

ADVANCING STATIONARY FUEL CELLS THROUGH STATE POLICIES



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ABOUT THIS SERIES

This briefing paper is one of four in a series of papers on fuel cells and hydrogen technologies produced by Clean Energy States Alliance (CESA) in the spring of 2010. These papers are part of a larger education and outreach initiative by CESA to inform and engage state policymakers about the benefits of fuel cells, their use in critical power applications, and model state policies to support them as well as information about hydrogen production and storage:

- *Fuel Cell Technology: A Clean, Reliable Source of Stationary Power*
- *Stationary Fuel Cells and Critical Power Applications*
- *Advancing Stationary Fuel Cells through State Policies*
- *Hydrogen Production and Storage: An Overview*

For further information on CESA's hydrogen and fuel cell activities, and to download all four reports, please visit www.cleanenergystates.org/JointProjects/hydrogen.html.

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Introduction

Over the past decade, states and municipalities have increasingly shaped public and regulatory policy to support renewable energy generation, from residential, roof-mounted, solar photovoltaic systems to large, commercial wind farms. They have done so for a number of reasons: in-state economic development, displacing emissions from conventional energy sources, diversifying the state's energy portfolio, and providing a long-term hedge against uncertain and volatile energy prices.

Stationary fuel cells share many of the characteristics of renewable energy generation. Fuel cells provide clean, quiet, efficient, and reliable distributed generation for a variety of applications: from critical facilities such as airports, emergency dispatch centers, hospitals, and telecommunications towers to office buildings, retail stores, and industrial facilities. Unlike many renewable energy technologies, fuel cells are not an intermittent source of power and can provide consistent, reliable power.

Yet, despite these advantages, most states have yet to give fuel cells the level of support they have provided to other clean energy technologies. This briefing paper identifies those policies that states have or can adopt to support fuel cells. These policies are broken down into three areas: 1) those that support the deployment of fuel cells, 2) those that remove state and local barriers to fuel cell installations, and 3) those that promote the development of an in-state fuel cell manufacturing sector.

Policies to Support Fuel Cell Installations Hydrogen “Road Maps”

Many state energy or economic development offices have developed strategic plans to grow hydrogen and fuel cell industries and markets within their states. While a number of these have focused on hydrogen-powered fuel cells for transportation applications, other state plans are centered on the development of a fuel cell manufacturing industry and the deployment of fuel cells in stationary applications. These plans help to provide policymakers with a vision of how fuel cells can play a role in their state's economy and energy portfolio. For an example of a state hydrogen and fuel cell roadmap, see the Connecticut Center for Advanced Technology website at <http://energy.ccat.us/energy/fuelplan.php>.

About Fuel Cells

Fuel cells operate much like a battery in chemically converting hydrogen (typically produced by reforming natural gas) into electricity. Unlike a standard battery, fuel cells do not need to be recharged and provide a constant level of power as long as there is a constant source of fuel. They can be sized at any scale, from micro-applications such as cell phones to multi-megawatt installations to power large commercial and industrial facilities. These larger facilities can also capture the heat that is released in the electrochemical conversion process and use it for either space or process heating and cooling. Fuel cells are quiet, have no moving parts, have no particulate emissions, and operate at high efficiency. For more information on the technology and benefits of fuel cells, please see the companion briefing paper on fuel cell technology at www.cleanenergystates.org/JointProjects/hydrogen.html.

Renewable Portfolio Standards

Twenty-nine states now have renewable portfolio standards (RPS), which have been the most important state-level policy driver for renewable energy development. These RPS policies primarily support large-scale projects such as wind energy. Few RPS laws include fuel cells as an eligible resource unless the hydrogen used in them is produced from a renewable resource such as biogas (almost all hydrogen produced in the United States currently is reformed from natural gas). By including fuel cells that utilize natural gas as an eligible resource, these technologies would qualify for the state RPS. If included in a distributed generation technology set-aside, as states have done with solar photovoltaics, fuel cells could receive some market-based financial support as well. Currently, only six states (CT, ME, MN, NY, OH, and PA) include all fuel cells, regardless of the fuel source, as RPS-eligible. An alternative approach would be to require utilities to install a certain amount of fuel cell generation capacity (either utility- or customer-sited) by a certain date and to allow cost recovery of these installations.



Tax Incentives

Many states provide sales tax and property tax exemptions for renewable energy technologies. These exemptions should be extended to fuel cells to assist this clean energy technology to gain marketshare. This would complement the 30% federal investment tax credit (extended through 2016), for which fuel cells are eligible.

State Purchasing Leadership

States can take the lead in acquiring fuel cells to replace diesel generators for back-up power in both new and existing facilities. Fuel cells could also be deployed as a primary source of power in new, high-profile public buildings such as at universities, administrative buildings, or airports. The long ownership cycle of these buildings, together with low financing costs, allows states to spread out the cost of these installations over many years.

Critical Facilities

States can encourage the use of fuel cells as primary and/or back-up power in new telecommunications towers, hospitals, and emergency service facilities. They could do so directly by specifying that fuel cells be used, or indirectly by increasing the performance standards for back-up power (e.g., lower emissions, greater operating efficiency or more reliable performance), which would lead to the selection of fuel cells as the ideal generation source. While it is difficult to calculate “payback” on emergency and back-up power installations, the long investment time horizons and the public purpose of these facilities should allow states and municipalities to support the higher up-front costs of fuel cells for backup power. For more information on the application of fuel cells for critical facilities, please see the companion briefing on *Stationary Fuel Cells and Critical Power Applications*.

State Clean Energy Funds

Eighteen states have ratepayer-supported clean energy funds that collectively have provided billions of dollars in support to renewable energy projects over the past decade. With the exception of California, Connecticut, New York and Ohio, state funds are not yet targeting fuel cells as an area of support. Direct grant assistance would encourage both private and public sector facilities to acquire fuel cells. These installations would, in turn, raise visibility of the technology and encourage further installations. States could consider establishing performance-based incentives rather than lump-sum grants at time of project completion. In addition, states will want to consider whether to only support projects using fuel cells for base-load power, or to also support back-up power applications.

These state clean energy funds have been the most active in supporting fuel cell installations at both private and public facilities.



NYSERDA

NYSERDA (New York State Energy Research and Development Administration), the state’s ratepayer-funded agency that supports clean energy research and deployment, has an \$11 million fuel cell support program under the “Customer-Sited Tier” of its state RPS. The current solicitation provides capacity payments of \$1,000-2,000 per installed kW (depending on system size) as well as a bonus incentive of \$500/kW for fuel cells installed at critical facilities (emergency services, hospitals, shelters, public utilities, telecommunications). The program also offers performance incentives of \$0.05–\$0.15/kWh of generation, where the higher incentive is used when the fuel cell is used for baseload power (>50% capacity utilization), while the lower incentive would be used for standby power.* Projects funded have included 23 telecommunications towers (averaging 10 kW in capacity) and 14 large projects of as much as 2 MW in size.



Connecticut Clean Energy Fund

The Connecticut Clean Energy Fund (CCEF) has been a national leader in its support of fuel cell installations in the state. CCEF’s On-site Renewable Distributed Generation Program has provided grants totaling approximately \$15 million to 11 fuel cell projects representing installed capacity of 3.4 MW. As of April 2010, there are an additional 2.5 MW of pending projects supported by up to \$6 million in grants.

Connecticut’s Project 150 is an initiative to increase the amount of in-state renewable energy generation by requiring utilities to enter into long-term contracts for 150 MW of Class I renewable energy generation (fuel cells are Class I in Connecticut). Seven fuel cell projects were awarded contracts under Project 150. Although CCEF is not directly funding these projects, it played an important role in evaluating project proposals.

CCEF’s Operational Demonstration Program has provided funds for a number of projects to demonstrate commercial viability of new methods of hydrogen and electricity production using fuel cell technology: (1) a regenerative PEM fuel cell capable of producing electricity and hydrogen (when operated in reverse), (2) hydrogen co-production using a molten carbonate fuel cell that generates hydrogen from unused fuel. These projects were supported by nearly \$4 million in seed

* The solicitation can be found at <http://www.nyserdera.org/Funding/1150summary.pdf>



NYSERDA

Price Chopper Supermarket, Colonie, New York

Financial support for this 400 kW fuel cell system came, in part, from by a grant of \$838,381 from NYSERDA's SBC-funded CHP Demonstration Program. This system will produce 2,400 MWh/year and almost 10,000 MMBtu/year of useful thermal energy. This system is paired with a 75-ton absorption chiller so the by-product thermal energy produced by the fuel cell can be used to make chilled water. Implementing the fuel cell system at this site will result in:

- Peak demand savings of 400 kW in the summer
- CO₂ reduction of 1,360,000 lbs per year
- Reduced energy dependency by 40-60%

funding which has leveraged approximately \$30 million in federal support.

CCEF has also begun a Fuel Cell Performance Monitoring Program at five sites with the economic and operating data to be used to establish the value proposition for fuel cells. The support from CCEF aligns well with the state's support of its growing fuel cell manufacturing industry (described below) through both CCEF's parent agency (Connecticut Innovations) as well as the Connecticut Center for Advanced Technology.

California

The California Public Utilities Commission's ratepayer-funded Self-Generation Incentive Program provides support for commercial-scale installations of a variety of distributed generation technologies. The program has funded 67 fuel cell projects totaling 30 MW in capacity. The program provides support levels of \$2.50/watt for fuel cells using non-renewable resources and \$4.50/watt for those using gas from renewable sources such as biogas from wastewater treatment facilities. <http://www.cpuc.ca.gov/PUC/energy/DistGen/sgip/>

These direct incentives are complemented by the work of the California Stationary Fuel Cell Collaborative (www.casfcc.org), which promotes the use of fuel cells for distributed generation and other specialized applications within California. Under the guidance of the Collaborative, private industry and public agencies work together to:



FUELCCELL ENERGY

Pepperidge Farm, Bloomfield, Connecticut

Pepperidge Farm, the cookie and cracker manufacturer, installed a 250kW fuel cell in its Bloomfield, CT bakery in 2006. This was followed by the installation of a much larger 1.2 MW fuel cell in 2008. Together, the two fuel cells will provide 70% of the electricity needed by the plant while utilizing waste heat in the plant's boilers. The fuel cells have an electrical conversion efficiency of 47% and an overall system efficiency of 70% through reusing the waste heat. Both installations were supported by significant grants from the Connecticut Clean Energy Fund, consistent with that state's commitment to supporting its fuel cell manufacturing industry.



Gills Onions of Oxnard, CA, with its Advanced Energy Recovery System, converts 100% of the onion waste at its processing facility (about 1.5 million pounds of onion waste per week) into clean, virtually emissions-free, heat, electric power, and high-value cattle feed by using an anaerobic digester to produce methane gas from the onion waste to power two (2) 300 kW fuel cells, which provide Gills Onions with up to 100% of baseload electricity requirements. For installing the system, Gills Onions is eligible to receive \$2.7 million from Southern California Gas Co. as part of the state's Self-Generation Incentive Program, which encourages self-contained generation by businesses.

- Advance programs and activities that accelerate the deployment of fuel cells
- Advance public policy supportive of stationary fuel cells, including addressing siting barriers, encouraging state procurement of fuel cells for use in public building and maintaining financial incentives for fuel cell installations
- Initiate public demonstrations of fuel cells
- Conduct key studies to further existing knowledge about fuel cell capabilities, performance and the impact of fuel cells for distributed generation, backup power and specialty vehicles and
- Raise public awareness about and acceptance of stationary fuel cell technologies

Removing Installation Barriers

In addition to providing appropriate incentives, state and local governments need to address and remove barriers that may restrict the installation of fuel cells.

Interconnection and standby charges

Interconnection is the process by which any distributed generation (both renewable and non-renewable) is connected to the local electric distribution grid. For many years, utilities put up roadblocks that made interconnection difficult. These included costly impact studies, insurance

requirements, and delays. Most state regulatory commissions have addressed the interconnection problems that have held back all forms of distributed generation. However, the effectiveness of interconnection rules varies by state, and there is room for improvement in many states. For a current review of state interconnection standards, see the annual "Connecting to the Grid" report, http://www.irecusa.org/wp-content/uploads/2009/10/Connecting_to_the_Grid_Guide_6th_edition-1.pdf. For model interconnection rules, see <http://irecusa.org/wp-content/uploads/2010/01/IREC-Interconnection-Procedures-2010final.pdf>.

Hydrogen Transportation and Storage

State and local fire marshals as well as the public are concerned about the movement and storage of hydrogen, even though hydrogen is a commonly used industrial gas stored at tens of thousands of industrial facilities. Both the International Code Council (ICC) and the National Fire Prevention Association (NFPA) have developed a set of codes and standards pertaining to hydrogen transport, storage, and distribution. In addition, NFPA is developing a new comprehensive set of hydrogen standards which will be released in 2010, and the International Mechanical Code and International Fuel Gas Code also address hydrogen. These codes cover storage tank specifications, setbacks and enclosures, signage and other factors. State policymakers should ensure that their state fire and building codes are consistent with these international and national standards and formalize this consistency through legislation if necessary. Since many of the larger fuel cell technologies produce hydrogen on-site within the fuel cell itself, this code adoption is primarily relevant to on-site storage of hydrogen for PEM fuel cells used for back-up power and materials handling equipment. See: <http://www.nfpa.org>; see also CESA's companion briefing guide on *Hydrogen Production and Storage*.

Project Zoning, Siting and Permitting

Siting approval and permitting for fuel cell projects is the domain of local governments. Like any energy project, local discretion can move a project forward or stall it. State policymakers should review local zoning and permitting codes regarding hydrogen storage and fuel cells and, to the extent possible, attempt to develop a consistent set of standards used by local governments. For more information on permitting, see http://www.hydrogen.energy.gov/permitting/permitting_process.cfm.

Fuel Cell Industry Support

Several states have invested considerable resources in building fuel cell manufacturing clusters. Connecticut, Ohio, South Carolina and Hawaii have all worked hard to make their states leaders in a growing fuel cell industry.



While the industry is not yet large enough to support manufacturers in every state, the activities in these states provide collaborative models for stimulating industry growth.

Connecticut

The Connecticut Hydrogen-Fuel Cell Coalition (www.chfcc.org), administered by the Connecticut Center for Advanced Technology (CCAT), is comprised of representatives from Connecticut's fuel cell and hydrogen industry, labor, academia, government, and other stakeholders. CCAT and the Connecticut Hydrogen-Fuel Cell Coalition work to enhance economic growth through the development, manufacture, and deployment of fuel cell and hydrogen technologies and associated fueling systems in Connecticut.

Connecticut companies now lead the world in the development of alkaline, molten carbonate, and phosphoric acid fuel cells and are among the leaders in proton exchange membrane and solid oxide fuel cell development. Connecticut companies in hydrogen generation are leaders in both alkaline and proton exchange membrane electrolysis systems and in converting natural gas or petroleum products to hydrogen through reforming processes. Connecticut is home to UTC Power, FuelCell Energy and Proton Energy Systems, among others.

One of the key strengths of Connecticut's program is that it has combined the industry development focus of the Fuel Cell Coalition with additional support for project deployment through the Connecticut Clean Energy Fund (CCEF). CCEF's financial support of commercial fuel cell installations not only helps the industry to build an in-state market but also provides outstanding fuel cell demonstrations which can be used to promote the technology and the industry throughout the country.

As a result of these efforts, employment in the fuel cell industry has grown dramatically in Connecticut, with an estimated 2,000 working in the industry supply chain, representing over 70% of all renewable energy jobs in the state.

Ohio

For the past decade, the State of Ohio has focused on building a fuel cell research and manufacturing cluster and industry supply chain. These efforts have been financially supported by the Ohio Third Frontier Program (www.ohiothirdfrontier.com), a state economic development program funded through tax-exempt bonds that provides financial support to move companies and products from R&D through commercialization. The program focuses on industry clusters where the state has competitive strengths, including advanced materials and fuel cells.

The Third Frontier Program has been enhanced by the work of the Ohio Fuel Cell Coalition (www.fuelcellcorridor.com), a group of industry, academic and government institutions working collectively to strengthen the state's fuel cell industry and become a global leader in fuel cell technology. Its primary objectives are to:

- Build upon existing industry and academic strengths in the state to advance the integration of a coordinated, robust fuel cell supply chain.
- Promote public awareness of fuel cells as both a source of clean energy and a source of economic growth for the state.
- Expand networking and information-sharing among those engaged in the industry
- Identify and encourage federal funding that can leverage state resources in the development of a fuel cell industry in the state.



Fuel Cells for Combined Heat and Power

At South Windsor High School in CT, a UTC PC25 fuel cell generates 200 kW of electricity. Not only does that clean energy significantly reduce the high school's demand upon the power grid, but the school further benefits by capturing the more than 900,000 BTUs of heat that the fuel cell generates hourly. That by-product heat is used for space heating and to preheat boiler return water.

This project was funded with support from the Connecticut Clean Energy Fund.



South Carolina

South Carolina has developed one of the most integrated and well-funded hydrogen fuel cell industry development initiatives in the country (www.schydrogen.org). These initiatives include:

- **Industry Partnerships:** There are many partnerships between institutes and large corporations. For example, Toyota Motor Corporation has invested approximately \$1 million in the Center for Hydrogen Research in Aiken.
- **Hydrogen Infrastructure Development Fund:** This \$15 million public fund is available to private companies that work with USC, Clemson, S.C. State University and the Savannah River National Laboratory. South Carolina taxpayers who contribute to the Fund receive a 25% credit against their state income tax. Fund contributions will be granted to promote the development and deployment of hydrogen production, storage,

distribution, and dispensing infrastructure.

- **Local Investments in Hydrogen Research:** South Carolina’s local communities have also shown strong support for hydrogen and fuel cells. In 2005, Aiken County fully funded the construction of the Center for Hydrogen Research, a \$10 million state-of-the-art facility designed to facilitate cooperative research among the Savannah River National Lab, universities, and industry.
- **USC Columbia Fuel Cell Collaborative:** The University of South Carolina, the City of Columbia, the South Carolina Research Authority (SCRA), and EngenuitySC joined together to form the USC Columbia Fuel Cell Collaborative in 2005. The collaborative has three principal goals: to position the Columbia, SC, region as a leader in fuel cell innovation; to become world-class innovators for the hydrogen and fuel cell economy;

Table 1: Summary of Current State Policies for Stationary Fuel Cells

State	Fuel Cells included in RPS*	Tax Incentives	Grants	R&D or Manufacturing Support	Public-Private Partnerships
Alaska			x		
California			x	x	CA Stationary Fuel Cell Coalition
Colorado			x		
Connecticut	x	x	x	x	CT Hydrogen-Fuel Cell Coalition
Florida		x			
Hawaii		x	x	x	Hydrogen Investment Fund
Massachusetts			x	x	Hydrogen Coalition
Michigan		x		x	
Minnesota	x				
Nevada		x			
New Jersey			x	x	
New York	x		x		
Ohio	x		x	x	Ohio Fuel Cell Coalition
Oregon		x			
South Carolina		x	x	x	
Texas					TX Fuel Cell Partnership
Virginia					VA Clean Cities Coalition
Washington		x			
Wisconsin			x		

* Includes fuel cells using hydrogen derived from any source (renewable or non-renewable); many states include fuel cells as RPS-eligible utilizing hydrogen from renewable resources do include fuel.

For a comprehensive guide to state policies and programs supporting hydrogen and fuel cell industry development and deployment, please see Fuel Cell 2000’s report, *The State of the States—Fuel Cells in America* at <http://www.fuelcells.org/StateoftheStates.pdf>.



and to recruit and retain fuel cell scientists, entrepreneurs, and innovators to help make South Carolina a pre-eminent location for the hydrogen and fuel cell economy.

Hawaii

Hawaii, as a state with high-cost energy, has always been seeking ways to increase its share of clean, locally sourced energy. Its long-running hydrogen program is an example of this. The program has centered on three areas: research, investment, and deployment.

- **Research:** In 1974, spurred by the OPEC oil embargo, the Hawaiian legislature established the Hawaii Natural Energy Institute (HNEI) at the University of Hawaii with the mandate to transition the state off of oil. Since that time, hydrogen has been supported as a key technology in this effort. In September 1985, HNEI was awarded a contract from the Department of Energy to establish the Hawaii Hydrogen from Renewable Resources Program. HNEI has also created the Hawaiian Fuel Cell Test Facility (HFCTF), with a public/private consortium of the Office of Naval Research, UTC Fuel Cells, and the Hawaiian Electric Company, the state's largest electric utility.
- **Investment:** In 2006, the Hawaiian legislature appropriated \$10 million for a hydrogen investment fund. This fund was created to develop a world-class renewable hydrogen program in Hawaii and has the goal of leveraging over \$100 million in additional capital. The fund is managed by a private venture capital firm with assistance from HNEI, which is responsible for

developing an overall state hydrogen program development plan, the technical evaluation of proposed investments, hydrogen infrastructure project management, and attracting cost-share projects to the state.

- **Deployment:** The first cost-sharing grant from the state investment fund was awarded to the Hawaii Hydrogen Power Park at Hawaii Volcanoes National Park (HAVO). The project includes hydrogen production from renewable electricity, compression, storage, delivery, and dispensing to hydrogen vehicles. Separately, HAVO was awarded \$2 million from the National Park Service to purchase two hydrogen fueled shuttle buses.

Conclusions

Despite being a proven technology with significant performance and environmental benefits, stationary fuel cells have yet to achieve the visibility or market acceptance that other clean energy technologies have. Proactive state policies that are targeted directly at fuel cells can play an important role both in increasing stationary fuel cell installations and in growing the fuel cell manufacturing industry. While direct financial support for fuel cell projects is an important element of these policies, there are a myriad of other actions that states can take to both raise awareness of and to remove barriers to fuel cell installations. Policymakers should develop comprehensive legislation that addresses all of the factors that can encourage or hinder fuel cell markets in their states.



Clean Energy States Alliance (CESA) is a national nonprofit coalition of state clean energy funds and programs working together to develop and promote clean energy technologies and markets. CESA provides information sharing, technical assistance services and a collaborative network for its members by coordinating multi-state efforts, leveraging funding for projects and research, and assisting members with program development and evaluation.

Many states across the U.S. have established public benefit funds to support the deployment and commercialization of clean energy technologies. Over twenty states are actively participating in CESA membership activities. Through these clean energy funds, states are investing hundreds of millions of public dollars each year to stimulate the technology innovation process, moving wind, solar, biomass, and hydrogen technologies out of the laboratory and toward wider use and application in business, residential, agricultural, community and industrial settings. State clean energy funds are pioneering new investment models and demonstrating leadership to create practical clean energy solutions for the 21st century.

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