



Hydrogen Today

"Clean Energy For A Better World"

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AHA Interviews Donald P.H. Huberts, Chief Executive Officer, Shell Hydrogen B.V.

Roy McAlister

Introduction

The world's economy now depends upon burning the fossil equivalent of some 180 million barrels of oil each day. This consumption rate is equivalent to annually burning what nature took about one million years to accumulate as fossil deposits. The Royal Dutch Shell Group has made a commitment to providing hydrogen as, ultimately, one of the potential alternatives to some fossil fuel use and we (the American Hydrogen Association) are greatly encouraged by the corporate leadership that is illustrated by Shell's decision.

AHA: Mr. Huberts, please tell our readers about your background and the events that helped you convince others in the top management of Royal Dutch Shell to be a substantial force in producing and marketing hydrogen.

DH: I have about twenty years of experience in the oil industry, in various technical and managerial roles. Most recently I was General Manager of a joint venture company in the Caribbean involved in the importation, refining and distribution of crude oil and derived products. Last year a team of Shell staff from around the world and from different businesses studied the developing market for fuel cells and became excited about the progress and the future prospects that this technology holds to contribute to sustainable development. Shell's senior management shares the positive future outlook and decided to establish Shell Hydrogen as a new business unit to pursue these opportunities. I was appointed to lead the development of this new activity.

AHA: Does Shell have goals that you can share with us regarding hydrogen sales as a percentage of Shell's income at future points of reference?

DH: It is too early to publicize specific sales targets, because the markets are at an early stage of development. We believe that over time, the alternative energy sources including hydrogen will become very significant. In some scenarios, we could for example see up to 50% of the world's energy supply from alternative energy sources as early as the middle of this century.

AHA: What will be the sources of hydrogen at progressive stages of Shell's development of hydrogen for the world markets? How will electrolysis be utilized to provide hydrogen in Shell's new ventures? Has Shell been encouraged by the recent trend towards deregulation of electricity production?

DH: These are three questions, which I will address in order. Firstly, one must recognize that infrastructure develops slowly and it is expensive to build. Especially in the initial phases of the market development when demand is low, one needs to make maximum use of the existing infrastructure to ensure that the fuel can be delivered economically. This will mean using fossil fuels, such as natural gas or gasoline, to produce hydrogen close to the point of consumption, for example at the filling station. Electrolysis is still relatively expensive, but it holds quite some promise for low-volume production. In that respect it may become a useful transition technology to supply low-volume markets. As costs will come

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down over time, there is an increasing potential to couple electrolysis with solar and wind energy. This will lead to real "zero carbon" power, whereby hydrogen is the energy carrier. The deregulation of electricity production is another matter, not related to hydrogen. Of course, such developments are encouraging because they lead to new opportunities and indeed may create room for the new technologies to find their way into the market more rapidly.

AHA: Will Shell emphasize carbon products that are produced by chemical processes that separate hydrogen and carbon from hydrocarbon feedstocks?

DH: We will continue to work on solutions to lower the carbon content of the fuel as well as to lower the carbon/CO₂ emissions. We are working to develop a spectrum of carbon sequestration technologies in Shell, and not only related to hydrogen but more broadly. Furthermore, Shell has also just launched its own internal emissions trading system, called STEPS.

AHA: Is Shell investing in technologies to produce hydrogen and carbon from gas hydrates (the methane/ice crystals that are abundant on the cold floors of the oceans)? Or, is Shell more interested in sending gas-hydrate sourced methane to the market as a renewable fuel without sequestering the carbon.

DH: We are not currently working on producing hydrogen from gas hydrates.

AHA: What new technologies are needed to facilitate Shell's production and marketing plans for hydrogen? What is needed regarding technological advancements for: sustainable hydrogen production, transportation, and storage for automotive and other propulsion applications, energy-conversion devices, and safety systems?

DH: What we need at the filling station are the devices to convert gaseous and liquid fossil fuels for delivery of Hydrogen to the vehicles in an economical manner at relatively small volumes. We have leading edge technology to enable this and we are actively developing it. Many other technologies are being developed in the market in all of the areas

you mention and we are involved in some of these. The most critical technology needed is for hydrogen storage in the vehicle in a compact, lightweight, safe and economical manner. We are working on developing such hydrogen storage solutions.

AHA: What countries or economies will initially benefit from Shell's hydrogen program?

DH: The benefits will go to those customers who value them most and who can afford them. Initially, we believe that the demand will be greatest in the US, Europe and in Japan. The second stage of market development will be in the emerging economies.

AHA: Is Shell's hydrogen program envisioned as a vehicle for improving the economies of economically depressed areas?

DH: The new technologies and fuels will benefit society and will also stimulate economic activity. They will therefore certainly have a positive impact on economies around the globe, but also on the local and global environment and on society as a whole.

AHA: How were these marketing plans developed, by request from the countries, or by some other approach?

DH: As I said before, we focus on those areas where customers want these new solutions most and can afford them. In this regard, we work closely together with Governments and regulators to develop proper frameworks within which the new options can flourish.

AHA: How much in annual dollars are in present and future budgets for Shell's commitment to the advancement of hydrogen?

DH: Our policy is not to disclose specific budgets. Shell will invest at the right time and in the amounts that are needed to develop the business. As you know we are an energy company with a broad portfolio and a long-term view.

AHA: Are the world's most polluted cities targets

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for Shell's hydrogen program? What will the time schedules and priorities be for bringing hydrogen to such cities?

DH: Shell is a participant in the World Bank Clean Cities program. The focus of this program is currently on the pressing shorter term needs, because solutions are needed immediately. Of course, as the markets and the technologies develop, these cities will become ever more interesting candidates for the new solutions. §

Convert your car to "Hy-Boost" Operation

Roy McAlister

After reading the last issue of *Hydrogen Today* - "How to tank and tube," you may have decided to have a multi-fuel capability such as hydrogen and a common hydrocarbon or fuel alcohol. "Hy-Boosting" is the practice of using hydrogen with another fuel. Adding hydrogen to other fuels provides many benefits including: operation at much leaner fuel-to-air ratios; unthrottled air entry into the engine; faster combustion; and numerous related advantages such as cooler peak combustion temperature due to the presence of surplus air; reduced oxides of nitrogen production; and improvement of the effective octane rating of the hydrocarbon fuel.

Unthrottled air entry into the engine greatly reduces efficiency losses due to the backwork required to overcome the atmosphere to produce a vacuum in the intake system while the pistons work against crankcase pressure. Most engines spend most of their life pulling a vacuum in the intake system of the engine. This causes much fuel to be wasted.

The energy to do work against the atmosphere to produce a vacuum is taken from the output of the engine. This causes a significant efficiency loss in addition to forcing oil to travel past engine seals, such as piston rings, from places at atmospheric pressure towards the vacuum.

It is of great advantage to accelerate the combustion process with hydrogen. Faster fuel combustion allows later spark timing. Delay of the optimal

ignition timing during compression reduces heat losses to the piston, valves, cylinder, and head components. Reducing heat losses provides greater power production with reduced fuel consumption.

Hydrogen for Hy-Boosting may be provided from a separate tank, mixing hydrogen with the other fuel selection or by on-board preparation of hydrogen from compounds that provide convenient storage of hydrogen such as gasoline, propane, fuel alcohols, ammonia, natural gas, or landfill methane.

It is possible to retain the original gasoline fuel delivery system and to add any of several other systems, including a hydrogen storage tank, that can compatibly operate the engine on an interchangeable basis. Hy-Boost "Dual Fuel" or "Multi-Fuel" systems offer numerous advantages including the option of using a clean fuel selection on cold starts and in critical areas of a city where pollution is the worst. It encourages the use of renewable fuel suppliers and compels competitive fuel pricing. You will notice other advantages such as a reduced need for oil changes and maintenance to overcome component degradation due to carbon and sulfur sourced acids in the engine.

Alternative fuels are generally classified as cleaner burning fuels in comparison with gasoline or diesel fuels. In order of cleanliness examples include: hydrogen, landfill methane, natural gas, propane, methanol, ethanol and propane. The advantages of hydrogen include faster flame propagation, greater energy per mass unit, cleaner engine processes, elimination of the need for complicated subsystems, reduced maintenance, longer engine life, environmental protection, and the development of jobs. Some disadvantages of hydrogen that need to be considered are its very low density, ability to leak through smaller openings than gasoline, no odor, or color, (hence detection if a leak occurs), wide flammability limits, limited commercial fuel availability, limited conversion equipment, and limited availability of accurate conversion information.

Benefits from using hydrogen and gasoline (Hy-Boost) include faster starting during cold and hot weather, advantages of faster combustion and delayed ignition for higher torque, and leaner overall fuel/air ratios which gives cooler, cleaner, and more efficient operation. Hydrogen, up about 20% of the heating value can be added to many intake systems

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without backfiring. The closer the hydrogen is added to the combustion chamber the better. Port injection is preferred over throttle body injection. Direct injection is even better than port injection.

Direct injection into closed combustion chambers provides important advantages. This avoids the possibility of backfiring into the intake manifold. Volumetric efficiency is improved when the hydrogen is added after the combustion chamber closes.

Collecting the appropriate manufacturer's literature and specifications of sub-systems for the project will help you make the most efficient selection of parts. Order the required components, inspect and make sure that everything is compatible before installing the ensemble of appropriate components for your vehicle. Apply early because space is limited.

Finding the literature and learning where to buy the components takes time. Taking the alternative fuel short course from AHA for \$325.00 (October 7th and 8th of 2000 in Phoenix, Arizona) is a bargain.

While the parts are being delivered, refurbish your power train with emphasis on adjusting and tuning the engine according to the manufacturer's recommendations regarding the fuel-metering and ignition systems. If your engine ran poorly before the conversion, you won't know if it is an old problem or a new problem. Make sure everything is running like new. Test drive and recheck tune-up setting.

Many said, "...it was hard to install the tank and tubing." The best results require special tools for consistent bending of steel tubing. An adequate tube bender can be purchased from many suppliers including McMaster Carr. (562-692-5911) Without this special tool it is difficult to get uniform bends in the tubing. Also make time for some practice before doing the actual tubing of the vehicle. Test for leaks before proceeding with the conversion.

Load the system with nitrogen and test for leaks. Eliminate all leaks. Test the valves, instrumentation and verify that all components are functioning properly. Verify that these systems work safely and as designed.

Remove the vehicle to an adequately ventilated place. Replace the nitrogen with your alternative fuel selection and retest for leaks.

You may want to start your conversion work on lawnmowers and one or two cylinder engines before advancing to car conversions. It is important to draw the system circuits and start writing your "Proper Use and Maintenance Manual" before doing your conversions. A good drawing of the assembly will help illustrate your manual.

The internet can help find parts and catalogs – you can compare specifications – not to mention comparative price shopping.

One problem with designing an engine conversion is that there are so many types of engines. Each type of engine requires a slightly different metering configuration and control system. That is why it is important to take the time to design your layout. Discussion with an accomplished alternative fuel mechanic in your community could be invaluable to your own efforts. §

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Parker Seal Group
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P.O Box 11751
Lexington, KY 40512
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Phoenix, AZ 85040
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Fax: (909) 594-9542

NVG systems Inc.
(CNG Cylinder Co.)
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Long Beach, CA 90805
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Fax: (310) 630-0206

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Catalina Cylinders-West
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Garden Grove, CA 92841
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Fax: (714) 890-1744

Letters to the Editor

Dear American Hydrogen Association:

My name is Scott D. Swanson and I am applying for membership in the American Hydrogen Association. I am a concerned citizen who is seeking to help make a change in how we produce our energy. My main goal is to develop and produce an affordable Hydrogen based system to run individual homes. A system that would consist of a Hydrogen generator and Hydrogen fuel cell to replace existing systems now being used in pre-existing homes and for new construction. As a concerned citizen I would like to be able in the future to make my living doing something that will help save the planet, and at the same time create badly needed living wage jobs. I am very interested in the Solar Dish Gensets that I read about on your web site. Also about the city you are building in Arizona. From what I have learned about Hydrogen power I gather for the type of system I want to develop I will need the following:

1. Energy source or sources for Hydrogen production – Solar Dish Gensets etc.
2. Storage system for the produced Hydrogen to run the system and for backup when generation of Hydrogen is not possible
3. Hydrogen fuel cell and components for wiring the fuel cell into existing wiring system and for creating (a) system for new construction.

Through membership with the Association I hope to obtain the information and make contacts with people and companies etc., to make an affordable system possible.

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Scott D. Swanson

Thought for the Day: "Not all chemicals are bad. Without chemicals such as hydrogen and oxygen, for example, there would be no way to make water, a vital ingredient in beer"

-- Dave Barry

*owns
SCI
Scuba*

AHA

The Road Ahead

Kathy McAlister

Measuring success verses wasting our time was ultimately important when we started the American Hydrogen Association (AHA) as a division of the Hydrogen Association in December of 1989. It only took a few meetings to outline AHA's goals for 50 years, at 10 year intervals, then for five years with yearly step-by-step advances. AHA thought that it was important for the goals be maintained, so that distracting events could not pull AHA off track. Goals would also provide us a valuable tool to measure our success. AHA wanted hydrogen to become a household word and to create the market pull for creating the infrastructure developments that were scheduled to begin in 2000.

Thomas Jefferson outlined our strategic plan – "I know of no safe repository of the ultimate power of society but the people. And if we think them not enlighten enough, the remedy is not to take the power from them, but to inform them by education." In 1989 "the people" were afraid to say the "H" word – "HYDROGEN." AHA believed that Jeffersons "informed people", the so-called "grassroots" were the key to changing to the 'Hydrogen Economy' based upon sustainable resources.

So AHA started with the goal of making hydrogen a household word. Our second goal was to get the educators to start teaching about renewable 'Solar-Hydrogen.' The third year goal was to build the demonstration models, so that everyone could see what we were talking about. The fourth goal was to take the message to the business community. Our fifth year goal was to provide demonstrations to federal agencies, and representatives in Washington D.C. By the sixth year AHA went across the World – to China, South America, Europe, Canada and Mexico. Each year we expanded our presentation. The purpose of these campaigns was to create market pull through our educational programs.

We entrusted informed people to do the job of teaching others. Many AHA members have traveled, given talks, provided seminars and made excellent demonstration models. You supported

AHA's educational and demonstration programs around the world. The success is entirely yours for doing the job. Much of the work had to be adapted to your own communities without a blueprint. The key to sustainability is beginning at home.

You be the judge of the successes – but AHA knows that it did not waste time. Look at what has happened – hydrogen is widely recognized as the number one answer for sustainable prosperity without pollution. People know that it is the answer to cleaning up the air and water in polluted cities.

So how do we do more in the next ten years? Hydrogen is the key to facilitating adoption of renewable resources. As fossil fuel depletion happens, hydrogen will pick-up the load. Many predictions can be made for the next decade. Oil can not be pumped out of the ground fast enough, pipelined and refined to keep-up with the growing world demand. Gasoline and diesel may soon become high priced, special fuels – too costly to burn, and more valuable for making plastics, carpets, T.V.'s., computers, etc.

The most difficult time to change would be to wait until final extraction (trying to get the last amount of oil left in the reserves) becomes to expensive to maintain using it as a fuel. Users will not want to pay the true replacement cost of gasoline.

AHA's ambitious goals belong to all of us. The hard work of achieving them is essential and worth what it takes to convert to a "wealth expansion" economy.

Industry is now willing to make the commitment. Engineers will need to sign-on for new career developments to make the entire Earth sustainable. Technologists must step-up to the plate and give the cities new blueprints for sustainable development. Leaders must come forth with vision, commitment and courage in this next decade. Preoccupation with defense spending must give way to the new paradigm of creating wealth expansion from renewable resources. This wealth-expansion paradigm will provide a "win" for every segment of civilization.

We can eliminate the have-nots by wealth expansion enterprises instead of practicing the present economics of resource depletion. Renewable resources are plentiful and are for everyone. We are in a technological trap that requires tremendous use of energy to maintain our living standard. Hydrogen

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will prevent the collapse of civilization at the foreseeable end of the fossil fuel age.

AHA's first goal of this decade is to test the technologies for making cost effective hydrogen from sewage and garbage. Our Mission is to take these technologies to the farms, industry and municipalities.

We can put up to 20% of hydrogen into our natural gas pipelines without change. We can store hydrogen in depleted natural gas fields. We need to make and store hydrogen for an expanding marketplace. Building a hydrogen/natural gas supply will provide our energy bank for the future.

The natural gas industry can earn sustainable profits by buying renewable hydrogen to extend their supplies. It will enhance their natural gas value by making it cleaner and faster burning. Storage in depleted natural gas fields will ensure a ready supply of fuel as gasoline prices continue to rise.

This next decade will prepare the century for hydrogen. Yes, there will be major changes ahead for fuels. Hydrogen will help civilization achieve the grand purpose of prosperity without pollution for the next millennium and beyond. §

Arizona State Senate Bill

Senator Spitzer of Arizona has introduced a State Senate Bill SB 1287 which provides \$1,000,000 for a Hydrogen Grant program. The bill is aimed at encouraging the use of Hydrogen for projects that benefit the public. Monies appropriated by the legislature or monies received by gifts, grants and donations will be administered through the state energy office. The Director of the Energy Office may award grants of up to \$500,000 to applicants who demonstrate the public benefit of the project to be funded, provide an acceptable project plan with a detailed cost and time line, limit administrative expenses to no more than 10% of the grant award.

The Spitzer Bill was developed by "grass-roots" efforts in Arizona. This illustrates a great opportunity for AHA members to assist in efforts to develop similar bills in every state. We need more legislative appropriate bills like this one in other state governments to support Hydrogen development programs. §

Coming Events:

April 6th-11th – Miami, FL, **Carbon Nanotubes – Commercialization of Nanostructured Materials** – Wyndham Miami Beach Resort. Contact: Knowledge Foundation at (617) 232-7400 fx: (617-232-9171 or e-mail: custserv@knowledgefoundation.com; register on-line at www.knowledgefoundation.com

May 17 – on PBS from WNET New York Channel 13 **"What Happened to the Hindenburg?"** - The flaming explosion of the Hindenburg over Lakehurst, New Jersey in 1937 is one of the most famous disasters of the 20th century. It took more than 100 years to develop what was, in its day, the fastest, most technologically advanced and most luxurious form of transportation in the world. It took only 34 seconds to destroy it. The accident that put an end to the golden age of airships is widely believed to have been caused by the ignition of hydrogen gas used for lift. But Addison Bain, member of AHA, and a retired NASA scientist, is not satisfied with that explanation. A hydrogen specialist who believes that it is the clean and safe fuel of the future, he sets out on a personal quest of theorizing and experimentation to prove that the Hindenburg's real flaw was only skin deep.

April 19-20 – Dallas Convention Center, Texas, **Globalcon 2000**, presented by: Association of Energy Engineers. Contact: 770-279-4388 or fx: 770-381-9865.

June 11-15 – Beijing, China, **Hydrogen 2000: 21st Century's Power Hydrogen Energy**, 13th World Hydrogen Energy Conference:
e-mail maozq@mail.tsinghua.edu.cn; Prof. Mao Zoungquiang or www.cicest.org/en/hydrogen or registration: e-mail zhenj@public.bta.net.cn

July 10-14 Lucerne, Switzerland, **Fuel Cell 2000**
Dr. Leo Blomen, Chairman, in conjunction with the 4th European Solid Oxide Fuel Cell Forum). Tel: +41-56-496-7292.

Sept 11-15 – Munich, Germany **Hyforum 2000 – The Hydrogen Energy Forum** – Prof. Dr. T.N. Veziroglu, e-mail: energie.forum@t-online.de
fax: +49 (0) 2 28/9 59 56-50

October 7-8, Phoenix, AZ, **AHA Hydrogen Auto Conversion Short Course**, Contact: Kathy 480-827-7915; www.clean-air.org; e-mail: aha@getnet.com

October 14-15, Phoenix, AZ, **Fuel Cell, Hydrogen Production & Storage Course**, Contact: Kathy 480-827-7915; e-mail aha@getnet.com or www.clean-air.org (See page 12 for registration)

Rotary Supports Advancement of Hydrogen

Roy McAlister



Paulo V.C. Costa, President of Rotary International in 1990-1991, shown on the left is presently Chairman of Rotary's "Environmental Task Force." He is shown handing his application to support the "Rotary Hydrogen Fellowship." David Waschak, shown on the right, is Chairman of the newly formed "Rotary Hydrogen Fellowship" program to support education and business developments related to hydrogen.

Rotary recognizes the advancement of hydrogen as a key to achieving the goals of the Environmental Task Force including Rotary's missions for the "Pollution Free Planet" and "Preserve Planet Earth." Rotary's 1.2 million members around the globe have an impressive track record of taking on big projects such as their very successful campaign against infantile paralysis or "polio" which has accomplished virtual eradication of this crippling disease. Rotary's environmental mission to have a Pollution Free Planet will be accelerated by the new Rotary Hydrogen Fellowship. §

**Hydrogen Investment Class May 20-21,
2000**

**Call Kathy McAlister to reserve your seat.
Cost is \$250 and includes lunch and materials.
(480) 827-7915**

AHA's New Hydrogen Plant Project

Roy McAlister

AHA is currently raising funds to setup a Hydrogen Production Plant to interchangeably produce hydrogen from landfill gas and /or natural gas. The plant was designed and operated to produce Hydrogen for an oil refinery. It was made available to AHA after being replaced with a larger unit. AHA will convert this plant to use biomass gases for the production of renewable Hydrogen and a multitude of other products. The plant will also be used as a technology demonstration facility for educational seminars. A renewable energy park will be developed as part of this project.

The Benefits

Creation of good jobs and a sustainable economy.

Our new plant will be used as a training center for delegates from all over the world to learn how to create a sustainable local economy while cleaning the air.

Business opportunities will arise from the disposing of bio-wastes for visionary entrepreneurs.

Hydrogen will be produced for fueling engines in converted cars, buses, and trucks that will clean the air. Renewable Energy Vehicles - Minus Emissions (REV-MEs) clean the air as they are driven.

AHA'S Mission: Low Cost Hydrogen

Our immediate need is to raise funds to acquire and move the plant to a host city where it will produce large amounts of Hydrogen and carbon. The Hydrogen from this plant will fuel up to 200 buses or a whole lot of cars and lawnmowers. Larger cars, for example, can clean enough air to fill three homes with cleaner air each day! Your engine will last longer, produce more power, and clean the air by using Hydrogen instead of gasoline.

But, where will you refuel with Hydrogen? Right here! (see picture next page). This is why we are raising money. We will demonstrate how to fill up

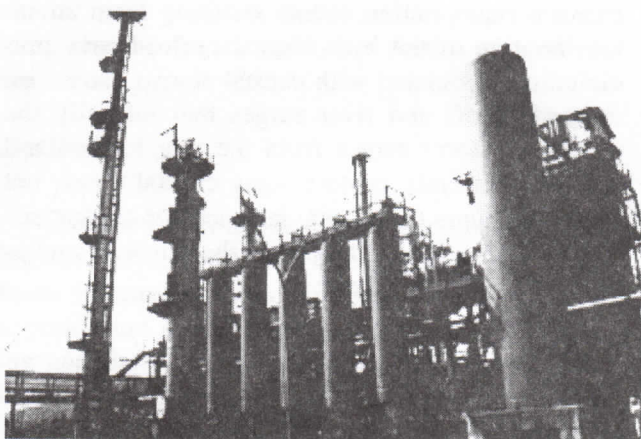
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with renewable Hydrogen made from sewage, garbage, and farm wastes.

Carbon from plant operations will be used to make activated carbon filters and fibers that are stronger than steel. We will use this Hydrogen production plant to teach others how to provide these same benefits for their cities.

How You Can Participate

About \$50,000 must be raised to get this project started. In exchange for your tax-free donation you will receive a 'PHD' certificate (Public-Minded Hydrogen Driver) for an equal amount of Hydrogen for your tank! Your certificate will be good till the certificate amount is used up. If you don't have a Hydrogen car yet learn how to convert your own by taking our conversion course.



We have three award levels for donations:

1st level - \$100 +

- You receive a 'PHD' Award Certificate* for Hydrogen
- An AHA T-shirt for each \$100 donated
- A *complete collection* of AHA Course Material i.e. Car Conversion Class, and Fuel Cells Class Notes
- Plus your name on our "Founders Plaque"

2nd level - \$50 - \$99

- You get a PHD Award Certificate* for Hydrogen
- Plus your choice of AHA Course Material (Car Conversion or Fuel Cell)

3rd level - \$20 - \$49

- You get a Hydrogen PHD Award Certificate* for an equal amount of Hydrogen.

* See an example of your very own PHD award at www.clean-air.org/phd

Send your check for \$25.00 or more to:

American Hydrogen Association
1739 W. 7th Avenue
Mesa, Arizona 85202-1906
Attn: H2Plant

As soon as our plant has been moved and set up we will supply you as much Hydrogen energy as you need to fill your tank at the same price per BTU as gasoline. Of course, your certificate will be made for the full amount of your check. Follow our Hydrogen Plant progress on our web site!

We Need Your Help

Help us create additional responses by making a copy of this article and forwarding it to five other people that would like to breathe cleaner air and help initiate a sustainable economy. Please discuss this opportunity to produce low-cost Hydrogen with a few 747 captains, your top three race car drivers, the mayor of your fair city, and the morning and evening shifts of car-pool moms in your area. We need thousands of responses.

We Solicit Your Suggestions

If you have any questions or suggestions for a faster way to get the AHA Hydrogen Plant operating to provide a working example of how to achieve prosperity without pollution, please contact me at the telephone number below or by e-mail at aha@getnet.com.

The Bottom Line

The motorized, mechanized, and electrified world now burns over one million years of fossil accumulations each year in search of the 'good life'. We are morally obligated to either produce energy from renewable sources or assume responsibility for more pollution, inflation, shortages, conflict and wars. §

"THE COMING OIL CRISIS"

A Book by C.J. Campbell

May be ordered at AHA.

Price \$32 Including UPS Shipping Throughout USA.

Union of Concerned Scientists Study on Global Warming

The Union of Concerned Scientists recently created a stunning poster map on the affects of Global Warming which can be seen at www.climatehotmap.org. The map was designed to stimulate interest and concern for the impact of global climate change on the environment and society. The researchers made every effort to conform to sound scientific principles in their research and categorization.

Two basic kinds of hotspots are represented on the map. The "fingerprints" of global warming such as heat waves, rising seas and the melting of mountain glaciers are indicators of the global, long-term warming trend observed in the historical record. By contrast the "Harbingers" such as exceptional droughts, fires and downpours, the spread of disease-bearing insects or other carriers and widespread bleaching of coral reefs may be directly or partly due to the warmer climate, but it is impossible to say for sure. Harbingers are events that are consistent, given our current scientific theories and models.

The overall geographic distribution of the hotspots is skewed towards North America and Europe. This is primarily because these regions have more readily accessible climatic data and more comprehensive programs to monitor and study environmental change.

Fingerprints

Heat Waves and Periods of Unusually Warm Weather

Hotspots in this category illustrate warm periods or head waves within the last few years. The observed magnitude and patterns of temperature change during the last century correspond well with model predictions when greenhouse gas, solar, and aerosol causes are considered together. Climate model simulations predict and increase in average surface air temperature of about 2.5 degrees C by the year 2100. A warming of global mean tempera-

ture will result in an increase in the frequency of warm temperature extremes at all time scales (days, seasons, years) Local small shifts in mean temperature can cause relatively large increases in the number of extremely hot days, increasing the likelihood of "killer" heat waves during the warm season.

Sea-Level Rise and Coastal Flooding

Worldwide measurements from tidal gauges indicate that global mean sea level has risen between 5 to 10 inches during the last 100 years. This rate is greater than the average of the last few thousand years estimated from geological and archaeological records. Sea-level rise leads to increased coastal flooding through direct inundation and an increase in the base for storm surges, allowing flooding of larger areas and higher elevations. In some areas, flooding be further exacerbated by an increase in extreme precipitation events resulting from an intensification of the hydrological cycle. Heavy precipitation associated with coastal storms causes increased runoff and river surges that intensify the effects of storm surges from the sea. Levees and seawalls currently protect many coastal areas, but these structures have been designed for current sea level and may be overtopped in the future or undermined by increased erosion.

Glaciers Melting

Glaciers exist on all continents except Australia and at virtually all latitudes from tropics to the poles. Mountain glaciers, such as those that exist at higher elevations in the mid-latitudes and tropics, are particularly sensitive indicators of climate change. There is widespread evidence that glaciers are retreating in many mountain areas of the world. Since 1850 the glaciers of the European Alps have lost about 30 to 40% of their surface area and about half of their volume. The shrinking glaciers will likely have a significant socioeconomic impact in some mountain regions, though the exact local impacts remain uncertain and will vary.

Arctic and Antarctic Warming

Climate change is expected to be more rapid and severe in polar regions compared to other places on Earth. Several positive feedback mechanisms exist,

Continued Page 11

particularly for the Arctic, that can amplify the impacts of anthropogenic global warming. Decreases in the extent of snow and ice cover, for example will lower surface reflectivity. As a result, incoming solar radiation will be absorbed by darker surfaces, thereby enhancing warming of ocean and land.

Harbingers

Spreading Disease

Climate change affects the occurrence and spread of disease by impacting the population size and range of hosts and pathogens, the length of the transmission season, and the timing and intensity of outbreaks. Warmer temperatures and greater moisture will favor extensions of the geographical range and season for vector organisms – such as insects, rodents, and snails. This in turn leads to an expansion of many vector-borne diseases, among them malaria, dengue fever, and some forms of viral encephalitis.

Earlier Spring

The rise in mean global surface temperature during the last century has been characterized by a faster increase in minimum temperatures compared to maximum temperatures. Both the overall warming and the disproportionate increase in minimum temperatures have contributed to lengthening of the warm (growing) season, especially in mid-to-high latitudes. Many plants and animals respond to a longer growing season by changing the timing of activities associated with the arrival of spring and onset of autumn – such as flowering, leaf fall, breeding and migration. There is growing evidence that such changes are now occurring.

Coral Reef Bleaching

Coral reefs are one of the most productive ecosystems on earth, providing many critical services to fisheries, shoreline protection, tourism and to medicine. They are also believed to be among the most sensitive ecosystems to long-term climate change. Elevated sea surface temperatures can cause coral to lose their symbiotic algae, which are essential for the nutrition and color of corals. When

the algae die, corals appear white and are referred to as “bleached”. Studies indicate that most coral are likely to recover from bleaching if the temperature anomalies persist for less than a month, but the stress from sustained high temperatures can cause physiological damage that may be irreversible. §

Below are suggested activities for us with the map:

- Use the map in a classroom, lecture or other academic setting.
- Display the map at your workplace
- Use the map as a visual to enhance a public presentation
- Share the map with the media
- Share the map with your elected local, state, and/or federal officials
- Share the map with relevant local, regional and state administrative agency officials

For more information visit www.ucsusa.org or write:

Union of Concerned Scientists
2 Brattle Square
Cambridge, MA 02238-9105

13th World Hydrogen Energy Conference

June 11-15 – Beijing, China, Hydrogen 2000: 21st Century's Power Hydrogen Energy, : e-mail maozq@mail.tsinghua.edu.cn; Prof. Mao Zoungquiang or www.cicest.org.cn/hydrogen or registration: e-mail zhenj@public.bta.net.cn

“The vision is staggering: a society powered almost entirely by hydrogen, the most abundant element in the universe . . . The overall goal of DOE's Hydrogen Program is to replace two to four quads of conventional energy with hydrogen by the year 2010, and replace 10 quads per year by 2030. A quad is the amount of energy consumed by 1 million households.” - NREL

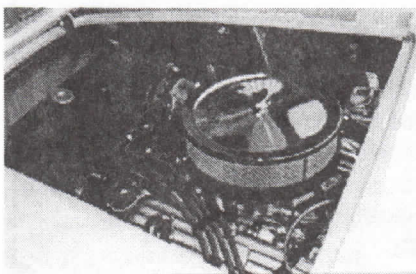
AHA and the ACE Project

We all become weak-kneed at the sight of seductive cars. Precision Design's GT250 California Spyder is one of the top cars on the short list. While not a replica of the '60's Ferrari SWB California, the Precision car does a great job of helping us recall the limited-production "redheads" of '60-'61 and evokes the same level of attraction that the original cars still garner. This car is in fact a kit car, originally marketed as a Modena and designed by Mark Goyette.

The Modena company went through several owners. AHA member, Lou Linxwiler rescued the tooling a few years ago and enlisted the help of Goyette to help improve his handsome car. Since the Precision Design version was introduced in 1995, it has garnered plenty of critical acclaim.

Lou and other volunteers are now working on the construction of one of these fine cars built from the ground up to run on Hydrogen. The effort has been dubbed the "ACE Project" Air Cleaning Engine Project.

The immediate goal of the group is putting together a rolling chassis, an engine and hydrogen fuel system. The aim is to show the construction, tubing and tanking configuration in the chassis assembly. The group will show the "Demo Version" of the ACE car at the Association of Handcrafted Automobiles show on April 29, 2000 at Knotts Berry Farm in Buena Park, CA.

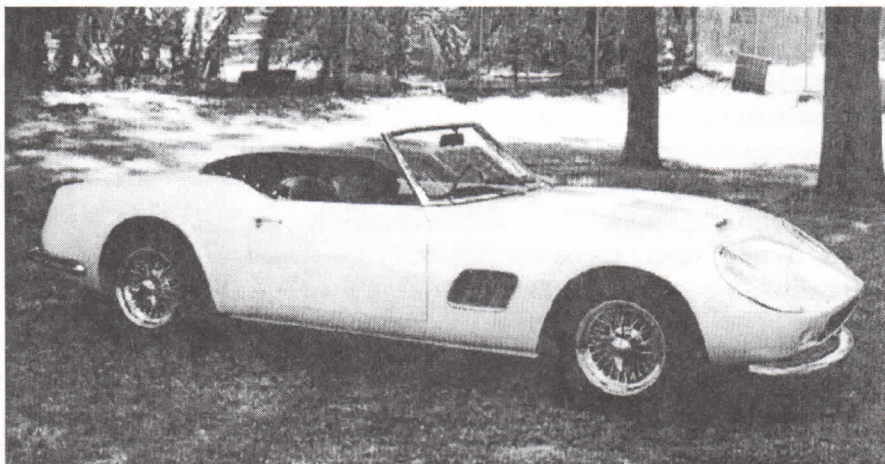


Engine Compartment of the ACE Car

After the show the group will carry the project forward and complete the Hydrogen powered ACE car. The prototype ACE will be perform-

ance tested at a drag strip as part of an AHA public relations demonstration. Dynamometer readings will be part of the over all engine-testing program. Emissions will be documented by an independent lab and are expected to reveal "minus emissions" with cleaner air in the exhaust than the intake to the engine. This provides a reduction between 30 to 70 percent removal of smog constituents from the air. The car will be also be demonstrated at the Bondurant School of Competition driving.

To accomplish this project, AHA needs donations amounting to \$50,000. Will you contribute to



AHA Sponsored ACE Car

AHA to support this project?

For the first phase of the Hydrogen ACE engine/chassis work we need:

- 4 H2 ACE supporters @ \$5,000 ea. – or
- 10 H2 ACE supporters @ \$2,000 ea. – or
- 20 H2 ACE supporters @ \$1,000 ea. – or

as many \$20 H2 ACE donors at it takes for the project.

Learn more about this project and help by making a contribution. Contact Kathy McAlister at 480-827-7915. Send your contributions to:

American Hydrogen Association
1739 W. 7th Ave.
Mesa, AZ 85202-1906
Attn: ACE Project

* See www.CalSpyder.com for Kit Car Information.

Concurrent Technologies Corporation to Operate Fuel Cell Test and Evaluation Center for the Government

Johnstown, PA., January 6, 2000 – Daniel R. DeVos, President & Chief Executive Officer of Concurrent Technologies Corporation (CTC) announced the collaboration of CTC and the U.S. Army Engineer Research Center (USARDEC) U.S. Army Corps of Engineers Construction Engineering Research Center Laboratory (CERL) to provide third-party testing and evaluation of fuel cell systems for military and commercial applications.

Through its National Defense Center for Environmental excellence (NDCEE), CTC will conduct test and evaluation operations within the Department of Defense Fuel Cell Test and Evaluation Center (FCTEC), located at the company's Environmental Technology facility in Johnstown. Fuel Cells from Avista and ONSIs are among those being tested. As the operator of the FCTEC, CTC is capable of independent demonstration and validation of complete fuel cell power plant systems ranging from 1kW-300kW. CTC's capabilities include testing and evaluation of performance under variable power load ranges and transient power loads (motor starts), as well as characterization of fuel cell thermal heat recovery systems. CTC also conducts testing of optional cooperating modes, including the use of alternative fuels, dual fuels, and fuel blends, in grid-connect or grid-independent configurations. The FCTEC is equipped with state-of-the-art data acquisition equipment and software with the capability for automated control of test parameters. It is also equipped with secured Web access for clients and partners to acquire system information and test data as it is collected and compiled. A ribbon-cutting ceremony for the FCTEC is set for February 2, 2000.

A fuel cell is a highly efficient electrochemical power generator that operates quietly and without significant pollution. In addition, byproduct thermal energy that is generated by the fuel cell is available for cogeneration of hot water or steam, raising the efficiency to about 85 percent. Fuel cells also provide secure, onsite electrical power generation.

Onsite, dispersed power generation avoids power outages due to weather, terrorist activities, or lack of commercial utility-generating capacity. In addition, as increased emphasis is placed on global warming, acid rain, and air pollution in general, the development of clean, highly efficient power-producing technologies is not only desirable, but mandatory.

"Our involvement in the applications studies and product development of fuel cells supports government and industry goals for a reliable and cost-competitive power production alternative for commercial use. Our participation is in collaboration with technology users and commercial industry developers to reduce life-cycle costs and develop strategies for effective deployment of the technology," commented Mr. DeVos.

Avista Corporation, ONSI Corporation, and the Air Expeditionary Force Battlelabs (AEFB) are currently utilizing CTC's FCTEC. "It's going to change the way we live," said Dave Holmes of Avista Laboratories, Spokane, Washington, developer of a fuel cell that is among those being tested by CTC. The Avista cell is approximately 23 inches by 24 inches, and is about 14 inches tall. Holmes said it would take four to six units to provide all of the power needs for an average home, but that it was too early to say how much a unit would cost. The Avista cell will be fueled by either natural gas or propane.

"We're still at the tip of the iceberg in understanding fuel-cell technology," said Herb Healy of ONSI as he stood in front of one of the company's fuel cells, which could supply power to a hospital or factory. Healy said ONSI is in the process of putting five units in an Anchorage, Alaska, postal center. Its unit is about 17 1/2 feet long, 10 feet wide, and 10-12 feet high.

Concurrent Technologies is an independent, non-profit corporation that assists industry and government in achieving competitiveness. For more information, contact George A. Blasiolo, Concurrent Technologies Corporation (CTC), 814-269-6287 §

*What would you like in your drinking
H₂O? MTBE or H₂?*

"Fuel Cells Vs IC engines"

DK Harrison

Fuel Cell Vehicles (FCV) can be true "ZERO EMISSIONS" vehicles depending on the source of hydrogen to fuel them. Electric cars still produce emissions as the electricity is generated. Hybrid cars still have emissions, even if they reach the bragged upon Ultra Low Emissions Vehicle (ULEV) levels. FCV's that reform hydrocarbons on board will only reach this ULEV level. They still emit CO₂. A recent SAE presentation on OEM Electric car as demanded by the California Air Resource Board (CARB), actually seemed to make the presenter complain about having to design such a car.

I say again: "ZERO EMISSIONS STINKS" if there are green house gases and ash emissions from the electric's power plant. We can still have the same amount of pollution in the air. In fact, when China and India begin burning more coal in fired electrical generation plants as is now planned; the jetstream is going to spread Nox, CO₂ and ash around the world!

So, why not remove half of that existing air-born pollution that passes through our existing Internal Combustion (IC) engines by converting them to Hydrogen powered 'Air Cleaning Engines'? Arizona State University students have documented that with unthrottled air, and timed Injection, clean burning Hydrogen powered IC engines removed 30% of existing Smog producing hydrocarbons from the ambient air... at idle! 70% of pollutants were removed at full throttle! NOx emissions were nil in the unthrottled air operation of the engine.

Now, you can bet we will immediately hear all the Gas Guzzlers' arguments that Hydrogen won't work as a fuel: High cost, No range, No power, Hydride tanks are too heavy, and Liquid Hydrogen is unsafe to handle and leaks, etc., etc. These arguments come from the same pundits that regard "good engineering" as fixing their last design faults! And last but not least, let us not forget the Lawyers and their favorite legal phrase "should have known!" When lawyers become part of the solution instead of most of the problem, then I will listen to their learned arguments.

Using direct injection to prevent flashback; unthrottled air to eliminate NOx emissions and removing all the heat adding devices used to vaporize

liquid fuels, a CARBON FREE hydrogen fueled IC engine will clean the ambient air as we drive.

Original equipment manufacturers don't have to scrap all that tooling for existing vehicles and will be able to save millions. Were Congress to have the wisdom to pass a simple "No Carbon, No Tax Fuel Exemption" in EPA's hydrocarbon emissions regulations, OEM's would respond and develop the IC Hydrogen Technology. Think about the simplicity of such leadership and the impact it would have on Air Cleaning Engines.

Roy McAlister has shown the solution to the range problem. (Take the auto conversion class in October. See Pg. 7) We need funds to test light weight hydrides that store 1 1/3 more H₂ than current designs. Compressed Natural Gas (CNG) tanks could store H₂ or CNG as available. We can then start to get rid of the DANGEROUS Leak - Puddle - and Burn gasoline we now use in our cars! It is possible to get 280 to 300 miles range on ACE our cars.

I can even see the FC/IC hybrids becoming the car of choice if they were designed for electric torque acceleration with IC performance. As to the cost of Hydrogen to fuel such cars, oil companies would provide H₂ at a low price if they were selling separated carbon from a million gallons of gasoline/day for anywhere near it's \$4.30/lb. current value. So become a super carbon salesman and H₂ will be inexpensive! I still want it from renewable resources and not from a fossil fuel.

Yes, I want 250 Million Fuel Cell (FC) cars! Particularly so I can use the Fuel Cells as electrolyzes for Solar, Hydro, or Wind generated H₂ production. I don't have to wait for H₂ distribution if I am converting gasoline cars to CNG/H₂ operation now. Just as we demonstrated in Randy Olive's Clean Air Race last March and just as Roy McAlister's ASU students demonstrated in the 1998 & 1999 SME competitions, minus emissions vehicles are a reality! Two Grand Prizewinners in a row are something to crow about! IC engines CAN still be the clean air work horses. What's more essential than the air we breathe? §

HYDROGEN LAWN-MOWERS
SEND SASE FOR CATALOG
AMERICAN HYDROGEN ASSOCIATION
1739 W. 7TH AVENUE

Hydrogen and Fueling Our Cars

Lou Linxwiler

Nearly all of the world's car manufacturers are working on the next generation of their products, and in one way or another, most will require Hydrogen in their fuel tanks! The transition will be gradual, but it has already started. We will see fuel cell cars running on electricity made from Hydrogen and we will burn this versatile gas in many of our internal combustion engines. Mercedes has finished their fuel cell-powered "Necar," BMW has internal combustion Hydrogen cars running in Europe and Ford has just announced that they have one being developed.

Why is this happening? Fossil fuels (gasoline, diesel, natural gas and propane) are finite resources. They took millions of years to develop and they will inevitably be depleted; some sooner than others. Various experts predict from 25 to 60 years for the future of gasoline and diesel. Natural gas will last longer, but it too, will become too expensive to recover and burn. Oil is much too valuable to burn and we need it for plastics (which can be recycled).

Approximately 65% of our petroleum comes from other countries. Therefore, those countries indirectly control some of our most important freedoms i.e., mobility and independence. They can raise the price of oil or they can lower it. They can even shut off the supply, if they want to. We have fought over this resource many times and we will again, if we don't wean ourselves from it.

Hydrogen on the other hand, is the most common element and when it is used in a fuel cell or burned, it forms water vapor and pure water. We'll never run out of it! There are almost no pollutants generated by using Hydrogen. Hydrogen is non-toxic; it is 14 times lighter than air, so if any of it escapes, it rises quickly. It will not pool on the ground like gasoline or diesel, and can be stored safely in several ways. Making Hydrogen even more exciting is the fact that it can be produced from so many things, like garbage, manure, corn and wheat stalks, and of course water. If a landfill is largely garbage, paper, wood and other cellulose, the methane gas it produces can be converted to Hydrogen and pure carbon, both of which are saleable as opposed to having it go into the atmosphere and becoming part of the problem. The volume in landfills can be dra-

matically reduced – something all cities will welcome.

Critics have said that the oil companies must be very opposed to this change. That may be so, although probably not; the fact is that changes are coming and the smart people and companies will not fight it, they will become the entrepreneurs and corporations that benefit first. Many new jobs will be generated from the building of new vehicles, retrofitting the old ones, producing Hydrogen and distribution. Our economy won't suffer, on the contrary it will grow if for no other reason than enabling us to keep a greater share of our energy dollars here in the U.S. instead of sending it abroad.

Over the past hundred and twenty years, the automobile industry has made a tremendous investment in the infrastructure it requires. The good news is that all of that can continue to be used. A new device is available which will allow Hydrogen to be introduced directly into the combustion chamber in an internal combustion engine, and by doing so, the power of the engine is increased. In a clean burning engine few if any oil changes are necessary, another advantage!

A new engine built to utilize this invention, or an older one altered to use it, will actually reduce the air pollution of the area in which it runs! Yes, the exhaust is really cleaner than the air going into the engine! When enough engines burning Hydrogen are on the road, we will begin to reverse the smog situation in our cities.

We have been improving the efficiency of our car and truck engines, which now pollute less now than they did before. But consider this, if we improve exhaust emissions from fossil fuel burning engines ten percent a year, the growth in the number of vehicles during the same period will offset the improvement! Only when we begin to burn something other than hydrocarbon fuel will we really see improvements in our air pollution.

There are hundreds of millions of vehicles with internal combustion engines all over the world. Converting even a small percent of them to use Hydrogen will have a huge impact on not only air quality, but also on future generations. If we don't stop using up our resources, these future generations will regard our present as we regard a 'Happy Days' sitcom. In other words, their quality of life won't begin to compare with ours. We have the means to pass on a better way of life and we must do it! §

Thank you for your membership Scott. You have touched on many excellent ideas and subjects. Please start by following the favorite links on our web page to get started. Feel free to ask questions through any of the AHA contacts listed on our web site. We need more people like you Scott who have meritorious goals built on the sentiment of doing good and we welcome you.

Editor –

Dear Hydrogen Today readers:

We do hold the solution to pollution and global warming in our hands. We can begin the conversion of Hydrogen immediately.

Yes, we do need money for the refining, tuning, and testing of conversion parts and processes, but no matter how primitive at first, hydrogen can become widely recognized as the sustainable, non-toxic, non-polluting, safe commodity that it is.

How? If we AHA members are serious about Hydrogen and believe that we can draw upon world wide developments to make our world a pollution-free planet, then let's demonstrate it by converting our own car, truck, lawnmower to dual fuel. This will encourage people to ask us questions.

We can drive our vehicles daily, even if some of our states have not yet accepted Hydrogen as an alternative fuel. We can change this by reporting the Hydrogen facts to a newspaper and enlisting a reporter to do a story. We can further aid public awareness by writing press releases for radio and TV that could be given to local stations. Imagine the potential if each of us took news incidents we see every day and write about them from the 'Hydrogen' viewpoint.

We can make a difference through example. Others will be informed if we take it upon ourselves to be informed and get the word out. AHA has many fine resources available; the web site www.clean-air.org, courses on auto conversion and fuel cells, books and course materials. Use these resources and start acting on your own ideas today.

– Lynn Thorp

Lynn, thank you for your comments and other suggestions. I will use some of your ideas on our web page and elsewhere, they are great!

IAHE President, Professor T. Nejat Veziroglu, nominated for Nobel Prize in Economics

The University of Miami Engineering Professor and the Founding President of the IAHE (International Association for Hydrogen Energy), T. Nejat Veziroglu, has been nominated for the 2000 Nobel Prize in Economics by the 5th Baku International Congress on Energy Ecology Economy held recently in Baku, Azerbaijan by the Chairman, Dr. Fegan Aliyev.

Professor Veziroglu is one of the world's leading advocates of the Hydrogen-Based Economy. He sees hydrogen as a solution to the world's dependence on fossil fuels, and the best way to reverse the damaging effects of these fuels on the environment. According to studies conducted by the Clean Energy Research Institute, fossil fuels cause \$4.7 trillion indamage to the global environment each year.

In 1997, the Institute's research on the use of hydrogen as a non-polluting, renewable energy source earned it the coveted "Center of Excellence" designation by the U.S. Department of Energy's Hydrogen Program. This designation recognizes the scientific achievements of the College of Engineering's Clean Energy Research Institute. The Institute is the headquarters for the IAHE. IAHE has also organized the biennial World Hydrogen Energy Conferences, pooling the efforts of the world's leading energy experts. Hydrogen 2000, the 13th WHEC, is the next scheduled conference, which will take place in Beijing, China, in June 2000. Most noted accomplishment is the IAHE publication of International Journal of Hydrogen Energy, which includes papers and findings from many of the world's most prominent energy researchers.

Professor Veziroglu has carried the banner for this distinction, as a representative of all who have gone before and are continuing in this effort. The Hydrogen Economy is at long last, being brought to fruition by those actively engaged in its promotion over the years. As Professor Veziroglu stated, "The true honor belongs to the Hydrogen Community throughout the world, who continues as a collective team effort to make the dream a reality."

For those wishing to add support and congratulations, send a letter to P.O. Box 248266, Coral Gables, FL 33124, USA §

Editor's Road Trip

Byron Anderson

Introduction

It is one thing to sit at my computer and research about Hydrogen on the web and quite another to visit firsthand with the people directly involved in projects and initiatives out in the 'real' world. Recently I had an opportunity to travel to San Diego for the 'Clean Fuels 2000' conference put on by Intertech USA. While in San Diego I was fortunate enough to meet Steve Bimson of Pearson Ford and talk with him about a project called, 'The Regional Transportation Center'. The RTC is a facility that will be build at the intersection of I-15 and El Cajon Blvd. in San Diego. It is hoped that the RTC will become a significant focal point for alternative fuel vehicles and education when it opens later this year. My next stops were at Impco Technologies in Irvine and Mazdatrix in Signal Hill. The IMPCO Technology and OEM Division is where the company is developing Hydrogen and Natural gas components for the automobile industry. My trip to Mazdatrix was spurred out of an interest in converting my own Mazda RX-7 to Hydrogen. I received good information from each of my stops. Let's start with the 'Clean Fuels 2000' conference.

Clean Fuels 2000

The 'Clean Fuels 2000' conference was held in San Diego, at the Catamaran on Mission Bay. The Polynesian theme, with it's motifs and artifacts, makes the Catamaran the next best thing to a trip to Bali. Exotic birds awaken guests in the morning with their calls and visitors navigate their way along winding paths flanked by palm trees, jutting ferns and other exotic flora.

The three day 'Clean Fuels 2000' conference brought people from all over the world. Among the participants were representatives from Italy, Germany, Sweden, Japan, Canada and South Africa. California government officials and speakers from a variety of refinery related industries offered their perspectives on the challenges facing the oil industry. The MTBE controversy and increasing clean-air legislation in California and elsewhere were par-

ticularly dwelled upon. Solution providers made their presentations, which included; special 'catalysts' for use in refining, bio-engineered 'bugs' that eat sulfur, refinery 'makeovers' and last but not least, the use of Hydrogen in the refining process. Shell made an impression on me with their plans to scale up production of natural gas and Hydrogen at their large Indonesian refinery.

Impressions

Midway through the conference I developed some sympathy for these people who are so earnestly trying to survive the coming paradigm shift. It was sobering to realize that any of the solutions available to refiners can only amount to one thing – higher prices at the pump for you and me.

Maybe you've heard the news stories lately; [at the time of this writing] the trucking industry getting angry about the high cost of diesel fuel, the OPEC countries meeting to discuss increasing production of oil to ease prices in Europe, Asia and the U.S., the ramifications of current and pending legislation, and greater concern for global warming etc. The implications for 'Oil Inc.' are far-reaching and the outcomes are nervously contemplated by industry observers. The economies of the U.S. and other countries around the world are on the line in a 'high stakes' game. The 'Clean Fuels 2000' conference evidenced a microcosm of concerns and attempts to find solutions. With so many foreign participants, it was clear that the challenges facing the industry are worldwide in scope.

Bottom line: there is no 'easy' solution to problems faced by the oil industry, at least in the context of the existing status quo. Yes, technological solutions exist, but oil producers and vehicle manufacturers will undergo a tremendous shake-up in rationalizing the investments necessary to share the regulatory burden. The fuels landscape is changing so rapidly some experts predict that gasoline and diesel may soon evolve into what we would consider today to be high value, specialty fuels! Fortunately, the message of alternative fuels is gathering more advocates as a result of this climate. If there are any opportunists reading, this is a great time to invest in Hydrogen futures and Hydrogen technology in general. Refiners can't get enough Hydrogen. It is "golden gas" for them.

Continued Page 18

Steve Bimson and the Regional Transportation Center

Coming away from the 'Clean Fuels 2000' conference left me with a heavy feeling. It was time to move on to something more upbeat and positive.

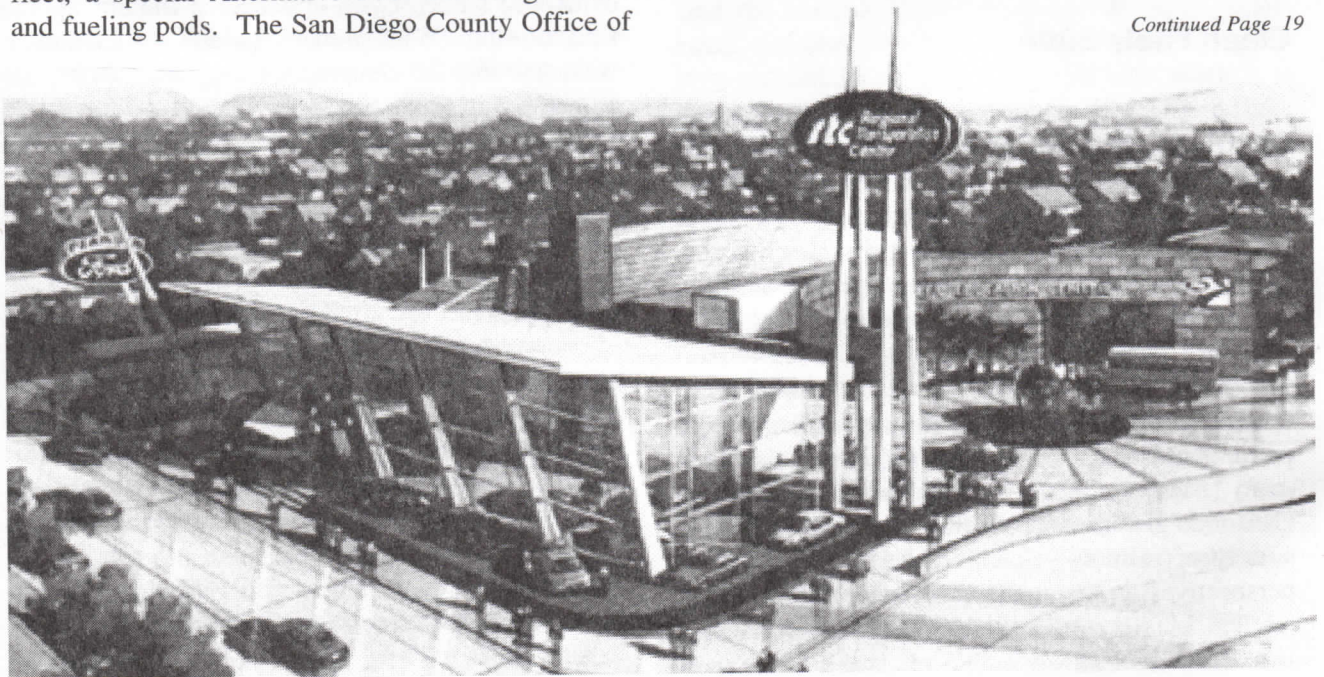
More than a year ago I first heard about the RTC while living in San Diego. My preliminary attempts to track down information netted me a few sketchy details about the RTC. I soon lost contact with my source person after moving to Arizona to volunteer for AHA. Recently, upon trying to reconnect with someone about the RTC, I eventually was able to contact Steve Bimson. Steve is the Marketing Director for Pearson Ford, a large Ford dealership in San Diego, which has put up several million for the RTC project with additional participation from the San Diego Environmental Foundation, U.S. Department of Energy, California Air Resources Board, City of San Diego and other organizations.

Steve and I had lunch where he expounded on the RTC, of which he is the Managing Director. The RTC is an innovative alternative fuel vehicle project designed to introduce the general public of San Diego County to the benefits of alternative fuel vehicles (AFVs). The 28,500 square foot RTC will house an Alternative Fuels Education Center, an AFV Showroom, an AFV rental/demonstration fleet, a special Alternative Fuel Servicing Center and fueling pods. The San Diego County Office of

Education is designing and writing the Education Center's curriculum relative to emerging alternative fuel technologies. With three scheduled field trips a day, it is expected that approximately 30,000 middle and high school students will visit the Education Center each year.

Mr. Bimson is also co-chairman of the Bi-National Air Quality Alliance, a focus group for air pollution issues concerning the San Diego-Tijuana air basin. The purpose of the BAQA is to improve the air quality and health of the citizens residing in the two cities. The alliance will serve in an advisory capacity to agencies, which are responsible for public health, as it relates to air quality and as a public forum for the discussion of air quality issues in the bi-national region. Another organization Mr. Bimson founded is the San Diego Regional Clean Fuels Coalition. This group brings together commercial interests and city governments to discuss a wide variety of topics including education, local proposals, technology demonstration projects and events of interest to the general public. Participants include the San Diego Unified Port District, the San Diego Environmental Foundation, Gas Equipment Systems, Inc., NGV Ecotrans, Mutual Propane, Pearson Ford and the Regional Transportation Center, the US Postal Service and Nelson Communications Group. I was invited to attend the meetings of these two groups when they have their quarterly meetings

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The San Diego Regional Transportation Center.

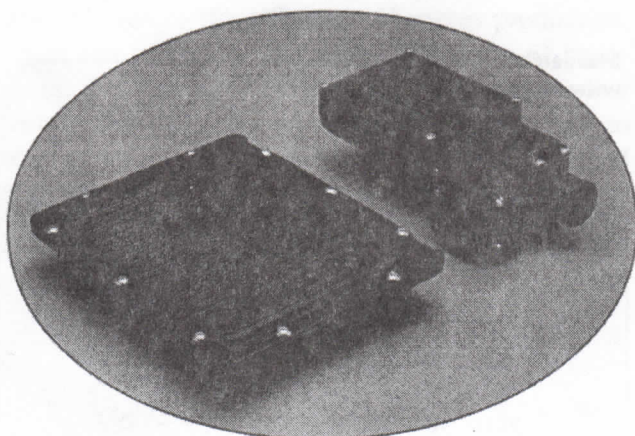
and I may have further information in the next newsletter.

In talking with Steve, I was filled with enthusiasm for the initiatives and connections he has made in San Diego. It is heartening to find that there are people like Mr. Bimson who are attempting to make a difference in their own regions. A ground breaking ceremony for the RTC is scheduled on May 6th which coincides with the 6th National Clean Cities Conference & Expo which will be held from May 7-10 in San Diego.

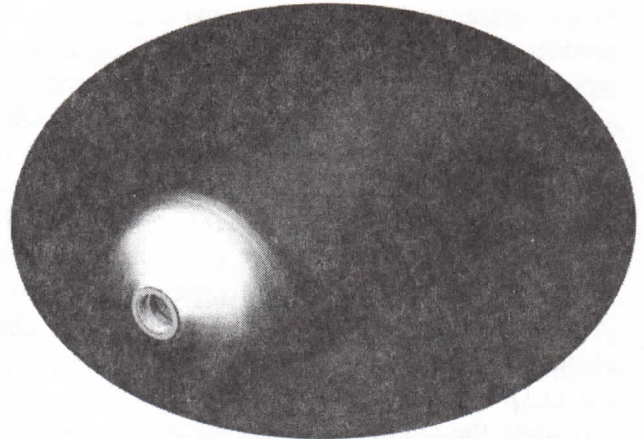
IMPCOs Technology and OEM Division

It was onward and upward (North to Irvine) after leaving Steve Bimson and San Diego. I spent a couple of days in Huntington Beach enjoying the surf and the 'Beach Boys' culture. Remember 'Good Vibrations'? It was perfect weather for early February. By coincidence I had applied for a job at IMPCO over the internet while in Arizona, so I decided to go to Cerritos and check on the 'status' of my application. I had also heard from Roy McAlister that IMPCO had some high-tech fuel systems components under development. I got to Cerritos and found that 'HR' was not in that day. Undaunted, I spoke with Marketing Director, James Mitchell, and after some discussion, he directed to IMPCOs Irvine facility which is their R&D technology center. I called and arranged an appointment with Alan Niedzwiecki, the Director of Business Development.

The Irvine facility deals strictly with OEMs. and is developing sophisticated and advanced CNG and Hydrogen fuel system components. (See pic-

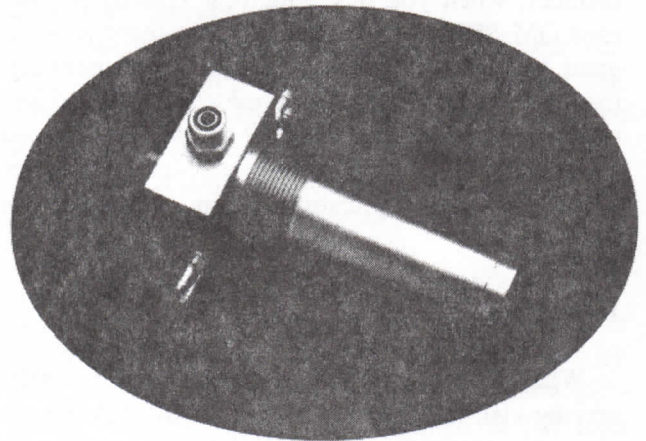


IMPCO OEM Controller and Gas Mass Sensor.



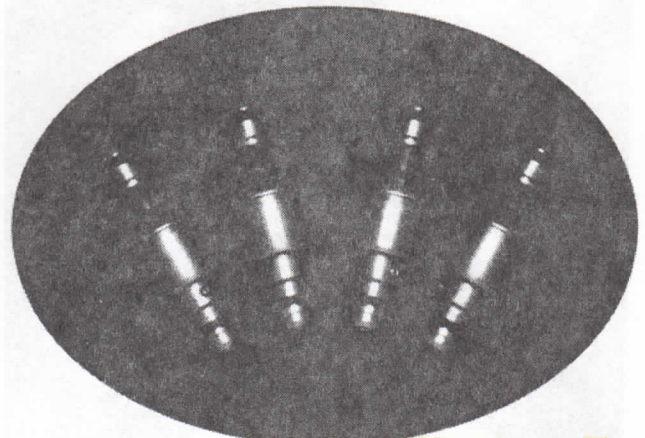
IMPCO High Volume CNG Storage Tank.

tures) The tank shown is made of composite materials and weighs in at 200 lb. A similar steel tank,



IMPCO High Pressure Regulator.

(today's industry standard) weighs 700lb.! IMPCO has also developed their own gaseous fuel, computer controlled injection system, which is superior



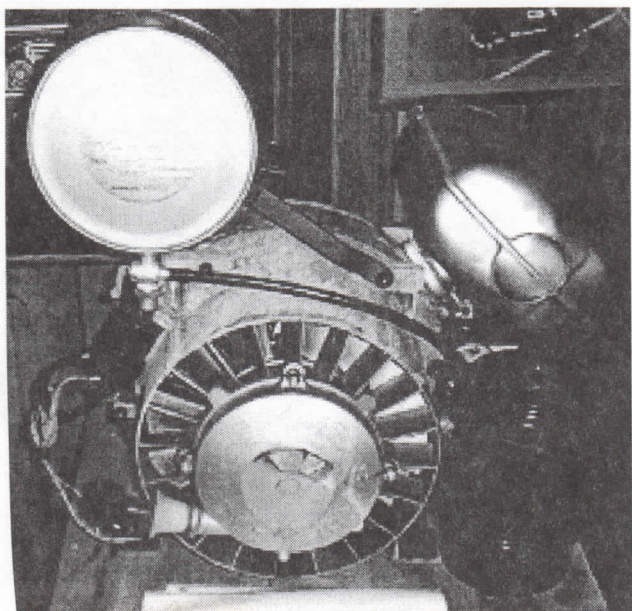
IMPCO Multi-point fuel injector for gaseous fuels.

Continued Page 20

to their older technology. IPMCO's objective is to produce fuel systems for OEMs like General Motors. They will develop, test and certify the systems and will sell complete fuel systems to GM and others. The beauty of the IPMCO fuel system is that it is completely integrated with the vehicle. All monitoring indicators and warning systems will be dash mounted. I for one would agree with Alan that their components are of NASA quality and again for you investors out there here's another opportunity! The components featured in this article will start appearing in GM cars and trucks in 2002 models. Alan was quite the enthusiastic 'evangelist' for IPMCO technology, and I was totally sold after hearing of IPMCO's plans for Hydrogen! The CNG components pictured are almost identical to the Hydrogen components. Truly a forward looking company! Remember, when you buy your first Hydrogen powered GM SRV you can be sure that there is some great technology behind it! IPMCO will continue marketing their aftermarket products in Mexico and other countries. In fact IPMCO recently announced a new manufacturing facility in Mexico. (Better check on that application again... Como estas usted?)

Mazdatrix

What better way to end my trip than with a self-serving visit to Mazdatrix of Signal Hill, CA. I have plans to convert my own RX-7 to Hydrogen as a



Sachs Rotary Engine at Mazdatrix.

demonstration project. I can't wait to get started on it. Mazdatrix sells everything 'Mazda' for the enthusiast. I arrived at their unassuming building right across from some of those 'dippy duck' oil pumps tirelessly pulling more liquid hydrocarbons out of a Cretaceous swamp. I talked with Lance Crain about clean-air politics and rotary engines, managing to get him away from the phones for a few minutes. One of the 'nifty' additions to their vast inventory of RX parts are some new 'old' Sachs rotary engines. These engines have been stored for 20 years in their original boxes and were used for snowmobiles in the early 80's. For all you Hydrogen go-kart enthusiasts out there one of these 'whining' babies can be had for \$300 plus shipping. They are rated at 11HP, but Lance told me you could take off the governor and 'tweak' them to 15 HP or more, depending how good you are at porting and other modifications. They are selling pretty good he says. Get yours today and enter your cart in the next Alternative fuel race!

Well that's about it. I had a great trip, talked to some interesting folks and increased my knowledge about Hydrogen technology. I found that the paradigm is truly shifting towards Hydrogen. There are many exciting developments going on at IPMCO and in San Diego that bode well for a better driving future for us all. The promise of Hydrogen is real and is happening now my friends! §

Intertech Conferences
www.intertechusa.com

San Diego Regional Clean Fuels Coalition
www.sdrafvc.org

Clean Cities Conference
www.ccities.doe.gov/conference.shtml

IPMCO
www.impcotechnologies.com/

Mazdatrix
www.mazdatrix.com

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**HYDROGEN, ARGON, AND
 SPECIALTY GASES
 FOR SCIENCE AND INDUSTRY**

Desert Mountain High School's Renewable Energy Park Takes 1st Prize

Billy Meade, Chris Meade, and Rajan Bhavnani,

Our Renewable Energy Park, as any is dependent upon location, local population expectations, long term industrial requirements and forecasted cost of energy. We have selected our high school grounds for our renewable energy park after the considering a number of factors.

We used a survey of 165 local middle school students to define future population expectations. Middle school students were very clear that a variety of energy options and choices are expected. One source is not adequate. There must be choices available. Energy production and delivery must create minimal pollution and delivery cost must be minimized.

We reviewed a published survey by the engineering community which defined the most necessary future innovations for energy production. We anticipate expansion of high-tech industry in the greater Phoenix area and a combination DSM (Dual Mode Transportation system) and SMM (Computerized Public Transportation system) using imbedded computer controlled magnetic levitation linear motor tracks to be part of the future Phoenix. We forecast mag-lev airplane take-off and landings and expect electronic entertainment and conveniences to increase. These future trends define energy needs our park will meet.

Energy production is only one part of the equation. Improving the efficiency of energy production, reduction of energy demanded, reduction of transmission losses and reduction of peak hour to low energy demand differential are equally important to energy production. The review of literature found that the Desert Mountain High School area is ideal for three types of renewable energy and one underutilized resource:

- Solar: including Passive, Water Heating, Power Tower and Photovoltaic Arrays.
- Biomass: including yard/park/agricultural

waste plus gopher wood production.

- Hydroelectric: The one renewable energy source being developed.
- Waste: Burning up of energy from collected waste presently buried in landfills (Methane flaring).

Other renewable energy sources are less reliable in this area. (Wind)

We like the idea of satellites collecting solar energy in outer space, beaming energy to the earth via microwave. But this is not a feasible economic choice for Phoenix. Instead, we will use more economic renewable energy resources presently available in the Phoenix area.

Existing hydroelectric energy supply is to be utilized and enhanced as possible. Our renewable energy park will augment energy supplied from hydroelectric sources.

To satisfy future resident demands, per our survey, our renewable energy park will deliver AC electrical power, DC electrical power, hydrogen fuel & synthetic fuel.

This is accomplished by 13 key sub-systems within our renewable energy park, as follows:

1) Four Electrical Power Generating Turbine-Generators are located on one central plant floor in our renewable energy park. One is a high efficiency base load steam turbine utilizing maximum efficiency features that will be operated at full load maximum efficiency at all times. The second is a low-pressure turbine that will operate at reduced steam conditions to augment the base load unit and as part of a heat recovery system when high-energy steam is not created. Both turbines receive steam from an interconnected header system to all steam sources that allows isolation of any steam source to any turbine. The third turbine is a dual fuel mode (hydrogen and synthetic fuel) gas turbine for peak loading and energy source backup that discharges to a heat recovery boiler. The fourth is an OTEC developed closed cycle turbine using ammonia in the primary cycle.

2) Power Tower Electrical Generation for daytime base load. Tracking parabolic mirrors called heliostats will collect and reflect sunlight to a tower mounted receiver. Water cooling the receiver is heated to very high temperature. Heated water is

Continued Page 22

heated to very high temperature. Heated water is flashed to steam by pressure reduction and drives the base load high efficiency turbine driving an AC generator. The turbine is maintained near maximum load and highest efficiency. During the hours of maximum solar energy collection, excess hot water is stored in a thermal storage unit for use in late afternoon and evening when the collectors can no longer provide enough energy to maintain full turbine load without the assistance of the thermal storage unit.

3) **Photovoltaic Solar Cells** will be arrayed for primary hydrogen production and secondary day peak electrical production. Tracking semi-conductor dissimilar metal solar cell panels collect and convert solar energy to DC power. Absorbed light "Photons" enter the semi-conductor dissimilar metal junction and release electrons from the silicon atoms. Typically each solar cell releases about 0.5 watts of DC power. The individual solar cells are connected in parallel to increase voltage and in series to increase current. Power from all solar panels connects to a moderate sized battery for system stability and to the DC voltage grid. The system is operated

at all times at full capacity. An inverter is used to convert DC power to AC power to provide additional AC power as required for peak loads. Remaining DC power is used to drive auxiliary equipment, i.e., the electrolysis of water. By electrolysis of water Hydrogen and Oxygen are formed. The Hydrogen is stored for fuel and provides back-up nighttime power as described later. Some Oxygen is stored. Hydrogen and Oxygen are used in the back-up energy and emergency start-up fuel cells.

4) **Solar Water Heating** for night base loading. Water that cools after passing through turbine condensers and other heat removal devices is routed through a series of tracking solar hot water heating

panels. The heated water is collected in an insulated hot water storage system for nighttime base load power production as described later in the closed cycle OTEC design turbine.

5) **Waste Burning System** for early morning power production. All household, commercial and industrial waste is burned in a "Karlsarue" design pyrolysis unit to extract heat energy to create steam to drive the turbines, to reduce waste volume to be land filled and to extract and break down toxic waste. The "Karlsarue" design pyrolysis unit burns waste at extremely high temperature at controlled oxygen levels to minimize pollution. Waste collected during the day and evening is burned in the



Arizona Alliance Statewide Competition Winners left to right - Billy Meade, Rajan Bhavnani, and Chris Meade.

early morning creating steam to provide power before solar energy is available.

6) **DC Electrolysis of Water** will produce Hydrogen for night peak loading and fuel supply. All unused DC buss power is used to break down water into Hydrogen and Oxygen. The Hydrogen is stored for use as fuel. Some Oxygen is collected and used for industrial demand in fuel cells and the rest released as a desirable byproduct. Cooling water cools the electrolysis cell collecting released heat and delivers it to the hot water storage system.

7) **Biomass for Synthetic Fuel Production** for night peak loading and fuel supply. As all plants collect and store solar energy in their vines, wood

Continued Page 23

and leaves, all plant yard waste, park waste and agricultural waste will be recycled by collection and burning in a Pyrolysis unit for maximum liquid yield. Pyrolysis is a process that converts organic material into gasses or liquid fuel or gasses. We favor the liquid fuel. The output is Char (for combustion), liquid (Oil) for combustion and IBG (Intermediate BTU gas). The Char and IBG gas are burned in the waste pyrolysis unit for steam production. The Oil is collected and stored as fuel supply.

8) *Euphorbia Lathyris Farming* for synthetic fuel production. *Euphorbia lathyris* (gopher plant, is a member of the poinsettia family) grows only at greater than 450 cal./sq. cm solar radiation and annual average precipitation of 15 to 50 cm. The undeveloped Arizona desert is ideal for its growth. *Euphorbia lathyris* makes hydrocarbons as well as carbohydrates by photosynthesis. The plant would be burned in a Pyrolysis unit to produce synthetic fuel. Again the Char and IBG is burned in the waste pyrolysis unit for steam production. The synthetic fuel is collected and stored for use as fuel.

9) *Hydrogen- Synthetic Fuel burning Gas Turbine* for night/back-up electrical power production. The gas turbine is fast responding system that can be fired by Hydrogen or synthetic fuel produced in our renewable energy park. It provides fast, reliable electrical power in case of inadequate steam turbine energy supply. Gas turbine operation is minimized to preserve hydrogen and synthetic fuel for consumer supply but is justified by assuring a secure, reliable, independent electrical power supply on days when solar energy is inadequate.

10) *Combined Cycle Heat Recovery System* for efficiency. The Gas turbine exhaust discharges into a heat recovery boiler. Both the Waste and Biomass Pyrolysis units discharge into the heat recovery boiler. When heat recovery boiler water is hot enough, steam produced drives either the high or low pressure turbines to produce electrical power. When boiler water temperature is too low, heated water discharges into the solar heating storage system.

11) *OTEC Cycle Power Production* for night base load. The OTEC design closed cycle turbine system using ammonia in the primary loop requires 40 deg. F. difference between cooling pond water and stored solar heated water, to produce electricity. Solar hot water is metered to pond cooling water to produce 40 deg. F. difference and supplied to the

warm side of the OTEC turbine. Pond cooling water is supplied to the cold water side. The stored solar hot water is used to produce power throughout the night.

12) *Fuel Cells for Emergency Backup* Power production and starting other equipment. Fuel cells fueled by our renewable energy park produced Hydrogen and Oxygen are used to backup emergency power and to provide the power to start site equipment in case of emergency. The fuel cell has two electrodes, an anode and a cathode, separated by a membrane. Oxygen passes over one electrode and Hydrogen over the other. The Hydrogen reacts to a catalyst on the anode that converts the hydrogen gas into negatively charged electrons and positive charged ions. The electrons flow out of the fuel cell and lie solar cells, individual fuel cells are connected in parallel to increase voltage and in series to increase current. The combined electrical energy connects to our DC bus and via the inverter to the AC bus. The Hydrogen ions move through the electrolyte membrane to the cathode electrode where they combine with Oxygen and an electron to produce water.

13) *Cooling Water Pond* for condenser cooling and hot water storage to support the OTEC system. Our cooling pond is covered with solar reflective covering to minimize evaporation and minimize solar heating. The pond uses ground temperature to remain cool. As the Arizona desert is unique in that day to night temperature typically varies 30 deg. F. per day (10 deg. F. greater than the world average), pond temperature will approximate the overnight low 30 deg. F. below daily ambient temperature minimizing the amount of stored solar hot water required. We also bury power cables underground and where possible, in canals to provide better maintenance access and help to avoid right of way problems.

In summary

The Desert Mountain High School's Renewable Energy Park is complete and self-contained. It can start any internal system without outside power. It can reliably deliver electrical power with back-up assurance and also provides renewable energy fuels of hydrogen and synthetic fuel to consumers. It provides DC power where appropriate for internal and near by industrial applications. Consumer and industry expectations are met in the most economic way for our community. §