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State of the States: Fuel Cells in America



Authors and Acknowledgements

This report was written and compiled by Sandra Curtin, Elizabeth Delmont and Jennifer Gangi of Fuel Cells 2000, an activity of Breakthrough Technologies Institute in Washington, DC, with significant contribution from Semee Jang and Brian Woodlock. Support was provided by the US Department of Energy's Fuel Cell Technologies Program.

About This Report

The information contained in this report was collected from public records, websites and contact with state and industry representatives as of April 2010, particularly the State Fuel Cell and Hydrogen Database (<http://www.fuelcells.org/info/statedatabase.html>) and North Carolina Solar Center's Database of State Incentives for Renewables & Efficiency (DSIRE - <http://www.dsireusa.org/>). To the best of our knowledge, fuel cell installations listed are currently active unless otherwise marked.

Front Cover Photos:

Top right: Three fuel cell buses demonstrated at Chicago Transit Agency

Middle left: Four 250-kW FuelCell Energy DFC fuel cell systems at the Sheraton San Diego Hotel

Middle right: Plug Power GenDrive™ fuel cell powered forklift

Bottom left: ClearEdge Power residential fuel cell system

Bottom right: General Motors Chevy Equinox fuel cell vehicle

Fuel Cells: Here Today

There is no doubt that there will be fuel cells in our future. **In fact, fuel cells are here today, available for purchase and already taking off in early markets:**

- Telecommunication companies are purchasing fuel cells to provide back-up or primary power to cell phone towers.
- Major companies are buying fuel cells to power forklifts and other materials handling equipment at their warehouses.
- Energy suppliers in the US, Europe and Asia are selling fuel cells to heat, power and air condition homes and small businesses.
- Large stationary fuel cells are being purchased to help power manufacturing facilities, hotels and public buildings, to name just a few.
- Major auto manufacturers (GM, Daimler, Honda, Toyota, Hyundai-Kia) plan commercial fuel cell vehicle sales by 2015.

The United States is home to major fuel cell manufacturers, small start-ups, fuel providers, as well as hundreds of component suppliers, end users and companies involved at one point or another on the development and manufacturing spectrum. **Fuel Cells 2000 estimates that there are more than 630 active companies and laboratories in 47 states involved in the fuel cell and related fuels industry, investing an estimated \$1 billion a year.** Other estimates put the total supply chain in the thousands of companies.

In this report, Fuel Cells 2000 has analyzed the seven regions of the United States, compiling state activities supporting fuel cell (FC) and hydrogen (H₂) policy, as well as installations and demonstrations in each state, so that readers can see how their state performs and compare efforts with their neighboring states.

We give green checkmarks to states that have put policies in place supportive of fuel cells and hydrogen (or red X's to those who don't!). These policies include fuel cell or hydrogen

The Fuel Cell Top Five

Here are the top five fuel cell states in 2009, based on their policies and activism:

- California
- Connecticut
- New York
- Ohio
- South Carolina

To learn why, see page 7

roadmaps that outline steps a state will take to encourage use of the technology. We assess not only the roadmap but the state's willingness to implement these plans.

We also examine Renewable Portfolio Standards that expressly include hydrogen as a qualifying energy source, and fuel cells as qualifying technology. Net metering and interconnection standards, which allow small energy producers to connect and send energy to the grid, are another place we look for fuel cells and hydrogen – a fuel cell's clean energy generation can potentially help to meet a state's electric renewable energy requirement. Finally, we examine a state's tax incentives, and available funding sources (grants and loans) that aid in promoting fuel cell use or attracting industry to the state.

We also note large and small stationary fuel cell installations; fuel cell-powered vehicles such as cars, buses and forklifts; and the presence of hydrogen fueling stations.

After detailing these state efforts, we chose the Top Five fuel cell states – states that are committed to supporting fuel cell technology and reaping the benefits of their investment, and who have made visible progress in their efforts.

These choices admittedly are subjective. Each state in our Top Five is recognized for different reasons - some for multiple stationary installations, vehicle demonstrations, and hydrogen fueling stations; others for taking the lead by providing grants and funding; supporting research and development; attracting business and jobs; or putting regulations in place to facilitate demonstrations and installations.

These are not the only states actively involved in fuel cell demonstrations and policy. States are realizing that the fuel cell and hydrogen industry provides much more than environmental benefits, it also provides economic benefits in the form of jobs and business. How can your state move up on our list? Use the Top Five as examples and follow their leads– your state's Department of Development is a good place to start. Attracting

A fuel cell is an electro-chemical device that combines hydrogen and oxygen to produce electricity, with heat and water as its only byproducts. In principle, a fuel cell operates like a battery, but does not run down or require recharging. It will produce energy in the form of electricity and heat as long as fuel is supplied.

To learn about the different types of fuel cells, visit www.fuelcells.org

Fuel cells are being tested or deployed in the following applications:

Portable – soldier power applications in the field, consumer electronics, auxiliary power units

Vehicles – cars, buses, trucks, materials moving equipment, shuttles, golf carts, wheelchairs, bicycles, motorcycles, scooters, boats, submarines, airplanes, trains, mining vehicles, military all-terrain vehicles

Stationary power – hospitals, hotels, municipal buildings, breweries, data centers, wastewater treatment plants, universities, high schools, police and fire stations, food production facilities, cell phone towers, E-911 and homeland security critical communications, airports, and many more

fuel cell businesses to your state and assisting start-up ventures means high-tech jobs and a leg up on the future, and federal support is available to help.

The Federal Investment Tax Credit (ITC) for fuel cell technology provides business property owners with a credit of 30% of the cost of the fuel cell units or up to \$3,000 per kW, whichever is lower. This credit also can be applied to converting a materials handling fleet to fuel cell power and expires on December 31, 2016. There is additional help for home owners, for fueling station operators and for those buying a fuel cell vehicle. For more information, see the [US Fuel Cell Council's Q&A](#)¹.

Your governor and legislatures can create and implement attractive policies and tax credits, to facilitate fuel cell installations and entice foreign and U.S. companies to your area. Here are some concrete examples of how some of our Top Five states are already showing benefits from their efforts to attract hydrogen and fuel cell industry and encourage deployments:

- Ohio's Third Frontier Fuel Cell Program has resulted in the creation or retention of 295 jobs with an average salary of \$61,651. They also report a leverage ratio of 4.5, meaning that for every dollar spent the state attains \$4.50 in benefits. The range of fuel cell technologies being pursued and commercialized has expanded to cover virtually all of those being seriously considered for the developing end-use markets, and the program's efforts have gained the state national recognition as a leader in fuel cell technology development. This recognition, backed-up with a strong support program, has attracted several new fuel cell new companies to Ohio (relocating from other states and the United Kingdom).²

¹ <http://www.usfcc.com/ITC-Tax9-2009.pdf>

² Ohio Department of Development, *An Update on Ohio's Fuel Cell Roadmap*, Mar. 2009

Fuel cells can use a variety of energy sources, including:

- **Hydrogen**
- **Hydrogen rich fuels** - Hydrogen is separated from these fuels using steam and heat:
 - *Traditional:* natural gas, gasoline, diesel, propane,
 - *Renewable/alternative:* methanol, ethanol, landfill gas, biogas, methane, ammonia
- **Renewable energy sources** - solar, wind, geothermal, using water (see below)
- **Water** - Hydrogen is separated from water molecules when an electric current passes through water
 - *Traditional:* electricity from the electric power grid
 - *Renewable/alternative:* electricity from solar, wind, hydropower or geothermal power
- **Innovative** - sodium borohydride, algae, peanut shells, and industrial gases are just a few of the potential sources being examined

To learn about the different types of fuel cells and their applications, visit www.fuelcells.org

- In Connecticut, which is home to several of the world's major fuel cell manufacturers, it is estimated that 240 jobs are created per MW of installed capacity, so annual production of 50 MW could yield around 7,500 – 8,000 jobs. In 2010, job growth is anticipated to increase by yet an additional 40%.³
- The South Carolina Hydrogen and Fuel Cell Alliance reports 65% job growth in its hydrogen cluster since 2004 and a 10:1 return on its hydrogen investment.⁴

A recent US Department of Energy (DOE) study estimates a net increase of 361,000 to 675,000 jobs⁵ is possible by 2035 in fuel cells and hydrogen. Fuel Cell Today predicts that the global fuel cell industry could create 700,000 green manufacturing jobs over the next decade. But state support will be needed to help retain these jobs in the US. Other countries, including Japan, Korea and Germany, are aggressively pursuing fuel cell development, deployment and new markets, and are anxious to lure companies overseas and overtake the US advantage.

This report attempts to summarize State activity in a format that is easy to read and to compare states. For more extensive descriptions of the policy, installations or demonstrations you find in the pages that follow, please visit [Fuel Cells 2000's State Fuel Cell and Hydrogen Database](#)⁶. You can also contact Fuel Cells 2000 at states@fuelcells.org for help connecting to industry and potential collaborators as well as for general fuel cell information. Please also refer to the Appendices for additional resources.

³ Connecticut Center for Advanced Technology, [Connecticut Fuel Cell Activities: Markets, Programs, & Models](#), Dec. 2009

⁴ South Carolina Hydrogen and Fuel Cell Alliance, [Jobs and Investments for Hydrogen and Fuel Cells](#)

⁵ U.S. Department of Energy, [Effects of a Transition to a Hydrogen Economy on Employment in the United States: Report to Congress](#), Jul. 2008

⁶ Fuel Cell 2000's State Fuel Cell and Hydrogen Database - www.fuelcells.org/dbs

Fuel Cell Benefits

- High quality, reliable power
- High efficiency
- Exceptionally low / zero emissions
- Modularity / scalability / flexible installation
- Silent operation
- Lightweight / long-lasting
- Can be used with or instead of batteries and diesel generators

Did you know?

Fuel cells are here today.

More than 30,000 fuel cell units were shipped in 2009.

Some fuel cell systems have achieved billions of kilowatt hours (kWh) of successful operation at customer sites worldwide, including many Fortune 500 companies.

Fuel Cells 2000 estimates that there are at least 500 forklifts currently deployed and we expect to see another 1,000 forklifts, if not more, shipped in 2010. These forklifts will be located in 18 states.

Efficiency is one of the key benefits of fuel cells. Fuel cells can operate on renewable or conventional fuels. Whatever the source of fuel, fuel cells save energy, save customers money and reduce emissions.

- Residential fuel cells reduce home energy use by one-third or more. Thousands of units are installed and millions are anticipated.
- Fuel cell passenger vehicles are nearly 60% efficient, and the best are even more efficient, according to tests monitored by the US Department of Energy, and the best vehicles yield 60 to 70 miles per gallon equivalent. Hundreds are on the road and millions more are anticipated by 2025.
- Fuel cell forklifts are 10% more efficient than battery forklifts (US grid mix) and 30% more efficient than forklifts using petroleum. More than a thousand are operating and market acceptance is growing.
- Fuel cell CHP systems are 80% to 90% efficient when both heat and electricity are used. Systems optimized to produce electricity achieve 50% or greater electrical efficiency. Hundreds of megawatts are installed and hundreds more are anticipated within the next five years.
- All this means CO₂ reductions: 20% to 40% for combined heat and power systems operating on natural gas, up to 100% on renewable fuel; 30% for residential systems; 60% or more for forklifts; 50% or more from passenger cars.

The Best of the Best: Top Five Fuel Cell States

California

- **Progressive policy, worldwide leader in fuel cell cars and buses, hydrogen stations, numerous stationary installations**

Connecticut

- **Home to major manufacturers, high profile installations, supportive funding policies**

New York

- **High profile and long-running installations, supportive funding policies**

Ohio

- **Focus on business attraction and development, building supply chain and manufacturing base**

South Carolina

- **Promoting demonstrations, hydrogen stations, business development**