

SOUTH CAROLINA'S HYDROGEN AND FUEL CELL CLUSTER SUCCESSSES

The South Carolina hydrogen and fuel cell cluster was recognized in 2005. The cluster strategy aims to create a closely knit community of research, development and deployment organizations that are focused on creating a knowledge economy for the emerging industry and increase the per capita income of the citizens of South Carolina.

The following list of successes demonstrates the increasing level of hydrogen and fuel cell cluster activity in South Carolina and progress that has been achieved over the past 5 years:

RESEARCH

◆ ***Center for Hydrogen Research (CHR; now a part of the Applied Research Center) Opening and Expansion***

- Aiken County built this 60,000 square foot facility, which opened in October 2005, to take advantage of the expertise that exists at the Savannah River National Lab.
- Education, Training & Development Center (ET&D) is a 2,000 square feet laboratory within ARC: Hydrogen that is dedicated to education and training and was opened on May 15, 2009.

◆ ***USC Future Fuels Receives a \$12.5 Million Research Award***

- The University of South Carolina has been selected by the U.S. Department of Energy (DOE) to house a research center that is expected to bring \$12.5 million in federal funding.
- The center is one of 31 Energy Frontier Research Centers (EFRCs) being set up by DOE's Office of Science at leading universities around the country for advanced scientific research on energy.
- Led by Dr. Ken Reifsnider, the University will concentrate on designing and creating materials essential for engineering devices such as: fuel cells,

electrolyzers, electrodes, photovoltaics, combustion devices, fuel-processing devices, functional membranes and coatings.

◆ ***Savannah River National Laboratory (SRNL) Reaches Six Million Dollars Per Year in Sustainable Hydrogen Research Funding***

- SRNL is the world leader in high temperature hydrogen production processes.
- SRNL leads the DOE Hydrogen Storage Engineering Center of Excellence, which is a 5 year, 40 million dollar effort by national laboratories, universities and major automotive and research companies.
- SRNL is a nationally recognized leader in hydrogen storage materials development.
- SRNL opened its Hydrogen Technology Research Laboratory(30,000 sq. ft.) within the Center of Hydrogen Research
- SRNL/Toyota partnered on a landmark hydrogen storage materials research program which includes opening Toyota's state of the art hydrogen laboratory within the CHR.

◆ ***Trulite and Boroscience Collaborate on Office of Naval Research Advanced Energy Storage Award***

- Trulite has received a \$531,000 contract to produce hydrogen generators for the U.S. Navy.
- The contract is for the company to develop a generator that can produce 500 watts of power for military applications.
- Trulite has chosen to partner with BoroScience International, a Columbia, SC based company that produces boron-based compounds used in fuel cell devices.

◆ ***Microbial Fuel Cell Technologies, LLC Awarded Phase I SBIR by NSF***

- Microbial Fuel Cell Technologies, LLC is located in Charleston, SC and develops cost-effective, sustainable, and renewable production of biofuels and chemical feedstocks.
- The goal of Phase I SBIR is to determine the feasibility of scaling up the process for creating hydrogen from cellulose (cellulose comes from inexpensive feed stocks such as switchgrass, corn stover and other organic biomass) for existing markets such as the fertilizer, petroleum or other

industries that presently use fossil fuels to generate hydrogen to process their products.

- If the hydrogen production process is proven to be scalable then it will be a major step in producing hydrogen for transportation fuel.

◆ *Industry and University Partnerships*

- Nationally competitive faculty and research expertise is collaborating with industry in a meaningful way with work being conducted across the fundamentals, applications and commercial spectrum.
- Examples include:
 - ◆ National Science Foundation (NSF), Industry/University Collaborative Research Center for Fuel Cells
 - ◆ USC and Trulite Technologies received an NSF grant to focus on basic science.
 - ◆ DOE Nuclear Energy Research Initiative (NERI) nuclear/hydrogen energy grant to USC/ multiple partners
 - ◆ Collexis Holdings launched its “Fuel Cell Dashboard” product in partnership with USC.

ECONOMIC AND WORKFORCE DEVELOPMENT

◆ *2009 National Hydrogen Association Conference*

- This was South Carolina’s first major alternative energy industry conference.
- Nearly 3000 people attended the event, of which, 700 were industry members and 2250 were from the general public.
- 18 Podium presentations and 18 poster presentations were from SCHFCA members and partners.
- There was nearly \$2 million worth of press coverage.

◆ *South Carolina Hydrogen and Fuel Cell Community Grows*

- Companies locating in the state of South Carolina for work on fuel cell systems include the Danish company Dantherm, Logan EnergySC, and Trulite.

- The South Carolina fuel cell community grew further with the addition of startup companies NextGenEn and Tetramer.

◆ ***South Carolina's First Fuel Cell Manufacturing Facility***

- In September of 2008, Trulite Inc. signed a Memorandum of Understanding with Midlands Technical College to develop a pilot manufacturing facility in Columbia, SC.
- The Facility will be the North American manufacturing site for the Hydrocell fuel cartridge.

◆ ***Kusters Zima and Nuvera Partnership***

- Nuvera Fuel Cells, headquartered in Billerica, Massachusetts, has selected Spartanburg based Küsters Zima as a manufacturing partner for its hydrogen generation product, PowerTap™.

◆ ***Midlands Tech's Fuel Cell Technology Program***

- Tech's existing fuel cell laboratory, opened in 2006, trains students in basic fuel cell technology. To develop a work force of fuel cell technicians, the college has expanded its facilities to include two additional laboratories.
- Midlands Tech has built a fuel cell subsystems lab and a commercial-variety analytical testing lab. The subsystems lab is designed to train technicians in the components and equipment that make up a fuel cell unit.

DEMONSTRATIONS, DEPLOYMENTS, AND COMMERCIALIZATION

◆ ***SC Hydrogen Freeway Opening***

- The first two hydrogen fueling stations in South Carolina opened in March 2009, one in Aiken and one in Columbia.
- The stretch of Interstate 20 between the two cities, dubbed the "SC Hydrogen Freeway", is now able to be traveled by hydrogen powered vehicles.

◆ ***Bridgestone Firestone Forklift Fleet***

- Traditional lead-acid batteries used in forklift trucks are being completely replaced with fuel cells at the Bridgestone/Firestone Manufacturing facility in Aiken, SC.

- In 2008, the first half of the forklift fleet was switched out, a total of 23. The remaining trucks in the fleet will be swapped out in 2009.
- ◆ ***CHR's Hydrogen Vehicle***
 - The Chevrolet Silverado 4x4 hydrogen internal combustion engine truck is the first registered hydrogen vehicle in South Carolina.
 - The truck was designed and engineered by eTech of Arizona and modified by Roush Industries of Michigan.
- ◆ ***Hydrogen Fuel Cell/Battery Hybrid Bus in Columbia***
 - The “Hydrogen Hybrid Bus” bus arrived in Columbia, SC in March 2009 and will service routes for CMRTA and the University of South Carolina (USC) bus fleets starting in fall of 2009.
 - The 35-foot, 37-passenger uses lithium titanate batteries to power an electric motor for propulsion. The batteries are recharged during operation by two onboard hydrogen fuel cells and regenerative braking.
- ◆ ***GENCO Award for Forklift Fleet***
 - GENCO was awarded \$6.1 million to deploy 156 fuel cell systems as battery replacements for fleets of electric lift trucks at six of GENCO's existing distribution centers, one being in South Carolina.
- ◆ ***USC Baseball Scoreboard Fuel Cell***
 - A hydrogen powered fuel cell was installed at the new University of South Carolina Baseball Stadium in February 2009.
 - The fuel cell powers a portion of the scoreboard.
- ◆ ***Net Zero Home in Aiken***
 - The ridge at Chukkar Creek will feature a home that will be powered by a combination of a hydrogen fuel cell and solar energy.
 - The expectation is that the home will be able to produce, on average, as much or more energy than it needs to operate.
 - Construction is to begin in May 2009.
- ◆ ***Greater Columbia Fuel Cell Challenge***
 - The Greater Columbia Fuel Cell Challenge was created and launched in 2006 as a mechanism to engage private sector investment, commercialization, and deployment of hydrogen & fuel cell technologies in the Columbia region.

- The GCFCC has had a total economic impact of over \$2,000,000 with more than 2/3 of project funding coming from federal and private sectors.
- More than 100 proposals have been reviewed. Funding has been provided for 19 projects covering the discovery, development, and deployment range of applications.

- ◆ Discovery:

- Edventure Children’s Museum Alternative Energy Exhibit
- SC K-12 Educational Program
- SC Citizen’s School for Hydrogen & Fuel Cells
- FIRST Robotics “Green Machine” competition
- Midlands Technical College Fuel Cell Technician Training Program

- ◆ Development:

- Hybrid Battery-Fuel Cell Segway project (Hydrogen Hybrid Mobility, LLC)
- NextGenEn Solid Oxide Fuel Cell Prototyping Project (NextGenEn, LLC)
- Sodium Boro-Hydride Energy Storage Pilot Project (Boroscience International)
- Trulite Hydrocell Pilot Manufacturing Project (Trulite)

- ◆ Deployment:

- LiftOne/Hydrogenics Fuel Cell Forklift demonstration project – Phase I (LiftOne/Hydrogenics)
- LiftOne/Hydrogenics DOE Fuel Cell Forklift demonstration project – Phase II (LiftOne/Hydrogenics)
- SCETV fuel cell camera project (SCETV/Jadoo Power)
- Benedict College Backup Power Project (Logan Energy/Plug Power)
- Jadoo XRT First Responders Demonstration Project (Jadoo Power)
- Trulite KH4 Beta Test Market Deployment Project (Trulite)
- USC-NASA Solid Oxide Power Generation Demonstration Project (USC Future Fuels)
- City of Columbia Telecom Backup Fuel Cell Power Project (Dantherm Power)
- Logan Energy Micro CHP Fuel Cell Demonstration Project (Logan Energy)

- USC Baseball Stadium Back up Power Project (University of South Carolina)

POLICY

◆ *The South Carolina Hydrogen Infrastructure Development Act was established in the 2007-2008 Legislative Session*

- The HIDA established a fund that allows for up to \$15 million to be distributed in the form of grants:
 - ◆ Seven million dollars for the fiscal year 2007-2008;
 - ◆ Five million dollars for fiscal year 2008-2009;
 - ◆ Three million dollars for fiscal year 2009-2010.
- Tax credit: A taxpayer who contributes to the HIDA Fund is eligible for a credit equal to twenty-five percent of a qualified contribution made by a taxpayer to the fund.

◆ *2009 State Budget Appropriations*

- The USC appropriation for hydrogen research totaled \$775,601.
- The Budget and Control Board (South Carolina Energy Office) hydrogen fuel station loans totaled \$1,450,800.

◆ *The 2009 Hydrogen Permitting Act*

- An SCHFCA working group and Speaker of the House, Bobby Harrell, collaborated to introduce legislation to the South Carolina Legislature in April 2009 that places the authority to permit hydrogen and fuel cell facilities at the state level.
- The South Carolina Office of the State Fire Marshal is proposed to assume the authority to permit facilities.
- As of April 16, 2009 the bill has been read, approved and passed to the Senate by the House. The bill has been referred to the Senate Committee on Judiciary.

COMMUNICATIONS, EDUCATION, AND OUTREACH

◆ *National and Local Press*

- The SCHFCA has remained successful with the local press. Its success with the national press improved this year due to the NHA 09 Conference.
 - In 2008 an estimated 4.7 million people were reached by SCHFCA.
 - In January – April of 2009, Chernoff Newman estimated that 78 million people learned about the NHA meeting in South Carolina.
- ◆ ***SCHFCA/Greenway DOE Education Award***
- The DOE awarded the SCHFCA and Greenway Energy \$190,000 to develop a program that will educate State and Local government officials in South Carolina.
 - To date, the program has educated over 50 state and local decision makers.
 - The award is one of 6 that were given to several other state focused initiatives that the SC team is coordinating with.
- ◆ ***2008 Hydrogen Road Tour***
- The California Fuel Cell Partnership, NHA, The US Department of Energy and the US Department of Transportation organized a coast-to-coast tour of hydrogen powered vehicles.
 - There were three stops in South Carolina: The BMW manufacturing facility in the upstate; Midlands Technical College in Columbia; and, the Bridgestone/Firestone manufacturing facility in Aiken. The SCHFCA was the local organizer for all three events.
 - Over 1000 people from the general public showed up for the event.
- ◆ ***Hydrogen Education mini-Tour***
- Prior to the 2008 Hydrogen Road Tour, the Hydrogen Education Tour purchased in 2005 was updated into an “Executive Summary” version.
 - The update consolidated the broader tour message into a smaller mini-tour that required less investment of time and money and brought outdated information up to current status.
- ◆ ***“Can a Fuel Cell Power It?” Video Series***
- A video series was started in late 2008 by the SCHFCA that shows fuel cells of various sizes in a variety of applications demonstrating the versatility of the technology.
- ◆ ***Codes Workshop***

- A workshop put on by the Department of Energy was conducted in April 2009 to educate codes officials about hydrogen and fuel cells, their proper handling and to show them the technology in action.
- The SCHFCA sponsored the event and contributed support resources to coordinate the event.