

Hydrogen Today

"Clean Energy For A Better World"

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Willits Solar Fair Includes Solar-Hydrogen Session

— by *Herb Hayden*

The entire Sunday session of the Solar Fair in Willits, California, was devoted to a discussion on Solar Hydrogen, lead by David Booth of Solar Technologies International, with hydrogen experts Professor Peter Lehman of Humboldt State University, Walt Pyle of Research and Development with Chevron, and Roy McAlister, P.E., President of the American Hydrogen Association. They addressed the packed house in the informal setting of a camp classroom, which lent well to questions and comments from the audience.

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Willits Fairgoers look over the AHA Hydrogen powered truck, which had just completed the Solar Energy Expo Rally

Hydrogen Racing Program Competes At S.E.E.R. '92

The third annual Solar Energy Expo and Rally (SEER '92) in Willits, California, provided yet another opportunity for hydrogen fuel to be demonstrated as a viable transportation fuel. The American Hydrogen Association Racing Program competed through the able efforts of Program Director Demetri Wagner, and Program Consultant Lee Radu. The team competed in the Alternative Fuel Vehicle Class using the A.H.A hydrogen fueled mini-truck. They finished second overall, the winner used compressed natural gas which provided the winning edge of vehicle range.

The Rally was a three leg event, the first leg began at the Exploratorium in San Francisco and ended across the Golden Gate Bridge, at the North Side View Point.

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Hydrogen Fueled DeeMobile Exhibited At SEMA Show '92

— by *Tim Murphy*

The Hydrogen Racing Program exhibited the first HYDROGEN fueled automobile at a SEMA Convention, which is held annually at the Las Vegas Convention Center the first week of November. The Specialty Equipment Marketing Association (SEMA) Show of 1992 attracted 60,000 pre-registrants and included exhibits by the Big Three auto makers, after-market automobile equipment manufacturers and marketers, wheel and paint vendors; and this year the Concept Center, with an Alternative Fuel Vehicle theme. The Hydrogen Racing Program (HRP) was invited to display the 1991 hydrogen fueled DeeMobile developed by HRP.

DeeMobile is named for its designer, Demetri Wagner, also HRP Program Director. The HRP exhibit included an infor-

mation booth in the Concept Center area of the Convention Center; and the DeeMobile, which was placed at the main entrance. The exhibit was produced and managed by Gas Development Resources (GDR) of Prescott Valley, Arizona. GDR performed the DeeMobile Gaseous Fuel Vehicle Test Bed Project with HRP, starting with a 1991 Oldsmobile Cutlass Calais.

The objective of HRP at SEMA '92 was to make significant contacts with major players in the high profile auto racing and auto concept demonstration arena. Ideally, these contacts

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Willits Solar Fair

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no need to be stuck waiting for PV (photovoltaics) to get cheap enough, for there is Dish-Stirling (electric generators), thermolysis of water, and the breaking-apart of wastes to release hydrogen."

Prof. Peter Lehman lead by describing the photovoltaic-hydrogen demonstration project he is running at Arcata, California. (See the article on the Schatz project in the next issue) "A private sponsor, L.W. Schatz is funding this project for the benefit of the world. This technology does work. We won't compete with a dollar-per-gallon gasoline, but it will compete with five dollars per gallon. A good analogy is the investment in the construction of the interstate highway system—30 years and a lot of work, but we did it and we can do this," he said, referring to the development of a solar hydrogen infrastructure.

McAlister describes Dish Stirling Solar generators



Walt and his associates are still pursuing solar thermal disassociation research on their own. They believe the technology will become a practical hydrogen production method.

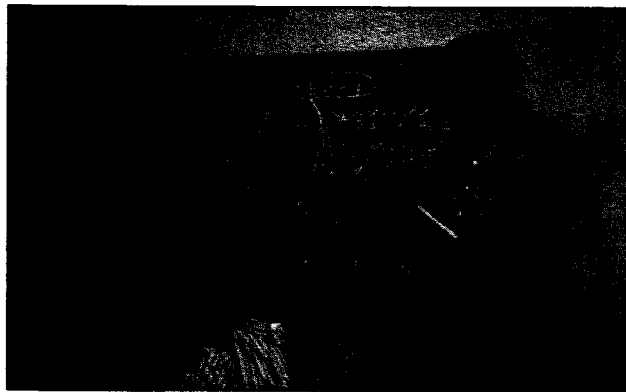
Roy McAlister, the final speaker, introduced biological production of hydrogen from waste products. "You get hydrogen by using wastes, and using nonunion labor - microbes - to separate out the hydrogen, with the assistance of solar heat. Do it in such a way that we keep the carbon from going into the atmosphere, and use the carbon as a building block. Hydrogen and electricity produced from biomass is better than letting it rot and dumping the carbon directly without any goods produced.

Solar Dish-Stirling generation is another option, which Roy illustrated with a small working dish-stirling engine. Dish-Stirling generators use solar heat, focussed by the dish reflector to a hot spot, as a fuel to run the Stirling engine to turn a generator, at up to 30% efficiency. Roy suggested the use of Dish-Stirling electricity to make hydrogen, or the use of the solar heat from the dish directly to decompose wastes, to release hydrogen along with the other carbon byproducts.

Also, suggested Roy, "Sponge iron or steel wool can be heated with water at high temperatures to make pure hydrogen and oxides of iron. The iron can be reclaimed, also using solar hydrogen as a fuel."

Roy closed the session by noting that "The world at large cannot gain the same quality of living that we have gained with fossil fuels. We should be helping the world by providing them with a better way with these renewable resources." ♣

David Booth introduced the speakers, and outlined many components of solar hydrogen technology with a black-board sketch of the sources, handling and end-use technologies encompassed in a diverse solar hydrogen system. "There are a lot of options for hydrogen production," said David, "so there is



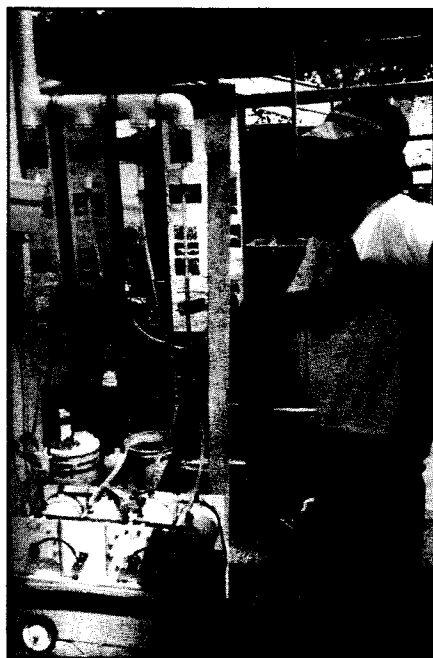
Pyle introduces thermal process as Lehman observes

Peter said the Schatz demonstration system makes hydrogen about the energy equivalent of one gallon of gasoline on a good day, or 25 standard liters of hydrogen per minute. The project is not intended to achieve commercial economies or production rates, but rather it is a demonstration of a small but complete PV/electrolyser/ fuel-cell system, with all of the controls and data collection for scientific study.

Next, Walt Pyle told of his continuing research in solar thermal "disassociation of water", which started out under a Chevron research effort. "Part of my job is to watch what is happening in solar technology for Chevron," said Walt. Thought not currently active in solar hydrogen research, "Chevron does have the largest production of hydrogen from fossil fuel."

Walt's efforts began when they looked at thermal disassociation work by the French, where hydrogen and oxygen were separated completely from water when heated to the high temperature of 3500 Kelvin. The unmet challenge was how to cool and separate the hydrogen and oxygen from the hot gaseous mixture before they recombined back into water.

Walt's group experimented with a concept used in nuclear fuel technology which separated different weights of uranium using centrifugal force, and applied it to separating hydrogen and oxygen. They also looked at combining thermal and electrolysis processes to help efficiently make and separate H₂/O₂ from water, and by adding ionizers to enhance the separation by electric fields.



Booth demonstrates hydrogen production.

SEMA Show '92

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would generate opportunity to advance gaseous fuel engine technology. The successful conclusion to these efforts will be demonstration and commercialization of the most promising gaseous fuel vehicle technology.

It is difficult to fully appreciate the success of HRP at SEMA '92. As a result of the efforts of the three man GDR Team, three Auto Racing Legends are fully on board with HRP. Their names will be divulged in later articles so that we do not offend their status with premature announcements. Oh, well, I have to tell you that "Big Daddy" Don Garlits has aggressively offered his full promotional resources to HRP. Let that sink in for just a moment. Other significant contacts were made with manufacturing companies who are just now "feeling out" the emerging gaseous fuel vehicle market.

In presenting the DeeMobile to the masses of humanity which filed past it at the main entrance the most common response was that this hydrogen-fueled car was the only significant thing at the SHOW; the rest were merely paint jobs and wheels. I heard that from at least a dozen individuals, including the Legends alluded to earlier. The Big Idea of the Hydrogen Economy, as always, appealed to their rational selves. You cannot argue against the obvious benefits of the Big Idea.

The Hydrogen Racing Program is in there with the best of them now. ♦

Another Hydrogen First

Demetri Wagner Creates First Hydrogen Traffic Jam On San Francisco's Golden Gate Bridge

His goal was more traditional. At the start of the Solar Expo Road Rally to Willits, California, Demetri Wagner, leader of the AHA Hydrogen Racing Program, began his historical first crossing of the San Francisco Golden Gate bridge in a Pure Hydrogen-Powered Pollution-Free Vehicle.

The Zweig Hydrogen Pickup Truck was unloaded from the transport trailer and fired up for the momentous occasion, and self-less Wagner pulled proudly into the onramp traffic, headed into history, never once considering the personal notoriety that would surely be thrust upon him.

Unfortunately, the photographers and TV news crews were not on hand to capture the images of what transpired. A few minutes after the truck entered the northbound ramp from San Francisco to Marin County, Team Chief Lee Radu noticed a growing pileup of traffic, and the familiar angry din of honking horns. Radu, suspecting something might be wrong, swung into action immediately, and began to maneuver the red Chevy truck and trailer rig in to investigate.

The scene Lee discovered will become history. Picture the adventurous Hydrogen-Powered Bridge-Crossing Solo-Pilot Wagner standing in front of the truck waving his arms in dismay, as the drivers who were stacked up behind him missed

Solar Hydrogen Industrial Workshop: Evaluating Strategies

A Hydrogen Workshop is being formed to bring together key representatives from government and industry to identify the major economic and institutional obstacles that need to be resolved for a transition to the "hydrogen economy" to take place. This initial Hydrogen Workshop is hoped to serve as catalyst in helping to establish a Hydrogen Implementation Board.

Of all the alternative fuels now being considered, only hydrogen is non-toxic, inexhaustible, and its use results in no carbon emissions. Made using renewable energy, hydrogen has the potential to make the U.S. energy independent and essentially pollution-free.

One of the obstacles to this transition from oil to hydrogen is the information-gap that exists within government and industry. In this regard, AHA is helping to organize a Solar Hydrogen Workshop in Los Angeles, California on February 8, 1992 that will include key business and governmental leaders.

One leader expected to attend is Congressman George Brown (D) California, who is the Chairman of the House Science and Technology Committee. Congressman Brown, who has a degree in physics, is also the author of the Hydrogen Bill that was passed in the House. It is worth noting that the senate version of this Hydrogen Bill was co-sponsored by Senator Wirth of Colorado, who has been nominated as President Clinton's new Energy Secretary.

Senator Harry Reid, the senior Senator from Nevada, and Governor Bob Miller from Nevada are also planning to attend the Hydrogen Workshop. Senior technical and management representatives from both Chevron and ARCO will attend, as well as several representatives from the automotive and utility industries. Senator Reid is planning to hold hearings on the U.S. making a rapid transition to the solar hydrogen economy, and one of the questions is, how long will such a transition take?

Inquiries may be directed to Harry Braun, through the AHA office.

the significance of the occasion. Imagine, these were the very very first urban commuters to be held up on their way home from work by a Pure Hydrogen-Powered Pollution-Free Vehicle, and on a Friday afternoon, no less.

But Hydrogen Today reports on educational matters, and there is science behind the story. Head Trouble-Shooter Radu loaded up the truck, and took it away to investigate. What was wrong? Did all of the oh-so-tough-to-contain hydrogen fuel leak out, only moments after being topped off at the SF Hydrogen Gas Station? Was there some exotic, new high-tech hydrogen engine phenomena to be analyzed and reported in the next International Journal Of Hydrogen Energy, for the worldwide technical community to learn from? Like, maybe hydrogen doesn't work in fog or something?

No, as it turns out. A last-minute repair and reassembly of a fuel shutoff valve had left it turned to a not-quite shutoff position. It would idle and go, but not fast enough to keep up with traffic. Radu opened the valve and the truck went on to successfully finish the rally.

Tim Murphy, who performed the valve repair, had stayed behind in the heat of Phoenix while the rest of the team headed to the cool pines of Willits. Tim attributed the incident to a communication failure, and denied any devious intent. ♦

FUTURE FUEL...

— *Norimasa Furuta*
Vice-Chairman,
Mazda Motor Corporation October 1992

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Germany Pioneers Solar Hydrogen.

Last fall the world's first complete solar hydrogen facility was opened in the German town of Neunburg vorm Wald in Bavaria. Six thousand solar modules covering 3,000 square meters will produce enough power to supply the needs of 70 households. Plans call for annual production of approximately 54,000 cubic meters of hydrogen that will be purified, compressed, and stored for later conversion into electrical energy. Future projects include using hydrogen for home heating and perhaps even to run specially equipped cars. ☉

**" IF THE AUTOMOBILE IS TO BE A GOOD FRIEND AND PARTNER TO MANKIND,
WE MUST PURSUE TECHNOLOGICAL INNOVATIONS FOR USING CLEAN ENERGY.
THE CONTINUED EXISTENCE OF THE AUTOMOBILE SHOULD NOT REQUIRE
IRREPARABLE ENVIRONMENTAL SACRIFICES."**

Joint Venture Announced To Develop H₂ Storage Technology

Syracuse University and Yung Technologies International, Inc. agreed to join forces in the research and development of advance hydrogen storage technology for future hydrogen energy systems. Applications will include land vehicles, space vehicles, aircraft, ships, utilities, solar energy, and wind energy. Hydrogen is the ideal carrier to store electrical energy. Hydrogen is also the cleanest fuel known, and it can be efficiently produced from water.

Syracuse's Laboratory for Advanced Storage Systems of Hydrogen (LASSH) has been conducting research in hydrogen adsorption using activated carbon for nearly 10-years. New techniques developed at LASSH permit large quantities of hydrogen to be stored at conditions that practical applications for hydrogen energy is now possible.

YTi began engineering development work with LASSH 4-years ago. With YTi's engineering efforts, research progress accelerated at LASSH. While research continues at LASSH, YTi is developing applied storage systems for different industries.

It will be YTi's charter to provide the world community with state-of-the-art hydrogen storage systems, and license the technology world-wide. This academia-industry partnership will be the most effective technology transfer method for people to enjoy new technologies as they become proven.

YTi is currently building laboratory scale hydrogen storage units for fuel cell and auto manufacturers' labs. With concerns for human health and the environment, YTi is looking forward to contributing to the world's evolution to cleaner energy.

For more information, please contact: Karl Young, Phone: (518) 523-8075; Fax: (518) 523-2365

Hydrogen Racing at SEER

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The first leg provided an exciting turn of events for the team. A partially closed gas supply valve starved the mini-truck engine of fuel, stranding Demetri on the Bridge. (see Another Hydrogen First).

The second leg of the Rally was from Ukiah to Willits, including about 25 miles on 7 to 8% highway grades. Demetri felt the mini-truck performed remarkably well here, better than could have been expected of the previous engine configuration (Pre-AHA). The third leg was a timed road rally format; the team finished in record time on squealing tires with Electric Vehicle Class participants being passed, rapidly.

When the mini-truck is fueled with solar hydrogen gas, could one argue in favor of direct competition between solar electric vehicles and the solar hydrogen fuel? The hydrogen vehicle will have greater power performance and range, as well as zero or "minus" emissions and greater option in fuel supply, and thereby, vehicle availability.

The Racing Program was able to participate at SEER '92 through the sponsorship of Gas Development Resources (GDR); a gaseous fuel consulting firm in Prescott Valley, Arizona. GDR feels that the AHA is to be commended for its tireless efforts in promoting the concept of prosperity without pollution. AHA leads the way by using the most important and effective method; showing the public of their energy alternatives. ❖

Arizona's 1st Hydrogen-Powered Vehicles Officially Registered.

The first two vehicles modified to run on Hydrogen were officially registered with the Arizona Department of Motor Vehicles at a special "Hydrogen for Clean Air" reception held on Friday December 18th at the National Headquarters of The American Hydrogen Association in Tempe, AZ.

The TWO hydrogen powered vehicles registered are a 1991 Oldsmobile converted by AHA's researchers to run on both hydrogen and natural gas and a 1979 Dodge Pick-up converted to run

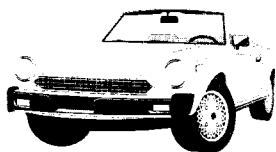
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Pouring Some Sunshine On The World's CO₂ Woes



— *Chemical Engineering*
September 1992

In a move reminiscent of its ambitious 10 year programs in computer science, Japan's Ministry of International Trade and Industry (MITI; Tokyo) will put into gear next year a 28-year, \$12-billion effort, the New Sunshine Project, to develop ways of curbing carbon dioxide emissions and increasing energy efficiency. The project will involve joint international research on, among other topics, the use of hydrogen as a clean energy source, and the development of CO₂ fixation routes. MITI hopes that as a direct result of the technologies developed, CO₂ emissions worldwide will be cut by 10% by 2030, and by 20% by 2050, and that one third of Japan's energy needs will be met with new technologies by 2050. ❖



Adopt-A-Car: Make A Better World

The newest donation to the AHA ADOPT-A-CAR Program is a 1976 Fiat from brothers Michael and David Galvin. AHA accepts the donation of vehicles at their fair market value, which can be used as an income tax deduction. Please call for details about AHA's program to demonstrate how a vehicle using hydrogen can "steam clean" the air.

HELP! AHA office needs donations to replace copy machine!

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HYDROGEN TODAY WRITER'S GUIDELINES:

AHA publishes *Hydrogen Today* to help educate the public about new developments in renewable energy, and the science and people behind them, and to let our Association members know about AHA news.

Would you like to help? We are always looking for interesting and informative articles and announcements to bring to our readers. Here's how to write for *Hydrogen Today*:

Articles published in *Hydrogen Today* should be informative and written in a style which members of the general public can enjoy. Acceptable topics include all forms of renewable energy developments and technologies, such as solar, wind, biomass, and ocean thermal energy systems, energy efficiency and new and innovative applications of renewable energy.

Related social and business issues are also of great interest, since the advancement of renewable resources is keyed to the marketplace and to public acceptance. Pure editorials and opinion, however, are less often used.

Photos and other graphics are highly desirable. Please always try to include some form of illustration or photo, preferably black and white, to help readers visualize and understand the article. And photos of the author are also welcome!

Hydrogen Today also features a Calendar of Events, and selected Letters to AHA. Please let us know about upcoming events of interest to our members, and write us about news that you may discover yourself.

We reserve the right to be selective of material received, and to edit for length if necessary. Each column of text in the publication is about 300 words, and articles are commonly about 300 to 1,000 words in length. Longer articles are also welcome, though in some cases they may be excerpted, or published in parts over more than one issue.

Please join us in helping inform others about pollution-free renewable energy resources. The world is ready to hear the news!

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EPRI/U.S. DOE Establish Initiative To Expand Use Of Wind Power

Palo Alto, CA — The United States Department of Energy (DOE) and the Electric Power Research Institute (EPRI) recently launched a nationwide utility wind-turbine field-evaluation program. Under an agreement signed in September, EPRI and DOE will assist utilities to evaluate a new generation of wind technology over the next five years. The new technology should make wind power in many states broadly competitive with electricity derived from fossil fuels.

The joint program calls for the DOE and EPRI to assist up to four host utilities to construct wind power test plants with about 20 turbines at each site. The host utility will select the vendor and turbine technology. EPRI and the DOE will assist with installation, site operation and testing. The \$40 million venture will provide first-hand experience for the host utilities, and establish an information base for manufacturers to improve their technology and for potential users to judge the value of deploying wind power plants.

“Our joint effort will increase utility participation and acceptance of wind energy systems,” according to J. Michael Davis, DOE assistant secretary for conservation and renew-

able energy. “The venture is expected to accelerate widespread utility adoption of wind power by three to five years.”

The primary goal of the DOE/EPRI utility wind power program is to assure commercialization of utility-grade wind power systems capable of delivering electricity at a cost of 5 cents per kilowatt hour (Kwh) in areas with 13 mph winds by 1998. Today, the best of the nation's 17,000 wind turbines are providing electricity at 7-9 cents/Kwh with 16 mph winds.

Spearheaded by EPRI's and DOE's parallel advanced wind turbine development programs, a new generation of technology is becoming available over the next two years. With utilities taking advantage of the new technology and recently legislated 1.5 cents/Kwh energy production incentive, the DOE and EPRI expect the nation's present wind power capacity of 1600 MW to at least double during the next decade.

“The joint program removes the biggest obstacle to substantially expanding wind power penetration, that being successful field verification of wind turbines with cost-competitive technology,” said Kurt Yeager, EPRI senior vice president of technical operations. “The program will provide the utility decision maker with a clear understanding of the performance, costs and risks of wind power.”

In a second phase of the joint program, EPRI and the DOE are considering evaluating another generation of technology expected to be available by about the year 2000. This technology, spearheaded by DOE's advanced turbine program, is designed to cut costs another 20% to 4 cents/Kwh with 13 mph winds.

“If both phases of the joint program are successful, wind power's penetration will not be limited by cost and could grow by another factor of 10 to 20 by 2030,” said DOE's Davis. “At that point, wind would be providing energy equivalent to 120 million barrels of oil per year.”

EPRI, founded in 1972, manages the technical research and development programs for the electric utility industry to improve power production, distribution and use. Some 700 utilities are members of the Institute. ☉



power penetration, that being successful field verification of wind turbines with cost-competitive technology,” said Kurt Yeager, EPRI senior vice president of technical operations.

“The program will provide the utility decision maker with a clear understanding of the performance, costs and risks of wind power.”

New U.S. Solar-Hydrogen Lobby Launched

Washington DC—Hydrogen's political presence in Washington is growing: A new organization that, more than before, wants to push the government along the path towards commercial introduction of renewable hydrogen as fuel has been launched here.

The American Renewable Hydrogen Energy Alliance, an offspring of the Solar Energy Industries Association, made its debut last spring. Founding members include the Florida Solar Energy Center, the Hawaii Natural Energy Institute, Bechtel Corp, and Solarex Corp of suburban Maryland. Ken Sheinkopf is Executive Secretary.

The development of a renewable-based hydrogen program which is industry-driven is critical to the future of solar-hydrogen, and the solution of the nation's transportation problems. The program should begin with the commercialization

of hydrogen in high-value niche markets with the purpose of integrating hydrogen into the conventional utility and transportation markets.

For starters, the new lobby is focussing on support of production and application technology R & D at the \$1.8 million level. It also calls for outlays of \$500,000 to support R & D and natural gas/hydrogen blending technologies. The new group is calling for a \$3.4 million hydrogen budget as a separate line item within the Energy Department's R & D budget.

American Hydrogen Association welcomes Ken and the ARHEA organization to the hard work that is going to be required to make the transition to renewables. Congratulations. Let us know how we can help. As an educational association of the people, AHA does not lobby, but we will help spread the word.

New Solar Dynamic Power System For NASA

— by *G. Michael Baker,*
President, AHA of Tucson

NASA has selected Allied-Signal Aerospace's Garrett Fluid Systems Division in Tempe, Arizona, to lead a contractor team in designing and testing a 2 kilowatt solar dynamic space power system that will be scalable to at least 25 kilowatts. Higher specific power output requirements would be targeted for follow on system development efforts. In addition to serving as a prime contractor of the program, Fluid Systems is providing the 2 kilowatt closed loop Brayton Cycle engine. The NASA Lewis Research Center contract is valued at approximately \$18 million over 44 months.

The system will supersede a previous NASA design concept that used a Free Piston Stirling cycle engine fueled with solar energy to provide electricity for space power requirements. The new system will use sunlight to provide heat to turbine engine coupled to an alternator that will generate electricity for the same purposes. Experimentation with magnetic bearings may provide near frictionless rotation.

The new design circulates a fluid in a closed-loop system that produces no exhaust. As sunlight is focused into a chamber, the fluid is heated, powering a turbine-alternator combination that produces electricity. Terrestrial applications are obvious to those familiar with Harry Braun's book, "The Phoenix Project".

The test system will demonstrate the capability to efficiently and reliably provide power for future space applications requiring high specific power capacity, such as Space Station Freedom. Testing scheduled for 1995 at the Lewis Research Center, will be the first for a solar dynamic power system in a simulated space vacuum with a simulated sun source. Key test requirements are the capability to produce 2 kilowatts of electricity with the ability to scale to at least 25 kilowatts; component longevity and reliability; and successful subsystem interaction.

Other team members and their contributions include Harris Corporation's Government Aerospace Systems Division in Melbourne, Fla., which is providing the solar concentrator; Allied-Signal Aerospace's AiResearch LA Division, the heat receiver and recuperator; LTV's Aerospace and Defense Company in Dallas, Tex., the radiator; and Rockwell International's Rocketdyne Division in Canoga Park, CA., system integration.

Significant Advance Reported In Fuel Cell System

Lower Cost Technology Brings Hydrogen Fuel Cell Closer to Commercial Use

West Palm Beach, Florida - The generation of more than 1.4 kilowatts of electrical power using low-cost graphite technology in a patented five-cell solid polymer fuel cell system has been achieved by Energy partners, Inc. This 1.4 kW system supplies enough energy to power a small home.

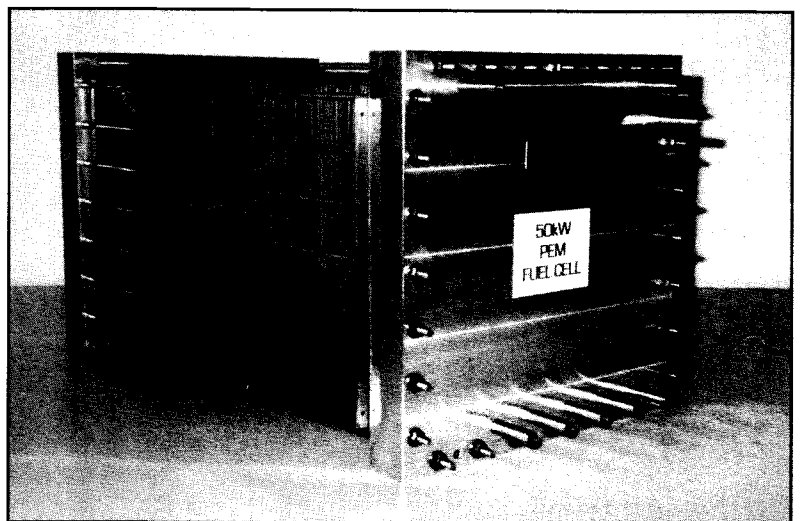
According to John Perry, Chairman of Energy Partners, the major advance in this hydrogen fuel cell development is the significant result obtained using low-cost molded graphite technology, rather than machined graphite or titanium plates. This holds promise for near-term, low-cost production of the technology.

Fuel cells are devices that combine readily available hydrogen with an oxidant (air or oxygen) to generate direct current electricity with only pure water and low-grade heat as by-products. Unlike petroleum-based devices, hydrogen fuel cells release no pollutants into the atmosphere.

"In the design and construction of this 1.4 kW fuel cell system, we have been successful in bringing manufacturing costs down without sacrificing performance, said Mitch Ewan, Vice President Business Development. Our goal in building this system was to produce a useful power size, while keeping in mind that our ultimate goal is developing manufacturing procedures that will enable this technology to be commercially viable when mass produced. The success of this system validates our approach; with future refinements we can only do better."

The hydrogen fuel cell system is being developed to create a completely pollution-free power source for use in such applications as automobiles, naval vessels, locomotives, and stationary power supplies. Today's development came as a result of work being done on two larger projects including a system for a foreign government and a fuel cell powered demonstration automobile. Most of the work is internally funded with support from California's South Coast Air Quality management District.

Energy Partners is a Florida-based research and development company dedicated to the development of clean, efficient and practical fuel cell systems. The company works through a growing network of licensed partners who help commercialize and manufacture the technology on an ongoing and worldwide basis. ♦



The National Energy Act of 1992

— by Kathy McAlister

A single year pales in comparison with a decade, or a century. And while the major highlights of a solitary year may focus on two or three major events, chances are a much longer period of time went into planning and the ultimate development. In turn, the events that are considered milestones over the course of a year may actually be better remembered as building blocks that helped establish the fundamental base for something much bigger, and much more permanent. Such is the case of the Nation Energy Act of 1992 in helping to build the hydrogen economy. The Energy Policy Act was created, debated, and passed October 8, 1992 (days before the election). The funding for several of the programs must still be appropriated by Congress and later released to the various federal agencies for spending.

The legislation requires the federal government to help create a market for **alternative fuel vehicles (AFVs)** by purchasing 5,000 AFV light-duty cars and light trucks in 1993; 7,500 in 1994, and 10,000 in 1995. By 1999, new vehicle purchases will be phased in as follows: 25% in 1996; 33% in 1997; 50% in 1998; and 75% in 1999. Currently, there are 375,000 light duty vehicles in the federal fleet, with about 20% annual turnover. The new law should result in about 125,000 to 160,000 alternative-fueled vehicles by the end of the decade. The federal government is required to diversify its AFV purchases among a number of alternatives...including hydrogen.

State governments provisions require centrally fueled state government fleets in metropolitan areas with populations of 250,000 or more to buy AFVs on the following schedule: 10% of their new vehicles in model year (MY) 1996; 15% in 1997; 25% in 1998; 50% in 1999; and 75% in MY 2000. 2.3 million qualifying state vehicles could result in as many as 500,000 hydrogen in the state fleet market by the year 2000.

Private and municipal fleets of 50 or more vehicles, with at least 20 vehicles in one location, and in metropolitan areas with excess of 250,000 population are required to phase in light-duty AFVs beginning with 20 percent of new vehicles, purchased in MY 1999. The program is subject to DOE determination in a rulemaking process in December of 1996 whether a private fleet program will achieve a goal of replacing 30% of imported motor fuels with domestic fuels by the year 2010. The industry must continue to press for a private fleet program that expands the fleet potential from the Clean Air Act. It is estimated that seven million private, centrally fueled fleet vehicles would be included in this program.

Gas and electric companies are required to phase in light-duty AFVs, beginning with 30% of their new fleet vehicles starting MY 1996; 50% in MY 1997; 70% in MY 1998; and increasing to 90% for MY 1999 and thereafter. All public utilities (including gas, electric, water and telephone) account for some 1.2 million vehicles. Approximately 28% of these are cars and about 60% are trucks...most in the weight classification affected by the legislation.

Important financial incentives include federal tax deductions for businesses or individuals on the incremental cost of AFVs at the following rates: \$2,000 for vehicles up to 10,000 pounds gross vehicle weight (GVW); \$5,000 for vehicles between 10,000 and 26,000 gvw; and \$50,000 for vehicles above 26,000 gvw. Qualifying tax deductions for businesses installing fueling stations are up to \$100,000 ceiling. Taking into consideration depreciation already allowed for business deductions, the vehicle and station, in terms of real dollar value, the business deductions equate to the following: \$111 value for light-duty vehicles; \$263 for medium-duty vehicles; \$2,630 for heavy-duty vehicles; and \$5,539 for stations (at the \$100,000 deduction level). For individuals claiming a tax deduction on a light-duty vehicle, the cash value of a \$2,000 deduction (assuming a 30% tax rate) is \$600.

The tax deductions begin June 30, 1993 (there is no "grandfather" clause for conversion or fueling stations installed before that time) and begin to phase out in 2001, ending in 2004.

Low interest loan program by the federal government to fund the incremental costs of vehicle conversion and purchases (including non-road vehicles) is authorized. Importantly for hydrogen, preference will be given to repayment schedules that enable the loans to be repaid by the borrower from the cost differential between gasoline and the alternative fuel. Twenty-five million dollars for each fiscal year 1993, 1994, and 1995 is authorized. The program will begin in late 1993.

The legislation allows non-utilities to sell hydrogen at the fuel pump without being subject to regulation as a utility. The legislation codifies a FERC rule providing an exemption from the Natural Gas Act for non-utilities selling hydrogen as a vehicle fuel; provides an exemption from the Public Utility Holding Company Act (PUHCA) for the sale of hydrogen; and preempts state laws in effect prior to January 1, 1989. These provisions overcome substantial regulatory hurdles that have blocked fuller development of the hydrogen fueling infrastructure.

DOE is authorized to enter into cooperative agreements and joint ventures with municipal, county or regional transit authorities to demonstrate the commercial application of alternative-fueled mass transit buses in areas with populations of 100,000 or more. Private firms willing to provide cash or in-kind assistance may also participate. Federal funding will be provided for 80% of the project costs, and private or municipal sector funding is required for the balance.

Funding for dedicated hydrogen school buses will be made available for the incremental costs of new purchases, conversion, and for fueling stations. Authorized funding for the bus program is \$30 million for each of the fiscal years 1993, 1994 and 1995. ♦

Letters

Subject: Damaging misconception of the **CLEANEST, SAFEST ENERGY AVAILABLE** To North America without importation of anything.

Editor:

Here in Arizona we are blessed with the largest nuclear power plant in the western world. The visible discharge is limited to water vapor from the secondary cooling system —CLEAN, CLEAN CLEAN! Granted spent fuel rods do constitute a menace, but there are demonstrated ways to reprocess these items and thus eliminate that atomic power complaint...but the so-called environmentalists waste billions of dollars fighting such facilities establishment in America.

Where I lived most of my life, the northwest, almost every river has been dammed to generate electrical power, but even that vast resource isn't adequate for future needs...and salmon runs have been seriously damaged by them so that now some of the power production capacity is unavailable. And a major hydro project causes far more damage to the environment than all the atomic power plants in the world do.

We have all the materials needed to meet our power needs right here in North America if we place maximum growth reliance upon the nuclear option. The expense of a new atomic power plant could be drastically reduced by elimination of the many foolish steps that such a project must pass through from conception to production. These steps represent waste that must be made up through needlessly excessive power sale

rates...the end customer pays for this waste, not the owners of the power generation plants.

Two major nuclear power plant incidents have occurred in the past few years. The Three Mile Island plant meltdown was the direct result of a defective design which the designer had not been using for several years for that reason.

The far more serious Russian plant disaster was a direct result of using a design that would never under any circumstances be permitted in this nation. Basically the primary heat exchanger was located below the reactor so that when the circulating pumps were turned off through human error, the system self-destructed.

Our Palo Verde Nuclear power plant has the heat exchanger located above the core so that even without pumps, the core can be shut-down without damage...but obviously we do not establish standards for a Russian power plant!

Having spent most of my working life as an engineer with *Westinghouse Electric* and contract manager with the *Bechtel Group, Inc.* I have been involved with major players in the atomic power business.

Nuclear seems like one of the best alternatives to produce the power needed to electrolyze water into hydrogen and oxygen. A cloudy location or month is of no importance...something that can't be said for solar. The amount of land needed for a major solar facility exceeds by several hundred percent what is needed for an equivalent nuclear facility and more importantly, the visual impact is almost zero in comparison with solar or wind. A drive to Los Angeles via I-10 treats you to the visual impact of a wind farm.

Vance T. Fagan,
Arizona

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Readers? Renewable or Nuclear? What do you think?

Dear Editor:

Perhaps you or the readers can comment on these positions:

1. *The reduction of hydrogen power physics to a unity:* Electrolysis could be done in a sealed container, thus eliminating mechanical compression to a separate storage container. This is tricky because the oxygen must be vented away or contained while containing the hydrogen.

The problems of this push one's thoughts to the ultimate conclusion wherein the fuel cell actually becomes the electrolyzer when reversed, and as well, becomes the compressed storage tank.

In effect if not in spirit, a direct and complete solution to the above would be the development of a small, efficient

compressor, maintaining the four-art conventional structure (electrolyzer, fuel cell, storage tank, compressor).

2. *A major commercial use of hydrogen* exists now that could very well be profitable - hydrogen power for bicycles and small scooters. A small electric motor over the front wheel could extend the utility of a bicycle by facilitating uphill climbs and long cruises. Gasoline powered versions of this have existed for decades.

For a bicycle, wind and solar power requirements for a renewable system are minimal, putting hydrogen power within the economic reach of many who would like to vote at the marketplace.

Ed Harvy,
New York

LETTERS POLICY

Hydrogen Today welcomes all letters to the editor.

Letters should include your name, address, and a telephone number where you can be contacted.

All letters are subject to editing. Please address letters to:

Editor, Hydrogen Today
American Hydrogen Association
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World Hydrogen Energy Conference In Paris Emphasizes Transportation Applications

This is the conclusion of the report on the Ninth World Hydrogen Energy Conference held June 22-25 in Paris, France, reprinted from The Hydrogen Letter by Peter Hoffmann. See the June/July issue of Hydrogen Today for the first part of the report.

To subscribe to The Hydrogen Letter, write to:
Peter Hoffmann at 4104 Jefferson St., Hyattsville, MD 20781.

In contrast to previous World Hydrogen Conferences that focused on theory and long-range hydrogen technology developments, this Paris conference clearly indicated that hydrogen energy technology can be applied practically in the near-term future. A particular emphasis of the material presented at WHEC-9 was hydrogen in transportation applications.

Hydrogen Busses: New hydrogen-powered vehicle developments included a hydrogen fuel cell and NiCad hybrid "Eureka" articulated city bus that is scheduled to make its first public runs in Brussels next year and in Amsterdam by 1994. The four companies involved in the project — Air Products, Netherlands (LH₂ specialist); Elenco, Belgium (fuel cell developer); Ansaldo, Italy (bus maker); and Saft, France (battery producer) — distributed a glossy, commercial-type flyer at the conference describing the vehicle's characteristics. The 80-passenger bus employs an alkaline fuel cell rated at 78 kW. The battery is a 775 V, 80 Ah system. The bus is reportedly able to refuel in 10-15 minutes, and it will operate at an overall efficiency of 50%. Its cost will be higher than diesel but lower than a trolley system, according to a company spokesman.

Munich appears to be emerging as a European focal point of alternative energy and hydrogen transportation technology, in part because of support from the Bavarian state government. Reinhold Wurster, the staffer at Ludwig-Boelkow-Systemtechnik, who is in charge of managing the European end of the Euro-Quebec Hydro-Hydrogen Pilot Project, reported on proposals to have a first liquid hydrogen bus demonstration running in Munich by 1994. The bus will be a derivative of a standard city bus built by MAN, a German company with experience in CNG and LNG propulsion technology.

The first bus will serve as demonstrator...but it will be licensed for regular passenger service. An additional one or two busses will be phased in by 1996, one as a shuttle to Munich's new airport. In a third phase, a fleet test is envisioned with 5-10 hydrogen busses in Munich and other Bavarian cities that would lead up to a commercially-available bus system by the turn of the century, according to Wurster.

Liquid hydrogen would be available in the near term from a new 4.4 ton/day Linde liquefaction plant at Ingolstadt, near Munich.

Dual-Fuel Vehicles — As a Transition

Dual-fuel vehicles, using hydrogen and gasoline, were also discussed by Wurster and by a separate paper presented by Wolfgang Strobl, BMW's hydrogen car R&D manager. Expressing concern about the current commercial viability of

hydrogen fuel cells, Strobl noted that dual-fuel internal combustion cars can, with current technology, operate virtually pollution free with a range of 300 km (190 miles) with liquid hydrogen, plus a gasoline range of 500 km (300 miles). This would permit practically pollution-free operation in metropolitan areas, Strobl said, without leaving the driver stranded when he ventures beyond the range of a future LH₂ refueling station. "Passenger cars which run on two different fuels (hydrogen/gasoline) are no longer an utopian future, Strobl concluded.

Daimler-Benz (Mercedes) was represented by Helmut Buchner, who observed that there has been significant advances in the use of conventional engine technology and hydrogen hydride storage in a dual-fueled vehicle. "Daimler-Benz proved that with three quarter of a million kilometers of testing with passenger cars and vans in Berlin" over a multi-year fleet test in the mid-1980's.

U.S. Support Needed: Buchner added that it would be helpful if the U.S. government would support construction of appropriate hydrogen refueling facilities in California, for instance, or at least provide electric power and rechargers. "If signals of this sort were to become evident, Daimler-Benz could envision (a new commercial fuel infrastructure) like this, obviously in cooperation with the utilities, with the natural gas industry, with fuel station operators, and with other carmakers — not as an alternative to gasoline and diesel, but as an alternative to electric vehicles."

Fuel Cells

Fuel cells for transportation were also among the conference's major topics. Although great strides have taken place with this technology, including U.S. work by Texas A&M University, and Westinghouse Corporation reported at Paris (along with work done by Norway, Germany, Japan, and Finland), there are still a number of technical problems that need to be worked out. Particular problems cited included reliability and a general lack of availability, both of fuel cells and electrolyzers. ♦

AZ's First H₂ Vehicles

Continued from page 4

on straight hydrogen. The conversion projects were headed by Demetri Wagner and Dr. Robert Zweig.

This motor vehicle registration marks the first hydrogen vehicle to be legally licensed under Arizona Statute 28-1591.04 passed in 1991. The bill was designed to encourage the use of alternative fuels such as propane, natural gas, hydrogen, alcohol, electricity and solar power to provide a solution to urban air pollution and to meet EPA clean air mandates.

AHA demonstrates the use of hydrogen as the cleanest burning automotive fuel through vehicle-conversion projects and on going test-stand research. Through these scientific demonstration projects AHA has determined that when hydrogen is burned it produces only water vapor and trace amounts of nitrogen oxides. There are NO hydrocarbon emissions and NO carbon dioxide, both significant green house gases. ♦

Upcoming Events . . .

Have an event for our calender? Write us and let us know!

- Dec. 16**—Tempe, AZ—A.S.U./AHA monthly meeting. Student Service Bldg. 7:00-9:00p.m. Contact: Kathy McAlister - (602) 921-0433
- Dec. 18**—Tempe, AZ—Open House National HQ 11:00 a.m. to 5:00 p.m.
- Dec. 30-Jan. 2, 1993**—Cairo, Egypt—Third International Conference on Renewable Energy Resources. Contact: Dr. Abdullatif I. Sel-Sharkawy, National Research Center, Dokki, Cairo, Egypt
- 1993**
- Jan. 10-13**—Detroit, MI—17th Automotive News World Congress
- Jan 10-14**—Washington, D.C.—Transportation Research Board 72nd Annual Meeting
- Jan. 12**—Southern California Chapter of AHA monthly Meeting, Town Center Hall, 11740 E. Telegraph Rd. Santa Fe Springs, CA Contact 1-(800) 854-5225. (Second Tuesday of each month.)
- Jan. 20**—Tempe, AZ—A.S.U./AHA monthly meeting. 7:00 to 9:00 p.m. Contact Kathy McAlister (602) 921-0433 (Third Wed. of each month)
- Jan. 18-31**—Carbondale, CO—Alternative Transportation, Electric Vehicle Conversion & Hydrogen Energy Workshops. Contact: Ken Olson & Johnny Wiess, Solar Technology Institute, P.O. Box 1115, Carbondale, Colorado 81623-1115
- Jan. 25**—Paper due for Solar '93 (see April 22)
- Jan. 25-27**—Houston, TX—Society of Automotive Engineers, LNG TOP-TEC.
- Jan. 28**—Tucson Chapter AHA monthly meeting. Contact Mike Baker (602) 469-5554. (Check each month for time and date)
- Feb. 16-18**—Las Vegas, Nevada—Gas Expo '93
- Feb. 16-19**—Paris, France—Gastech '93 Fax (33-1) 40-310165
- Feb. 17**—Tempe, AZ—A.S.U./AHA monthly meeting. Contact Kathy McAlister (602) 921-0433
- Feb. 19-20**—Phoenix, AZ—National Engineering Week. Chris-Town Mall 19th Ave and Bethany Home Rd. Contact: Mary Halperin, (602) 930-9816
- March 1-5**—Detroit, Michigan—Society of Automotive Engineers International Congress and Exhibition. Tele. (412) 776-7131.
- March 3-5**—NGV Institute, Moving the Industry Forward, The Registry Resort, Scottsdale, Arizona. Sponsored by Thomason & Associates, Inc. Contact: 702-254-4180

- March 12-14**—Los Angeles, CA—Third Annual Eco. Expo., The Los Angeles Convention center. Contact: The National Marketplace for the Environment, 14260 Ventura Boulevard, Suite 201, Sherman Oaks, CA. 818-906-0367.
- March 15-17**—San Antonio, Texas—Gas Processors Association 72nd Annual Convention. Tele. (918) 493-3872
- March 24-25**—Washington, D.C.—Fourth Annual Hydrogen Meeting, Sheraton Hotel. Contact: Charlene Burgin, (202) 223-5547
- April 4-8**—Graz, Austria—25th International Symposium on Remote Sensing and Global Environment. Tele (313) 994-1200 Ext. 3234; Fax (313) 994-5123
- April 22-28**—Washington, D.C.—Solar '93 - ASES Annual Conference. Contact: (303) 443-3212 Fax: (303) 443-4212
- April 25-28**—Nashville, Tennessee—Annual Meeting of the National Association of Fleet Administrators. Tel. (201) 494-8100
- April 28-30**—Colorado Springs, CO—Annual Council on Alternate Fuels Spring Coference.
- June 20-23**—Kansas City, Missouri —Adam's Mark Hotel, Project Hydrogen '93. Contact (816) 229-3800, Fax: (816) 229-1000

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AHA Of Tucson Visits Biosphere

— by: G. Michael Baker
President, AHA of Tucson

On September 26 and 27, 1992 Biosphere Ventures sponsored an energy and environment fair in celebration of the one year operational anniversary of Biosphere 2. Located about one hour driving time north of Tucson, Biosphere 2 is a miniature closed ecosystem - with tropical rainforest, savannah marsh, ocean, desert, farm and human habitat ecosystems enclosed within a three-acre airtight structure.

The eight member biospherian crew entered Biosphere 2 September 26, 1992 for a two-year test mission where all air, water and food will be recycled within the transparent enclosure of glass and spaceframe. This two year closure will be the first of many over the hundred year lifetime of this miniature world.

Inside, air is recycled by plants, animals, soils, and the non-living parts of the environment like rocks, bodies of water, and some mechanical systems that mimic geological processes in Earth's biosphere.

Biosphere 2 may help to advance our understanding of how ecosystems recycle air, water and food, providing important information for the intelligent management of the environment on Earth or life habitats on space frontiers.

In celebration of the one year operational anniversary of the Biosphere 2 facility, AHA of Tucson was invited with numerous other environmentally concerned organizations, to participate in a fair designed to attract visitors to the facility and provide them with an opportunity to receive information and entertainment focused on the Biosphere scientific objectives, energy concerns, and the environment.

AHA of Tucson members, Jim Beall, Tom Lanik, and Tom Jaquish brought their solar energy, compressed nitrogen gas, and hydraulic accumulator powered dragster to the fair on behalf of AHA as an illustration of a practical, high performance, pollution-free, renewable energy system. Christened appropriately, the Clean, Green, Mean Machine, the prototype dragster is a proof of concept demonstrator billed as the first step towards the construction of a serious quarter mile drag world record challenger.

Tom Jaquish also demonstrated pollutionless production of solar-hydrogen using two photovoltaic panels, a plastic container filled with water and baking soda, and two pieces of steel for electrodes. The visitors were amazed that such a simple process could be used to actually generate a

pollutionless and inexhaustible fuel supply, economically, safely, and without having to sacrifice anything in performance.

Thousands of visitors attended the event and approximately three thousand pieces of hydrogen information literature were distributed complete with membership application forms. New membership applications have already started coming in from this event.

An opportunity to discuss renewable energy options with the biospherians for possible incorporation in future Biosphere growth and expansion upgrades is in the wings. At present, for capital expense reasons, the energy requirements for Biosphere 2 are supported by natural gas systems. The build-up of CO₂ is due to natural gas and could be eliminated if Biosphere 2 used solar-hydrogen.

Special thanks are in order for Don Rieffel, Joe Blankinship, Jim Beall, Tom Lanik, and Tom Jaquish for all their efforts in support of the Biosphere event.

Mike, thanks for the report on a great Chapter activity. Support your local AHA Chapter. ☺

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