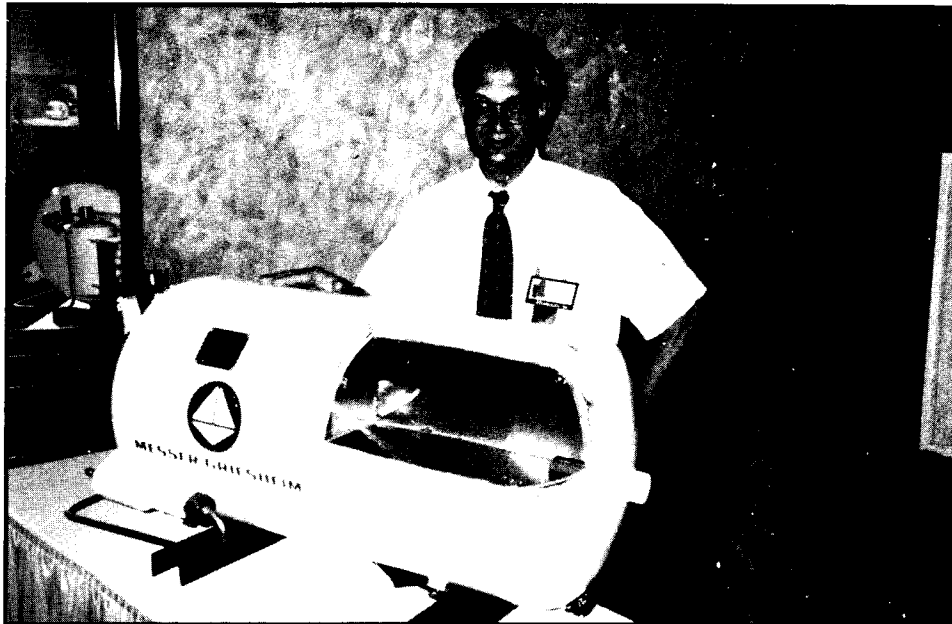




Hydrogen Today

"Clean Energy For A Better World"

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Dr. Martin Kesten of Messer Griesheim GmbH shows a cut-out display version of their liquid hydrogen "dewar" cryogenic tank, similar to what could be used in automobiles.

HYDROGEN '94, *10th World Hydrogen Energy Conference And Exhibition*

— Herb Hayden

Cocoa Beach, Florida, June 20-24

This year's International Association of Hydrogen Energy conference covered the full scope of in-depth hydrogen research with scientists from around the world. In addition, there was much focus on the introduction of hydrogen into the current ultra-low emissions vehicle market by way of "hythane," which is the partial blend of hydrogen with natural gas.

Presentations included research on advanced storage using "carbon absorption," where cold hydrogen is stored on lightweight carbon, and advanced pressure electrolysis work that is being performed under a German program.

The real standout of this conference was that there was a great variety of hydrogen products, or at least product concepts, on display that appear to be precursors to commercial hydrogen products of the future. Present-day hydrogen storage products, from compressed-gas tanks to cryogenic liquid to metal hydrides were all on display, along with fuel cells, electrolyzers and safety equipment.

New electrolyzers and fuel cells based upon Dupont's Nafion membrane material were shown from companies such as Packard and Hamilton Standard. Product concepts offered were the Regenerative Fuel Cell system that stores relatively large amounts of energy with less weight than batteries, and the Automotive Hydrogen Fuel Generating System.

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Hydrogen Is The Safest And Cleanest Fuel

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Cookin' Hydrogen Veggie Burgers At "One World" Reggae Festival

— Clare Van Ausdal

Snowmass, just north of Aspen, CO.

The "One World" reggae festival, featuring reggae greats such as James Brown, Ziggy Marlie, Bunnie Wailer, War, Big Mountain, 8750, and the Third Dimension was attended by thousands, over labor day weekend. Upon the suggestion of Andy Heath, this crowd got a bonus. They enjoyed real hydrogen cooking!

Continued, page 7

Hydrogen Conference '94

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According to literature provided by Hamilton Standard, their SPE Unitized Regenerative Fuel Cell uses a single "cell stack" to provide up to 5 kilowatts of power in its Fuel Cell mode, then can recharge hydrogen fuel tanks and oxygen tanks when solar power is available. This system would have a higher energy storage density than advanced batteries (350 wh/kg), and produce zero emissions with a projected life of over 10 years. This system could be used to allow a solar powered aircraft to stay in flight continuously for days for tasks such as communications, environmental monitoring, law enforcement or military surveillance.

High Pressure Electrolyser for Home Refueling

Equally exciting was the Hamilton Standard SPE HYGEN-90 Automotive Hydrogen Fuel Generating System. This system could be installed in a garage to provide home refueling for hydrogen cars or for other household energy uses. Based upon a high pressure electrolyser stack, the HYGEN-90 can refill pressure tanks or hydrides directly at up to 2,000 psi without using a mechanical compressor, and can produce up to 12 pounds of hydrogen per day.

This unit can use electricity from a wind-generator, dish-genset, photovoltaic panel, or biomass fueled engine-generator to provide renewable hydrogen. Wind power at 4 cents per kilowatt-hour would result in an incremental cost of hydrogen at about \$1.60 per gallon of gasoline equivalent. This is a very low price compared to making gasoline from wind and water. If you think thermochemical processes are difficult (See BBS notes) try making gasoline from wind and water.



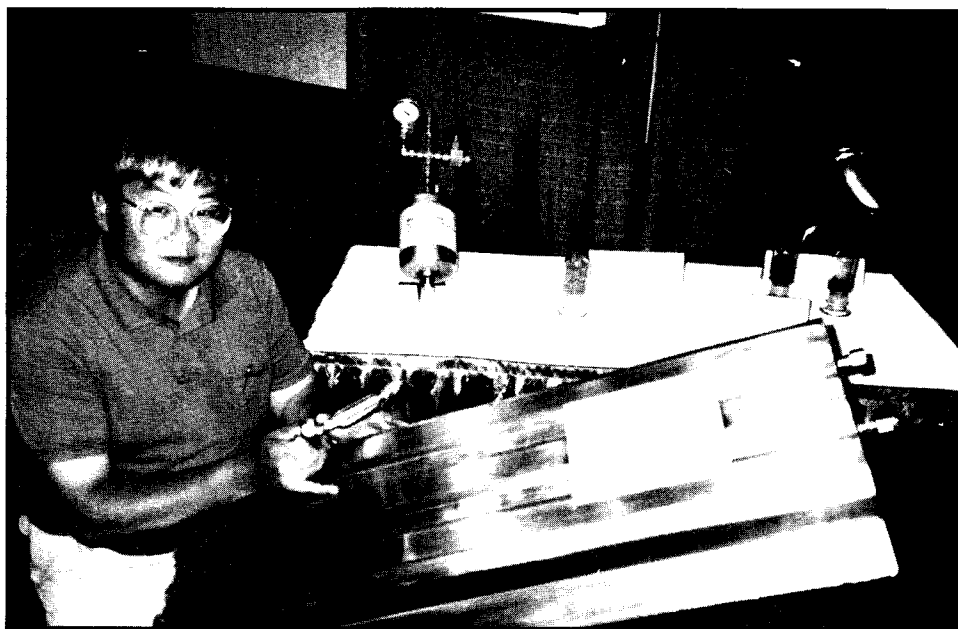
Trent Molter, Chemical Engineer with Hamilton Standard was on hand with the Du Pont Nafion display, showing a model of Hamilton's home-sized electrolyser product concept.

Hythane Offers Bridge to Hydrogen

Several research groups are studying the environmental and economic benefits of blending hydrogen and natural gas together into a transportation fuel that has become known as "hythane."


The University of Toronto Centre for Hydrogen and Electrochemical Studies reported that using Hythane fuel, after retarding the engine timing, can result in less emissions and greater fuel efficiency.

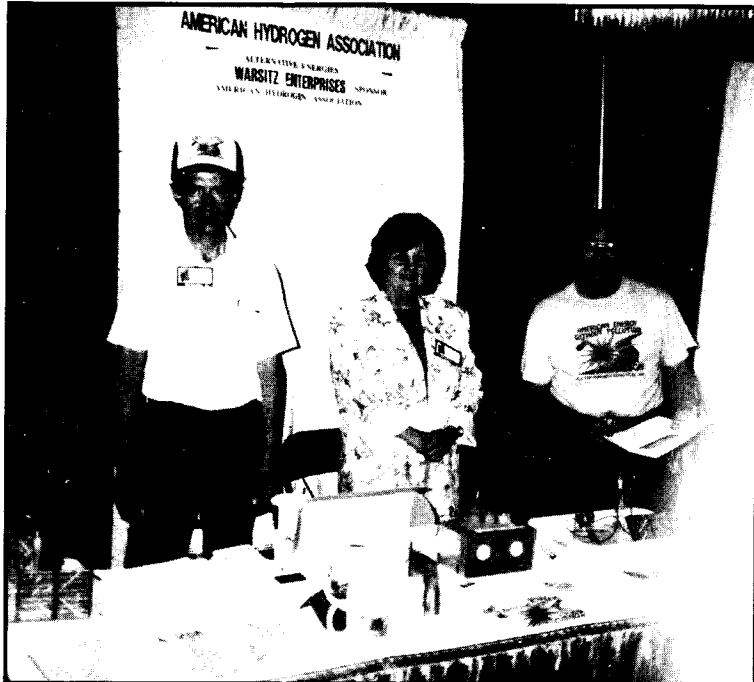
Researchers at Florida Solar Energy Center and the University of Central Florida found that hythane containing 28% and 36% of hydrogen achieved extremely low emissions of nitrogen oxides. Their proposal is that using high percentages of hydrogen with natural gas in vehicles with catalytic converters will approach the objective of a non-polluting vehicle, without requiring new engine designs. Their results were obtained with a test engine simulating a truck traveling at 55 mph, and under reasonable acceleration, though they have not yet tested full drivability.



Michael Williams of Shieldalloy Metallurgical Corporation, Newfield NJ, displays samples of the wide range of custom and semi-standard hydride storage system his company can offer, based upon the GFE metal hydrides. (1-800-762-2020)

Pure-hydrogen powered vehicles from VCST Hydrogen Systems of Belgium and Messer Griesheim of Germany were tested for emissions. Hydrocarbon emissions (CO, CO₂, HC) and H₂ were below measuring range. NO_x (nitrogen oxides) were estimated at 0.25g/kwh, compared to the California standard of 3.30 g/kwh.

The International Association for Hydrogen Energy holds this conference at various locations around the world every two years, and produced a three-volume set of proceedings from this meeting. The Association also publishes the International Journal of Hydrogen Energy, a regular research journal, that is provided at no cost to its members. You can write for membership information to IAHE, P.O. Box 248294, Coral Gables, FL 33124. 



AHA President Roy McAlister, Roberta and Paul Warsitz offered the Warsitz Fuel Cell demonstration kit, newsletters and other hydrogen education items and promotional mugs and hats, along with solar energy demonstration and educational items.

Hydrogen '96-Designing The Energy Link- 11th World Hydrogen Energy Conference

23-28 June 1996, Stuttgart, Germany

A sufficient clean energy supply for an increasing world population, environmental problems and questions of social co-existence have become topics of vital importance. In this context hydrogen will acquire significance as a future energy carrier if renewable energy sources, such as water, wind and solar power, are increasingly incorporated into the world's energy systems. The conference will focus on the hydrogen industry today and its role in the coming decades. It will cover decisive aspects of the transition to hydrogen-based sustainable energy systems and of the technologies of hydrogen energy carriers. Additional topics are fundamental research and both national and international programs and projects. These subjects will be presented and discussed in plenary sessions, parallel technical sessions and poster presentations.

A number of technical tours related to hydrogen will be offered to participants. Visits are planned to DLR, ZSW and Mercedes-Benz in Stuttgart, BMW in Munich.

"Call for Papers" is February 1995.
Conference Coordinator and Organizer:
DECHEMA e.V. - c/o Hydrogen '96
Theodor-Heuss-Allee 25
P.O. Box 15 01 04
D-60486 Frankfurt am Main
Germany


US Renewable Budget Increased By 98% For Fy '95

— Ken Bossong

For 1995, \$49 million dollars has now been allocated for research, development, demonstration, and commercialization programs for renewable energy. Increased investment for emerging renewable energy technologies continues to be a win-win proposition for the economy and the environment, spurring economic growth, creating jobs, reducing carbon emissions, other air and water pollutants, increasing export and enhancing national security.

Since then however, there has been a backlash within DOE from administrators of conventional energy programs which got cut. Conventional energy programs will end-up having been cut somewhere between \$164 and \$201 million. Auto companies, oil industry and utilities acted quickly by cutting jobs. A major victory was achieved by the House of Representatives and the Senate in terminating the Advanced Liquid Metal Reactor.

President Clinton has been a strong supporter of renewables and efficiency. This year budget represents a bold step... a step in the right direction. It is an ambitious demand but renewable energy supporters are calling for a \$1 billion shift to renewable and efficiency for FY'96, even though DOE administrators are complaining about cuts in fossil and nuclear programs.

We must pull together to support renewables in the FY'96 budget. Our goal is \$1 Billion Dollars in FY'96. This investment in energy efficiency and renewables can produce great wealth for the Nation. The public has not wavered on jobs, environmental improvement and expanded export markets. Our slogan, "Renewables Comeback Strong In FY'96 For 1 Billion Dollars" is another bold step in the right direction. 

Hydrogen Technology

NASA Cleans Up!

— Roy E. McAlister

United States has used hydrogen throughout our successful space flight program. Two new approaches are under development for using hydrogen fuel to enter the vacuum of space. These new approaches will vie for future opportunities to launch payloads into orbit. Multistage hydrogen rockets using solid-fuel boosters are well-proven but objectionable because of the harmful exhaust emissions from the solid-fuel boosters. The solid-fuel emissions contain chlorine which destroys ozone in the stratosphere.

Lower-cost reusable lifting bodies that launch payloads into orbit and return for rapid turnaround by refilling with liquid hydrogen and liquid oxygen are the goals of the present design competition.

McDonnell Douglas has started to demonstrate test flights at low level with a SSTO (single-stage-to-orbit) rocket that uses liquid hydrogen and liquid oxygen. This single stage concept called the DC-X is simple and in ways fulfills the rocket image suggested by the Buck Rogers comic books. It takes off and lands in the vertical position. So far, tests have shown good stability and control in the vertical takeoff and landing orientation.

NASA has a contract with McDonnell Douglas to provide White Sands range support worth \$1.6 million out of a total of \$5.1 million for five low-altitude test flights. In the second flight which had a full propellant load for the first time the DC-X reached an altitude of 2,850 feet and a maximum angle of attack of 70 degrees, and stayed aloft about 136 seconds. The previous maximum time aloft was about 72 seconds. The second flight was landed under emergency conditions because of a fire that followed the DC-X from the launch pad. The hydrogen that was burning externally was determined to be hydrogen being intentionally vented from the DC-X's vent

ports several feet above the base. The vented hydrogen was being used to precool the rocket engines.

The DC-X fire was external and caused skin damage which did not show up on flight instrumentation but when pieces of charred skin started falling off of the DC-X pilot Pete Conrad was advised to make an emergency landing for inspection. After landing it was determined that the DC-X, had no serious damage except to the skin areas. Post-flight inspection showed that none of the helium or nitrogen pressure vessels used for pressurizing the liquid hydrogen and oxygen storage vessels had ruptured as first feared. There was no internal damage or overheating of the hydrogen rocket.

Another emerging approach is a TSTO (two-stage-to-orbit) design being developed by NASA Ames Research Center. The NASA Ames TSTO will use a runway-launched winged booster stage. It will boost its second stage to Mach 5 and then return to a runway to land with wheeled landing gear. This first stage uses hydrogen fueled turbofan jet engines that breathe air and produce no harmful emissions. These turbo-fan engines were originally developed for the F-22 fighter plane and have been modified for burning hydrogen.

Hydrogen fuel provides the greatest payload capacity for the TSTO by sequentially fueling two kinds of engines. After reaching the speed of Mach 1, hydrogen-burning ramjet engines are ignited. At Mach 2 the turbo-fan engines are shut down as the ramjet engines continue to accelerate to Mach 5 and launch the lifting-body second-stage hydrogen rocket which uses liquid hydrogen and liquid oxygen.

A more advanced development in propulsion for future launch vehicles is the scramjet for burning

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Search For The Oldest Hydrogen Cylinder — Roy E. McAlister, President

One of the most frequently discussed myths concerning hydrogen is the claim that it is impossible to keep hydrogen in captivity because it is the smallest atom. In 1964, I noticed a hydrostatic test date of 1909 on a cylinder of hydrogen in my fuel cell laboratory at the University of Kansas. I asked a professor that had stated that hydrogen was so small that it could pass through most metals what kind of liner was in the cylinder that was manufactured in 1909. He said that he did not know and was surprised that the cylinder had been in commercial use for 55 years. We took great interest in the stamp dates showing mandatory hydrostatic tests to prove structural viability every five years which later changed to safety tests every ten years.


These safety test dates are stamped on the neck area of the cylinder just beneath the safety cap that covers the valve for protection during shipment. The neck area was chosen as a

safe area to remove a small amount of metal for analysis to determine what wonderful metal was able to contain hydrogen. A few metal filings were carefully taken from the center of one of the numbers in a safety date. Chemical analysis showed the metal to be a low alloy carbon steel containing about 98% iron, 0.6% manganese, and 0.2% carbon. Not even as exotic as a plow steel from the farm. This meant that there must be a liner material that was holding the hydrogen within the shell of low alloy steel.

But on careful inspection of the cylinder no liner was found. The low-alloy or "mild" steel cylinder had been in commercial service since 1909 providing countless trips to and from the gas supplier to welding shops, heat treaters, brazing houses, and university laboratories like mine. Eventually it was emptied as I conducted tests on fuel cell catalysts and the 1909 cylinder was routinely exchanged

Continued, Page 6

hydrogen in supersonic air at speeds greater than Mach 5. Russian efforts in scramjets have already advanced to flight testing of a scale-model scramjet. U.S. test efforts remain in wind-tunnels. NASA had a scramjet program that stalled after spending \$1.5 billion on the X-30 SSTO that apparently will not be built. The VTO (vertical-take-off) DC-X and TSTO using hydrogen turbofans are much less expensive developments and are deemed to have much higher probability of near-future success than the X-30.

In conclusion it is apparent that hydrogen is the choice for clean, low-cost, reusable launch vehicles. These new launch vehicles will protect the environment and launch into the vacuum of space with the fuel of the future. We applaud these developments that make it unnecessary to damage stratospheric ozone from solid fuel emissions. The TSTO hydrogen-powered air-breathing engines will be minus-emissions air cleaners that reduce atmospheric concentrations of smog-forming hydrocarbons, tire particles, and soot from hydrocarbon fueled engines. 

What Is A Microsphere Anyway?

— *By: Tracey Dudman*

Convenience, high compression and low cost are some of the current goals of research in hydrogen storage. Three basic methods have had the most attention and results thus far. These are Hydrogen stored as compressed gas, liquid hydrogen using cryogenics and storage in solid hydrides.

These three areas of research have had positive results, however another storage method is gaining impressive results. Offering high pressure storage, is light weight, has low cost and design simplicity.

Simply put, this storage system is glass. Silica glass microspheres to be more specific.

The microspheres which are composed of silica glass, quartz and polymers are tiny bubbles of glass. 50 - 200um (micrometers) in diameter. Heated and pressurized at temperatures of 200 - 400 C the spheres become porous, allowing the hydrogen to seep into the spheres. As the temperatures return to ambient levels, the spheres become impervious, entrapping the hydrogen within. When the spheres are heated again to 200 C, the hydrogen can be extracted.

In one experiment, the use of hydrogen stored in microspheres as a fuel for an automobile was compared to one using petroleum. The latter used 301 liters of petro to travel 500K (161 miles), whereas the hydrogen car needed only 6.5 kg (25 liters) of hydrogen for the 500K distance.

Other advantages of microspheres:

1. Storage life of the hydrogen with minimal losses (less than 5%) may reach 30 years.
2. Microspheres offer an excellent method for shipping of mass quantities on a commercial level.
3. Polymer microspheres can be used for storage with relative weight content of hydrogen at the temperature of liquid nitrogen or oxygen. The mixture of liquid oxygen and the microsphere encased hydrogen may be a prospective for rocket and jet fuel.

The applications of microspheres are very promising, and we look forward to hearing more impressive results!

Ballard Signs \$9.3 Million Contract

TO SUPPLY FUEL CELL TO GERMAN SHIP BUILDER

Ballard Power Systems has signed a collaboration agreement to supply Ballard Fuel Cell power plants for use in marine vessels built by the German shipbuilder Howaldswerke-Deutsche Werft AG (HDW).

Under the first phase of this multi-year agreement, Ballard has been awarded a U.S. \$6.7 million contract (Canada - \$9.3 million) to supply a prototype fuel cell power plant that will provide propulsion and auxiliary power for marine vessels such as submarines and merchant ships. This first phase will be completed by December 1995.

"We are pleased that HDW, a strategic customer, intends to use our fuel cells in marine application", says Firoz Rasul, Ballard's President and Chief Executive Officer. "By providing an early

market opportunity, this collaboration with HDW will accelerate the commercialization of our fuel cells."

"The contract announced is the first of several that we expect to sign with HDW and one that compliments the development work we are already doing with stationary fuel cell power plants."

Located in Kiel, Germany, HDW is an innovator in the shipbuilding industry with a history of introducing new technologies in the design and fabrication of submarines and merchant vessels.

"HDW has worked on fuel cell power plants for submarine applications for more than 13 years and introduced the first fuel cell submarine into the sea. This boat, operated by the German Navy, was the first fuel cell powered submarine in the Western World. Our relationship with Ballard and access to the Ballard Fuel Cell technology provides HDW

with a substantial advantage in an increasingly competitive market," says Mr. Dirk Rathjens, Member of the Board of Management of HDW.

Ballard recently was awarded a \$3.5 million project from the Canadian Department of National Defence to design and construct a fuel cell power system.

Ballard Power Systems, a world leader in the development of fuel cell power systems, has been developing this clean technology for 11 years. At the heart of its products is the Ballard Fuel Cell, a proprietary zero emission engine that converts natural gas or methanol fuel directly into electricity without combustion. Ballard fuel cells are being used by more than a dozen leading international companies including Daimler-Benz, General Motor and The Dow Chemical Company to develop zero emission vehicles and clean stationary power plants that generate electricity for buildings.

Oldest Cylinder

Continued from page 4

for a full cylinder of hydrogen which had a test date of 1940. The gas supplier confirmed that they had several pre-World War I cylinders in stock along with numerous pre-World-War II cylinders and that there was no reason to take a cylinder out of service so long as it had been safety checked on schedule.

After thinking about the success of pre-World-War I cylinders in continuous commercial service it occurred to me that low alloy steel pipelines probably could carry hydrogen with the same efficiency and safety that the 1909 cylinder had provided and I began an investigation of the suitability of steel for pipeline distribution of hydrogen. All the theories seemed to indicate that the pipeline would do as well as the old cylinders were doing but when I asked pipeline authorities another myth was uncovered. Pipeline operators said that a common problem was weld failure due to "hydrogen embrittlement" presumably from tramp hydrogen in the pipeline.

Deeper investigation showed that hydrogen embrittlement does occur when the welding process introduces hydrogen. Typical sources of hydrogen are dissociated water from damp welding rod flux or due to welding in a wet environment. The welding arc electrolyses water into hydrogen and oxygen ions. Ionic or nascent hydrogen are much smaller particles than normal hydrogen which occurs as a diatomic molecule. In the ionic state hydrogen is a proton. In the nascent state hydrogen is a proton and an electron. In the molecular state hydrogen is two protons sharing two electrons.

Certified welders know how to avoid hydrogen embrittlement. They keep the welding rod dry in sealed canisters and prepare the welding area by cleaning it and keeping it dry during the welding process. This avoids hydrogen introduction into the steel.

Several years ago we started a search for the oldest hydrogen cylinder with the help of Arizona Welding Equipment Company, our local supplier of hydrogen and specialty gases. So far we have discovered two cylinders that were first tested in 1916 and two in 1917. Arizona Welding Equipment Company has been looking for older cylinders but so far these are the oldest that we know of in Arizona. And they are extremely interesting.


The two 1916 cylinders were apparently first tested in Germany because they are marked with the Iron Cross. At the end of World War I Germany was forced to give up war materials and the hydrogen cylinders were handed over to the Allied victors as part of the war reparations program forced on Germany to keep Europe safe from another military adventure. These cylinders were then re-branded like cattle after going to a new owner. The Iron Cross was boxed to form an outer box with four smaller boxes within it. The next test date on one of these 1916 cylinders is 1921 and the other is 1922. Apparently the war reparations arrangement allowed the passage of six years between hydrostatic safety testing on one of the cylinders.

One reason that hydrogen cylinders were taken from Germany at the end of World War I is because we hated the German's hydrogen dirigibles that had been used for observation posts, to hang anti-aircraft cables over strategic military locations, and for long range flights during World War I. From about 1900 to 1937 German engineers such as Von Hindenburg wanted to use helium as a lifting gas for lighter-than-air dirigibles but at that time America was the only source in the world of this rare gas. We had vast natural gas fields in the Hugoton, Kansas area that produced small percentages of helium. U.S. engineers had learned how to extract the rare helium for uses ranging from electron tubes, to welding cover gas, and for toy balloons. But U.S. Government forbid sales of helium to Germany after it became apparent that the dirigible could be used in military applications. Germany was forced to use hydrogen for buoyancy in the dirigibles.

After World War II more hydrogen cylinders with the Iron Cross or Swastika at the safety test date were handed over as part of the World War II reparations arrangement in Germany's surrender. If these hydrogen cylinders taken from Germany could talk they might tell of voyages from Berlin to and from New York or Rio de Janeiro as the Zeppelins flew over the oceans at 75 miles per hour leaving ocean liners far behind. The German Zeppelins offered far greater range than any other aircraft. They could fly nonstop to virtually any point on the Earth. On board these lighter-than-air Zeppelins were cylinders of compressed hydrogen for filling the giant sausage skins that confined the hydrogen. Altitude was adjusted by the pressure and volume of hydrogen maintained in these animal-gut casings that resembled giant sausage skins.

Help us find some pre-World War I cylinders. We will pay AHA annual membership dues for each person that helps us find a cylinder that is older than the 1916 date that we have.

Currently, hydrogen pipelines made of welded steel tubing are expanding. Refineries produce large amounts of hydrogen for making petrochemicals and more recently for making cleaner gasoline and diesel fuel. Hydrogen is used to remove sulphur and to hydrogenate gasoline molecules to improve the hydrogen-to-carbon ratio which results in an improved octane rating.

An emerging trend is for industrial gas suppliers such as Air Products and Praxair to produce and sell hydrogen to numerous refineries from pipelines. Some of the most extensive hydrogen pipelines are in Germany and the Houston, Texas area where the same hydrogen pipeline serves gasoline producers, ammonia synthesizers, and petrochemical plants. Natural gas pipelines bring a mixture of methane, and heavier molecules such as ethane, propane, and butane. The heavier molecules are used to make polymers and petrochemicals. Methane is reacted with steam to form methanol, carbon dioxide and hydrogen. The hydrogen is separated and added to the hydrogen pipeline. User-owned hydrogen plants add hydrogen to industrial gas supplier's input of hydrogen to this pipeline. This provides an assured supply and has spurred growth to more than 8 trillion cubic feet world wide in 1993. 

COOKIN'

Continued from page 1

Andy Heath (Hector) called me three days before the event and asked if I would bring up our Hydrogen Barbecues to do a hydrogen cooking demonstration. So I loaded up the truck with two barbs, one with an auto-igniter. I also brought the H₂ gold-dredge engine. Andy said to not bring hydrogen tanks, because they would be arranged through a local welding shop in Glenwood Springs.

It was tough getting there, because I got caught in a mud slide, but eventually, I was at the concert. Then they could not find my name on the exhibitor's list. One of the guys giving out passes took care of it once I mentioned Andy's name. He said, "He believed in what we were doing with the Hydrogen demonstration".

Next morning, I took the bus to the city center, found Andy and loaded up the gear and went to the concert, but security said, "We were too late" to set-up. So we watched the concert and passed out hydrogen literature. This was fine with me, because we got to see War play. After the concert, we set-up for the next day.

We set-up in the environmental booth section to cook our hydrogen veggie burgers, which were called "garden burgers". You could eat them raw if you wanted to, but they certainly tasted better cooked on our hydrogen bar-b-ques.

On the start of the second day, I fired up the bbq's and started cooking burgers. Andy got the opportunity to get on stage and announced to the whole crowd that we were cooking with hydrogen. People started flocking to the booth...big time.

A few minutes later, Security shows up and threatened to throw me in jail for running an illegal commercial food booth. We explained that donations were optional and that we were

feeding people for free if they were hungry. Garden Burger had donated the burger, a local bakery in Crested Butte donated the buns. Andy bought some salad dressing, and a local gardener donated vegetables from her organic garden.


Security wanted us to tear down everything and get it out of the concert. I started to tell him he could stop me from cooking, but not from demonstrating hydrogen...but then a girl from Save the Ancient Rain Forest yelled at him...and the guy left. Then a woman from Greenpeace got fired up and went after him.

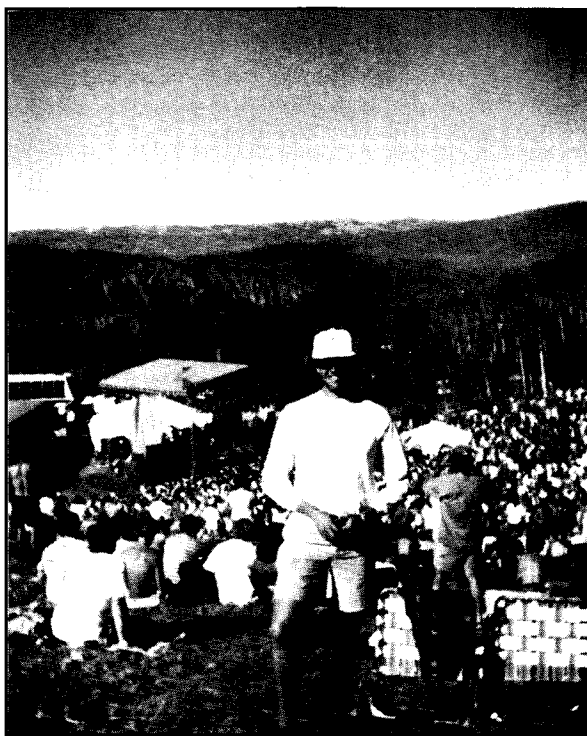
So we went back to the parking lot and later that night, we set-up again in the parking lot to feed the hungry crowd. The crowd was great. They loved the burgers, but I don't know if the healthfood or the hydrogen aspect drew them more. If they came for veggie burgers you explained the hydrogen, if they came for the hydrogen, they learned about veggie burgers. Either way, they learned something about renewable hydrogen.

Next day at the concert, the guy running the show said we should set-up again because he had the final say, but it was too late to bring the truck in, so we had to pass. I spent the day passing out literature, and helped people get their cars running, and then left for Crested Butte.

In Crested Butte, I demonstrated my hydrogen gold-dredging engine to Fritz that was in charge of the Crested Butte ski transit system. Then I did the same for a band called the Space Janitors who said, "They wanted to be the first band

to run on hydrogen". After that, I went to see the local white buffalo, and then went home.

One thing I would like to mention again is Andy Heath. That guy is the most avid H₂ person that I have ever seen in my life. He does more with less than anyone I've seen, he doesn't let anything impossible stop him, and I think he deserves special recognition. *Thanks Andy!* 



Andy Heath, Hydrogen Rasta Man.

The Hydrogen Association
dba The American Hydrogen Association
in the United States

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A New Energy Education Event

Good news... Science teachers are going to help teach High School students about Photovoltaic Systems.


For at least five years, the National Science Olympiad has been requesting that one of the states develop and test a Trial Energy Event.

The American Hydrogen Association in cooperation with the Arizona Council of Engineering, Science Associates (ACESA) and Division C Science Olympiad are developing details of integrating a High-Concentration Photovoltaic Systems High School science event. The development (or use of existing technology) and performance of improving the efficiency of Photovoltaic systems is the main goal of the Event. Rules are being written and details of the event will be highlighted in *Hydrogen Today*.

The major purpose of the Arizona Council for Engineering and Science is to join together various individuals and groups to aid in

the improvement of mathematics, science and technology education in Arizona's schools. The alliances offers science update series, science teachers training workshops, tours and workshops on biotechnology and grant writing workshops.

Mr. Charles Terrey, Electrical Engineer with the American Hydrogen Association and Dr. Charles Y. Hoyt, Division C Science Olympiad Coordinator are developing this Event. Teams will participate in the energy project at the State Finals on February 25, 1995.

The American Hydrogen Association will supply the award trophies and will help in the award ceremony. AHA's Volume 5, No 2 '94 *Hydrogen Today's* article on New High Concentration Photovoltaic System and Matt Meschke's outstanding award in calculus sparked the interest in developing and testing an Energy Event for the Science Olympiad. 

Dear Kathy McAlister

On September 17, 1994, the Los Angeles Community Reuse Organization Energy Technology Engineering Center held its first Community Seminar. The seminar was titled "The Paths to a Hydrogen Economy". The event was extremely successful due in large part to your support. We wish to express our appreciation for the loan of the Micro Solar Energy Experimenters Kit. The exhibit drew considerable attention, especially from the younger members of the audience.

Again, thank you for your help and we look forward to other collaborations in the future.

Sincerely,
Laurie Golden, Community Relations

AHA Volunteers Raise Money — Kathy McAlister

Would you believe! I signed AHA up to sell coke and other soft drinks at the ASU football games. Then it was rumored that I had signed AHA up to sell beer at the Cardinal games. Yes, it is true. We are paying off loans.

AHA can make up to 10% on soft drink sales and 8% on beer sales. I said, "I'll hold AA meetings after the game, if I corrupted any of our members." However, we do need volunteers to help at the games. Call 921-0433 if you would like to help. We are thinking of extending the soft drink sales into the basketball season.

AHA's year ended July 31st. The books are with Steve Loney, CPA, for filing of tax reports. As you know, the membership is what supports AHA. AHA cannot say "thank you" too many times. It is average people, just like you and me, that will make the difference. It is due to your financial support, that makes AHA a viable organization.

Donations for 1994 came to \$35,151.00 with a Total Income being \$42,926.00 (representing sales of books, demo kits, t-shirts and videos). Our Expense Total was \$47,138. The best part, we can account for every dollar received or spent...but we had to borrow to make ends meet.

Our biggest expenses were rent and utilities of \$17,390.00. Printing and mailing our newsletter was \$8,361.00; office supplies \$5,329.00 and converting cars and educational programs amounted to \$5,313.00. We gave away informational packets for \$3,393.00. T-shirts, demo kits, fuel cells and promotion material costs were \$6,998.00. There were license fees, bank fees and etc. that make-up the rest of the expenses.

I am really proud of AHA for our accomplishments. Our Board of Trustee, for the Education Foundation is working towards a Capital Campaign to raise money for four Department Chairs and scholarships at four different Universities. The Education Foundation Board of Trustees consists of: Dr. Fazle Rabbi, Dr. David Sanborn Scott, Dr. Stan Settles, Dr. William Van Vorst, John Vernon, Dr. Philip Wolfe, Dr. Byard Wood, and Dan Zavaleta. We will continue to fund worthy demonstration and education program. AHA... a group that is dedicated to bringing about renewables.

AHA's Advisory Board: T. Nejat Veziroglu, Addison Bain, Dr. Walter Corson, Dr. Ed Glenn, Peter Hoffmann, Michael J. Pattera, Michael Peavey, Walter Pyle, David Zavaleta, Dr. Robert Zweig... will advise AHA on long-term goals and how to bring about renewable resources.

AHA is developing a Transportation Safety Board. Scott Grainger (Chairman of the Arizona Fire Code Association), Chuck Terrey and Clare VanAusdal are current members. We are still accepting applications for membership to this Board.

Did we meet our goals FY '93-94? Our goal was to provide information to businesses about the kind of products needed to bring about renewables. Some of AHA's biggest accomplishments were getting the BBS and auto conversion classes started by our Education Program Committee.

Special thanks to John Vernon, Rod Gallagher, Howard Smith, Clare VanAusdal, and Steve Loney, CPA.

AHA Tempe BBS Upgrading – Rod Gallagher

By the time you read this, the AHA Tempe BBS (602) 894-8403 will have upgraded its software and services. The new software allows for easier access to the wealth of information that is available to the average user. Also added were a cd-rom with over 3,500 files, Internet access, and a special fax program that allows the user to request information that is sent via fax automatically!

Our cd-rom has over 3,500 files that range from alternative energy information to the latest games for both pc and mac. This cd-rom allows any caller access to some of the latest and most complete information available. Its official title is the "Solar cd-rom", and is a collection of files that have been collected over several years. Updates will be added to AHA Tempe BBS as they become available.

Our Internet access has been growing. We have finally worked through most of the bugs and have been operating internationally for some time. We offer direct E-mail as well as news groups. The internet is an added fee feature, meaning that a charge is made if you would like to utilize this important feature to help defray the costs. Please see the information on-line for current rate structures, and note that AHA members get a substantial discount.

We do offer several free conferences from the internet as well. We offer the

hydrogen and renewable energy conferences to anybody that dials in to our system. There are over 7,000 other conferences available, but these are the two that seem to fit our users the best. They are provided free of charge courtesy of the Education program at AHA. Many thanks go to the students in this program for their donations and enthusiasm.

The fax program that we are adding will allow anyone with a fax machine to receive selected AHA material. They simply choose the information that they would like to receive and wait for it to arrive. The average wait is between 2 and 30 minutes depending on traffic. This will allow users to receive information without requiring someone to be in the office. The computer will do most of the work! Please look on-line for a current list of available documents.

There still are some needs for the BBS. All of this expansion has given us great growing pains. The AHA has donated the phone lines, Howard Smith has donated the computer and some of the software. The Education Program has donated the cd-rom, but there are still a lot of needs. Please contact Rod Gallagher, sysop, if you would be able to help with this system. It is rapidly becoming one of the premier - and most used - systems in the country relating to alternative energy. The needs are great, but the benefits are even greater!

FROM THE BBS

Two items of interest selected from recent BBS dialog: Thermochemical production of hydrogen, and hydrogen storage in titanium-wound tanks...

* * * * *

Subject: Re: thermochemical cycles for H₂ production

Newsgroup: sci.energy,hydrogen,sci.energy

Sandeep Sukumaran writes:

I am doing a technical assessment on the production, distribution and storage of hydrogen. I am having a tough time finding recent papers on the production of hydrogen through thermochemical cyclic processes. I would also like to find which thermochemical process is the most efficient. The information must be technical. Thank you.

I've been sort of out of hydrogen production myself since about 1984-5, but I agree with you that research in thermochemical cycles for hydrogen production has waned quite a bit. Most of the work now, I believe, is being done on variants of the sulfuric acid cycle, but there's a lot of problems associated with it. (Let me know if there currently is serious research with other cycles.)

This brings up an old memory. Back in 1982, I was fortunate enough to work with Dr. James Funk, who was doing consulting work for Sandia Livermore. Now, Jim was the person who really got research in this area going way back in the 60's when he was with GM Research (he later went to Kentucky, I believe). The initial assessment was done for nuclear heat systems, but as time went on solar and other heat sources were considered as well (thus his consulting for Sandia who wanted to look at chemical processes for solar thermal plants).

I remember quoting to him one of my rare sayings that carries a lot of truth (at least I believe so): "It's unfortunate that God did not bless the multi-step thermochemical hydrogen people." When he heard that quote, he just smiled. The hidden meaning behind this quote, for

Silicon Valley Chapter Update

– John Gotthold, President, Silicon Valley Chapter

We can't win! We decide to cut down on our Hydrogen work and the next day get seven orders for Hydrogen Fuel Cell Kits in the mail.

We passed out four or five hundred AHA information handouts at the Solar Energy Expo and Rally (SEER) and are running out.

At the Santa Rosa Home Show we showed the Kit and also a model of a Hydrogen Homestead based on a doll house from Sun Toys, Inc. which includes our Hydrogen Desert Survival Truck. We are also acquiring a 12 volt electrolyser from Hydrogen Wind, Inc. and will be adding it to our Hydrogen Cooking display. We are trying to get one of the Catalytic Stove top burners from Germany but probably will just use a modified propane burner. Along with the Hydrogen Systems Catalog and catalogs from Alternative Energy Engineering and Sun Toys we will have a full range of Information to make people aware that there is a bright and clean alternative to the dark and cold once the oil supply tightens up.

Yours for Prosperity without Pollution!

MORE FROM THE ABS...

those of you who haven't figured it out yet, is that there doesn't seem to be any inherent reason, in a general sense, why multi-step thermochemical processes for hydrogen production "won't" work. However, years of digging into thousands of candidate cycles have not identified even one that seems to just lunge out and say "here I am!". When you analyze these cycles, you always find some serious flaw with each one, e.g., uncontrollable side reactions, very expensive chemicals/elements, unsolvable corrosion problems, overall low process efficiency due to the thermodynamics, etc. Even the current front-runner (at least I think it is), the variants of the sulfuric acid cycle, have a LOT of difficult problems as well. My personal opinion is that there are too many intractable, real-world problems to ever make this cycle economical, much less workable. (Of course, I should never say 'never', but you can say I am quite skeptical about this particular family of cycles.)

Sandia even had Foster-Wheeler, a top notch chemical engineering process design firm, try to design a solar-powered hydrogen plant using this cycle back in 1983. It turned out to be an absolute plumbers-nightmare, and FW finally said the sulfuric acid cycle (they looked at the iodine variant) will never work, EVEN with a traditional heat source — and FW had every incentive to not say this since we offered them big \$, I mean BIG \$, in follow-on research if they could come up with a design that showed even the "remotest" possibility of working! They were disappointed in the results, but were happy not to have

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to continue further research (as I said, it was a real nightmare in design.)

Thus, I still conclude that God just did not bless us in this area. Now, if we could all of a sudden find millions of tons of some of those currently very expensive and rare metals that are a part of interesting and probably workable cycles (none specifically come to mind at the moment), then we can start looking into this area again! Get out your shovels!

Jon Noring

* * * * *

Subject: Re: Hydrogen storage in titanium

Newsgroup: sci.energy.hydrogen

HELICALLY WOUND TITANIUM

Pressure vessel technology reached it's apex in the space program. A light weight helically wound titanium tank was developed to store both liquid and gas substances. The principal is to partially pre-load a bullet shaped tank by machine winding in a helical (crisscross) pattern with a graphite or boron fiber, even fiberglass. The synergy works like a tire, the titanium tank is the tube and the windings act like the tire. This will allow light weight portability of compressed ambient temperature Hydrogen, and other gasses, making exchanging the tank a way to fill up and much simpler and lighter than the heavy steel tanks of today used for oxygen, acetylene, propane, LNG or natural gas (methane). Titanium is slightly more expensive than aluminum but is one of the more plentiful metals on earth if taken from sea salt. This method of storing Hydrogen is almost as safe as the Hydride tank and much safer than the gasoline tank of today in general and 100% safer than a Pinto. Chrysler

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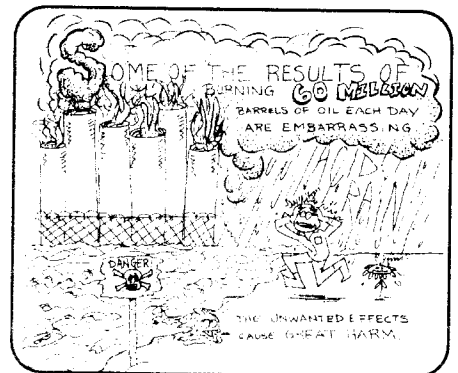
is using this idea for the fuel storage tank in the natural gas mini van.

The helically wound titanium tank just might be the delivery system of choice for all uses including transportation.

The helically wound titanium tank when massed produced will allow pure Hydrogen for fuel cell use in transportation and a way of anybody to distribute any quantity of waste gas and be as popular and convenient as propane torch fuel and lantern fuel at a fraction of the cost. The low cost high tech helically wound with composite fiber Titanium 10 gallon size 10,000 psi tank (5 or 10 pounds full) will deliver BTUs at maybe a hundredth the weight of the heavy walled steel tanks used for delivery and storage of bottled gas today.

NOTE: A little hundredth monkey, hundredth wise men of the world thinking: By selective frequency induction coupling of a crucible of sea salt the plasmionic deposition on a meltable substrate mold allows us to create a titanium tank directly from the multi mineral salt in a vacuum chamber or in space. Somebody (alchemist) should try that, we did it with silicon for thin film PVs, the silicon came up to plasma at a certain frequency (atomic weight X 1000 if memory is right) but the gallium doping didn't.

For the planet
 Raleigh



Hydrogen Today
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 Printed by: B&B Printery (the B)

Energy Partners Teams With Texas Researchers, Detroit, To Bring Zero Emission Technology To Market

— *By: Ed Trlica, edited by AHA staff*

Energy Partners announced the signing of a cooperative research agreement with Texas A&M University and Southwest Research Institute to increase the viability of proton exchange membrane fuel cell (PEMFC) technology for the marketplace, and a separate contract with Ford Motor Company to take part in the development of an alternatively fueled, hybrid electric vehicle.

The idea behind the Texas research agreement is that the talent existing in these three entities, when combined, will expedite the entrance of PEMFC's to the commercial marketplace. The three groups include expertise in fuel cell manufacturing, electrode structure, materials and modeling. Each team member will conduct research in their field of expertise with all results being pooled to a lower rapid advancement of the technology.

The Ford agreement makes Energy Partners a critical team member in the \$122 million cost-shared project, "U.S. Hybrid Propulsion Systems Development," recently awarded to Ford Motor Company by the U.S. Department of Energy. Under this contract with Ford, Energy Partners will conduct research regarding the feasibility of commercial Proton Exchange Membrane (PEM) fuel cell power systems in a hybrid electric vehicle. The contract between Energy Partners and Ford is for \$1 million over a three year period, with Energy Partners participating on a 50% cost share basis.

The PEMFC, which is an electrochemical device that produces electricity from hydrogen fuel with no harmful emissions, holds great promise for reducing pollution and reliance on foreign fuel sources. PEMFC's have been successfully demonstrated for both transportation and stationary power applications with fuel-to-electricity conversion efficiencies as high as 30 to 60% as compared to carbureted

combustion engines with 20 to 30% efficiencies and diesel generators with 25-50% efficiencies. Operating characteristics of PEMFC's are attractive also including relatively noiseless fan or compressor "whirring" compared to the high-pitched "whine" of gas turbines or "throb" and vibration of piston engines.

The primary factors preventing widespread use are weight (for transportation) and cost (for all applications). The consortium will focus on research that will have the greatest potential impact on these factors.


Energy Partners is the developer of the EP Green Car, a prototype PEM fuel cell/battery hybrid electric vehicle developed to demonstrate the feasibility of PEM fuel cells for transportation. PEM fuel cells, which use hydrogen as fuel to produce electricity while releasing no pollutants, show significant promise for cleaner energy systems in both the transportation and stationary power production sectors.

Texas A&M University's Center for Electrochemical Systems and Hydrogen Research, has been working since 1983 to develop hydrogen technology and fuel cells for better use of future energy resources. It's teaming with Energy Partners will provide a means to transfer developed technology to a high-tech-oriented industrial concern.

Southwest Research Institute has a broad base of expertise concerning electric and hybrid vehicles. This includes the development of a detailed computer model to predict hybrid and electric vehicle performance over various operating cycles. According to Southwest Research engineers, inclusion of a fuel cell model would make their model unique.

The award of the contract with Ford comes shortly after Energy Partners' receipt of a grant from the Florida Energy Office for \$750,000 to be used for equipment and research necessary to

take PEM fuel cell technology from the prototype to the commercial stage.

"Ford Motor Company and the DOE's interest in the further investigation of PEM fuel cell technologies as an alternative to the standard internal combustion engine is very promising. It shows that the progress made in PEM fuel cell technology over the past several years with projects like the EP Green Car has been noticed by the right people, and these people are willing to invest in the technology," stated Julie Couch. Energy Partners is hoping that its PEM fuel cell technology will be chosen for follow-on phases of the Hybrid Project and will eventually be incorporated into a Ford vehicle. The use of PEM fuel cells by the Big Three for vehicle propulsion could eliminate tail pipe emissions, reduce U.S. reliance on foreign oil, and strengthen the U.S. auto industry. 

Happy Birthday Earth Day... 25 Years

April 22, 1995 is the 25th Anniversary of Earth Day. Denis Hayes, the Father of Earth Day, is back in the program as Chairman of the event. The theme for this year's event is Energy Efficiency and Renewable Energy.

AHA will need some new slogans and posters for Earth Day. We need a Display Chairman and other committees (such as media and public relations) to make sure that AHA is ready for Earth Day. We also need a new T-shirt design.

We will also need volunteer speakers to visit schools. Several schools have already called (almost on the first day of this school year) to make sure that AHA would be at their school as a guest speaker or provide a display.

Give Kathy at the AHA office a call if you can help!

Running Vehicles With Hydrogen From Water Utilizing Electricity As The Power Source

— By: *Cliff Ricketts, Professor*

Agribusiness and Agriscience, Middle Tennessee State University

A Middle Tennessee State University professor and his students started working on alternative fuel projects in 1979. The intent was spurred by the fact that the Iranians have taken hostages and OPEC was attempting to control the world's fuel (petroleum) supply. Out of frustration, Dr. Cliff Ricketts and his students started a program for the American farmer to be energy independent.

Running an engine off corn (ethanol) was the first challenge for Ricketts and his students. Although many other persons or groups were doing similar research for making ethanol, it was the persistency of the MTSU team that led to eventually to the building and running on ethanol a powered truck that ran over 25,000 miles on pure ethanol. Presentations were made at the 1982 World's Fair and TVA's 50th Anniversary Barge Tours.

Having accomplished all the goals in ethanol production, the next challenge was to run an engine off cow manure (methane). Once Hydrogen Sulfide and Carbon Dioxide are removed, the gas which remains is mostly CH₄ (natural gas). Natural gas engines were fairly common, and Ricketts observed several engines which ran on methane. Ricketts found that methane production was viable in large dairy farms.

The knowledge gained in the study of methane production transcended.

to the ultimate challenge for the MTSU professor and his students, which was to run an engine on hydrogen produced from water. Being relatively un-informed in the area of chemistry, Ricketts reasoned that since methane (natural gas) had the formula CH₄ and hydrogen had the formula H₂, then the two fuels were close enough to react similarly in an internal combustion engine. An expert chemist later told Ricketts of his inaccuracy. However, this was told after Ricketts and his students on October 14, 1987, ran an engine for eight seconds on hydrogen from water. The



next day they ran the eight horsepower engine for two minutes.

Since that time Ricketts and his students, especially Terry Young, a graduate teaching assistant, have run tractors, cars, and stationary engines off hydrogen. The MTSU professor and his students were invited to the World's First Hydrogen Race at the Bonneville Speed Trials in 1991 at the Great Salt Flats in Wendover, Utah. The event which called for a fuel with at least five percent of Hydrogen.

Although the MTSU team won with a winning speed of 109.85 mph, Ricketts did not agree with the rules of the event believing that only engines running off pure hydrogen should enter the race.

Securing the sponsorship from Tractor Supply Company (TSC Industries), and

University research funds, Ricketts, Young, and MTSU students preceded to build an engine to run on pure hydrogen. The MTSU team entered the vehicle in the SCTA-World Finals on October 18th at the Bonneville Salt Flats in Wendover, Utah, and set a new World Landspeed Record for a pure hydrogen fueled vehicle. Although Ricketts has different stages of research on various hydrogen projects, this particular vehicle ran off bottled hydrogen purchased at a welding supply store.

The major thrust of the research on hydrogen in the Agriculture Department in running engines on hydrogen from water. Along with his students, Ricketts has developed a process where he can equip an automobile so that overnight the vehicle can be connected to an electrical outlet and a water faucet and produce fuel overnight for about 50-60 miles of driving the next day.

Tap water is deionized. The deionized water is sent to an electrolysis unit (a reverse fuel cell). The electrolysis process involves three major components: an anode, a cathode, and an electrolyte. The cathode plate is made of titanium and is electroplated with platinum which serves as a catalyst. The proton transporter or electrolyte is a product of the Dupont Corporation which is called Nafion. When the water is dissociated, the proton from the water's hydrogen atoms are transported by this plastic Nafion membrane through an electrochemical process to the cathode where the proton, which is a hydrogen ion, meets the returning electron to reform into hydrogen gas.

Since the hydrogen is to be stored in a metal hydride tank, the hydrogen must be 99.9999 percent pure to prevent side reactions. The purifying process uses platinumized pellets, which are hydrogen oxidation catalysts. Any oxygen impurity in the hydrogen reacts with the pellets to form water. Next, the hydrogen moves into another tube which contains a molecular sieve which will trap the water, nitrogen, and other impurities that could contaminate the metal hydride in the storage tank.


The hydrogen is stored in the metal hydride tank as a solid. The hydride consist of an iron-titanium alloy with a small amount of manganese. When the gaseous hydrogen is brought in contact with a metal that forms a hydride, hydrogen is absorbed onto the surface of the metal. Molecular hydrogen dissociates into hydrogen atoms which then enter the crystal lattice of the metal and occupy specific sites in the metal alloy's crystalline structure.

In order to convert the solidified hydrogen into a gaseous form, the metal hydride is heated through the use of a heat exchanger connected to the coolant system of the engine. The engine that uses hydrogen effectively has to be adapted including fuel system, valves, cam, spark plug, piston and timing.

The MTSU hydrogen car team improved its' own world's record by 20 miles per hour at the 1994 World of Speed at the Great Salt Flats. After four rain cancellations, and waiting for two years, the MTSU team was about to test their newly designed engine. A standard Nissan KA24E engine was modified specifically to run on hydrogen. The KA24E engine was selected because it is a three-valve engine. (Two intake valves and one exhaust valve per cylinder.) The major modification included building a partition between the two intake valves. The reason for this is safety since the hydrogen and oxygen from the air supply never meet until they get to the combustion chamber. This design is different than many previous Hydrogen engines that mix the hydrogen and oxygen in the intake system before entering the combustion chamber of the engine block.

The next biggest change was the fuel system. MTSU chose to use neither a carburetor or fuel injectors, instead the system works under pressure. By using the pressurized metering system, when the intake valves open, the fuel enters the engine. The pressure is at approximately 50 p.s.i.'s. Another component of the engine is water injection. Just as the hydrogen enters the engine head, a mist of water is added to lines containing hydrogen that go to each cylinder. The water serves two purposes: it dramatically expands, and it curbs pre-ignition.

The MTSU team consisted of Dr. Cliff Ricketts, Director of the Hydrogen Research Project; Terry Young, driver and technical assistant; David Townsend, agricultural education major; Dave Tompkins, recent business major graduate; and Billy Green, Political Science major.

The Hydrogen research of the MTSU team will now focus on economic production of hydrogen. Several chapters or areas are involved with hydrogen research. These include: water purification, electrolysis, drying of the hydrogen, hydrogen storage, safety, and system economics as well as engine modifications. The research is sponsored by Tractor Supply Company with matching funds from the University, as well as the graduate research committee of MTSU. 

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**Real Cost Of
Depletion And
Pollution**

The Commerce Department has released a new report that will help determine whether the economy is using natural resources faster than it is finding new reserves or alternative sources. This report is doing what AHA has been advocating... that the real cost and effect on the environment of the use and exhaustion of resources, and the resulting pollution, should be index into the counted, non-cash transaction of doing business.

The report states that the average annual rate of return on capital for the oil industry would have been 4 to 5%, not 23%, if the resources were being used-up and the resulting pollution had been taken into the accounting.

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BOOK REVIEW:

The Keys To The Car: Electric And Hydrogen Vehicles For The 21st Century

World Resources Institute — \$14.95

Controlling air pollution, reducing the risks of global warming, and cutting oil imports are three major problems resulting largely from our use of cars and trucks powered by fossil fuels. Although we can improve emission controls and the fuel efficiency of conventional vehicles, only switching to radically different kinds of propulsion systems will enable us to solve these problems in the long run.

Surveying the problems of oil-powered vehicles, this provocative report explains why so many so-called alternative

fuels will fail to solve them and calls for the widespread introduction of electric-and hydrogen-powered vehicles. Dr. MacKenzie examines the status, benefits, projected costs, and potential barriers to developing these emission-free machines. He describes the status of programs in the United States, Europe, and Japan, to develop prototype vehicles and new types of batteries and hydrogen fuels. In *The Keys to the Car*, the impacts of these promising new vehicles on air pollution, global warming, and oil imports, are sized upon along with ways to get them on the road. — *James J. MacKenzie*

POWER SURGE - Guide to the Coming Energy Revolution

WorldWatch Institute, tel (202) 452-1999; fax (202) 296-7365; e-mail wwpub@igc.apc.org

At the beginning of *Power Surge*, the latest book in the Worldwatch Institute's Environmental Alert Series, there is a quote: "The best way to predict the future is to invent it."

The story of inventors of the future is compelling and heartening. Because they believe — and their actions are proving — that we can have clean skies and cold beer, unpolluted forests and hot showers. We can have an energy future that serves humanity and not just the fossil fuel industries.

Power Surge predicts a turbulent next decade, as large energy companies struggle to preserve the status quo, while newer firms and their environmental allies fight to change government policy and open up energy markets to greater competition. Some giant oil, auto, and utility companies may find themselves in the current position of IBM - squeezed out of markets they have dominated for decades by fast-moving entrepreneurs.

Power Surge also shows that this new future is coming just in time. Developing countries, relying on out-dated and inefficient energy technology, are creating pollution and drags on their economies. . . global warming and acid rain continue to threaten our globe . . . indeed, the scientific consensus is that we must cut global carbon emissions by at least 60% to stabilize our climate.

As this book demonstrates, the energy industry so far has been unable to make the technological leaps that have occurred in virtually every other industry in the 80's and 90's. They have ignored the vital need to change the coal-oil-central planning "business as usual" scenario. Fortunately, the groundswell of innovation is happening anyway, and the story is exciting.

Order *Power Surge* today. You'll see why sun power will replace oil and coal — how waste reduction and recycling will make garbage collection and disposal obsolete — why energy efficiency will create a stronger economy — and much more. Look for the book in the book stores or order from WorldWatch. Cost: 1 copy: \$10.95; multiple copies are available at discounts.

1994 Arizona Energy Management Conference

Tempe, Arizona

The 1994 Arizona Energy Management Conference is scheduled for December 8 and 9th at the Buttes Conference Resort in Tempe, AZ.

The conference provides information on energy and energy-related topics to energy managers, city, school and utility officials, maintenance personnel and private sector representatives. The conference includes a wide variety of technical sessions to review the latest in energy management products and services, hands on training for facility managers and presentation on innovative energy conservation programs for public and private sector organizations. Tours are also hosted to local energy management sites of interest. This year's conference will host an optional golf tournament at the Shalimar Country Club.

The Energy Management conference is sponsored by the Arizona Department of Commerce Energy Office, the League of Arizona Cities and Towns, and the Arizona School Boards Association.

For more information contact Gloria Castro at the Arizona Department of Commerce Energy Office at (602) 280-1410.

Partial List of Sessions:

- A Review of ASHRAE 90.1 - Commercial Building Codes
- Energy Basics 101
- School Energy Conservation Case Studies
- Case Studies in Fuel Cells and Plasma Pyrolysis
- The Changing Role of Utilities
- Alternative Vehicular Fuels
- Integrating Energy Management and Facilities Operations
- A Technical Look at Solar Projects in Communities
- Choices for New Chiller Refrigerants
- The Energy Information Super Highway
- Energy Conservation in Commercial Buildings - Lessons Learned

Upcoming Events . . .

AHA National Meetings: (Third Wed of each month — 7:00 p.m.): Roundtable discussions: (Like AHA's first meetings) Conference Room B: Student Service Building at Arizona State University. 7:00-9:00 p.m. Contact: Roy McAlister (602) 921-0433

Southern California Chapter of AHA monthly Meeting: Contact: Dick Williams (800) 854-5225.

AHA - Silicon Valley Chapter: BBS@(415) 494-3116 (1200 to 14,4000 BAUD, 8N1) Phone/fx (408) 738-4014: Monthly meetings:

Nov 28 - December 1 - San Diego, CA - 1994 Fuel Cell Seminar. The Town and Country Hotel, Contact: Annmarie Pittman, (202) 639-4994, fx: (202) 347-6109.

Dec 5-7 - L.A., CA - 12th International Electric Vehicle Symposium. Contact: (408) 253-5262

Dec 7-9 - Atlanta, GA - 17th World Energy Engineering Congress - America's Largest Energy & Environmental Show. Contact: Ted Kurklis (404) 925-9648 fx: (404) 381-9865.

Dec 12-15 - Denpasar, Bali, Indonesia - "International Conference on Fluid and Thermal Energy Conversion" Contact: Prof. G.A. Mansoori, Thermodynamics Research Lab, university of Illinois at Chicago, IL 60680.

January - 216 S. Clark Dr. #103, Tempe, AZ 85281 - Auto Conversion Class - Teaching Gaseous Fuel Conversions. Contact: Rod Gallagher (602) 921-0433 fx: (602) 967-6601 (Price \$225.00)

Jan 29-Feb 1, 1995 - Houston, TX - Fourteenth ASME Wind Energy Symposium. Contact: Susan Hock: (303) 231-7650.

Feb 19-25, 1995 - National Engineers Week, "Engineers: Turning Ideas Into Reality". Contact: Steve Smith (703) 684-2852.

Mar 7-9, 1995 - Alexandria, VA - Sixth Annual National Hydrogen Association Meeting; "Hydrogen Technologies: Moving Toward Commercialization" Contact: (202) 223-5547

Mar 9-11, 1995 - Palm Springs, CA - EXPOTRANS '95 (successor to TRANSCO 2000 held Oct 1993):

Mar 13-15, 1995 - Long Beach, CA - California Fleet Operators' Alternative Fueled Vehicles EXPO. Contact: Jim Warren (612) 521-1515; Fx: (612) 521-1751

April 3-8, 1995 - Hannover, Germany - HANNOVER FAIR '95 (USA Pavilions: Electric Automation; Power Transmission & Motion Control; Energy & Environmental Technology; Factory Equipment, Tools & Compressed Air; Subcontracting & Industrial Materials; Research & Technology; Lighting Technology) The key ingredient of successful entry into and participation in the international marketplace. Contact: Rita Dommermuth (609) 987-1202 fx: (609) 987-0092.

April, 1995 - Asheville, North Carolina - 25th American Solar Energy Society Annual Conference & the 21st National Passive Solar Conference. Contact: Becky Campbell-Howe (303) 442-3130, Fx: (303) 433-3212.

July 15-20, 1995 - Minneapolis, Minnesota - "Solar '95" - "10,000 Solutions: Paths to a Renewable Future". Contact: Becky Campbell-Howe (303) 443-3130, Fx (303) 443-3212.

Sept 20-22, 1995 - Donetsk, Ukraine - "First International Conference on Hydrogen Treatment of Materials". Contact: Professor Victor A. Goltsov (0622) 936141, Fx (0622) 921278.

Oct 8-12 - Minneapolis, MN - "International Power Generation Conference and Exposition" Contact: American Society of Mechanical Eng. 345 E. 47th St. NY, NY 10017.

Nov 8-10, 1995 - "International Conference on Towards Relatively Sustainable Energy and Mineral Resource Development in Developing Countries". Contact: Asst. Professor Rotchanatch DDarnasawadi (074) 211030-49, Fx (66) (074) 212802 or 212805.

Nov 20-24, 1995 - Melbourne, Victoria, Australia - "International Symposium on Energy, Environment and Economics". Contact: Prof. T. Nejat Veziroglu, University of Miami.

April 97 - Washington, DC - SOLAR '97 - Solar Energy Industries Association (SEIA) and the American Society of Mechanical Engineers - "26th American Solar Energy Society Annual Conference, the 22nd National Passive Solar Conference and SOLTECH. Contact: Becky Campbell-Howe (303) 442-3130, Fx (303) 443-3212



MEMBERSHIP APPLICATION

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

Name _____

Address _____

City _____ State _____ Zip _____

Telephone - Home: () _____ Office: () _____

Occupation and/or Areas of Special Interest _____

- | | |
|--|---|
| <input type="checkbox"/> Regular Membership (\$30/Year) | <input type="checkbox"/> Sustaining Membership (\$100/Year) |
| <input type="checkbox"/> Student/Senior Membership (\$20/Year) | <input type="checkbox"/> Life Membership (\$1,000) |
| <input type="checkbox"/> Family Membership (\$40/Year) | <input type="checkbox"/> Corporate Sponsor (\$1,000/Year) |
| <input type="checkbox"/> Monthly Pledge | <input type="checkbox"/> Newsletter Sponsor |

All donations to the **American Hydrogen Association** are **Tax-DEDUCTIBLE** under IRS 501-(C)-3 as a Non-Profit Organization

Enclose check or money order and mail to:

American Hydrogen Association, 216 S. Clark Drive, Ste. 103, Tempe, AZ 85281



Hydrogen Lawnmowing

As an experiment, Clare Van Ausdal converted this household lawnmower to run on hydrogen, and put it to good use in taming a shaggy lawn.

Clare used hardware-store plumbing parts to fabricate a fuel mixer to replace the gasoline carburetor, with a ball valve as the throttle, fed by a long air hose carrying low-pressure hydrogen, supplied by a welding bottle with a set of pressure regulators.

During the lawnmower operation, the engine popped a few times from backfire in the intake manifold, but ran pretty well otherwise. We would sure like to test this mower for emissions, to see how it would stack up against the new EPA rules for small engine emissions.

Please call if you can help with emission testing.

AHA Will Celebrate 5-Year Anniversary: With A Glass of Champagne Party

Party Will Be Held December 17th, 1994.

Five years ago on December 17, 1989, eight people met to organize AHA; David Belksis, Sherwin Berger, Harry Braun, Jerry Dellwo, Roy and Kathy McAlister, David and Dan Zavaletta met and formed the American Hydrogen Association. At the end of the luncheon meeting each reached into their pockets and AHA was started on approximately \$30.00. The lunch was at Camelback Inn explaining the empty pockets.

You are invited to celebrate this anniversary with a "A Glass of Champagne" with us from 2:00 to 4:00 p.m. Saturday December 17th at the AHA headquarters at 216 S. Clark Dr. #103, Tempe, AZ. (921-0433) This will be AHA's annual Holiday party. Remember last year, we Bar-B-Qued with Hydrogen, and the year before we had an open house and free rides in the hydrogen pick-up.

For those who do not drink alcoholic beverages, like myself, there will be plenty of hot apple cider and snacks.

Kathy McAlister

THE HYDROGEN ASSOCIATION
216 South Clark Drive, Ste. 103
Tempe, AZ 85281
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