The Implications of Controlled Hot Hydrogen Fusion

Controlled fusion will change the course of humanity, making our world and civilization 100-200 years from now unrecognizable to those of our day. The priorities of engineering design will change. When cost of fuel approaches zero percent of operational costs, all other design parameters including cost of manufacture, reliability, and ease of use will overshadow fuel efficiency considerations. Synergistic combinations of technology, science, and society will go in unimagined directions.

A comparable revolution was the invention of the light bulb by Edison in 1879. It's now a simple, ubiquitous device. However, as a result of it's invention, the world changed more in 75 years than it probably had changed in previous human history. From candles and steam engines to rockets, jets, radio, television, computers, and nuclear bombs. All as a result of the light bulb.

Man primarily rose and slept with the sun. Gas, candle, wood, kerosene, oil and other light sources existed, but for the amount of light produced they were expensive. In most instances, the light produced was very weak and of very limited coverage compared with todays nighttime illumination. Turning on a light bulb was an event just a short 120 years ago. Only father turned on the light. People traveled to cities and fairs just to see light bulbs. People dressed up in suits to be treated to electric illumination. Electric lights were the sensation of that age.

The light bulb also changed the world in ways that most people today don't even realize. Edison's early bulbs were vacuum evacuated. Residue from filament breakdown coated the inner surface of the bulb, dimming it. Early light bulbs often became unusable before the filament burnt out. Edison ran many experiments attempting to remedy this problem.

One series of experiments lead to the discovery of the Edison Effect in 1883. A small electrode placed in a lighted bulb produced a current flow from the filament with relation to this electrode. This current would flow only in one direction. Edison did not know what to make of this effect and developed it no further. It did not solve the dimming problem.

What Edison had discovered and not understood changed the world as we know it in ways he could not have imagined. Edison is credited with discovering thermionic emission of electrons from a glowing filament. Fleming developed this into the first electronic diode, the Fleming Valve. A few years latter Lee DeForest inserted a grid between Fleming's filament and plate. The triode, the first amplifier, was born. This is the foundation of electronics which has made the most significant changes in human history. From light bulb to Edison effect to electronics to rockets, jets, radio, television, computers, and nuclear bombs.

Marconi had transmitted radio waves, but his system was electrical, not electronic. The birth of electronics is credited to DeForest and his triode amplifier which he called an Audion. All based on Edison's lowly light bulb and the mysterious Edison effect.

Controlled fusion will bring presently unimaginable technological revolutions. I have had ongoing interest in the history of science and technology. I studied the ideas of others, especially of those inventors of the late 19th century and onward. I explored, studied, and took in the rich technological creativity of past minds. Much is learned by going over the work of previous generations. Over and over ideas are forgotten, only to be rediscovered again. I did not imagine or understand the depth to which I was preparing myself for rapid future movements in directions in which I could not have even imagined.

Then it happened! An article in Popular Mechanics in December of 1998 sparked an explosion in my mind. Within an hour or two of reading the article Star in a Jar I did the unexpected: I invented a hot fusion process! [1] Superior in every way. Why could I have not seen it earlier. It's function then appeared so obvious. But the light bulb became obvious, so elegantly simple, after Edison invented it. Invention is a matter of time, perception, previous experiences, and I believe a creative gift.

I am pleased to inform you that after more than 10 years of scrutiny, the U.S. patent office (USPTO) has granted me a patent on a hot hydrogen fusion nuclear reactor. As you know, it is very difficult to get a US patent on fusion. During the cold fusion controversy, thousands of patent applications were received. The USPTO rejected all of them and refuses to process cold fusion applications. The first fusion reactor patent was granted in 1947 to Sir George Paget Thomson of Britain. My patent may be the most recent of very few issued patents on fusion. This invention is a unique and patented means of efficiently providing sustainable energy in significant amounts.

Since that time, I began to slowly see more ideas develop. With time the pace of idea development increased rapidly. An invention and idea would trigger another. It was a synergistic cascade effect. I hope to share with you some idea of where the development of operational controlled fusion can lead us in the future. This invention provides controllable hot hydrogen fusion efficiently. This will change the course of history. It will change all engineering priorities. It means safe and clean: energy, water, waste recycling, and propulsion of all vehicles: marine, surface, and aerospace.

A sustainable energy source. Large-scale reactors using fusion reactive fuels and thermal power production (turbine based) are the most comparable to fission power from an engineering and economics viewpoint. Both fission and fusion power plants involve a relatively compact heat source powering a conventional steam turbine-based power plant. Both may produce enough neutron radiation to make activation of the plant materials an issue (there are some fusion reactions with no neutron flux). The main distinction is that fusion power produces no high-level radioactive waste and does not consume precious uranium or thorium.

Fusion power proponents commonly propose the use of deuterium, an isotope of hydrogen, and or lithium as fuel. As an illustration; consider a fusion energy output equal to the 1995 global power output of about 100 EJ/yr (= 1 x 10^{20} J/yr), and that this rate of consumption does not increase in the future. The known current land based lithium reserves will last about 3000 years. Lithium from sea water will last about 60 million years. A more complicated fusion process using only deuterium from sea water will have fuel for about 150 billion years. An advanced fusion process using light hydrogen from sea water will have fuel for about 1005 trillion years. To put this in context, 150 billion years is close to 30 times the remaining life-span of the sun, and more than 10 times the estimated age of the universe. 1005 trillion years is close to 201,000 times the remaining life-span of the sun, and more than 67,000 times the estimated age of the universe. [2,3]

Take the Diablo Canyon nuclear plant in California. A 2.25 gigawatt plant. Fuel needed to operate this plant for one year. With coal, 4.5 x 10^6 tons, a train of 45,000 cars, 560 miles long. With oil, 22.5 x 10^6 barrels, the capacity of 16 super tankers. With water, 360 gallons, an amount able to be carried with one pickup truck. [4]

Safely controlling the weather...A hurricane buster, a means of safely stopping these storms far out in sea. A fusion neutronic detonator will be used to trigger the explosion of isotopes of lithium and hydrogen. No chain reaction of heavy isotopes is needed, only isotopes of lithium and hydrogen are reactants. There is fission of lithium six, but it splits only one way into deuterium and helium four with no release of radioactive isotopes. Tritium is also released from the fusion reactions. Over open ocean the neutron burst will activate some of the device's component residues. Some short lived atmospheric radioisotopes will be produced from nitrogen and oxygen. Careful design will mitigate these considerations resulting in no significant environmental hazards, as with fission triggered devices.

A hurricane is a gigantic Carnot cycle heat engine transporting ocean heat to above the greenhouse gas layer to allow effective radiation of that heat back into space. Detonation of a pattern of predetermined hydrogen explosions in a ring pattern at a calculated distance from the eye of a hurricane will accelerate it's dissipation safely and rapidly without diminishing it's role in the proper transportation of ocean heat into space.

A high rate sea-water distillation plant for fresh water production. With a 20 million gallon per minute (Mgpm) of cold sea-water input, this plant will output 10 Mgpm of doubly flash distilled fresh water using fusion energy. Fusion energy changes the relationships of all the engineering parameters. Free water is the fuel, so inexpensive construction and operation overshadow fuel efficiency considerations. In 2002 I estimated the cost of such a plant at about 10 billion US dollars, not counting inlet and outlet water conduits. The waste heat and brine would be discharged back into the ocean at another water level with salinity not exceeding 200% that of normal sea-water and a temperature not exceeding 100 degrees Fahrenheit. Based on 50% evaporative and transport losses, the output of this plant would equal an irrigation capacity of about 8 million acre feet of

water. In 2008, the US used a total capacity of about 92 million acre feet of water for irrigation. The US averaged a consumption of 2.35 acre feet/acre/year (afay) for irrigation in 2008. At 2.35 afay irrigation consumption, the output of such a plant described above would irrigate about 3.4 million acres, around 5,360 square miles (sm), about the area of the state of Connecticut. Arizona and other western dry areas consumed a rate of around 5 afay. [5] At 5 afay this plant would irrigate about 1.6 million acres, around 2,520 sm, about the area of the state of Delaware. This design is for a plant that is nearly "idiot" proof to operate and maintain. The water quality does not even need to be tested, for if it's not of potable quality, it won't be able to get out of the plant based on the plant's hydraulic design. I designed wastewater treatment systems from 1972 through 1979 and I am well versed in making such designs "idiot" proof.

Carbon dioxide recycling. Presently about 5-6 million metric tons of CO2 is captured annually. Projects in the US, Canada, Norway and other countries are working on carbon sequestration. Fusion energy and the DeLuze fusion reactors open up a new pathway of CO2 recycling as opposed to just sequestration. Electrolysis of water to hydrogen and the release of the oxygen to the atmosphere starts the process. Collected CO2 reacted with this hydrogen in modified forms of my reactors will produce hydrocarbons, primarily methane, and water. The water will be split to oxygen and hydrogen as above. At this point in the energy economy, all the methane produced can be used as pipeline natural gas. As the technology and industry of this process develops, the excess production of methane can lead to synthetic liquid fuel production of clean burning fuels such as octane.

Enhanced oil recovery. Hydrogen production from fusion energy can be used to produce acidified steam and other hydrogen rich mixtures for coal, oil, and gas field injection to promote in-situ cracking of heavy hydrocarbon deposits. This can increase the energy content and recovery potential of embedded carbon deposits. This becomes a process of "carbon mining". Such mixtures can be injected into coal beds producing petrochemicals. In the future CO2 greenhouse gases will become a natural resource. Presently they are not a natural resource because we lack a controllable primary energy source here on earth. Energy is far too expensive to consider recycling greenhouse gases. Once we get energy from water by fusion, greenhouse gases potentially become important natural resources. International control will then focus on how much CO2 will be allowed to be removed from the atmosphere and ocean for fuel and chemical production. We do not want to precipitate another Azolla event where the drawdown of atmospheric and oceanic CO2 transformed the planet from greenhouse earth to icehouse earth.

A turbo, ram, scram jet engine. A turbo ram version will fly a fully loaded stretch 747 over 250,000 miles (@ 12 gallons per mile jet fuel equivalent) non stop using one pound of fuel. A turbo, ram, scram variant will propel an equivalent aerodynamic load using one pound fuel to about 250,000 feet (50 miles) at hypersonic speeds. A ram jet variant was the matter of one of my US Air Force grant proposals in 2003. [6] This 50-75 pound engine was rated at 300 pounds of thrust. It was designed to run for 1200 hours on 1/8 pound of hydrogen gas.

A hydrogen fusion rocket engine. This engine will push a high altitude scram-jet powered craft into orbit. The craft powered by such an engine could carry sufficient fuel to continuously accelerate and then continuously decelerate at 2 g's to the moon. Such a trip would be measured in hours, not days. A trip to outer solar system bodies would involve 1.5-2.0 g acceleration to about 10% of the speed of light. Then would follow a coast phase at 10% of the speed of light followed by a 1.5-2.0 g deceleration period placing the craft into orbit. A trip to Mars would be measured in days to weeks. A trip to Pluto would involve a 10% speed of light coast phase that would exceed the coast period to Mars in terms of just a few more days. The craft would be able to enter orbit about Pluto as opposed to just a quick flyby. This matter was the subject of my other US Air Force grant proposal in 2003. [7]

A hydraulic ramjet engine. The current state of technology for surface and subsurface water vehicle propulsion is either the oxidation of fossil fuels or nuclear fission. This engine is a fusion reactor and associated structures which heat up on absorbing the emitted radiations and also generate electricity thermoelectrically. Water flowing through this structure is heated directly by the reactor, by emitted radiations, and by heat transfered from the asociated structures. This provides for hydraulic thrust using the jet principal. There are no moving parts within the engine proper. This provides for very silent operation and concurrent electricity generation. The primarily detectable results of this operation would be the emitted heat plume. This engine is equivalent or exceeds the performance of the hypothetical submarine engine portrayed in the movie The Hunt for Red October. This was the matter of my DARPA SBIR proposal in 2003. [8]

A radiation absorber electric generator. This is a technological innovation that can surround a fusion reactor and eliminate release of all radiations from the reactor, converting them to electricity and heat. This allows safe nuclear powered vehicles. As an example a 24″ by 24″ by 10″ toroidal phase I reactor can operate at about 80 kilowatts (kW). An absorber surrounding this reactor of about 4-6″ thickness can contain all released radiations transforming them to direct current (DC) at a predetermined design voltage. This is about 100 horsepower (hp). With a storage battery to equalize current demand, this could easily operate a 200-300 hp motor and power most cars. A 3 foot cube could produce about 300-500 kW, sufficient to operate a city bus. Fuel would be stored as compressed gas in a small tank and wastes will be collected and compressed into an exhaust tank. No materials or radiations other than waste heat would be released into the environment and operation would be nearly silent. A pound of fuel gas would propel a car over 30 million miles (@ 15 miles per gallon (mpg) gasoline equivalent) and a city bus over 8 million miles (@ 4 mpg diesel equivalent).

The transmutation recycling of radioactive waste. Gasified radioactive wastes can be changed into non radioactive elements. This is Alchemy! Alchemy is a nuclear reaction. You can change lead into gold, but more importantly for today, you can change something like a radioactive isotope of cesium into something innocuous like oxygen.

A means of solid, fluid, and gas recycling. Consider an old school bus with tires, paints, battery, waste fluids, and all the buses components. Fill the bus with metal containers of

nerve gas. Recycle in reduction back to precursor materials comprising: gases and fluids including hydrocarbons, nitrogen, water, and industrial gases such as chlorine and fluorine. Hot liquids which solidify including salts, glass, metals and other minerals. No ashes. Ashes and contaminated soils can be recycled to the above.

An efficient, self contained and powered two stage biomass dryer. Large quantities of biomass are currently produced which are problematic for transport and disposal due to high water content. This process allows processing and large volume reduction on site. Included within the unit is thermoelectric power generation to power blower motors and electronics, therefore the unit can be self contained. A totally mixed fluid bed dryer is followed by a second stage plug flow dryer resulting in trapping of dust within the high moisture first stage. This was the matter of my US Department of Energy SBIR proposal in 2003. [9]

I will briefly mention others. A means of fluid recycling. Reasonably gasified fluids and gases processed in reduction back to precursor materials. An interstellar craft engine and inertial recovery electrical power generation system. A nuclear fuel cell. A high efficiency, low pollutant power source for electric vehicles using clean burning hydrocarbons such as pure octane.

I know all of this sounds like imaginary Flash Gordon and Buck Rogers nonsense, but it's not. All of the above items of intellectual property I have been developing on my "patent blackboard" and are in various stages of development. I have learned that once fusion is harnessed, almost unimaginable horizons open up. Just like what happened after the first operational light bulb.

The technologies most highly developed and ready for patent applications include the hurricane buster (an advanced hydrogen explosive); the high rate sea-water distillation plant; the turbo, ram, scram jet engine; the hydraulic ramjet engine; the nuclear fuel cell; the efficient, self contained and powered two stage biomass dryer; enhanced oil recovery; and transmutation recycling of radioactive waste. Other technologies are near to being ready for basic patent application filings. Others may need further engineering and scientific research.

In my work I have learned the influence of intellectual property and patent law upon the creative, inventive process. My first patent application was on the above fusion reactors. Consider the realm of intellectual and patent law as a means of defining a universe in three or more dimensions describing all potential intellectual property. A patent and application carve out of this space a defined, specified dimensional space of intellectual property. Within the boundaries of this space one or more inventions reside.

Often inventors and patent lawyers write patent specifications and claims such that to tightly wrap a given invention or apparatus within a very narrowly defined intellectual property space. This approach allows other "clever inventors" to define a "nearby intellectual space" containing a similar invention with similar or identical operation. They

thereby can capture and or take all of the market from the original inventor, thus circumventing the intent of issuing patents.

My approach with inventions has been to "reverse engineer" the original concept in as many ways as I could possibly do. I would then broaden the scope of the defined intellectual property space to the limit of my creative vision. The invention would be contained therein, but surrounded by much more intellectual property space. This means of proceeding allows for as many additional embodiments of the invention as possible. It also allows for "growth" of the invention through the possibility of future offspring generations of patents.

Of course, the USPTO will limit the domain and scope of the application via election and restriction requirements. However, the "priority" of the original defined intellectual property space is maintained as long as patent and divisional patent applications are pending.

I proceeded in this manner with the original fusion patent application. Over 90% of the domain of the original application is still pending within it's divisional application of 13/317,838. The USPTO and I are only presently proceeding with prosecution of a very small segment of this remaining intellectual property.

This may seem counterproductive, but it also is not. I do not have the financial means to prosecute multiple patent applications simultaneously, though such prosecutions are allowed. But by preceding with a small incremental portion of this intellectual property, I have kept the defined priority space of the whole original application intact.

My current ongoing application is a snapshot of my fusion reactor intellectual priority space as of August, 2001. There has been much further development since then. I have not proceeded at this time with newer applications. It is not my intent to define intellectual property space to just let it go into the public domain. I will wait until I have in place a business environment which will protect my ongoing intellectual property.

Japan, China, and India have what is called the one year foreign filing requirement. Once a novel definition of intellectual property is made public via a presented publication or patent application, the discloser has to file a patent application within these three countries within one year. If this is not done, the disclosed intellectual property is within the public domain in those countries.

The US has reciprocal patent treaties with over 140 countries around the world. With all these other countries, except Japan, China, and India, maintenance of an ongoing application at the USPTO maintains priority in all the other countries with which the US has treaties. Filing a regular patent application (RPA) or a provisional patent application (PPA) necessitates also filing RPA's with Japan, China, and India within a year.

This situation has been further complicated, and made much more difficult, by the US patent law change made by the Obama administration in September 2011. Prior to that

date, the patent priority date was established by the date of invention. Priority of invention was also previously established most commonly by notarized, bound lab records and witnesses.

Under the new law, priority is now just a matter of who files first. Anyone getting "wind" of someone's invention, if they file on it first, they then get the patent. A lot of people are not aware of the implications of this law change. I must not, and will not release any information on pending ideas. I do not want my intellectual property "pirated" by groups with the financial means to do so.

The US has many large firms who may be described as "intellectual property legal think tanks." These firms imagine possible intellectual property space. They then define such space with US patent applications. Then when someone actually "invents" something within the domain of such a defined intellectual property space, they get sued and have the intellectual property that they developed taken from them by this process. The 2011 patent law change works for the benefit of such "firms," but hurts everyone else. I do not want my intellectual property lost to such maneuverings.

I have much more significant intellectual property, much at a very high level of development and design. I will not disclose it until I have partnered with others of legal, business, and financial experience and means to provide such a business environment within which it is prudent to proceed. As a result, I have made the descriptions of the above technologies very brief. I'm not in a business environment within which it is safe to release such information. So, these ideas and this presentation may seem like fantasy. I sincerely assure you that these ideas presented above have been well thought out and developed by me in significant ways. I am not yet in a position where I can safely elaborate further without jeopardizing my intellectual property.

I have touched on some of the areas in which controlled hot hydrogen fusion can influence the future. The changes will be revolutionary, explosive, and synergistic. Controlled fusion changes all engineering priorities. It means safe and clean: energy, water, waste recycling, and propulsion of all vehicles: marine, surface, and aerospace.

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