rule may be made on a case-by-case basis for projects that demonstrate significant public benefits consistent with program objectives. There are no minimum or maximum size limits for projects, though incentives will generally be granted only for installed capacity not exceeding the customer's electrical load. Exceptions to this rule may be made on a case-by-case basis and participants are permitted to install excess capacity at their own expense.

Incentive levels and limitations vary by system size. Bonus capacity incentives are available for large projects that provide secure/standalone capability at sites of Essential Public Services (e.g., police stations, hospitals, public utilities). Performance incentives can be received for up to 3 years for systems with an annual capacity factor of 50 percent or greater. The total value of incentives is capped at $50,000 for systems of up to 25 kilowatts (kW) and at $1 million for larger systems.

## Pennsylvania

In July 2008, Pennsylvania enacted a broad $650 million alternative energy bill designed to provide support for a variety of renewable energy and energy efficiency technologies. Included in this legislation was a provision authorizing the creation of a grant and loan program for alternative energy and clean energy production projects. The program is jointly administered by the Department of Community and Economic Development (DCED) and the Department of Environmental Protection (DEP), under the direction of Commonwealth Finance Authority (CFA). The most recent Program Guidelines were issued in January 2013. Incentives are available to businesses (including non-profits), economic development organizations, and political subdivisions (e.g., local governments, schools, etc.).

The program will offer support for alternative energy and clean energy projects in the form of loans, grants, and loan guarantees (i.e., grants to be used in the event of a financing default). Under this program, alternative energy production projects and clean energy production projects are governed by distinct sets of definitions and rules. Eligible activities for each type of project are described briefly below (see program rules for more detailed descriptions).

Cell incentives, and where the levelized cost of electricity (CoE) from the utility is mid-to-upper-teens per kWh (i.e., 13–19 cents) (including generation, distribution/transmission, ancillary fees and taxes) on a PPA basis. Each PHA must evaluate their prospective CoE for a fuel cell by working with a qualified manufacturer, developer, or integrator who will have an intimate knowledge of all system design and installation factors, incentives, and cost/tax implications (which vary widely state by state). Major suppliers of fuel cells in the US can generate levelized CoE (and heat value in the case of CHP) under a PPA Agreement. These same suppliers' solutions are competitive to

| Priority | Consider Fuel Cells if: |
|---|---|
| PHA Location | Your PHA is in one of the following Fuel-Cell Eligible incentive States (as of Jan. 2014): CA, CT, NJ, NY, PA |
| Electricity Demand | Your PHA has a base-load electricity demand of > 50 kW |
| Cost of Electricity | Your PHA cost of electricity is > $.12 per kWh |
| Efficiency | Your PHA is looking for a more sustainable, efficient approach to the traditional power grid |
| Reliability/Resiliency | Your PHA is looking for a continuous, reliable supply of power in the event of grid outages and emergencies; a system not dependent on the electrical-utility grid alone |
| Greenhouse Gas Reductions | Your PHA is looking for a power source that provides exceptionally low/clean emissions |
| Utility Management/ Scalability | Your PHA is looking for a power source that has modularity, scalability and flexible installation that can meet the changing demands of your housing authority |
| Low Noise Operations | Your PHA is looking for a system with noise abatement vs. generators, eliminating the hazards associated with traditional diesel or gas generators |
| Fuel Flexibility | Your PHA is looking for a system that can run on a variety of fuel sources (Natural gas or directed biogas) |

Table 2 –Self-Assessment Tool

the levelized grid CoEs in states that offer fuel cell incentives—currently, these are California, Connecticut, New Jersey, New York, and Pennsylvania.

## Clean Power

Fuel cells are extremely clean. Since there are typically no combustion related emissions from the fuel cell itself, emissions depend on the choice of fuel. When using pure hydrogen, the emissions are zero. When using natural gas, the emissions are still much lower than fuel combustion. Based on measured data, a fuel cell power plant may create less than one ounce of pollution per 1,000 kWh of electricity produced, compared to the 25 pounds of pollutants for conventional combustion generating systems. See www.fuelcells.org for more information.

## Backup Power

Fuel cells can be configured in either *grid-parallel mode* or *island* mode. In grid-parallel mode, the fuel cell will cease supplying power to the PHA during a utility outage to not *back-flush* the grid with electricity that may harm utility line workers. In contract, in *island* mode, the fuel cell is integrated to the PHA's critical electrical load so the fuel cell can continue to provide electricity to the PHA while the grid is out. In *island* mode, the fuel cell serves as a reliable back up power source, augmenting or replacing the need for backup generators. Not having to pay for a generator and related expenses adds to the cost savings that the PHA achieves from base load electricity savings.

## Next Steps

As a housing authority considering fuel cell technology, each entity must assess their current situation, priorities and goals and then determine the fit and value accordingly. Table 2 is intended as a self-assessment tool to prioritize PHA objectives.

The self-assessment is an internal first step. The next step completes a full assessment by engaging with a service provider that can ensure a PHA best-in-class, turnkey solution. The turnkey solution starts with a service provider's PHA needs assessment. A qualified service provider must

> It is estimated that the global fuel cell market revenue will reach $2.5 billion by 2018.


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## Additional Resources:

- Fuel Cells 2000 is a non-profit education and outreach program of the Breakthrough Technologies Institute and offers numerous resources on its website, www.fuelcells.org for any audience.

- The DOE Fuel Cell Technologies Program conducts comprehensive efforts to overcome the technological, economic, and institutional obstacles to the widespread commercialization of fuel cells and related technologies. Visit energy.gov/eere/fuelcells/fuel-cell-technologies-office.

have established relationships with the leading technology manufacturers, distributors; EPC services firms, finance providers, professional firms, and development partners and an appreciation for the intricacies of PHA business operations and HUD's subsidy programs.

Fuel cell technology offers opportunities for improving air quality, impacting climate change, improved energy efficiency, and energy independence. The turnkey technical and financial resources are in place to transition the technology into reality, making fuel cells a practical alternative to traditional power sources in PHAs.

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