In Japan, Home Sweet Fuel Cell Home

The potential environmental and economic benefits of fuel cell technology extend well beyond the automobile industry. A recent study commissioned by Ballard Power Systems and Plug Power and independently verified by the Center for Energy Efficiency and Renewable Technologies (CEERT) show that global greenhouse gas (GHG) reductions through the year 2025 from hydrogen and fuel cell technologies could be in the range of 30,000 to 115,000 kilotonnes. The analysis focused on fuel cell applications most likely to achieve near-term commercialization, including residential cogeneration, distributed generation, and backup power systems.

There are fuel cells installed in stationary applications all over the world, in a wide variety of locations, including hotels, hospitals, schools, telecommunications towers, breweries and in some parts of the world, notably Japan, in houses and apartment complexes. I was recently in Tokyo for the 4th International Hydrogen and Fuel Cell Expo and there were several presentations, including a keynote speech, on Japan’s aggressive approach to demonstration, testing and commercialization of residential fuel cells. My boss and I were also fortunate enough to schedule a side meeting at Tokyo Gas where we learned more about the program firsthand and received a tour of a model home with fuel cells installed.

Japan, in an effort to reduce its fossil fuel imports and lower GHGs, was the first country to undertake a large-scale hydrogen fuel cell R&D program – a ten-year, ¥18 billion effort that was completed in 2002. Since then, the Japanese government has continued funding numerous programs that focus on demonstrations, as well as research into the technical obstacles including hydrogen storage, codes and standards and components such as membranes and balance of plant. Japan is confident that, with continuing strong financial support, hydrogen fuel cells can become competitive within the next two decades.

The Ministry of Economy, Trade and Industry (METI)’s New Energy and Industrial Technology Development Organization (NEDO) has overseen a lot of the funding for fuel cell and hydrogen research, development and demonstration in Japan. Several of the programs focus on the stationary and residential markets, with demonstration programs that place fuel cells at the homes of utility customers for testing. The Demonstration of Residential PEFC Systems for Market Creation program allocated billions of yen from FY2005-FY2008 to install fuel cells at homes in cooperation with util-

Check out www.fuelcells.org to see where the U.S. Presidential candidates stand on hydrogen and fuel cells and what YOU can do at the grassroots level to encourage the commercialization of the technology.

Ebara Ballard and Matsushita units
In the first three years of the program, more than two thousand low-temperature 1-kW fuel cells were installed in homes all around Japan, each with a period of operation of 2 years. The subsidy decreased every year, in 2005, it was ¥6 million per unit dropping down to ¥3.5 million per unit in 2007. Numerous utilities participated in the program and five fuel cell manufacturers - Ebara Ballard, Sanyo, Toshiba, Toyota, and Matsushita Electric Industrial Co. Ltd. (Panasonic subsidiary) - were all involved as well. Some units used LPG as the hydrogen feedstock, others natural gas and some kerosene. A survey of customers by Tokyo Gas showed that the majority of the participants were excited to be able to generate electricity on-site at their homes as well as for the environmental and economic benefits. The program has led to a price reduction of 20% so far and has generated more than 7 million hours of power.

The Demonstration of Residential PEFC Systems for Market Creation program ends in 2008, but government support will continue via the Strategic Development of PEFC Technologies for Practical Application project. Between 1,000 and 1,300 additional fuel cells are planned to be installed in FY 2009. The location area and scope are expanding, too. The Fukuoka prefectural government (located on Kyushū Island), with partners Nippon Oil and Saibu Gas Energy Co., is set to install fuel cells in two housing complexes, one hundred in all, to provide power to 150 households.

Another benefit to these large-scale installations is to the fuel cell manufacturers. One of the main obstacles of fuel cell commercialization is cost, which can be driven down with larger orders and streamlined manufacturing processes. Many of the companies participating in these programs see the sales and revenue potential of the technology within Japan’s competitive energy market and are announcing large-scale production within the next few years. Matsushita recently announced they would offer units to homeowners in April 2009 for a price below ¥1 million and by March 2011, it expects to sell between 3,000 and 5,000 units, with a target of between 60,000 and 100,000 planned for March 2016. Ebara Ballard is expanding its Fuisawa plant to be equipped to produce 1,500 units beginning in 2009, ramping that up to 10,000 units a year by 2011. Toshiba has also announced plans to increase its production volume to more than 10,000 fuel cells a year by 2012.

My boss and I received a tour of a model home on-site at Tokyo Gas that showcases exactly what its customers have installed at their homes. Tokyo Gas works with both Matsushita and Ebara Ballard and packages the units as LIFUEL. LIFUEL’s specifications are 37% electrical efficiency and 50% heat recovery for a total efficiency of 87%. The units store 200L of hot water and are fueled by city gas. The model home, much bigger than a typical Japanese house, had both a Matsushita and an Ebara unit installed outside – the actual customers only have one. We were able to see how the remote controller inside the house shows all of the vital statistics in real time, including how much energy is being utilized. Upstairs Tokyo Gas created a mini-museum with posters and displays of the technology and its evolution. The décor and design of the entire house was amazing, I wanted to sneak away and hide so I could live there. After the tour, we were able to visit the hydrogen fueling station, also on-site, and then received a ride back to the train station in Toyota’s fuel cell vehicle, the FCHV – it was a very cool day.

Companies based in the U.S. or focused on commercializing products here aren’t targeting the residential market like Japan. The subsidies from the Japanese government are not only enabling the companies to manufacture units on a larger order scale, but also educating the public about fuel cell technology, reducing greenhouse gas emissions and reducing dependence on foreign oil. Hopefully other countries will follow the lead. (JG)
Scooters and Bikes and UAVs, Oh My!

At the 4th International Hydrogen & Fuel Cell Expo in Tokyo, Japan, there were a lot of specialty vehicles on display in the exhibition hall, including scooters, motorcycles and electric bicycles.

Most gas-powered scooters have two-stroke engines, so even though they are small, they produce almost as much particulate matter, hydrocarbons and carbon monoxide in their tailpipe emissions as a heavy diesel truck. To see so many vehicles on display was an encouraging sign that underscored that companies are still pursuing this market, particularly in Asia and India.

Asia Pacific Fuel Cell Technologies, a company that has been relatively quiet the past few years after demonstrating several versions of a fuel cell scooter, showcased its newest prototype, the ZES V.b. This scooter sports a fuel cell/lithium-ion battery hybrid system and reaches top speeds of 60 km/h (38 mph). The hydrogen is stored in a metal hydride canister and takes less than one minute to refuel.

Intelligent Energy, exhibiting as part of the UK pavilion, brought along the Crosscage, a sleek concept fuel cell motorbike developed with its partner Suzuki and first unveiled at the 2007 Tokyo Motor Show. The Crosscage incorporates a fuel cell and lithium-ion battery hybrid system and the frame cage, shaped like an X to give the bike its name, shields the hydrogen storage tank. Intelligent Energy has been working on fuel cell motorbikes for some time now - in 2005, the ENV fuel cell motorbike was shown around the world.

Yamaha had its FC-Dii on display - a methanol-water powered fuel cell scooter. The 1-kW fuel cell creates electricity which continuously charges the on-board lithium ion battery pack and achieves 30% efficiency.

Osaka Sangyo University brought its FCV-3 race-car prototype to the FC Expo. The car participated in the Panasonic World Solar Challenge in 2007 in the Greenfleet category, a class that included advanced technology.

Not to limit fuel cells to the ground, Deutsches Zentrum für Luft- und Raumfahrt e.V (German Aerospace Center) showcased its HyFish Flying Fuel Cell Demonstrator, an unmanned aerial vehicle (UAV) that has already completed a successful first flight last year. In that flight, the plane performed vertical climbs, loops and other aerial maneuvers at speeds reaching 200 km/h. The HyFish has a sleek, shark-like design, with a fuselage length of just 1.2m and a short 1m wingspan. The UAV also incorporates a 1.2-kW Horizon Fuel Cell Technologies’ fuel cell stack. Other partners on the project include Team SmartFish, DruKon, Luxfer, BaltiCo, Technikzentrum Ainet, and LTB-Borowski. UAVs are a very-fast growing market segment of the aerospace industry, predicted by the Teal Group to be worth $54 billion over the next 10 years.

There were other interesting and exciting displays of creative fuel cell integration at the FC Expo – one company displayed fuel cell-powered robots and a menacing fuel cell Godzilla, while others (Vantec Co. Ltd.) showed how they installed a fuel cell into a go-cart. These specialty applications such as scooters and other small recreational vehicles demonstrate the power of fuel cells and also help with reducing the cost, building the infrastructure and supply chain and educating the public about the technology, its potential and benefits. (JG)
Stylish and Speedy Fuel Cell Cars

The latest fuel cell cars are sure to appeal to the automotive enthusiast, with sleek contours and powerful performance. The Geneva Auto Show was the launching pad for a few of these concept vehicles that incorporate fuel cells without compromising on speed or style.

The Italian auto manufacturer, Pininfarina, debuted its Sintesi fuel cell-powered concept vehicle in Geneva. The Sintesi features Nuvera Fuel Cell's Quadrivium drive - four distributed power modules comprised of a 20-kW fuel cell, a lithium-ion battery pack and power electronics - which are located at each wheel. This unique placement of the fuel cells delivers better weight distribution and a lower center of gravity to improve driving dynamics. Using fuel cell power alone, the vehicle can attain a top speed of 191 km/h and can accelerate from 0-100 km/h in 9.1 seconds.

Also in Geneva, Morgan Motor Company, based in the United Kingdom and famous for its hand-built roadsters, debuted its LIFECar fuel cell concept vehicle. The 1930's-styled roadster is powered by Qinetig's four-stack PEM fuel cell, and uses ultracapacitors, charged by regenerative braking, to deliver an extra punch for accelerating and climbing hills. The roadster can attain a top speed of 80-85 mph and can go from 0-60 mph in seven seconds. Morgan has not ruled out an eventual production model of the LIFECar and planned to gauge reaction at the Geneva Auto Show before coming to a decision.

Reviewers at the Geneva Auto Show called the cars "remarkable and innovative" and "stunning and amazing" respectively.

Formula Zero, a new zero emission racing class for open fuel cell single-seater vehicles, will debut its Student Edition for fuel cell racing go-karts during Summer 2008. The championship will pit competing university teams, who will develop their own fuel cell race vehicles, in four races per season on a portable road track. The initial race is slated for mid-August in Rotterdam, followed by races in Detroit, Dubai and London. Among the seven university teams competing in this year's championship are teams from Lawrence Tech (Michigan, car shown) and UCLA. Formula Zero will debut new racing classes in coming years, with the City Edition scheduled in 2011 for Formula 3-sized cars and the Circuit Edition in 2015 for full-size racing vehicles.

While not officially racing, Honda Motor Company's FCX Clarity fuel cell vehicle will serve as the official pace car of the 2008 Indy Japan event in Tochigi, Japan. The FCX Clarity will lead the 18 race cars at the start of the event, and will be on display inside the paddock. (SC)

Billionaires Back Fuel Cells

Billionaire Mikhail Prokhorov, former chairman of Norilsk Nickel and one of Russia's wealthiest men, says he plans to "invest billions" in hydrogen fuel cells through his new investment company, Onexim Group. He believes that nanotechnology advances, which will allow fuel cell energy to be stored to meet consumption peaks, makes the technology preferential to other alternative technologies such as solar and wind.

Another billionaire, Sir Richard Branson, president of the Virgin Group, Ltd., is also a fan of fuel cells. He is urging governments worldwide to construct hydrogen fueling stations in key cities to make it easier to fuel hydrogen-powered vehicles and emphasized the major role that governments play in providing incentives for new technology. Branson's Virgin Atlantic airlines recently partnered with General Motors to offer Upper Class airline passengers a complementary ride to and from the airport in a Chevrolet Equinox Fuel Cell Vehicle. Three Equinox fuel cell vehicles will soon join Virgin Atlantic's passenger transport fleet for the airline's service at Los Angeles International Airport. Three more Equinox fuel cell vehicles will be added to serve Virgin Atlantic's New York passengers later in the year. (SC)
Several new studies have been released that support the continued development of fuel cell vehicles, and the eventual transition to a hydrogen economy and infrastructure.

The first, *Comparison of Transportation Options in a Carbon-Constrained World: Hydrogen, Plug-in Hybrids and Biofuels*, is the work of Dr. C.E. (Sandy) Thomas, president H2Gen Innovations, Inc. and an expert on alternative fuels. Thomas evaluated various configurations of hybrid, plug-in hybrid, bio-fuel and hydrogen vehicle pathways including associated infrastructure and determined that “the hydrogen-powered fuel cell vehicle is the only option that can achieve the goal of reducing greenhouse gases by 60% or more below 1990 levels in the transportation sector.” The cost of a transition to hydrogen would be small compared to the cost of maintaining and expanding the current gasoline infrastructure, according to Thomas’ calculations, and that the benefits would far exceed the costs. Thomas also concluded that “the hydrogen-powered fuel cell vehicle is the only option that would virtually eliminate urban air pollution from the transportation sector by 2100; all other vehicle/fuel options including both gasoline and ethanol PHEVs would produce essentially the same or greater urban air pollution as the existing car fleet due to increased vehicle miles traveled.”

Oak Ridge National Laboratory, in Oak Ridge, Tennessee, recently released *Analysis of the Transition to Hydrogen Fuel Cell Vehicles and the Potential Hydrogen Energy Infrastructure Requirements*, which identifies Los Angeles and New York City as two ideal urban centers that with targeted deployment policies, could boost fuel cell vehicles to a 50 percent market share by 2030. This goal would require supportive policies, including federal cost sharing for vehicles and infrastructure, as well as ensuring policies like California’s ZEV regulations continue in that state and are adapted in others. The report also examines “carbon policy” and forecasts dramatic reductions in carbon emissions, depending on the hydrogen feedstock.

The analysis concludes that hydrogen can be produced at a highly competitive price compared to gasoline from natural gas, biofuels or other feedstocks. With fuel cell test vehicles achieving about 70 miles per gallon equivalent, the hydrogen transition promises lower prices at the pump for American drivers: less than $1.50 per gallon equivalent on a dollars-per-distance-travelled basis. Estimated costs to convert to a hydrogen economy are projected to be about $10 billion over 14 years, more than the current federal government investment in fuel cells and hydrogen but much less than the current incentives for ethanol.

The National Research Council (NRC) of the National Academies of Science published its annual report on the progress of the federally-supported FreedomCAR and Fuel Partnership programs. These initiatives were introduced (FreedomCAR in 2002 and Fuel Partnership in 2004) to develop petroleum and emission-free vehicles and supporting infrastructure by focusing on the research and development of advanced vehicle technologies, such as fuel cells and hybrid electric engines. The report concludes that development of fuel cells and supporting hydrogen infrastructure would provide the most efficient and least polluting means to power personal transportation vehicles, but that significant improvements in durability and cost are needed to enable the mass production and sale of vehicles. The NRC also found that while several barriers hinder the program from achieving its full objectives, the potential benefits -- reducing dependence on imported oil and minimizing harmful environmental effects -- justify the cost of the research.
The *Road to a Cleaner Future*, a report by the American Lung Association, concludes that $142 billion in human health and global warming reduction benefits would result from converting the entire California motor vehicle fleet from gasoline vehicles to zero-emission vehicle (ZEV) technologies (including fuel cells) in the 2010-2030 timeframe. The study, conducted by TIAX LLC, also found that California can avoid at least $2.2 billion per year in health costs from reduction of dangerous particulate matter by converting the motor vehicle fleet to ZEVs instead of relying on the lowest emitting gasoline technologies.

These studies reinforce the need to continue research, development and demonstration with fuel cells and hydrogen technologies. Please forward them on to others and use the information to help educate critics and skeptics. (JG)

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**Energy Tax Credit Package Passed by Senate**

*Contributed by Bud DeFlaviis, US Fuel Cell Council*

A bipartisan energy tax package introduced by Senator Maria Cantwell (D-WA) and Senator John Ensign (R-NV), was passed by the Senate last week by a vote of 88-8. The initiative, included in an unrelated piece of legislation, approved a $6.6 billion revision and extension of alternative energy tax credits.

The package included a nine-year extension of the Investment Tax Credit for fuel cells. It also eliminated the cap, currently set at $1,000 per kilowatt.

While the House of Representatives has passed similar legislation earlier this year, the Senate version did not include revenue-raising provisions that eliminated tax incentives enjoyed by oil and gas producers. The revenue-raising provisions are designed to ensure the pending incentives do not negatively impact the federal deficit.

While House leaders reconfirmed their position to pass a revenue-neutral bill following the recent Senate action, Democratic leadership aides have suggested that they would work with the Senate to find offsets that do not impact the oil and gas industry.

Meanwhile, Senate Finance Committee Chairman Max Baucus (D-MT) announced that he plans to introduce a similar energy tax plan as part of a broader tax strategy. The pending proposal would be revenue-neutral, though he has not indicated the nature of the offsets.

Contact your State’s Representatives and Senators today to tell them to ensure these credits get enacted into law.

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**Fuel Cells 2000 Joins with GM and Horizon for NSTA**

For the past eight years, Fuel Cells 2000 has been exhibiting at the National Science Teachers Association’s national convention, a huge event with an average of 15,000 science teachers from all over the world attending. It was held March 27-29, 2008, in Boston, Massachusetts. Last year, we joined forces with General Motors Education at a 20x10 booth in order to consolidate the fuel cell and hydrogen presence at the event. Because it was such a huge success, there was no hesitation to do it again this year. In Boston, we were also joined by representatives from Horizon Fuel Cell Technologies who graciously donated 6 of their H-Racer fuel cell cars to raffle. Heliocentris also donated an educational kit to raffle as well, so we were a very popular booth for the teachers to visit. Fuel Cells 2000 created several flyers touting our resources, particularly the Fuel Cell Match Maker and our Fuel Cell Career and Education Center, and we also secured 200 copies of DOE’s brochure “Hydrogen & Our Energy Future”, 60 copies of the DVD “Hydrogen: the Clean and Safe Fuel,” copies of the CD-Rom “The Fuel Cell Handbook” and marketing materials from several fuel cell companies to distribute. We also had t-shirts made, which flew off the shelves. The conference was a huge success and all our material was gone by the last day – the teachers are not only interested in fuel cell and hydrogen information to teach in their classrooms, but also because they are environmentalists and activists in their own right, which is really great to see. (JG)