

## FUEL CELL Q U A R T E R L Y

### Aiken Emerging as Hydrogen Hot Spot

Aiken County, South Carolina is a big supporter of hydrogen and fuel cells - the county has been making investments over the last few years to make the area a hub for hydrogen development. There have been several new developments reported in Aiken over the last few weeks.

First, Aiken County's first hydrogen station was opened in late March.



Fuel cell bus at Columbia station - courtesy of The State newspaper

Located in the Sage Mill Industrial Park, the station will be used by tenant Bridgestone/Firestone to fuel its fuel cell-powered forklifts, and also by the nearby Center for Hydrogen Research to fuel its hydrogen-powered Chevy Silverado & Kia Borrego. The Aiken station is the second hydrogen station to open in the state. The other is located in the South Carolina's capitol, Columbia, and the 59-mile roadway between the two is now

officially known as the South Carolina Hydrogen Freeway. The Columbia station will be used to fuel a new fuel cell bus that will be used by the City of Columbia.

Also, a new solar and hydrogen-powered home has been constructed through a partnership of Aiken Electric Cooperative, a "green" developer, and others. The new housing development, which will feature some "net zero" houses, had initially planned to use only solar power. But officials learned that fuel cells could be used in conjunction with the solar power system, leading to the addition of a fuel cell to one solar home. In this type of system, excess solar energy is typically converted to hydrogen and stored, and fed back to the home through a fuel cell when solar resources are low. Officials hope that consumer demand will lead to the development of more solar-hydrogen-fuel cell homes in the new community.

To see what else is happening in South Carolina, or in any other state, please check out Fuel Cells 2000's [State Fuel Cell and Hydrogen database](#). It contains all state policy/legislation, grants/incentives and initiatives as well as stationary fuel cell installations, fuel cell vehicle demonstrations and hydrogen fueling stations. (SC)

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## FTA Releases Survey of Worldwide Hydrogen Bus Demonstration Participants

The Federal Transit Administration (FTA) recently released, "A Report on Worldwide Hydrogen Bus Demonstrations, 2002-2007," a survey of transit agencies, and their partners, about their experience in placing fuel cell and hydrogen internal combustion (ICE) engine buses into daily revenue service. The report was authored for FTA by Fuel Cells 2000's parent organization, Breakthrough Technologies Institute, and the Center for Transportation Excellence.

The authors interviewed parties involved in hydrogen bus demonstration sites in California and Connecticut, Spain, Portugal, Germany, the Netherlands, Luxembourg, United Kingdom, Iceland, China, Japan and Australia. The survey also includes an upcoming deployment of 20 fuel cell buses in British Columbia, Canada.



AC Transit's fuel cell bus

### Study Findings

Interview participants were overwhelmingly impressed with the progress made in fuel cell development for vehicles, and how the lessons learned from earlier fuel cell bus trials have been successfully incorporated into the next generation of fuel cell design. Fuel cell durability has grown since the last generation, with buses in the European Commission's CUTE hydrogen bus program averaging about 3,000 hours of operation, and some attaining a maximum of more than 5,000 operating hours. Participants indicated they would like fuel cell durability to continue to grow, to allow fuel cells to last 12-15 years – the lifetime of a typical diesel bus. An alternate suggestion was to reduce the fuel cell cost to allow affordable replacement, similar to the 2-3 engine rebuilds/ replacements performed on typical diesel buses.

Limited range did pose an issue for some transit agencies. Typical transit buses are deployed 16+ hours per day on one tank of fuel, but the fuel cell and hydrogen ICE buses only operated 6-8 hours per tank and required a mid-shift hydrogen refill. The hybrid fuel cell buses, however, offered a much greater range, and all participants believe that hybridization will be necessary for future hydrogen buses.

Most participants were impressed with fuel cell reliability, although there was an issue with cell stack assembly failures in the U.S. buses that was reportedly re-

solved. Participants were less impressed with battery reliability in the hybrid deployed in North America. Although most all interview participants felt that hybridization is required for hydrogen buses, frequent battery failures in this generation of vehicles showed that much work needs to be done to improve reliability and durability of battery technologies. In addition, supporting components also caused a number of failures and participants recommended that these components be ruggedized for bus use.

Also troublesome to many sites were hydrogen infrastructure failures that shut down some fueling stations, and put hydrogen buses out of service, for prolonged periods. Some interview participants felt this was because some of the equipment had been adapted from other fueling technologies, and

many recommended that fueling equipment be designed specifically for hydrogen use.

Interview participants were, nonetheless, pleased with relative ease in deploying hydrogen buses in revenue service, although the greater height, weight and higher center of gravity caused a few transit agencies to put a few restrictions on maximum speed and the routes traveled. These limitations are being addressed in the design of the next generation of hydrogen vehicles.

To learn more about the findings, the 57-page report can be downloaded free from the FTA's website: [http://www.fta.dot.gov/documents/ReportOnWorldwideHydrogenBusDemonstrations\\_2002to2007.pdf](http://www.fta.dot.gov/documents/ReportOnWorldwideHydrogenBusDemonstrations_2002to2007.pdf). (SC)

### Recent Bus Updates

The Alameda-Contra Costa Transit District (AC Transit) has exercised options for four more UTC Power PureMotion® Model 120 fuel cell systems for its next-generation Van Hool hybrid-electric fuel cell buses. This adds to AC Transit's order for eight fuel cell buses last year.

A consortium of 6 partners from the German State North Rhine-Westphalia (NRW) and the Netherlands began the development of an 18-meter long 120-kW fuel cell-battery-hybrid bus for public transport. Four of these buses will be publically presented at 18<sup>th</sup> World Hydrogen Energy Conference 2010 which will take place in Essen, Germany, and then they will be operated in Cologne and Amsterdam.

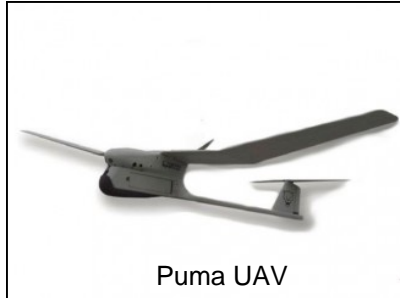
The city of Hamburg, Germany, will have ten fuel cell buses beginning in 2010.

## Specialty Vehicles Continue to Drive Ahead

While fuel cell cars and buses are steadily making their way onto the roads of the United States and around the world, there have been many new advancements and demonstrations in the specialty vehicle world on all fronts – land, sea and air.

It's no military secret that the Armed Services are extremely interested in fuel cells for all sorts of applications – portable soldier power, electricity and heat for barracks and officer's quarters and for unmanned aerial vehicles (UAVs) that are used for surveillance, search and rescue and weather monitoring.

Protonex Technology Corporation has been awarded a \$3.3 million contract from the Department of Defense (DoD) to develop a robust, deployable pre-production fuel cell power system designed for powering a small, unmanned aerial vehicle (UAV) that will be capable of extended flight duration and mission endurance. Last year, the company achieved a big success when its "Puma" UAV (with partner AeroVironment) broke its own record and flew continuously for over nine hours. That project was funded by the U.S. Air Force Research Laboratory (AFRL).



The Air Force, with the Defense Advanced Research Projects Agency (DARPA) is also planning on spending \$400 million on a new surveillance airship. The ISIS (Integrated Sensor Is the Structure) will be kept aloft (65,000 feet in the air) by helium and powered by hydrogen fuel cells that are recharged with solar panels. The finished vessel would be capable of staying airborne for 10 years. The Air Force aims to deliver a prototype by 2014.

On land, the military is also working on unmanned ground vehicles (UGVs) and Protonex is involved in that as well. Recently, Foster-Miller, Inc. (a QinetiQ company) successfully demonstrated a TALON robotic UGV using a 200-watt hybridized fuel cell-battery power system from Protonex. The UGV achieved three times the operational mission range (from 15 km to 45 km) and twice the energy density of its existing advanced battery systems. The



TALON UGV

demonstration was conducted as a part of the OSD-sponsored Next Generation Manufacturing Technologies Initiative (NGMTI), led by the South Carolina Research Authority (SCRA) in Charleston, South Carolina, and funded through the Defense Logistics Agency and managed by the Naval Surface Warfare Center Crane Division.

Also on land, New Holland recently showcased its NH<sub>2</sub> fuel cell tractor – the first to be shown by any tractor maker – in Turin, Italy. Based on the company's T6000 tractor model, the NH<sub>2</sub>'s fuel cell generates 106 horsepower with two electric motors – the first providing power to traction and the second directed to the power train and auxiliaries. The tractor can run for 1.5-2 hours on a single tank of hydrogen. The NH<sub>2</sub> is the first step in New Holland's vision – they are currently working on second generation version as well as an experimental farm to serve as a potential source of hydrogen, with the goal of New Holland's NH<sub>2</sub> fuel cell tractor mass production in 2013.



Fuel cells may come via special delivery in the United Kingdom. Royal Mail, the UK's postal operating authority, is working with CENEX, PostEurop, and FuelCellEurope to develop a universal design specification for hydrogen fuel cell postal vans. After the draft design specifications have been developed, Royal Mail plans to share them with other European postal operators for comments and input before presenting it further to vehicle manufacturers.

Under the sea, fuel cells have been showing their potential in submarines. South Korea's DAPA procurement agency has signed a contract with HDW for 6 "material packages" used to build Class 214 submarines, consisting of unassembled submarine parts and partial assemblies. This is the second order of submarines from South Korea – the first group used 120kW Siemens PEM fuel cells which gave the submarine an underwater endurance of 2 weeks. The second batch will reportedly improve on that system.

A comprehensive chart of fuel cell specialty vehicles can be found at <http://www.fuelcells.org/info/charts/specialty.pdf>.

# How the Recovery Bill Could Benefit Fuel Cells

by Bud DeFlaviis, U.S. Fuel Cell Council

On February 17<sup>th</sup>, 2009, President Obama signed the American Recovery and Reinvestment Act of 2009 (ARRA). Also known as the Recovery Bill, the ARRA consisted of two separate parts: Division A - Appropriations Provisions and Division B - Tax, Unemployment, Health, State Fiscal Relief, and Other Provisions.

The stated purpose of the 407-page bill is to “jumpstart our economy, create or save millions of jobs, and put a down payment on addressing long-neglected challenges so our country can thrive in the 21st century” .

During his campaign, and throughout his new administration, the President has expressed a strong desire to invest in and promote alternative energy technologies.

The items listed below represent sections of the bill where fuel cell and accompanying hydrogen technology may receive funding.

## Division A - Appropriations

### **Title III - Department of Defense:**

Provides **\$300 million for RDT&E** programs managed by the Army, Navy, Air Force and Defense Wide. Fuel cells are specifically mentioned as eligible for funding under this program as noted in the report language. Solar, wind, biofuels and bioenergy are also eligible.

### **Title IV - Department of Energy:**

The ARRA provides the Office of Energy Efficiency and Renewable Energy (EERE) with \$16.8 billion, of which \$2.5 billion will benefit applied research, development, demonstration and deployment activities. The legislation specifically carves out \$1.2B carve out for biomass and geothermal. Proceeds from the remaining funds will be determined by the Secretary of Energy

EERE will also receive \$3.2 billion for **Energy Efficiency and Conservation Block Grants**. The program, which is already in existence, will provide \$400 million for competitively awarded grants. Historically, eligible projects include fuel cells in buildings.

The **State Energy Program (SEP)** will receive \$3.1 billion to provide grants to states to address their energy priorities and program funding to adopt emerging

renewable energy and energy efficiency technologies. As with the Conservation Block Grants, fuel cell projects have been funded through this program in the past.

The **Alternative Fueled Vehicles Pilot Grant Program** managed by the **Clean Cities program** will receive \$300 million. The funds will be used to help acquire motor vehicles with a higher fuel economy, including hybrid vehicles, electric vehicles, commercially available plug-in hybrid vehicles and the necessary infrastructure. A total of 30 grants, based on geography, will be awarded on a competitive basis.

**Transportation Electrification** activities will receive \$400 million to benefit a variety of vehicle platforms including fuel cells and fuel cell plug-in vehicles. Priority will be given to large-scale projects including programs at airports, material handling facilities, etc.

The **office of Electricity Delivery and Energy Reliability** will received \$4.5 billion for Smart Grid applications. In addition to grid upgrades, Smart Grid spending could benefit a number of distributed energy applications, including fuel cells.

**Office of Fossil Energy** was granted \$3.4 billion. Of the total, \$1 billion will be used for fossil energy research and development programs. High-temperature Solid Oxide fuel cell work has been incorporated into this suite of programs.

### **Office of Science**

The **Advanced Research Projects Agency-Energy (ARPA-E)**, will receive \$400 million for RDT&E. Created under the America COMPETES Act of 2006, ARPA-E was designed to fast-track commercialization of high-risk/high-reward technologies.

### **Title V—Financial Services and General Government**

The **General Services Administration** will receive \$300 million for **Energy Efficient Federal Motor Vehicle Fleet Procurement**. This supports purchase of advanced, efficient and lower carbon federal vehicles.

## Division B: Tax Credits

**Repeal of Limitation on Property Financed by Subsidized Energy Financing** – This section changes existing rules by eliminating the reduction of grants and subsidies on fuel cells – and other eligible technologies - to allow for maximum tax credit impact.

**Modification of Credit for Residential Energy Efficient Property** – Modifies the dollar limitation of the Investment Tax Credit for residential fuel cells placed in service in January 2009 and limited to joint occupancy dwellings. The new cap was increased to \$3,334/kW from \$1,000 kW.

**Hydrogen Refueling Property** – Until January 1, 2011 the tax incentive for hydrogen fueling stations will be 30% up to \$200,000. The dollar cap was previously set at \$30,000.

**Grants for Energy Property in Lieu of Tax Credits** - Between 2009 and 2010, facilities with insufficient tax liability can apply for a grant instead of claiming the ITC. Only tax-paying entities are eligible.

OMB has issued guidance to all agencies instructing them post updates and information on ARRA funds on [www.grants.gov](http://www.grants.gov). More specifically, it instructed that agencies shall post funding or “synopses” within 20 days of enactment, with full announcements to follow within thirty days of passage. (BD)

### **DOE Providing \$41 Million to Deploy Fuel Cells**

The U.S. Department of Energy recently announced \$41.9 million to support the immediate deployment of nearly 1,000 fuel cell systems for emergency backup power and material handling applications (forklifts) that have emerged as key early markets in which fuel cells can compete with conventional power technologies. The recipients, awards and projects are:

**FedEx Freight East** - \$1.3 million to deploy 35 fuel cell forklifts in Springfield, Missouri.

**Jadoo Power, Acumentrics Corporation, NASCAR Media Group, Lynch Diversified Vehicles, California's Police and Fire Departments of the City of Folsom, and Airgas, Inc.** - \$1.8 million to establish the environmental and cost benefits of using a 1-kW fuel cell power system to generate electricity.

**PolyFuel, Inc.** - \$2.5 million to further integrate and miniaturize the components of PolyFuel's portable power system for use in mobile computing, and analyze failure modes to increase durability.

**Anheuser-Busch** - \$1.1 million to deploy 23 fuel cell forklifts at their facility in Fort Collins, Colorado.

**Nuvera Fuel Cells** - \$1.1 million to deploy 10 fuel cell forklifts at East Penn Manufacturing's facility in Topton, Pennsylvania.

**Delphi Automotive** - \$2.4 million to develop, test and demonstrate a 3- to 5-kW solid oxide fuel cell (SOFC) auxiliary power unit (APU) for heavy duty commercial class 8 trucks.

**MTI MicroFuel Cells** - \$2.4 million to accelerate fuel cell use in consumer markets by demonstrating a one-watt consumer electronics power pack.

**Plug Power, Inc.** – \$3.4 million to validate the durability of Plug Power's 5-kW stationary combined heat and power fuel cell system and \$2.7 million to demonstrate the market viability of the GenCore® rack-mounted fuel cell product (275 kW of backup power).

**GENCO** - \$6.1 million (six awards) to deploy 156 fuel cell systems as battery replacements for fleets of electric lift trucks at six of GENCO's existing distribution centers (South Carolina, Pennsylvania - 3 locations, and Ohio - 2 locations).

**Sysco** - \$1.2 million to deploy 90 fuel cell forklifts at Sysco's new distribution center in Houston, Texas, due to open in August 2009.

**Sprint Communications** - \$7.3 million to demonstrate the viability of packaged 1-kW to 10-kW fuel cell systems with 72 hours of on-site fuel storage for backup power to communication infrastructure used by state and local first responders and by public safety answering points (911 centers).

**ReliOn Inc.** - \$8.6 million (two awards) to deploy 180 fuel cells with a new refillable 72-hour fuel system to locations across the AT&T Mobility Network, providing back up power to 25 sites throughout central and northern California.

## New Hydrogen Stations Planned in California and New York

Four new hydrogen refueling stations are coming to California under grant funding recently awarded by the state's Air Resources Board. Three of the stations will be located in Southern California and the fourth in San Francisco. Each site has been awarded \$1.7 million. The funded sites include new stations at the University of California, Los Angeles, and at San Francisco Airport. The university's public fueling station will provide up to 140 kilograms (kg) of hydrogen each day - enough to fuel more than 25 hydrogen-powered vehicles. The airport station will produce 120 kg of hydrogen/day to support both passenger cars and hydrogen transit buses operating in the Bay area. Two other sites will add hydrogen pumps to existing stations - Mebtahi Station Services in Harbor City and a Shell fueling station in Newport Beach.

Other good news for California include the recently passed Assembly Bill 118 which authorizes the California Energy Commission to provide approximately \$120 million annually over seven years to develop new fuels and technologies, ensure that they are accessible to the public, and encourage motorists and fleet operators to purchase new advanced vehicles. This bill specifically includes \$46 million for electric vehicles, public charging stations, and manufacturing plants and \$40 million for hydrogen fueling stations.



Hempstead, Long Island (New York) will also have its first hydrogen station this year. Construction work has started on the hydrogen station, located at the Conservation and Waterways headquarters in Point Lookout. Hydrogen for the station will be produced through electrolysis, using energy derived, in part by solar and wind power. The station will also dispense fuel for other green vehicles, including a blend of hydrogen and compressed natural gas) and compressed natural gas (CNG). (SC)

### California Fuel Cell Partnership Releases Fuel Cell Vehicle and Hydrogen Station Deployment Plan

The California Fuel Cell Partnership (CaFCP) recently released [Hydrogen Fuel Cell Vehicle and Station Deployment Plan: A Strategy for Meeting the Challenge Ahead](#), detailing strategies for deploying hydrogen fueling stations and fuel cell vehicles in California - including 4,300 hydrogen-powered passenger vehicles and 20 fuel cell buses by 2014. Forty-six retail hydrogen stations would be sited in six key communities, with the cost split between industry (\$60 million) and government (\$120 million).

CaFCP anticipates that hydrogen vehicle deployments will increase significantly over time and estimates that the state will need 50-100 hydrogen stations within eight years. To date, 250 hydrogen-powered cars and transit buses have been demonstrated in California. Presently only six of the state's 26 hydrogen stations are available to all automakers and their customers.

### Tokyo Fuel Cell Expo A Huge Success

The 5<sup>th</sup> International Hydrogen and Fuel Cell Expo (FC Expo) was held February 25-27, 2009, at Tokyo Big Sight in Tokyo, Japan. The show was held congruently with the PV EXPO and attracted a record number of 925 exhibitors and 63,590 throughout the three days of the exhibitions. Downstairs, the Secondary Battery Fair was held, and attendees from that show were also admitted into the fuel cell and PV ones.

The FC EXPO divided the exhibition center into several zones and areas: Devices/Materials Zone, Evaluation/Testing/Analysis Zone, Manufacturing Equipment Zone, Prototype Manufacturing Area, Hydrogen Production Zone, Supplying Technology Zone, Hydrogen Storage/Supply Area, Related Equipment Zone, Heat Utilization/Thermal Technology Area, Fuel Cell Systems/Products Pavilion. There was also an Academic Forum inside the exhibition area.



At the show, many companies displayed and demonstrated their products and systems. One highlight included seeing the ENE-FARM, a residential fuel cell unit that several utilities and oil and gas companies will begin selling in May. The six companies involved, Tokyo Gas, Osaka Gas Co., Nippon Oil Corp., Toho Gas Co., Saibu Gas Co. and Astomos Energy Corp. (joint venture between Idemitsu Kosan Co. and Mitsubishi Corp.), aim to sell a total of 5,000 units of the Ene Farm system in the first year. There were also a wide range of fuel cell vehicles on display as well as available for a ride and drive.

Next year's [FC EXPO 2010 & PV EXPO 2010 & BATTERY JAPAN](#) will be held March 3-5, 2010 at the same venue.