

Hydrogen Today

"Clean Energy For A Better World"

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MANUFACTURING SUSTAINABLE PROSPERITY

By: Roy McAlister, President of AHA

Did you ever wonder who is manufacturing 40 million tons of automobiles, countless light bulbs, train loads of appliances, enough semiconductor devices to help everyone on Earth stay in friendly contact, billions of miles of electrical wiring, and millions of miles of piping each year? These are the workings of manufacturing engineers. The modern world is shaped by engineers that provide manufacturability improvement studies to optimize automated production, assembly, inspection, and packaging systems.

One of the world's leading educational centers for manufacturing engineers is the Arizona State University College of Technology and Applied Sciences. Located in Mesa, Arizona, at the former Williams Air Force Base, the ASU College of Technology and Applied Sciences offers hands-on opportunities along with class-room instruction of manufacturing engineering topics ranging from making micro-size medical semiconductor instrumentation to giant tooling for bridges and virtually anything else that is needed.

A current project of Professor Donald Kelley illustrates the emerging mission of manufacturing engineers which is to manufacture what is needed to achieve sustainable prosperity. Professor Kelley is leading his Capstone Class of seniors in manufacturing studies of common things like automobiles and lawnmowers that can clean the air as they operate. With help from mentors from the American Hydrogen Association, Professor Kelley's classes have learned how to make, store, and use hydrogen as a fuel in ordinary engine driven equipment. These studies focus on how to make cost-effective equipment that is safer but as convenient to use as with fossil fuels.

The Society of Manufacturing Engineers (SME) has taken notice of the progress that Professor Kelley's engineering students have made and is sponsoring their work in a prestigious international contest by WESTEC. ASU's WESTEC entry will detail a business start-up including the manufacturing studies, a prototype lawnmower, and a marketing study. ASU's Capstone Project student leaders determined that they could overcome the common lawnmower's disproportionately high levels of pollutive emissions including unburned hydrocarbons, carbon monoxide, and oxides of nitrogen. Professor Kelley agreed with the selection of a hydrogen-fueled lawnmower and sees the project as a worthy step towards the manufacturing engineers' mission to: "provide solutions to the long-term survivability of the Human Race."

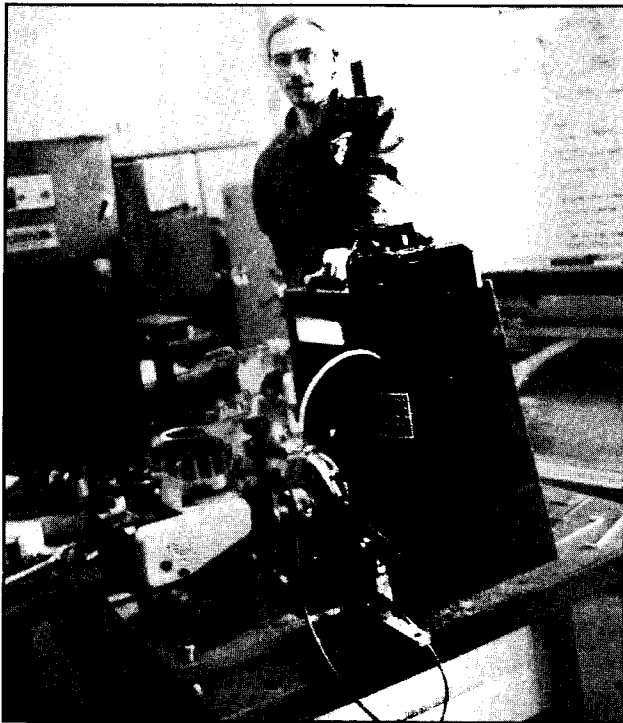
"Our students have learned how to safely make hydrogen by numerous techniques including: a home appliance called an electrolyser, by dehydrogenation of yard clippings and other waste biomass, and by reactions between water and an active metal such as sodium. They have envisioned start-up of the lawn mower business with bottled hydrogen which would be supplied much like propane. First, our emerging engineers learned how to make better lawnmowers. Soon they will be ready to tackle the problem of how to make enough hydrogen to allow the world's fossil reserves to find better uses as materials such as polymers and carbon fibers for production of durable goods," said Professor Kelley.

ASU's manufacturing engineers will have the knowhow needed to protect and foster the opportunity to convert 100 gallons of oil into \$3,500.00 worth of durable goods including better computers, carpeting, clothing, vehicle components, and countless other products. They realize that burning a gallon of oil incurs the opportunity cost of

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at least \$34 (\$35 worth of durable goods less a \$1.00 fuel sale) and that sustainable prosperity depends upon designing and manufacturing durable goods that can efficiently be recycled. These emerging engineers can help Civilization produce more profits and have a much better environment by making recycleable durable goods from fossil hydrocarbons instead of burning them.

Ray Smucker heads the publicity bureau of the Phoenix Rotary Club's "Pollution-Free Planet" programs and has closely followed the ASU students' progress on the minus-emissions lawnmower. Mr. Smucker said: "This is the type of business-opportunity analysis that our 1.2 million Rotary members around the world can understand and endorse. We are anxious to help bring city managers and other delegates from the world's most polluted cities to AHA's out-reach programs so they can learn how to use renewable hydrogen to achieve sustainable prosperity along with environmental protection. Rotary International's ten-year program to "Protect Planet Earth" will be greatly advanced by students that enter the work place with practical knowledge of how to engineer and manufacture profitable solutions to the pollution and un-employment problems that plague every major city."



*Kevin Venesnik working on the hydrogen
Capstone Project*



*AHA's Fuel Cell Class - the fuel cell is the
AHA's Northern California chapter's project
Micro-experimenter's fuel cell kit: \$169.00*

Steve Harris, a Detroit engineer that develops electronics and instrumentation for Chrysler, learned of the students' lawnmower project as he attended an AHA short course on electrochemistry and fuel cells. Mr. Harris said "this is the type of project that produces the engineers that we want to hire."

POLLUTION-FREE PLANET PROGRESS

By: Bill Chase, Chairman
Pollution Free Planet Committee

Rotary Clubs from coast to coast have been receiving the *Pollution-Free Planet* message from the Phoenix Rotary Club's speakers bureau. The central points of this message are:

1. That we can convert the present economy from dependence upon fossil fuels to a sustainable economy that actually expands the available resources instead of depleting them. Illustratively, using solar energy to replace heat produced by burning fossil fuels actually adds wealth to Earth. This is because the inventory of energy-intensive goods and services can expand without causing scarcity of a clean environment, the fossil reserve, or the good health of productive persons. Using solar energy including derivatives such as wave energy, wind, falling water, and waste biomass allows the Earth's reserves of fossil hydrocarbons to be utilized for much more valuable applications such as to make products that can be indefinitely recycled. Similarly, inflationary costs of dealing with radioactive wastes from nuclear plants can be avoided by selecting renewable-energy sources.

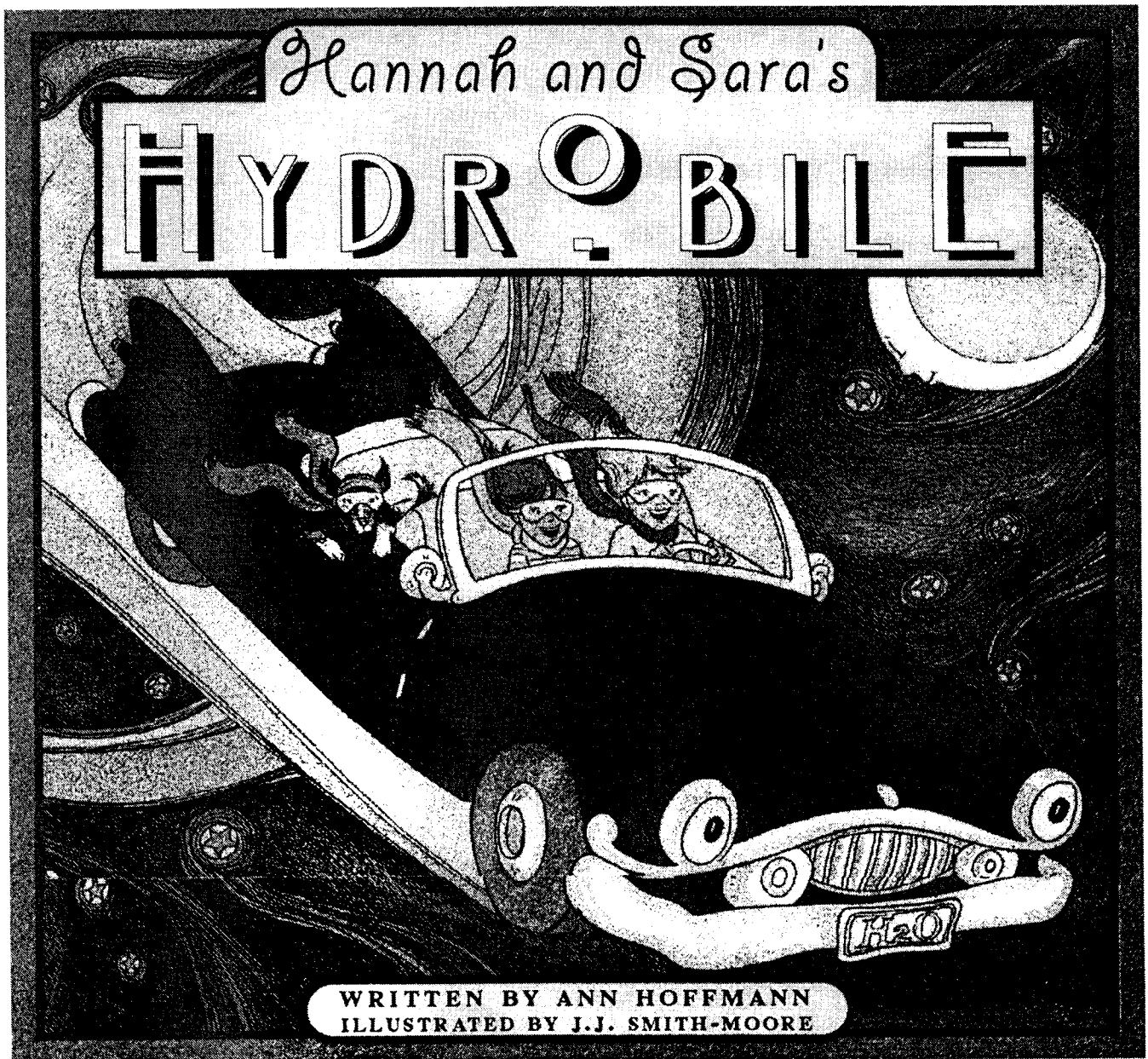
2. That it is to virtually everyone's benefit that renewable resources replace the habit of burning fossil reserves. Owners of oil reserves can revalue their potential income by increasing it from fuel at pennies per gallon to many dollars per gallon by conversion to polymers, carbon fibers, and crystalline carbon products such as diamond semiconductors. The hydrogen left over from these product manufacturing operations can be used in vehicles that clean the air and achieve minus-emissions and improved performance benefits.

3. The transition from *scaracity* as a consequence of contiguating the fossil-depent farming, manufacturing, and transportation industries to *renewable resource expansion* will provide a new mental climate that is conducive to long-term investments. This long-term investment climate is needed to provide adequate productivity to meet the challenges of increased demand for energy-intensive goods and services, particularly in sectors of the world economy that have been considered as have-nots. It is necessary to adopt a *resource expansion economy* in order to avoid the hardships now confronting the majority of the world's population. In developing countries, the average person exists on energy expenditures that are less than 1/15th of the average person in the U.S.A.

4. That Rotary Members welcome the *service-above-self* opportunity to invest the time and effort required make sure that it is widely known that practical alternative energy options are available for continuing to produce the many benefits of the Industrial Revolution without causing scarcity or pollution. All three of Arizona's District Governors have endorsed the Phoenix Rotary Club's *Pollution Free Planet Resolution* and the plan has been presented to the president of Rotary International for specific public education and commercialization actions within Rotary International's ten-year program to *Protect Planet Earth*.

These efforts have been widely commended and requested by other service organizations including The American Lung Association, Kiwanis, and Lions Clubs. As declared in the Phoenix Rotary Club's *Resolution* which has been appropriately adapted for adoption by many other Rotary Clubs, the Pollution Free Planet vision will be "to provide to all a pollution free planet through the worldwide use of Hydrogen and other renewable energy sources." This *Resolution* further provides for financial support of "pilot projects to demonstrate the viability of Hydrogen as an alternative energy source in concert with the American Hydrogen Association (AHA)."

Rotary members have worked with Phoenix and Arizona officials to initiate development of clean-air corridors by using hydrogen in municipal vehicles such as transit buses, garbage trucks, and personnel fleets. These demonstrations are needed to encourage citizens to convert vehicles to similar minus-emissions operation by using hydrogen in motor vehicles and to encourage visiting delegates from the world's most polluted cities to adopt these leadership demonstrations. The Pollution Free Planet Committee will have a booth with minus-emissions demonstrations and literature on these programs at the Rotary International Convention which runs from June 14 through June 17, 1998, in Indianapolis, Indiana.



WRITTEN BY ANN HOFFMANN
ILLUSTRATED BY J.J. SMITH-MOORE

Hannah & Sara's *Hydr O Bile*

Ann Hoffmann, Author - J.J. Smith-Moore, Illustrator

Hannah peers into her fish bowl on a bright Saturday morning and finds her favorite goldfish dead. She meant to clean the bowl but she was too busy playing T-ball and watching the Kid's Cable Channel. Now her fish have suffocated in the marky water. She contemplates this thought as she sobs herself to sleep under the thinking tree. Join Hannah, as she and her sister Sara find a magic flying car that cleans the polluted air so that all God's creatures can breathe.

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<http://www.clean.air.org>

IF THE PEOPLE LEAD, THE LEADERS WILL FOLLOW

By: Sherwin N. Berger

Never has there been a more relevant time to voice fierce indignation over events that individually, and certainly cumulatively are, like a rogue elephant running wild thorough a village - - entirely capable of smashing everything that nature and humans have created. This is not strident, unsupported rhetoric but rather an expression of the collective wisdom, fear and conclusions reached by a large majority of the world's scientific community who soberly appraise the population and energy statistics that are converging to overwhelm the carrying capacity of a small planet already relentlessly stressed.

The United States is the third most populous nation in the world. By the year 2000 China, India and the U.S. will account for approximately 43% of the total world population. By the year 2020 the total mass of humans packed into a finite space, using and competing for finite resources and contending for food will exceed seven billion souls.

If these shocking numbers resonate with the American public, there is scant evidence of it. Population demographics of such obscene magnitude are simply figures that are relegated to the dustbin of "less pressing issues." We pay extravagant attention to sport and entertainment personalities but callously and indifferently little to millions of our needy fellow citizens or to the terrifying consequences that soaring human numbers will have on the day-to-day struggles of those already oppressed by poverty and neglect.

To the casual, uninvolved citizen we live in a nation bountifully endowed with broad stretches of forest, endless plains, magnificent mountain vistas, hundreds of rivers and streams, thousands of lakes, vast farmlands, abundant natural resources, thousands of miles of coastlines etc. From an airliner at a 30,000 foot elevation everything appears idyllic; the country is enormous, diverse, relatively uncongested and one in which the impacts of population seem reassuringly mild. Or so it would appear to many. Unhappily, we respond only to what our shamefully hedonistic and consumption oriented lives have conditioned us to accept. A closer ground level look reveals acute problems of urban congestion and sprawl; poverty; homelessness; racial strife; crime; inequitable wealth distribution; shoddy educational performance; massive soil, air and water pollution and resource depletion of frightening proportions.

Each of these horrifying problems is replicated all around the world and each is further exacerbated by the permissive, unconscionable ballooning numbers of humans who are viewed as consumers of manufactured goods or as a source of cheap, exploitable labor. This population pollution is then utilized to produce virtual mountains of even more disgracefully wasteful, unneeded factory created talus slated for ubiquitous landfills. If the pathetic fate of billions already condemns them to lives of poverty, misery, degradation and hopelessness in a world overflowing, for some, with absurd material wealth, how can billions yet unborn be expected to improve any of the conditions that plague us today? Resources are far from limitless; the people who rely upon them are seemingly not limited. This is a socio-economic juggernaut that can't overwhelm us, regardless of where we live or how secure we think we are.

Ignorance of or apathy toward crucial issues of population and energy permits the further rending of the environmental and social fabric of our planet. These are the most momentous issues of our age. They are converging to forever alter life styles, attitudes, politics, social structures, technology - - in fact virtually every aspect of life. Unlike dramatic events that briefly grab the headlines, population and energy are so surreptitiously woven into the pattern of our lives that we seldom focus on them as distinct problems capable of forcing us to face the true humanity of our professed beliefs. Unless there is a dedicated activist buffer to steadfastly crusade against corporate and political intransigence can't to page 12.

GREENHOUSE GAS EMISSIONS: Captured for Profit

By: Roy E. McAlister

Garbage and sewage have presented disposal problems throughout the history of civilization. Offensive to our senses of sight and smell, garbage and sewage wastes have been discarded in places that are out of sight and far enough from where we live to spare us from the repugnant odors of rot and decay. Eventually wet sewers were developed for carrying water and sewage to local rivers, lakes, or to the ocean.

Beginning in 1619, water was piped into the homes of London. This "city water" was much easier to use than the small supplies that previously had to be carried into the home in buckets. Regular bathing, clothes washing, and floor scrubbing became more practical and expected of self-respecting citizens. Hoping for better sanitation and to eliminate the fear of something bad falling on you, King James I issued a building code prohibiting the use of overhanging commodes and the dumping of chamber pots into the city streets. The invention of the modern flush toilet, which was greatly improved by a man named Crapper and called the "water closet" made it possible to use city water to flush unmentionable wastes out of sight and out of mind.

As wet sewers and flush toilets became the standard for city dwellers, it became apparent that rivers could not sustain the growing load of sewage without becoming dangerous sources of disease. Sewage disposal plants were developed to kill dangerous microbes and remove concentrated sludge which could be buried in landfills or used in other applications. The water remaining after sludge removal processes could be drained to rivers, lakes, and oceans with less danger.

As the industrial revolution sourced more and more ready-to-eat, ready-to-use, appeal-packaged disposable products, the scope of garbage accumulation and disposal became hidden. Landfills became the standard place to dispose of garbage and sewage sludge. Wastes were hauled to remote areas, compacted by tractors and covered with soil. But this approach often produced continuing problems including contamination of ground water, the stench of rotting biomass, and a trail of paper shreds and trimmings from trees that littered the roads to the dump and the area around the dump. Eventually standards were developed to assure public safety by requiring garbage collection trucks to have provisions for compacting or at least containing garbage as it was transported to landfills. Landfills are required to seal wastes such as garbage and sewage sludge within an impermeable liner and to provide for positive venting of gases such as carbon dioxide and methane with provisions for preventing the escape of poisonous hydrogen sulfide fumes.

Bothersome Emissions & Depletion of Soil Nutrients:

During the last 100 years, it has been learned that greenhouse gases are accumulating in the atmosphere. Even the most modern sewage-treatment and garbage disposal facilities eventually release the carbon and hydrogen to the atmosphere as methane (CH₄), water vapor (H₂O) and carbon dioxide (CO₂). If the disposal conditions are provided with an abundance of air, the releases of carbon and hydrogen are predominantly as carbon dioxide and water vapor. *If the disposal conditions are anaerobic (in the absence of air or oxygen) the carbon and hydrogen releases shift to methane (CH₄) or possibly hydrogen (H₂) depending upon the kind of garbage, type of microorganisms present, and conditions of disposal including the temperature, pressure and amount of water mixed with the biomass. Landfills designed to be anaerobic generally produce about 40% methane, 40% carbon dioxide, and various other gases.*

These gases allow most of the solar radiation including ultraviolet, visible, and infrared wavelengths con't to pg. 7.

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to penetrate to the surface of the earth. After reaching the surface, these solar wavelengths that represent the 10,000°F radiation spectrum of the surface of the sun are converted to much lower-temperatures (-60° to 120°F) that heat earth's oceans, land masses, and ice caps. Greenhouse gases such as carbon dioxide, methane, and water vapor block re-radiation of the longer wavelength infrared spectrum from the earth's surface and trap heat energy that would have radiated into the cold black vacuum of space.

Since greenhouse gases cause more heat energy to be trapped near the earth's surface this results in increased evaporation of the oceans; more extremes in the weather, including tornados, hurricanes, snow or ice storms, and flood-producing rains; and the possibility of eventual warming of the atmosphere.

Sludge and garbage being buried in landfills gases such as methane and addition, the present

Soil nutrients may remain imprisoned for hundreds of years with little or no hope of being restored to the farm soils that sourced them.

continue to decay after and produce greenhouse carbon dioxide. In disposal practices

deplete farmlands of essential minerals that are taken from productive soils as part of the crops that end-up in sewage and garbage landfills or the oceans. Soil nutrients such as calcium, phosphorous, potassium, iron, cobalt, molybdenum, manganese, chromium, nitrogen, and trace minerals are taken to the cities as food and fibers. After these essential soil nutrients are taken to landfills as ingredients of sewage and garbage, they may remain imprisoned for hundreds of years with little or no hope of being restored to the farm soils that sourced them.

Fugitive Emissions: Captured for Profit

New ventures are being developed for collecting, processing, and distributing renewable energy from biomass landfills. Shallow wells are placed in landfills for the low-pressure extraction of methane. These wells produce renewable methane and other gases such as carbon dioxide, nitrogen, water vapor and hydrogen sulfide. This mixture of raw gases is collected in the landfill gas discharge stream.

In order to increase the energy value per cubic measure, methane is filtered through special membranes and liquefied to facilitate delivery by cryogenic trucks or rail tankers to market. This filtration and liquefaction process eliminates gases such as carbon dioxide and nitrogen which do not add heat upon combustion. The finished products are separate streams of very high quality liquefied carbon dioxide and liquid methane that have much less variation in energy content, viscosity, and dew point than pipeline supplies of conventional natural gas. In vehicular

applications, liquid methane also avoids contamination and plugging of fuel injectors with compressor oil that often plagues compressed natural gas systems.

In comparison with natural gas, which may require thousands of miles of pipelines and many compressor stations to connect distant gas fields with markets, delivery of landfill methane to local markets requires much less pipe and only one compressor station which is used in the liquefaction process.

Table 1 compares combustion characteristics of natural gas with methane and several other fuels. As shown in Table 2, methane is the

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major ingredient of natural gas which typically contains lesser percentages of heavier hydrocarbons such as ethane, propane, and butane. Because these heavier hydrocarbons occupy less space than methane there is slightly less energy in methane than natural gas.

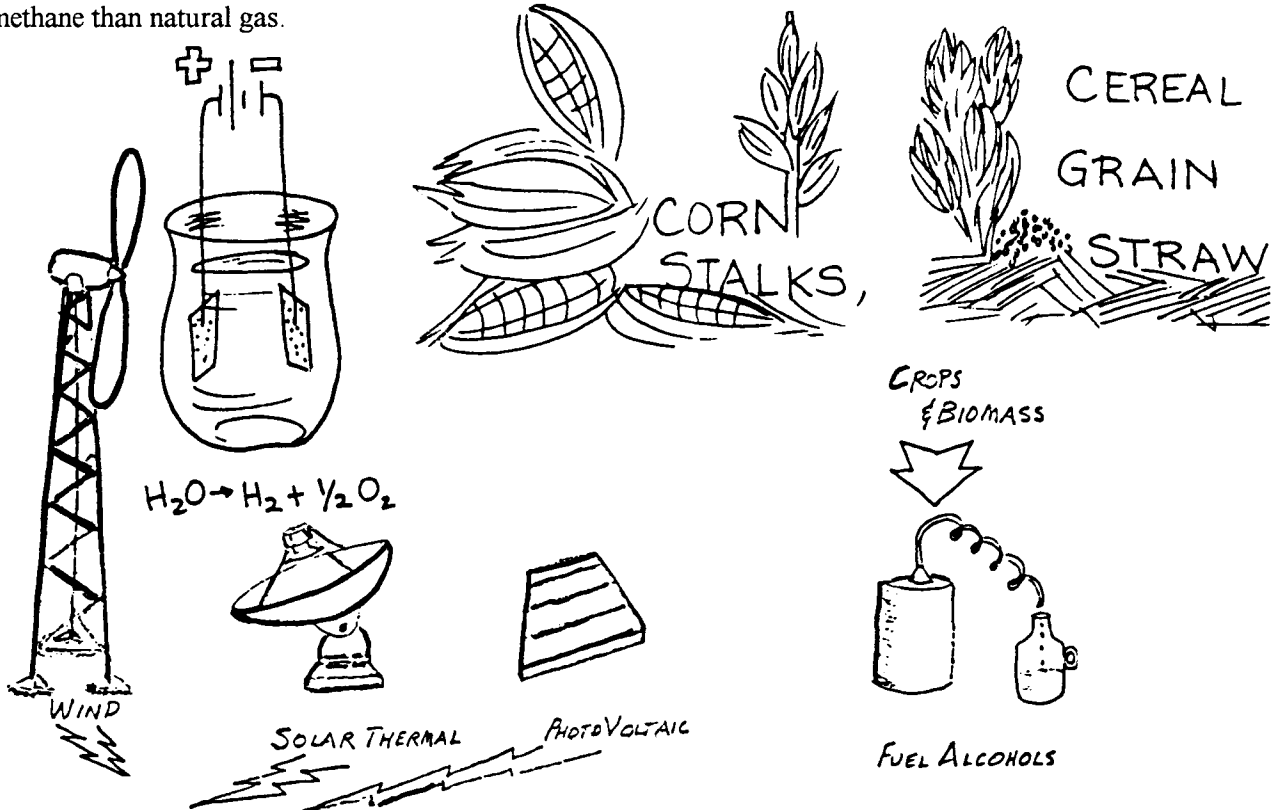


Table 1. FUEL COMBUSTION CHARACTERISTICS

Fuel	Lower Flame Limit	Upper Flame Limit	Lower Heat Release (BTU/lb)	Higher Heat Release (BTU/lb)	Air-Fuel Speed	Flame Speed (Ft/Sec)
Hydrogen	4% Vol.	75% Vol.	51,593	61,031	34.5 lbs/lb	30,200
Carbon Monoxide	12	74.2	4,347	4,347	2.85	
Methane	5.3	15	21,518	23,890	17.21	4,025
Ethane	3	12.5	20,432	22,100	16.14	4,040
Propane	2.1	9.4	19,944	21,670	15.65	4,050
Butane	1.8	8.4	19,679	21,316	15.44	4,060
Benzene	1.4	7.1	17,466	18,188	13.26	4,150
Methanol	6.7	36.5	7,658	9,758	6.46	3,900
Ethanol	3.2	19	9,620	12,770	8.99	4,030
Octane			19,029	20,529	15.11	4,280
Mexane	1.18	7.4				4,200
Gasoline	1.0	7.6	18,900	20,380	14.9	4,010

*At Atmospheric Pressure

Cont'd from page 8..

“Natural gas” is anything that comes out of the well from petrocarbon deposits. It may contain varying amounts of methane, ethane, propane, butane, casing-head gasoline, hydrogen, and non-fuel constituents such as water vapor, nitrogen, carbon dioxide, hydrogen sulfide, and helium. Coal-seam deposits produce natural gas that is higher than average in methane. Some wells around Junction City, Kansas, are high in hydrogen. Many Pennsylvania wells are known to produce rich gas that is high in ethane, propane, butane, and natural gasoline.

In order to standardize the quality of natural gas that reaches customers through pipeline delivery, the heating value must exceed 900 BTU on a lower heating value. Poisonous and corrosive constituents such as carbon monoxide and hydrogen sulfide must be removed and an odorant such as mercaptan must be added. Water vapor must be reduced to a lower concentration to prevent ice from building up in valves and exposed lines in cold weather.

TABLE 2: Comparison of Natural Gas and Methane

<i>Pipeline Natural Gas</i>	<i>Pure Methane</i>
<i>1 scf = 923.7 BTU (LHV)</i>	<i>1 scf = 909.49 BTU (LHV)</i>
<i>1 lb. = 21.826 scf</i>	<i>1 lb. = 23.635 BTU (LHV)</i>
<i>1 GGE* = 5.66 lbs.</i>	<i>1 GGE = 5.309 lbs</i>

* 1 GGE = One Gallon of Gasoline Equivalent using the energy reference of 114,118.8 BTU's (LHV) per gallon.

These complications are reduced by compressing, cooling, and liquefying methane and using the liquid methane as a compact cryogenic fuel or as compressed gas following regasification. Ecogas Company of Austin, Texas, is a company formed to collect greenhouse gases and they find these gases in abundance in landfills. Using gasoline as a comparison, Ecogas plans to sell one million BTU's of liquid methane at about the same price as 6 gallons of gasoline. In other words, for six dollars you can receive one million BTU's of Ecogas renewable methane. The energy value of the Ecogas methane will be equal to about 8.3 gallons of gasoline at the rate of 120,000 BTU's per gallon (114,118.8 BTU's on a lower heating value) which is the heating rate established by the National Conference on Weights and Measures.

In addition to cost savings, the Ecogas methane will greatly reduce atmospheric pollutants. The gasoline would produce about 20 pounds of carbon dioxide per gallon. Because Ecogas methane comes from landfills, there will be no new carbon dioxide. Carbon dioxide that comes to green plants though the air is photosynthesized into plant tissue. When the plant residues are converted to methane in landfills and recovered by Ecogas for use as an engine fuel, there is no net addition of carbon dioxide. In addition, the collection of methane prevents its escape as a greenhouse gas. This is a less than zero emissions result for the combination of fuel source and vehicular use.

Ecogas's new cash crops of liquid methane and carbon dioxide from landfills may stimulate profitable taking of additional cash values from landfills. Soil nutrients could be processed after extraction of the fuel gases. This would be encouraged by the fact that extracting energy constituents such as carbon and hydrogen from biomass assures a low probability of dangerous microbes being found in the residues.

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Ecogas provides a *“good deal”* for nearly every interest. For the vehicle operator, the price of fuel at the pump is lower than gasoline. For the city manager struggling to comply with clean air rules, the combined pollution emissions from the tailpipe and fuel-production system are greatly reduced in comparison with fossil-sourced gasoline, diesel and fuel oils. As shown in Tables 3 & 4, it is seventy-times better to use methane as a fuel to produce carbon dioxide than allowing the methane to escape from landfills. Additional greenhouse gas savings result from displacing fossil fuels. For good-health advocates, methane is not poisonous to persons exposed to the refueling operation compared to highly poisonous and carcinogenic ingredients of gasoline, especially gasoline with oxygenation additives such as MTBE and methanol. For the economist, values are created from wastes that would have rotted into the atmosphere. Anyone interested in America’s future will notice that companies like Ecogas are helping to reduce the drain of one billion dollars per week that is now paid for foreign oil. For the Chamber of Commerce, the project helps get credit for the area in all of these categories.

As noted by Jerrel Branson, president of Ecogas, “we are trying to create wealth for the communities we serve by making good use out of what has ordinarily gone to waste as greenhouse gases.”

Table 3: Comparisons of Greenhouse Gas Impact

<i>Species Concentration Rate of Increase Contribution</i>			
	(PPBV)*	(% Per Year)	(Relative % of TOTAL)
CO ₂ =	353 x10 ³	0.5	60
CH ₄ =	1/7 x 1-3	1.0	15
N ₂ O =	310	0.2	5
CFC-12	0.48	4.0	8

Table 4: Heat Trapping Capacity

<i>Atmospheric Species</i>	<i>Relative Heat Trapping Effect</i>	<i>Decay Time (Years)</i>
CO ₂	1	120
CH ₄	70	10
N ₂ O	200	150
CFC-12	6,000	120

Reference: Henning Rodhe, *“A Comparison of the Contribution of Various Gases to the Greenhouse Effect”*, *Science*, Vol 24-8, June 1990.

Table 6: Ignition/Combustion Comparisons

<u>Properties Units</u>	<u>Hydrogen</u>	<u>Methane (Natural Gas)</u>	<u>Gasoline</u>
1. Self-ignition temp, (°C)	585	540	228-501
2. Ignition limits in air (Vol.%)	4-75	5.2-15	1.0-7.6
3. Min. ignition energy (mWs)	0.02	0.29	0.24
4. Flame speed (cm/s)	265	40	40
5. Flame temperature (°C)	2045	1875	220
6. Lower heating value (kWs/g)	120	50	44.5
7. Detonation limits (Vol.%)	13-65	6.3-13.5	1.1-3.3
8. Detonation velocity (km/s)	1.48-2.15	1.39-1.64	1.4-1.7
9. Expl. energy (kg TNT/m ³)	2.02	7.03	44.22
10. Diffusion coefficient (cm ² /s)	0.61	0.16	0.05

BioENERGY 1998
Expanding Bioenergy Partnerships

The focus of BioEnergy '98 is to build a thriving biomass energy industry through partnerships for energy, the environment, and the economy. This conference will be the first major biomass conference to examine implications from the Kyoto Conference meeting on greenhouse gas emissions and other environmental topics.

Special emphasis will be on mitigating greenhouse gas emissions, financing issues, and innovative bioenergy projects around the world. Topics include liquid biofuels, electric power production from various feedstocks and technologies, biogas production and utilization, biomass cultivation and harvesting, technical and economic assessments of cropping and production systems, national and international policy issues and market opportunities.

The conference will be held at the Monona Terrace & Convention Center designed by Frank Lloyd Wright in Madison, WI, October 4-8, 1998. Hosted by the Great Lakes Regional Biomass Energy Program and the U.S. Department of Energy. For more information, including the call for papers and trade show exhibitor application call Fred Kuzel at (312) 407-0177; <http://www.cglg.org/bioenergy98>; or e-mail fkuzel@cglg.org; other web sites: <http://www.cglg.org/projects/>

Silicon Valley Chapter of the American Hydrogen Association:

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Monthly Membership Meetings: 2nd Saturday, 10:00 a.m. to Noon @ the Peninsula Conservation Center 3921 East Bayshore, Palo Alto, CA. The American Association for Fuel Cells 50 San Miguel Ave, Daly City, CA 94015 (650) 992-3963 is a division of AHA. Tom Dickerman edited the *“Renewable Energy Experts & Advocates.”*

con't from page 5. "If the People Lead, the Leaders Will Follow"

that encourages population growth and the sacking of the biosphere, with its myriad of interrelated life forms, then we can only anticipate a more precipitous decline in everything esthetic, wondrous and precious.

Our actions have totally obscured the incontrovertible reality that it is not only our population, but also populations everywhere that threaten the carrying capacity of the Earth. In an ever shrinking world, what transpires thousands of miles from our shores will quickly exhibit a direct impact on us just as surely as though they had happened within our borders. Together with the frightening reality of economic, political and environmental entropy there is the equally vexing problem of escaping the degree of disorder attendant to breakdown of these essential systems. But at the point of breakdown there will be no escape. To take refuge in an isolationist belief that all is well, that we will always enjoy prosperity and that we are free of the problems of other countries, is to refute reality.

Those multinational corporations and their political allies who orchestrate the theme of the global economy are persuaded that "produce and consume" is the ultimate answer to all conditions in all countries and under any circumstances. They have adroitly sold this concept to the gullible, the unsuspecting and the uninformed who see only virtue in the machinations of corporate empires. Left to educate and to do battle are those guardians of sanity who are fully cognizant of the grand design of evolution whose ecological threads are woven into the wondrous tapestry that comprises our zone of life (biosphere). These sensitive ecological threads are easily unravelled by wanton actions of rapacious business interests.

We permit a ravaging of the biosphere for profit and power under the guise of economic growth in a free-market economy. Thinking people do not dispute the virtues of a free market economy; what we must unequivocally reject is the mindless, ugly, reckless and dehumanizing way in which it is achieved. Humanity stands at a crossroad where the choices are limited to taking a path that is environmentally healing, feasible, cost effective, practical, logical and absolutely imperative or choosing a road that will lead to an irreversible collapse of our environment as it loses its ability to absorb the massive punishment of accelerating pollution, deterioration and the population explosion. It is the ethical and self-protective duty of every person to become actively involved in efforts to reverse the onslaught that is so pathetically evident all around us.

The title of this article is a sentence I have used often in my writing. I do so because it is so profoundly true. It is at the core of the actions that are mandatory for a transition to hydrogen energy systems. Such a transition will significantly reverse our precipitous slide into the abyss of planetary immolation. To destroy our planet as a sacrificial victim for the momentary aggrandizement and rapacious greed of corporations whose goals are specious growth, the revered bottom line, insanely inflated executive salaries and shareholder satisfaction is a concept so monstrous and so lacking in any underlying redemptive value that it must be rejected as preposterous. Unhappily, what seems absurd and contrary to reason is reality masked in seductive, manipulative advertising together with grossly disingenuous representations by corporate Philistines who put us all at risk

FOLLOW THE LEADERS???

In a paradox of reality reversal we have come to believe that leaders make decisions and set policy based upon some superior wisdom or exalted position of influence. What we forget is that we the people ultimately pay their salaries, buy their products and elect them to office. In the final accounting they are beholden to us - - not we to them. Collectively we are in fact the leaders.

"Leaders" are in their positions because in some fashion, be it large or small, we placed them there to implement what we wanted. In reality these folks should be called implementers since that is what they are there to do. We hire them to implement and attend to all the minutiae of running a corporation or even a country. Whenever we have been so motivated, citizens have forced changes simply by making themselves aware of options and DEMANDING necessary changes. Sometimes it is called social progress, sometimes revolution.

It is surprising how much influence we have over our destiny *when armed with the knowledge and determination to use it wisely.*

If wisdom and resolve fail us, if the only legacy our children and grandchildren can anticipate is poisoned water, poisoned air and poisoned soil on a planet packed with teeming wretched billions, how do we measure our stature as intelligent humans? A hydrogen based economy with all its stunning, healing potential speaks to the wounded soul of the world. The multiple salutary benefits of a hydrogen based economy to replace fossil fuels and nuclear energy cannot be overstated. Yet, powerful interests continue unabated in their quest for fossil reserves.

In helping to redefine for others how tragic is environmental desecration accelerated by population growth, we become emissaries on a mission of enlightenment. We must convey the message that the carrying capacity of the planet has already been *seriously compromised.* If we are open to the truth, the evidence is all about us. Rain forests around the globe are being cut at the staggering rate of 214,000 acres every day for firewood, for growing crops and raising cattle to feed swelling numbers of humanity or to provide exotic woods and lumber for building homes for more and more people. Temperate forests are experiencing a similar onslaught to provide lumber and paper for burgeoning populations. The repercussions of such extravagant encroachments into any ecosystem are predictable, ugly and result in ecological and/or economic ruin.

Rivers and streams are often dammed, diverted or drained till they are dry stream beds or only vestiges of their former splendor. With all this ill considered "management" comes the inevitable loss of wetlands, loss of habitat for aquatic plants and animals, siltification, unnatural erosion, loss of groundwater and a host of related problems. Rivers have become industry's dumping ground for thousands of toxic chemicals in an orgy of corporate malfeasance.

The oceans, our major source of oxygen from algae, are open sewers, particularly at the junction of river deltas and over the continental shelves adjoining cities where human excrement and industrial wastes threaten aquatic life and oxygen production. The oceans are severely over-fished to supply growing populations. The inevitable consequences of diminishing sea resources have become a major flash point of serious friction among seafaring nations.

Oil, gas, coal and metals are extracted from the earth in gargantuan quantities to provide for the needs of people everywhere. The extraction, transport, processing, storage and final utilization of these finite materials terminates in a shocking plethora of polluting contaminants whose grim after effects are incessant reminders of a psychopathic aberration of values that glorifies profit above survival. This fouling of our biosphere is responsible for global climate change, acid rain, ozone depletion, poisoning of crops and the loss of thousands of plant and animal species whose interrelationship with other species to form an ecologically balanced environment is lost forever.

The list goes on and on; it is long, morbid, dispiriting. It is also an accurate, detailed description for **ECOLOGICAL GENOCIDE.** *The threat is real, it is deadly serious, it is imminent!* To stem the tide of destruction we must be courageous, dedicated and inventive in our quest for creative, equitable and healing changes. We must focus on the major threats of population, resource depletion and the culpability each of us shares in the produce and consume trap into which we have been drawn by the allure of "product mania." A critical, in depth exploration of available options (like hydrogen and solar power) to halt the threat to our individual and collective security will be forcefully communicated *if we reprioritize our patterns of consumption.* The leverage inherent in this one action alone will send a clear and powerful message to corporate executives and politicians that odious acts of planetary sabotage will not be tolerated.

If the people lead and express their contempt for actions and policies that deplete precious, finite resources or savage the biosphere with noxious, deadly pollutants, then the corporate world will act upon the message.

All around us are dramatic manifestations of ongoing pollution, climate change and adverse health conditions and increasing poverty that shape the struggles of innocents everywhere. There is no place to hide from the hypnotic allure of convenience, comfort, leisure, pleasure and all the “good things” of our modern age. However, the good things come wrapped in an attractive, seductive package, marketed with all the Madison Avenue advertising expertise that money can buy. But this is a snare and a delusion. The package when opened and examined, reveals a condition akin to Pandora’s box. In Greek mythology the box contained all human ills which, when Pandora opened the lid, escaped into the world, leaving only hope at the bottom of the box. The mythological and real life parallels are striking.

The new millennium is almost upon us, yet we lack a coherent energy strategy that will take us into the next century and beyond. Instead there is a looming energy catastrophe that will expose our vulnerabilities on every level of life. We live in a childlike state of denial despite a landscape strewn with environmental, population, political, economic, climate, health, social and national security consequences of our folly. As the savaging of the planet’s resources progresses at an accelerating pace most of us stand mute, content to observe the wondrous nature of the engineering and technological skills that can locate, extract and convert raw materials into products for which we have a frivolous, selfish and insatiable appetite.

Industrialized nations and newly developing economies play into the same shortsighted hope for a better, easier life. What they give up to achieve a “better” life is often of infinitely greater value than what they receive. It is from this “produce and consume” trap that we must extricate ourselves now. Without such dedicated action, posterity faces a bleak future. It is criminal to wait for a catastrophe before we accept the error of our wasteful ways. But do we have the resolve to face the implementers and compel them to recognize their self-destructive actions?

THE OIL PATCH AND BEYOND:

The issues of energy resources and how they are utilized transcends all others except population growth. These two issues are handmaidens of our contemporary living; each one serves and feeds the other. Population growth, by virtue of clever sophistry, is represented by some as an ideal catalyst for corporate growth; good for earnings, good for inflated executive salaries, good for shareholders. The fact that it is hideous for humanity is never mentioned.

In a new TV advertising campaign, Texaco extols the efforts of its employees who scour the world for rocks that give evidence of oil deposits. They test them, smell them, even taste them to “find the energy the world needs to keep on running.” If this company, and others like it, is aware that it is living on the brink, it shows no evidence of that fact. *Our often reiterated declaration that oil reserves will be depleted in 30-40 years is still being ignored.*

On Wall Street stocks of oil companies and the oil service sectors are touted as the next profit bonanza. The thinking relies on the possibility of world demand for oil exceeding supply, particularly in the Far East. This positions oil companies, producers of drilling equipment and retrofitters in a commanding position for rapid growth and profits. Add to this potent brew the unrest with Iraq and the lack of consensus between the U.S. and the 14 other countries of the security council as to how to play their cards with Saddam Hussein, the cleverest, most determined and dangerous poker player in the world. As oil supplies tighten, expect to hear more from Saddam as he manipulates other nations, not for the alleged benefit of the Iraqi people, but rather to further his personal influence in the region. But Iraq is not the only problem country in the Middle East. Iran, long suspected of quietly assisting Iraq to evade the UN embargo on selling its oil, could form an open alliance with its former enemy or conversely, the recently elected “moderate” government may break openly with Iraq and spark a new conflict with other nations in the region. Perhaps Syria perennially the potential wild card in this high stakes geo-political game, will make an overt move of some kind. Meanwhile severe political unrest in Egypt, Sudan and Algeria together, with Israel and the Palestinians involved in sporadic episodes of “peace processing” lends more permutations to an already

agonizingly complex political drama. Another frightening possibility is the rather improbable but not impossible scenario in which Islamic fundamentalists everywhere in Africa, the Middle East and Asia forge a formidable economic alliance that could drive the price of oil to startling new heights.

The current price of oil, while low now, due to a frenzy of exploration, drilling and an announced quota increase by OPEC (which had already been quietly implemented for quite some time prior to the public declaration) cannot persist. There will be fluctuations in crude oil prices as events, like the financial crisis in parts of Asia, temporarily moderate the world appetite for oil. But this is just a blip on the chart of where oil prices will surely head. Unless the law of supply and demand is repealed, an upward trend in consumption of oil will assure significant and inflationary price increases.

KYOTO CONFERENCE: DO NOTHING TO ROCK THE BOAT

As regards the global warming conference in Kyoto, Japan, I am truly perplexed, angered and frustrated. The U.S. entered the conference calling for industrialized nations to return emissions to 1990 levels by 2010. This stance contravened our own 1992 position to reduce emissions to 1990 levels by 2000 as affirmed by President Bush. The European countries entered the talks with a proposed cut of 7% by 2005 and a 15% cut by 2010. What resulted after chaotic negotiations was a proposed reduction of 7% by 2012 for the U.S., Japan will cut 6% and Europe will cut 8%.

Eighteen months ago the U.S. stood tall and firm in protecting the science of global climate change at the July 1996 Intergovernmental Panel on Climate Change (IPCC). If the science was correct then, why did we go to Kyoto with such a lackluster, wimpy attitude that angered many participants and forced Vice President Al Gore to eat crow by announcing on December 8th, a new more flexible negotiating stand for the U.S.? Why were the targets and timetables not related to the science and to the ability of countries to achieve them? As the world's most profligate polluter, we should have taken Kyoto by storm with a powerful, upbeat and courageous position that set a standard for all the other 158 participants. That kind of leadership example would have assured a result in keeping with the desperate need for much more than we received. The discontinuity between what actions are absolutely needed and what was proposed is simply astounding - - shocking. It is a graphic demonstration of monetary values over the preservation of the biosphere.

Our administration and those of other countries have capitulated (read, sold out) to powerful interests whose priorities are to wage the same kind of ecological warfare on the planet that has historically been successful for them. Apparently the old adage that "nothing succeeds like success" is true. Surely those individuals are devoid of conscience and confer new meaning to the word "amoral". (Like, willing to sacrifice a planet to gain their ends).

As a result of the Kyoto pact special interests are voicing their displeasure, based upon the monetary losses that they anticipate. Priorities are so badly skewed and intertwined that they are ridiculous. Some rightly demand an end to fossil fuel subsidies amounting to \$60 billion per year in the U.S. But the energy firms refute the figures and oppose such a move. Apparently corporate welfare is desirable while social welfare is dangerous.

One oil industry spokesman contends that not only is the case for global warming inconclusive but in addition "oil industry subsidies are almost always either wrong or highly misleading". The spokesman goes on to state that the U.S. Energy Information Administration (EIA) recently did a comprehensive examination of these subsidies for congress and "it used an unrealistically broad definition". Of course when the EIA conclusions on other issues happen to agree with the oil industry position, the shoe is on the other foot. Among other complaints is: "the EIA definition includes tax provisions that allow petroleum companies to recover production costs, which all businesses are entitled to do, and the costs to the government of regulating the industry". I am appalled that petroleum companies are entitled to recover production costs; logic would dictate that a wealthy, mature industry would be able to easily absorb production costs as a normal expense of conducting business. I also seriously doubt that all businesses are entitled to do the same, as alleged in the statement quoted. Another assertion by the same spokesman

to low income families for winter heating fuel.” Do critics of these subsidies want to eliminate such aid to needy families?

This same spokesman makes other erroneous charges like this: “Attaining the emission reductions that the administration agreed to in Kyoto would mean cutting U.S. energy use by as much as 37%. That would require much higher energy prices. Gasoline prices for example would have to increase 75 cents a gallon. Those higher prices would do immense damage to the U.S. economy and severely lower Americans’ standards of living and drastically alter their lifestyles”.

This kind of inflammatory, untrue statement is the type of essentially unchallenged rhetoric that is being fed to us by the energy consortium who can easily afford massive expenditures to get their self-serving message to an uninformed and therefore a gullible public. When this dangerous humbug comes from an organization that gives the impression that they are knowledgeable about this topic simply because of some official sounding name, then their deception is believed and spread as anti-environmental gospel. In this instance the quotes excerpted above come from an article by the director of policy analysis and strategic planning at the American Petroleum Institute (API) who, you can be absolutely certain, does not promote the best interests of the public over those of the oil industry.

One must examine these statements carefully to realize how misleading they really are. I find the API figures extremely suspect; to me they seem badly inflated. A 37% reduction in energy consumption over a 14 year period is not only unlikely but also contrary to the forces at work right now. Energy utilization in the U.S. is *increasing* and productive entities will not cut back but *should*:

1. Switch to less polluting energy sources;
2. Eliminate wasteful practices by continuing the overall efficiency procedures put in place by industry during the 1990’s and the late 1980’s.
3. Improve emission abatement procedures.
4. Recognize the virtues of hydrogen and put emphasis on its large scale production so that hydrogen energy can meet business needs while eliminating fossil fuel emissions.

The entire API article is predicated on the assumption that the U.S. is going to use less energy rather than switching to non-polluting energy sources.

The 75 cent per gallon price increase is also suspect. Federal and state mandates on auto emissions will become more stringent to meet the target (7% below 1990 levels by 2012) and this in turn will promote the development of more fuel efficient internal combustion engines together with the proliferation of more and improved hydrogen fuel cell engines. In reality, even if the price of gasoline did increase by 75 cents it would do so incrementally and would be absorbed by consumers in the same way that they are today when seasonal or other factors push the price up. If the true environmental costs had been calculated into the pump price of gasoline, U.S. drivers would have been paying a much higher price for many years, just as they have in European countries, New Zealand, Australia and elsewhere. Those higher prices have not done the “immense damage” that the API predicts will befall us.

A 75 cent gas price increase computes to \$375.00 based upon a national average of 10,000 miles driven per vehicle at a modest 20 miles per gallon. This is hardly an unhearable burden and pales compared to the price increases of books, newspapers, magazines, movies, sporting events and entertainment of all kinds that cost the public considerably more than the threatened rise in gasoline prices. Indeed, the 75 cents could easily accrue through industry manipulation of accounting figures for purposes of inflating profit margins. I am not the first to ponder the gyrations of pump prices over the years and the multiple rationalizations that have supported them.

On every level the Kyoto conference was a farce. It has been preceded by an intensive campaign of lies and distortions specifically calculated to denigrate and mock the consensus statement by 2500 world scientists who believe that global warming is a reality. Before writing this article, I referenced a commentary that I had written

for "*Hydrogen Today*" Vol 7, No.2 , page 6. That piece talks about the Intergovernmental Panel on Climate Change (IPCC) that convened during July 1996 in Geneva. At that conference, Timothy Worth, the U.S. Under Secretary for Global Affairs was very forceful in outlining and defending the U.S. position. It is instructive to quote from Mr. Worth's statement at the IPCC conference. 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 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." That statement was true in July 1996; it is equally true in March 1998.

Mr. Worth's position was admirable but on one crucial point he was apparently uninformed. I said in my article, "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. Worth is aware of advanced hydrogen technologies and their ability to defuse the entire global climate change crisis, he shows no indication of such knowledge". My statement is even more germane today but the urgency index for worldwide recognition of this reality has increased enormously.

Despite the "treaty" finally hammered out, the time by which target reductions must be met are an illusion when viewed in context of what is happening today, tomorrow and each succeeding day. Targeting today's emission levels for possible reduction by the year 2012 or 2020 is doomed to failure, and worse still, emission levels will actually increase, because of population pressures and growing demand due to globalization of economies using progressively more energy. During the conference the phrase "alternative energy sources" was used ad nauseum. Was there any American representative that dared to let the H word slip from between his/her lips?

However the political and economic scenario plays out, the rationale for massive investment in hydrogen production facilities becomes ever more imperative. With population leapfrogging by 90+ million each year, humanity will surely view hydrogen as a blessed alternative that can be produced locally in virtually every part of the world. What could become a universal awareness of the hydrogen potential, if enough people fight to get the story out, might induce oil companies to finally recognize that their best interests are served by PRODUCING AND SELLING HYDROGEN. In the long run, regardless of initial costs, hydrogen will prove to be their best and wisest investment.

Hydrogen will surely become the most enormous, global business enterprise in history. I believe it will eclipse in scope and dollar volume the fields of electronics, biotechnology, wireless communication, medical or any other technology. Energy is the only bedrock element tht every society shares. No matter how remote or how technologically unsophisticated, every tribe, every group, no matter its size, relies upon some form of energy for heat, light, cooking, agriculture, or for making tools and artifacts. The more "advanced" the society the greater the need for energy. Progress from cave to skyscraper, from walking on Earth to walking on the moon, all required prodigious quantities of energy, essentially all of which we took from the Earth and never replaced. Instead we burned it, secure in the mistaken belief that we could continue our tactics of depleting finite energy resources despite ample evidence to the contrary.

DREAMS OF THE PAST, DREAMS OF THE FUTURE, WHAT CAN WE CONTRIBUTE?

It is not difficult to find blatant expressions of vile corporate disregard for the public welfare. Given these conditions, is it reasonable to expect that long cherished views which enrich a few and imbue others with corrupting power can be reversed? Yes and no. No, if something is not instituted to instill a conversion of spirit. Yes, if those of us who care are skillful and motivated sufficiently to present cogent and compelling reasons to convince the culpable that paradise has many faces.

If we had some special mechanism for recouping all the time, thought, energy and financial resources that have been invested in resisting the environmental imperative, we would have everything needed to achieve our goals of "*prosperity without pollution*" and sustainable growth together with a sustainable planet. But that is a dream of

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the past. Now we must dream of the future.

If you are weary of being lied to or manipulated by giant, rapacious industries; if you are incensed that population growth can, by sheer weight of numbers, erase worthy gains made in other areas; if you are frightened by the maddening acceleration of all forms of environmental degradation; if you are saddened and angered that there are not any areas of nature and beauty that have not been touched by desecration and hideous contempt for our heritage; if you want to have a voice in the green revolution, then you are part of the solution. The solution is in every way a function of political and industry initiative that must be urged on by vigorous public outcry as well as potent citizen action. Seemingly impossible obstacles can be surmounted if enough dedicated citizens “take to the streets” to force the issue, by voicing their passion for environmental and economic sanity. Surely the continued viability of our biosphere is a cause mighty enough for such massive displays of collective conscience.

There is a new consciousness circulating throughout the world. We must nurture it, grasp it firmly and lovingly, mold it ever so gently with great and spirited resolve; such merciful awareness can act as a catalyst to encourage and nourish the psychic and physical well being of peoples everywhere. We must teach, we must craft a new image of what can be done. That must be our legacy for the future, for everything we hold dear, for posterity.

A RACE AGAINST TIME:

It is tragic that given the known environmental impacts of fossil fuels and nuclear energy, in addition to the geopolitical and economic upheavals attendant to utilization of traditional energy sources by populations growing exponentially, that at this late date an argument still ensues among some groups about the merits of hydrogen to replace increasingly scarce and/or poisoned power energy sources. Whatever the alleged limitations of hydrogen, I submit that I know of none that are not trivial when measured against the draconian consequences of not immediately embarking upon a full transition to a Hydrogen based economy. Every argument advanced by those who believe that selective tinkering with our present energy systems can solve our profound current and future problems, tumbles in disrepute when compared to the simple, obvious, provable and non-threatening virtues of environmentally benign hydrogen.

In an article entitled “*Dawn of the Hydrogen Age*” that appeared in WIRED magazine, October 1997 issue, the author Jacques Leslie reveals the tensions and competition developing between small firms as well as between industry giants who have become involved with various aspects of hydrogen utilization. But tragically, nowhere in the article was there any indication of any firm committing to large scale renewable hydrogen production facilities. This was not an oversight by the author; such a facility does not exist! Instead industry is concentrating its financial and research resources on new car engines utilizing fuel cells that produce hydrogen from feedstocks like gasoline and methanol rather than from renewable hydrogen. There is some recognition that sustainable sources like biomass could be used to make hydrogen for fuel cells but little is being done in that area. While development of advanced fuel cell technology is critical, what about hydrogen for the 200 + million internal combustion engines already in service in the U.S. and the 400 + million elsewhere, plus the millions more that are being manufactured each year? What about hydrogen to fuel factories or for heating and cooling commercial, industrial and residential structures? Or hydrogen to make electricity for distribution on the existing grid? Most internal combustion engines can be converted to burn hydrogen or mixtures of hydrogen and other fuels, with huge savings of oil, while achieving greatly increased efficiencies, together with a dramatic reduction in all pollutants.

With a major focus on only one aspect of the hydrogen transportation equation, it does not appear that industry cares one whit about a totally integrated hydrogen based economy. While this is frustrating it is not surprising. Unless the public is educated to and demands reasonably priced hydrogen and internal combustion engine conversion abilities, industry will ignore the few “radical nuts” who want everything at once. Only the car conscious public can alter this singleminded, self-defeating, expediency driven, piecemeal and slow-paced approach toward what should be the most conspicuous, popular, and eagerly endorsed idea for pushing hydrogen into the limelight.

Pop Quiz: Don't look now but the answers follow!

1. What year was the warmest year in the last century of global weather reporting?
2. Regarding accumulation of greenhouse gases in Earth's atmosphere, which is more damaging to the investments that have been made by the Industrial Revolution:
 - (a) an increase in atmospheric temperature, or
 - (b) more energetic weather-related events such as increased evaporation of the oceans, and more: floods, snow fall, ice storms tornados, hurricanes and lightening strikes
3. What energy carrier provides minus-emissions opportunities including:
 - fuel for cars that clean the air;
 - ways to refine and/or smelt metals and clean the air;
 - chemicals production with air cleaning;
 - and farming that cleans the air.
4. If some condition blocked 20 to 30% of the solar radiation that now reaches the surface of the Earth what would happen?

Answers:

3. Solar hydrogen
2. (b) More energetic weather which occurs as nature converts more trapped solar energy into the work products of the atmosphere.
1. 1997
4. The oceans would freeze and reflect more solar energy back into space plunging Earth into a devastating ice age.

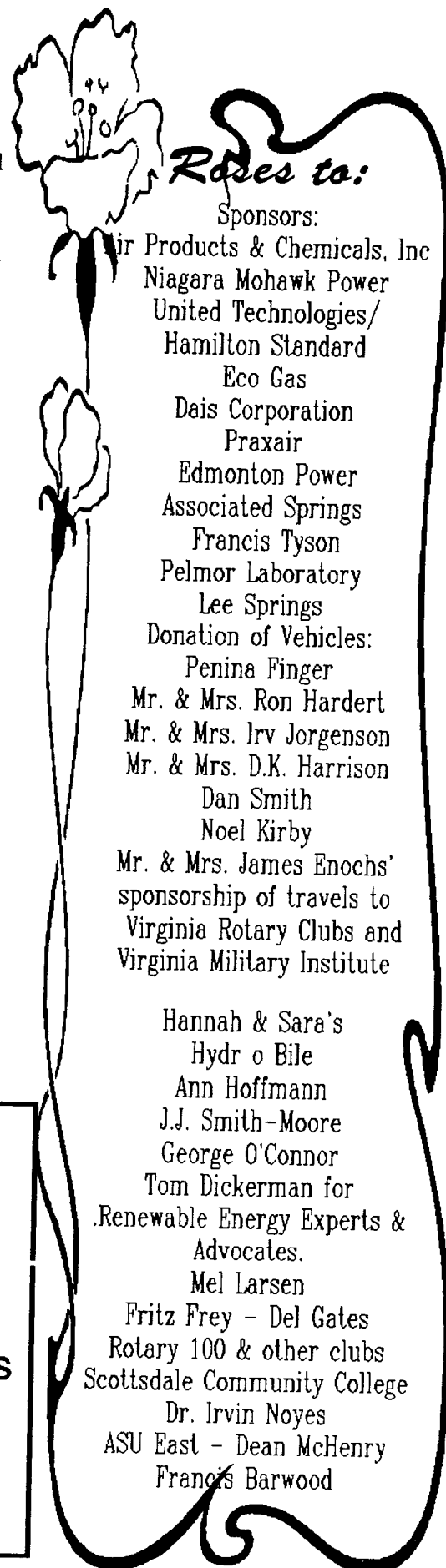
Courtesy of Mel Larsen
Larsen Radax Corporation
www.clean-air.org

Did you know, that the jet pilots dump their jet fuel over the ocean, before landing the jets on the Navy's carriers? They do this as a safety issue. Perhaps the Navy should think of using hydrogen as a fuel.

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Dr. Irvin Noyes

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Franco's Barwood

cont'd from page 18. "If the People Lead, the Leaders Will Follow"

In the same WIRED article the author makes the point that is the thrust of this essay. He states, "The irony is that for all this technology's potentials benefits, the one thing that it notably lacks is strong public support." This is sadly true but I would add that hydrogen technology also lacks a sense of urgency on the part of industry or on the part of the public that has heard a bit about hydrogen but still views it as a laboratory curiosity.

Hydrogen advocates who believe passionately, not only in the rightness of the technological concepts inherent in our cause, but also in the distinctive character and pragmatic rational of our position are frequently asked why hydrogen is not being more universally accepted and aggressively promoted by commercial interests, industry leaders, financial institutions, the environmental community, the political sector or by the general public.

A major component of the answer is found in a public that has been lulled into a dangerous sense of complacency that all is well as long as the fossil fueled engines of production keep stamping out all the tens of thousands of things that we have been convinced we cannot live without. But for how long can we continue to manufacture goods on such a prodigious scale when oil reserves are near exhaustion? Will we learn in time to avoid the ambush of errors repeated and enter a glorious new age of a revitalized socio-economic system that works for the elevation of the human condition?

The distorted relationship that has developed between business and consumers over a period of years has been wonderfully illuminated in the award winning book "Ishamel" by David Quinn. It is a unique and endearing novel that overflows with truths and provides a direction for those who shudder at the shortness of time before events spin totally out of control. Read it to bolster your feelings of not being alone in your perceptions. Read it as a guide for your own acitons.

CORPORATE RESPONSIBILITY vs. INDIVIDUAL RESPONSIBILITY:

It is easy to place blame for all economic shortcomings on the corporate hierarchy and their political allies. But are corporations solely at fault for dreadful conditions that can catapult us into a new dark age? Certainly not. Make no mistake about it, corporate behavior is the alter ego of contemporary expectations. While we are quick to legitimately criticize many of the manipulative actions of powerful business interests, we must also look honestly at our own personal complicity in this yin-yang relationship.

Multinations and other business entities are only able to promote what the public wants or is willing to accept. We have capitulated to unrestrained hedonistic and materialistic values and in doing so have surrendered the choice of what is good for whom to those forces that are ideally positioned to take full advantage of our collective weakness. But the weakness can be turned to great strength, if we recall the wisdom of Mahatma Gandhi as exemplified in his own words, "You must become the change you wish to see." What is enormously important is the development of an ethic that addresses the desperate state of the world. What is even more mportant is a commitment to act upon that ethic. We no longer have the "luxury" of remaining passive observers, critics, or apathetic bystanders; at stake is the fate of the world.

VOICE YOUR INDIGNATION:

In a thoughtful and provocative article entitled "*Ethnics - A Matter of Survival*", that appeared in the 1992 March-April issue of The Futurist magazine published by the World Future Society, Rushworth M. Kidder made these closing remarks: "We will not survive the twenty-first century with the 20th Century's ethics. The dangers are simply too great - - and the ethnical barometer is simply too low." Nowhere is one likely to find so succinct, prophetic or profound a statement to summarize our present sad condition.

Clearly, steps must be taken to break the chain of institutionalized barbarity and self-destructive events that characterize the wretched conditions so evident everywhere. How do we infiltrate, influence or change those entities

whose powers appear absolute? They control technologies, manufacturing, monetary policy, political actions, etc. However, they do not yet control what we feel and think about issues; they do not control what we instinctively know is terribly wrong and must be changed. The opportunities for rational, progressive, enlightened changes are as great as the opportunities for continued regression. We must school ourselves to be vigilant and open to the former.

The power of the many who feel emotionally, spiritually and economically violated can overcome the towering contempt of the few who dictate our destinies. A new knowledge of a hydrogen based economy, together with its potential for eliminating many environmental, economic and social ills, can become the cornerstone for dedicated, ethical involvement. The circumstances and the plea presented in this essay are a call to awareness, a call to action. **TO IGNORE THIS ALARM IS TO IGNORE OUR FUTURE!!**

We are uniquely positioned to literally change the world for the better. The responsibility is ours; our posterity demands it. Our sense of pride, purpose and community creativity demands it. Planetary and family continuity is the most meaningful treasure we can leave as our tender legacy for all future generations. The window of opportunity to make a proactive choice is still open. Choosing to inspire others by instructing them in the wonderful attributes of hydrogen and by educating them to the excellence of replacing fossil fuels and nuclear energy with hydrogen energy systems is a truly humane, ethical and life-preserving introduction to the 21st Century. To do otherwise will condemn future generations to the pernicious gridlock of conventional energy perceptions, together with all its deadly consequences.

We must preserve the majesty of our blue planetary home with all the wondrous diversity that is a hallmark of what and who we are. A legacy of planetary defilement and personal torment for our children and their children is not an option; it violates every tenet of meaningful or decent societal behavior.

Only one life form can destroy all, only life form can save all. In the noblest spirit of constructive rebellion, we must recapture our heritage. We must think, move and speak with one single, rational, powerfully persuasive voice or the only sound heard above the roar of the wild winds will be an agony of lamentation propelled upon the emptiness by billions of lost souls.

“It must be considered that there is nothing more difficult to carry out, no more doubtful of success, nor more dangerous to handle, than to initiate a new order of things. For the reformer has enemies in all those who profit by the oil order, and only lukewarm defenders in all those who could profit by the new order. This lukewarmness arises partly from fear of their adversaries, who have the laws in their favor, and partly from the inexperience of mankind, who do not truly believe in anything new until they have had actual experience of it.”

Machiavelli

*Sherwin N. Berger is editor of “Hydrogen Today”. With all of our volunteers, we say thank you for helping to put this newsletter together. Many hours goes into writing, editing, printing and mailing. Thanks.

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**GOOD PEOPLE
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The Volume of Carbon Dioxide

By: Irving Newman (Ref: Roy E. McAlister)

Recently there was a story about a high school chemistry teacher's effort to help his students and people everywhere remember Avogadro's number. Avogadro was an Italian scientist who first defined that one mole of any substance contained exactly the same number of molecules. The number is 6.02×10^{23} . To commemorate this number, the chemistry teacher declared that at 6:02 a.m. on October 23rd of each year we should pause for a moment and reflect on the wonderful discovery of Avogadro's number.

6.02×10^{23} is a very large number. The mass of the Earth's atmosphere in grams is 5.136×10^{21} . We can use the concept of Avogadro's number to help estimate the volume of carbon dioxide released into the atmosphere and the amount of oxygen consumed when gasoline is burned in a car engine for example.

For simplification, think of the burning of gasoline as the following reaction: $\text{HC}_x + \text{XO}_2 = \text{XCO}_2 + \text{H}_2\text{O}$. For ease in estimating, I assumed that all the carbon is completely oxidized to carbon dioxide and water. However, we know that a very small percentage of gasoline is converted to some very toxic gases like carbon monoxide and unburned hydrocarbons which contribute to urban smog when combined with the emissions of thousands of other vehicles on the road.

PROBLEM: When one gallon of gasoline is burned, how much carbon dioxide comes out of the exhaust pipe?

One gallon of gasoline produces 20 pounds of carbon dioxide. We also know that at standard temperature and pressure, one gram-mole of any gas will occupy a volume of 22.4 liters. The reason that one mole of any gas, whether a heavy molecule like bromine or a light one like hydrogen, occupy the same volume in the same conditions is because the smaller molecules move faster proportionately so they occupy the volume as heavier molecules.

One mole of any substance contains Avogadro's number of molecules of the substance. Another useful bit of information is that one mole of any element has a weight equal to the atomic mass of the element.

$$20 \text{ lbs CO}_2 = \text{how many grams CO}_2?$$

$$(20 \text{ lbs}) (454 \text{ grams per lb}) = 9080 \text{ grams.}$$

So, 9080 grams of CO_2 divided by the formula weight of the molecule which is 44; times 22.4 liters per gram mole is about 4,622.5 liters (volume) of carbon dioxide. Dividing this number by 3.784 gives the volume in gallons which is 1,221.3 gallons (volume) of carbon dioxide. This is equal to about 163.3 cubic feet of this greenhouse gas.

Burning one gallon of gasoline in your car will produce about 1,221 gallons of carbon dioxide to be emitted from the tailpipe! Also, in the process of burning one gallon of gasoline, free oxygen is removed from the atmosphere and combined with carbon to form carbon dioxide and water vapor. The increase in CO_2 from burning fossil fuels and other human activities has already dramatically changed the percentage of CO_2 composition of the atmosphere and will continue to change it even more in the future.

It also should be understood that the same 20 pounds of carbon dioxide, or over 1,221 gallons, will be released from an automobile engine whenever a gallon of gasoline is burned, regardless of the make of car, or its age, or whether or not it needs a tune-up. Be it a Jaguar, a Rolls Royce, a Yugo, a Rambler, a Pinto, a Chevette, a Lexus, or a BMW, so long as a gallon of gasoline is burned whether by racing, driving or idling this amount of carbon dioxide will always be produced.

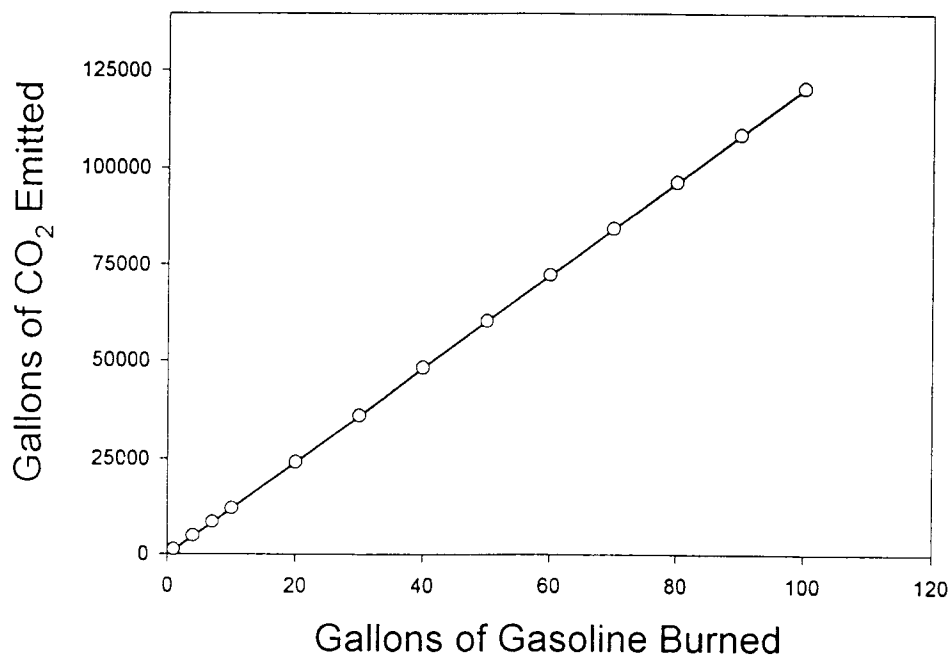
Arctic snow cores show that Earth's atmosphere now carries about 30% more carbon dioxide than at any time

in the last 160,000 years. Although green plants are greatly stimulated by this increased concentration they have not been able to keep up with the exponential rate that energy intensive human activities add carbon dioxide to the atmosphere. Increased carbon dioxide in the atmosphere causes solar energy to be trapped in the global air mass. With more energy the atmosphere can evaporate more water from the oceans and cause more damaging floods, hurricanes, and tornadoes.

To a great extent, modern food production is trading fossil petrocarbons for lesser amounts of edibles. This is because fossil fuels are used in farm tractors and other equipment to prepare the seed beds, for cultivation, to harvest, and to dry the crops for storage. Petrochemicals are used for fertilizers, insecticides, herbicides, and crop preservatives. Much more process energy is used along with liberal amounts of biodegradable plastic packaging made from petroleum at the point of converting bulk foods into familiar foods such as bread, cheese, frozen dinners, breakfast food, beer, and all the other marvels at the super market. As an example, it is estimated that two thirds of a cup of oil is required per cup of milk to grow the fodder, milk the cow, make the roads, refrigerate the milk, truck the milk to the homogenizer/pasteurizer/bottler and deliver the milk in disposable cartons to the refrigerated stands at your grocery store. Because our food selections, often from far away places, feature highly refined, ready to eat foods, distilled beverages, precooked and frozen TV dinners, and ice cream, it results in releases of about 40,000 pounds of carbon dioxide per person each year. *This is over 13 times the weight of the family car!*

Most coal, oil, and natural gas fired electricity production cause stack emissions of about 3.5 to 4 pounds of carbon dioxide per kilowatt-hour. A home using 12,000 kilowatt-hours per year would cause the release of about 44,000 pounds of carbon dioxide at the power plant. This amount of carbon dioxide is nearly 15 times the weight of the family car! Virtually all of these examples could be brought to virtually zero carbon dioxide emissions by replacing fossil energy with hydrogen and recycling used packaging. If the hydrogen is derived from fossil sources the carbon left over can be used to build better highways, bridges, cars, airplanes, golf clubs, and tennis rackets. This is a much more appropriate use of our technological prowess and natural resources than to tempt more record breaking floods, hurricanes, and tornadoes. It will make you healthier, wealthier and happier. And future generations will thank you for not wasting Earth's precious fossil carbon reserves.

CO₂ Produced for the Amount of Gasoline Burned



“The Law of the Minimum” notes on conversations with Dr. Robert Zweig

By: Roy E. McAlister, President of AHA

The renowned physician Dr. Zweig has often noted that Civilization is accountable to the “Law of the Minimum” as is the natural world. In any complex interactive system, an essential ingredient that falls below the minimum requirement will cause the whole system to collapse. If farmers deplete the aquifers in irrigated areas or cannot afford the energy to pump water, then all the fertilizer, know-how, and market demand is immaterial. Similarly if cities run out of healthful air, all the investment in infrastructure, know-how and market demand is immaterial.

Hydrogen is the only fuel that can offer fundamental sufficiency in energy while satisfying the healthful air requirements of the “Law of the Minimum.” The policies of Theodore Roosevelt gave us representative government oversight on anti-trust, food and drug purity, and wilderness preservation. Almost a century later these policies are still part of the core values of this country and our perception of what is right and necessary.

Enduring policies are seldom built on abstractions, logic, or analysis but on what is perceived to be real. The motoring public perceives gasoline to be the cheapest fuel.

But in reality U.S. taxpayers provide \$26 billion in subsidies for fossil fuels and an additional \$19 billion for nuclear power. Upwards of \$54 billion subsidizes military protection of the Persian Gulf oil, which means that we may have been paying the equivalent of \$70 per barrel for the last 20 years even before additional billions were spent for the Gulf War. Indeed, Congressman Bill Alexander estimated that when the Desert Storm military costs are included in the cost of gasoline, the true cost of gasoline was elevated another \$5.50 per gallon or more than \$200 per barrel.

It is also an important reality that 100 gallons of oil can be used to produce durable goods such as TVs, computers, carpeting, clothing, and vehicle components. These durable goods sell for over \$3,500 which makes the opportunity cost of burning gasoline over \$34 per gallon. Every ten years since 1900, the amount of petroleum burned by the world’s vehicles has doubled! We cannot afford to burn the opportunity to produce present and future inventions of durable goods from the fossil reserves.

Health costs related to caring for diseases caused by, or aggravated by fossil fuel combustion continue to increase. Recent epidemiological studies reveal that citizens living in heavily polluted areas show increasing signs and incidence of chronic lung disease and some cancers. Health care dollars spent to care for these patients could serve a greater societal need by preventing the diseases. Solar hydrogen technology will go far in preventing diseases due to airborne contaminants while facilitating adoption of a sustainable economy.

Electrochemistry and Fuel Cell Primer

First of a five part series

By: Roy E. McAlister, P.E.

Have you been wondering what it is like to take an “AHA Fuel Cell” class? The subject sounds complicated, but the lessons are provided in easy steps with working systems and models. This article will introduce you to some of the chemoelectric language of fuel cells. Consider taking a class in the Fall of 1998. “*Hydrogen Today*” will have a series of articles on electrochemical fuel cells. Making, applying, and maintaining hydrogen fuel cells has started important industries for motive and stationary applications. Call the AHA Office at (602) 827-7915 about class schedules and sign-up.

Fuel Cell Primer

Part 1.

In 1992, Albert Einstein hypothesized that mass could be interchanged with energy by the following relationship: $E = mc^2$; where E is the energy, m is the mass that is exchanged, and c is the speed of light. Mass disappears when energy is released as in the burning of coal or fission of uranium in a nuclear power plant. A 600 MW coal-fired power plant burns 220 tons of coal per hour or about 2 million tons per year. A 600 MW nuclear power plant requires about 1 ton of uranium fuel rods per year. *Each of these electricity generators use finite fuel reserves to convert only about 1.5 pounds of mass into energy each year along with notorious by-products.* The coal plant produces more than 6 million tons of carbon dioxide, carloads of flyash and slag along with surprising amounts of radioactive heavy metals. Each year at the nuclear plant about 1 ton of nuclear fuel wastes are added to the growing inventories of radioactive materials that will be dangerous for 7,000 years.

In comparison, solar energy is the most abundant energy of all forms of energy available to Civilization. Solar energy is nonpolluting, nondepletable, reliable, free, and it can be used in processes that are compatible with virtually all forms of life on Earth. Solar energy is produced in the sun by the conversion of matter into energy by gravity induced thermonuclear fusion.

Electromagnetic radiation travels at the speed of light (c) through a vacuum as a wave in which the energy E is directly proportional to the frequency ν : $E = mc^2 = h\nu = hc/\lambda$ (where h is Planck's constant and λ is the wavelength)

The most energetic, shortest wavelength, and highest frequency radiation is called *gamma radiation* which usually emanates from an atomic nucleus. *X-rays* are next in radiative energy and are emitted by excitation of orbiting electrons. The next most energetic band is *thermal radiation* which includes ultraviolet, visible, and infrared wavelengths. Most of the energy from the sun is thermal radiation. *Microwave* and *millimeter-wave* radiation is next in the energy spectrum and the least energetic is the long-wave *radio wave spectrum*.

Chemical energy is released in reactions as a result of electron interactions. *Nuclear energy* is released as the result of the particles transiting from a less stable to a more stable configuration. Thermal energy is associated with molecular or atomic vibration. *All other energy forms can be converted into thermal energy.*

Solar radiation reaching Earth may be converted into chemical potential energy as matter is produced from received radiative energy. Illustratively, the first step of photosynthesis is production of hydrogen and oxygen from a slightly smaller mass of water. Hydrogen is retained by the green plant to be combined with carbon dioxide in a variety of organic compounds. Oxygen is released to the atmosphere.

Numerous opportunities exist for utilizing solar energy to produce hydrogen. One way is to pyrolyze an organic compound to release hydrogen. Another approach is to produce electricity for electrolysis of water. *Solar hydrogen* refers to any approach that uses solar energy to produce hydrogen. One of the most efficient methods of utilizing hydrogen to release energy is in an electrochemical application called a fuel cell.

Fuel Cells: Chemoelectric Power for your Electric Car Conversion

In 1839, William Grove published information about an electrochemical cell that combined hydrogen in a porous platinum electrode with oxygen in a porous platinum electrode in a sulfuric acid electrolyte to produce electricity and water. Grove's discovery of what has become "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 which have the Carnot efficiency limitation.

The quantity of energy that can be extracted from a given amount of matter by non-nuclear reactions that result

in the matter coming to rest at equilibrium with the “ambient” surroundings is the internal energy which is the sum of the potentials for doing work by pressure expansion, thermal processes including radiation and heat engine operations, chemical reactions, and kinetic energy processes. Perhaps the most difficult of these components of energy to measure is the “free energy change” for a chemical reaction. Designated G_o , the “Gibbs free energy” (after J. Willard Gibbs 1839-1903) of a chemical reaction is not equal to the heat release or *total enthalpy of the Products* $\sum H_{PO}$ minus the *total enthalpy reactants* H_{RO} as measured, for instance, from some specific chemical reaction in a bomb calorimeter. $\sum H_{PO} - \sum H_{RO} = \Delta H_o$. The quantity G_o cannot be so easily determined by a simple experiment such as measuring the heat released by a chemical reaction. The free energy change in a chemical reaction is equal to the enthalpy change minus the absolute temperature (T) times the change in disorder or entropy (S):

$$\Delta G_o = \Delta H_o - T (\sum S_{PO} - \sum S_{RO}) \quad \text{or} \quad \Delta H_o - T \Delta S_o$$

In the case of a phase change including sublimation, fusion, and vaporization, the addition or subtraction of heat energy does not result in a temperature change. The Gibbs free energy of the mass is constant through a phase change. In chemical reactions Gibbs free energy is of utmost importance and allows chemical reactions to be considered as a constant pressure and constant temperature events followed by temperature and pressure consequences.

An interesting philosophical exercise is to note the historical bickering between scientists observing spontaneous reactions and astronomers. Before astronomers theorized black holes, all spontaneous events known to humans seemed to occur with an overall increase in entropy. In space, the stars of the Universe seem to be racing away from each other in an enormous entropy increase. A peach tree can blossom and assemble millions of carbon dioxide molecules from the atmosphere with hydrogen from water, and various minerals from the soil to produce beautiful peaches that are very well organized compared to the atmospheric content of carbon dioxide. The amount of disorganization or entropy increase that occurs in the sun to produce the radiation that powers the peach production processes is obviously enormously greater than the chemical structuring of disorganized atmospheric molecules.

Contemplate the possibility of organization or entropy decrease by gravitational forces. Black holes seem to exist and may be the only locations in the Universe that spontaneously reverse entropy by collapsing matter and energy in overwhelming gravitational force fields. It is conceivable that larger black holes will devour the smaller black holes. Gravity might ultimately produce total reversal of all entropy increases so far by reversing the big-bang expansion of matter and light and collect all the energy and matter into a single universal black hole.

Here on Earth, it is possible to build fuel cells that theoretically convert more than 80 percent of the chemical potential energy of hydrogen into electricity. The maximum efficiency of a fuel is the ratio of change in Gibbs free energy (G) to the change of enthalpy (ΔH) in the reaction:

$$\text{Efficiency} = \Delta G / \Delta H = (\text{WORK}) / (\text{ENERGY EXPENDED})$$

If both G and H are expressed in joules (energy units) per kilogram-mole, the electrical work that can be done is provided by current equivalent to the passage of 1 kg-mole of electrons which is equivalent to Avogadro’s number 6.023×10^{23} in which the charge of each electron is 1.602×10^{-19} C. Thus the sum of charges associated with 1 kg-mole of electrons is 9.65×10^7 C and this quantity of charge is defined as one Faraday or F_y . If n moles of electrons are released in a reaction and the internal cell voltage (without losses) is E_g the value of electrical work W_e possible is: $W_e = nF_y E_g \leq \Delta G$

The maximum internal cell voltage is found by the Nernst equation: $E_g = E_g^\circ -$

As noted by the Nernst equation, increasing the temperature (T) of the reaction usually decreases the voltage of operation and thus the amount of electrical work that can be done. Conversely, increasing the temperature decreases the voltage required for electrolysis of water because the electrolyzer reverses the chemical equation of the fuel cell. An energy conversion system could utilize concentrated solar energy to reduce the voltage of electrolysis, cool the hydrogen to ambient temperature, produce higher voltage in a fuel cell, and supply part of the electrical work to the

high temperature electrolysis and the remainder to other loads.

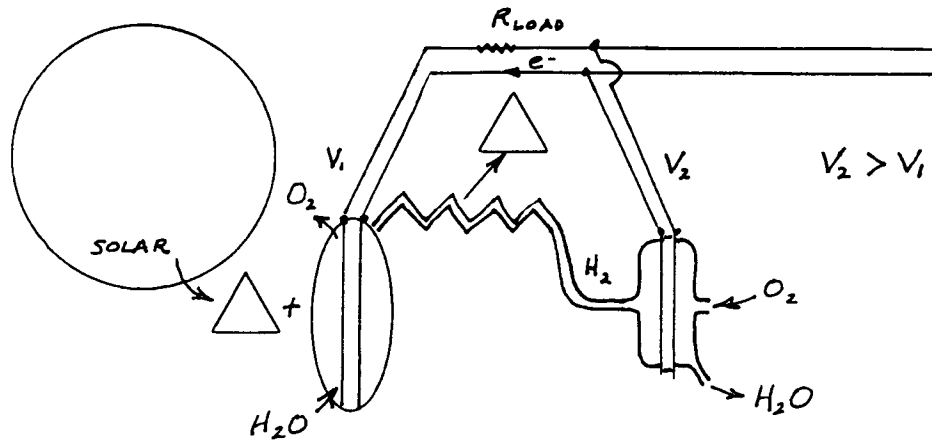
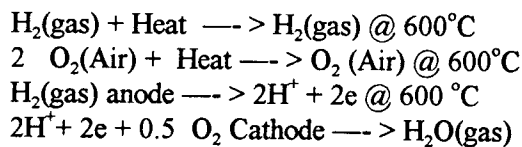


Figure 1.

To illustrate the operation of a fuel cell find the maximum theoretical efficiency and output voltage of a hydrogen-oxygen fuel cell operating at 600°C. Assume the hydrogen is supplied at 1.1 atmospheres and the oxygen is supplied from air at 1.2 atmospheres. Steam is the product of the reaction at 600°C. Enthalpy of formation H° and Gibbs free energy G° are given in Table 1.



Maximum Efficiency $= \Delta G / \Delta H = 78.22\%$

Compound or ion	Enthalpy of Formation H° J/kg - mole	Gibbs free energy G° J/kg - mole
CO	-110.0 x 10 ⁶	-137.5 x 10 ⁶
CO ₂	-394.0 x 10 ⁶	-395.0 x 10 ⁶
CH ₄	-74.9 x 10 ⁶	-50.8 x 10 ⁶
H ₂ O (water)	-286.0 x 10 ⁶	-237.0 x 10 ⁶
H ₂ O (Steam)	-241.0 x 10 ⁶	-228.0 x 10 ⁶
LiH	+128.0 x 10 ⁶	+105.0 x 10 ⁶
NaCO ₂	-1122.0 x 10 ⁶	-1042.0 x 10 ⁶
CO ₃ ²⁻	-675.0 x 10 ⁶	-529.0 x 10 ⁶
H ⁺	-0.0 x 10 ⁶	0.0
Li ⁺	-277.0 x 10 ⁶	-293.0 x 10 ⁶
LiOH	-230.0 x 10 ⁶	-157.0 x 10 ⁶

The State of the Union Message Not Given to the American People

World oil production has reached its midpoint, and we are now approaching the depletion side of the bell curve. The discovery of crude oil has been credited with providing abundant and cheap energy during administrations for the last 100 years. In the present administration we have gone from a \$5 trillion dollar economy to \$29 trillion dollar global economy. The consequence of this policy is that we are on a collision between the expanding economy, with Asian economic deflation, and the earth's natural limits. More than two-thirds of all known oil reserves are situated within 5 Muslim countries in the Middle East, including Iraq, Iran, Saudi Arabia, Kuwait, and Abu Dhabi. The OPEC cartel has 78.1 percent of the world's reserves and will soon be in control of world's oil markets. The world has been extensively explored with sophisticated technology and geology. It is not likely that any large oil potential remains to be discovered. Here in the U.S. most of the energy produced during the last 150 years came from 300 giant oil fields larger than 500 million barrels whose discovery peaked during the 1960's. Light crude oil has been relatively easy to find and produce. It flowed naturally from the reservoir into the wellbore under a high bottom-hole pressure. U.S. production has followed a characteristic depletion pattern, starting at zero, rising to peak production before declining exponentially towards zero again as the field is exhausted. It should come as no surprise that the era of cheap and abundant oil is about to end. We now have to make a plan to sustain civilization.

We are in a technological and industrial era that has been based on fossil fuels. It has allowed us to produce enough food to increase the world's population to 6 billion. The present rate of addition is 98 million new babies every year. It has allowed us cheap electricity. We have made many mistakes by entering the nuclear age. We have nuclear wastes that we cannot afford to store. Many countries have been dumping the waste into oceans and landfills. Here we have on-site storage at the nuclear power plants. With the many promises of nuclear, the U.S. made many mistakes. We can no longer afford to travel this path. We must learn new ways to produce energy.

I mention the "D" word, deflation, because the Asian financial crisis appears to be a major drag on

our markets. After easing out of 20 years of worrying about inflation, we are now facing its counterpart, deflation, which became a major element of the Great Depression of the 1930's. These three elements, diminishing oil supplies, population and unstable economies are going to shape the next century.

If we continued to hide the facts from you, then you won't have time to prepare. We have much work to do. We are going to convert our nation to renewable resources. We are going to expand our economy by the huge amount of work that needs to be accomplished by switching from fossil fuels to renewable energy technologies. It is going to take all of us working day and night to make this happen. This will not be an easy process. Our schools are going to have to learn to teach the new technologies. We cannot afford to have our seniors retire. We cannot afford the brain drain as they go to pasture to play. Alas, our social security can no longer afford to have them retire. It takes nearly 25 years to prepare a student from birth to working age. We must be more efficient and learn more in 20 years and include work-study programs so what we learn will have more meaning. Students are going to have to work hard - we are all going to have to stay focused as we work harder, smarter, and more creatively to achieve sustainability.

Let me mention here that the social programs that have swelled our budget will now have to stop. If we are to remain financially responsible, then the capitol that goes for social programs will now have to go to finding ways to warm your homes, feed the people, and have your cars run on the forever fuel - hydrogen. We cannot afford mistakes in the path that we outline. We have run up against the time-line. Americans love to wait until the last minute. I am here to tell you that we waited almost too long. Developing renewable resources will be the greatest new type of social program. It will go from expecting the government to take care of you to preparing the infra structure, so that you can be warm and free to travel.

How much time do we have left before OPEC is in control? The pumping rate of taking the oil out of the ground and into production will not be able to keep up with demand in the year 2005. We have been selling the Navy oil reserves to support government programs. The OPEC countries have not held to their quotas. We are going to let Iraq sell a billion barrels of oil by the year 2000 - a deal hammered out by the United Nations. All of this is to support our oil habit. But it will not last long. We are going to experience the oil shock.

I have instructed the Secretary of Energy to start preparing for the Solar-Hydrogen Economy. I know that Americans have the vision and faith to see that we expand our economies to renewables. I instruct you to become self-sufficient. For more information: www.clean-air.org

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STUART ENERGY SYSTEMS Bringing Hydrogen To Market

Congratulations from AHA to all the new businesses:

A new enterprise, Stuart Energy Systems Inc, plans to offer hydrogen generators based on electrolysis of water to meet the growing demand for hydrogen. This includes refueling systems for fuel cells and systems for storage of renewable energy. Alexander K. Stuart, Chairman and founder of The Electrolyser Corporation Ltd, announced that the company's SunFuel Energy Systems Division has been amalgamated with Electrolyser's subsidiary Les Industries d'Electrolyseurs du Quebec Inc. By combining the efforts of Electrolyser's SunFuel Division with IEQ's advanced water electrolysis research, a strong team has been established to accomplish the objectives of the company.

SunFuel Division has recently completed a turnkey photovoltaic hydrogen production and vehicle fuel supply project in Los Angeles. At present, the SunFuel Division, dba Stuart Energy Systems is in the process of supplying hydrogen and a refueling system to Ballard Power Systems. IEQ has led Electrolyser's program to make water electrolysis systems. The development effort of reducing the weight, volume production and the cost of water electrolysis makes Stuart Energy System a primary producer of renewable hydrogen. Stuart Energy Systems will continue developing the electrolysis and related technologies and will commercialize these under its SunFuel brand name. The hydrogen electrolyzers will utilize off-peak capacity from existing electric producers. Hydrogen produced from off-peak power has the potential to compete with hydrogen from reacting water with natural gas or gasoline to fuel "minus-" and "zero-emissions" vehicles. To produce these results hydrogen will power internal combustion engines (ICEs) and fuel cell engines (FCEs).

Stuart systems also expects to assist the advancement of renewable energy on a broader scale. Renewable energy such as sun and wind tend to be intermittent in nature. Water electrolysis enables these clean primary sources to produce hydrogen for energy storage with "power on demand" capabilities through ICEs or FCEs. This allows the renewable energy resource to be connected to the electrical grid in a stable, controllable, and predictable system. This will make hydrogen available to homes and businesses for appliances and transportation needs. Stuart estimates that this system will be about \$5,000.00 for a home size unit.

For more information: Andrew T. B. Stuart at (416) 621-9460; fx: (416) 621-9460 (Toronto, Canada). Matthew Fairlie is Vice President of Energy Systems and Jean Dube is Vice President of Development. Jean Dube's phone number is (819) 539-1531 in Shawinigan, Canada. email: info@stuartenergy.com

AHA's Investment Opportunity Class

By the time you get this newsletter, AHA will have completed the March - 98 Investment Class. The next class will be in October of 1998. Each day we learn of new companies, new products, and new research progress.

For instance, "*Hydrogen Today*" has reported on the progress of *FuelMaker Corporation*. FuelMaker Corporation has two new significant shareholders, Magna International, Inc., and Canadian General Capital Limited. FuelMaker produces a compressor for natural gas. Natural gas or landfill methane powered vehicles can be loaded with high pressure fuel from the FuelMaker compressor. If you have natural gas delivery to your home, you can put a FuelMaker in your garage and have your own supply for re-fueling your vehicles. Many homes have natural gas hot water heaters, furnaces, or gas stoves for cooking. Now you can have your FuelMaker producing compressed gas for re-filling your converted vehicles.

Ergenics, Inc., in Ringwood, New Jersey just reported some marketing progress. Ergenics has received a new Defense Advanced Research Projects Agency (DARPA) contract to develop a high-power version of its "Hy-Stor" battery system. This will allow Ergenics to target specific power output of 1,000 watts per kilogram for its fuel-cell battery. The company says its power-storage technology is well-suited for use in hybrid-electric vehicle applications because of its ability to provide high discharge rates during acceleration. Its battery system is capable of 100,000 cycles to 80 percent discharge; has zero self-discharge; has reduced thermal-management problems and a high tolerance to states of over and undercharge. Hy-Stor uses "multi-cell bipolar" technology to store hydrogen outside the battery in a metal hydride until needed.

Another potentially important technology development was recently announced by *Energy Research Corporation*. It is called *Direct Fuel Cell technology*. John J. McMullen Associates Inc, a naval architectural firm awarded a contract of \$270,664 to design a Direct Fuel Cell Power Plant configuration for a U.S. Coast Guard maritime application. This design effort is expected to lead to the construction and demonstration of a fuel cell power plant in a land-based setting followed by installation on a Coast Guard cutter.

Jerry Leitman, President and CEO, says, "The project is synergistic with the company's recent contract with the U.S. Navy to develop a ship service fuel cell. Power plants for naval and commercial ships offer a potentially large fuel cell application. ERC has already successfully demonstrated operation of its fuel cell on diesel fuel and other logistic fuels." Hans Maru, is the Executive Vice President for ERC. For information contact: Peter R. Voyentzie (203) 792-1460; e-mail: moreinfor@ercc.com

The U.S. Navy, U.S. Coast Guard, Maritime Administration and National Oceanographic & Atmospheric Administration seek highly efficient, low maintenance technologies for ship electric service and propulsion. Potential markets for fuel cell power plants include commercial fleets, surface and submarine combat, and support ships, shore-patrol vessels, and ocean-going research ships.

ERC calls its fuel cell technology the Direct Fuel Cell because a suitable hydrocarbon fuel gas is fed directly to the fuel cell instead of through an external fuel processor. Fuel cells are often described as either continuously fueled batteries or electrochemical combustion engines. Fuel cells produce power without conventional combustion or rotating machinery. Unlike batteries, however, fuel cells operate as long as fuel continues to be supplied. Some types of fuel cells can operate on fossil or biomass fuels and oxygen from the air to produce electricity. ERC interchangeably uses hydrogen or hydrocarbon fuel that goes directly to the fuel cell.

Another emerging competitor in the fuel cell market is *Plug Power*. The U.S. Department of Energy's Los Alamos National Laboratory has signed a preliminary agreement with Plug Power to commercialize fuel cells for automotive and stationary applications. Plug Power's President and CEO, Gary Mittleman, said, "Los Alamos researchers have made significant strides in laying the foundation for polymer electrolyte-fuel-cell systems." The commercialization work will be in conjunction with a CRADA which stands for Cooperative Research & Development Agreement.

International Fuel Cell (ONSI Corp.) of South Windsor, CT) reports that its first model fuel cell has surpassed 40,000 hours of operation. The PC25 fuel cell unit is owned by Southern California Gas and provides electricity and co-generated heat for the Hyatt Regency Hotel in Irvine, CA.

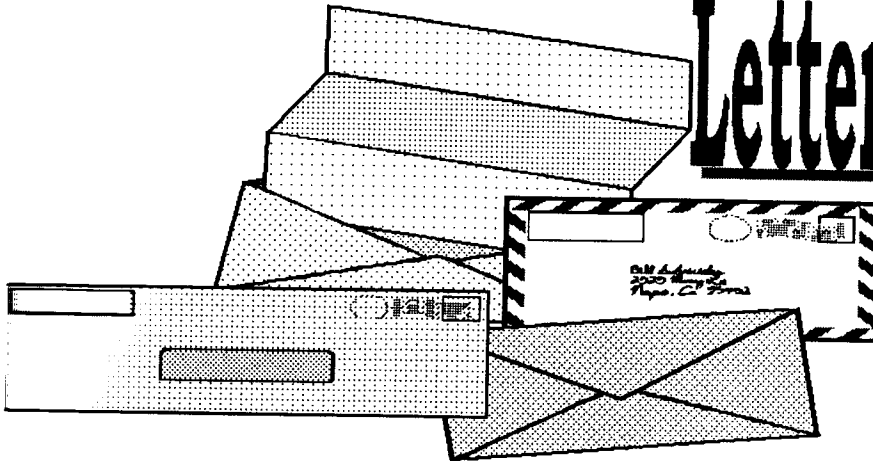
Robert Suttmiller, President of International Fuel Cells, says that "Each of the 120 fuel cells in the ONSI fleet of PC25 power plants provides 200 kW- enough to supply electricity for nearly 150 homes." The cells use an electrochemical process to directly convert chemical energy into electricity and hot water. The chemical energy normally comes from hydrogen contained in natural gas. "The ONSI unit at Irvine has functioned with an operating availability of 95.6% - It has produced more than 7 million kW-hr of commercial-grade electricity."

For more information fax: Michael London at (203) 459-1032.

To sign-up for the Investment class contact: Kathy at AHA; (602) 892-7915 or fx: (602) 967-6601.

Long over-due is a big ***THANK YOU to Dick Williams***. Dick was the first President of the Southern California Chapter of AHA. Southern California is a large area - and Dick was able to organize and run smoothly this Chapter. You might be interested in getting their newsletter: Contact the editor Dan Morton 4424 N pershing Ave, San Bernardino, CA 92407. For membership: contact Craig Pals 3026 Associated Road #102, Fullerton, CA 92635. This chapter is doing great work.

Letters to the editor



Marcia Greenshields sends this letter to each of you. It is a new type of crossword puzzle that makes sense by doing the puzzle. Looking at the answer will not give you any meaning to her message. The message is in finding the words.

ACROSS

1. Produces smog & illness: any;..... (form of energy). (2 words)
21. ... & I, or any (freed) (individual) can (& ought to) promote the solar-hydrogen economy. (3 words)
41. From solar gen sets and H₂O, (two) (gaseous) elements. (are) (produced). (4 words)
61. R E: (Regarding) peace: ... (allow) a ... (conflict) ... (not) ... (begin). (6 words)
- 81 (Add oxygen to)(pulmonary organs) ... (refined fuels). (6 words)
- 101 The' (young lady is) (correct): . (energy) .' (entrepreneurs') (growing older) (mental selves thwart progress. Aging enlightened people can (& are encouraged to) further "*Prosperity without pollution*". (6)
- 121 (Try):...' (even) a (pair) of (try's), any pos. effort, to foster clean, renewable hydrogen. (4 wrds.)
- 141 Abbrev'ns: A I (night), t d (touchdown[s]), C a (Canadian), r (rational) C (concentration), O (overdue), n (no) r (reason), no excuse to delay renewable energy, not night or football enthusiasm. Canada is concentrating on overdue energy independence. Germany & Japan, too, but not the U.S. (8)
- 145 Oil is none (uneconomical) e (energy); L (liq.) P Propane) is better: H₂ IS BEST! (4 words)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
21																				
41																				
61																				
81																				
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161																				
181																				
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261																				
281																				
301																				
321																				

- 161 ...! (Ah!), ... (petroleum) . (energy) is ... (innocuous); Don't d o nothing to change the status quo. (Really!) (5 words)
- 174 T (tantalum), T (tantamount), T (tellurium), garde A (4 words)
- 181 Be a good (guy); .. what we all should be, - ... (investigators for Good); ... (yours and my) efforts need protection. (4 words)
- 201 "*Prosperity without pollution*": can (draw together) (sick) (groups of humans) in peace. (3 words)
- 221 .. (That is (latin)): (capable of good results) energy & a ... (large amount) .' (of) . (brotherhood) can change

SPRING GREETINGS FROM AHA

As we each partake of the pleasures that come with the spring season, it is appropriate to remember the freedom to enjoy, travel, visiting friends and family or - are all made possible by virtue of utilizing precious fossil fuels. Please, in moments of relaxation and contemplation, give some thought to the clean revolution that AHA promotes.

- Yes, I want to join AHA, or give a gift to help make a transition to clean Hydrogen energy.
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- Yes, Enroll me in the Hydrogen Production class.
- Yes, Enroll me in the Automotive Conversion class.
- Yes, Enroll me in the Investment Opportunity class.
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- Yes, I want to buy "*Renewable Energy Experts & Advocates*," published AHA price & shipping of \$15.00: check enclosed.

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- American Hydrogen Association Foundation donation: \$ _____

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