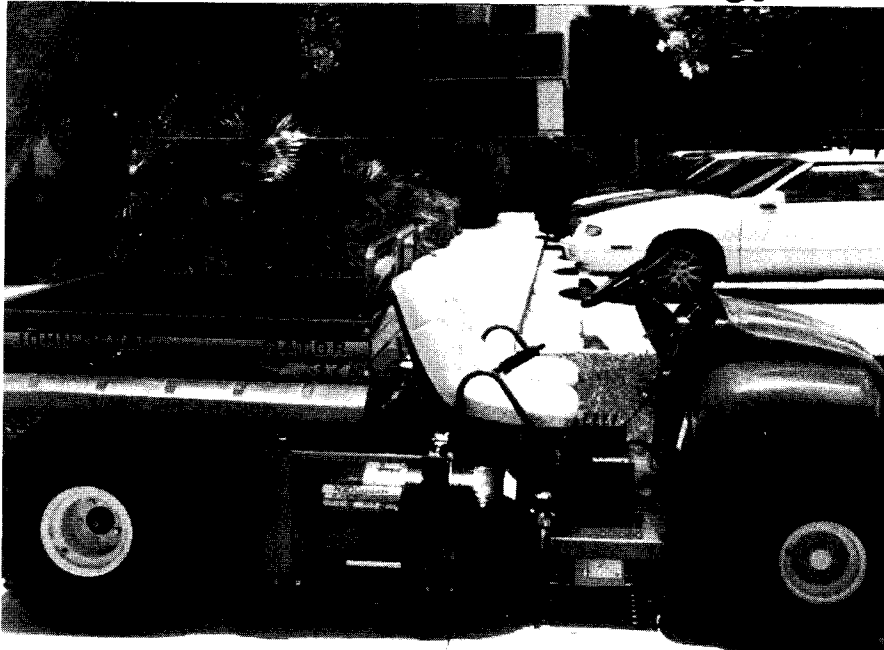


Hydrogen Today

"Clean Energy For A Better World"

Official Publication of the American Hydrogen Association • 216 S. Clark Drive, Suite 103 • Tempe, AZ 85281 Vol. 7, No. 2 1996

"Clean Energy For A Better World"



The Genesis is a prototype zero emission transporter powered by PEM fuel cells producing 7.5 kilowatts, allowing the vehicle to carry up to eleven passengers over a distance of 45 miles at speeds approaching 15 mph. PEM fuel cells convert hydrogen to electricity by a chemical reaction that converts hydrogen and atmospheric oxygen to water. The source of the hydrogen may be the chemical reversal of the process.

Energy Partners, Western Golf Cart, and W.L. Gore & Associates are dedicated to the development and commercialization of this vehicle. This vehicle was delivered to Atlanta, Georgia, at a state-of-the-art demonstration home sponsored by the

Energy Partners of West Palm Beach, FL and John Deere collaborate to develop a 6x4 utility vehicle powered by a proton exchange membrane (PEM) fuel cell.

Energy Partners was founded in 1990 to develop and commercialize PEM fuel cell technology. PEM fuel cells are electrochemical devices that produce electricity from hydrogen while producing no harmful emission. First developed for the U.S. Space program, fuel cells are leading candidates to replace batteries as the primary energy source for zero emission electric vehicles.

Using a John Deere Gator 6x4 chassis and Energy Partners' PEM fuel cell technologies, this first of three demonstrator prototypes is powered by a 10 kilowatt PEM fuel cell. The vehicle carries two passengers and a payload of 750 pounds for approximately six hours at speeds up to 23 mph.

The electric Gator was displayed throughout the duration of the SunDay Challenge at the Walt Disney World Epcot Center in Orlando, FL, and at a country rally at the Florida Solar Energy Center in Cocoa Beach, FL. This vehicle will one day lead the way to a non-polluting lawn and garden equipment era.

U.S. DOE, Oak Ridge National Laboratory and Southface Energy Institute; it will use hydrogen fuel generated by solar power from a photovoltaic array on the Center's house-like structure.



High Tech Genesis Transporter Designed In Collaboration with Energy Partners.

Hydrogen Technology

HYDROGEN SENSORS

By: Bill Wray

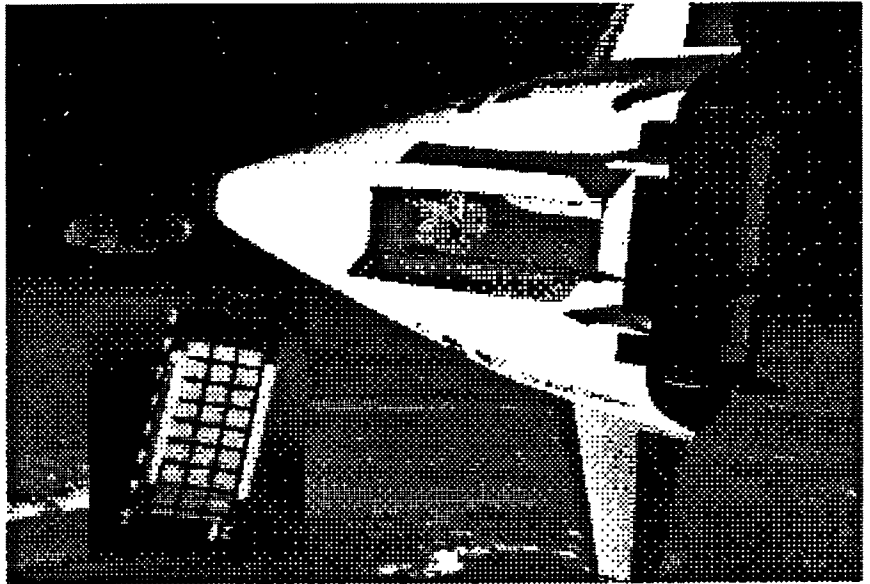
The recent billion dollar contract awarded by NASA to Lockheed-Martin for the development of a prototype of the X-33 Space Shuttle has inspired the use of a new innovative Hydrogen Sensor. This Complementary Metal Oxide Semiconductor (CMOS) device is functionally based on an Application Specific Integrated Circuit (ASIC) known as the Robust Hydrogen Sensor. This sensor was invented by Sandia National Laboratories which is operated by the Lockheed-Martin Company. Sixty-four of these Hydrogen Sensor Assemblies (HSA's) will be included in the X-33 VentureStar's Hydrogen Leak Detection System being designed by Allied Signal Aerospace of Torrance, California, a major subcontractor to Lockheed-Martin.

A hydrogen systems and applications engineering firm, DCH Technology of Sherman Oaks, California has been selected by Allied Signal to provide the Hydrogen Sensor Assemblies (HSA's) for the X-33. The sensors themselves will be fabricated by the Microelectronics and Technology Center of Allied Signal located in Columbia, Maryland.

The Robust Hydrogen Sensor has many features that make it uniquely suitable for use in space vehicles. For example, it will detect Hydrogen in concentrations that range from 0.001% to 100%. It provides reliable results at any temperature from -100 degrees C to 140 degrees C, and is only 0.0004 liter in volume and weighs only 1 gram. The response time is <2 seconds. As their name implies, these sensors are very robust due to the semiconductor

construction, and will withstand hostile vibration and radiation environments.

They are being used currently in a hydrogen leak detection system on NASA's Delta Clipper (DC-XA) vehicles. They are also being used in the commercial marketplace to sense the presence of hydrogen in applications of lead acid storage cells.



The quick response sensor is also slated for use at the Hanford's nuclear waste sites and is currently being used in the commercial marketplace for many chemical manufacturing processes. If this sensor were built into an alarm system, the sensor would trigger an early warning for hydrogen wherever the presence of the gas could pose a problem.

For more information on the American Hydrogen Assoc. (AHA) - Arizona State University (ASU) collaboration contact:

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FUEL CELLS: CHEMO-ELECTRIC POWER

Part Three of a Three Part Series

By: Roy E. McAlister, P.E. (reprinted from Hydrogen Today, Vol 1, No. 3, 1990, pp. 4-5.)

In 1837, William Grove made a cell that combined hydrogen with oxygen to produce electricity and water. Grove's discovery -- "fuel-cell technology" -- has great importance to the modern world. Fuel cells are electrochemical devices that are technically capable of being more efficient than heat engines. In theory, it is possible to build fuel cells that convert more than 80% of the chemical potential energy of hydrogen into electricity.

Fuel cells are deceptively simple. Consider, for example, the following solid-polymer electrolyte type of fuel cell: Against both sides of a special sheet of plastic called a "semi-permeable membrane" are pressed two electrode grids such as nickel-plated wire. This assembly is housed in a canister that provides for hydrogen to be fed into one of the electrode grids. Oxygen or air is fed to the other electrode. At the hydrogen electrode, diatomic hydrogen (H_2) is broken into individual hydrogen atoms (H), each of which transmits an electron to the grid as it enters the semi-permeable membrane as a proton (H^+).

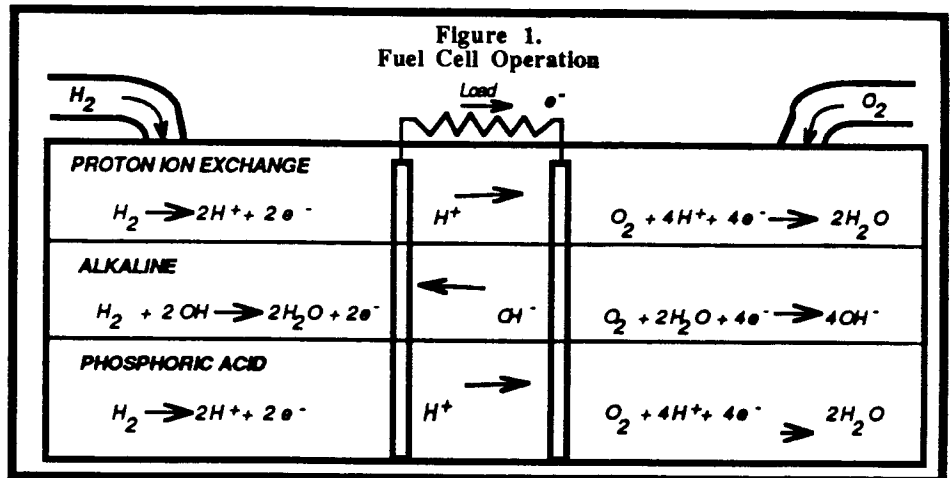
The protons react with the electron-rich oxygen to form water (H_2O).

Operation of a fuel cell to produce electricity does not require combustion or moving parts. Fuel cells are simple, noiseless, vibration-free devices. Most fuel cell types, including the solid-polymer electrolyte cell described above, have a much smaller metal content than an engine-generator set of equal electricity-production capacity.

electrodes, and other features of some fuel cell types.

Hydrogen Solid Polymer Cells:

Early in the U.S. space program, proton exchange fuel cells were chosen to provide electricity and water for on-board use in manned rockets because the chemical propellants were hydrogen and oxygen. These same reactants could be used in a hydrogen solid-polymer electrolyte fuel



**Table 1.
Operating Temperatures of Various Fuel Cell Types**

Type	Electrolyte	Operating Temps.	Notes
Biological	Sodium Chloride	Ambient	Organic Cell
Proton Exchange	Semi-Permeable Polymer	50 - 100	1st In Space
Alkaline	Potassium Hydroxide	50 - 100	Nat'l. Gas to H ₂
Direct Methanol	Sulfuric Acid or Polymer	50 - 120	Methanol
Phosphoric Acid	Orthophosphoric Acid	190 - 210	Nat'l. Gas to H ₂
Molten Carbonate	Lithium/Potassium Carbonate	630 - 650	Carbon Fuel
Solid Oxide	Stabilized Zirconia	900 - 1,000	Metal Fuel

* (Degrees Centigrade)

Electrons from the hydrogen are used in an external circuit that is in series between the two electrode grids. The electrons do work by powering a device such as a light bulb, motor, toaster, etc. The protons diffuse through the semi-permeable membrane to the other grid, where oxygen has collected electrons that have passed through the external circuit.

Table 1 compares the operating temperatures of several fuel cell types.

Types of fuel cells vary greatly in many respects, but all have in common a pair of electrodes on both sides of an electrolyte where electrochemical reactions are facilitated.

Figure 1 shows the direction of ion travel, characteristic reactions at the

cell (like the one described above) to provide both electricity and water -- at a much lower lift-off mass than batteries and water.

In order to expedite the reactions shown in Figure 1, catalysts were often used. Early space travel used proton exchange fuel cells with expensive catalytic electrodes such as heavily platinum-coated tantalum. New developments in proton exchange fuel cells, however, provide higher reaction currents using carbon electrodes with very low platinum loadings.

These new carbon electrodes are quite inexpensive and provide an important opportunity to utilize the carbon and hydrogen products of recycling municipal wastes and sewage with bioremediation techniques. In addition, high-density storage of hydrogen can be achieved in activated carbon "adsorption storage tanks" for

Continue to page 12.

Microorganism's genetic information yields surprises.

By: DOE; Contact: Tracy I. Cozzens, Editor
Sept 1996

Researchers have decoded the first complete set of genetic instructions from a microorganism that confirms the existence of the third major branch of life on Earth.

In a paper published in the Aug. 23 *Science* journal, DOE-funded researchers at The Institute for Genomic Research, the University of Illinois, and Johns Hopkins University have achieved a milestone in science that is also of commercial interest to emerging biotechnology industries.

The researchers have sequenced the genetic information or "genome" of *Methanococcus jannaschii*, a single-cell microorganism known as an archaeon (meaning "ancient" in Greek). *M jannaschii* is a thermophile discovered at the base of a Pacific Ocean thermal vent. Thermophiles are organisms that require high temperatures for growth. As is characteristic of thermophiles in general this organism is a methane producer that might become a new source of renewable energy.

"This gives us fundamental information about life on Earth, its evolution and diversity," said Craig Venter, director of the Institute for Genomic Research, of Rockville, MD. "These findings represent the scientific equivalent of opening a new porthole on Earth and discovering a wholly new view of the universe."

"In decoding the genetic structure of archaea, we were astounded to find that two-thirds of the genes do not look like anything we've ever seen in

continue to page 6.

UNITED NATIONS REPORTS THAT THE OZONE LAYER IS NEARLY DEPLETED: Here's what you can do about it.

By: Roy E. McAlister, President of AHA

Ozone in the stratosphere plays a key role in shielding people, animals and plants from dangerous forms of ultraviolet radiation. Destruction of the ozone layer has worsened. Alarming depletion of ozone has been measured in the portion of the atmosphere called the *stratosphere* which is about 10 to 20 miles above the Earth. The size of the ozone hole has doubled during each of the previous four years. This hole is now estimated to be 7.7 million square miles - twice the size of Europe from the Atlantic to the Ural Mountains.

A hole in the ozone layer, first observed in the Antarctic in the 1980's, has grown to be an ominous general condition of the stratosphere.

Chlorine is released from freon and other man-made chemicals by intense ultraviolet sun light in the upper atmosphere. In turn, chlorine destroys ozone in a catalytic reaction which means that each atom of chlorine can destroy thousands, millions, or perhaps billions of ozone molecules before the harmful chlorine is eventually returned to the surface of the Earth by the random motion of particles in the atmosphere.

The bad news is that human activities have already released gigantic quantities of chloro-carbons into the atmosphere. Unless remedial actions are taken, chlorine released in the stratosphere from these chloro-chemicals

will continue to cause destruction of ozone for centuries and life at the surface of the Earth will suffer greater harm due to skin cancers, crop losses, and cataracts.

We have proactive remedies in mind and AHA invites you to take part in supporting efforts including experimental testing of our theoretical approaches.

These tests will start in a laboratory chamber that duplicates the conditions of the stratosphere. If one or more of these proactive remedies prove to be safe and effective, we will graduate to sending a test probe into the stratosphere to determine the capability of rapid and safe removal of chlorine from the stratosphere.

In one approach, we envision launching a projectile into a polar orbit. This projectile will be launched using hydrogen as a propellant and the exhaust will be healthful clean water. Once in orbit the projectile will emit sodium which will react with chlorine to form table salt (NaCl) which will collect moisture and fall to the Earth's surface where it will do no harm.

Most of the sodium chloride will fall into the oceans and what falls on the land represents only a minor addition to chloride salts that are already present.

If all the chlorine that is in the atmosphere above a land area such as Wisconsin came down as sodium chloride it would produce a smaller change to the state's soil and water supplies than adding one grain of table salt to a pan of water. Eventually the salt that is added to land areas will be carried by rivers to the oceans.

We have established a dedicated account for contributions to this most worthy project. Write or call AHA and one of our volunteers will be pleased to take your pledge.

Hydrogen Technology

Hydrogen Fuel Could Eliminate Los Angeles Smog and State Taxes Within 10 Years: A hopeful scenario.

By: Paul Greenshields

Historians have labeled the present period the 'Petroleum Age'. Few people who witnessed the beginning of this awesome period in 1859 would have predicted such a short life span. Although the Petroleum Age is not officially dead, it will soon be replaced by the 'Hydrogen Age' and will usher in a new era of prosperity without pollution. In the beginning of the Hydrogen age the gradual phasing out of all fossil fuels (and their infrastructure) will eliminate smog; its many pollution related respiratory diseases will disappear.

Our present dependency upon gasoline and the profit motives of the existing fossil fuel energy industries are placing roadblocks in the way of a smooth transition. It will take a grass roots revolution to free us from this addiction to fuels that pollute our air and destroy the ozone layers that protect us from the sun's rays.

The necessary stages of development for leading us into the Hydrogen Age within a reasonable period of time are as follows:

1. *The universal recognition that there is a pollution-free fuel available and at an affordable price.* New industries are on the rise which are producing renewable fuels from agricultural biomass and wastes generated in densely populated areas. The almost limitless amounts of sewage and industrial wastes will be collected and used to make useful products such as fertilizers, feed supplements and most importantly, alternative fuels, such as hydrogen.

2. *To strategically place these biomass processing plants around the periphery of Los Angeles. They can either be municipal or privately*

owned. These plants will produce hydrogen fuel at a price lower than gasoline and reduce the need for landfill sites by processing biodegradable wastes at the same time. Hydrogen gas, produced economically from these wastes will power the city transit system, school buses, city power stations, highway, police and fire department vehicles.

It will take five years (or longer) to convert all of the city's vehicles to hydrogen, but this alone will reduce pollution in L.A. by as much as 15%. Parallel to this development will be the expansion of hydrogen production at similiar plants in the County of L.A. to supply the growing number of hydrogen powered private and commercial vehicles.

In the year 2000, legislation will be introduced in California to eliminate the use of fossil fuels in vehicles by the year 2010, thereby eliminating smog and drastically reducing respiratory diseases.

Conversion centers will be installed at most garages, allowing everyone easy access to mechanics who can convert cars and trucks to burn hydrogen fuel.

Also there will be pollution-free zones within the city limits reserved exclusively for zero emission vehicles powered by fuel cells or hydrogen

engines. These zones will be expanded over a 10 year period until the entire county, if not the state, will be pollution-free. Within that period, hydrogen fuel would be available at every filling station through existing natural gas pipelines, and will be used to carry hydrogen gas to every home and factory.

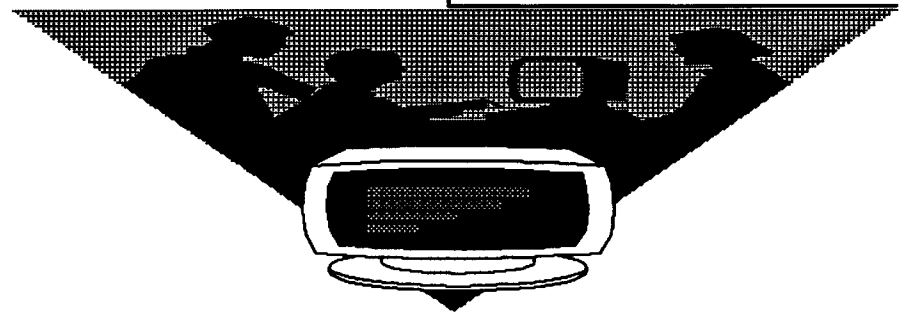
Theoretically, IF the State of California goes into the hydrogen production business using this scenario, sufficient income will be generated to eliminate state taxes and create thousands of new jobs. Private industry can achieve the same results, perhaps even sooner.

Even before California becomes the first pollution-free state, the hydrogen revolution will spill over into the other states and, in time, the world. The fossil fuel vehicle must become a relic of the past. Then this, is truly the beginning of the Hydrogen Age. A revolution worth supporting.

ENTHUSIASM

Enthusiasts are fighters, They have fortitude. They have staying qualities, Enthusiasm is at the bottom of all progress - with it there is accomplishment, without it there are only alibis.

Henry Ford's Fireplace Motto



CHECK OUT AHA ON THE WEB!
WWW [HTTP://WWW.GETNET.COM/CHARITY/AHA](http://www.getnet.com/charity/aha)

Hydrogen Politics

Microorganism's genetic information yields surprises:

Continue from page 4.

biology before," Venter said. "This brings to closure the question of whether archaea are separate and distinct life forms." Scientists previously believed that a microorganism with such a small genome (1,760 genes) would contain much more known genetic information, but instead the unexpected genetic information is of great interest because it will allow scientists to understand more about the operation and functions of the cell, the fundamental unit of all life.

Besides archaea, the other two major groups of life are bacteria and the more complex "eukaryotes," which include plants, animals and humans. Formerly known as archaeobacteria, archaea are believed to have separated from true bacteria over three billion years ago.

U.S. Supports Carbon Dioxide Reductions at Climate Change Conference

By: Sherwin Berger

On July 18, 1996 at Geneva, Switzerland, Timothy Wirth, the U.S. Under Secretary for Global Affairs, issued a spirited statement in defense of the Intergovernmental Panel on Climate Change (IPCC), their recommendations, and in particular the position of the U.S. within that body.

Mr. Wirth's remarks were blunt in defense of the IPCC findings and critical of those who were derogatory in their response to the scientific efforts on which the findings were based. He said, "We are not swayed by and strongly object to the recent allegations about the integrity of the IPCC's conclusions. The concerns were raised not by the scientists involved in the IPCC, not by participating governments, but rather by naysayers and special interests bent on belittling, attacking and obfuscating climate change science... there can be no question but that the IPCC's findings meet the highest standards of scientific integrity."

Despite Mr. Wirth's positive tone, nagging questions remain regarding the speed of selecting reliable joint implementation measures and the use of trading mechanisms (trading of pollution permits). Mr. Wirth left the impression that the U.S. was claiming the middle ground between a 20% reduction of 1990 emissions levels by the year 2000, as proposed by the Alliance of Small Island States, concerned about rising sea levels as the planet warms, and at the other extreme the oil-producing states of Saudi Arabia, Kuwait and

other OPEC members who denigrate any warnings or scientific evidence proposed by the world community.

The Under Secretary spoke of a non-specific medium-term emissions target for which the U.S. will seek a binding international agreement to combat global warming. Current recommendations are not binding. He also stated, "In addition, our view is that it will be necessary to continue working toward a longer term concentration goal (e.g. for the next 50-100 years), as set out in the Convention's objective, recognizing that scientific understanding and technology will improve over time. Working toward such a goal would better establish the long-term, global nature of the problem."

Editor's note: Mr. Wirth's statements are welcomed, long overdue but are still terribly shortsighted with relation to the only viable solution at hand that could impact carbon dioxide reductions and other climate change anomalies with much greater speed and effectiveness than any current or future proposals. A vigorous and dedicated commitment to rapidly phasing out the use of finite fossil fuels for energy purposes while transitioning to hydrogen energy systems to replace fossil fuels is in total harmony with the spirit and intent of the Convention. The concept of a 50-100 year period for fine tuning our concentration goals of permissible emissions levels is at total variance with the facts. There is insufficient oil in the earth's crust to

Continued on page 12.

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ENVIRONMENTAL ORGANIZATIONS' PLEDGE

BY: TOM DICKERMAN

**50 San Miguel Ave
Daly City, CA 94015
(415) 992-3963**

WE, THE UNDERSIGNED representatives and leaders of our respective _____
_____ (environmental or other non-profit) organizations,
commit ourselves, and our organizations to the urgent and essential project of ending America's
dependence on imported foreign oil. We pledge our effort to eliminating the waste and pollution of fossil
fuel burning upon Earth.

The use of fossil fuels is the major cause of manmade air pollution. It contributes greatly to the carbon
dioxide, particulate matter, and ozone-depleting chemicals in the atmosphere.

The production, transportation, storage and disposal of fossil fuels are major contributors to pollution
of air, land and water resources in America and of the world. These materials have contributed to the
death of many people as well as animals and plants. Evidence suggests that such pollutants are major
contributors to global warming and global climate change.

It is recognized that American oil production is in decline, due to depletion. America now imports
more than half of the oil it consumes. Increasingly, this oil comes from the most politically-volatile area
of the world: the Persian Gulf area. A major supply interruption could occur at any time.

In addition to the high cost of environmental degradation, importing oil costs America one billion
dollars every five days, sapping our economy, and our ability to create jobs.

We hereby commit ourselves and the resources of our organizations to working with like-minded
people and organizations, through our memberships and the political process, to bring about the will to
transform American energy systems to renewable resources.

We must make every effort to create a conservation ethic with the public, and champion sustainability
as a way of life. Technologies, which improve the efficiencies of energy use, should be implemented to
help stretch scarce fossil energy resources until sustainable resources carry the load.

We believe that, in the longer term, the only energy available will be that produced from sustainable
energy generators. America needs to make the development of sustainable energy systems a high priority
now, so they will become available before the depletion of fossil reserves result in reduced energy
supplies, inflation and hardships.

We, believe that sustainable energy systems warrant long-term investment, because they hold the
promise of clean, efficient energy generation, capable of meeting all our needs for many, many years to
come.

Signature/Organization

As an individual you may wish to sign and send this pledge to your legislators.

UNIVERSAL PLEDGE FOR THE NONVIOLENT RESOLUTION OF CONFLICT

By: Joseph Dillard

If there be righteousness in the heart, there will be beauty in the character.

If there be beauty in the character, there will be harmony in the home.

If there be harmony in the home, there will be order in the nation.

If there be order in the nation, there will be peace in the world.

As the dawn of a new millennium approaches, we survey the history of man and find the broken bones of countless proud civilizations scattered across four thousand years. And still the world is yet to see its first civilization worthy of the word "civilized" — a community of persons who value the sanctity of life above all else, who treat one another with civility and who refuse to abuse or kill one another in war. Will the United States be remembered as the last of the inhumane civilizations or the heart of the first true civilization?

Of all the pressing priorities in the world, feeding children, reducing crime, providing employment, eliminating fossil fuel burning, resource depletion, ensuring individual rights, eliminating poverty and illness, controlling the Earth's population, none is more important than eliminating war.

We are on the brink of war with Iraq over oil security. War, which is always fought in the name of security, is the elimination of security. In war, the innocent always suffer first and longest. War can erupt at any time and undo centuries of progress. As long as that possibility remains, progress in eliminating other pressing world problems can be extinguished overnight, as was the repository of the wisdom of the ancient world, the great Library of Alexandria. The advances of science can all be wiped off the face of the Earth by war. Nothing else has the power to do such horrendous damage to humanity.

There are several common rationalizations used to justify war. Jesus said, "There will be wars and rumors of war." It is said that those who are not prepared to defend their liberty have to be prepared to lose it at any time. As Thrasylbulus argued with Socrates in Athens millennia ago, "Might makes right." If you get rid of arms, only the thugs of the world will have them; everyone will be easy prey. In addition, the defense industry creates jobs. Those who financially benefit from the "defense industry" are powerful lobbyists. But the most fundamental rationalizations used to justify war are fear of persecution, religion, economics, enslavement, and death.

Rules continue to be legislated and agreed upon

internationally that reduce the scope of war based on the self interest of nations and a higher moral standard. This is what has happened with nuclear testing, with certain categories of nuclear weapons, with chemical and biological weapons, and with some land mines. There is a slow march toward tightening the rules of engagement and lessening the bloodshed of war. The eventual goal is clear, the road to its accomplishment is well marked, what is lacking is the public will to hasten the pace. Leaders require a clear sense that walking down the road to peace is the fundamental civil priority and that the time to act is now.

Part of the resistance to the elimination of war lies in our cultural values. When our differences outweigh our similarities, abuse often follows. When land, resources and riches are more valuable than the sanctity of human life, war has often followed. When the good of one's country is placed before the good of the whole, war seems to follow, sooner or later. The decision to choose to resolve conflict nonviolently is basically a decision to place the sanctity of human life before all other values.

What we want to eradicate when we speak of eliminating war is one particularly violent form of social conflict. It is about changing the rules of the game so that conflicts are resolved without bloodshed. A system of punishment of violations must exist that all parties agree is equitable and effective. It is not enough to eliminate the seeds of war psychologically; we must also plant the seeds of inner peace. We must love, teach, and protect those in our care. Peace is an active, assertive and vigilant stance which requires specific and definite actions from people.

The social mechanisms for resolving conflict without bloodshed are well known and are variously called assertiveness training, conflict resolution, grievance procedures, diplomacy or treaty negotiation. How much more bloodletting will be required before we finally outlaw shedding blood as a legitimate means for nations to resolve conflict? Will refinements in the means of mass destruction destroy us before we can arouse ourselves from the slumber of our apathy?

continued on page 9.

continue from page 8.

Currently, our national fossil energy security is threatened and so we need to place our attention on committing ourselves to the *moral issue of giving up oil or destroying the OPEC countries*. In doing so, we will burn up the oil reserves at a faster rate, or if no war...at a slower pace. The U.S. is so addicted to oil, that we the people have given our blessing to the politicians, CIA, and the armed services to attack any country that opposes our views on oil.

Using U.S. arms under the disguise of national interest cannot be tolerated. However a strong defense against aggression on U.S. soil is a legitimate use of power only after extensive and wise public debate.

We are at the end of the petroleum age. We can now clearly see the results of our experiment. We know we are polluting ourselves, killing the atmosphere and oceans, and eliminating the Earth's water, mineral and fossil fuel reserves.

People everywhere are being urged to publicly state what we and our leaders can do to make nonviolent conflict resolution and the elimination of war a reality for the world.

To receive a copy of the entire Pledge document, write to: The Pledge for the Nonviolent Resolution of Conflict (PNRC), P.O. Box 13872, Scottsdale, AZ 85262. The pledge also includes a statement on the elimination of abuse and violence on the streets of America.

Peace is a daily, a weekly, a monthly process, gradually changing opinions, slowly eroding old barriers, quietly building new structures. And however undramatic the pursuit of peace, that pursuit must go on.

**John F. Kennedy
UN General Assembly - 9-20-63**

**To: President Bill Clinton
From: Chuck Terrey**

Mr. President:

Can the world solve the global warming problem by limiting emissions of carbon dioxide?

In order to maintain the level of carbon dioxide at its current level, photosynthesis must remove CO₂ as fast as it is being added. The level of CO₂ emission in 1990 obviously exceeded the level at which photosynthesis can remove it. Reducing CO₂ to 1990 levels can not solve the global warming problem.

The earth has a lot of mass and it requires a lot of heat to raise the average temperature of the ocean even one degree. It is like a pot of water, it will come to a boil with a small or large flame. If the flame is large, it will boil sooner. It is not a question of how large the flame but how long it will take to come to a boil.

By burning carbon fossil resources for energy (not their best use), we have been turning up the flame for more than a century. In order to solve the global warming problem we must turn off the fossil-carbon flames completely. We must stop putting greenhouse gases into the atmosphere faster than they can be removed. Even if we stopped putting CO₂ into the atmosphere completely, it would take photosynthesis a long time to return the CO₂ to pre-industrial revolution levels.

To achieve a sustainable economy we must stop burning carbon fossils for energy. Ultimately the carbon fossils will be depleted to the point where they are no longer available for energy or any other use. Since our use of carbon fossils as fuel is on an exponential curve, the time to depletion is much nearer than we think. In the United States we will

burn as much oil in the last 40 months of the 20th century as we did in the first 40 years. In the next 30 years the world will burn twice as much oil as it did from the beginning of history to 1990. If the world cuts its consumption of oil to 1990 levels it will consume all of its 1000 billion barrels of oil reserves, (at 25 billion barrels per year) in 40 years. Sometime in the next 10 years the use of oil will be limited by production capabilities or political decisions of OPEC. Production of oil will peak and then gradually drop to a trickle sometime in the first quarter of the 21st century. If we do nothing the global warming problem will eventually cause dislocation and suffering on a massive scale.

The world must have energy in the form of fuel, if it is to prosper. It would be a shame, if you were known as the President who knew the world was running out of fuel and did nothing about it. I am writing to tell you about the urgency of making the transition to a source of energy in the form of renewable hydrogen that will end our use of carbon fossil for fuel. If we don't produce ample supplies of renewable energy, there are no solutions to our other problems.

It will require a man of vision to lead us through the next 4 years.

HEY BUDDY, CAN YOU SPARE A DAY TO SAVE CIVILIZATION?

"Millions long for immortality who don't know what to do with themselves on a rainy Sunday afternoon."

Susan Entz

Be a mortal who helps Civilization; donate time to help advance a Solar Hydrogen Economy and achieve sustainability. It is a sure way to be a part of immortality.

LOOKING AWAY: A PSYCHOLOGICAL LUXURY

By: Sherwin Berger

In a fascinating book entitled *In Quest of the Baboon*, author Hans Kummer says, "A person faced with a threatening baboon is safe if he pretends not to notice and casually blows the dust from his binoculars."

Until I read those words I hadn't given much thought to what my response might be to a wild baboon, a charging elephant, an irate water buffalo, a hungry grizzly bear or even an escaped boa constrictor. After all, I live in the Sonora Desert of Arizona where I tend to think more about indigenous fauna like scorpions, brown recluse spiders and once every ten years or so I let a thought about gila monsters float momentarily on my stream of consciousness.

What I do ruminate and fulminate about very frequently, one might even say continually, is the more dangerous realities of air pollution over Phoenix, what causes it and why there is so much general apathy and ignorance relating to cause and effect and cure.

Yes, there is much sound and fury about tail pipe emissions from our share of the 200,000,000 polluting vehicles in the United States. The nub of the problem lies buried much deeper than the simplistic truism that internal combustion engines create all manner of gross, pernicious pollutants that causes the brown cloud that so often adorns Phoenix and which also raises the carbon monoxide, ozone and particulate levels that trigger air pollution advisories and alerts.

Behind the obvious, or more accurately for this discussion, thousands of feet below the obvious "vehicle-emissions-pollution" scenario lies the quintessential question of Why, so late in this technologically sophisticated 20th century, we are sucking billions of barrels of 180 million year old oil out of the earth to burn in new cars? There are many suggested answers for the query but one that seemingly has not been explored relates to the baboons referred to in the opening sentence.

Among other provocative insights and enlightening tidbits of information, Hans Kummer indicates that the ancient Egyptians considered the hamadryas baboons as sacred. Some time later, in Medieval Europe, all primates were viewed as greedy, shameless and conceited. An interesting juxtaposition indeed - one that surely has its counterparts in a deadly serious, real life drama that is unfolding today and which is infinitely more momentous than defining baboons as deity or devil.

Meditating on the public's perception about oil companies and the oil products produced by them, the appellation of greedy, shameless and conceited may imbue some with a sense that they have hit on a definitive response

to the "WHY" question, while others consider sacred as an equally appealing adjective to define the oil companies, their ubiquitous products and the goods and services these products provide. In the tension between these widely disparate outlooks is the terrifying prospect that while we debate, a convergence of events is rushing to overtake us that will trivialize any consideration of who is right.

The reserves of oil that lie buried deep below ground are estimated by geological engineers at one trillion barrels of crude oil. This seems like a reassuringly huge amount until our euphoria is demolished by the demand portion of the energy equation. The world consumption of oil is at 25 billion barrels per year and increasing at 1 1/2% annually as population, worldwide industrialization and consumer demands increase. Simple calculations indicate that 40 years is the maximum time span in which we must initiate and complete a transition to an energy source that will efficiently take the place of all fossil fuels and nuclear power. Benign hydrogen represents the only response to the conundrum in which we seem inexorably mired. Without the intervention of a hydrogen energy system we are playing Russian roulette with all chambers loaded.

It is no longer rational to accept the tired, self-serving sophistry offered by giant corporations. To do so makes a mockery of those concepts that define us as decent, caring humans with better expectations for the future. A responsible stewardship for the planet and taking pride in leaving a legacy of humane sustainability are the sword and armor with which we do battle to defend and preserve the delights of our world for posterity.

Just as millions of ordinary citizens are aware of the evil nature of events rushing to overtake our children and grandchildren, so too industry must surely be aware. Yet, nothing is basically changing. Small nibbling around the edges of the pending catastrophe do virtually nothing to break the chain of tragic events that are demonstrated so graphically by the figures given above. The numbers originate with the Energy Information Administration and are not challenged by the oil industry; in fact their figures support those of the Energy Department.

If all this seems like a

continue to page 11.

continued: page 10

nightmare from which we will not awaken, you are correct as long as millions of citizens who are subliminally aware of the pending catastrophe continue to look the other way.

This brings me back to the book that precipitated this essay. In his study of the hamadryas baboon, Kummer had occasion to transport two males in a cage five feet long. Avoiding eye contact, they turned away from each other, thus preventing a terrible conflict from which neither would emerge as clear cut victor. This species of baboon evolved this *avoidance behavior* as a method of survival under the environmental conditions which govern their lives. The situation with humans "looking away" when conditions elicit profound apprehension is avoidance of another kind. This is a psychological luxury in which we can no longer indulge when the consequences of burning and depleting fossil fuels emerges as such a horrifying spectacle.

Energy providers look away and attempt to lull us into a sense of "all is well" with their carefully rehearsed script that attacks all who criticize their tactics as being prophets

of doom. Energy consumers, long aware of oil spills, pollution, drilling platform accidents, fires at refineries, oil well fires, hundreds of thousands of leaking fuel storage tanks and other environmental horrors, look away and repeat their carefully rehearsed script that takes the defeatist position that nothing can be done because the energy consortium has the power, influence and money to do anything they wish. Both are wrong!

Energy consumers have the power to reclaim their individual and collective rights through potent citizen actions that demand responsible conduct on the part of corporations who, not so incidentally, the consumers support. But, if we persist in our peculiar type of avoidance behavior we are no smarter than baboons. The baboons developed their behavior patterns to protect against mutually assured injury or death. Are baboons really smarter than humans or can we catch up?

Subsidizing Big Oil's Foreign Investment: Importing Oil, Exporting Jobs and Making War...Creates a Huge National Debt for the U.S. by: Staff Writer

Manipulation of energy supplies, pricing and their true costs is an ongoing project of gaint oil corporations who want the public to know as little as possible about the subsidies for products they use. Their actions result in supportive legislation in the form of tax credits, subsidies and other preferred treatment (i.e. EPA regulations). The problem is exacerbated by tinkering with rates of growth in Gross Domestic Product (GDP) and with interest rates.

Criticism comes from many quarters, two view points have been selected below to give an overview of a truly critical situation that taxpayers should be made aware. The issue receives virtually no media coverage even though it is much more important than most of the repetitive stories to which we are continually subjected.

Tanzi West and Ed Rothschild of Citizen Action (202) 775-1580 write about the susidies that are given to big corporations: "Multi-billion dollar taxpayer subsidies encourage major

U.S. based oil companies to invest in high-risk oil drilling, and foreign ventures that shift jobs overseas, making Americans more dependent on oil imports, and increasing the national trade deficit. With oil company foreign tax credits, U.S. taxpayers are on the line for nearly \$8 billion of government underwriting for the high-risk ventures of U.S. oil companies and other multinationals. Military expenditures of roughly \$50 billion a year are required to defend the Middle East. The U.S. government is providing an expensive welfare program to encourage major U.S. multinational oil companies to produce foreign oil at the expense of domestic energy."

Another cost according to Chuck Terrey of AHA, "that producing goods and services (GDP) with cheap energy is the root cause of the Fed's action to control Gross Domestic Product at 2.3%. This is 2/3 the historic growth rate of 3.4%

adjusted for inflation from 1870 to 1973."

1973 marks the year the Feds reduced its growth target on GDP to 2.3% in an effort to conserve domestic oil supply. In 1979 the Fed's pushed the prime rate to 21% because of the oil energy crisis created by Iran; all interest rates followed. This is the root cause of the huge national debt and deficit. Homelessness and the flow of jobs overseas were a direct result of lower interest rates and cheap labor in other countries.

Currently, to ease the price of heating oil and to pay for the interest of the national debt, the DOE is now planning to sell some of the Strategic Petroleum Reserves, timber, gold and silver. Last year, the government borrowed money from the pension plans to meet the dead-line on the interest payment, then in November - March sold the reserves for cash to pay back the pension plans.

The U.S. will have sold off half of the Strategic Petroleum Reserve in just two years. The U.S. must reverse these trends by replacing petroleum with renewable energy resources.

SCOTTSDALE PARTNERS WITH AHA

By: Roy E. McAlister, President of AHA

Scottsdale, Arizona, already proclaimed as the "Most Livable City" by the U.S. Conference of Mayors, is implementing dozens of measures to improve air quality. To reduce hydrocarbons, oxides of nitrogen and carbon monoxide, the city is requiring citizens to replace gasoline fueled lawnmowers with pollution-free lawnmowers. During pollution alerts, fireplaces and barbecues are restricted to carbon-free fuels. The only fuel that qualifies as carbon-free is hydrogen.

For decades Scottsdale has been an important leader in the advancement of vehicles that use compressed natural gas (CNG) and now plans to work with the American Hydrogen Association to develop "minus emissions vehicles" (MEVs). "Minus emissions" results from various uses of hydrogen and/ or methane that would have been released from landfills.

Illustratively, substitution of landfill methane for gasoline provides one step in the minus emissions program and eliminates the carbon dioxide and other pollutive emissions that would have been released from the combustion of gasoline. Elimination of the release of landfill methane into the atmosphere is another important step because the carbon dioxide produced by burning the methane is about 70 times less harmful as a greenhouse gas than the raw methane.

Even greater "minus emissions" benefits will be demonstrated by Scottsdale/AHA cooperative efforts aimed at producing hydrogen from landfill biomass. Sunlight will be concentrated sufficiently to cause biomass molecules to break apart. This allows hydrogen to be extracted from methane and other waste

hydrocarbons. The hydrogen can be used in vehicles that cleans the air through which they travel. Carbon that is released by the dehydrogenation process will be used to stimulate economic development with products ranging from safer low-curb weight cars and water filters to golf clubs.

Adding hydrogen and substituting landfill methane in Scottsdale's existing fleet of CNG vehicles will be closely monitored to determine the best approaches for maximizing the "minus emissions" result. The best approaches will be analyzed and demonstrated in workshops and classes that are provided to scholars and business leaders from all over the world. The Scottsdale/AHA minus emissions projects are envisioned as the founding efforts for development of an "Environmental Technology Academy" which will emphasize the efforts of Scottsdale and surrounding communities as living laboratories for scientifically advancing clean air and sustainable economy concepts.

continued from page 3.

Fuel cell technology explained: more compact, higher-range transportation applications.

Leading companies in these type of fuel cell developments in the U.S. are United Technologies Corp., Dow Chemical, General Motors, DuPont Chemicals, AlliedSignal, H-Power, Roger Billings "LaserCel", and Energy Partners of Florida. In addition, Ballard Technologies of Canada, Vickers Ship Building & Engineering of England, and Daimler-Benz of Germany have significant proton-exchange fuel cell development programs.

Carbon Dioxide Reductions at Climate Change Conference:

continued from page 6.

support continued use of petroleum.

In 50 years, the planet will not even be able to support the transportation sector with the use of fossil fuels. It takes 50 years after introducing pollutants for the atmosphere to cleanse itself of the fossil fuel insult. Right now our atmosphere is being damaged by the 1960's use of fossil fuels. Mr. Wirth believes "scientific understanding and technology will improve over time" to better define concentration goals. That appears inconsistent with his other expressions of urgency and commitment to "realistic, verifiable and binding" targets.

Clean burning, inexhaustible hydrogen would eliminate all these problems while also promoting the preservation of finite fossil fuels for their thousands of other essential uses. If Mr. Wirth is aware of advanced hydrogen technologies and their ability to defuse the entire global climate change crisis, he shows no indication of such knowledge.

The AHA stands ready and indeed anxious to assist Mr. Wirth or any other interested parties with advanced information and experience to help in implementing safe, viable, large scale production facilities for hydrogen together with data on its transport, storage and end uses.

A joint program to develop a road vehicle powered by a proton-exchange fuel cell has been announced by the U.S. Department of Energy (D.O.E.), Los Alamos National Laboratory, and United Technologies Corp. Hydrogen will be produced from Methanol or petroleum gas using light-weight reformers. General Motors has announced a similar program to produce hydrogen for fuel cells using

MESA, AZ TO TESTING FUEL CELLS FOR USE IN CITY BUILDINGS

By: Staff Writers

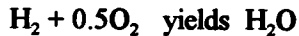
The U.S. DOE awarded the city of Mesa, Arizona a \$200,000 grant to plan a \$600,000 pilot program to use a 200 kilowatt fuel cell to power a new utility building. The unit will supply electrical power needed in the office building that houses 200 city employees.

The city's pilot program is intended to demonstrate the quality, reliability, and safety of the technology. The project is similar to a 2 megawatt unit in Santa Clara, California.

Fuel cells produce electricity without combustion by controlling the chemical reaction of hydrogen and oxygen. Pure hydrogen is not distributed widely by pipelines, so most fuel cells use hydrocarbons such as natural gas. If a hydrocarbon like methane is used, the carbon is usually stripped off by a reaction with water to release hydrogen:



The oxygen is free. Air offers an ample supply of oxygen which is circulated through the fuel cell to replenish the oxygen and remove water that is formed in the following fuel cell reaction:

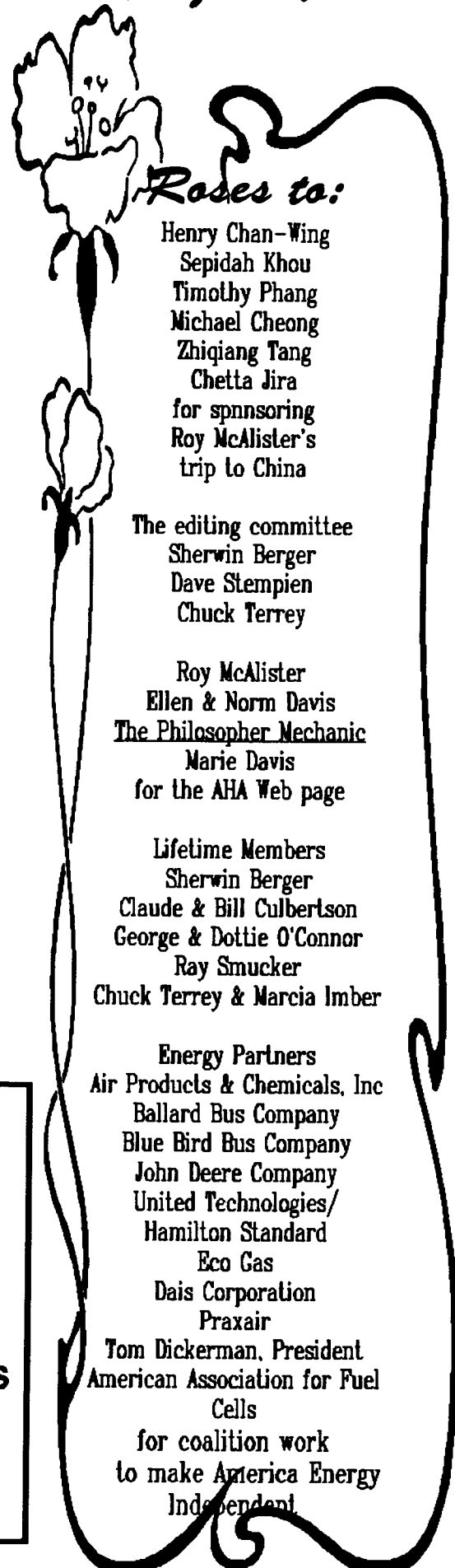


The fuel cell chemical processes produce heat, electricity and a small amount of potable water as by-products. This process in a modern fuel cell system creates less noise, vibration, and pollution than most engines that use hydrocarbon fuels.

The units planned for the Mesa utilities building would be about the size of a cargo box on a semi-trailer truck. With the proper maintenance, the unit should last about 20 years.

Editor's note:

It should be noted with respect to fuel cell operation that using hydrogen is the key to success. Making hydrogen from hydrocarbons should be the first step for greatly reducing the emissions from conventional engines. If conventional piston and gas turbine engines were operated on hydrogen instead of hydrocarbons, they too would have greatly reduced emissions and last longer.



Roses to:

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Daimler-Benz Fuel-Cell Van...NECAR II

By: Roy E. McAlister

The newest fuel cell minivan has a range of 150 miles and reaches speeds over 60 miles per hour. NECAR II is a demonstration vehicle powered by two 25-kilowatt Proton Exchange Membrane (PEM) fuel cells which are fueled by pressurized hydrogen gas.

The two fuel cells that power NECAR II are small enough to fit under the floor of a minivan or in the storage compartment behind a rear seat. This gives NECAR II virtually the same interior space as a fossil fueled vehicle.

The fuel cell was developed by Ballard and Daimler-Benz. Ballard's PEM uses a polymer foil membrane to separate the hydrogen and oxygen. Although the temperatures reach 212° F, the foil membrane prevents combustion and catalyzes the ion-exchange that generates electricity. The only emission is water vapor.

Each two fuel cell stack consists of 150 individual cells and the stack measures about 25 x 25 x 50 centimeters and produces 25 kilowatts at 0.7 volts and an operating efficiency of about 40-60%.

The pressurized hydrogen fuel is carried in two carbon fiber-reinforced plastic tanks made by Canada's EDO Corporation. The tanks are mounted on the roof of the van. Each tank holds 140 liters of compressed hydrogen...50% more hydrogen than the glass fiber-reinforced aluminum tanks of the earlier NECAR vehicle (Mercedes Benz (MB) 180BZ) demonstrated two years ago and are at the same time 20% lighter.

The drive motor is a three-phase asynchronous-drive 33-kilowatt unit coupled to a two-speed electrically controlled automatic transmission.

The NECAR II electronics system has been compacted to a single control board roughly the size of an 8.5 x 11 inch sheet of paper. The entire vehicle management electronics, which is the MB 180BZ filled a voluminous box, is now housed on a single weight saving DIN A 4 sized plate.

The air circulation fan features a reluctance motor developed by Daimler-Benz research. A major advantage of this lightweight, compact motor is improved efficiency in contrast to traditional electric motors.

Energy recovery from the exhaust gas ensures that air can be supplied to the fuel cells using a

minimal amount of energy. In particular, the long experience of the Mercedes-Benz development department with heat exchanger and compressor technology proved very valuable.

Further innovations include the new silencers, which reduce the already scarcely audible noise of the compressor, electric steering assistance, and a new, automatic two-speed gear box.

Daimler-Benz researchers are working on new developments aimed at making the fuel cell vehicle even more efficient, lighter, and simpler. It is envisaged that the next generation of research vehicles will produce the hydrogen on board from methane. This would have the advantage that an ordinary fuel tank could be used, and that the driver could fill up with fuel in the same way as with conventional fuels. The existing infrastructure of filling stations and fuel pumps could thus be adapted at relatively little expense.

“The Philosopher Mechanic”

Written by: Roy E. McAlister, P.E.

President of the American Hydrogen Association

AHA's class notes for converting your car to hydrogen and/or other alternative fuels are available for you to study before taking the course. These class notes are dedicated to the *philosopher mechanics* who will change the world, one car at a time until the economy is sustainable and the air is clean. The class instructors, Claude Culbertson, Mel Larsen, Clare VanAusdal, Bill Wray and Roy McAlister, have been using these course notes to provide readers with many answers to the “how and why” questions.

These notes are used as a guide and reference to equipment that you study when you take the auto conversion class at AHA. The price of the short course is \$225.00 for members and \$400.00 for non-members. The price of the *Philosopher Mechanic* class notes is \$35.00, plus \$3.00 shipping. The next short course is scheduled for February 8-9, 1997 at AHA's shop and on the second day we will cook lunch with hydrogen.

So you want to hear some philosophy and learn how to convert your car to a Minus Emissions Vehicle or MEV, take the short course! *“No matter how much money is printed, it and all the kings men will not overcome the looming hardships that we are creating by remaining dependent upon diminishing fossil reserves.”*

Civilization must focus on the Grand Purpose of achieving pollution-free stainability. Become the philosopher mechanic with the Grand Purpose of providing Civilization with practical, peaceful, healthful, safer, and satisfying ways to escape from the fossil fuel trap of depletion and pollution and to achieve a wealth-addition economy.

CONFERENCE PLANS UNDERWAY: *Investment Potential in Emerging Hydrogen Technologies Featured:*

By: Sherwin Berger

A paradigm shift in the technological marketplace is quietly unfolding. In its ultimate manifestations it will eclipse in scope and universal significance anything currently being discussed in financial and investment circles. Rapid growth industries like banking, computer software, biotechnology, the entertainment industry, wireless electronics, etc., will all take second place to this vibrant new industry. That such a revolutionary pattern of change will take place can hardly be debated in light of compelling need, widespread recognition for the change and the historical and accelerating record of seminal economic events that are even now unfolding and jeopardizing continued energy utilization.

Energy is the bedrock foundation on which all societies are built. In every modern society energy is the lifeblood of economic development; it is the one ingredient without which our ability to produce, to compete on world markets, or most importantly, to meet the basic needs of our citizens would be suicidally compromised. Readers of *Hydrogen Today* are already aware of how current energy systems have invaded our security and how pathetically thin is the time line for transition to and full implementation of clean hydrogen energy systems.

The advent of the Industrial Revolution together with its characteristic form of energy usage brought enormous changes in the way goods and services were marketed to the general population. Machine and factory production quickly replaced the more labor intensive handicrafts method of producing goods. Besides the wealthy industrialists who reaped gigantic profits and built business empires that still exist today, there was a general unleashing of entrepreneurial spirit that sparked thousands of smaller firms who utilized the new and emerging technologies to create successful enterprises that added to the burgeoning growth of commerce and industry.

The first Industrial Revolution, the one we are still experiencing now, is based upon the exploitation of finite natural resources. While it accomplished many wondrous results it was at a ghastly price in pollution, health problems, irreplaceable resource depletion and life-threatening environmental problems. Today all these alarming problems are proceeding at an accelerating pace to meet the demands of an ever expanding worldwide market. *But now a new global phenomenon is about to take center stage - a transition from a filth-producing revolution to a clean, renewables revolution is even now capturing the imagination and dedication of millions everywhere who yearn for and demand sane economic policies. Sane, as in the subtitle of E.F. Schumacher's visionary book, Small is Beautiful: Economics as if People Mattered.*

The capital needed to build

companies of all sizes and all types during the Industrial Revolution also saw a parallel growth in stock exchanges that enabled the public to invest in new industries. Until then average folk had little interest and even less opportunity to become involved in ownership potential leading to participation in an entirely new way. Today, the public interest level in this type of investment has grown, here and abroad, and has become an economic force enabling much of what happens in the business community to proceed at an ever accelerating pace. Now, people are conscious of investments on a scale that is truly astonishing. Mutual funds, IRA's Keogh Plans, annuities, treasury instruments, etc., are all flourishing. Bond and stock issues are actively traded every day and have indeed reached historic highs.

Always mindful of the spectacular performance of stocks like IBM, Xerox, Apple and Microsoft, all of whom brought radical insights to technological excellence, there are those who seek opportunities about which most people are not yet aware. *Hydrogen technologies represent a new, unheralded wave of extraordinary growth and financial potential.* All levels of participation will develop. Some will seek out possibilities for investing in or completely financing firms that have no existing product but have the ideas and/or patents that are tremendously exciting in their ability to generate monetary miracles. Others will gravitate to possibilities inherent in products already being manufactured as finished marketable items or as vastly improved components that will greatly accelerate the growth and

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MEMBER'S FORUM

implementation of remarkable developments. For sophisticated investors and neophytes, the emerging hydrogen technologies represent the most stunning, most far reaching developments ever conceived by a modern society.

What is about to unfold is a flowering not only of technological developments of immense importance in themselves but vastly more significant will be a *fundamental reversal of attitudes* that have locked us into acceptance of ugly, dehumanizing methodologies that have plagued us for the past 250 years. The transition from a dirty, polluting, resource-depleting, planet-threatening Industrial Revolution to a *Second, Clean, Industrial Revolution* will completely replace the already antiquated, inadequate and ill-advised energy systems in use today. This sweeping change will not only be away from fossil fuels and nuclear power but also toward a new Rosetta Stone of energy production and utilization that will unlock and stimulate a tidal wave of innovation and invention more significant than any technological expansion that preceded it. *This is a revolution that will be imprinted with the universal social approbation so often lacking in other momentous change.* The financial track for attracting capital to speed development of a radically new energy infrastructure must be promoted with a special vigor and dedication.

To bring meaningful data and updated information to interested individuals, investors and businesses the American Hydrogen Association is planning a major conference that will address the unique investment potential in hydrogen technologies. Exhibits representative of exciting new products already in production or on the drawing board will also be featured. Exciting speakers from

diverse segments of the industry will enlarge upon new developments and their effects on the public, businesses and investors in the 21st century. The impetus for broadening the scope of capital formation in this dramatic new market will, in large measure, stem from the recognition of those who are inspired and motivated by knowledge of the hydrogen revolution with all that it portends for a vibrant future of prosperity without pollution. Attending this upcoming conference, in addition to taking advantage of the many activities of the American Hydrogen Association, represents the most advantageous vehicles for expanding factual information and general understanding so necessary for future investment rewards in emerging hydrogen technologies.

The date for the conference has not yet been determined but those who have learned of our plans have expressed great excitement and interest about such a provocative event. As additional plans unfold, details will be announced in this newsletter. Stay tuned - there are stimulating times ahead.

Hydrogen Hannah

by Kathy McAlister

The Purple Storm, written by Ann Hoffmann and illustrated by Elizabeth Ann Safian was generously donated to 100 schools in Arizona by George O'Connor, funding director for AHA. This childrens' story book is about Hannah, Ann's niece who lives in Scottsdale, Arizona. Hannah loves horses and is caught in a purple storm with her friend. They weather the storm and strengthen their friendship.

Mr. O'Connor has commissioned Ann Hoffmann to write a new book on busting the "brown cloud" with hydrogen. The "brown cloud" is the

name given to describe the cloud of smog that hangs over urban areas and is caused by vehicle emissions. The project name is "Hydrogen Hannah" and will have Hannah of the *Purple Storm* as the main character. The book will be published about Earth Day '97.

George O'Connor has funded the project with a restricted donation for Hydrogen Hannah. The text has been written for 3rd-5th grade level. Thank you Ann and George. Write or call AHA (602) 921-0433 if you would like to buy a copy of *Hydrogen Hannah* or to contribute to AHA's educational programs.

AHA WINS AGAIN

As *Hydrogen Today* was about to go to press, we were notified that AHA had won the prestigious Arizona Pollution Prevention Leadership Award (APPLE), given annually by the Arizona Department of Environmental Quality (ADEQ).

On Nov. 21, 1996 at the Haz Waste '96 Symposium, Mr. Russell Rhoades, Director of ADEQ will make a formal presentation to AHA at the Arizona Biltmore Conference Center.

LEADERSHIP ...

"A Leader discovers the hidden chasm between where things are and where things would better be, and strings up a makeshift bridge to attempt the crossing. From the other side, they guide those who dare to cross this rickety traverse until the engineers can build a sturdier span for all."

...Mel Zeigler

WATER POWER

By: Robert Frenay, Audubon Society

FOR THOSE who care about nature, the routine announcement that a Canadian underwriting group had purchased \$27 million worth of Ballard Power Systems stock should have been front-page news.

The Vancouver-based company will use the money to commercialize hydrogen fuel cells — silent, highly efficient power sources that operate with no moving parts and without combustion, and which have the potential to end industry's long dependence on carbon fuel. The announcement serves as one more piece of evidence that we are within reach of a world that borders on science fiction — where cars, home-heating units, and power-generation plants use water as fuel and release purified water as their only by-product.

Ballard is not alone in its efforts. Another private company, International Fuel Cells (IFC), has long provided hydrogen cells for the National Aeronautics and Space Administration (NASA). The water that Apollo astronauts drank on their way to the moon was produced by a hydrogen fuel cell that also electrified their instruments. To date, IFC co-generating power plants have logged more than 950,000 hours of operation for both the Department of Defense and the private sector.

Ballard and IFC, though currently the leaders, are being challenged by a host of ambitious start-up companies and by major corporations such as AlliedSignal Aerospace, General Motors, Ford, and Chrysler. Undaunted, Ballard has entered into working agreements with Honda and with Daimler-Benz, which recently developed a Ballard cell small enough to fit under the hood of a midsize car.

There are currently five types of fuel cells, all using variations of the same principle. Ballard favors a small, solid core design — called a proton-exchange membrane, or PEM — which runs at temperatures below boiling and is probably the best choice for motor vehicles. In a PEM cell, hydrogen is fed into one side of a central core that is halved by a proton-permeable membrane. When air is fed into the other side, hydrogen protons migrate through the membrane to bond with the air's oxygen and form water. As that happens, the newly freed hydrogen electrons, which remain behind, are drawn to a metal electrode, creating a charge that can be used for power.

Water can be split into hydrogen and oxygen to animate a PEM cell and then recombined into water as part of a virtually clean process. Although water-splitting devices are not yet marketable, the cascade of advances now taking place with fuel cells — as well as successful efforts to convert combustion engines to hydrogen fuel — are spurring innovation. Development is also being pushed by a dramatic rise in demand: The National Hydrogen Association says that the United States now produces some 100 billion cubic feet of hydrogen each year, mostly for industrial use. Within a decade that figure is expected to double.

Major production and cost questions remain, but perhaps the largest hurdle to an economy based on hydrogen is the lack of infrastructure for its distribution and safe storage. But according to *Harnessing Hydrogen: The Key to Sustainable Transportation*, by James Cannon of the environmental research group Inform, there are now 1.3 million miles of natural gas pipelines in the United States that could be modified to carry hydrogen.

Other approaches involve localizing production. These range from home reformers — which would allow commuters to split a day's hydrogen fuel out in the garage, from their own water supply — to on-board processors that could convert hydrogen from feedstocks such as natural gas, methanol, or gasoline while a car is being driven. Safety questions about storing a gas as volatile as hydrogen are being answered with new tanks that absorb the gas into metal hydrides, which then release it as needed. Engineers at California's Lawrence Livermore National Laboratory have found that tiny glass bubbles absorb hydrogen at pressures of 9,000 pounds per square inch, then release it when crushed or heated.

How close is this dream to reality? A recent issue of the *Hydrogen & Fuel Cell Letter* speculated that General Motors would demonstrate a fuel-cell car as soon as 1997; reported that a remotely piloted, solar- and fuel-cell powered plane designed for NASA has already sailed higher than 50,000 feet; and said that by this summer Chicago commuters will be able to ride to work on one of three experimental buses powered by Ballard's PEMs (A Chicago newspaper recently showed a picture of Mayor Richard Daley chugalugging a glass of Ballard bus "exhaust").

Meanwhile, a "hydrogen corridor" is taking shape in the desert basin east of Los Angeles, where people have learned their air-quality lessons the hard way. The corridor's western reach is anchored in El Segundo by North America's largest solar converter of water into hydrogen — a \$2.5 million facility recently built for Xerox. A hundred miles to the east, the wealthy enclave of Palm Desert is working

continued from page 17.

to build small fleet of fuel-cell golf carts, which, if all goes well, could ultimately stand in for the family car on trips to the local supermarket or restaurant. The carts will be used to test a variety of power and storage systems. According to Paul Shillcock, the city's director of development, Palm Desert also hopes to build two fueling stations, which will use hydrogen produced with energy from a solar converter and from a large wind farm already in operation there. And he points to other hydrogen projects nearby, from the Los Angeles airport to Torrance to West Hollywood. In January, after a successful pilot project in Palm Desert, California, opened the door to other fuel-cell projects by legalizing the use of golf carts on local streets throughout the state.

Editor's note: Keeping Current with Hydrogen Developments:

Books, magazines, newspapers, the Internet and videos provide a broad spectrum of fascinating topics relating to environmental, geo-political, economic, social, atmospheric sciences and national security topics. These issues, generally considered the domain of specialized disciplines, actually have very direct and profound relationship with a transition to hydrogen energy systems.

Through book reviews, commentary and calling attention to dynamic strides being taken in any area that influences hydrogen developments, this "Member's Forum" column will strive to keep readers informed.

The article above, printed with permission from Audubon Magazine (May-June 1996) demonstrates how industrial firms and communities have grasped the value of hydrogen technologies and their role as center stage participants in reversing the

damage being done by mining and burning finite fossil fuels or by using nuclear energy. It is informative and encouraging to find a substantive article on hydrogen in a well respected national environmental publication. Thank you Audubon Society for your support and interest in renewable fuels for transportation.

Sherwin Berger

WHO WILL BE NEXT ON THE EXTINCTION LIST?

The main threat to quality of life on Earth is environmental degradation. Half of all the persons that ever lived on Earth are alive today, so why should we worry?

Accommodation of our large human population in the fossil-fueled search for happiness has resulted in tremendous disruption and degradation to the habitat of other life forms. According to George Rabb, director of Chicago's Brookfield Zoo, a total of 5,205 species are in endangered categories including 11 percent of the bird species, 20 percent of the reptile species, 25 percent of the amphibians, and 34% of the fish species. The U.S. ranks among the 20 countries with the most endangered species.

Some 44% of crocodile species are endangered and more than 100 species of marine fishes were added this year, including sharks, tuna, coral reef fish and sea horses.

Pollution of the environment is universally harmful to all life forms. Human species suffers losses in the quality of life, health, and wealth, when our animal and plant life is endangered or vulnerable to environmental degradation that results from fossil fuel burning. To achieve sustainability we must adopt clean, peaceful, renewable energy resources to replace fossil burning.

Humboldt State University Given \$4 Million Cash Gift for Schatz Energy Research Center:

By: Staff Writer

Schatz Energy Research Center (SERC) will be designing, building and operating a refueling station for a hydrogen-based transportation systems. This will include two hydrogen refueling stations. One station will be wind powered, while the second will be solar powered.

Another project will be to design, build and operate a fleet of personal utility vehicles and neighborhood electric vehicles powered by hydrogen-fueled PEM fuel cells. Various modes of onboard storage of hydrogen will be investigated in a companion project undertaken by Sandia National Laboratory. Special emphasis will be on research into new materials and techniques to lower manufacturing costs of the PEM fuel cells.

A diagnostic and service center will serve as an incubator to attract fuel cell manufacturing industry to the City of Palm Desert. The Palm Desert Fuel Cell Vehicle Project involves a consortium including the City of Palm Desert, DuPont, SERC and Lawrence Livermore National Laboratory.

Machining the future

Appropriate technology exists. Now, we need the tools and raw materials to advance educational efforts in Solar Hydrogen.

Do you have or do you know someone who has CNC or manual milling machines, lathes, or other machine shop equipment.

We also need steel tubing, barstock and materials ranging from engineering polymers to ceramics.

Please contact Norm Davis at AHA to arrange for donations.

Hydrogen For Sustainable Progress In China, By: Roy E. McAlister & Henry Chan-Wing

In September, several loyal members of the American Hydrogen Association sponsored travel for Roy McAlister to go to China to evaluate the environmental situation and prospects for advancing the Solar-Hydrogen Economy in Asia. These members, including the families of Henry Chan-Wing, Sepidah Khou, Timothy S. Phang, Michael Cheong, and Zhiqiang Tang, contributed much time, energy, and funding to make these travels possible. The American Hydrogen Association sincerely thanks everyone involved who made these trips a reality.

Seriously degraded environmental conditions were found in the major manufacturing centers that were visited. Prospects for advancing the Solar-Hydrogen Economy are favored by the general desire to curb pollution in China. However, formidable barriers exist and must be overcome if significant environmental improvement is to be achieved.

In China, the density of people per square mile is nearly five times higher than in the U.S. Motorized two-wheel scooters and bikes swarm through traffic in every city that we visited. A new veil of black and blue smoke is added as each stop light changes to green, and the two-stroke engines using mixtures of oil and gasoline are "revved." Motorized bike drivers and passengers learn to accelerate past slower traffic. Cars, with horns honking, fill the developing gaps in traffic, and are followed by trucks and buses belching diesel smoke. Peddled bikes and pedestrians race through the smoke to fill any space left on the roads. Although the entire Chinese vehicle count is less than 20 million compared to about 150 million in the U.S., - the Chinese have more than 272,000 traffic fatalities per year, about six times the number in the U.S.

China has 40 cities with populations over one million and far fewer paved roadways than cities with comparable populations in the West. To reduce traffic congestion and pollution, many cities such as Beijing limit vehicles with engines less than 1 liter to be used only on odd-numbered days, if the license number is odd, and on even-numbered days, if the license number is even.

Construction projects surround the highways in a struggle to fill any open space and to replace old buildings with new high rise buildings. At ground level, more smoke curls from restaurants and street vendors who burn wood, coal, and charcoal to cook Chinese style.

Interviews with students, professors and business leaders provided interesting perspectives on the all-day-long traffic rushes and high-pitched tempo of new

commerce within the context of labor-intensive public works. China is experiencing a commercialization revolution. In a reform program, China has started to experiment with privatization of 1,000 state-owned enterprises. This experiment will define the property rights and social responsibilities of privately held companies. This is a dramatic change from the policies that converted China's economy into a closed state-owned system from 1949 to 1978 when China initiated the present reform policies and opened its borders to outside commerce. Their reformation goal is to transform the country, with the world's largest population, from low-technology subsistence to a world-class economic giant.

These policy changes have allowed energetic entrepreneurs to become very wealthy. However, the poor particularly in rocky and desert areas of western China struggle to reach average annual income of 530 yuan, or (\$63) per year. It is estimated that China has more under-employed or unemployed persons than the entire U.S. population. The reform policy has brought much hope for getting rich quickly, regardless of the environmental consequences of burning coal. These circumstances would perhaps be more acceptable, if the clean and sustainable alternatives of renewable solar, wind, and falling water energy, along with hydrogen distribution systems were not better choices for immediate improvement. The primary problem is that very few of the persons that we met have heard of hydrogen.

Many of the Chinese expressed surprise or had little to say about personal health problems and the environmental impact that comes from burning sulfur-laden fossil fuels including leaded gasoline. Too often it seemed acceptable to them, if the environment was degraded, so long as they realized their goal of putting more food on the table and moving into a better home. In 1949 the life expectancy in China was 45 years. Today, it is 68 years for men and 71 years for women. But in spite of improved prospects for a longer life, a general discontent was evident regarding the lack of cars, TVs, fine homes, and other comforts of the West. This discontent and the struggle against starvation outweighs concerns about using coal as compared to clean fuel progress.

Now that they are living longer, the most prevalent hope for getting rich quickly seems to follow the thinking of peasants that migrated to the cities of Europe at the beginning of the Industrial Revolution. Chinese have learned how to make products in factories that use coal energy. But opening the

MEMBER'S FORUM

continued from page 19.

borders to the ideas of the modern West has enabled China to become the world's largest steel producer, while leapfrogging into the electronic age during the last 10 years. To achieve these accomplishments, China has increased its GNP at an average annual increase of 9.3 percent to develop an economy that is 2.8 times the GNP of only 15 years ago.

In order to achieve this revolution from state-owned enterprises to entrepreneur-driven enterprises, China has imitated Germany, USA, and Korea. This imitation assumes that burning lots of fossil fuel per capita will result in progress. China holds the world's record for burning coal, at more than a billion tons per year, yet endeavors to double consumption of this fossil fuel.

Our suggestion of leapfrogging to the Solar-Hydrogen Economy and leading the world in achieving sustainable prosperity without pollution was met with questions followed by a high degree of enthusiastic volunteerism. The Chinese are ready to go to work. In a communistic country, the primary question became "where do we report, to whom and what do we do." Much leadership is needed!!

In summary, manufacturing areas of China are experiencing severe environmental degradation. Unfortunately these situations will probably worsen as population increases and more fossil energy is consumed. China is striving to become a world class economic giant and like the West they have planned to burn all the fossil fuel that can be produced. Prospects for adopting a Solar-Hydrogen Economy depend on education and development of an infrastructure for producing and delivering hydrogen.

Gas Development Resources, Inc.

Gaseous Fuel Development and Utilization

"Developing American Fuels for a Clean Tomorrow"

Natural Gas, Hythane, Hydrogen, LNG, LH₂

8480 East Valley Road (520) 772-6000
Prescott Valley, Arizona 86312

TOOT! TOOT!

CLEAR THE LANES FOR HYDROGEN OPERATED VEHICLES! By: Roy E. McAlister & Sherwin Berger

After five years of effort the AHA is tooting its horn for achieving a major breakthrough with lawmakers who have finally recognized the merit of our entreaties.

If you thought HOV meant high occupancy vehicle, you were only partly correct. Now HOV has a new meaning. Hydrogen Operated Vehicle!

With the goal of achieving energy independence and curbing pollution, lawmakers have developed incentives to increase the rate of vehicle conversion to fuels that are produced in the U.S. If you convert your car to an alternative fuel, such as hydrogen, landfill gas, natural gas, ethanol or propane, you can get a \$1,000 Arizona tax credit. In Arizona, you can also get a \$1,000 grant for installing a refueling station at your home or business. If you build a larger refueling station for public use, Arizona will provide up to \$100,000 in grant funds.

After March of 1997, if you use alternative fuels, you can apply for a special license plate that allows you to drive in the HOV lane even if there is only a single occupant in the vehicle. Auto registration fees are already at rock bottom for alternatively fueled vehicle. These license taxes are reduced from 60% of the assessed value to 1% for alternative fueled vehicles.

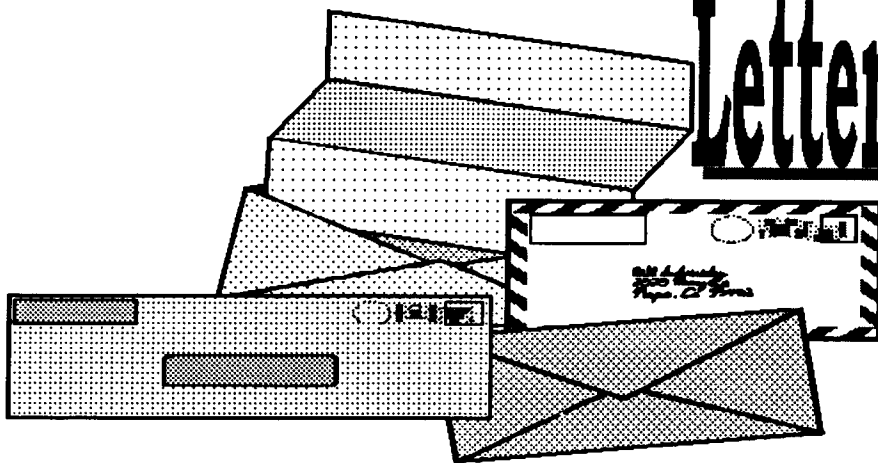
Federal incentives are also available. Up to \$2,000 can be taken as a federal income tax deduction over a three year period.

Courage

*It is not the critic who counts,
not the man who points out how the strong man stumbled
or where the doer of deeds could have
done them better.*

*The credit belongs to the man who is actually in
the arena; whose face is marred by dust
and sweat and blood;
who strives valiantly; who errs and comes up short again
and again; who knows the great enthusiasms,
the great devotions, and spends himself in a worthy cause;
who knows in the end the triumph of high achievements;
and who at the worst, if he fails,
at least fails while daring greatly;
so that his place shall never be with those cold
and timid souls who know neither
defeat nor victory.*

*Theodore Roosevelt
April 10, 1899*



Letters to the editor

Dear AHA,

Just a note to let you know about the outstanding performance of the Hy-Stor battery that Ergenics demonstrated for the electric and hybrid electric vehicles market. We have coupled the established know-how of high energy storage density of metal hydrides with high cycle life capabilities of nickel-hydrogen batteries.

The Hy-Stor battery offers safety, performance and economic advantages over lead-acid, nickel cadmium and nickel metal hydride batteries. The battery will provide much longer cycle life, much greater range between charge cycles, and greater temperature range of operation and substantial cost efficiency.

The Hy-Stor battery stores its hydrogen, at higher densities, in a chemical bond with powdered metal at ambient temperature and ambient or slightly lower pressures, thereby eliminating the safety hazards associated with highly pressurized gas tanks.

The other good news is that manufacturing the Hy-Stor battery is a very "clean" process and involves no heavy metals or toxic substances. For those of who are concerned about the environment, the Hy-Stor is environmentally friendly.

The Hy-Stor battery will provide

an electric vehicle with more than double the range between recharges of currently available lead acid batteries and 20% greater range than nickel metal hydride batteries, at equivalent levels of acceleration performance.

At the same time, the Hy-Stor battery will retain its stored energy when not in use...it will not "self discharge" as happens with other types of batteries when idle, and will last far longer, longer than the average life of an automobile today, due to its extraordinarily high cycle life.

Ergenics believes that, eventually, the hybrid electric vehicle will prove to be the most popular and, indeed, effective means of achieving energy savings and pollution control objectives. It will have a base load, highly efficient internal combustion engine, and use a battery for purposes of acceleration and to store power from regenerative braking. In that case, the Hy-Stor battery should prove an ideal application with its life of 2,000 cycles at 100% discharge, 100,000 cycles at 15% discharge and high power pulse capacity.

With this demonstration the final step is to fabricate a full size electric vehicle battery.

Philip A. Burghart, Sr. VP
Ergenics (201) 962-4480

Congratulations to Marie Davis of the AHA the creator of our web site: <http://www.getnet.com/charity/aha>

The National Academy Press has selected the Hydrogen (AHA) web site as the cool science link of the day...October 1, 1996. The National Academy Press is the publisher for the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and the National Research Council. The National Academy Press web site, with more than 700 online publications, is at <http://www.nap.edu/>.

Sincerely,

Mark Griskey (202) 334-3169
mgriskey@nas.edu

A letter to our own members Membership Renewal/Do You Have A New Address - *AHA Needs Your Entire Zip Code for Bulk Mailing!* and Keep Us Updated on Projects and Progress:

AHA's fiscal year ended July 31, 1996. In order to balance project budgets with income from membership donations, we sent a fiscal year-end request for renewal donations. Not everyone received this notice...If your membership donation was not due, you did not receive this letter. You will get a similar letter in January 1997.

I want to brag about the high percentage of renewals...off the scale compared to the National average of renewal giving. Thank you for your continued support. AHA depends upon your voluntary interest and support in achieving sustainable prosperity without pollution. Keep us updated on your address.

SEASONS GREETINGS FROM AHA

*May this Holiday Season Be Filled with a Spirit of Thanksgiving for All our Many Blessings;
May Joy, Hope, and Celebration Fill the Air;
And May 1997 Find Us Working with Renewed Spirit and Commitment
To Make Every Day Bright and Clean*

- Yes, I want to join AHA, or give a gift for the holidays to help make a transition to clean Hydrogen energy
 Yes, Enroll me in the automotive conversion class. [Dates currently being offered: Feb 8-9, 1997]

Name _____

Address _____

City _____ State _____ Zip _____

Telephone - Home (____) _____ - _____ Office (____) _____ - _____

Occupation and /or Areas of Special Intrest _____

- Regular membership (\$30/year) Family Membership (\$40/yr) Corporate/ Institutional Membership (\$1000)
 Student Membership (\$20/year) Sustaining Membership (\$100/year) Auto Conversion Class (\$50 Deposit
/ \$225 Total)

All donations to The American Hydrogen Association are Tax Deductable under IRS 501 (C) 3 as a non-profit Organization. Enclose Check or Money Order and Mail to:

*American Hydrogen Association, 216 S. Clarke Drive, Suite 103, Tempe AZ 85281
Phone: (602) 921-0433 Fax: (602) 967-6601*

The Hydrogen Association

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