



ViewFromTheTop

WITH MUCH AT STAKE, DEDICATION GROWS STRONGER

Two words sum up the world's greatest threat today – global warming. Once the subject of an “esoteric scientific debate,” it has now become a harsh reality. The facts are ominously clear. CO₂ emissions are rising steadily. So are global temperatures. The ecosystem is changing. And now scientists fear the buildup of greenhouse gases could “flip a global switch” that would alter the face of the planet. With so much at stake, we must move quickly to a future energized by hydrogen and powered by fuel cells – to lower the risk of potential irreversible damage.

Some companies and nations are already making changes. Under the Bush Administration, the US road map to commercializing hydrogen technology was accelerated from 2030 to 2015. Unfortunately, the policy change influenced continued government financial support for the development of gasoline reformers, which are used to generate hydrogen on-board fuel cell vehicles. According to the US Department of Energy (DOE), it was “unlikely” that on-board fuel processing would improve sufficiently [in the next 11 years] to support the transition to a hydrogen economy. We, at Nuvera, are grateful for DOE's support over the years as it has enabled the rapid advancement of on-board fuel processing technology to the point where it has successfully transferred from a government R&D project into a privately funded development program with a commercial objective in line with the Administration's vision.

Today, world leading companies such as ExxonMobil and Nuvera are continuing to advance the commercialization of on-board fuel processing technology with OEMs like Toyota and the Renault alliance, respectively. Representing a combined production volume of more than 11 million vehicles per year, the future of fuel processing remains bright, especially since the task of advancing the introduction of the H₂ economy by 15 years is fraught with risk and uncertainty.

We are committed to developing fuel cell technologies that address both our near-term environmental concerns as well as our long-term energy needs. We intend to accomplish this by using hydrogen as a primary fuel source where and when possible as well as by converting hydrocarbon fuels, such as gasoline, on-board of vehicles.

Along those lines, we want thank our suppliers and partners who have endured the journey with us, and we want to assure you that there is a bright future for our products – including on-board fuel processing. During the challenging times that lay ahead as we move towards commercialization, we believe it is the strong relationships with our partners around the world that will enable our success. It is our hope and goal to continue to act collectively with our partners and suppliers to move the industry forward – toward commercialization – using all means possible.



William L. Mitchell
Vice President
Nuvera Fuel Cells

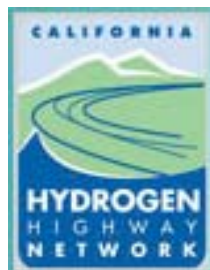
GlobalInsights

BUILDING MOMENTUM FOR THE HYDROGEN ECONOMY

As has long been the case, the major challenges to commercializing fuel cells involve the production, storage, and distribution of hydrogen. But to steal a line from American icon Bob Dylan, “The times, they are a changin’.”

On the heels of the **US Department of Energy's** announcement to fund some \$350 million in hydrogen research comes news that **California Governor Arnold Schwarzenegger** aims to make hydrogen available to residents by establishing 200 hydrogen filling stations along the State's highways and cities by 2010.

But that's not all. The **European Union** is investing some 2.8 billion euros from 2004-14 for hydrogen production and use. The



Korean Ministry of Science and Technology is funding an initiative in the amount of \$843 million through 2019 for hydrogen energy. And the **United States** is contributing some \$227 million from

2003-15 for hydrogen fuel. Similar to efforts engaged by governments across the world nearly 70 years ago, a new fuel infrastructure is slowly emerging to support the advancement of fuel cells.

Another challenge facing the industry is the lack of international regulations and standards for purity of hydrogen, fuel cell and filling equipment specifications. Agencies and institutes from around the world, including the

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Canadian Standards Agency, the **American National Standards Institute**, the **American Society of Mechanical Engineers**, the **US Department of Energy**, and **Underwriters Laboratories** are working on various fuel cell standards and aim to complete a North-American hydrogen generation and storage standard by the end of 2004.

Additionally, energy ministries from Australia, Brazil, Canada, China, the European Commission, France, Germany, Iceland, India, Italy, Japan, Korea, Norway, Russia, the United Kingdom, and the United States are working together in the **International Partnership for the Hydrogen Economy** (IPHE).



In addition to helping advance hydrogen and fuel cell programs, IPHE aims to support the demonstration of hydrogen production, storage, transport, and distribution and common codes and standards for hydrogen fuel utilization.

According to **Romano Prodi**, President of the European Commission, "the broadest possible international cooperation is crucial to a major revolution such as the Hydrogen Economy. We need this broadening because we are addressing long-term objectives, such as environmental protection and the strategic independence of our energy supply – and because not only are we discussing a vision of the future in 20 or 30 years, but we also want to start a global process to get there efficiently and in time."



Francesco Fiore, Business Development Manager with Nuvera Fuel Cells, participated in the IPHE Ministerial Meeting as a panelist in a session on fuel cell research. Fiore's role was to discuss recent technological advancements made in fuel cell architecture, in particular, bi-polar metal plates that are developed by Nuvera for the automotive, distributed generation, and industrial vehicle equipment industries. Fiore emphasized the need to build robust stacks capable of operating in rugged conditions and yet lightweight and compact to minimize costs.

It's encouraging to see governments across the world beginning to take action, both independently and collectively. The sign posts of tomorrow are starting to take shape today.

MarketNews

RENAULT, NUVERA STRENGTHEN TIES

CAMBRIDGE, MA – International automaker **Renault** signalled its support for on-board fuel processing when the long-time innovator recently became an investor in Nuvera Fuel Cells. As the newest shareholder, Renault joins **Amerada Hess Corporation**, a global integrated energy company, and **Gruppo De Nora**, a worldwide manufacturer of electrochemical plants, electrolyzers, and electrodes, by virtue of its purchase of a 10 percent equity stake in Nuvera.



According to **Pierre-Alain de Smedt**, Renault's Executive Vice President for Industry and Technology, "The agreement enables us to play an active role in the development of fuel cells powered by reformed hydrogen." Nuvera chief executive **C. Roberto Cordaro** added, "With the addition of Renault as a strategic stakeholder, we have securely positioned ourselves for the challenges that lay ahead to execute our business plan for the next four years."

Much has been debated about the promise of on-board fuel reforming as an alternative

to commercializing fuel cell vehicles in the near future. To their credit, Renault and Nuvera have maintained a close collaboration during the past few years to demonstrate the technology amidst growing speculation among critics in the public and private sectors.

"This is further proof that gasoline fuel processing offers a viable path to commercialization," said **William Mitchell**, Vice President of Nuvera. "We expect to continue making progress toward overcoming the obstacles that remain, such as reducing start time and start energy."

In addition to becoming a shareholder, Renault also agreed to terms on a new four-year R&D contract that extends the companies' efforts to advance Nuvera's state-of-the-art **STAR™** 75kW fuel processor and prepare it for prototype demonstration by 2010. As part of this agreement, Nuvera granted to Renault a license to use its technology for automobiles and light-duty vehicles.



At the signing of the shareholder agreement. From left to right: William Mitchell (Nuvera), Mauro Saponelli (Gruppo De Nora), Barclay Collins (Hess), Gianfranco Mora (Gruppo De Nora), Pierre Beuzit (Renault), Roberto Cordaro (Nuvera), John Gartman (Hess), and Francesco Fragasso (Nuvera).



The Renault Scenic prototype fuel cell vehicle will incorporate Nuvera's STAR gasoline fuel processing technology.

TAKAGI TO DEVELOP FUEL CELL COGEN SYSTEMS

TOKYO, JAPAN – Takagi Industrial Co., Ltd., a manufacturer of water heaters for residential and commercial markets in Japan, is about to leap into new, uncharted waters – the world of fuel cell technology.

Since 1946, Takagi has been making products that are “directly linked to people’s happiness.” During this time, the company has consistently introduced innovative technologies to its product line, resulting in compact, high-quality, energy efficient, environmentally friendly applications that deliver an endless supply of hot water, instead of heating and storing water like a traditional tank unit does.

So, what’s the big deal? Compared to a traditional gas water heater, a tankless unit is considered safer and more economical to operate because there is no pilot light and the unit only runs when the system is used, resulting in lower gas bills.

Now Takagi intends to develop a commercial fuel cell-based cogeneration system with its partner **Nuvera Fuel Cells** for the Japanese market.



The plan calls for integrating Takagi’s innovative heat management system with Nuvera’s 5kW **Avanti™** fuel cell power system. The Avanti system uses natural gas to generate hot water and electricity, often referred to as cogeneration or combined heat and power (CHP). Takagi’s heat management system will store the hot water and interface it with the end customer’s thermal demand.

“Fuel cell cogeneration systems will allow the next large improvements in overall efficiency of water heating systems,” said **Gunji Kawashima**, President of Takagi. “These efficiency improvements will result in lower running costs and environmental impact.”

In fact, Takagi has already earned a reputation as a leader in energy efficiency. The company has won the Energy Conservation award from The Energy Conservation Center Japan, an affiliated organization of Japanese government in 2001, 2002, and 2003 for its high-efficiency boiler products.



Takagi’s Flash T-K2 tankless water heater generates hot water on demand.



Inside view of Takagi’s Flash T-K2 tankless water heater.

JGA LEADS CODES & STANDARDS INITIATIVE

TOKYO, JAPAN – For the past several years, the **Japan Gas Association (JGA)**, under the Japanese government’s prestigious **Millennium Program**, has been examining PEM fuel cells for the purpose of establishing technical codes and standards for the Japanese market. JGA’s efforts continued recently with the acceptance of a combined heat and power (CHP) system developed by **Takagi Industrial Co. Ltd.**, and **Nuvera Fuel Cells**. Takagi, a Japanese manufacturer of water heating systems, teamed up with Nuvera to deploy an integrated unit containing Nuvera’s **Avanti™** natural gas fuel cell power module and Takagi’s heating equipment. The collaboration between the two companies was organized by **Mitsui & Co. Ltd.**, which also facilitated participation in the program.

Natural gas is a major sector in Japan’s national energy supply with nearly 26 million customers consuming some 24 billion cubic meters of gas on an annual basis for residential, industrial, and commercial use.



With members comprising all of Japan’s gas utilities, JGA is responsible for overseeing the Millennium Program, which is funded by Japan’s **New Energy and Industrial Technology Development Organization**, a semi-governmental organization under the auspices of the **Ministry of International Trade and Industry**.



Nuvera’s Avanti fuel cell power module is helping JGA to develop PEM fuel cell codes and standards for the Japanese market.

Results from JGA’s 5-year test initiative are expected to be released sometime within the next year.



Fuel cell power systems mounted atop building in Shinagawa, Tokyo, Japan are providing combined heat and power for occupants as part of an ongoing fuel cell demonstration project.

ETHANOL SYSTEM MAKES HISTORY IN US

PEKIN, IL – **Nuvera Fuel Cells** recently teamed with **Caterpillar, Inc.**, and **Aventine Renewable Energy** (formerly William BioEnergy) to successfully operate the nation’s first ethanol-fueled PEM fuel cell demonstration in the field. The system was operated for more than 1,350 hours with minimal technical disruptions. The program was jointly funded by the **US Department of Energy**, **State of Illinois**, and **Renewable Fuels Association**.

The technology demonstration was initiated in large part to display the advantages of using ethanol as a primary fuel source for fuel cell systems. Ethanol, a renewable fuel derived from natural resources such as corn, sugar cane, and biomass, can be converted into hydrogen using a fuel processor and then fed to power a fuel cell and generate high-efficiency, low-emission energy.

Aventine, a major producer of ethanol, hosted the demonstration and provided onsite safety supervision of the unit. The company also provided the ethanol fuel for the program.

Caterpillar, a Fortune 500 company and global leader in the design, manufacture, and sale of distributed generation equipment, was responsible for designing and delivering the power

inverter that converted raw DC power from the fuel cell power system into consumer usable AC power, the data acquisition and system controls, and the program management for the entire project.



Nuvera’s ethanol-fueled power module was used in a recent field demonstration at Aventine Renewable Energy’s site in Pekin, Illinois, operating for more than 1,350 hours.

Nuvera designed and delivered the fuel cell power module that converted the ethanol into DC electrical power using its integrated fuel processor and fuel cell system.

Said **Prashant Chintawar**, Executive Director at **Nuvera**, “The ethanol technology demonstration provided valuable data and knowledge transfer that will inevitably contribute to advancing the commercialization of fuel cells.”

REMOTE CONTROL

CAMBRIDGE, MA – For the first time in company history, a fuel cell power system was successfully started remotely from Nuvera’s corporate headquarters to generate power in the field. The remote application, developed internally at **Nuvera**, was used to bring a system deployed in Pekin, Illinois online and achieve a stable operation using remote controls.

Nuvera has continued advancing the development of this online tool and is currently using a similar system to monitor the activity of its **Avanti™** fuel cell power system demonstrations in Japan and Rhode Island.

INTERESTING FACTOID

CAMBRIDGE, MA – **Nuvera** recently passed the final milestone for a **US Department of Energy** Fuel Processor contract by successfully operating its STAR™ Automotive Fuel Processor Test System for 500 hours during durability testing at the company’s headquarters.

For the final deliverable, the on-board fuel reformer processed 1,056 gallons of sulfur-free gasoline, or, for the technically minded, converted 0.126 billion kJ of energy in the form of gasoline into approximately 0.1 billion kJ of energy in the form of hydrogen.

Just to provide a little perspective on what that means, if the reformer had been installed onboard a car that averaged 25 mpg, the vehicle would have traveled 26,600 miles – or about four round trips between Boston and San Francisco.



BUILDING THE NUVERA BRAND

Brand building, internally and externally, is an important component to any successful marketing program. Since its inception in April 2000, Nuvera has taken steps to ensure its ideas and messages are effectively communicated across all product platforms and key target markets. The result is the delivery of a clear, consistent vision to our customers and prospects about who we are, the products we develop, and the way in

which we are accelerating the commercialization of fuel cell technology. Below are the newest additions to our growing list of marketing materials that communicate the Nuvera brand. For more information on Nuvera's brand building efforts, as well as company press releases and other value-added information, please visit our web site at www.nuvera.com.

Nuvera advertisement appearing in *Automotive* magazine (March 2004).

Nuvera advertisement appearing in *Automotive* magazine (August 2004).

Energy Storage Technology	Energy Density (kWh/ltr)
Gasoline	~12
Lead Acid Battery	~0.1
NiMH Battery	~0.15
Li-ion Battery	~0.2
Hydrogen (compressed)	~1.5
Hydrogen (liquid)	~8
Hydrogen (metal hydride)	~1.5
Hydrogen (solid state)	~1.5

Nuvera position paper on US Department of Energy's on-board fuel processing "Go / No Go" decision.

Nuvera advertisement appearing in *Material Handling Management* magazine (June 2004).

PLACES TO GO... PEOPLE TO SEE

2004 Hannover Fair

The 2004 "Hydrogen and Fuel Cell Group Exhibit," which was conducted in conjunction with the 2004 Hannover Fair, attracted more than 110 exhibitors from 24 countries, including **Nuvera Fuel Cells**, which displayed its H₂e™ fuel cell power module, Avanti™ power system, Andromeda™ fuel cell stack, and STAR™ gasoline fuel processor. Total attendance at the Fair was estimated at nearly 250,000.



The Fiat Seicento, powered by a Nuvera 40kW fuel cell, was the main attraction at Nuvera's exhibit booth.

Among the many highlights at the event was a visit by **German Chancellor Gerhard Schroeder**, who posed for a photo opportunity onboard a fuel cell powered fork lift truck developed by **Proton Motor, Stihl, and Linde Gas**. The vehicle uses the fuel cell as a replacement for conventional battery power. Another significant attraction was the on-site demonstration of the fuel cell powered **Fiat Seicento**, which uses a **Nuvera 40kW fuel cell**.



German Minister of Lower Saxony, exits the Fiat Seicento after an impressive ride at the indoor track.

According to many eyewitnesses, the hydrogen-fueled Seicento literally stole the show, generating exceptional traffic at Nuvera's booth while "quietly" impressing those lucky drivers who took the car for a ride at the indoor test track. Molto bene!

2004 Congressional Fuel Cell Expo

An estimated 1,000 members of Congress, congressional staff, federal officials, business executives and news media representatives recently filled the Cannon Caucus Room on Capitol Hill for the US Fuel Cell Council's **4th Annual Congressional Fuel Cell Expo**. More than 35 fuel cell industry leaders, including **Nuvera Fuel Cells**, exhibited at the event. Support for fuel cell and hydrogen technologies crosses party lines, and this year's event received bi-partisan sponsorship from Congressional leaders. In her remarks, Rep. Nancy Johnson (R-CT) said she was "very



Nuvera's booth at the 2004 USFCC Congressional Fuel Cell Expo on Capitol Hill, featuring the H₂e fuel cell power module (front right).

proud of the progress you've made...to demonstrate the power of fuel cells." Rep. Shelia Jackson Lee (TX-18th), who is on the House Science Committee, added, "We need a continued commitment" to fuel cells, and "we must not shun any technology that will make us [energy] independent."

Many members of Congress, their staff, and other federal officials took advantage of the opportunity to drive the General Motors Hydrogen 3 Opel Zafira minivan and to ride on the Vectrix, a fuel cell scooter prototype developed by Parker Hannifin.



Nuvera's H₂e fuel cell power module.

Noteworthy Calendar Events

September 15 - 17, 2004

Hydrogen Expo, Hamburg, Germany
www.h2expo.com

[Nuvera staff attending](#)

September 20 - 23, 2004

XXI IASP World Conference
on Science and Technology Parks
Bergamo, Italy

www.iaspbergamo2004.com

[Nuvera exhibiting at SIAD/RIVOIRA booth #TBD](#)

September 21 - 23, 2004

Electric Transportation Industry
Conference, Orlando, Florida
www.edtaconference.com

[Nuvera staff attending](#)

September 25 - 28, 2004

Hydrogen & Fuel Cells 2004
Conference and Trade Show
Toronto, Ontario, Canada
www.hydrogenfuelcells2004.com

[Nuvera staff attending](#)

October 6 - 7, 2004

Industrial Utility Vehicle Technology
Conference, Denver, Colorado
www.specialtyvehiclesonline.com

[Gus Block, H₂e Marketing, key note speaker](#)

October 14 - 16, 2004

ISH North America, Boston, Massachusetts
www.usa.messefrankfurt.com

[Nuvera staff attending](#)

Look for more events that Nuvera will be speaking or exhibiting at in our next issue of *Elettrizzare*. Until then, may the force of fuel cells be with you!