FUEL CELLS 2000'S

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FUEL CELL QUARTERLY

Hydrogen Funding Restored (Almost)

After a huge proposed cut to the U.S. Department of Energy's hydrogen fuel cell vehicle program by Secretary Chu, which basically phased out the program, the hydrogen and fuel cell industry and its supporters mobilized to restore the funding and show why fuel cell vehicles are a crucial part of our nation's energy portfolio.

A recent paper by the United States Council for Automotive Research LLC, a cooperative effort between General Motors, Ford Motor Co. and Chrysler, urged the Obama administration to restore the funding cut from hydrogen fuel cell research, arguing that failing to do so would make the U.S. "uncomfortably dependent" on foreign nations for the technology. The paper, *Hydrogen Research for Transportation: a USCAR Perspective*, concludes that "only hydrogen fuel cell electric vehicle technology offers the promise of true-zero emissions, superior efficiency and uncompromised functionality" and also suggests that electric vehicles can't compete with fuel cell vehicles in terms of driving range and refill time.

This report echoes the sentiment of several other prominent studies, including one from the National Research Council of the National Academies entitled, *Transitions to Alternative Transportation Technologies – A Focus on Hydrogen*, that conclude that while dedicated EV's, plug-ins, and biofuels will all need to do their part, hydrogen will get us across the goal line of cutting U.S. greenhouse gas (GHG) pollution by 80% below 1990 levels. The National Hydrogen Association released their own report called the "*Energy Evolution: An Analysis of Alternative Vehicles and Fuels to 2100*" that also shows that a scenario which initially includes a mix of alternative vehicles, and is later dominated by hydrogen fuel cell electric vehicles sales, is the only way to reduce GHGs down below 1990 levels; reach petroleum quasi-independence by mid-century; and eliminate nearly all controllable air pollution by the end of the century.

Letters were sent to Secretary Chu and the appropriations committees of both houses of Congress by the California Air Resources Board; a group of National Organizations including the Alliance of Automobile Manufacturers, American Lung Association, Electric Drive Transportation Association, National Hydrogen Association, Stella Group, Ltd., Union of Concerned Scientists and the U.S. Fuel Cell Council; the Hydrogen and Fuel Cell Caucus; a group of bi-partisan Governors; and the general public, highlighting the need for a balanced energy technology portfolio that includes hydrogen and fuel cells.

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Automakers Reaffirm Commitment to Fuel Cells

Automakers, in partnership with national and regional governments, are reaffirming and in some cases accelerating their fuel cell commercialization time tables. While some companies are also pursuing plug-in hybrid and biofuel options, they are making it clear they believe the fuel cell vehicle (FCV) is a superior product and an integral part of their technology future.

General Motors (GM) currently has 115 fuel cell vehicles on road in average Americans' hands and has reaffirmed commitment despite management changes and financial hard times. GM's goal is to have a fuel cell powertrain ready for production by 2012. "Technology leadership is one of the pillars of the company. That is going to remain, and it will probably be emphasized as part of the brand of GM," says Alan Taub, executive director of GM Research and Development. GM recently unveiled its 5th generation fuel cell stack, which is significantly smaller than previous version. The new stack now uses 30 grams of platinum, a reduction of more than 50% from the 4th generation, which greatly reduces the cost. Motor Trend characterized the next generation stack as "vastly cheaper." GM intends for the 6th generation fuel cell stack to only use 10 g of the precious metal. The new stack also shows improvements in durability, and the company expects the 5th generation to last 120,000 miles.

Honda's Clarity FCX was named "World Green Car of the Year" at NY Auto Show and is currently being leased in small numbers in Southern California and Japan. Actress Jamie Lee Curtis drives one. The Clarity received an EPA certified fuel economy of 72 mpg. Honda has reiterated its commitment to fuel cell vehicles, with its head of environmental planning claiming, "A conventional battery-powered car would require a battery weighing two tons to match the range and performance of the Clarity, and it would take hours to charge fully." The Clarity fuel cell vehicle refuels in about three minutes.

Honda FCX Clarity outside our office

Daimler began small series production this summer of its Mercedes-Benz B-Class F-Cell vehicle with plans to increase to tens of thousands of vehicles in the 2015-2017 timeframe and 100,000's within a few years after that.

Daimler F-Cell driving up an icy hill

Toyota reaffirmed its commitment to commercialization by 2015, perhaps a year earlier, and recently claimed that the auto industry will be "shocked" by the low price of its first production fuel cell vehicle. Toyota's Highlander Fuel Cell Hybrid Vehicle – Advanced (FCHV-adv) achieved an estimated range of 431 miles on a single tank of compressed hydrogen gas, and an average fuel economy of 68.3 miles/kg (approximate mpg equivalent). The data were monitored and confirmed by the National Renewable Energy Laboratory.

Kia's Borrego FCV

Hyundai-Kia plans production of 1,000 fuel cell vehicles in 2012 and 10,000 per year by 2015. Kia's Borrego fuel cell vehicle has a range of 340-370 miles. The company also plans to invest $1.7 billion (US) in fuel cells, hydrogen and hybrid vehicles by 2013.

Volkswagen, which has not been a visible fuel cell advocate until recently, confirmed that it remains committed to building fuel cells for its hydrogen-powered vehicles. A total of 16 VW fuel cell vehicles originally tested in China are now operating on the road California, joining 8 others already there.

Volvo, through its subsidiary Volvo Technology Transfer, is to receive a total of $25 million (US) from the Swedish Energy Agency and two international investors for fuel cell research.

The automakers seem to be charting their course for the future and we are excited that fuel cell vehicles seem to play a major role.

Fuel Cells Enlist in Armed Forces

Fuel cells have the potential to dramatically change how the military carries out its missions, and how soldiers operate in the field. With the largest, most technologically advanced military in the world, the U.S. armed services uses an immense amount of fuel and electricity, and any use of alternative energy would have positive effects on reducing greenhouse gas emissions. However, fuel cells are of particular interest to the military not for their environmental savings, but because of unique technical features that can aid soldiers in the field.

The military has power needs that are quite different from commercial or residential applications. In a combat setting stealth is of the utmost importance, since noise and heat signatures can be used to locate military personnel. Fuel cells have no moving parts and are extremely quiet with a low heat signature, making them more difficult to detect by remote infrared scanning. Fuel cells can operate close to body temperature, as opposed to batteries which give off significant heat.

Due to their scalability and power output capabilities, fuel cells have been demonstrated and tested for use in numerous military applications.

Following a groundbreaking earlier this week, the U.S. Army is constructing a new Department of Defense's Ground System Power and Energy Laboratory (GSPEL), a one-of-a-kind research and testing laboratory complex. Eight different labs will be housed in the 30,000-square-foot facility and they are being designed as the cornerstone for the Army's next generation of power and energy initiatives. The facility will provide scientists and researchers with the ability to integrate hybrid-electric and fuel cell technologies into advanced military vehicles. The Army, with the world's largest vehicle fleet, has been working on fuel cell auxiliary power units (APUs) for vehicles, to reduce the amount of gas and diesel they use to power on board equipment and electronics. This laboratory will help further development and demonstration of APUs and fuel cells for propulsion.

The Army has also been testing fuel cell powered Unmanned Ground Vehicles (UGVs) and they aren't the only branch interested in the technology. The Air Force has been working with private companies to develop fuel cell powered Unmanned Aerial Vehicles (UAVs), both for surveillance and operational missions. The Army and Marine Corps are funding projects for portable soldier power and the Department of Defense has been deploying fuel cells to provide electricity for barracks, camp operations and officer's quarters since the early 1990s. The Navy is also researching fuel cell-powered submarines.

Unmanned Aerial Vehicles

Unmanned Aerial Vehicles (UAVs) are remote-controlled or self-piloted aircraft that can be used to collect surveillance data or deploy weapons, all without putting soldiers in harm's way. UAVs have been used since the 1950's but technologic advances have made UAVs an invaluable resource for modern warfare. Fuel cell-powered UAVs have the potential to further improve capabilities because they can fly higher and longer than current battery powered UAVs. Batteries' weight and bulk make the units less maneuverable and reduces the payload.

PUMA UAV taking flight

Protonex Technology Corporation is working closely with the military to design fuel cells for UAVs. The company's UAVs have increased flight endurance, are smaller, more flexible, and more cost effective than alternatives, allowing for more persistent surveillance, improved search and rescue capabilities, chemical and biological monitoring.

This past March, Protonex was awarded a $3.3 million dollar contract from the Department of Defense (DoD) to continue its work on developing fuel cells for UAVs. The company will receive a $2.2 million base award, with a $1.1 million option, for working with partner AeroVironment on its PUMA-AE plane. In May, Protonex also received a $265,000 dollar award from the Air Force Research Laboratory (AFRL) to continue their efforts to miniaturize fuel cells already used in the PUMA project, this time for AeroVironment's Raven UAV. The Raven is a battle tested, light weight UAV designed for rapid deployment, high mobility and mass production.

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The goal is to create a UAV that has longer flight duration to extend mission capabilities.

Unmanned on the Ground

Fuel cell power systems have also proved advantageous for unmanned vehicles on land, or UGVs. UGVs are small, remote controlled vehicles that can gather surveillance information while keeping soldiers safe. To be useful, UGVs need to have a long enough range to get to mission critical areas, and they need to be able to power the necessary on-board electronics to gather data.

Adaptive Materials' UAV fuel cell

Protonex is also integrating their fuel cells into UGVs and has teamed up with Foster-Miller, Inc. to work on a project funded by the Defense Logistic Agency (DLA) and managed by the Navel Surface Warfare Center, Crane Division. Protonex designed a fuel cell power system for Foster-Miller's Talon robotic UGV and in April, 2009, the Talon demonstrated three times the range, extending to 45 km, and twice the energy density, as an advanced battery powered system. The fuel cells provide 200 watts of continuous power and met all the peak demands of the Talon.

In May 2009, Adaptive Materials demonstrated a real world test of their IRobot scout UGV. The IRobot held a constant speed for 3.1 mph for 40 miles. The UGV was operational for 12 hours, running on 150 watt fuel cell system, with a peak output of 600 watts. The fuel cell system powered all onboard cameras and computers, using three 8 oz canisters of commercially available propane gas. In a comparison test, a battery powered UGV provided 40 minutes of similar operation. The fuel cell not only dramatically increased range and mission time, but Adaptive Materials was able to achieve these improvements at a fraction of the cost. To put the test into perspective, the IRobot covered the same distance as between the GreenZone in Baghdad to Fallujah. In August, the company completed a successful demonstration of its UGV at the Naval Air Weapons Station, China Lake.

Portable Power

Ultracell fuel cell

Soldiers carry anywhere from 50 to 100 pounds in their packs, depending on mission and closeness to camp. This does not include advanced electronics needed for missions, and their battery sources. Batteries are heavy, and need to be replaced on a daily basis, not to mention recycled or safely disposed of. Batteries also drain, reducing the output and requiring frequent recharging. Fuel cells deliver constant power and can last longer before refueling, which is a fast and easy process, reducing precious time. During Operation Iraqi Freedom battery supplies barely met demand, so the military is extremely interested in lighter and longer-lasting fuel cells.

The Army Communications-Electronic Command, the Marine's Expeditionary Program, and scientists from the Pacific Northwest National Laboratory have been working together to develop a 100 watt fuel cell system that could recharge batteries and power small electronics. Battelle has developed a fuel processor and a PEM fuel cell that is the size of a half gallon of ice cream. The fuel cell would run on methanol fuel processed into hydrogen. The system would allow soldiers to carry only one battery, recharging it from the fuel cell output.

In July 2009, the Army awarded Protonex a $345,000 dollar contract to continue its research into advanced fuel cell portable power systems for soldiers. Protonex and its partner UltraCell will integrate and test power systems using UltraCell's XX25 and XX55 fuel cell sys-

Israel Also Testing Fuel Cell UAVs

The Israeli company BlueBird Aero Systems has completed their fuel cell-powered Boomerang UAV, which uses a PEM fuel cell system from Horizon Fuel Cell Technologies. The Boomerang has a maximum takeoff weight of 20 pounds and can carry a little over 2 pounds of payload. The fuel cells give it 9 hours flight endurance, and it has an operating range of 3,000 – 15,000 ft. The Israeli's intend to follow up in 2010 with a fuel cell powered version of their Skylite UAV.

The fuel cell system in the Boomerang is the AeroPAK, developed by Horizon. The AeroPAK can increase flight endurance by 300%, and is designed to operate at 22,000 feet. The fuel cell has been miniaturized, so it can be used as a drop in replacement for battery packs for UVAs already in service. Horizon developed the AeroPAK for commercial use, but the system does have military capability because the fuel cell can power on board GPS, cameras, and lasers.

tems in the Protonex Soldier Power Manager and Battlefield Power Manager. The two companies will also develop standards for portable power plug-and-play. Since both companies use a methanol/water mixed fuel, they will work together to develop a universal fuel mix. By standardizing packaging, components, and fuel, it will be easier for the military to procure fuel cell products from both companies, and know the systems will work together.

Silent Watch/Silent Camp

Fuel cell power systems can be used in silent watch and silent camp operations. As the name suggests, silent watch is when surveillance activities are undertaken in a stealth manner, and silent camp is when the camp goes dark and quiet. It is difficult for a tank or armored vehicle to operate in stealth mode, since the engine must be turned on to power onboard computers, cameras and other electronics necessary for information-gathering. At camp, noisy generators supply electricity, so moving to stealth mode requires the use of batteries. However, since batteries give off a high heat signature, the camp would still be detectable with infrared cameras.

In 2006, the Energy Branch at the Army Engineering Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL) hosted an industry forum to determine if civilian focused companies might already have commercial technologies that could be used for military applications. For silent watch, the idea of a Stryker vehicle with an APU came out of this forum. While the Stryker is running, some power is siphoned off to run an onboard electrolyzer that generates hydrogen fuel. Then the vehicle can be shut off, and run in silent mode, where the fuel cell powers onboard electronics. For silent camp operations, a fuel cell power system would be used as a back up to standard generators. The fuel cell also allows for generator maintenance to occur without disrupting camp activities.

Fuel cell submarine taking a dive

Under the Sea

Fuel cell-powered submarines have the potential to be a safer alternative to nuclear power subs, with the obvious benefits in that fuel cells are not radio-active, and do not require extensive decommissioning at the end of life. Like nuclear power subs, fuel cells are virtually silent, a key factor in modern day sub building.

The German government has taken the lead on developing operational fuel cell powered submarines. Working in this area since 1995, Howaldtswenke-Deutsche Werft (HDW) has created two fuel cell powered subs, the U212 and the U214. Both models run on nine 34 kW Siemens PEM air-independent fuel cell power system. The subs have increased diving depth, underwater endurance, and overall efficiency. These are fully equipped and operations submarines that can spend up to three weeks under water. The German Navy has ordered four U212s for their fleet. In February of 2000 the Greek Navy ordered four U214s which will be in production soon, and the Italian Navy has ordered two U212s as well.

This month, the Polish Navy announced they have contracted with Sweden-based Morphic Energy to deliver fuel cell technology for submarines. Morphic's design is also an air-independent fuel cell system. The technology will be delivered for testing in submarines, but it is not clear when the subs will be operational.

The American Office of Naval Research has been involved in fuel cell research for both submarines and surface ships, although there are no definitive plans to roll out fuel cell-powered crafts. The Navy is interested in fuel cell systems that can operate in all necessary environments, including: surface, air, underwater, and combat. The Navy already has a diesel infrastructure in place, and is using technologies that obtain hydrogen from diesel.

Fuel cells are important to the future of the Navy because they can increase efficiency while reducing cost. Currently, the engine on a surface ship is located in a single spot, and if the engine is knocked out, the ship is rendered inoperable. Fuel cells can be scaled down and are modular allowing for their placement throughout the ship. This allows for greater design flexibility, but also increases survivability in combat.

All four branches of the U.S military are actively working on various fuel cell projects and demonstrations with the hopes that the technology will help our soldiers and equipment continue to be all they can be. (ED)

Hydrogen Infrastructure Continuing to Grow

In our last newsletter, we highlighted new stations that opened in South Carolina as well as announcements of upcoming hydrogen station openings in both California and New York. Since then, there has been a lot of activity both here in the United States and overseas.

Shell has been operating a hydrogen station in White Plains, New York, for more than a year now, and last month, opened another one at John F. Kennedy (JFK) Airport in Jamaica, Queens. Shell is working with General Motors to provide a cluster of hydrogen stations to service Project Driveway participants in the metro New York area. The companies also collaborated with the Port Authority of New York and New Jersey, and the US Department of Energy (DOE) on the JFK station. A third will open in 2009 in the Bronx in conjunction with the New York City Department of Sanitation, forming a cluster of stations about 30 miles apart from each other.

Airports seem to be the 'it' spot for hydrogen fueling stations. Yeager Airport, in Charleston, West Virginia, just opened a hydrogen production & fueling facility, with assistance from DOE and the National Energy Technology Laboratory (NETL). The airport will receive three hydrogen-powered vehicles from DOE in exchange for donating land. There will be other vehicles that will eventually fuel up at the Yeager station - the airport is purchasing a hydrogen-powered pickup truck that was previously used in an Arizona demonstration project and the Air National Guard's 130th Airlift Wing has received a hydrogen fuel cell-powered forklift that will be used for loading aircraft and other applications. This station in West Virginia is set to be part of a mini hydrogen highway in the I-79 corridor with another station set to be located at West Virginia University (WVU) at Morgantown and a third located in Pittsburgh.

Yeager Airport station opening

In 2010, the San Francisco International Airport (SFO) will also open a hydrogen fueling station, designed and installed by Linde North America. The hydrogen will be used to fuel a fleet of SFO's shuttle buses as well as a demonstration of San Francisco Municipal Transportation Authority's hybrid transit bus that incorporates a hydrogen-powered fuel cell, batteries and low sulfur biodiesel technology. California already leads the way with 22 operational stations and the SFO station is just one of 11 planned in the near future.

NASA has experience with fuel cells for decades aboard the space shuttle and is now delving into hydrogen and fuel cells on land. NASA's Glenn Research Center is leading a team of industry and university partners to demonstrate a prototype of a renewable hydrogen fueling station using wind and solar power to produce hydrogen from water. The station will be located in downtown Cleveland at the Great Lakes Science Center, where it will use Lake Erie water to generate hydrogen for a Greater Cleveland Regional Transit Authority bus powered by fuel cells. The transit authority will operate the bus in revenue service.

Hydrogen Station at Tokyo Gas HQ

Overseas, there is a lot of movement on the hydrogen infrastructure front as well. In Japan, which already has eleven hydrogen fueling stations, has stepped up its game as of late. Thirteen Japanese companies, led by Nippon Oil, have formed an alliance develop to commercial technologies for supplying hydrogen to fuel cell vehicles by 2015. The companies joining Nippon Oil include Idemitsu Kosan Co., Ltd.; Iwatani International Corporation; Osaka Gas Co., Ltd.; Cosmo Oil Co. Ltd.; Saibu Gas Co., Ltd.; Japan Energy Corporation; Showa Shell Sekiyu K.K. Ltd.; Taiyo Acid; Tokyo Gas Co., Ltd.; Toho Gas Co., Ltd.; Air Liquide Japan, Ltd.; and Mitsubishi Kakoki Kaisha, Ltd. The alliance will focus on making hydrogen competitive with gasoline.

Germany has also been aggressively working to build up their hydrogen infrastructure for Daimler's F-Cell vehicles (see "Automakers Reaffirm Commitment to Fuel Cells") and hydrogen-fueled buses. Daimler recently unveiled its new Mercedes-Benz Citaro FuelCELL Hybrid bus in

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Specialty Vehicles Moving Forward

Fuel cell vehicles are not limited to cars, trucks and buses. Car companies, along with fuel cell designers, machine manufacturers and even government entities, have worked together to bring fuel cell technology out of the laboratories and into everyday life. With smaller and lighter fuel cells, scooters, bikes, motorcycles, even wheel chairs are showcasing the possibilities fuel cells have to offer.

Scooters, motorcycles, and bikes are are excellent for city use because they are lightweight, maneuverable, and considerably cheaper than owning a car. However, each has their own limitations that fuel cell technology can help address. Fuel cell powered scooters and motorcycles release no greenhouse gas emissions during use. Bikes can be an excellent way to get around a city, especially if one's commute isn't very long. However, hills and long distances can make using a bike as a personal vehicle rather difficult. Fuel cell powered bikes are still pedaled like a regular bike, but have a fuel cell for additional power when needed.

Fuel cell powered motorcycles have been designed and tested since the early 2000's. Intelligent Energy, a company based in the United Kingdom, launched a fuel cell motorcycle with a top speed of 50 mph in 2005. The beauty of the ENV motorcycle (pronounced envy) was that the fuel cell stack could be removed from the motorcycle when you reached your destination and used as a power source for your radio, tv, grill or other electronic device. The ENV can run at top speed for almost 100 miles, and at current prices it only costs $4 to refill the tank.

Intelligent Energy first developed the ENV as an example of how far fuel cell technology has come in terms of power, reliability, size, and cost. The PEM fuel cell motorcycle proved to be so successful that the company has continued designing and developing fuel cell motorcycles. Intelligent Energy has partnered with motorcycle maker Suzuki and in 2007 they released the Crosscage. The PEM stack designed for the Crosscage is small enough to fit in a motorcycle, and lends itself well to mass production. Intelligent Energy has committed to designing a motorcycle that has zero tail-pipe emissions, a good range, and a short refueling time and says it will release a test fleet by the end of 2009, and they hope to have a commercially available product by the 2012 Olympics.

Intelligent Energy/Suzuki Crosscage

All of these motorbike technologies are great ways to promote fuel cell vehicles before a full hydrogen infrastructure has been developed for cars. Specialty vehicles are intended for shorter intra-city travel. The refueling needs for these vehicles are smaller than the needs of cars would be. By installing a few, well placed, hydrogen refueling stations fuel cell scooters, motorcycles, and bikes could be a viable transportation option in cities all across the US.

Another exciting application for fuel cells is wheelchairs. Electric powered wheelchairs have been available on the market for a while, but recharging takes a long time, and the battery can discharge before you get to your destination, making them unreliable. In 2006, Suzuki unveiled a fuel cell wheelchair proto-type named MIO. The chair is powered by a fuel cell fed by 4 liter methanol tanks, and has a lithium ion battery to store energy and for use as backup power. The methanol tanks can power the chair for 25 miles, and the chair comes equipped with an LCD display which tells users what power source they are using, and what the fuel level is. Because fuel cells are smaller, the wheelchair is compact, allowing for easy crowd mobility.

In 2008, the Japanese government committed to building a hydrogen economy. This focus on hydrogen-based technologies, and the knowledge that a large portion of the Japanese population would soon be over the age of 65 has prompted many non-automotive companies to begin to design fuel cell -powered vehicles such as the wheelchair. Kurimoto, a machine manufacturing company, has developed a PEM fuel cell wheelchair, and is looking to expand to fuel cell powered walkers and scooters in the future.

Kurimoto fuel cell wheelchair

Switzerland started a projected called *hy.muve* to attempt to design and build a hydrogen based municipal vehicle. The project was funded largely by the Swiss government, and was a collaborative process between many companies and laboratories.

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The project is the brain-child of EMPA laboratory in Switzerland and includes the cooperation of Messer Schweiz AG, Brusa Elektronik, the Paul Scheerer Institute, Proton Power Systems, a fuel cell manufacturer, and Bucher Schorling, a municipal street cleaning vehicle manufacturer,. The goal was to take hydrogen technologies out of the world of labs and science, and into the real world. So far the project has been a huge success. This past July, Proton Power Systems announced they have developed a fuel cell powered municipal street cleaning vehicle This vehicle is the first of its kind, and highlights the importance of collaborative research.

The street cleaner is compact at 3.78 meters in length and 1.28 meters wide. The 20-kW fuel cell can power the vehicle with a maximum speed of 40 km/h for more than 7 hours, and it takes less than 10 minutes to refuel with hydrogen obtained from natural gas.

The success of the project comes not only in just developing a fuel cell vehicle, because that has already been done, it comes in creating a specific vehicle to address specific needs. The fuel cell street cleaner replaces a conventional diesel internal combustion engine, which was loud, smelly, and had high greenhouse gas emissions. The fuel cell vehicle is virtually silent and emission-free. This allows the street cleaning vehicle into pedestrian only areas, and into areas of high air pollution, where the diesel powered street cleaners cannot. Even taking into account the process of obtaining hydrogen from natural gas the fuel cell street cleaner saves about 50% of the energy when compared to the diesel engine.

The prototype street cleaner has been put into use in the Swiss city of Basel, where it will be tested for 18 months in real world conditions. This means actual city employees will operate the fuel cell vehicle in order to test how well it holds up to changes in weather, impurities in the hydrogen supply, and reaction to dust kicked up during the street cleaning process. The group will also gauge public acceptance of the vehicle, efficiency, and cost savings before deciding whether or not to order more vehicles.

The *hy.muve* project spotlights how important innovation is for fuel cell technology. Fuel cell specialty vehicles have the potential to play a very important role in emissions reductions, because there are no in-use emissions of greenhouse gases. Thus these vehicles are safe to use in doors, such as at airports, hotels/resorts, and convention centers. With more and more cities creating pedestrian only zones, fuel cell-powered vehicles could potentially still be allowed because they are silent and do not emit pollution. These vehicles could be used on golf courses, universities or national parks, or other places where clean, quiet, efficient technologies are necessary. If the Basel fuel cell street cleaner proves to hold up in real world settings, it will be interesting to see where the market will go from there.

The *hy.muve* project also highlights how government involvement can help push technology advances. The Swiss government wanted a hydrogen municipal vehicle. They got a street cleaner, but the project was set up in such a way they could have developed hydrogen police cars, or buses. The support for innovation was there, with out stifling creativity.

Intelligent Energy is involved in another government sponsored, collaborative hydrogen project. The United Kingdom's Technology Strategy Board has allocated £23 million for 16 innovative low carbon vehicle development projects. Intelligent Energy has partnered with Lotus Engineering, London Taxis International, and TRW Conekt to develop a fleet of fuel cell hybrid taxis for the 2012 Olympic Games. The goal is to develop a fuel cell battery system that will allow the taxi to run all day before refueling, and have a top speed of 75 mph. The fleet will refuel at night at a centralized hydrogen filling station. So far it looks as if the project will be successful in meeting its 2012 goal.

People who say fuel cell vehicles are a thing of the future are wrong. We already have plenty of fuel cell powered vehicle options from bikes to buses. Each generation of fuel cell technology becomes more compact and lighter than the one before. This past decade has seen the development of scooters, wheelchairs, even Segways. As these technologies prove themselves in the market, what other fuel cell powered vehicles can we look forward to in the next 10 years? (ED)

Funding, from page 1

All the hard work and outreach seems to be paying off. The Full Senate recently passed its version of the Energy Water Appropriations bill proposing $190 million for fuel cells and hydrogen managed by DOE's Energy Efficiency and Renewable Energy (EERE) and $58 million for DOE's Fossil Energy department's SECA (solid oxide fuel cell) program. The House also passed its version of the spending bill which provides $153 million for EERE activities - an $85 million increase from the administration's request. This included $40 million added by the Energy and Water Appropriations subcommittee and $45 million proposed by a bipartisan group of lawmakers which was part of a managers amendment approved by the entire House. The House proposal provided $54 million for SECA. The next step is the Conference Committee where the two bills will be combined into a final bill to be voted on by both chambers and then hopefully signed by the President.

http://capwiz.com/fuelcells/home/ - Keep using this tool to send letters of thanks and pleas for continued support to your Congressmen. You can tailor the letter however you want - you can find lots of great resources here to help.

Two New Cool Contests!

Have a great slogan to promote hydrogen and fuel cells? The California Fuel Cell Partnership is holding a contest to provide a catchy slogan for some of their t-shirt designs. Winners receive a Horizon Fuel Cell Technologies' fuel cell car kit. Hurry up, though, the contest ends Friday, August 28th! Go to http://www.cafcp.org/tshirtcontest and enter as many times as you like.

The National Hydrogen Association is also holding a contest through their H2 and You program. Submit a picture of yourself with hydrogen and win a scale model of a Daimler F-Cell fuel cell vehicle. The contest ends on September 30th, so either dig through your files and albums or find a station or installation near you and take a picture! Fuel Cells 2000 has a great database that lists all U.S. stationary fuel cell installations and hydrogen fueling stations that you can find at http://www.fuelcells.org/info/statedatabase.html. Contest information can be found at http://www.h2andyou.org/photoContest.asp.

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Vienna and starting in 2010, will deploy ten of these buses for operation in Hamburg. Shell is adding hydrogen pumps to four public filling stations to support the vehicles and the country plans a large-scale build up of public stations with the goal of 1,000 stations by 2020. Germany is investing US$2–2.8 Billion (1.5 – 2 Billion €) until 2017 and hopes to have enough stations by 2013 to make a continuous drive from the north to the south of Germany, about 635 miles, equivalent to driving from Washington, DC to Chicago.

Hydrogenics Corporation worked with Heliocentris Fuel Cells AG to install a HySTAT™ electrolyzer at a bus fueling station in Barth, Germany, which will be incorporated within a solar-assisted gas generation system, to provide hydrogen for a fuel cell bus. Hydrogenics also installed a similar system in Dunkirk, France for buses running on a blend of hydrogen and natural gas.

In Greenland, a new project started by Nukissiorfüt, the national energy company, called H2KT, seeks to establish a renewable hydrogen electrolysis system using a hydro power plant. H2 Logic A/S has been selected to supply the system that will generate hydrogen to be stored for use in a fuel cell. The plant will also be prepared for a future upgrade of a hydrogen refueling station.

As the stations keep opening or adding electrolyzers to provide hydrogen at a dedicated pump at an existing station, we hope more vehicles are built to utilize the fuel and keep the positive momentum going for a clean and green hydrogen future.

Which big corporations have bought fuel cells recently? Coco-Cola and Whole Foods are installing them in their facilities and Wegman's, Nissan and H-E-B have purchased fuel cell forklifts to replace their battery-powered ones!