# Project #4:

# Clean Energy

***"....If we could produce electric effects of the required quality, this whole planet and the conditions of existence on it could be transformed. The sun raises the water of the oceans, and winds drive it to distant regions where it remains in state of most delicate balance. If it were in our power to upset it when and wherever desired, this mighty life-sustaining stream could be at will controlled. We could irrigate arid deserts, create lakes and rivers and provide motive power in unlimited amount. This would be the most efficient way of harnessing the sun to the uses of man....."***

**( Nikola Tesla, June 1919 )**

## Introduction

**Clean Energy** is a major issue in the world today. We have developed a deep dependency on fossil fuels supplemented by nuclear energy. Both of these energy modalities are nonrenewable and severely pollute the environment. The extraction of such fuels from the environment is a dirty process. The refining of the fuels is a dirty process. The burning of the fuels is a dirty process. Anything we do to "clean up" these processes while maintaining a dependency on them simply pushes the dirt around from one place to another. We know the answer, and we know the technology. We must commit to the development of a clean energy infrastructure and phase out the use of fossil and nuclear fuels as rapidly as possible.

We know that the earth receives almost all her energy resources from the sun. Even fossil fuels are delayed resources that derive from the sun. Sunlight is our primary energy source. Secondary "clean" resources such as flowing wind and water ultimately derive from solar radiation. Solar energy is free in the sense that the sun provides it in abundance every day. The only cost we face is in the harvesting of the energy into a usable form.

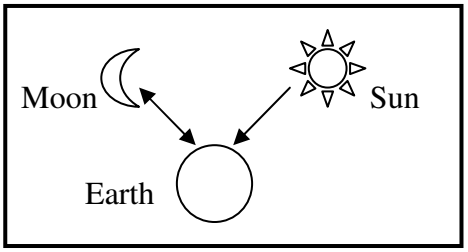
The energy infrastructure of the future basically has two components:

1. Capturing of clean energy
2. Packaging of clean energy for distribution and use in applications.

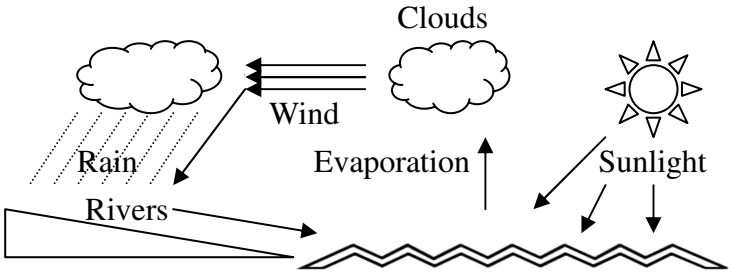
Al Gore has created an organization called Alliance for Climate Protection and issued a challenge for the US to replace dependence on carbon-based fuels with “Green Energy” within 10 years. Mr. Gore laid down his challenge with an example of how America has demonstrated the ability to make something amazing and “unbelievable” into a reality: "When President John F. Kennedy (in 1961) challenged our nation to land a man on the moon and bring him back safely in 10 years, many people doubted we could accomplish that goal. But 8 years and 2 months later, Neil Armstrong and Buzz Aldrin walked on the surface of the moon."

In response to this challenge Green Plans are now beginning to sprout in countries around the world. During his preparations for inauguration President-Elect Barack Obama made a strong declaration in his “New Chapter on Climate Change” message to the Governors’ Global Climate Summit. Speaking with reference to global discussions such as the Poznan Conference he said, "Once I take office, you can be sure that the United States will once again engage vigorously in these negotiations, and help lead the world toward a new era of global cooperation on climate change. . . . Now is the time to confront this challenge once and for all. Delay is no longer an option. Denial is no longer an acceptable response. The stakes are too high. The consequences, too serious. . . . . I promise you this: When I am president, any governor who's willing to promote clean energy will have a partner in the White House. Any company that's willing to invest in clean energy will have an ally in Washington. And any nation that's willing to join the cause of combating climate change will have an ally in the United States of America." Specifically, Mr. Obama promised a federal cap-and-trade system that would mandate that greenhouse gas emissions be reduced to 1990 levels by 2020, and then reduced an additional 80 percent by 2050. The government, he said, would invest $15 billion annually “to catalyze private sector efforts to build a clean energy future.” This is movement in the right direction, but is barely a start on a project of such magnitude.

# What Are Our Clean Energy Resources?



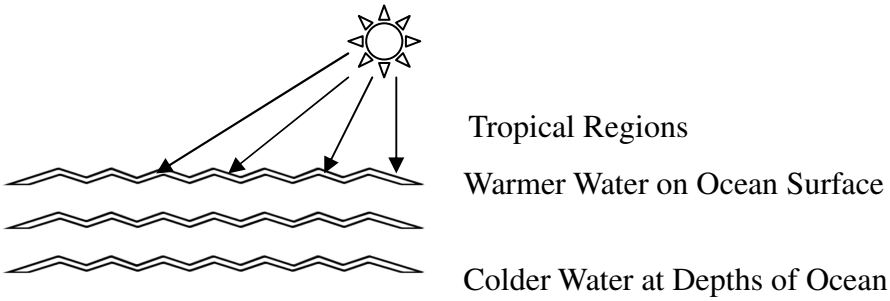
Our planet receives a continuous supply of usable clean energy from the sun and the moon. The sun provides electromagnetic energy, and the moon provides gravitational energy. The oceans cover over 70% of the earth's surface and thus capture the largest portion of this incoming extraterrestrial energy. We must learn to harness these two primary resources in the oceans and their clean secondary energy flows for our energy needs.




By far earth's largest clean energy resource is sunlight. The sun's radiation heats the ocean, generates weather flows, and generates clouds. The weather flows generate wind, and the clouds generate rainwater. The flows of **wind** and **fresh rainwater** in the environment that the sun's energy input generates are secondary clean energy resources.

Thus, the primary energy resources of our planet are as follows:

1. **Solar radiation causes significant temperature differences in ocean water between surface waters and deep subsurface waters in Tropical Regions.**




2. **Solar radiation causes significant temperature differences between ocean water and the local air above it in Arctic Regions.**

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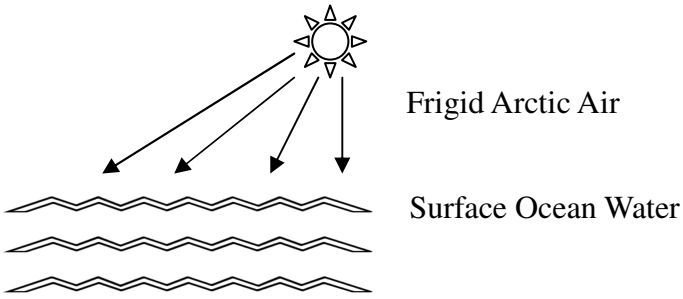
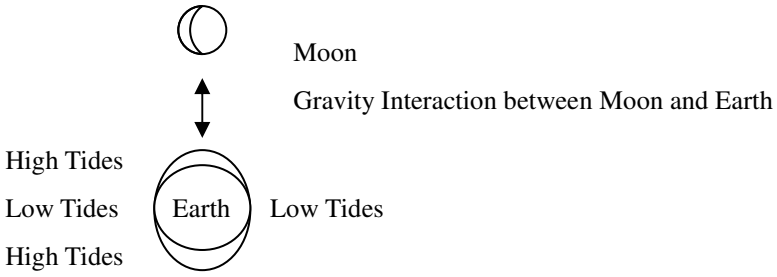


3. **Moon's gravitational influence causes tides in the ocean.**




These are Earth's only significant extraterrestrial energy inputs that can be harnessed as useful energy. However, this energy is constant and plentiful. It is also clean, since it forms the foundation of the planet's ecosystems. (Cosmic rays and starlight also provide extraterrestrial energy input, but probably are far too weak in intensity to be effectively used as energy sources.)

Large-scale harvesting of any "terrestrial" energy resources definitely will contribute to global warming and, in most cases, generate pollution.
Such resources include:

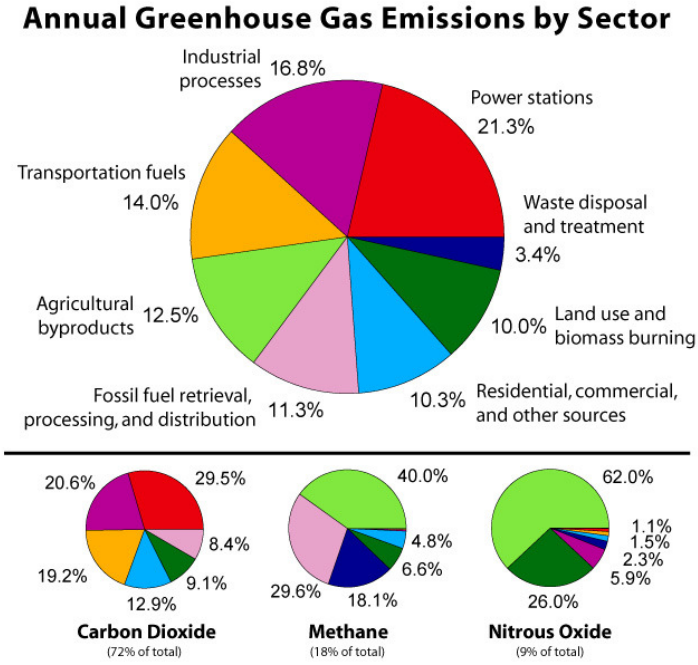
- Nuclear,
- Geothermal*,
- Coal,
- Oil,
- Natural Gas,
- Biofuels, and
- Any other terrestrial resources you can think of.

(*Geothermal resources can be used wherever they naturally exist at the earth's surface. Large-scale mining of subsurface geothermal energy will contribute to global warming through thermal pollution.)

The terrestrial resources listed above consist of energy that has been trapped on or in the earth for long spans of time in various forms and states of matter. Fossil fuels and nuclear fuels are classic examples of this type of resource. This energy originally came from our sun (or other stars).

When we release energy from resources that are stored in the earth, we add to the overall kinetic energy in Earth's environment. Kinetic energy tends toward the status of heat, which is simply random motion of particles. Any release of energy beyond the usual extraterrestrial diet of solar radiation and lunar gravity inevitably

warms up the planet temporarily. Excess heat on the planet gradually radiates away back into outer space. Therefore, on a very small scale the use of bio-fuels and fossil fuels is not a problem. Primitive man used bio-fuels for thousands of years since the discovery of how to make and control fire. This did not seriously affect the planet's ecosystem, because the human population was so small compared to the size of the planet. Human initiated burning was minute compared to the natural burns caused by lightning generated forest fires. However, the human population has expanded dramatically, and we now release more heat than the planet can shed. We also deliberately burn forests on a large scale to clear land for agricultural or other development. Thus, the main problems associated with using bio-fuels are deforestation, use of cropland for growing bio-fuels instead of food production, and green house gas emissions such as methane, carbon dioxide, and nitrous oxide. Otherwise, the recycling of existing surface biomass does not contribute to global warming.




(Pie chart from Wikipedia, "Greenhouse Gas")

At present most human additions to earth's greenhouse gases come from **clearing of forests** and **burning of fossil fuel**s. Therefore, if we can eliminate these two major impacts, emissions from recycling gases retrieved from waste disposal processes and other sources would be negligible.

Of course, if nothing is done about deforestation, that issue will resolve itself with the disappearance of any large forested areas on the planet and the subsequent extinction

of tens of thousands of species that dwell in those forest habitats. We know, also, that fossil fuels are nonrenewable. So these two problems will resolve eventually even if we do nothing to stop the current trends of steady increase in these two categories. What the long-term condition of global temperatures will be if these two processes continue unabated is still under debate, but the ecosystem will definitely be in poorer shape than before for supporting life, and may take millions of years to recover. It will never recover from the destruction of certain nonrenewable resources. Whether there will be catastrophic disasters is unknown, but serious environmental pollution and degradation is already apparent.

**Burning of Bio-fuels and Fossil Fuels**

Combustion of bio-fuels and fossil fuels generates emissions that modify the climate so as to increase the planet's retention of incoming heat. We now can see clear evidence that the planet is getting warmer from the increase in human activity.

The combustion of fossil fuels is especially a problem. When burned, these fuels release previously sequestered carbon into the atmosphere as carbon dioxide, carbon monoxide, and smoke particulates. These substances are all toxic to humans if they are breathed in and usually include other toxic emissions as well. In large amounts these emissions change the atmosphere so that it tends to trap and hold more heat from sunlight. Surprisingly the burning of coal in power plants also releases significant amounts of uranium and thorium into the environment – far more than nuclear power plants and appears to be a source of heavy metal poisoning that is starting to occur in some parts of the world.

The fossil fuels derive indirectly from sunlight that has been absorbed by plants through photosynthesis and used to fix atmospheric carbon dioxide into organic materials. Over long spans of time the organic materials died, compacted into the earth and fossilized. When we exhume them and burn them, they burn "dirty" and pollute the planet. They put large masses of **previously sequestered carbon dioxide** into the atmosphere. Some fossil fuels also contain sulfur, another source of pollution.

The fossil fuels are non-renewable resources. When the earth's coal and oil resources are used up, that is it for fossil fuels, because it takes millions of years to fossilize organic material. Human activity evolves at too fast a rate to wait that long. For these various reasons we must rule out further use of fossilized organic matter as fuel.

The shift toward bio-fuels is a major ecological disaster. On the one hand fields that can produce food are diverted to the growing of bio-fuels. On the other hand, huge tracts of forest are being cleared to make way for bio-fuel plantations. The destruction of the forest means the end of the line culturally for forest dwelling humans and extinction for innumerable species. The burning of the cleared bio-mass is a huge waste of energy that pollutes the skies. The growing of bio-fuels diverts precious fresh water resources, and the refining of the bio-fuels requires the investment of more energy and more fresh water resources. The final result is loss of forest and food producing farmlands, pollution of air and water, and general acceleration of the environmental degradation process. Whoever dreamed up the idea of bio-fuels was a highly professional con-man without a conscience.

**Nuclear energy** is also a non-renewable resource and pollutes the planet with hazardous radioactive waste, some of which remains hazardous for tens of thousands of years. Although some of this material can be reprocessed, hazardous waste inevitably accumulates. Nuclear power plants also produce thermal pollution that adds to global warming and is especially damaging to water resources if it is released in such a manner that it significantly changes the normal temperature of the resource.

We still do not know how to completely recycle the hazardous radioactive waste from nuclear facilities. Some of this waste remains hazardous for tens of thousands or hundreds of thousands of years. Written communication in human civilization has only been around for about 6000 years. We have not even decided yet on permanent nuclear storage sites for such waste, and yet we continue to use nuclear energy and accumulate this long-term hazardous waste. How are we going to tell people 50,000 or 100,000 years from now to stay away from nuclear waste storage sites, however compact and resistant to decay and leakage we may make them? How can we be sure there will not be geological changes that compromise the security of such sites and release toxic radioactive materials into the air, soil, and water? We have no way to deal with that issue unless we come up with technology to artificially speed up the transmutation of the hazardous radioactive waste into a non-hazardous condition. Maybe this will happen, but it seems reasonable that **a technical solution to the recycling of hazardous nuclear waste should PRECEDE the implementation of ANY nuclear power usage.** Why do we invest a single dollar in implementing such poorly planned projects before the R&D has been done? We know that the answer lies in political motivation and economic greed, not concern for human welfare or the health of the ecosystem.

Regardless of any possible solutions to the hazardous nuclear waste problem, nuclear plants still become major thermal polluters, because they release additional heat into the environment that was not previously a part of the thermodynamics of the ecosystem. Therefore, I suggest that use of radioactive materials should be limited to small-scale medical and industrial uses and not to the fuelling of power plants, and absolutely not to the arming of weapons.

The only way for modern human civilization to survive long term on this planet and still maintain a large population is to learn to use only the extraterrestrial inputs of energy that are built into the planet's ecosystem and to stop releasing additional energy that not only generates thermal pollution, but toxic substance pollution as well.

With this introduction to the nature and scope of the Clean Energy Challenge, let me present some suggestions for areas of major focus in the technologies of capturing and converting clean energy for use by human civilization.

## I. Capturing and Converting Clean Energy through OTEC

Sunlight is the primary source of clean energy for our planet. The intelligent approach to energy management is to focus primary efforts on harnessing the current flow of sunlight onto our planet directly or indirectly and converting it into useful applications.

Agriculture is an excellent example of a technology that makes direct use of sunlight as an energy resource. The food we eat is a natural fuel that does not add to global warming and need not be a source of pollution. Manmade solar collectors can be very effective wherever sunlight is sufficient. For example, there are projects underway to establish large-scale solar energy farms in desert regions. However solar collectors are puny compared to the energy reservoir capability of the oceans and only function during bright daylight hours and in regions with lots of sunlight. The global system of oceans covers 70 percent of the earth's surface and constitutes a gigantic natural heat sink that captures the energy of sunlight in its waters as heat 24 hours a day every day of the year. A small portion of that heat rises upward in clouds of water vapor that then cool and condense as rain. Almost all of earth's fresh water comes from ocean water that has been distilled by the action of sunlight on the ocean waters. We have learned to use the downward flow of this fresh water as a dynamic force to drive turbines.and to generate electricity. However, there is a much vaster resource in the thermal differences generated by sunlight acting on ocean water.

One efficient method of converting the clean energy of sunlight on a large scale for use in applications is to go to the biggest reservoir that captures and stores the most solar energy. Therefore, the first suggestion for this project is that, in addition to pursuing our development of solar energy collection technologies, we should initiate a global-scale plan to establish the heat engine infrastructure for converting the solar energy that is stored in the oceans as various thermal states into electricity and other uses. This process has been known for over a hundred years and is called **Ocean Thermal Energy Conversion**, or **OTEC**.

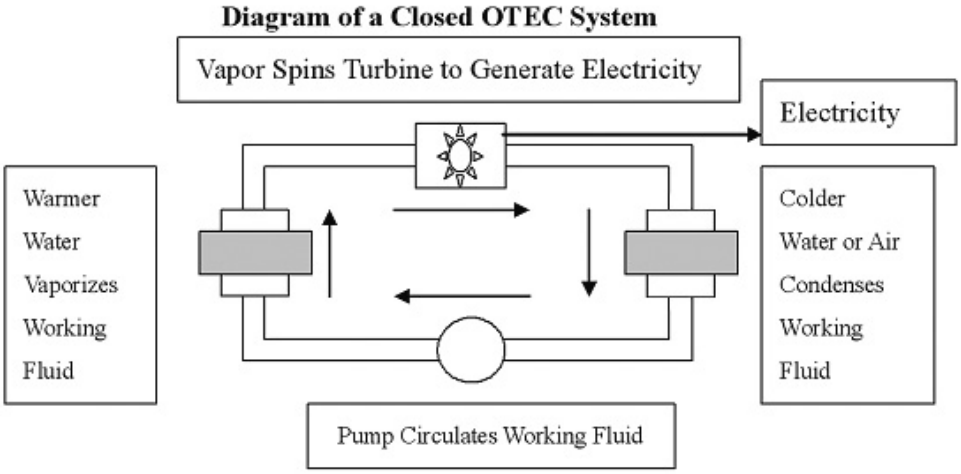
Development of OTEC will involve a huge capital-intensive investment in the construction of a global OTEC infrastructure. The technology is understood and tested. Pilot projects already exist and the efficiency of the process is improving. Major commitment of funding and development will lead to rapid technical progress.

The energy potential of solar heat in the oceans constantly dissipates in the environment. We can harness that energy flow and dissipate it deliberately in directions that we prefer without adding any warming effects to the ecosystem, because that heat flow is already present. We do not increase it, we simply direct it intelligently. Plants and animals on our planet have always survived by doing this. Solar energy is clean energy. It is also free in the sense that it is already there, but a considerable cost is associated with efficient harvesting of it to support the activities of a civilization. OTEC can be one of the major contributors to a global clean energy solution.

The first order of business for developing a permanent clean energy OTEC power plant infrastructure throughout the globe is to determine where such operations are most practical and to implement a variety of pilot projects that will help to sort out the most effective methods.

Tropical OTEC systems can use **open** or **closed** heat exchangers. Arctic OTEC systems would run closed heat exchangers and would not need to expend energy drawing water from ocean depths. **Closed systems** use a warmer water source to vaporize a “working fluid” that is sealed in pipes at an appropriate level of low pressure. The vapor runs turbines and then is cooled by the cooler source of water or air until it condenses and then is pumped back to the vaporizer chamber to be reheated by the warmer water until it again vaporizes. This process can continue to recycle the liquid in the heat exchanger over and over, because the temperature difference

between the two macroscopic environmental thermal reservoirs that drive the system remains almost constant within a range of small fluctuations.




An **open cycle** is basically the same as a closed cycle except that warm ocean water enters the system and is used as the working fluid. The warm water is taken to low pressure until it boils and becomes steam. The steam drives the turbine, and then condenses back into pure water when it passes through the condenser that is cooled by the cold air or cold water reservoir. Thus, the system simultaneously desalinates sea water into pure water while it generates electricity.

**OTEC Efficiency and Technical Issues**

- The extraction of energy by OTEC works from the low end of the energy scale boosting the thermal energy of the ocean upward to electricity and other applications. The working temperature differences may be no more than around 25 degrees Celsius. Thus, OTEC is not very efficient as a heat engine and has an ideal maximum of about 6 or 7% as opposed to up to 60% for a steam-cooled combined cycle gas turbine. For the conversion of ocean heat to be cost effective, it will have to be on a very large scale. Fortunately, the scale of the oceans is very large and the thermal reservoir is very stable, renewing itself constantly.
- Developing OTEC infrastructure will require a cooperative global effort with major investments from many governments and agreements with regard to legal use of sites and energy sharing.
- Many locations suitable for the process will be remote and involve costs to package and transport the recovered energy.
- Many locations will be offshore and will involve challenges similar to what offshore oilrigs face. Of course that means they can use some of the same methods learned by the oilmen.

- Another challenge is that the cold water for the condenser phase has to be brought up from the depths of the ocean in the case of tropical systems. This requires a certain amount of energy to raise the water. Also, the water or other working fluid must be pumped through the system, and that costs energy.
- An OTEC power plant can use a closed cycle, open cycle, or hybrid of the two. If a closed cycle is used, there is a consideration of what working fluid to use. For example, ammonia is low in cost and plentiful, but is toxic and flammable. The ideal would be to use a fluid that is low in cost, and also non-toxic.
- The vapor pressure of the working fluid influences the size of the power plant.
- Another problem is that gases released from the sea water must be removed to prevent degradation of performance. This adds cost and energy requirements.
- Fouling of the warm water heat exchanger by microbes is another problem that tends to degrade performance over time. Microbial fouling varies with the temperature of the water, the nutrient level in the water, and the tubing material used in the equipment. One approach to this may be to use a reservoir of fresh water that obtains its temperature from the ocean's surface water and sunlight. The water in this reservoir can be recycled over and over like the working fluid of a closed system.

Commitment of major brainpower to OTEC will surely be able to come up with increasingly effective ways of handling these issues. When we consider the brainpower and technological advances that have accompanied the relatively more complex tasks of prospecting, drilling, and refining oil in difficult locations on land and at sea (such as the recent tab of over $130 billion eagerly invested to develop the Kazakhstan oil fields that produce polluting high-sulfur oil), the challenges of OTEC are relatively simple in comparison.

**Some Economic Advantages of OTEC**

Economic advantages of OTEC over coal, oil, and nuclear energy include:

- Elimination of prospecting and drilling costs;
- Elimination of the cleanup costs from spills;
- Elimination of the environmental costs from air pollution, acid rain, and so on;
- Elimination of exhausted wells, repair of exhausted strip-mine sites, recovery from mountain top removal mining, and decommissioning of nuclear plants and oil refineries;
- Elimination of the hidden long-term costs associated with managing and storing hazardous waste byproducts and cleaning up mishaps;
- Elimination of the inevitable down line inflation of costs as the fuel resources

peak and then deplete to exhaustion.

These economic advantages also apply to solar collection and wind farm ventures. Water power faces the downside of environmental impact due to dams and other water management procedures.

**Partial Offset of Costs by OTEC Spin-off Technologies**

OTEC has several positive spin-off applications in addition to generating electricity that can offset to some extent the cost associated with the setup and operation of energy conversion facilities. These include:

- air conditioning,
- chilled soil agriculture,
- aquaculture,
- desalination of sea water,
- mineral extraction from sea water, and
- production of hydrogen by electrolysis.

**The Virtual Inexhaustibility of OTEC as an Energy Resource**

The ocean thermal energy reservoir is a virtually inexhaustible source of "free" and clean energy captured from the sun. It will be available for as long as the sun, earth, and ocean exist in their current relationships – which at the least is probably many millions of years. Oil prospecting and production has already peaked, and coal may last only a century or so, depending on which estimates you choose to follow.

**The Myth of "Clean" Coal**

The notion of "clean" coal that some of the clean energy advocates are starting to bring up is a joke. Just the harvesting and transporting of coal is an environmental catastrophe, especially in the case of strip mining and mountain top removal. To get coal to burn clean you must remove the toxic emissions. This is a major extra cost that until recently has been largely avoided by ignoring it and putting up with the nuisance of toxic emissions. Then you must sequester the toxic residues that you remove to get to the "clean" coal. Done on a large scale the sequestering will result in pollution unless you find ways to recycle the pollutants. Even if you succeed in sequestration, the environmental destruction from mining remains on the front end and thermal pollution remains on the back end. Also the resource is nonrenewable.

## II. Packaging, Storage, and Transportation of Clean Energy

The major second aspect of this Clean Energy Project is to develop efficient methods for the packaging, storage, and transportation of energy. This is critical because the OTEC efficiency is not universal in the oceans, and land-based civilizations are not always anywhere near an ocean. Conversion plants will have to be located where they have the maximum efficiency. Then the energy will have to be packaged for storage and transport. This is especially critical for the use of energy in the transportation sector. The portable fuel of choice for many applications would seem to be **hydrogen**, because it is plentiful, light-weight, and burns clean, leaving as its only byproduct pure, potable water.

Theoretically the best source for hydrogen as a fuel is water, because water is abundant on the planet, theoretically can be harvested without any pollution and the byproduct of burning hydrogen is pure water.

- The technology of using hydrogen as a fuel first requires an efficient means of **hydrolysis** (splitting the water molecule into its hydrogen and oxygen components).
- Then it requires an efficient method of **packaging and storing** the hydrogen in a lightweight, safe, and portable format that can be retrieved on demand.

Hydrogen is an ideal mechanism for storing and transporting the energy captured by a stationary conversion facility. However, it is the lightest atom and tends to leak away into outer space if not contained properly. It is also very flammable. Hydrogen can be stored in liquid or pressurized form using special tanks. It can also be stored by temporarily bonding it to other atoms. Storing hydrogen chemically and then releasing it on demand through a controlled chemical reaction may be more compact and convenient in some respects. However, this entails intermediate packaging steps that require significant additional energy and expense. Researchers are coming up with a variety of creative ways to store hydrogen.

Since plants developed the ability of photolysis and photosynthesis some three billion years ago, they have captured, chemically stored, and released on demand solar energy for a variety of uses that support their survival and growth. Management of solar energy is therefore a highly tested and reliable clean technology on our planet. We have to learn the basic principles of the physics and chemistry involved and then adapt the process to our survival and growth needs, -- which of course are rather different from those of plants.

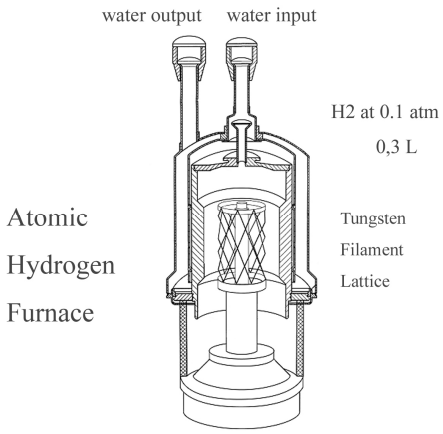
Simple methods already exist for electrolysis of water to generate hydrogen, and the efficiencies of various hydrogen extraction techniques are improving all the time, hindered only by the skimpy budgets under which the development programs and pilot projects proceed when compared to the lavish budgets for fossil fuel extraction and exploitation. The same is true for various types of hydrogen storage technologies. The next few years should show remarkable progress in both these areas, especially if major commitment of public and private funding becomes available. This funding should be on the scale of the "bailouts" being handed around to financial institutions and businesses that have not been following proper fiscal management procedures. Why are we investing to save old mismanaged institutions when we can invest in our future in a way that not only creates as many new jobs as we might want to have, but also stabilizes the energy and economic foundation of the planet for millennia to come?

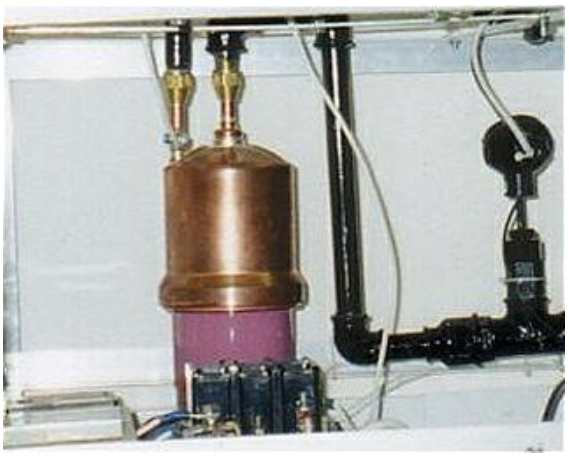
**An Idealized Clean Energy Transportation Scenario**

In the following section I present a possible scenario for the development of a Clean Energy Transportation System (CETS). This technological vision goes beyond simply producing hydrogen and burning it in fuel cells or combustion engines as a "clean energy". How far we can realize this proposal depends on the dedication and ingenuity of the inventors and engineers backed up by solid financial support to bring out the full potential of the idea. Miniature-scale feasibility tests at JLN Labs indicate that a COP (Coefficient of Performance) with this technology can be over 10 and perhaps with refinement over 20. What level of reliable performance we can attain at practical scales remains to be seen, but this is a promising development.

Clean cars of the future probably will run on steam – not nuclear power or fossil fuels. You will fill your tank with purified water.

The starter mechanism will be a battery or other power supply that ignites a hydrogen furnace by means an intermittent current of electricity.

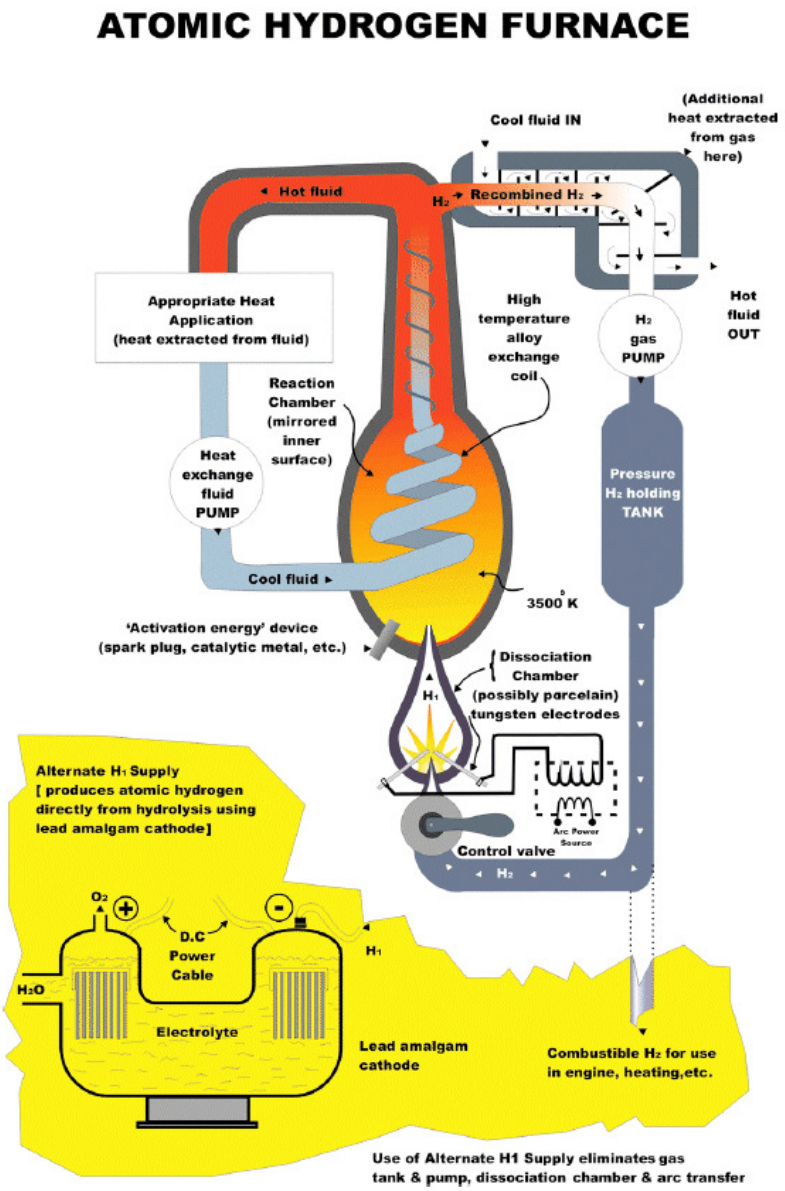


Drawing of Atomic Hydrogen Furnace Prototype in Operation at J.L. Naudin's Lab

The above diagram shows a feasibility demo of an atomic hydrogen furnace that is based on discoveries made by the great experimental physicist Irving Langmuir almost a hundred years ago in 1912 when he researched the properties of atomic hydrogen produced from dissociation of molecular hydrogen and the recombination of atomic hydrogen into its molecular form. At that time he developed an atomic hydrogen torch that came to be used for welding. For some reason the unusual behavior of his torch never attracted widespread interest in the scientific community. Some believe that information about the technology was suppressed by special interests intent on developing the energy infrastructure for maximum profit. In 1963 an engineering student named William R. Lyne became interested in Langmuir's atomic hydrogen welding process. He collected information about it and eventually in 1981 built and tested his own version of the torch. By 1996 he had created a preliminary design for what he called the Lyne Atomic Hydrogen Furnace. In 1997 and 1998 he published a small book about his findings and included his furnace design, releasing the technology into the public domain. Nicholas Moller picked up the idea from reading Lyne's book (as I also did) and refined it to the current feasibility demo stage that has been under testing at JLN Labs in France for the past few years. J.L. Naudin reports that he consistently is able to achieve COP (Coefficient of Performance) that ranges from 13 up to over 21. The COP is determined by dividing the amount of energy output produced by a system by the amount of energy input into the system to operate it. Systems commonly operate at under unity COP. However, if a system can make use of energy in the environment, as certain heat pumps can do, then it can have an over unity COP. This system shows great promise as the furnace that fires a steam engine to drive a vehicle. I have not seen a convincing theoretical explanation of Naudin's high COP measurements. We should have such a hypothesis and thoroughly test it, to verify

the reality of this technology and its potential benefits as well as any possible hazards.

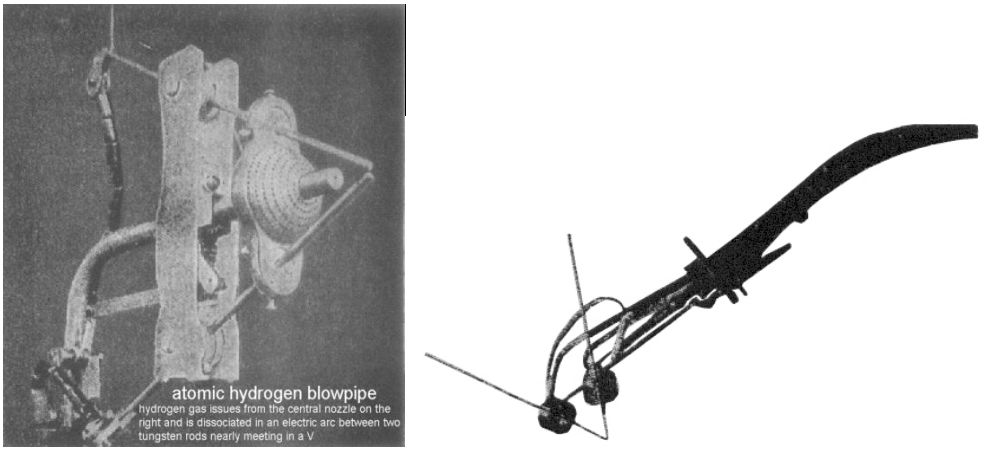



Lyne's earlier design for an Atomic Hydrogen Furnace

Lyne tries to describe the technology in terms of "Occult Ether Physics" and Moller speaks about "Zero Point Energy". That is not science. I think these explanations tend to put people off, and so they think the idea of a hydrogen furnace is weird science. Let me give a brief theoretical explanation to suggest how the system may operate according to real physics and be worthy of serious research and development. Langmuir and his friend Neils Bohr found the technology interesting enough to carry out extensive research when Langmuir first discovered the phenomenon. These heavy weights in the field of physics were certainly not crackpots.

We will begin by examining the Atomic Hydrogen Welding Blowtorch, since that is

the simplest demonstration of the effect involved in the hydrogen furnace.




Two Models of Atomic Hydrogen Torches

The Atomic Hydrogen Torch has been used for certain types of welding for nearly a century. The torch involves two tungsten rods that serve as electrodes and a source of current that can produce an electric arc. A stream of molecular hydrogen is projected through the arc from a nozzle. The electric arc creates plasma in the air between the electrodes. As the hydrogen molecules pass through the plasma region, they dissociate into a stream of atomic hydrogen. The formula for this event is:

$$H_2 > H + H - 422\ kJ$$

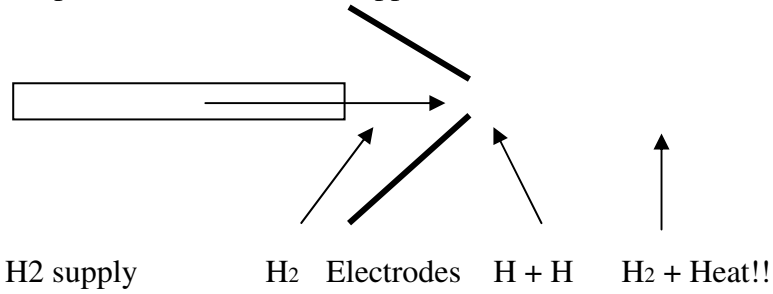
This is a very endothermic reaction. When the stream of atomic hydrogen leaves the plasma region of the arc and hits a cooler zone, it recombines into molecular hydrogen and releases the energy that it picked up when the hydrogen dissociated into atomic form in the plasma region. The formula for this event is:

$$H + H > H_2 + 422kJ$$

The number of kilo-Joules involved varies according to the setup of the system, but the amount of energy transferred is substantial. This tremendous release of heat can be micro-controlled and can be used for welding or to cause steam to expand rapidly. In a vehicular application the torch might operate intermittently with short bursts rather than as a steady stream in the case of a welding torch. The purpose would be to maintain the necessary steam pressure to drive a steam engine, or possibly a compressed air engine.

Now the interesting question here is this: “Where does the energy come from that the hydrogen absorbs when it dissociates from molecular to atomic form?” Contrary to expectation, it does NOT come from the electric current in the electrodes. The experiments done at JLN Labs (http://jlnlabs.online.fr/mahg/index.htm) have demonstrated that the output power can be 13 to 21 times the input power depending

on the setup of the experiment. These are only exploratory lab prototype bench tests that have not been optimized for real-world applications.




**Test Runs on a Miniature Atomic Hydrogen Furnace at JLN Labs, June, 2005**

| RUN | Power Input (W) | Input Setup | Power Output (W) | Duration (sec) | COP (Power_Output/Power_Input) |
|---|---|---|---|---|---|
| 76 | 2,98 | Pulsed 51 Hz, DTC 5% | 43,19 | 3575 | 14,5 |
| 77 | 2,9 | Pulsed 51 Hz, DTC 5% | 46,85 | 2575 | 16,2 |
| 78 | 2,9 | Pulsed 51 Hz, | 45,58 | 3225 | 15,7 |
| BLANK TEST | 1324 | CONTINUOUS DC | 879 | 185 | 0,7 |
| 81 | 4,82 | Pulsed 51 Hz, DTC 5% | 78,44 | 1205 | 16,3 |
| 82 | 4,88 | Pulsed 51 Hz, DTC 5% | 77,22 | 4895 | 15,8 |
| 83 | 4,38 | Pulsed 51 Hz, DTC 4,8% | 92,97 | 4465 | 21,2 |

How can this process produce such large over-unity efficiency if the energy comes exclusively from the current in the electrodes? The torch functions like a "capacitor" with a gap serving as a dielectric between the two conducting electrodes. The current in the tungsten electrodes generates the capacitance. The capacitance sucks electromagnetic radiation from available non-local field sources surrounding the torch into the space between the electrode tips. Thus the 422kJ of heat that is released by the hydrogen when it recombines does NOT come from the current in the electrodes. The only power input is due to the current that passes through the electrodes. The power input can be tuned to the minimum required to start and sustain the hydrogen dissociation process for however long is needed. To understand the mechanism, let us step back a bit and examine the crux of the issue – how to manage the electron from the viewpoint of energy.

**The Crux of the Issue**

Scientists, technologists, and businessmen have been busy for the past century exploiting the discovery of electricity and its tiny carrier, the electron. The problem is that they do not have a clear understanding of just what an electron is, or even what energy is. In addition there has been a great desire to commercialize this perceived "asset" (management of the electron) for as much profit as possible. The theories of classical physics advanced into quantum physics, and there has never been a retrospective alignment of the old theories with the new theories. This has led to obfuscation at the foundations of the scientific theories. The combination of

theoretical confusion plus political and economic profiteering of extremely powerful technologies has led us to a situation where the ecosystem of the planet is seriously out of balance. We need to step back, look closely at the foundational issues, and redefine the paradigm. This is a big challenge, because the inertial momentum of scientific research and development is moving at such a fast pace and the information load is stupendous. The little feasibility study done by Mr. Naudin may just give us a glimpse into the crux of the problem of how to manage the electron from an energy viewpoint.

What we know.

- The electron appears to be a point particle, at least according to quantum mechanics. That means there is nothing there to constitute a solid particle.
- Nevertheless the real world electron has quantized mass and quantized charge. It moves about and behaves as if it were a solid particle.
- This can only be explained by assuming that the electron is a stable energy vortex of some type. The electron appears to have a constant charge, spin, and mass because there is a constant flow of energy into and out of the point in space that defines the center of the vortex.
- The stable physical world is made entirely of atoms, and the atoms are made of protons, neutrons, and electrons. The protons and neutrons are variants of the same composite particle that forms the nucleus of every atom. The energy flows of the physical world are carried by the electrons that form dynamic orbits around the nuclei.
- Projects to provide energy resources for various human activities must focus on understanding and harnessing the fundamental stable flow of energy associated with the electron, because that is the ultimate energy source in the physical world on the microscopic scale. (The sun is our local macroscopic source.)
- The energy that flows in and out of electrons is electromagnetic and operates by the general principle of phase conjugation in three orthogonal dimensions: **E, B**, and **S**. In the notation **E** is the electric field, **B** is the magnetic field, and **S** is the photon energy field. Phase conjugation means that the vectors in all three dimensions operate simultaneously and in opposite directions so as to form a standing wave cycle. That means there are six components running all at once. These components are mutually orthogonal, but inseparably linked as a unitary system. Therefore, when a photon energy packet travels in a certain direction, it also vibrates (oscillates back and forth) as an electric field and a magnetic field in its two other orthogonal dimensions. This generates our notion of 3D space and time.

- Each photon energy flow that moves in one direction in space and time has a corresponding equal and opposite anti-photon component that flows in the opposite direction in space and time. That conserves energy.
- There is a **fundamental misunderstanding** in the general populace of how energy flows in electromagnetic systems. If we wish to solve the energy "crisis", the first order of business is to understand **what energy is, where the energy is, and how it flows** otherwise we are likely to get hornswoggled.
- Energy is not a "thing", it is a potential. The ultimate potential is pure empty space – **pure nothingness**. In Project #1 we identified it as **Undefined Awareness**, or the **Undefined Potential of Pure Existence**. We can also view this as a **superposition of all possible actualities that appears to cancel out every possibility by its exact phase opposite**. Thus, it is both full and empty at the same time. (Yes, it boggles the mind.)
- This Undefined Potential willingly accepts any definition we give it.
- Energy does not "do" anything at all except exist as a potential until someone defines a relative viewpoint from which it can operate. In physics we **arbitrarily**(!!!) define energy in terms of concepts such as mass, space, and time. For example, Einstein says that $E = mc^2$. This is not a scientific discovery. It is really just the fundamental definition of pure energy as mass times the constant velocity of electromagnetic (EM) photons squared. We use photon velocity, because that is the limit fastest speed possible for a physical object. At that speed the rest mass must become zero and all that remains is a kind of inertial momentum. That inertial momentum of restless mass-less photons is the essence of potential energy. But to use it we must make it appear to slow down.
- Velocity is a ratio of space to time. Space and time are mental markers that we use to store and keep track of information. They do not exist other than as definitions we create in our minds out of the Undefined Potential. In other words, they are products of a particular viewpoint that we have defined for experiencing the world. Thus, velocity is a way of tracking the movement of data in the space/time information storage system we have defined for ourselves. We can say, "Oh it is here at point A today and will be there at point B tomorrow."
- Mass has been a problem ever since Newton tried to define it in terms of force and acceleration. He said, "$F = ma$". A force is mass times acceleration. We know that acceleration is a change in velocity, and thus indicates a shifting of data somewhere in our information storage system.
- What is a force? It is some kind of resistance. The only way we can detect a

mass is by subjecting something to a resistance. A resistance is an attempt to initiate, stop, or influence a change in velocity. (Velocity can be zero or any value we imagine within the system of space/time that we define.) In other words, $m = F / a$. We define the mass as a resistance per change in velocity. The only thing you can observe as a detached observer in this definition is the change of status of data in your information storage system. That observable is the acceleration component. So where is the resistance? It can only come from you. You define the resistance. First you define something. Then you push on it to change it. Only then do you feel a force and detect a mass. In other words, you have to get involved subjectively. You jump in and start to push and shove. This defines a mass, and it also defines **you** with an equal and opposite reaction. The mass that you detect is simply a reflection of your own resistance to the original data that you defined.

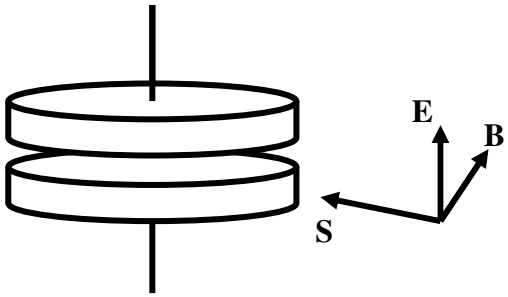
- If you do not push and resist an accelerating object, it may accelerate but there is **no detectable mass** as long as you remain a detached observer. You see this when you watch a movie. Motions and accelerations that we observe from a purely detached viewpoint are called phase waves. Phase waves can accelerate to speeds faster than light speed, because they require no mass and no resistance. For example, go outside on a clear night and spin while watching the stars. If you **assume** they are thousands of light years away and that motion is relative, then the relative motion they have when you turn is many times the speed of light. You gently turn and you see countless stars, each with a mass that you imagine to be 10^30 kg or more, whirling about across thousands and millions of light years. Did you know you can do stuff like that so effortlessly, just with a bit of imagination?
- The physical matter that we experience as our solid everyday world is generated (so say the physicists) by stable photon vortexes that form protons, neutrons, and electrons.
- Almost all interactions that occur in our physical world are mediated by the outermost (valence) electrons of atoms. If we do not want to destabilize our physical world too much by deconstructing atoms, protons, and neutrons, we use the energy available from the manipulation of valence electrons. The energy available there is quite sufficient for most of our energy purposes if we know how to manage it.
- We generate an actual energy potential by defining a physical relationship that contains a strong resistance. We activate the energy potential by **relaxing** the resistance that defines the potential or by adding more resistance. Then the potential energy becomes kinetic. That is, something in the system we have

defined accelerates and components of the system change position in space and time. In this way we can accomplish "work". Work is a form of energy that involves a deliberate displacement of a force from one place or condition to another place or condition. As you can see "energy" is a pretty abstract idea. Usually talk about energy is an excuse for not wanting to take personal responsibility for a situation – in other words it is a mental fixation on resistance.

- From the previous statement we can observe that, if we want useful energy to perform work, we want to activate an energy potential by relaxing resistance rather than by adding more resistance. Adding resistance means you end up putting in more work than you get out.
- The physical qualities of mass, charge, and spin associated with electrons are simply another way of defining the three orthogonal electromagnetic fields of photons, because electrons are made from photons. The **E** field generates charge, the **B** field generates spin, and the **S** (photon energy) field generates mass-energy. An electron maintains constant charge and constant spin because it is constantly flowing photon energy in and out of the region that defines the electron's center of mass. This observation is relatively far out physics, but you do not have to believe it to follow the rest of the discussion.
- Mass means energy, as Einstein nicely defined for us. However, the energy source, as we have seen in our analysis, is not in the point particle. The point particle is merely the focus that defines a physical system and allows energy to condense out of the Undefined Potential around that point. That is why the energy of an electrical system does not come from the flow of electrons per se. The core of an electron is simply a point in space that defines a vortex of energy flow.

Now we can turn to the physical application of these concepts. The 20$^{th}$ century master of Quantum Electro-Dynamics (QED), Richard Feynman, explains the situation in Vol. II of his famous **Lectures on Physics** ("Field Energy and Field Momentum", 27-7). In this lecture Feynman gives an example of a capacitor that is charging. (In our case we have two electrodes that charge up to the point where they discharge as an arc that jumps across the space between the electrodes.) As the charge builds up, the space between the plates of the capacitor receives energy. The energy must flow in from somewhere, and we might suppose that it comes from the wires that lead into the electrodes.

Feynman points out that this is not the case.




Sketch of a Capacitor based on Feynman, Fig. II, 27-3.

Feynman explains that the incoming energy "can't enter the space between the plates from that direction (i.e. along the wires), because **E** is perpendicular to the plates; **E** x **B** must be parallel to the plates (27-7)." This principle is general, because **E**, **B**, and **S** are the vectors for electromagnetic waves, and are always mutually orthogonal.

This means that the energy we see radiating from an incandescent light bulb or an electric heater comes not from the current in the filament, but from the space surrounding the filament. The resistance in the filament that causes it to heat up is due to many microscopic "capacitors" in the structure of the filament that suck in energy from the surrounding field and heat up the filament. When the filament glows, the energy radiates back out to where it came from. The filaments in such devices are not very efficient at storing and releasing heat compared to atomic hydrogen.

Feynman was a genius clown. He knew more than he said or was allowed to say, so he would set up an argument, leak a clue or an insight, and then shut up so he could stay alive. I quote from his "Field Energy" lecture at length, because this passage is a rare moment when Feynman suddenly opens up and tells it like it really is – but then, anticlimactically, he adds a final paragraph to obfuscate the issue. This final paragraph that I put into bold face type may have been ordered by the editors and his political handlers so that students would only be mildly amused by his statements and not shaken to the very foundations of their perceptions of reality. Read carefully what he says. The comments in brackets [. . .] are added by me.

"When we are charging a capacitor, the energy is not coming down the wires; it is coming in through the edges of the gap. That's what the theory says!

"How can that be? That's *not* an easy question, but here is one way of thinking about

it. Suppose that we had some charges above and below the capacitor and far away. When the charges are far away, there is a weak but enormously spread out field that surrounds the capacitor. Then, as the charges come together, the field gets stronger nearer to the capacitor. So the field energy which is way out moves toward the capacitor and eventually ends up between the plates.

"As another example, we ask what happens in a piece of resistance wire when it is carrying a current [e.g. the filament in a light bulb or electric heater]. Since the wire has resistance, there is an electric field along it, driving the current. Because there is a potential drop along the wire, there is also an electric field just outside the wire, parallel to the surface. There is, in addition, a magnetic field which goes around the wire because of the current. The **E** [electric field vector] and **B** [the magnetic field vector] are at right angles; therefore there is a Poynting vector [the photon energy vector **S**] directed radially inward, as shown in the figure. There is a flow of energy into the wire all around. It is, of course, equal to the energy being lost in the wire in the form of heat. So our "crazy" theory says that the electrons are getting their energy to generate heat because of the energy flowing into the wire from the field outside. Intuition would seem to tell us that the electrons get their energy from being pushed along the wire, so the energy should be flowing down (or up) along the wire. But the theory says that the electrons are really being pushed by an electric field, which has come from some charges very far away, and that the electrons get their energy for generating heat from these fields. The energy somehow flows from the distant charges into a wide area of space and then inward to the wire.

Finally, in order to really convince you that this theory is obviously nuts, we will take one more example – an example in which an electric charge and a magnet are *at rest* near each other – both sitting quite still. Suppose we take the example of a point charge sitting near the center of a bar magnet, as shown in Fig. 27-6. Everything is at rest, so the energy is not changing with time. Also **E** and **B** are quite static. But the Poynting vector says that there s a flow of energy because there is an **E x B** that is not zero. If you look at the energy flow, you find that it just circulates around and around. There isn't any change in the energy anywhere – everything which flows into one volume flows out again. It is like incompressible water flowing around. So there is a circulation of energy in this so-called static condition. How absurd it gets!

Perhaps it isn't so terribly puzzling, though, when you remember that what we called a "static" magnet is really a circulating permanent current. In a permanent magnet

the electrons are spinning permanently inside. So maybe a circulation of the energy outside isn't so queer after all.

**"You no doubt begin to get the impression that the Poynting theory at least partially violates your intuition as to <u>where energy is located</u> in an electromagnetic field. You might believe that you must revamp all your intuitions, and, therefore have a lot of things to study here. But it seems really not necessary. You don't need to feel that you will be in great trouble if you forget once in a while that the energy in a wire is flowing into the wire from the outside, rather than along the wire. It seems to be only rarely of value, when using the idea of energy conservation, to notice in detail what path the energy is taking. The circulation of energy around a magnet and a charge seems, in most circumstances, to be quite unimportant. It is not a vital detail, but it is clear that our ordinary intuitions are quite wrong." (Bold face and underline mine)**

What Feynman tells us is that **E**, **B**, and **S** form a holistic structure by which we define our 3D space/time information storage system. Space and Time are relative to the observer who defines them. If you have any concern about energy resources, you had better perk up and listen carefully to what Feynman says instead of relaxing into the assumption that "it is not a vital detail", or else you may be thoroughly obfuscated by the censoring power of the establishment.

The heat energy that radiates from your electric heater does **not** come from the "friction" of electrons feeling resistance as they bump along the wire. It is the phase conjugate form (anti-Poynting vectors) of the photon energy sucked in along the Poynting vectors.

Try this experiment. Place a coffee cup on a table and go stand at the far end of the room and look at the cup. How big does it look? Hold the tip of your index finger up by your eye and notice which looks bigger -- the fingernail on your finger tip or the cup. Now walk over to the table and put your face right next to the cup. How big does the cup look now? Put the tip of your index finger by the cup. Which looks bigger, the fingernail on your finger tip or the cup?

In the case of the capacitor (also called a condenser), charges (**E** field) start out quite separate, and then collect at the capacitor plates. They move along the wire. The **B** field defines the space around the wire. The **S** field, which contains the photon energy is spread out and diffuse when the charges are separated. When the charges

come together, the photon energy condenses from the surrounding space and moves directly into the gap between the plates. That is why a capacitor is sometimes called a **condenser**. It condenses photon energy from space just like water vapor condenses out of the air onto the side of your cold beer glass. That condensation does **not** come from your beer. Put an empty beer glass in your freezer for half an hour. Then take the glass out of the freezer, do not add beer, and condensation will collect on it as if magically appearing from nowhere. Try it.

This is science, not magic. The moisture that condenses on the glass comes from water vapor that is already present, though invisible to you, all around in the air due to evaporation caused by the sun. It is defined, but subtle to the point that we ordinarily do not notice it, because it is widely dispersed. The moisture on your glass is a tiny bit of solar energy that you capture by cooling the glass.

The photon energy that condenses out of space into the capacitor/condenser comes from [valence] electrons somewhere in the environment that have been excited, in most cases ultimately due to solar radiation, and have released or are ready to release photons. Photons come from nowhere, and have to be defined into existence by vortex terminals (e.g. electrons and protons) that capture and release them. The particles form stable charge centers that appear to have a stable (quantized) spin. They also have quantized energy, but that energy is spread out in space due to the geometry of the point particle vortex terminal. By bringing the charge points together along the wire, the photon energy also comes together from surrounding space and the magnetic field intensifies. This is manipulation of space and time in our information storage system just like what we did when we walked over to our coffee cup.

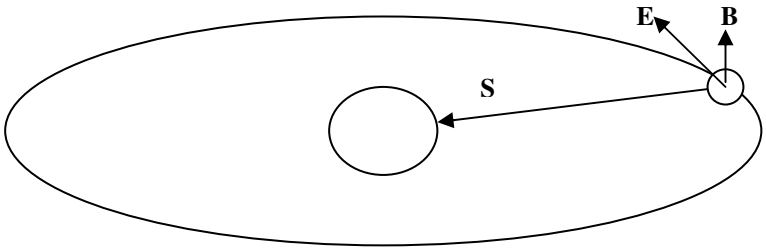
We warp space/time with electromagnetic fields when we change their intensity.

The heat that radiates from your space heater is (for the most part) not electrons flying off into space. It is photons. The photons do not come from the electron point charges, they come in from the space outside the charges when the charges are “densified” and excite the valence electrons on the wire. Then the valence electrons relax and re-emit the photons back out into the space all around. The overall electron structure is not a point particle. It is a potential that is spread out through our entire information storage space that we call the universe. It is defined most clearly and intensely in the point particle that we call the electron and the partner vortex “particle” that provides the companion terminal between which photon energy

flows.

The simplest photon energy system in our universe is the hydrogen atom. It consists of one positively charged proton and one negatively charged electron in a stable relationship. There are no simpler stable atomic structures. Neils Bohr, the close friend of Irving Langmuir, developed the first model of an atom by describing the structure of the hydrogen atom. Obviously he was **very** interested in Langmuir's research into the properties of atomic hydrogen at the GE labs.

What makes the hydrogen atom stable is the constant flow of photon energy in the system as a standing wave form. The major portion of this flow is not directed outward, but is a constant bremsstrahlung (braking radiation due to the constantly changing acceleration of the electron) exchange that goes on between the electron and the proton. We do not see that photon energy bremsstrahlung radiation because it flows between those two terminals (electron and proton), but it is the same as the radiation that appears when charged particles are circulated in a cyclotron.




The above sketch (obviously not to scale) shows a model of a hydrogen atom. The smaller electron moves around the larger proton. We can think of the motion of the point particle around the proton as an electric current consisting of a single electron that forms a standing wave. As the charge moves, it defines a magnetic field that oscillates "up and down" as the electron goes around the proton. This corresponds to what we call electron spin. The electron never stops and goes around the proton with a characteristic speed, so the spin never stops and has a characteristic "speed". Even if the electron dissociates and becomes "free", it continues to oscillate characteristically regardless of its motion through space.

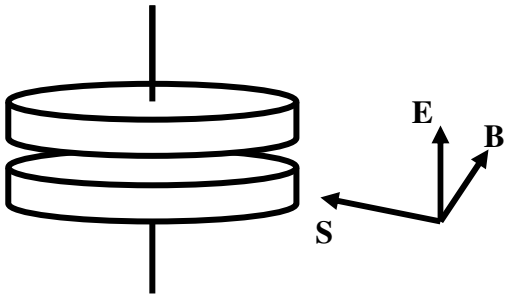
Photon energy constantly radiates from the electron inward to the proton. Why doesn't the proton eventually just swallow up all the energy of the electron? The answer is that the energy flows in a circuit just like the water on the earth flows in an endless circuit from ocean to clouds to rain to rivers and back to ocean. The photon energy flows from the electron into the proton, where it is swallowed up by an anti-electron (i.e. positron) in the core of the proton. (Most physicists still do not

accept this viewpoint, although it is the only reasonable way to account for a continuous standing wave energy circuit that is not exchanging energy with the "outside".)

The positron is the anti-partner of the electron and runs backward in time, just as the electron runs forward in time. The photon energy enters the positron vortex and reverses in time. It goes to the point core of the positron vortex moving back in time to the point where the electron and the positron first split apart. At that point they were together as pure energy potential. The momentum of the backward flowing energy carries it across the vortex core to the electron's vortex core, where it reverses in time and begins moving forward again in time and again radiates out from the electron across space to the proton. The photon energy flow simply goes around this circuit most of the time and maintains the stable structure of the hydrogen atom.


(The photon travels forward through space, the antiphoton goes backwards through time.)

Compare the stable hydrogen configuration sketched on the previous page to the sketch of the "stationary" capacitor. Electrons drift along the surface of the wire charging and discharging the condenser, so the electric field is parallel to the wire. The magnetic field oscillates around the wire. The Poynting photon energy field goes in and out of the space around the capacitor gap at ninety degrees to the electric and magnetic field. You can imagine an electron at the crux of vectors **E**, **B**, and **S**.




The hydrogen atom ordinarily appears to be a stable standing wave because the energy exchange is internal between the proton and the electron. Also it does not charge and discharge energy by accumulating electron point charges like a condenser, because it has only one electron. Instead, the single electron moves to a larger or smaller orbit when it charges and discharges energy from outside the system. It can draw energy from other sources outside the hydrogen atom. In other words it can interact with other electrons and protons in the universe. When an orbital electron

absorbs energy, it shifts into a larger orbit around the proton. The electron can also release any extra energy that it has absorbed. Then it drops back to a smaller orbit. There is a minimum orbit called the ground state that involves only the exchange between the electron and its nuclear proton. This shifting of valence electron orbits forms the basis for modern chemistry. The outward and inward shifting of electron orbits is the recoil expression of the Poynting incoming and outgoing photon energy vector. (There is some possibility that under special conditions the electron may drop to orbits below the ground state analogous to the way liquids can be super-cooled without freezing, and that may have bearing on the energy issue. See the theories of Dr. Randall Mills in which he proposes models to explain quantum phenomena using classical physics.)

If the electron in the hydrogen atom becomes too excited by absorbing too much photon energy from outside, then it moves so far away from its proton nucleus that it no longer is clearly associated with that proton. Then the proton is "ionized" and moves around with a positive charge and is very reactive unless the whole environment is filled with such excited particles and that becomes the normal condition. A gas of such excited particles is called plasma. Plasma physics is one of the most exciting fields of research today, and involves the study of the dynamic complex interactions and structures that plasmas can manifest. However, plasmas are generally unstable in our ordinary "low energy" planetary environment.

Of great interest to us with regard to the energy question is to find the most efficient way to cause a valence electron of a catalytic atom to quickly and efficiently absorb the maximum amount of photon energy, perhaps store it for a span of time, and then release that photon energy on demand quickly and efficiently. It appears that in our planetary environment hydrogen -- the lightest and simplest element -- may be the ideal catalyst for capturing and releasing photon energy.

In our ordinary earth environment hydrogen spontaneously tends to prefer a diatomic molecular state in which two atoms of hydrogen closely associate and together share a pair of electrons. One reason for this is that this configuration allows the hydrogen atom to feel more "complete".

What does it mean to be complete? This has to do with phase conjugation. A system that circulates goes through phases, just like the moon. To be complete, the moon must go through all its phases. A waxing moon must have a waning moon to balance the phases into a complete cycle. A full moon must have a new moon. In

the same way the spin on an electron must have a counter spin. The perfect counter spin is only in the anti-electron. If the electron and anti-electron meet, they annihilate each other and return to Undefined Potential Energy. Spin can only be relatively up and down. Anti-spin then is down and up. There are only two relative possibilities. (Get a top and play around with it.) Thus, the electron seeks to pair up with another electron that is still an electron, but flipped over relative to it. The simplest solution is to find another hydrogen atom with an electron flipped over and mate with it. Since the two electrons have the same charge, they tend to stay on opposite sides of the molecule as they move about, keeping their mutual distance, but hugging in toward the two protons with their positive charges.

The key to the atomic hydrogen technology is to use the minimum effort to dissociate hydrogen molecules. This sucks in a lot of photon energy from the surroundings. Then we simply let the atomic hydrogen settle back to its "environmental ground state" as molecular diatomic hydrogen. As it does so, it releases all the absorbed energy.

The hydrogen acts only as a catalyst, so it can be used over and over to pump energy in and out of the system. As the energy flows out from its locally concentrated space, we can harness it to do whatever we like.

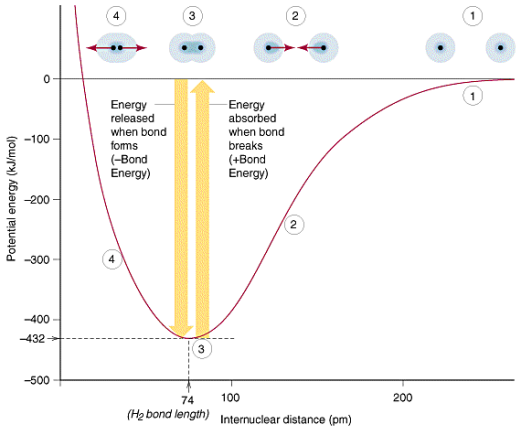
In the case of our original example of the hydrogen torch, the electric field vector (**E**) lies along the electrodes, the magnetic field vector (**B**) girdles the electrodes, and the Poynting vector (**S**) that describes the flow of energy (the power per unit area crossing a surface whose normal is parallel to **S**) comes in from the space around the gap between the electrodes to the axis between them and not from the electrodes:

**S** is proportional to (**E** x **B**).

The "extra" energy is drawn, not from a mystical source, but from ambient electrons in the surrounding environment that happen to be giving off radiation and dropping to less excited states. This continuous chaotic background radiation source can include ambient sunlight, sunlight that is reflecting off atmospheric molecules and objects in the surroundings, or any other energy that is radiating in the environment, perhaps even including cosmic ray energy and atmospheric lightning discharges.

When the space between the electrodes charges up to a certain point, it discharges forming an arc. In the case of the hydrogen torch, the energy transforms the air in

the space into hot plasma, and most of the molecules there are ionized. When molecular hydrogen is blown through this arc, it participates in the arc plasma, and the component atoms of $H_2$ are so excited from the incoming energy that they dissociate from each other and absorb a lot of the energy. Their electrons may even be blown away leaving only pure naked protons in a plasma state. The ambient photon radiation gets captured and stored in the atomic hydrogen (or raw protons) in this way.




Graphic by J.L. Naudin

The theoretical maximum of atomic hydrogen energy absorption is the range from molecular hydrogen at room temperature up to the total ionization of hydrogen into pure plasma of raw protons. In between are many possible states. This explains why different experiments give different dissociation/resociation energies. Physicists studying hydrogen plasma find that it is a fascinating and complex arena with many possible internal configurations and many technological applications.

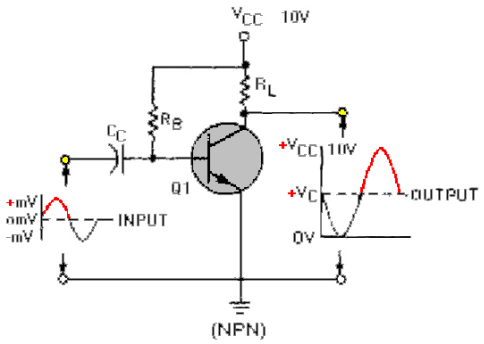
As the mono-atomic gas passes by the electrodes with pressure from the oncoming flow of gas from behind, it quickly leaves the highly charged region of the arc plasma. Once the hydrogen plasma atoms are out of the intense region of the arc, they recombine. The electrons fall back into their more compact molecular orbit space and release back to the environment the electromagnetic energy that they have captured momentarily from the environment during their mono-atomic state. The atoms come together and the electron orbits collapse inward emitting a lot of thermal radiation. This is the reverse of the initial process that occurs when they enter the space of the arc.

The key point is that the energy provided by an Atomic Hydrogen Torch or Furnace

comes primarily from field energy radiation in the environment and NOT from the electric current in the electrodes. That is why it can achieve COP over unity. Conservation of energy is still maintained as Feynman points out. Energy in (including the energy used to drive the current) and energy out along the Poynting vector is equal.

For example, if I have a water tank on my roof 10 meters above my sink, the water pressure at the tap is about 98.1 kilo-newtons per meter squared. However, I can gently twist the tap and get a strong flow of water that I deliberately manipulate for my purposes. The water tank can simply collect rain water, a natural flow of solar energy in the environment that condenses onto my roof from the sky. This is a deceptively simple, yet powerful technology that has made urban civilization possible.

An example from electronics is a field-effect transistor. A transistor can be used to manipulate voltage, current, or power. "Because the controlled (output) power can be much larger than the controlling (input) power, the transistor provides amplification of a signal. . . . The transistor is considered by many to be *the* greatest invention of the twentieth-century, or as one of the greatest. It is the key active component in practically all modern electronics. . . . The essential usefulness of a transistor comes from its ability to use a small signal applied between one pair of its terminals to control a much larger signal at another pair of terminals. This property is called "gain". A transistor can control its output in proportion to the input signal; this is called an "amplifier". . . . . small swings in $V_{in}$ produce large changes in $V_{out}$ ". (Wikipedia, "Transistor") A few millivolts can manipulate a few volts. Scale that. In the case of a power amplifier, loss of efficiency produces heat as a by-product of the energy lost during the conversion of power. Of course, that is fine if heat is what we want. It seems that someone decreed that the field-effect transistor principle was only to be used for micro-scale applications and managing of signals, not for the manipulation of energy on a macro-scale.



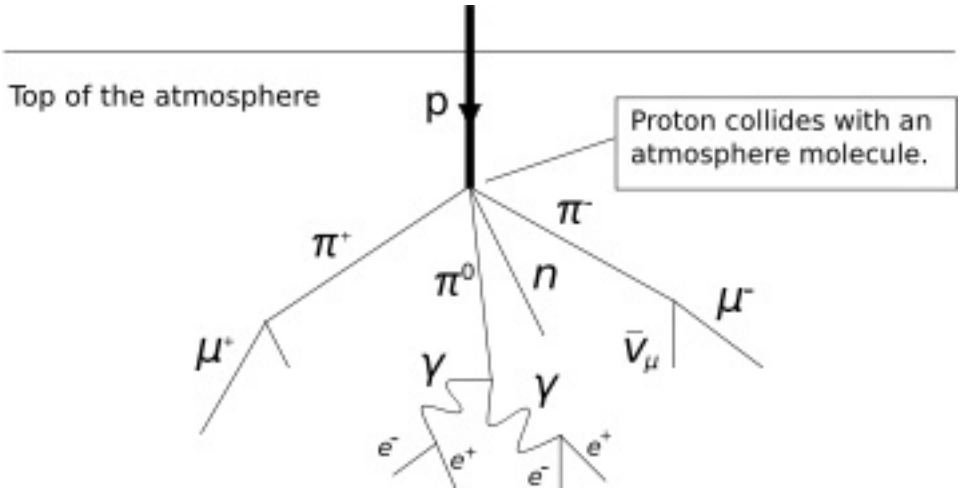

Sample Diagram of a Transister Circuit

Refer back to the sample I gave of Naudin's test run charts on his miniature Atomic Hydrogen Furnace (AHF), and you will see that he inputs only between 2 and 5 W of power, but he gets a response between 40 and 90 W of power in a reliable manner. This is similar to the transistor principle.

**Possible Sources of Diffuse High Energy that Feed into the AHF**

When $H_2$ molecules dissociate in the AHF, there must be a source of high energy in the surrounding environment that will be drawn to the reaction area of the furnace as a natural part of their energy dissipation process. I have identified several sources that are constantly present in the environment, and there may be others. Physicists can sort out in laboratory experiments the various sources of energy..

1. Radiation in the UV or higher range that reaches Earth as part of sunlight.
2. Ionized atomic hydrogen (protons and electrons) particles that make up the solar wind and constantly strike Earth's atmosphere. They are particularly active around the magnetic poles of the planet and produce auroras.
3. Cosmic ray particles consist of about 89% protons, 9% alpha particles (helium nuclei), 1% other atoms, and 1% beta particles (electrons). These particles can have very high energies, usually above 10^9 eV, but also ranging with increasingly less frequency up to 10^20 eV. They come from galactic sources such as black holes and supernovae, and include some very high energy extra-galactic sources (10^18 eV and above) such as quasars and radio galaxies. The sources for the extremely high energy particles that are over 10^14 eV are currently unknown. But those over 10^18 are thought to be extragalactic. When the high energy particles enter earth's atmosphere, they interact with air molecules and produce a shower of subatomic particles similar to what is seen in collider experiments.



The showers of secondaries generally contain mesons, muons and electron-positron pairs. These secondaries decay, giving off high energy photons. Gamma radiation from electron-positron annihilation events provides a nice source of high energy radiation that is present in the atmosphere, but very diffuse. The incidence at earth's surface is 100/m^2/year for particles above 10^15 eV and drops off rapidly for higher energy primary particles that go up to 10^20 eV. Muon density at earth's surface averages close to 10,000/m^2/minute. The showers usually begin higher in the atmosphere when the primaries begin to collide with atmospheric molecules. Thus the shower produces photon radiation at all levels of the atmosphere. Muons come into the atmosphere at around 6 GeV, and lose about 2 GeV to ionization as they pass through the atmosphere and still have 4 GeV when they reach sea level. They decay in about 2.2x10^-6 seconds in the following manner. (The underline indicates an antineutrino.)

$$\mu- \text{ --> } e- + \underline{\nu_e} + \nu\mu, \quad \mu+ \text{ --> } e^+ + \nu e + \underline{\nu\mu}$$

The positrons annihilate with electrons releasing further gamma radiation. The muons form about half the Earth's natural background radiation. The other half comes from natural isotopes found in the earth. The AHF catalyzes the collecting of these gamma photons into the arc gap to dissociate and ionize the hydrogen molecules as they flow through the arc gap.

4. The Van Allen Belts are two toroid shaped regions beyond earth's atmosphere that contain charged particles (mostly protons and electrons) that are trapped by the earth's magnetic field. These charged particles are a rarified form of the same ionized atomic hydrogen that occurs in the AHF. They are close enough to Earth that some of the radiation they release may be drawn into the AHF reaction. They are probably energized by sunlight.
5. The ionosphere is the highest layer of the earth's atmosphere, extending from about 50 km up to around 1000 km. It consists of excited electron and ionized atoms in a plasma state energized by UV and higher radiation from the sun. Thus, although it is actually very hot from this radiation, it would seem cold if measured with a thermometer, because the air is so thin. This ionized gas is an excellent energy source for the AHF. It is just like the excited plasma gas within an electric arc, except that it is highly rarified. It is also present above every location on the planet.
6. Lightning occurs in the lower atmosphere at various locations around the planet about 100 times per second. Lightning discharges electrons into the Earth thereby maintaining the fair weather field voltage potential that exists between the ground and the ionosphere. Lightning generates plasma in the air by a

mechanism in which water vapor in the air condenses and collects a pool of electrons in the lower regions of thunder clouds. Lightning discharges the electrons down to the Earth. Manmade electric arcs, including the AHF, work by the same principle of charging and discharging across a gap that consists of a gas. Some of the energy released by lightning can be drawn into the arc gap.

7. Terrestrial background radiation from natural isotopes forms about half of the average background radiation. The remainder mostly comes from decaying cosmic ray muons.

To summarize our list, the environment contains a steady supply of high energy events spread out over a wide area: solar radiation, solar wind (ionized atomic hydrogen), cosmic ray particles (high speed ionized atomic hydrogen), the Van Allen belts (ionized atomic hydrogen plasma), the ionosphere (ionized atomic hydrogen plasma), lightning (ionized air molecule plasma), and radioactive terrestrial isotopes. Interestingly, most of these sources consist of the same excited atomic hydrogen plasma that we find in the AHF. The UV, X, gamma, and high end cosmic photon radiation from these sources moves at the speed of light and can proceed to the AHF from any direction within at least a 1000 km radius, if we assume that the dissociation of hydrogen from molecular to plasma in the AHF occurs within about .003 seconds. The exact rate of dissociation and ionization of $H_2$ depends on temperature, pressure, and the mixture of various hydrogen states ($H_2$, H, $H^-$, $H_2^+$) as well as other factors. Generally, at least UV level of photon radiation is required to dissociate hydrogen. There is uncertainty in the process due to the number of pathways available (at least 17 different possible reactions have been identified). By controlling the initial conditions, we can find the least energy required at each stage of transition from $H_2$ to the desired percentage of plasma for efficient operation of the AHF. This process echoes the primordial cosmological processes in deep space hydrogen gas clouds.

A plasma arc is like a discharging condenser. A current causes a charge to build up in electrodes adjacent to a normally non-conducting gas. At some point the gas ionizes enough to permit current to flow across the gas gap between the electrodes. This is a non-linear event, because the arc generates great heat that then ionizes more gas and lowers the voltage between the electrodes. That allows more current to flow. Thus, negative impedance in the arc can produce a runaway effect that drains all the current available in the circuit and destroys the equipment, so positive impedance must be introduced into the circuit to maintain a stable, controlled arc. The AHF must generate the critical potential to initiate the arc and the dissociation of hydrogen, but not allow the current in the electrodes to be out of control.

A century ago Tesla experimented with high voltage arcs to produce and study artificial lightning. He also developed many versions of his famous Tesla coil and proposed to construct a wireless transmission of electric power distribution system (US1119732 — Apparatus for Transmitting Electrical Energy — 1902 January 18). He felt that thirty large antennas distributed at key locations throughout the world would provide a global energy network for all of humanity. He said, "Ere many generations pass, our machinery will be driven by a power obtainable at any point of the universe." ["Experiments with Alternate Currents of High Potential and High Frequency" (February 1892).]

He wanted to build a giant "condenser" apparatus on Long Island as part of a project to provide cheap energy for the world by drawing from this atmospheric high energy source with similar stations around the world. However, J. P. Morgan and George Westinghouse withdrew their financial backing when they realized Tesla's plan might jeopardize the ability to meter and sell for profit every Watt of electricity. This lack of support for Tesla's research in this endeavor was a great loss to humanity in the light of the many great inventions that he was able to complete.

In the AHF, the arc produced by the electrodes becomes a tiny lightning bolt that ionizes the atomic hydrogen. The freed electrons of the plasma then tend to flow into the earth ground and the hydrogen is like the positively charged atmosphere near the ionosphere or the top of a thundercloud. When the atomic hydrogen relaxes outside the arc, it first draws electrons back into the ground state hydrogen orbit and then goes back into its usual low energy diatomic molecular state. This diffuses the potential created by the hydrogen plasma and releases the briefly focused energy back into the environment.

The hydrogen furnace therefore serves as a very efficient energy pump or amplifier that captures, momentarily focuses, and then releases back again energy flows that exist chaotically everywhere in the environment. As the energy flows back out from its focused state within the arc plasma into the general environment, we can harness a portion of it to perform work that we consider useful. The hydrogen acts as a catalyst for the process of focusing and releasing the energy, so it can be used over and over again. All we are doing with the arc current is slightly deflecting the pre-existent environmental energy flow so some of it flows through our devices.

To summarize, the electric current moves in the electrodes. The magnetic field surrounds the electrodes, and the Poynting vector comes into the gap between the electrodes from ninety degrees relative to the direction of the electrode current, and

the hydrogen dissociates and ionizes. The atomic hydrogen then moves away from between the electrodes under the pressure from the constant oncoming flow of molecular hydrogen gas and hits a cooler, more relaxed, region. The heat in the atomic hydrogen tends to flow from the excited hydrogen out to the less excited surroundings. The atomic hydrogen then spontaneously recombines back into its usual molecular state that it prefers under most earth atmospheric conditions and releases its temporarily stored energy. In the application that you choose, you can extract the heat released from the recombining hydrogen and put it to some use such as high temperature welding, heating your house, or running a steam engine.

An interesting feature of the hydrogen program we suggest to explore is that it does not require a continuous supply of hydrogen. The hydrogen is sealed into the system and simply cycles back and forth between the molecular and atomic states. The system may require periodic recharging of the battery system that ignites the furnace and other maintenance. The turning of an engine and inertial motion of a vehicle can be used to recharge the battery, at least to some extent. This all depends on the levels of efficiency achieved by the engineers with such a technology.

As an interesting final note, J.L. Naudin ran blank tests in which he did not allow the temperature to reach the critical point at which hydrogen dissociation occurs. (Again refer to the sample chart summarizing a few of the test runs.) The system then functioned like a water heater and ran with a COP of 0.7, very solidly **under** unity as opposed to his findings of COP 13-21 when the AHF operated at its proper temperature. He also noted that the system performed best when the current was pulsed at about 51 Hz rather than steady. Below are Naudin's comments after running his initial series of tests.

Comments from Jean-Louis Naudin : Today, after a lot of tests of the MAHG, I am able to confirm the previous results conducted by A. Frolov during the genesis phase of the project. The results are stable and fully reproducible although measured with a completely different set of electronic equipments. The MAHG is one of the best devices that I have tested until today. It seems a very good candidate unit which can be used to produce a clean and independent energy source for our next future and for the benefit of All...

Below is a comment from Nicholas Moller who refined the preliminary designs of Lyne into a feasibility prototype.

*When you add the fact that the hydrogen is not consumed in the "burning" process, and can thus be recycled, it should become very clear to any scientist, humanist, environmentalist, business executive and indeed to every human being that is concerned about the state of our wonderful planet, that no more time should be wasted. The time has come for removing the responsibility of defining the energy policies and structures of the future from the hands of the established energy industries, and place it in the hands of men of science who will work for the preservation of the environment that sustains all life on Earth. Men who will work for the economic development of the third world by means of providing clean, abundant and inexpensive energy technologies.*

*Such initiative will only succeed when massively supported by the visionary captains of industry who will have the courage to dismantle the existing and scandalous energy grid which now envelopes our planet, by investing in the production and marketing of small energy generators for individual households, factories, transport etc.*

*Once such a generator has been acquired by the consumer, his further energy requirements will be covered for FREE, giving him independence in terms of energy as well as increased buying power for any other economic development.*

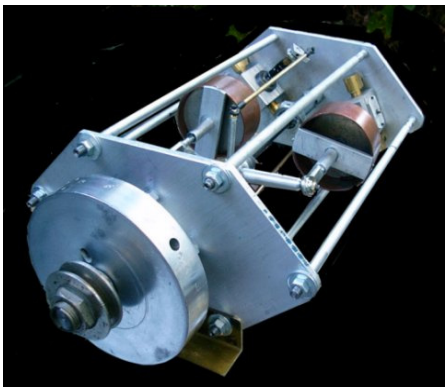
*Nicholas Moller*

By the way:

"No anomalous radiations (alpha, beta, gamma and X-radiations) have been detected close to the main reaction chamber of MAHG during the one hour test run. This confirms that the MAHG process is clean and safe..." JLN

**Motive Power**

Once you have an efficient clean heat generator, you can hook it up to a modern steam engine. Recent developments in steam engine design such as Robert Green's "Green Steam Engine" will provide quiet and efficient operation for your car, boat, train, or even airplane.



A Powerful,. Lightweight, **Green Steam Engine**

The electrical energy needed to generate the hydrogen used by the system will come from solar panels, from OTEC, or some other clean source.

The idea of cars powered by solar panels is a silly joke played on students to waste their time, because the area needed to collect solar energy to run a vehicle efficiently exceeds the practical surface available on a vehicle and renders it aerodynamically absurd. Also, direct solar power from panels depends on bright daylight. Solar car contests must have been promoted by the oil companies to convince people by "hands-on" experience that running cars on sunlight is impractical.

We can and will have solar-powered cars, but we will not collect the solar energy with solar panels on board the car. We will use hydrogen furnaces or a similar technology to collect it. With the proper approach, solar-powered aircraft become quite feasible.

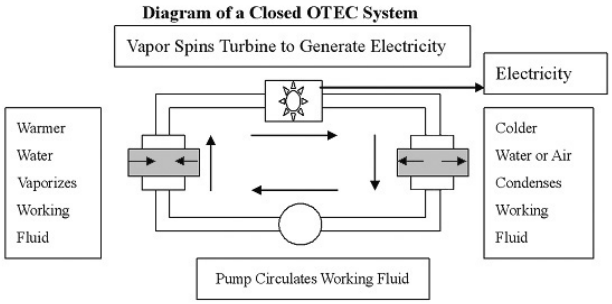
I will address the hardware issues involved with transportation equipment and infrastructure in **Project #5: A Green Economy**.

**Some Benefits to be Derived from Widespread Use of Clean Energy**

Reassignment of fossil and other carbon resources away from combustion,
Retirement and cleanup of all nuclear power plants,
Massive reduction in air, water, and soil pollution,
Retirement of global warming concerns,
Retirement of all aboveground power line infrastructure,
Retirement of freshwater turbine methods out of environmental considerations,
Unlimited energy resources derived directly or indirectly from the sun,
Development of highly efficient hydrolysis technologies,
Development of efficient hydrogen storage and retrieval systems,

Use of hydrogen as the primary portable or energy catalyst,
Large-scale development of Ocean Thermal Energy Conversion,
Continued development and deployment of solar energy conversion technology,
Continued development and deployment of wind energy conversion technology
Research and development of "zero impact" tidal energy conversion technology
Development of highly efficient electric generators and motors.
Development of highly efficient Atomic Hydrogen Furnaces.
Development of other highly efficient "furnaces" such as "cold fusion"..
Development of highly efficient and lightweight steam engines.
Plentiful low-cost clean energy available globally for the foreseeable future.

Further note on OTEC-type systems:



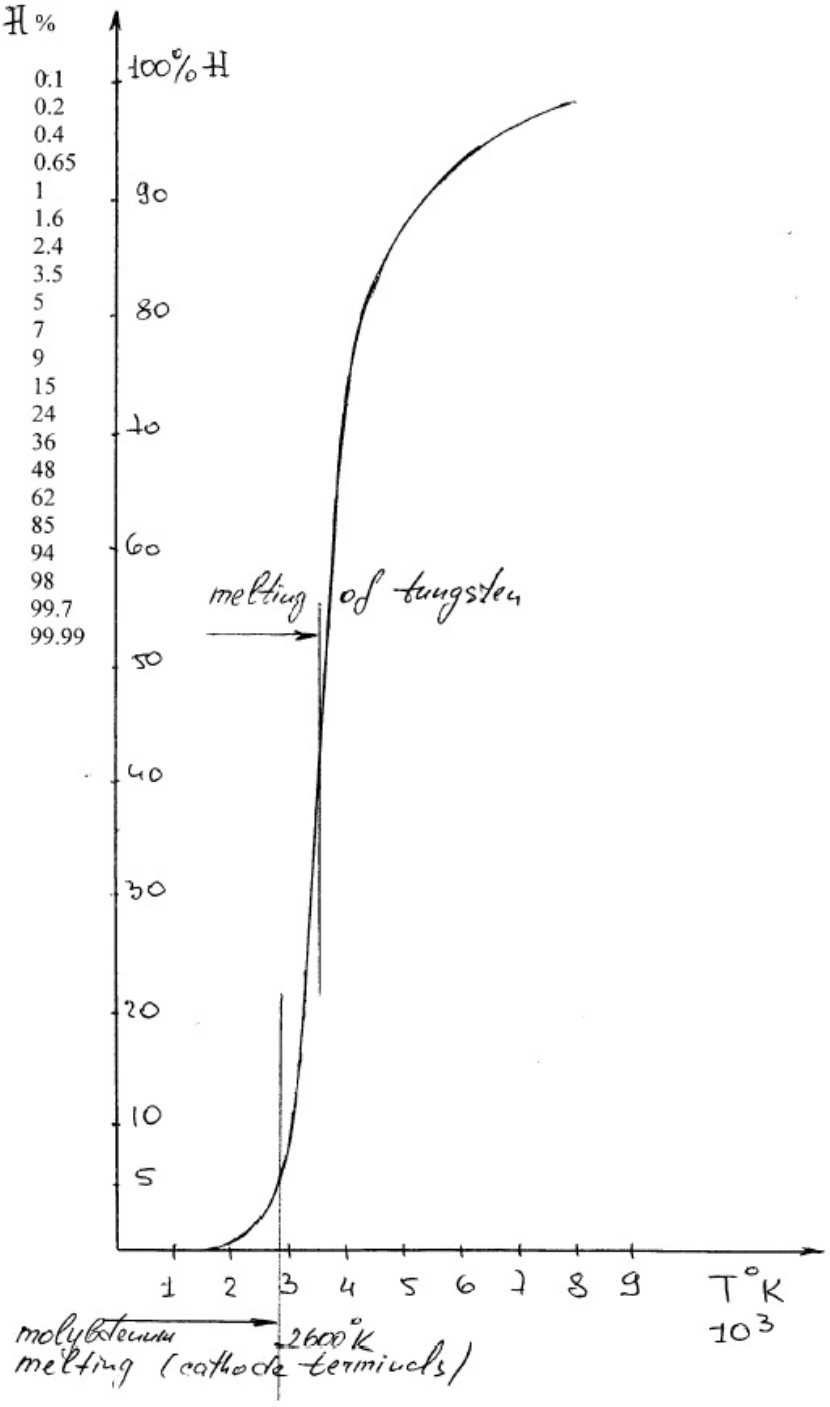

In the OTEC heat exchanger the energy that turns the turbine does NOT come from the pump that moves the working fluid through the pipes. It comes from the thermal reservoir that is outside the pipe through which the working fluid flows. The arrows in the vaporizer indicate the inflow of energy. After work is extracted from the thermally excited working fluid, the condenser cools the working fluid by facilitating the release of the fluid's excess thermal energy back out into another thermal reservoir. The arrows in the condenser indicate the outward flow of energy. This is analogous to the way a transistor works and the way the AHF works. Both the OTEC system and the AHF system harness solar energy from environmental reservoirs. Neither one adds any extra warming to the planet.

**Langmuir's Study of Dissociation of Hydrogen to Atoms**

courtesy JLN Labs and Nicholas Moller

Dissociation of hydrogen to atoms (article Flames of Atomic Hydrogen, General Electric Review, Vol. XXIX, #3, 153, March 1926)

| T (K) degrees | H % |
|---|---|
| 2000 | 0.1 |
| 2100 | 0.2 |
| 2200 | 0.4 |
| 2300 | 0.65 |
| 2400 | 1 |
| 2500 | 1.6 |
| 2600 | 2.4 |
| 2700 | 3.5 |
| 2800 | 5 |
| 2900 | 7 |
| 3000 | 9 |
| 3200 | 15 |
| 3400 | 24 |
| 3600 | 36 |
| 3800 | 48 |
| 4000 | 62 |
| 4500 | 85 |
| 5000 | 94 |
| 6000 | 98 |
| 7000 | 99.7 |
| 8000 | 99.99 |




Moller and Naudin find that the best efficiency seems to come at lower temperature when only a tiny fraction of the hydrogen is actually dissociated.

**A List of Known Atomic Hydrogen Reactions**

| | Reaction | Reference |
|---|---|---|
| 1 | $H + e^- \rightarrow H^- + \gamma$ | Wishart (1979) |
| 2 | $H^- + H \rightarrow H_2 + e^-$ | Glover, Savin, Jappsen (2005) |
| 3 | $H + H^+ \rightarrow H_2^+ + \gamma$ | Ramaker & Peek (1976) |
| 4 | $H + H_2^+ \rightarrow H_2 + H^+$ | Karpas, Anicich, & Huntress (1979) |
| 5 | $H^- + H^+ \rightarrow H + H$ | Glover, Savin, Jappsen (2005) |
| 6 | $H^- + \gamma \rightarrow H + e^-$ | Wishart (1979) |
| 7 | $H_2^+ + e^- \rightarrow H + H$ | Schneider et al. (1994) |
| 8 | $H_2 + H^+ \rightarrow H_2^+ + H$ | Savin et al. (2004) |
| 9 | $H_2 + e^- \rightarrow H + H + e^-$ | Stibbe & Tennyson (1999) |
| 10 | $H_2 + H \rightarrow H + H + H$ | Mac Low & Shull (1986) |
| 11 | $H_2 + \gamma \rightarrow H + H$ | Draine & Bertoldi (1996) |
| 12 | $H + e^- \rightarrow H^+ + e^- + e^-$ | Janev et al. (1987) |
| 13 | $H^+ + e^- \rightarrow H + \gamma$ | Ferland et al. (1992) |
| 14 | $H^- + e^- \rightarrow H + e^- + e^-$ | Janev et al. (1987) |
| 15 | $H^- + H \rightarrow H + H + e^-$ | Janev et al. (1987) |
| 16 | $H^- + H^+ \rightarrow H_2^+ + e^-$ | Poulaert et al. (1978) |
| 17 | $H_2^+ + \gamma \rightarrow H + H^+$ | Dunn (1968) |

Data from Glover, Savin, Jappsen. "Cosmological Implications of the Uncertainty in $H^-$ Destruction Rate Coefficients". (arcXiv:astro-ph/0506221v1 9 Jun, 2005).

## Other Relevant Research

There is a lot of R&D focused on hydrolysis technologies. A promising area of investigation is what I call "Tease and Tap" hydrolysis. The hydrogen atoms in a water molecule form a funny angle of 104.45° with oxygen. The idea is to **tease** the hydrogen atoms into an appropriate angle with the oxygen and then give the structure a gentle resonant **tap** to split hydrogen atoms loose from the oxygen. The energy condenser method described in the body of this article can also be used, with pure water serving as the dielectric. Store only water on board and use both the $H_2$ and the $O_2$ on the fly to drive combustion, steam engine, or fuel cell.