

# Hydrogen Today

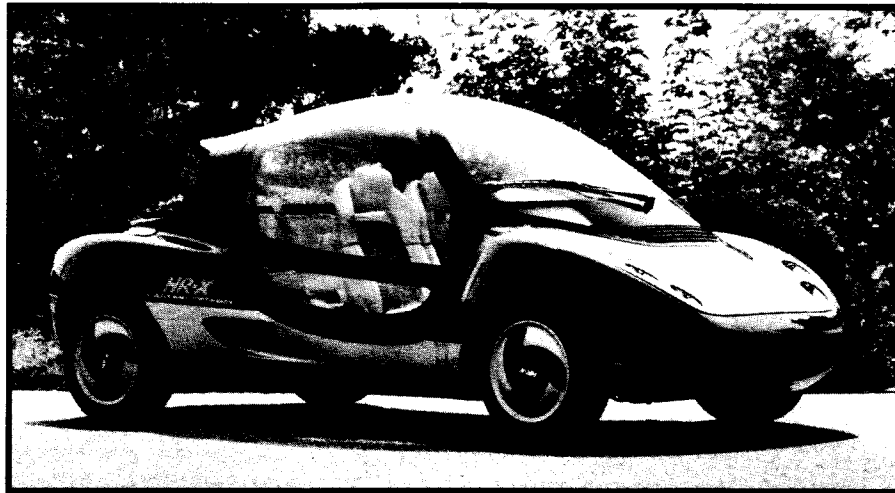
*"Clean Energy For A Better World"*

Official Publication of the American Hydrogen Association • 219 S. Siesta Lane, Suite 101 • Tempe, AZ 85281 Vol 4, No. 1 1993

## Mazda Advances Environmentally-Correct HR-X: Powered By Hydrogen

*The refined Mazda HR-X shown below is a concept car that runs on pure, renewable hydrogen, and emits primarily only water vapor. It has been improved since its original debut in 1991 by Mazda engineers to improve its performance and increase its fuel efficiency. The Mazda vehicle shows that hydrogen can be safely used as a fuel.*

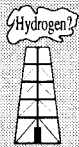
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## Hydrogen Potential From Existing Natural Gas Wells



*— by Erik B. Melchiorre,  
Senior, Geology Dept, Arizona State University*

The simplest and lightest element - hydrogen - is an alternative fuel which provides a clean and renewable energy source. Hydrogen can be used to power gas-type appliances and modified automobiles with water vapor as the only byproduct of combustion.

Examples of renewable hydrogen production include solar or wind-powered electrolysis, where water molecules are "split" into hydrogen and oxygen by an electrical current, and extraction from "biomass", where hydrogen is produced using heat or by microbes interacting with organic

waste. The purpose of this article is to discuss a non-renewable possibility for hydrogen production.

The potential for production of hydrogen from existing natural gas wells may provide a "bridge" for oil companies to facilitate a smother transition from a hydrocarbon extraction industry to a hydrogen production industry.

This is not a proposition to encourage drilling and exploitation, but to simply make the best of the present situation. Current natural gas production will

*Continued, page 5*

## US Senate Holds Hydrogen Hearing



*— by David Clayton*

Reprinted from the Las Vegas Sun

*Monday, March 22, 1993.* President Clinton's chief science adviser was among the influential people scheduled to attend a hearing today in Washington that could lead to Nevada's emergence as a world-class energy producer.

The hearing, which concerns hydrogen fuel production was to be chaired by Sen. Harry Reid, D-Nev. He arranged for the hearing in his capacity as chairman of the Senate Environmental and Public Works Committee.

Reid is impressed with hydrogen's potential as a clean, safe fuel for cars,

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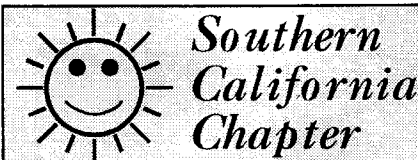
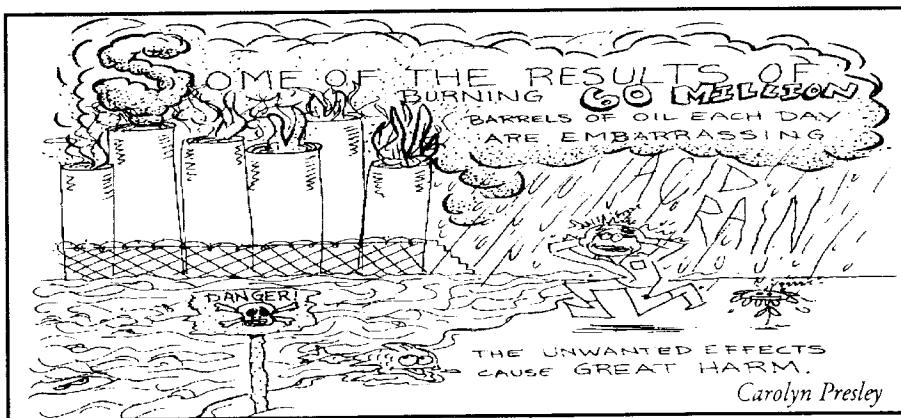
## Inside the AHA . . . .

### Tempe Arizona Chapter Earth Day Arizona

The Earth Day Arizona schedule will begin on April 22 with a sidewalk PARADE (assembly time 4:30 p.m. Tempe Beach Park 54 W. 1st St, Mill Ave, and 1st Ave. South of the Salt River) to Arizona State University campus. Speakers will be scheduled for the environmental rally from 7:00 to 8:30 at this location.

April 23 (Friday) 6:00-12:00 p.m. at Tempe Diablo Stadium a free concert will be composed of approximately five local bands. With a Benefit Concert on April 24 (Saturday) from 4:00 to 12:00 p.m. with a major national group brought in for this concert. Earth Day Arizona members and ecological businesses will have informational booths at this event.

Sunday April 25th Earth Day Arizona Exposition will be held at Wesley Bolin Plaza from 10:00 a.m. to 7:00 p.m. Environmental booths designed with children's activities as the feature of the day's events, including healthy food booths, recycling on site, and special environmental programs. ☐



The Southern California Chapter of the American Hydrogen Association participated in ECO-EXPO at the Los Angeles Convention Center, March 12, 13, and 14th. Terry Kollman was the project manager. LeRoy Essel drove to Tempe to pick up the historic Zweig hydrogen pick-up for display.

Mr. Babak Aghamohammadi, Senior Engineer from MTCI was the guest speaker at the March 9th meeting on "Hydrogen Production from Organic Waste". Coming up on April 24, join the tour of the Linde/Praxair hydrogen production facility in Fontana, in conjunction with the Society of Automotive Engineers at 10 a.m. Call the hot line (800) 854-5225 for information. Steve Robinson, Senior member of the Technical Staff at Sandia National Labs in Livermore will speak May 11 on "Hydrogen Storage and Transmission". May 15th is a tour of the U.C. Riverside Hydrogen Project.



### Tucson Az Chapter – International Fuel Cell Seminar

– by Neil W. Hartman

The 1993 International Seminar on Fuel Cell Technology was held in Tucson from November 30 to December 2, 1992, at the Weston La Paloma Resort, in the foothills of the Catalina mountains. Over 700 people attended from all over the world, indicating that interest in this technology is growing quite rapidly. This seminar was sponsored jointly by the US Department of Energy, the Electric Power Research Institute, the Gas Research Institute, NASA, the Commission of the European Communities, and the Fuel Cell Development Information Center in Japan.

Over 190 papers were presented by authors from 15 countries. The papers, for the most part, focused on fuel cells based on 4 main technologies; molten carbonate, phosphoric acid, solid oxide, and proton exchange membrane. One thing that all of these fuel cell types have in common, is the fact that they run best on hydrogen. A great deal of effort was spent on reformer technology to provide clean hydrogen for the cells. (A reformer is a device that converts a conveniently available fuel into a

hydrogen rich mixture.) In some systems shown, the reformer takes up as much or more space than the actual fuel cell. This complexity would be eliminated if hydrogen were utilized directly. Some fuel cell technologies are able to internally reform, and thus suffer only small penalties for the use of hydrocarbons or alcohols as compared to pure hydrogen.


The main carrot for pursuing fuel cell technology into the product phase, is the high efficiency (40%-70%) available, as compared to existing systems. If applied to the transportation industry, the increased efficiency would go a long way toward offsetting the high cost of hydrogen. Reducing vehicle related pollution is also a major consideration. Transit bus demonstrators are either on road test or being built in the U.S., the Netherlands, and Italy. Work is also underway on that unless someone makes a major breakthrough and leapfrogs the current players, you will not see commercially available systems or vehicles for another 6 to 10 years. This is a field that desperately needs concentrated effort to accelerate its fruition. ☐

## *Silicon Valley Chapter "The Hydrogen Spirit"*

— John Gotthold, Chapter Secretary

A mockup of the "Hydrogen Spirit," a 1,000-mile range gull wing commuter car, was displayed at the Automotive Services Show at the Santa Clara Convention Center on the 13-14th of March, 1993. Basic details of the design included a slide show of the hydride storage, fuel cell, surge battery, electric motor, and cog-belt transmission system that Paul Warsitz and John Gotthold designed. They are attempting to get 50% of the energy stored in the hydrogen to the ground.

AHA's Silicon Valley Chapter showed a small scale working model of the PEM electrolyser and a hydride tank, and a hydrogen cooker. The Chapter has also enough materials to make a try at the Los Alamos style PEM fuel cell and plans to build a working prototype.


The American Hydrogen Association's Electronic Data/Bulletin Board Heart Beat Earth BBS can be reached at (415) 494-3116. The bulletin board isn't set up to handle faxes automatically but the fax number is (408) 738-4014. It is generally on-line from 12:00 noon to 6:00 a.m. The settings are N,8,1 at 2400, or 1200, or 300 baud. Try to access it at 2400, as the data will be massive and you will want to read fast. Currently, it is organized into 15 Conferences, trying to provide space for all levels of Hydrogen interest. All the files are available for down-load. The lowest security level is NEWUSER and that reaches most areas. The second level is AHA MEMBER and that is reserved in some areas for members who are working on specific projects. The highest level is SYSOP and that is reserved for the Silicon Valley Chapter members who are trying to keep it all organized. 

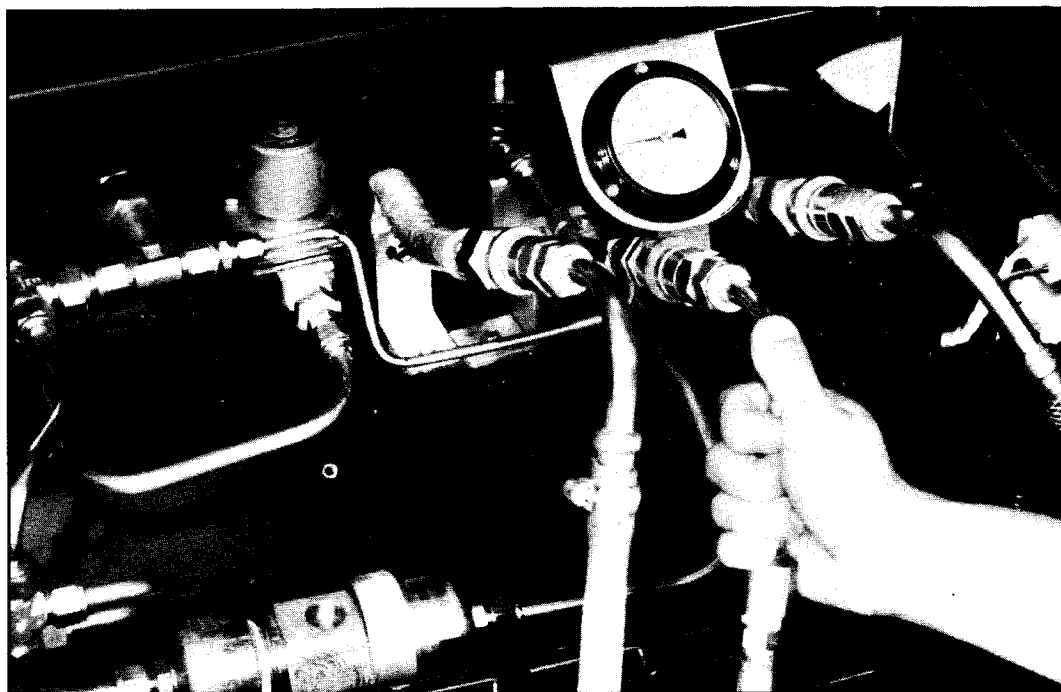
## *Ohio Man Claims He Fuels Car With Just Water!*

In many public disclosures, Mr. Stan Meyer of Grove City, Iowa, has maintained that water can be decomposed within an engine by a special energy source such as a laser that is powered by the engine. In other words Mr. Meyer wants to turn water into hydrogen and oxygen and then burn the hydrogen and oxygen to power the engine and the laser! This claim is similar to the proposal by a California man that wants to electrolyze water as he drives, run the engine on hydrogen and oxygen and use the engine to produce electricity for the electrolyzer.

The potential of these concepts can be readily checked by referring to thermodynamics. If you started with the best opportunity for success and had hydrogen and oxygen to be burned in the best engine that has been built, about half of the energy would be converted into shaft power and the other half would be lost to the surroundings. Assuming that the driver wants to deliver some power to the wheels and that about half of engine output is used to power the laser or electrolyzer for decomposing the water then only about one-fourth of the energy released by burning the hydrogen and oxygen would be available to decompose water into hydrogen and oxygen to keep the engine running.

Producing hydrogen from water with one-fourth of the energy released by burning the hydrogen and oxygen violates common sense and the Second Law of Thermodynamics. Another source of energy would be required to keep the Ohio and California cars going.

Or, could it be that they were planning to only make down-hill trips? 



## *Mazda...*

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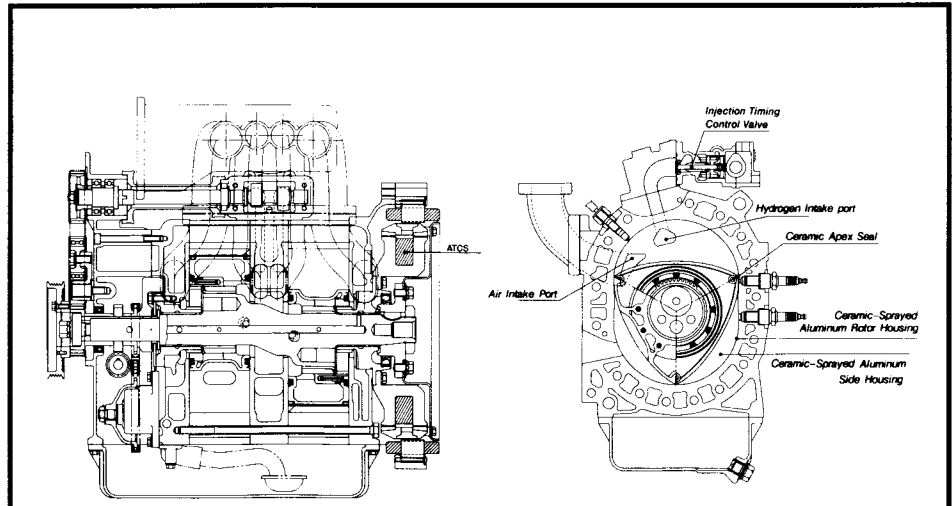
*The metal hydride tank is shown being fueled with one hydrogen fuel line, and two lines which run cooling water through the tank. During refueling, the metal hydride in the tank warms as it absorbs hydrogen, and the water cools it to allow more to be absorbed. When the engine is running, the warm engine coolant water is circulated through the tank to warm the metal hydride, causing the hydrogen fuel to be released.*

*Continued, page 4*

## Mazda Continued from page 3

Unlike piston-engines, the rotary engine has separate intake and combustion chambers. This allows the rotary engine to avoid the backfiring and preignition problems that other engines have experienced. The rotor draws the air and hydrogen in as it passes the top of the cycle, then moves the mixture to the lower right and compresses it, where it is ignited to drive the engine.

The HR-X hydrogen car's rotary engine delivers 100 horsepower, which is nearly the same as the original RX-7. This concept car, shown at the Tokyo Motor Show, and auto shows in New York and Los Angeles, has generated much excitement and public awareness of hydrogen as a fuel with today's technology. Mazda's break ahead of the other auto companies is truly an advancement to the solar hydrogen industry.



**"GREEN ROTARY"** -- Using separate intake and combustion chambers that are unique to the rotary engine, Mazda engineers solved the backfiring and pre-ignition problems inherent when using hydrogen in conventional reciprocating engines. The HR-X concept car engine features technologies adapted from Mazda's rotary engine and produces 100 horsepower -- nearly the same amount of power as the original RX-7. Another advancement found in the HR-X is the hydrogen storage system that uses a Mazda-developed metal hydride and heated engine coolant to provide greater vehicle range and fuel storage durability.

## US Senate...

*Continued from page 1*

homes and businesses. The senator is particularly drawn to the issue because Nevada has three key elements of any conversion to hydrogen: plenty of sun, plenty of space and the Nevada Test Site.

"Fossil fuels are destroying our environment and economy," Reid said. "The time is long overdue to seriously explore national conversion to a viable alternative fuel. Hydrogen is clean, safe and renewable."

The most efficient technology available today for producing hydrogen fuel uses solar energy to extract hydrogen from water. For Reid, the Test Site is the ideal location for a demonstration project of hydrogen fuel production.

Dr. John Gibbons, a solar-energy expert and President Clinton's top adviser on science matters, was to attend the hearing, along with representatives of companies such as Texaco, Arco, Ford, Lockheed and McDonnell Douglas.

Gibbons' presence at the hearing speaks volumes for the Clinton administration's commitment to alternative fuels. In his book, "Earth in the Balance," Vice President Al Gore outlined the need for abandoning reliance on oil, the earth's leading source of pollution. Clinton and

Gore were briefed during the presidential campaign on Nevada's potential as a site for hydrogen production.

Keith Thomas, Nevada's project manager for Phoenix based Hydrogen Engineering Associates, said Gibbons' attendance will be tantamount to that of a Cabinet-level officer paying attention to this issue.

*"He's a very strong supporter of renewable resources, and reports directly to Clinton," Thomas said.*

Hydrogen Engineering Associates is a consulting company that owns the rights to the "dish-Stirling" system of using solar energy to produce hydrogen fuel. Harry Braun, company president, said he is delighted with the national attention that may result from Reid's hearings.

"Any exposure is helpful because this is the best-kept secret in the country," Braun said. "If the American public knew more about the hydrogen option, if they understood that the technology has already been developed, they would demand it."

For Nevada, a national effort to convert from an oil-based economy to one based on hydrogen could mean thousands of new jobs and a world reputation as a leading producer of liquid hydrogen fuel. Last month, Reid, Sen. Richard Bryan, D-Nev., and Gov. Bob Miller attended a hydrogen conference in attended a hydrogen conference in Los Angeles where


they heard about 100 technical experts from dozens of top national and international companies agree that hydrogen is the energy of the future.

At peak production, hydrogen is estimated to cost about \$3 a gallon, a figure proponents say is cheap considering the environmental and strategic benefits.

"When you add all of the cost of environmental damage, and the military cost of securing the Persian Gulf, oil goes from \$20 a barrel to \$120," Braun said.

Don Schueler, special assistant to the manager of local Department of Energy operations, said hydrogen research is already a component of a special \$200,000 solar-energy study under way at the Nevada Test Site.

But Reid's vision goes much farther, and would devote considerable funding specifically to a solar-hydrogen project. At the Los Angeles conference, he lamented that Japan and Germany are devoting hundreds of billions of dollars to solar-hydrogen research while the U.S. budget devotes about \$4 million.

As chairman of the Senate Environment and Public Works Committee, and as a member of the Appropriations Committee, Reid is in a unique position to seek funding for hydrogen development at the Test Site. 

## ...Existing Wells

Continued from page 1

probably continue for the next several decades, and eventually will taper off. Meanwhile, the hydrogen potential of these wells is not being exploited. It is hoped that if oil companies begin to utilize this resource that the market for hydrogen as a fuel will expand. As technology improves, the renewable production of hydrogen will become cheaper and more practical than the extraction of hydrogen from wells.

In Arizona many of the natural gas wells have hydrogen contents of less than 0.1% but it is not uncommon to find wells with 0.1 to 1% hydrogen. In some cases the hydrogen content is as high as 4.2% (Steve Rauzi, 1993). Please see Table 1 for a listing of values for selected wells in Arizona.

Within the lower 48 states of the U.S., hydrogen contents of up to 15% have been reported. About 30 to 40% of all natural gas wells in the U.S. are believed to have hydrogen values of greater than 1% (Howard Meyer, 1993). In Siberia a gas field was even reported to contain up to 43% hydrogen (Nechayeva, 1968).

Hydrogen in natural gas is a concern to gas extraction companies because hydrogen gas lowers the volumetric heat production of a fuel. As a result the higher the hydrogen content is, the lower the burn value will be. Gas companies try to keep their hydrogen contents low in their fuel to produce a better product. The present abundance of low-hydrogen natural gas has precluded the need to separate the two gases, and the high-hydrogen content

natural gas wells may never be used for production.

The technology does exist to separate the two gases, but there never has been a need to do so. The separation process has a low operating cost and consists of simply passing the gas through a polymeric or metallic membrane at high pressure. The result will be a high-purity natural gas with hydrogen as a by-product. (Howard Meyer, 1993). A high-purity natural gas will be more marketable as it will burn hotter, and of course the hydrogen can be sold. Current pipeline systems can be used for gas transport, with separation stations located at strategic locations near the major metropolitan markets.

All of this is dependant upon the creation of a stable market demand for hydrogen gas. It is imperative that the information gap that exists between the public, industry, and the government be bridged so that the transition can


proceed. Once the gap has been reduced or closed, hydrogen-powered automobiles and appliances will become more readily available and demand for hydrogen gas will increase. It is hoped that as the demand increases, the oil companies will realize that renewable hydrogen production is cheaper and more efficient than hydrogen and hydrocarbon extraction through wells. Once this last step has been made, hydrogen will become a truly renewable resource.

### References:

Meyer, Howard, 1993, *Personal Communication, Gas Research Institute.*

Nechayeva, O.L. 1968, *Hydrogen in gases dissolved in water of the western Siberia Plane: Dokl. Akad. Nauk.*

SSR., n. 179, v.4, p. 961-962.

Rauzi, Steve, 1993, *Personal Communication, Arizona Geological Survey.* 

**Table 1. Hydrogen content for selected wells in Arizona**

Hydrogen Content	Well Name	Location	Host Rock
0.20%	Navajo 88 #	Dineh-bi-keyah	Intrusion
0.50%	Spurlock #1	Petrified Forest Area	Basal Chinle
1.20%	Ram-Hortenstine #19a	Petrified Forest Area	Basal Chinle
4.20%	Ram-Hortenstine #19b	Petrified Forest Area	Basal Chinle

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# Solar Hydrogen Industrial Workshop

## EXPERTS SHARE H<sub>2</sub> CAPABILITY

— *by Herb Hayden*

*Los Angeles, CA, Feb 8, 1993.* This meeting was created as a workshop to bring together individuals from widely diverse organizations to discuss their capabilities, plans and interests in developing hydrogen energy equipment and services. A highlight was that the Governor and two US Senators from Nevada and one California Congressman were in attendance, further diversifying the interests and information exchange.

The meeting was organized by Harry Braun of Hydrogen Engineering Associates and the American Hydrogen Association, sponsored by International Energy Partners of Las Vegas, Nevada, and hosted by the Center for Clean Technology of the University of California at Los Angeles, in conjunction with the International Association for Hydrogen Energy.

The format was a morning session of speakers, followed by a working lunch, and an afternoon roundtable discussion session.

Harry Braun opened the workshop by stating that a number of renewable energy technologies developed over the last several years could be mass produced for large-scale production of hydrogen fuel. These include wind, solar dish-stirling, ocean thermal energy and biomass conversion systems. Given the cost of any industrial transition, it would be desirable to focus on hydrogen since it is pollution-free, renewable, and efficient, as well as the most versatile of the "alternative" fuels.

### Summary of Speaker's Comments:

**US Senator Harry Reid of Nevada, Chairman of the Subcommittee on the Environment and Public Works** - "I believe that hydrogen will happen", Japan and Germany have \$100 million programs, while we have \$4 million. We will have a hearing March 22 in the Senate on this topic. We suffer from oil spills and global warming, and though Al Gore's book was laughed at, it spoke about being no longer dependant on

fossil fuels in 25 years, which is a reasonable goal. "I have spoken to Al Gore about hydrogen, and he has people working on it. It needs the attention of major companies".

**US Senator Richard Bryan** - We have two public policy imperatives: the environment and energy independence. I supported Desert Storm, but the region is no more stable today. During the last ten years, federal renewable energies programs were on "life support", so time was lost. We need DOE to focus onto renewable energy resources, though the past focus was on nuclear and fossil. Al Gore will take the lead. Tax policy and private/public marriages will be developed to support the effort. Senators will have to learn.

**Bill Hoagland, Hydrogen Program Manager of the National Renewable Energy Lab** - From the onset, hydrogen was one of the eleven DOE programs for the original SERI institute, beginning in a conference in 1979. Early advice from a Congressman was that "hydrogen needs a constituency." There is a grassroots interest, but there needs to be an industrial interest. We have a Hydrogen Technical Panel setting priorities and funding percentages. NREL has released a program plan document which describes the "pathway analysis" used to determine which entire energy source-to-use pathways are most efficient. With existing technology to store hydrogen at 6,000 PSI in tanks, and with fuel cell electric vehicles we can get 300 mile range. We are looking at polyhydrides for storage of hydrogen from wind and solar, and for low cost storage is needed for use by utilities. There is a role for natural gas and solar hydrogen generation.

**Roy McAlister, P.E., President of the American Hydrogen Association** -

Today's internal combustion engines can be converted to use hydrogen or any other fuel more efficiently than gasoline by the use of the Precision Spark Injection (PSI) system. This enables us to begin the conversion to hydrogen

now, rather than waiting for fuel cells or other new technology to be developed. If mass produced, the PSI system could be installed on most passenger vehicles for about the cost of a major tune-up, plus the installation of the hydrogen storage tank.

We should be using the carbon in oil to make carbon fibers, Fullerenes and diamond materials for optics, filters, buildings, etc, rather than burning it as fuel that pollutes. Roy then showed a video of the operation of his PSI Precision Spark Injection system being used to convert common gasoline and Diesel engines to run with direct fuel injection, which allows hydrogen and other fuels to be used without difficulty. The method also brought the advantage of "stratified charge combustion", where the combustion takes place in the center of the cylinder volume, and less heat is wasted into the walls of the cylinder. Using hydrogen, cars would clean the air as they are driven.

**Pat Ryan, PhD, Senior Consultant to the Atlantic Richfield Corporation** -

Formally with ARCO, and now a consultant on energy technologies compared the various alternate transportation fuels. In comparing methanol, ethanol, alcohol, natural gas, electricity, reformulated gasoline and hydrogen in terms of efficiency, renewability, environment, cost, domestic security and other issues, the best were considered to be reformulated gasoline, electricity, natural gas and hydrogen, but the alcohols were the worst. CNG and reformulated gasoline are good transitions to electric and hydrogen, which are the only long term choices. Reformulated gasoline is the most cost-effective fuel over the next 25 years, requiring modifications to refineries costing about \$22 billion. Conversion to Compressed Natural Gas (CNG) would cause an increase in consumption of 15 trillion cubic feet per year. The car of the future, after 25 years, is the electric car with a hydrogen fuel cell.

Governor Bob Miller of Nevada -

The Governor opened by offering to answer all technical questions after his talk. Noting that the two Nevada US Senators were also present for this hydrogen energy discussion, the Governor noted that it is rare for all three of them to be anywhere out of state together at the same time. The arguments for hydrogen are so compelling, but the high cost of its development is the biggest obstacle. But we should add the environmental costs as a consideration, and then a hydrogen program could be competitive. Nevada has an abundance of the cleanest energy, solar. Coinciding with the timing of our fossil fuel difficulties, oil spills as an example, Nevada is willing to get out and try new things.

Dave Wensley, VP Advanced Programs & Technology, McDonnell Douglas Aerospace -

Defense conversion is now a high priority, but it is really only a transition, not conversion: create jobs and commercial products. The space industry has been using hydrogen for decades, and can well handle hydrogen. It can be generated from solar using Stirling engines. The Senators will be visiting MD's Huntington Beach facility in the afternoon to see systems based upon developments they made in this field in the 70's, being modernized today.

Ken Wolfenbarger, Senior Chemical Engineer, Texaco Corporation -

Texaco has a coal gasification process which is an attractive technology for producing hydrogen from plentiful coal, with much less pollution than burning coal. This process takes all forms of coal, oil, coke, and organic wastes into a high pressure vessel where it produces hydrogen and carbon monoxide (H<sub>2</sub>+CO) as a cleaner fuel output. Ammonia and methanol can also be produced. Byproducts of the process are sulfur and slag, and carbon dioxide (CO<sub>2</sub>), though some of the CO<sub>2</sub> can be trapped off as a liquid. The process produces much less NO<sub>x</sub> than steam reforming, and is in use in 47 plants worldwide, eight of which were licensed in 1992. Texaco is using this process in the DOE IGCC clean coal

demonstration project, which produces much less CO<sub>2</sub> than conventional coal plants do.

Charles Lopez, Solar Research Project Manager, Southern California Edison -

SCE has been testing and evaluating many forms of solar electric generating systems for many years, including Photovoltaic, Central Receiver and Dish Stirling systems. Based on the measure of electricity out versus solar energy in, the Dish Stirling systems have been 2 to 3 times more efficient than other systems. There are different benefits from Dish Stirling and Central Receiver; though Central Receiver is 12% efficient compared to Dish Stirling at 30%, the Central Receiver systems have an energy storage capacity which is important to an electric utility. The McDonnell Douglas dish-stirling system which SCE tested is nearly commercial ready, and it is modular, automatic and efficient.

Lennart Johansson, President, Stirling Thermal Motors -

STM is an American company involved in a joint venture with Detroit Diesel to bring the STM Stirling engine to the commercial market. The engine can be used as a refrigerator, and as an electric generator both in the existing genset market, and in creating new markets such as the solar genset. If mass produced at sufficient volume, the STM engine in a solar dish could produce electricity at 3 cents per Kilowatt-hour, which could produce hydrogen at the pump for about \$3. We now make 15 million cars per year, and we could make 15 million Dish Stirling systems per year and become energy independent using solar in 30 years.

Robert Zweig, M.D., Chairman, Clean Air Now -

As a lung physician in Los Angeles, Dr. Zweig has witnessed the increase in children's lung damage and ailments over the years. There are thirty seven chemical components in smog which injure the lungs, ozone being the worst. Smog causes lung damage, scarring and bacteria. Children are getting more asthma, and are hospitalized more, and the Natural Resources Defense Fund is

releasing a treatise on the effects pollution has upon children. If the defense and societal costs were included, gasoline costs us \$5.75 per gallon. Zweig took part in bringing a 19 passenger dual-fuel hydrogen powered Dial-A-Ride bus into California. The demonstration vehicle identified a carburetion problem which was resolved in the next vehicle, a hydrogen powered Dodge D50 pickup which used direct-injection of hydrogen, which had emissions less toxic than the local city air. In fact, as a test, a man ran a mile breathing through a face mask connected to the tailpipe of the truck driven ahead of him, with Dr. Zweig measuring his vital signs along the way. Southern California patients spend \$12 billion per year for the costs of pollution, over 12 million people, with 20 to 30% higher emphysema inside the SCAQMD than outside.

Gary Noland, Lockheed Missiles and Space Company -

Lockheed's Marine Group has extensive experience with manned underwater vehicles, which lead to their ability to study and design Ocean Thermal Energy Conversion systems capable of generating electricity and fresh water, and therefore hydrogen, from the energy in the temperature differences of surface and deep sea water. Lockheed built and operated a OTEC ship for research, and has proposed the construction of 500 MW commercial OTEC plants. With money financed at 4%, electricity could be produced at less than 7 cents per Kilowatt-hour. Lockheed also proposes the development of Fuel Cell Electric Vehicles (FCEV) as the ideal vehicle; safe, cost-effective and without pollution. A fuel-cell car would get twice the fuel efficiency and so the hydrogen fuel cost would be half as much as with a combustion engine. Lockheed estimates a \$2-\$3 trillion FCEV market in the US, in 50% of the new vehicles. 30-70% of urban air pollution is from vehicles, and \$51 billion is spent by the US each year on imported oil. The benefits of a hydrogen technology infrastructure include jobs, reduced deficit, and reduced pollution. Lockheed proposes to supply hydrogen

*Continued page 10*

# Hydrogen History . . . .

## Mrs. Dorothy Conrad Helps AHA Continue A Legacy

On April 7, 1929, a 20-year-old pilot named William H. "Bill" Conrad soloed in eight hours and started a long career in flight safety and advancement of aircraft equipment. Eventually Bill Conrad would solve numerous mysteries that had caused airplanes to crash. Bill was interested in the safety of some 2,500 pilots that he certificated in his capacity as an FAA "Airline Transport Pilot Examiner" (ATP) and "Pilot Instrument Examiner."

Bill spent much of his time that was available after conducting approximately 400 original ATP's, type ratings and Pilot in Command proficiency tests each year as an expert in aircraft safety issues. Bill authored or helped in the preparation of numerous safety-improvement studies. Bill often was called as an expert in court cases.

In 1974, when Dan Brewer an engineer with Lockheed Aircraft Corporation first initiated a plan for converting jet-oil engines to hydrogen, Bill Conrad began to take a keen interest in

hydrogen powered flight, perceiving that an alternate energy source would prove valuable in the event of another fossil-based fuel shortage such as the one in 1973. The topic piqued his interest enough to inspire him to travel the world, meeting with leading

professors and scientists from New York to Asia and most everywhere in between. The subject fascinated this safety expert and he was convinced that hydrogen was the fuel of the future.

After Lockheed decided to not pursue hydrogen powered aircraft Bill Conrad said he believed in the future of hydrogen as an aircraft fuel and would demonstrate it. In October 1982, he had several meetings with Professor Gabor Somorjai of the Department of Chemistry at the University of California at Berkeley after reading of his success in developing a system for making hydrogen from water, iron, and sunlight.

Then in march of 1985 he contacted Professor Shoichi Furuhamu at the Musashi Institute of Technology in Tokyo, Japan. The professor had produced an automobile fueled by direct cylinder injection of hydrogen. Then on August 12, 1985 Bill traveled to Japan to study their automobile and the LH-2 pump and nozzles and at first hoped for assistance from Professor Furuhamu with his aircraft engine plans but the intended charge for his services were too high.

All during this time Mr. Conrad was in close contact with Dan Brewer of Lockheed Aircraft Corporation who is an authority

on hydrogen-fuelled aircraft. And, Bill continued his busy schedule as an FAA Flight Examiner and Aircraft Safety Consultant.

Several more years went by with more studies and conferences and then he started to look for a proper airplane. He eventually decided on the Grumman Cheetah, model AA-5A because of the space in back of the cockpit and the sliding canopy for allowing installation of equipment for his experiments.

In the summer of 1987 Bill retired and became engrossed in pursuit of his goal. He would not stop until he demonstrated a hydrogen-powered aircraft.

On September 10, 1987, he purchased the Grumman Cheetah from Roy D. Parsons. Bill and Roy Parsons shared interests in aircraft and respected each other's areas of expertise. Roy Parsons provided assistance to Bill in electronics and instrumentation. Dan Brewer continued to provide engineering assistance. Thomas Johnston, a high performance engine


specialist, joined the group. Michael Deakter, president of Consolidated Precision Corporation of Riviere Beach, Florida, designed and manufactured the jacketed vacuum-insulated tank that would be used to store liquid hydrogen for the Cheetah.



Bill's team accomplished what most people thought was impossible. The team was super enthusiastic and considered the nine months they donated out of their lives to succeed with the actual flight as something they were doing for society. The history making flight of a hydrogen-powered prop plane was accomplished on June 19, 1988.

Mr. Conrad and his team felt that this flight was a giant step for reducing world pollution. He felt that it was encouragement for all countries to make their own hydrogen. He felt that the whole world would benefit from this experiment.

Mr. Conrad died before he could continue this work. Mrs. Dorothy Conrad has donated the historic correspondence, design records, and equipment used to convert the Cheetah to the American Hydrogen Association. Her thoughtful gift is making it possible for students and others that visit the American Hydrogen Association headquarters to know how Bill Conrad helped change history with his hydrogen-powered Cheetah.

Bill Conrad's legacy of sharing his knowledge and dedication to safety is continuing because of Mrs. Conrad's gift to the American Hydrogen Association. 



# Letters

Dear Editor,

In the last issue, Vol.3, No.4, Hydrogen Today, a letter writer described nuclear energy as "...the cleanest, safest energy available." In actuality it is the most dirty, most dangerous, and most expensive means of producing energy ever devised. It will be centuries, if ever, before the environment can recover from damage already done.

We have, at present, 110 nuclear power plants, many heavily contaminated and reaching the end of their 30-year life expectancy (11/91 the NRC, responding to great pressure from the industry, extended that to a frightening 60 years), and we yet have no idea whatsoever of safe disposal of, not only spent fuel, but this huge mountain of radioactive demolition waste. Even if Yucca Flats were not such a dubious prospect that repository could not absorb more than a small fraction of the total.

The NRC and the nuclear energy industry claim causes and effects of nuclear power plant aging are well understood. Here is a 1989 General Accounting Office report to Congress quoted from Nucleus, Vol. 14, No.2, a quarterly report from the Union of Concerned Scientists: "...neither the NRC nor

the nuclear industry fully understands the nature and effects of aging on nuclear power plants; the operating and maintenance practices of each utility are different; and each plant has a unique history of operating conditions and minor accidents that can accelerate aging by inadequate maintenance, improper testing, and abnormal operating conditions."

Mr. Fagan, the writer of the "clean energy" letter totally ignores the many, many accidents in nuclear power plants here, in this country, that escaped disaster by a hairbreadth.

The nuclear power industry spends millions on misleading TV commercials which carefully ignore the huge problems and dangers of nuclear power so as to lull people into a fool's paradise. Believing this group would be like believing the auto industry ads with that industry's long history of reluctance to do anything about air pollution and/or safety.

Let us hope the Hydrogen Association does not permit itself to be deluded by self-serving claims of the nuclear industry.

Yours truly,  
Wayne J. Anderson  
Frewsburg, NY

Dear Editor,

Your magazine is intellectually exciting and wonderful. I'm an 8th grade student of Woodbridge, VA. I'm interested in different forms of energy. I have been thinking about and planning to build some sort of perpetual energy source. When my science teacher came back from the American Hydrogen Association Convention, I was very excited and interested. He explained your ideas and uses of hydrogen. In my opinion I say, go ahead and let the new age of hydrogen take its place in history. I would be honored if you would send me any literature you have available. I plan to go into a career in the energy field. I have been blueprinting car plans for your hydrogen tanks and it looks pretty good. I wish you the best of luck on your magazine and hydrogen future.

Sincerely, James L. Mastros, Woodbridge, VA

## 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  
219 S. Siesta Lane, Ste. 101  
Tempe, AZ 85281

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### The Hydrogen Association

dba The American Hydrogen Association  
in the United States

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V.P. Research: Harry Braun  
V.P. Engineering: Herb Hayden, P.E.  
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Media Liaison: Jack Mullens  
Newsletter Sponsorship: Kathy McAlister

Bill Clinton  
The President  
The White House

Dear Mr. President:

During a trip to Phoenix recently I visited the headquarters of the American Hydrogen Association, 219 South Siesta Lane, Ste. 101, Tempe, Arizona. I was privileged to meet the president of the Association, Roy McAlister, and learn about the exciting work that he and the members of the Association are doing in the field of HYDROGEN POWER.

You and the country are currently placing substantial emphasis on energy, on gasoline and BTU taxation, on atmospheric pollution and on our massive dependence on foreign oil.

The development of renewable energy is indeed timely and necessary. Natural gas and electricity as power sources answer part of the problem but ultimately rely on fossil fuels. HYDROGEN POWER, with its unlimited domestic availability and other important secondary benefits could indeed help make the country stronger and cleaner.

I came away convinced that the Association has an important message and mission, a message that must be taken to Washington and to the energy and fuel industries of America. Time has given us a second chance.

Sincerely,  
Robert W. Michels  
Washington D.C.

## IRS Form 1065 for Partnerships:

### DEDUCTION FOR CLEAN-FUEL VEHICLES AND REFUELING

New section 179A to the U.S. Internal Revenue Code allows a deduction for part of the cost of qualified clean-fuel vehicle property and qualified clean-fuel vehicle refueling property placed in service after June 30, 1993.

Qualified clean-fuel vehicle property includes:


1. The part of the basis of a new vehicle designed to use a clean-burning fuel that is attributable to an engine that uses that fuel (and its related fuel storage delivery, and exhaust systems), and
2. New retrofit parts and components used to convert a motor vehicle to operate on a clean-burning fuel.

Clean-burning fuels are natural gas, liquefied natural gas, liquefied petroleum LP gas, hydrogen, electricity, and fuels containing at least 85% alcohol (including methanol or ethanol) or ether.

The deduction for most motor vehicles is limited to \$2,000 per vehicle. A motor vehicle is any vehicle with at least four wheels that is made for use on public roads. The limit is \$5,000 per vehicle for trucks and vans with a gross vehicle weight (GVW) over 10,000 pounds but not over 26,000 pounds. For trucks and vans with a GVW over 26,000 pounds and buses that seat at least 20 adult passengers, the limit is \$50,000 per vehicle.

Qualified clean-fuel vehicle refueling property is new depreciable property used to store or dispense clean-burning fuels (or to recharge an electric vehicle) that is located at the point where the fuel is delivered into the tank of a clean-fuel vehicle (or where the vehicle is recharged). The deduction for this property is limited to \$100,000 per location.

Qualified electric vehicle credit.-New section 30 provides a credit equal to 10% of the cost of a qualified new electric vehicle, or \$4,000, whichever is less, for each vehicle placed in service after June 30, 1993. Vehicles qualifying for this credit are not eligible for the deduction for clean-fuel vehicles under section 179A. Get Form 8834, Qualified Electric Vehicle Credit, for more details.

Renewable electricity production credit.-New section 45 provides a credit equal to 1.5 cents per kilowatt hour for electricity produced by the partnership using closed-loop biomass and sold to an unrelated person. The facility from which the electricity is produced must have been originally placed in service after 1992. Get Form 8835, Renewable Electricity Production Credit for more details. 

## Solar Hydrogen ...

*Continued from page 8*

from OTEC to both coasts without pollution, and provide proprietary cold pressurized gas storage, as well as transport and distribution.


Vahe Kluejian, Manager of Research, Mazda Motor Company -

Mazda developed the hydrogen fueled rotary engine as an option to meet new emission standards. The rotary engine is more difficult to reduce emissions in, except with hydrogen. With the oncoming zero-emission vehicles (ZEV), hydrogen is the future fuel. Mazda plans to use metal hydrides or any nonliquid for safety. Their main problem has been convincing regulators that hydrogen is viable. Mazda has built three test vehicles, and more are being built for real-world standards for fleet testing and demonstration. Mazda's hydrogen car can be made commercial in 1998-2000 per the ZEV specification.

Congressman George Brown, Chairman, House Science and Technology Committee -

The Congressman expects that the President's March budget announcement will include an R&D increase from the current level of less than \$1 billion to \$2-3 billion, with additional growth thereafter. There will be a push for large increases in funding for these new energy technologies.

• • •

The meeting closed with an upbeat discussion about the surging interest in the US in developing and using renewable energy, and many of the participants stated that they would follow up by establishing cooperative efforts in hydrogen development. A follow-up meeting in June of this year is in the planning stages. 




## Arizona SB1311 Proposed To Demonstrate Hydrogen Production, And Use In Vehicles



On February 4, 1993, an act was introduced into the Legislature of the State of Arizona to demonstrate hydrogen fueled vehicles, as follows: "A. The department of commerce energy office shall provide an opportunity to persons to apply for a grant from the oil overcharge fund for a two year demonstration project for hydrogen fueled vehicles beginning October 1, 1993. The energy office shall comply with all applicable federal regulations, court orders and state accounting procedures and shall comply with section 41-1509, Arizona Revised Statutes.

"B. The demonstration program prescribed by subsection A of this section is intended to assist in developing, testing, evaluating and implementing the most cost effective methods of purchasing or producing hydrogen fuel on site. The demonstration program shall include the modification of fleet vehicles to operate on hydrogen fuel systems.

"C. For fiscal year 1993-1994, the department may award grants totalling one hundred sixty thousand dollars." The Act was introduced by Senators Pearce, Buster, Chesley, Turner, with Representatives Groscoast, Richardson G. 

# Upcoming Events . . .

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

- April 3, Litchfield Park, Arizona — West Valley Earth & Art Expo, Estella Mountain Community College Center. Contact: Arnott Duncan, (602) 935-8996.
- April 4-8, Graz, Austria — 25th International Symposium on Remote Sensing and Global Environment.
- April 13, Southern California — Chapter of AHA monthly Meeting, Contact Dick Williams (800) 854-5225. (Second Tuesday)
- April 21, Tempe, AZ — A.S.U./AHA Chapter monthly meeting 7:00 to 9:00 p.m. Student Service Building, A.S.U. Contact Kathy McAlister, (602) 921-0433. (Third Wednesday of each month).
- April 22, Tucson, AZ — Chapter meeting of AHA. Contact Mike Baker (602) 469-5554. (4th Thursday of each month).
- April 22-28, Washington, D.C. — Solar '93 - ASES Annual Conference. Contact: (303) 443-3212.
- April 24, Arcata, CA — Second Annual Renewable Energy Fair. Contact (707) 822-3481.
- April 24-28, Washington, D.C. — Joint American Society of Mechanical Engineers/American Solar Energy Society International Solar Energy Conference.
- April 23-24, Tempe, Arizona — 12 News Earth Day Arizona Concert, Tempe Diablo Stadium. Contact: (602) 279-1406.
- April 25, Phoenix, Arizona — 12 news Earth Day Arizona Exposition, Wesley Bolin Plaza. Contact (602) 279-1406.
- April 25-28, Nashville, Tennessee — Annual Meeting of the National Association of Fleet Administrators.
- April 28-30, Colorado Springs, CO — Annual Council on Alternate Fuels Spring Conference.
- May 5-7, Washington, D.C. — Society of Automotive Engineers Government/Industry Meeting
- May 10-14, Colorado Springs, CO — 15th Symposium on Biotechnology for Fuels and Chemicals
- May 23-29, Boston, MA — Fifth American Tour de Sol Solar & Electric Car Race.
- May 24-27, Las Vegas, Nevada — National Propane Gas Association International Convention.
- May 31-June 4, Florence, Italy — 26th International Symposium on Automotive Technology and Automation.
- June 6-8, Austin, Texas — Alternative Vehicle Fuels Market Fair and Symposium, 1-800-6-FUEL-99.
- June 9-11, San Diego, CA — Responsive Energy Technology Symposium
- June 11-12, Topeka, KS — Second International Alternative Fueled Vehicle Roundup.
- June 20-23, Kansas City, Missouri — Adam's Mark Hotel, Project Hydrogen '93. Contact (816) 229-3800, Fax: (816) 229-1000. Note: \$100 discount for AHA members!
- June 20-24, New Paltz, New York - International Conference on Gas Hydrates.
- June 27-30, Yokohama, Japan — First International Conference on New Energy Systems and Conversions.
- July 25-28, Seattle, Washington — Pacific Rim TransTech Conference, "A Ride into the Future."
- August 2-6, Cheyenne, WY — Second Western Conference on Energy & the Environment.
- August 9-12, San Antonio, TX — Future Transportation Technology Conference.
- August 16-19, Carbondale, CO — Hydrogen Energy Workshop. Contact Sustainable Technologies International (303) 963-0715.

**HYDROGEN TODAY**  
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**YES**, I want to join the American Hydrogen Association and help make a transition to clean Hydrogen energy.

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Occupation and/or Areas of Special Interest \_\_\_\_\_

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# American Hydrogen Promotes Business....

Mr. Roy E. McAlister  
President  
American Hydrogen Association  
219 S. Siesta Lane, Ste. 101  
Tempe, AZ 85281

Dear Mr. McAlister:

Your letter to the Secretary of Commerce has been referred to me for response.

We very much appreciate your offer to assist the U.S. Department of Commerce to promote business expansion and to also assist the Advanced Technology Program (ATP). One of the ways that you might assist the ATP would be to help disseminate information concerning the program through your newsletter to companies that might have an interest in submitting proposals to the program in future competitions.

Sincerely,  
George A. Uriano  
Director  
Advanced Technology Program  
U.S. Department of Commerce  
National Institute of Standards and Technology  
Gaithersburg, Maryland 20899

## What is the (ATP) Advanced Technology Program?

The U.S. Commerce Department's Advanced Technology Program (ATP) assists businesses in carrying out research and development on precompetitive, generic technologies. The ATP emphasizes high-risk enabling technologies underpinning a wide range of potential applications capable of generating significant benefits to the nation's economy. The program is administered by the Technology Administration's National Institute of Standards and Technology (NIST).

What support does the ATP provide?

The ATP provides technology development grants to single businesses or to joint ventures, but requires cost-sharing by the participants. Awards to individual firms are limited to \$2 million over no more than three years, and can be used only for direct R & D costs—single applicants must agree to pay all indirect costs. Awards to joint ventures can be for up to five years. Joint ventures must provide more than 50% matching funds. Joint venture awards are not subject to the \$2

million limit. The funding requested for either type of award must be appropriate for the proposed R&D plan and commensurate with the projected benefits. Often, NIST can also make available to awardees technical assistance from scientists and engineers involved in NIST's wide variety of intramural R&D programs.

are sufficiently reduced to permit preliminary assessment of commercial potential, and prior to development of application-specific commercial prototypes. The ATP will support development of laboratory prototypes and proof of technical feasibility, but not commercial (premanufacturing) prototypes or proof of commercial feasibility.

Who may apply for ATP support?

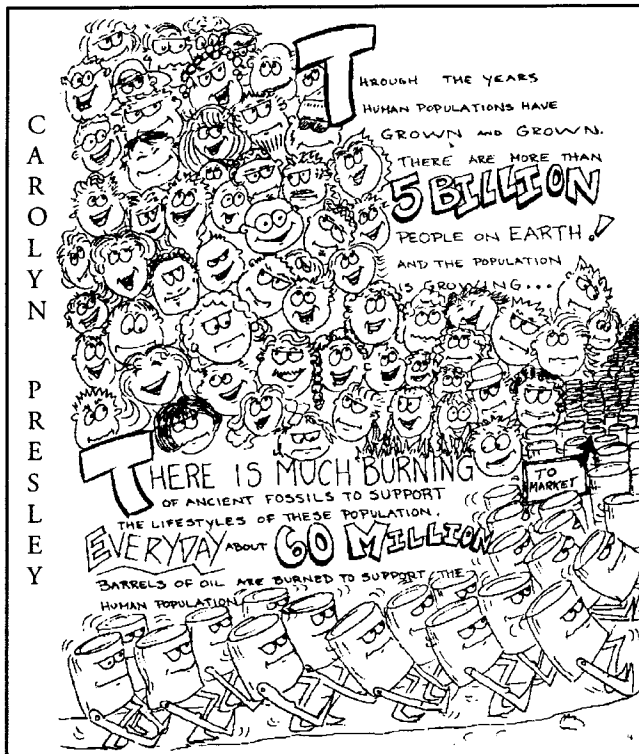
Any eligible U.S. business, for-profit independent research organization, or industry-led joint venture may apply for an ATP grant. Special legislative requirements apply to businesses that are not U.S.-owned.

A joint venture must consist of at least two companies, both of whom are performing R&D and contributing towards the matching funds. No direct funding will be provided to universities, government organizations, or non-profit independent research organizations, but they may participate and receive funding indirectly as members of an eligible joint venture or as subcontractors to an eligible single applicant or joint venture. The Program can sponsor cooperative research between private industry and Federal laboratories such as NIST, although NIST may not receive ATP funds from an ATP awardee for intramural R&D. All applicants must provide evidence that their proposed programs would promote U.S. economic growth.

When may applications be submitted for ATP awards?

NIST publishes announcements calling for ATP proposals in the Federal Register and the Commerce Business Daily.

Continued, page 13



## ATP...

*Continued from page 12*

Program announcements are published at intervals which depend on available funding, usually once or twice per year. A booklet ("proposal preparation kit") providing proposal submission guidelines and application forms will be mailed upon request. Only proposals meeting the criteria outlined in the proposal preparation kit and received during the solicitation periods noted in the program announcements will be accepted. Unsolicited proposals will not be accepted. Interested parties may request that their names be added to the ATP mailing list so that new announcements will be mailed automatically.

### How are projects selected for ATP funding?

Selections are made through a multistage evaluation process managed by a Source Evaluation Board composed of senior level technical and business experts. Proprietary information is protected throughout the process, and precautions are taken to eliminate conflicts of interest incoming proposals are screened for compliance with the basic requirements of the program. Technical experts evaluate proposals for scientific and technical merit. Those rated highest by the Board for scientific and technical merit are then rated on additional business-related criteria including experience and qualifications, the credibility of the strategic plan for transferring the technology from the R&D laboratory into wide-spread commercial application, potential broad-based benefits to the United States, the level Federal scientists and engineers in a variety of agencies and Federal laboratories to assess the technical merit of proposals. Private sector individuals with expertise in areas such as strategic business planning and financing and new product commercialization assist the Board with the business assessment of proposals.

Proposals ranked highest relative to all selection criteria are designated "semi-finalists." Those proposers are asked to make oral presentations at NIST. In some cases, site visits may be made to assess special facilities. The highest ranking semi-finalists are designated "finalists." Funding recipients are selected from among the finalists based on: (1) the rank order of the proposals with respect to all of the selection criteria, (2) the availability of funds, and (3) assuring an appropriate distribution of funds among technologies and their applications.

### Who will own the rights to the intellectual property?

In general, award recipients may patent inventions and retain title to them and/or copyright X developed under an ATP grant. In most cases the government will retain a non-exclusive license for the use of technologies or materials developed under the ATP. The ATP will encourage publication of research results in a manner consistent with preserving copyright or patent rights to the developments. "Publication" in this context does not refer to disclosure of trade secrets, but rather dissemination of information regarding the new developments such that other businesses may become aware of opportunities to license technology developed with ATP funding.

### What areas of technology are appropriate for ATP proposals?

The ATP accepts proposals in all areas of precompetitive, generic technology. In previous competitions, proposals have been funded in areas such as semiconductor processing, high temperature superconductors, machine tool controls, automated manufacturing, automotive technology, biotechnology, environmental technology, advanced materials, laser and electro-optics, energy conservation, displays, robotics, and high-performance computing.

### How much funding is available? How many awards have been made?

Three competitions have been completed as of December 1992. Sixty awards have been announced (forty-two single applicants, and eighteen joint ventures). The ATP budget has grown from \$10 million in Fiscal Year 1990 to \$68 million in Fiscal Year 1993. The total of ATP funds plus private sector funds over the life of the sixty awards amounts to nearly \$400 million. Each ATP program announcement specifies a projected amount of funding available for awards for that competition.

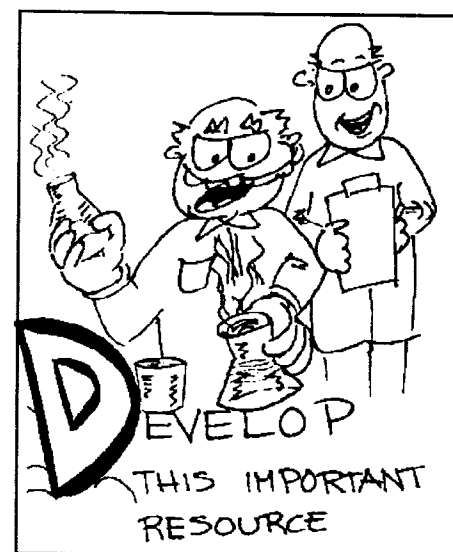
### Where do I get additional information?

The ATP proposal preparation kit includes a description of the Program a copy of the ATP legislation, a reprint of the most recent announcement calling for proposals, the forms required for submitting a proposal, and guidelines for proposal preparation. A copy can be obtained by writing to or calling the ATP:

#### Advanced Technology Program

A430 Administration Building  
National Institute of Standards and  
Technology  
Gaithersburg, MD 20899  
Phone: (301) 975-2636  
Fax: (301) 926-9524

The ATP has established a telephone "Hotline" with a periodically updated recorded status report. This number is (301) 975-2273



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THE SOLAR-HYDROGEN ECONOMY, 8 minute video, AHA, 1990.

This VHS-format closed-captioned video concisely illustrates the exciting potential of renewable hydrogen fuel

Qty: \_\_\_\_\_ at \$14.95 each... \_\_\_\_\_

THE PHOENIX PROJECT: AN ENERGY TRANSITION TO RENEWABLE RESOURCES, H.W. Braun, 1990

Harry Braun presents a wide range of information related to the growing economic and environmental crises resulting from our continued reliance on fossil and nuclear fuels. Most importantly, the book describes the types of solar technologies that could be mass-produced for large-scale hydrogen production.

Qty: \_\_\_\_\_ at \$14.95 each... \_\_\_\_\_

SOLAR HYDROGEN: MOVING BEYOND FOSSIL FUELS, Joan M. Ogdan, Robert H. Williams, 1989

An excellent technical overview of a solar-hydrogen transportation-energy system, with emphasis on photovoltaic supply. It compares alternate sources of energy and their pollution products and costs and proposes a practical path to the hydrogen economy.

Qty: \_\_\_\_\_ at \$12.50 each... \_\_\_\_\_

FUEL FROM WATER: ENERGY INDEPENDENCE WITH HYDROGEN, Michael A. Peavey (Formerly Hydrogen Home and Auto Fuel Conversion, first copyrighted in 1979)

A technical report of hands-on research and experimentation in hydrogen production, storage, and use. Originally published in the 1970's this book is still invaluable to the technical individual who wants a specific understanding of hardware.

Qty: \_\_\_\_\_ at \$16.00 each... \_\_\_\_\_

STEERING A NEW COURSE, Deborah Gordon, et al, The Union of Concerned Scientists, 1991

An in-depth review of the history and effects of our transportation system, air pollution and alternative fuels, and their relative merits.

Qty: \_\_\_\_\_ at \$10.00 each... \_\_\_\_\_

HYDROGEN: THE INVISIBLE FIRE, Patrick Kiernan, 1991 This is an excellent overview of hydrogen production and use techniques and there tradeoffs. Written in concise, straightforward language.

Qty: \_\_\_\_\_ at \$10.00 each... \_\_\_\_\_

THE GLOBAL ECOLOGY HANDBOOK: WHAT YOU CAN DO ABOUT THE ENVIRONMENTAL CRISIS, Walter H. Corson, 1990.

An overview of the interrelationships between the environment, economic development, energy policy, population growth, and related issues. This is a supplement to the PBS series *Race to Save the Planet*.

Qty: \_\_\_\_\_ at \$16.95 each... \_\_\_\_\_

AHA SOLAR-HYDROGEN T-SHIRT, 4 Color

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 Utility Energy Strategies for 2000 & Beyond -- Demand Side  
 Energy Production from Waste and Biomass  
 Fusion Energy

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 Energy Projects  
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 Natural Gas Vehicles  
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New technologies will be displayed and demonstrated in an indoor-outdoor exhibit. For more information please contact John Bradley, Exhibits Coordinator, at the address below.

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 American Council for an Energy Efficient Economy  
 Alternative Energy Research Organization  
 International Association for Energy Economics  
 American Society of Gas Engineers

**Registration:** (Members of AHA are entitled to a \$100 discount from the registration price listed below.)

Name (Indicate Dr./Mr./Ms.): \_\_\_\_\_ Phone: \_\_\_\_\_

Mailing Address (City, State, Zip, Country): \_\_\_\_\_

Please send more information.

#### Payment before June 1, 1993:

Conference Registration \$ 350.00  
 Proceedings Only \$ 250.00  
 Accompanying Person Registration \$ 120.00

#### Payment after June 1, 1993:

Conference Registration \$450.00  
 Proceedings Only \$300.00  
 Accompanying Person Registration \$ 120.00

**Exhibit Reservation:** \$1000.00  Grand Foyer  Royal Ballroom Annex  Outdoor Exhibit Area

#### Adam's Mark Hotel On-site Reservation:

Single Room (\$72/night + tax)  Double Room (\$90/night + tax)

Arrival date: \_\_\_\_\_ Arrival time: \_\_\_\_\_ Departure date: \_\_\_\_\_ Departure time: \_\_\_\_\_

Check or Money Order  Visa  MasterCard  American Express  Discover Exp. date: \_\_\_\_\_

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## Reformulated Gas — What Is It ?

By now we all know about greenhouse gas and ozone destroying chemicals, but why all this fuss about oxidants...like mandating reduction of carbon monoxide by making reformulated gasoline. The answer is the *low-level exposure* and the *lethal effects of exposure to high concentrations* of carbon monoxide. CO binds to blood hemoglobin (COHb), and reduces the oxygen-carrying capacity of the blood. At COHb levels of 10 to 30%, headache, dizziness, weakness, nausea, confusion, disorientation occurs. At 30 to 50% these symptoms are added to pulse and respiratory rate increase and fainting. Lethal complications such as comas, convulsions, and cardio-respiratory arrest, occur at COHb above 50%. The highest levels of CO generally occurs while idling your car. The concentration of CO in a closed garage could reach 1 percent (10,000 ppm) vary rapidly. At this concentration of CO, it takes approximately 10 minutes to reach the lethal blood COHb concentration. Because of our habit

of using fossil fuels, each day we are accumulating CO in our blood. *Now with hydrogen we will never have these problems...another great advantage of hydrogen.* Why not use hydrogen as a completely clean, carbon free fuel?

ARCO, Chevron, Mobil, Exxon, and others are spending large sums of money to produce reformulated gasoline by using different oxidant blends in gasoline. The Federal regulators, that mandated reformulated gasoline as provided in the Clean Air Act Amendment, are spending \$11 billion annually to subsidize reformulated gas. The hydrogen budget is \$4 million dollars. MTBE (methyl tertiary butyl ether) is an oxygenated blend in gasoline based on olefinics; DIPE is a di-isopropyl ether based on a fixed-bed catalytic hydration of propylene; TAME is tertiary amyl methyl ether from isopentenes and ETBE is ethyl tertiary butyl ether. In general, emissions studies report that oxygenated fuels provide some decreased carbon monoxide and exhaust hydrocarbons. But increase

nitrogen oxides, unburned oxygenates and evaporative emissions. There is an increase in aldehyde emissions in MTBE due primarily to formaldehyde, while for ethanol blends, the increase is due primarily to acetaldehydes. Increased emissions of aldehydes poses a concern because of their health impact and their potential for forming atmospheric oxidants which increase the potential for photochemical smog formation. Formaldehyde is particularly hazardous because it is a known carcinogen and respiratory irritant.

The Rio (1992) Declaration on Environment and Development... *Principle 16* requests national authorities to promote the internalization of *approach that the polluter should bear the cost of pollution.* President Clinton's *Mandate for Change* has a chapter entitled "*The Greening of the Market: Making the Polluter Pay.*" Will he hold the Federal Regulators and the producers accountable for paying for health costs and atmospheric and ground pollution? 

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