Pat Boone & Tom Tamarkin and have organized EnergyCite LTD

Our business objectives are:

- **The launch of the EnergyCite® home energy management system with utility account payment & automatic funds transfer enterprise.**
- **The launch of the "Games That Mater" PowerMasters video Game series.**
- **The formation of a Fusion Energy Consortium to fund existing and new private sector fusion energy science, research, and development companies.**

Our plan requires that the Trump administration support proposed legislation allowing for the stimulation of the private sector to fund and engage in fusion science R&D leading to the demonstration of fusion as a future energy source.

The following background material is enclosed:

Introduction

A plan to solve energy by educating our citizens and enlisting their support through educational entertainment

Mankind thrives on Earth today with a worldwide population of over 7 billion people. Fundamental to his existence is agriculture and energy. It takes massive amounts of energy to sustain agriculture. And it takes energy to produce and transport water for man and crops.

We have developed a worldwide infrastructure of transportation, agriculture, industrial production of goods, and modern comfortable living. This is all based on and sustained by the extremely high energy flux density hydro-carbon fossil fuels produced from petroleum, natural gas, and coal.

These hydro-carbon fossil fuel resources have naturally formed on Earth over a 400 million year period of time. Through the process of photosynthesis and high geological pressure, ancient plant life has converted energy from the Sun into the potential chemical energy contained in these natural fuel sources.

The quantities of these fuels on Earth are both enormous and finite. It takes millions of years to produce useable quantities. As more and more of these fuels are extracted, the cost to extract remaining fuels increases because more expensive recovery techniques must be used to recover harder to extract resources. Hydraulic fracturing (fracking) and synthetic liquid pressure are examples. Even more expensive techniques are required for the extraction of oil from oil sands and the strip mining of oil shales.

Since 1850 we have extracted over 1,000 billion barrels of crude oil. Over the last ten years, worldwide demand has exceeded 95 million barrels per day.

Economically viable recoverable oil will be depleted sometime between 2050 and 2100. At the same time, we have a $70 trillion worldwide infrastructure of gasoline, kerosene, and diesel operated transportation, construction, and production machinery.

Although man has experimented with “renewable” energy sources such as solar and wind, none of these can remotely provide the massive amounts of power currently consumed by man…. let alone what will be required to power a world of 9 billion people by mid-century while addressing the energy needs of the over 3 billion people that now live in energy poverty; over 1 billion having no electricity.

As an example, once hydro-carbon fuel sources are no longer available, solar cannot be used to produce more solar cells. It takes roughly 3,000 times more power (power is energy per period time) to produce solar panels than they can produce. Wind turbine production has similar characteristics.

Burning hydro-carbon fuels liberates thermal energy or heat through a chemical reaction. As stated above, these fuels were produced through photosynthesis converting kinetic energy from the Sun into potential energy stored in the fuel source. When the fuel sources are combined with oxygen and thermally ignited, a sustainable reaction takes place until the chemicals are "burned up" leaving bi-products such as carbon, CO_2, and water.

We have written an authoritative article explaining what energy is and where it comes from on Earth. The physics law of ***conservation of mass and energy*** is explained as well as the convertibility of mass to energy and energy to mass. Also included are comparative energy flux density tables.

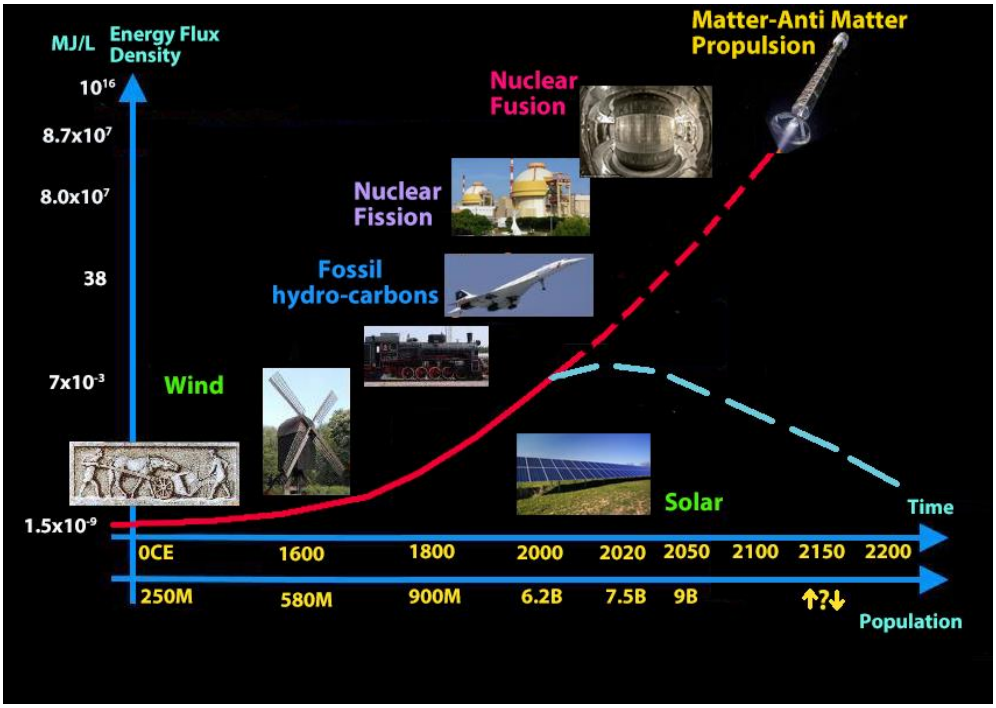
Beyond hydro-carbon chemical reactions, the only way to produce large amounts of energy is to convert matter into energy per Dr. Albert Einstein's famous formula $E=MC^2$. This formula states that matter and energy are simply different manifestations of the same thing, a concept the average man finds somewhat unfamiliar as Dr. Einstein famously stated in his own voice in a lecture. Because C is the velocity of light or 299,792,458 meters per second, this formula shows that a very small amount of matter (mass) is equal to a very large amount of energy.

Today we have taken the "baby step" to convert small quantities of matter into energy through nuclear fission where we split heavy elements like uranium and plutonium into a collection of lighter elements along with a release of energy. We do this through nuclear fission.

Only nuclear fission (uranium, plutonium and thorium) can produce sustainable amounts of energy for man's future once hydro-carbon fossil fuels are no longer economically viable. However, nuclear fission itself is not sustainable in the long term, primarily due to the radioactive waste disposal issue. Additional problematic factors include weapons proliferation and safety concerns.

Therefore, in order to provide for the safety and security of future generations, and the countries that protect and serve them, we must develop a much safer form of atomic energy. There are only three known ways to liberate energy from atomic reactions. These are **fission** which we have today, **atomic fusion**, which we believe we can demonstrate over the next few decades and harness as an energy source thereafter, and **matter anti-matter annihilation** reactions; something that may be impossible to do on Earth in sufficient amounts to harness usable energy.

The only sustainable form of material amounts of electrical energy production beyond the above comes from hydro-electric power generation. However, electricity only cannot produce large quantities of synthetic gaseous or liquid fuels which will always be required for air transportation. You cannot power a commercial airplane with solar cells! Nor can hydro-electric power produce new generation equipment and power a significant fraction of the world's population of energy.



The graphic above depicts energy flux density or specific energy in Mega Joules per Liter versus energy sources as well as a recent time line of man and worldwide population

As can be seen from the graphic image above, there is a direct correlation to worldwide population and available energy. The worldwide population has increased by a factor of 10 since the industrial revolution and the production of abundant energy. If we cannot maintain these levels of abundant inexpensive energy, the population will quickly decline to pre-industrial revolution levels.

Therefore, it is a matter of urgent priority that we prove fusion can be harnessed. In order to do this we have to conduct much more theoretical and experimental science which is costly and time consuming. We are in a race to prove and commercialize fusion before the rarefication of hydro-carbon fuels sets off energy wars and precipitates population decline.

We first proved that man can indeed trigger fusion reactions in the early 1950s. Thermonuclear weapons such as Ivy Mike (1952) and Castle Bravo (1954) proved the fusion physics. However, these reactions were instantaneous and uncontrollable making them ideal weapons of mass destruction but wholly unsuitable for peaceful energy production.

The U.S. government, along with Russia and the U.K., spent decades studying controlled fusion as a means of energy production, but as we explain in our article *"Who Killed Fusion?"*, without practical results due mostly to incompetent management and politics.

Today, a group of private enterprise fusion companies have been started by scientists and entrepreneurs[1]. Additionally, we have 7 major international partners who have joined together

in an International project called the International Thermonuclear Experimental Reactor (ITER) in France to demonstrate fusion in a "controlled environment" followed by another experimental project called DEMO to demonstrate the production of electricity from fusion and placing such power on a utility power grid.

The problem is all of the private startup companies have vastly underestimated the amount of scientific learning that still remains as well as the practical issues to actually demonstrate fusion. Thus, all of these companies will most likely "go broke" in the process of trying.

ITER has been plagued by cost overruns, management problems and scientific issues. Now, a demonstration of a fusion reaction based on deuterium and tritium leading to greater output energy than the energy inputted into the process to initiate fusion is set for 2035 and subject to further delays.

The overwhelming concern…. and the problem we have identified and propose to solve…. is that should these companies fail along with ITER, fusion will be effectively written off as the solution to solving energy and sustaining human life on Earth as we know it today.

Fusion has many detractors. These include big oil interests, the green energy industry, their respective lobbyists, the political establishment, and "elitist" authors like Charles Seife who are quick to say that over 30 billion dollars has been spent on fusion science and research over the last 60 years yet fusion is still 20 years away and always will be. Thus, no elected leaders will advocate for a strong and robust fusion science regiment leading to the knowledge to harness fusion.

Consider the above statement; over $30 billion dollars has been spent on fusion science and research over the last 60 years. That is only ½ billion per year. And the majority of this was spent decades ago before ITER became a possibility.

To put this in perspective, we spend over $5 billion annually on cancer research. And no one asks how many years away from curing cancer we are. We just know we must do it.

What we are proposing is to "crowd source" fusion science, research, and ultimately development utilizing the public through a fusion energy consortium. We propose to fund the consortium through the sale of a hit video game series as well as through revenues produced by our U.S. patented electric utility smart meter automated billing system. The video games are educational and will teach the American people the basics about energy related science and math in a fun and exciting way.

We will propose to the new administration that it enable and stimulate significant fusion energy science, R&D through new legislation, changes in the upcoming IRS tax code and a Presidential proclamation.

Once people begin to understand the science of energy and discover on their own through the games that we are wasting over $1.5 trillion dollars annually on climate change driven green energy subsidies and schemes, people will voice their concern with politicians and vote based on facts.

Our games and the associated public awareness of energy can stimulate today's youth to become interested in science and math and to take on the challenge of solving energy for the future. Many things must be developed over the next few generations including new types of engines as chemical fuels powering internal combustion engines are no longer viable. Air transportation will require a radical "rethink" and new propulsion designs.

It must be kept in mind that the development and commercialization of fusion will take place over many decades prior to the widespread adoption through commercialized fusion based power generation devices. And those will give rise to smaller, simpler devices ultimately suitable for the transportation industry. We must begin the task now before it is too late.

In terms of our practical contribution to fusion development, we can generate annual revenues in the ≈ $300 to $500 million USD range and will distribute these funds based on scientific review as a function of private company's achieving agreed to milestones. Thus, early investors can be assured they will receive financial returns on their investments in a fusion company irrespective of the company ever achieving the demonstration of sustained triple product Lawson criterion in a controlled environment, let alone the commercialization of a "fusion energy reactor system" capable of generating baseload electricity.

1. Helion Energy, General Fusion, Tri Alpha Energy, Lockheed Martin compact fusion reactor (skunk works,) MIFTI, Tokamak Energy & PPL Focus Fusion. Additional projects have been proposed at the University of Washington, the MIT ARC compact reactor program, and the PJMIF project proposed by Dr. Scott Hsu at Los Alamos National Labs in conjunction with private company partners.

Analysis of scientific approaches & challenges of current private sector fusion energy companies

CONFIDENTIAL

The following analysis is based on the review of publically available scientific journal papers written and published by scientists at each of the identified companies as well as recent "poster presentations" at meetings such as the October-November 2016 American Physical Society Division of Plasma Physics, conference held in San Jose, CA, and others. The following descriptions and challenges may be updated from time to time as new information is obtained.

This information is provided solely as an example of the State-Of-The-Art practiced by the private sector as readily known in the public domain based on our best judgment analysis. This information is not meant to be used in any financial analysis of these firms.

Helion Energy

Helion Energy aims to repetitively compress a field-reversed-configuration (FRC) plasma using a pulsed magnetic field that is generated by external coils. Advantages of their approach include (i) being at slightly higher fuel density than steady-state magnetic-confinement concepts (which requires shorter energy confinement times), (ii) using a magnetic field to compress and heat their fuel (which avoids the need to repetitively form an imploding liner), and (iii) having a geometry that is amenable to highly efficient direct conversion of the fusion products to electricity.

Challenges:
-Demonstrate both global plasma stability and a sufficient energy confinement time at the Lawson-relevant fuel densities and temperatures. These challenges are significant in that they have less to do with engineering and more to do with fundamental limits of plasma physics.

-In addition, these challenges are orders of magnitude more difficult for D ^{3}He rather than DT fuel.

-Furthermore Helion aims to self-generate ^{3}He (which is not available in relevant quantities on Earth) in a "breeding reaction from DD. How the reaction is started without ^{3}He needs significant investigation and work.

Tri Alpha

Tri Alpha Energy (TAE) aims to create a steady-state field-reversed-configuration at low densities typical of mainstream magnetic fusion, i.e., tokamaks. One of their key innovations is to inject high-energy beam ions into their FRC, which has recently been shown to provide global stability, an important achievement. Being an FRC, it does have the advantage of a favorable geometry for fusion-heat extraction and efficient direct conversion to electricity.

Challenges:
-The beam ions are supposed to improve the energy confinement time, which is a major challenge and remains to be demonstrated.

-Unless TAE demonstrates energy confinement that is better than a tokamak (which would be challenging and unexpected,) it will likely need to be a large device, making it more costly than other higher-density approaches such as Helion or General Fusion.

- As with Helion, Tri Alpha's challenges for reaching Lawson conditions are exacerbated if they use p ^{11}B rather than DT fuel. P ^{11}B is at least another order of magnitude more difficult than D ^{3}He

General Fusion

General Fusion's approach belongs to a class of pulsed, high-fuel-density concepts called magneto-inertial fusion (MIF), which is theoretically a low-cost minimum for achieving triple product Lawson conditions. Their specific approach is to compress a magnetized plasma via acoustically driven shock implosions through a liquid-metal vortex, which would also serve as the reactor coolant and tritium-breeding medium. This is a particularly elegant aspect of General Fusion's approach. Another advantage is the relatively low cost of their pressurized-gas-driven piston drivers.

Challenges:
-Must form a suitable target in a reactor-relevant manner

-Must achieve global stability of their target in a manner compatible with repetitive compressions

-Must achieve sufficient energy confinement time exceeding the relative slow implosion time by a fair margin.

Tokamak Energy

Tokamak Energy seeks to use novel, high-temperature superconducting tape and compact tokamak geometry to achieve a simpler and modular design that could potentially benefit from the tokamak's advanced performance while reducing the cost/size of a conventional tokamak by an order of magnitude.

Challenges:

-Achieving triple product Lawson conditions in a sustained manner overlap with those of the traditional tokamak (JET, PPPL NSTX, MIT Alcator, ITER and the like,) namely achieving sufficient stability, confinement time, global disruptions, and also steady-state plasma interactions with the "first wall" (even if it is a liquid).

-Susceptibility to magnetic quenches causing machine damage

Magneto-Inertial Fusion Technologies, Inc (MIFTI)

MIFTI proposes to use a concept called the staged Z pinch, in which a cylindrical plasma is magnetically imploded onto gaseous DT fuel. Shock heating of the gaseous DT fuel is supposed to play a key role in providing effective, stable compressions of the fuel, and diffusion of the exterior magnetic field into the core is supposed to reduce the rate of heat loss from the fuel. An axial magnetic field can be added to help with reducing heat transport from the fuel.

Challenges:

-Overcoming known Z-pinch instabilities that are well-studied over 60+ years of controlled fusion research, and in the difficulty in achieving a high enough repetition rate for economical fusion.

- A discussion of potential discrepancies in mathematical calculations in MIFTI published papers is discussed on page 38, paragraph 3, of "The Ignition Design Space of Magnetized Target Fusion," Irvin R. Lindemuth, Ph.D., December 28, 2015.

Lockheed Martin Compact Fusion

Lockheed Martin aims for a mirror-based concept operating at high beta (ratio of plasma pressure to magnetic pressure) and densities typical of tokamaks. It aims to have a field-free interior at fusion pressures supported by a steep pressure and magnetic-field gradient at the boundary. This geometry is to be sustained in part by coils internal to the main plasma.

Challenges:
-achieving sufficient stability, especially at the sharp edge boundary

-achieving sufficient energy confinement time, despite having coils interior to the plasma (a general no-no if you want good plasma confinement)

-being low density, requires higher confinement time and therefore larger sizes, which makes the "compact" goal difficult

LPP Fusion – Focus Fusion

LPP aims to use a variant of the Z pinch called the Dense Plasma Focus (DPF), which is a known effective source of beam-target (not thermonuclear) neutrons. To achieve energy gain in a DPF requires thermonuclear neutrons and electrical current of more than 10 MA. This is another case of going against the history of 60+ years of controlled fusion research, where Z pinches are known to suffer all sorts of instabilities, precluding them to pinch down to the small sizes needed to attain triple product Lawson conditions. LLP's work has centered on p ^{11}B which, due to cross sectional diameters, is many orders of magnitude more difficult to achieve triple product Lawson criterion than DT.

Games That Matter Website
http://gamesthatmatter.us

All profits from PowerMasters™ products will be channeled into an industry consortium to accelerate the rate of fusion energy science, research, and development. Matter anti-matter annihilation reaction proposals may be considered as well. Social media based video games have the potential to generate hundreds of millions of dollars annually.

EnergyCite LTD Website
http://energycite.com

Our utility account payment program allows customers to pay their bills from their smart phone at their convenience. Pay monthly, weekly or even daily as cash permits. Funds are electronically transferred at the press of a button. Our PowerMasters™ Video Games make saving energy fun and easy. Revenue is produced in part by transaction fees & licensing fees. Third year revenues projected > $250 million.

Fusion 4 Freedom Website
http://fusion4freedom.com
Fusion 4 Freedom & Fuel R Future has become "The world's most comprehensive Fusion Energy website for fusion & plasma science, research, project management, academic journal articles, videos, fusion politics, news, and advocacy." Our plan is to Bring Fusion Energy to the World from America.

Plan to Bring Fusion Energy to the World from America

Embedded link for Website presentation

We are developing an energy based action game series and a utility payment method that will:

- Facilitate the American public in discovering that climate change occurs from variable factors in nature; manmade climate change theories are not sufficient justification to subsidize massive green energy projects which are inefficient and unsustainable.

  See our Climate News archives

- Facilitate the American people in discovering that mainstream renewable energy sources are not sustainable without massive tax payer subsidies; only hydro-carbon and nuclear energy can produce baseload power for electricity & transportation.

  See our Energy Management Simulation outline

- Facilitate the American people in discovering and learning about different forms of nuclear power; i.e. safe modern 4th generation fission, MSR, thorium/uranium fuel cycle and the need to master fusion.

  See our Why fusion is the only realistic solution

- Facilitate the American people in discovering that hydro-carbon fuel sources are finite and that we can be energy independent in America today but our grandchildren and certainly great grandchildren will be energy dry unless we start to master new sources of nuclear energy today because much science needs to be learned and technology developed.

  See our 2060 and Lights Out

- Our games and patented utility bill payment system will generate tens-hundreds of millions of dollars in annual recurring revenue which will be contributed to the Fusion Energy Incubator managed by the private sector.

  See our Games Comparable Analysis

- The Fusion Energy Incubator distributes money to private sector companies engaged in fusion energy science R&D and potential commercialization. We have identified several such private sector companies listed in the expanded section of this bullet point. This insures that the investors in these very high risk private sector companies will receive a return on their investments regardless of the commercialization of any science & technology.

  The United States government has funded fusion energy science research for over 50 years and at a combined total cost in excess of $25 billion. The research has been divided into two different scientific approaches known and Magnetic Confinement Fusion (tokamak and stellarators) (MCF) and Inertial Confinement Fusion (ICF.). The Magnetic Confinement

projects receive funding from the Department of Energy Offices of Fusion Science and the Inertial Confinement projects are principally nuclear weapons oriented projects funded by the National Nuclear Security Administration division of the DOE.

Our current state-of-the-art scientific understanding strongly suggests that neither the MCF nor ICF approach will ever lead to fusion energy reactors suitable for commercialization and production of electricity.

Scientific arguments by Dr. Glen Wurden and Dr. Robert L. Hirsch suggest that the MCF magnetic tokamak will never lead to a commercial power producing system suitable for utilities and grid level power.

An official Office of Defense Programs review of the ICF and High Energy Density Science portfolio suggests that America's flagship ICF project known as NIF at Lawrence Livermore National Labs will not achieve "fusion ignition."

Recognizing that the facility cost was a large component of the R&D cost which was the principal impediment to the progress of fusion development at the time, around the mid-1990's, Drs. Irv Lindemuth, Richard Siemon and Kurt Schoenberg of Los Alamos National Laboratory began to examine the cost of developing various fusion concepts in a fundamental way. The fusion parameter space is spanned by two basic plasma parameters, namely the plasma density and the magnetic field embedded in the plasma, which govern the physics of attaining fusion burn. The tokamak attempts to burn a plasma at a density of 10^{20} ions per m^3 in a magnetic field of several teslas (T), while laser ICF attempts to burn a plasma at a density of 10^{32} ions per m^3. In conventional ICF, no external magnetic field is applied to the target, but laser-plasma interaction can self-generate magnetic fields up to about 100 T. Essentially, these two mainline approaches sit at two extreme isolated spots in the fusion parameter space.

Over the next decade, a fusion approach generally known as Magnetized Target Fusion developed. Dr. Irvin Lindemuth explains how this works in his MTF tutorial.
Today the development of fusion can be tackled by private enterprises without the heavy burdens and constraints associated with on again…off again government agency projects with bureaucratic management structures.

Therefore we are putting forth a plan which effectively puts the private sector in charge of fusion energy development and commercialization.

Funding will be obtained from the private sector and distributed to participating firms engaged in fusion science R&D. Through the enactment of new federal legislation similar to that proposed by Dr. Robert Bussard and James A. Bowery in 1995, success based awards are given to these private sector companies based on agreed milestone achievements.

Thus investors, venture capitalists, and the like will receive a financial return on their investments without the necessity of a "breakthrough moment" consisting of a commercially viable fusion reactor.

This further stimulates innovation and develops a spirit of competition to "win" major financial prizes as well as collaboration and scientific cooperation between the competing firms.

Currently we have identified Helion Energy, Tri Alpha, General Fusion, Tokamak Energy, Magneto-Inertial Fusion Technologies, Inc., and Lockheed Martin Compact Fusion program within their “skunkworks” division.

In addition to the existing private fusion based companies mentioned above, we strongly advocate encouraging additional companies and projects such as the Plasma Jet Magneto Inertial Fusion program proposed by Dr. Scott Hsu, et al, at Los Alamos National Labs in partnership with the private sector. The ARC compact fusion reactor proposed by MIT, and similar to the work being done by Tokamak Energy in the UK, should also be encouraged and funded.

See our Fusion Incubator outline

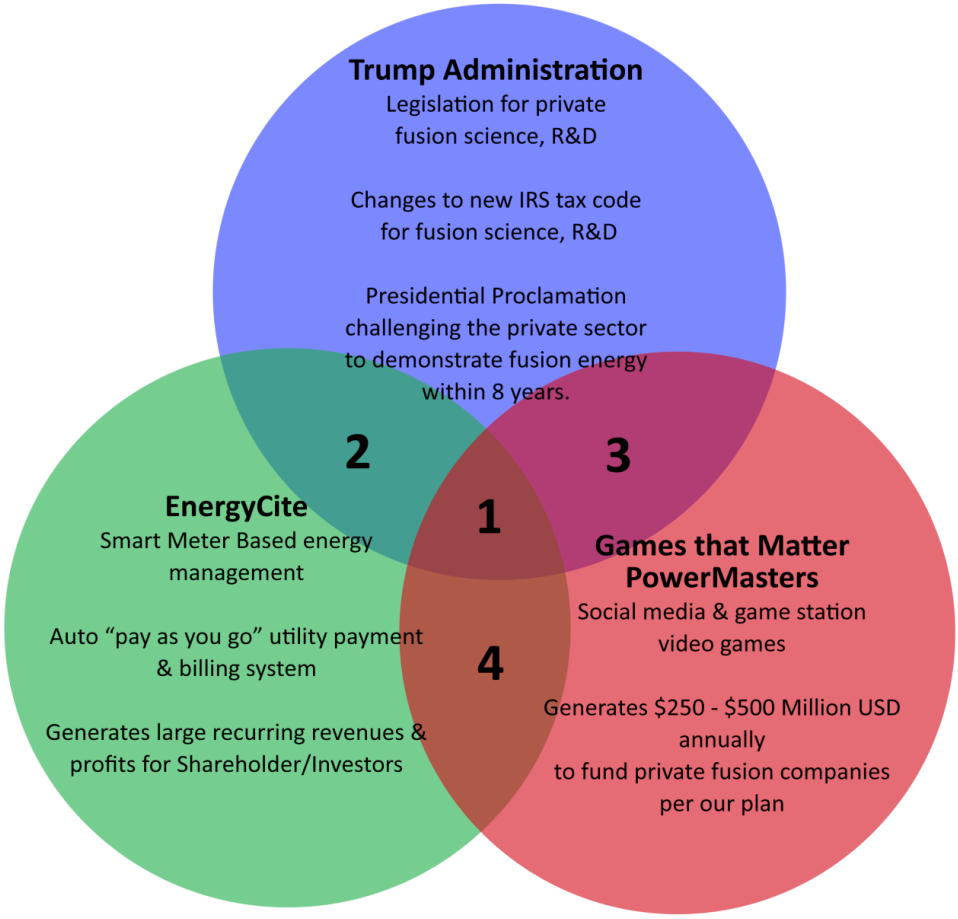
- Awareness is further developed and reinforced through the integration of the video game series and the use of electricity through the modern utility smart meters in conjunction with new innovative utility billing and payment methods.

  See our EnergyCite LTD site

We need the new administration to be aware of these issues and our outreach work

- We want a Presidential Proclamation to challenge the private sector to demonstrate fusion power within a decade

  See our Proclamation to the World



Follow these links for additional information and websites described in the Venn diagram above:

EnergyCite.com | Trump Administration | GamesThatMatter.us

1. **Industry Fusion Energy Consortium Generates $250 – $500 Million USD annually to fund private fusion companies per our plan**
   Learn more here
2. **New Administration favors conservation & individual control of energy use**
   Learn more here
3. **Presidential Proclamation challenges private sector and citizens to Fusion Solution. Energy Games allow people to help & feel good**
   Learn more here
4. **Games are based on home energy use; help consumers save money and drive EnergyCite sales**
   Learn more here

Proposed Means for the Trump Administration to Further Fusion Energy Development in the Private Sector

Embedded link for website presentation

We propose that the United States Government embark on a new program to incentivize the private sector to support and engage in fusion energy science, research and development leading to the successful demonstration of a controlled, sustained, net energy producing fusion reaction within ten years.

Whereas the US scientific community has actively studied and experimented with atomic fusion for energy production since the early 1950s, virtually all the US government work conducted in US national laboratories has been centered on two scientific fusion "confinement" approaches:

1. Magnetic Confinement Fusion (MCF) principally conducted using tokamaks, spheromaks, and stellarators.

2. Inertial Confinement Fusion (ICF) using laser driven techniques.

Furthermore, the enormous worldwide lead America had in the basic understanding of the science governing fusion energy was dissipated in 1985 when our government capitulated to the suggestions of the Soviet Union. This led the US to virtually abandon its national fusion programs in favor of what would become ITER twenty years later. ITER is an international science based program to continue the experimental research the U.S. started.

The history of America's ill-fated fusion energy development activities is described in our article, "*Who Killed Fusion*."

Over the last 60 years, the scientific community has discovered and compiled an enormous amount of scientific and mathematical knowledge concerning fusion.
However the US has been stuck in a scientific quagmire of only pursuing fusion approaches involving MCF and, to a lesser extent, ICF. These approaches, by their very nature, require enormous facilities and experimental scientific equipment costing hundreds of millions and even billions of dollars.

Recognizing that the facility cost is the largest component of fusion science, research and development costs, which is the principal impediment to fusion progress, Drs. Irvin Lindemuth, Richard Siemon, and Kurt Schoenberg of Los Alamos National Laboratory began the examination of fusion development costs in a fundamental way.

The results of the Lindemuth, et al, analysis were presented in numerous scientific workshops and published in "*Why Magnetized Target Fusion Offers A Low-Cost Development Path for Fusion Energy*." Simply put, a new set of preferred fusion parameters are set forth leading to more easily achievable triple product Lawson criterion in terms of temperature, confinement time, and density.

A Tutorial on the Parameter Space of Magnetized Target Fusion (MTF) by Irvin Lindemuth, Ph.D., presented at annual meeting of American Physical Society Division of Plasma Physics, Nov 2016, describes the physics and mathematics of MTF.

Therefore we propose that the Trump Administration pursue a fundamentally new way forward to allow America to regain the lead in fusion energy science, research, and development leading to the ultimate commercialization of fusion power systems before the world depletes fossil fuels beyond their point of economic viability.

To wit:

- The President of the United States will Issue a presidential proclamation challenging the American people and the private sector to demonstrate a controlled sustained net energy producing fusion energy reaction by 2030.

- The American Congress shall enact a private sector fusion energy bill by Q3 2017 that shall:

- Establish the national Private Enterprise Fusion Energy Program (**PEFEP**) to conduct science, research and development of fusion energy as a matter of the national security of the U.S.

- The **PEFEP** legislation shall include program goals and definitions of key concepts, identifiers, and metrics; the principle objective of which is the demonstration of a proof of concept fusion reactor with a deuterium · tritium "controlled plasma burn" within 10 years, followed by additional demonstrations of plasma burns using so called "aneutronic fuel cycles;" the direct conversion of fusion produced energy to electricity without the need for a thermally coupled electromagnetic generator; and a series of practical designs capable of being produced, licensed by the NRC and purchased by the energy producing industry having acceptable utility generation capacity life cycles to produce electricity and synthetic liquid fuels at a cost competitive with base line energy costs.

- The **PEFEP** shall authorize funding through government loans for the acquisition of facilities location site property in government controlled areas such as the nuclear proving sites in Nevada thus enabling private fusion companies to conduct early experiments using tritium, a mildly radioactive isotope of hydrogen and further funds to enable the expeditious relocation of companies who may have significant facilities located in areas unable to receive needed NRC licensing for the use of tritium. Additional funds or near zero interest loans will be provided to such companies to build facilities, roadways, and utility access on such property.

- The **PEFEP** shall be authorized to award participating private companies significant milestone payments upon a company's achievement of an approved milestone event;

such milestone events shall include the first controlled sustained net energy DT reaction; the first controlled sustained net energy aneutronic fuel cycle reaction and various other milestone events which shall be identified and codified in the **PEFEP.**

- The **PEFEP** shall encourage charted companies to pursue MTF approaches in accord with the teachings of Lindemuth, et al, however not at the exclusion of other proposed approaches reviewed by an outside evaluation authority.

- The **PEFEP** shall authorize the formation of an approved private fusion energy consortium who shall be charted to raise funds through a variety of means described and approved in the enabling legislation to be distributed to private companies engaged in fusion science, research and development on a grant and milestone award basis; such funds shall not be taxed as income pursuant to changes in the proposed tax code herein provided.

- The approved private fusion energy consortium shall include a scientific executive review board consisting of highly qualified and credentialed fusion and plasma physicists who shall review private enterprise fusion energy companies as part of the chartered qualification process and shall evaluate the progress of each such company against published criteria germane to each specific company and issue recommendations for milestone performance awards.

- The **PEFEP** shall direct the U.S. Department of Treasury, IRS to incorporate the following changes and additions in any new Trump administration revised tax code:

    - Any qualified private enterprise company engaged in fusion science, research and development charted by the **PEFEP** shall be qualified to receive 501c3 exempt charitable funds as part of such a firm's capitalization in accordance with accounting rules set forth by the IRS contemporaneously with such provision.

    - Any qualified private enterprise company engaged in fusion science, research and development charted by the **PEFEP** that receives either 501c3 funds or funds from an approved fusion energy consortium shall pay no federal income tax on such grants or awards.

    - Any qualified private enterprise company engaged in fusion science, research and development charted by the **PEFEP** that receives milestone achievement award funds from the federal government or authorized fusion energy consortium pursuant to the FEFEP shall pay no income tax on such funds.

- Any qualified private enterprise company engaged in fusion science, research and development charted by the **PEFEP** shall be qualified to deduct all expenses associated with the firm's business as part of its science, research and development activities at a rate of 2:1 against future earnings; such tax credit loss carry forward shall have no expiration assuming the firm continues its business, regardless if a successful future revenue stream is created from fusion related products and services; said loss carry forwards can be transferred to any investor in such a company pursuant to the rules and regulations of the tax code governing same.

- Any qualified private enterprise company engaged in fusion science, research and development charted by the **PEFEP** shall be qualified to capitalize all expenses related to the preparation and prosecution of patents based on the work of the company and its employees as assigned to the company.

- In the event that a qualified private enterprise company engaged in fusion science, research and development charted by the **PEFEP** is unable to obtain profitability based on the capitalized fusion related expenses it may treat all such capitalized expenses as a loss carry forward based on 2 times the actual accrued losses.

- Such other desirable tax benefits as may be defined as part of the process leading to the preparation and enactment of the **PEFEP**.

Considerations for Oversight by Fusion Energy Consortium

Irvin R. Lindemuth, Ph.D.
Biography & contact info: http://science.fusion4freedom.us/lindemuth/

Draft February 11, 2017

The “fusion” devil is in the details!! Nobel Peace laureate Andre Sakharov has been quoted by his Russian colleagues, some whom I know personally, as saying “with one (appropriate) false assumption, you can prove any theory.” In fusion, changing one or several really big “ifs” into (an assumed) certainty allows one to project putting electrical power on the grid quickly. And in fusion, it is often quite difficult to sort out real achievements, i.e., facts, from religious-like beliefs. An independent expert panel as unbiased as possible and free from funding dependency, i.e., something equivalent to a fusion “supreme court,” must be formed to sort through the facts and beliefs and make a technical judgment that can provide guidance to investors. Such a panel can readily be formed in the present time because of the large number of fusion experts who have retired over the last decade or two and who are now free from the “don’t bite the hand that feeds you” restrictions previously placed on them.

Approaches to fusion can be categorized as either (1) steady state, or (2) pulsed.

STEADY-STATE FUSION

Steady state is exemplified by magnetic confinement fusion (MCF). The burning plasma, once formed, continues to burn ad infinitum. In a reactor, energy must be released continuously. Because the plasma must be contained, the combined pressure of the plasma and magnetic field is limited by the strength of materials of the vessel used to confine the plasma. This typically leads to a plasma pressure of around 1 atm, so since the plasma temperature must be on the order of 8 keV, the plasma density is limited to about 1e14/cubic-cm although some approaches try to raise this value by about an order or magnitude or so.

When the plasma runs continuously, the initial startup energy is negligible and the figure of merit is

> Q=rate of fusion energy production (units: Watt)/rate of heating required to sustain the plasma (units: Watt).

Examples of private companies trying to produce what would ultimately be steady-state burning plasma are:

Tri-Alpha
Tokamak Energy
Lockheed Martin

These differ by the type of plasma configuration used and the type of fusion fuel used.

Generic steady-state questions:

- What density, temperature, lifetime and size have been attained in a single experiment? With what fusion fuel? What Q has been attained and for how long? What are the challenges of extending all of the system components to steady-state operation?
- How do present experimentally demonstrated results compare with projections made when the experiment was first conceived?
- What density, temperature and size are required for a reactor?
- What is the next step? Will the present technique for plasma start-up work or will a new, untried approach need to be developed? What are the criteria for success or failure of the next step? What if the criteria for success are not met?
- What is the basis for believing the next step will be successful? If computer modeling, how complete is the simulation and how well has the simulation predicted past and present experiments with no modification? If scaling laws, how well has the scaling law predicted past and present experiments with no modification?
- How will the reactor plasma be sustained and refueled? Will fluctuations in the sustainment method or refueling have a negative impact on sustaining the plasma and possibly lead to quenching of the plasma?
- How are reactor components (coils, etc.) shielded from fusion product damage?
- How will heat be extracted from a reactor?

PULSED FUSION

Pulsed fusion is exemplified by inertial confinement fusion (ICF), magnetized target fusion (MTF), and others. Fusion temperatures are obtained by compressing the fusion fuel. The pressure of the burning plasma is much higher than the strength of any material (e.g., 1e12 atm in ICF), but the burning plasma quickly expands to a low pressure after it has burned and released its energy. The fusion energy is released in very small fractions of a second, from nanoseconds to milliseconds, depending upon the approach. Production of fusion energy in a "continuous" manner then requires multiple pulses per second. Pulsed reactors have the potential of advantage of readily adapting to load demand simply by adjusting the pulse rate.

The figure of merit is gain:

> G=fusion energy released (units: Joule)/energy required to get the plasma to burn (units: Joule).

Gain can have multiple definitions depending upon the denominator, energy required. Sometimes, this is simply the thermal energy in the plasma at burn time. For ICF and MTF, this is often the kinetic energy of the pusher used to compress the plasma. Of course, the only definition relevant to energy production is the total energy (from the wall plug??) required to produce the burning plasma: this includes, e.g., the energy to charge the capacitor bank that drives the laser flash lamps in laser-driven ICF.

Examples of private companies that are pursuing pulsed approaches are:

Helion
General Fusion
MIFTI
LPP-Focus Fusion

Based on information publically available, it appears that the first three use a high (relative to the initial fusion fuel) density liner or pusher to compress the plasma. They differ in the type of liner, how the liner is propelled, and the plasma configuration within the liner. The first two require a magnetic field in the plasma fuel to reduce thermal conduction losses. The third apparently does not use a strongly magnetized plasma fuel so it is not obvious how losses are overcome with the low implosion velocity reported in publications.

LPP uses a plasma focus electrical discharge to directly heat and compress the fusion fuel directly by a magnetic field without the intermediary liner or pusher.

Generic pulsed fusion questions (implosion questions not relevant to LLP):

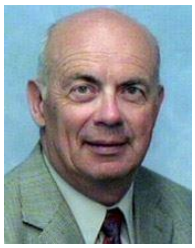
- What density, temperature, lifetime, and size have been attained in a single plasma formation experiment? How do present experimentally demonstrated plasma formation results compare with projections made when the experiment was first conceived?
- Does the method for combining the formation and implosion systems potentially disrupt the implosion symmetry?
- What is the energy, velocity, and symmetry (convergence) attained in a complete implosion experiment without plasma inside the pusher/liner? How do present experimentally demonstrated implosions results compare with projections made when the experiment was first conceived?
- Has a combined, integrated plasma formation/implosion experiment been conducted? If not, when? What gain and other significant parameters (convergence, density, temperature) have been attained in a (or is expected to be attained in your first) single integrated implosion experiment with plasma (and how is gain defined)?
- What initial density, temperature and size and implosion system energy and velocity are required for a reactor? What would be the pulse rate?
- What is the next step? What are the criteria for success or failure for the next step? What if the criteria for success are not met?
- What is the basis for believing the next step will be successful? If computer modeling, how complete is the simulation and how well has the simulation predicted past and present experiments with no modification? If scaling laws, how well has the scaling law predicted past and present experiments with no modification?
- How are reactor components (coils, etc.) shielded from fusion product damage?
- How will heat be extracted from a reactor?

ADDITIONAL COMMENTS

Although the fusion triple-product (density* confinement time*temperature) is often used as a figure of merit, the qualifier that the temperature must be of the order of 8-10 keV is not always stated (certainly, if the temperature is below about 4 keV, the plasma cannot produce net energy). Furthermore, this really applies to a pulsed system, but at the present state of research, all fusion experiments are pulsed. Reaching a triple-product of approximately 1^{24} sec*eV/cubic-meter is certainly a necessary, but not sufficient, condition for energy production, whether steady-state or pulsed. For steady-state, this product must be infinite, since the time in the product must be infinite. For pulsed, this value must be exceeded by perhaps a factor of 10 or more for useful energy production. It is worth noting that the fluorescent bulb has essentially an infinite triple product but, of course, it operates a very low temperature.

This parameter is derived under the assumption that all plasma loss mechanisms are exactly balanced by some external heating source. Use of this parameter ignores the fact that there is, in general, for each density and temperature, a minimum size plasma that must be formed. For example, the size of burning plasma in tokamaks must be on the order of meters, whereas in ICF the minimum size is on the order of 10^{-2} cm .

Irvin Lindemuth, Ph.D.



Dr. Irvin Lindemuth is by many measures considered to be the "father" of the Magnetized Target branch of fusion energy research and proposed solutions to commercial power.

Recognizing that the facility cost was a large component of the R&D cost which was the principal impediment to the progress of fusion development at the time, around the mid-1990's, Drs. Irv Lindemuth, Richard Siemon and Kurt Schoenberg of Los Alamos National Laboratory began to examine the cost of developing various fusion concepts in a fundamental way. The fusion parameter space is spanned by two basic plasma parameters, namely the plasma density and the magnetic field embedded in the plasma, which govern the physics of attaining fusion burn. The tokomak attempts to burn a plasma at a density of 10^{20} ions per m^3 in a magnetic field of several teslas (T), while laser ICF attempts to burn a plasma at a density of 10^{32} ions per m^3. In conventional ICF, no external magnetic field is applied to the target, but laser-plasma interaction can self-generate magnetic fields up to about 100 T. Essentially, these two mainline approaches sit at two extreme isolated spots in the fusion parameter space.

The results of the Lindemuth, et al, analysis were presented in various papers, workshops and conferences, since the mid-1990's and recently collected and published in their paper of 2009 [3]. The principal results of their analysis are:

1. The cost of plasma confinement is proportional to the thermal energy or the fuel mass in the confined plasma, whereas the cost of plasma heating is proportional to the required heating power density. The cost of a breakeven fusion facility is the combined cost of confining the burning plasma at breakeven and the cost of heating the plasma up to ignition.
2. For magnetically confined plasma, the amount of plasma energy required to produce fusion ignition is approximately inversely proportional to the square root of the plasma density.
3. For fusion approaches that use compression to heat the plasma, the power density of the compression required is proportional to the fuel density and the velocity of implosion.
4. The net results of the analysis for the cost of a breakeven fusion facility as a function of the fuel ion density and temperature is shown in Figure 3, which correctly explains the costs of ITER and NIF. ITER corresponds to a point in Figure 3 for a density of 10^{14} ions per cc and temperature of 10^4 eV (108 degrees K.) NIF corresponds to a point of 10^{25} ions per cc and the same temperature.
5. There appears to be a sweet spot where the burning plasma density is in the range 10^{19} to 10^{22} ions per cc. In this sweet spot, the stunning result of their analysis is that fusion approach exists for which breakeven fusion facility might very well cost as low as $51M! (A typical nuclear fission power plant costs in excess of $5.5 billion 2008 USD.)

Dr. Lindemuth retired in November 2003 after more than 32 years with the University of California, first at the Lawrence Livermore National Laboratory and then at the Los Alamos National Laboratory. At Los Alamos at the time of his retirement, Dr. Lindemuth was a special assistant for Russian collaboration in the Office of the Associate Director for Weapons Physics, the team leader for Magnetohydrodynamics and Pulsed Power in the Plasma Physics Group, and a project leader for Pulsed Power Science, Technology, and International Collaboration in the High Energy Density Hydrodynamics Program. His primary responsibility was to provide technical leadership for a scientific collaboration between Los Alamos and Los Alamos's Russian counterpart, the All-Russian Scientific Research Institute of Experimental Physics (VNIIEF) at Sarov (Arzamas-16). Prior to joining Los Alamos in 1978, he was a technical staff member in A-Division at the Lawrence Livermore National Laboratory where he was involved in fusion research.

Dr. Lindemuth received his BS degree in electrical engineering in 1965 from Lehigh University, where he was a Hertz Scholar, and his MS and PhD degrees in applied science engineering in 1967 and 1971, respectively, from the University of California, Davis/Livermore, where he was a Hertz Fellow. His thesis research was conducted under the advisorship of Dr. John Killeen, founder of the National Magnetic Fusion Energy Computer Center. One of his graduate school advisors was Edward Teller.

He has been an adjunct professor at the University of New Mexico Los Alamos branch, where he has taught engineering and mathematics courses. He spent the 1991-92 academic year as a visiting professor in the Nuclear Engineering Department of Texas A&M University, where he taught undergraduate and graduate courses, helped lay the groundwork for the Department's expansion into the controlled fusion area, and assisted the Department in forming collaborations with Russian laboratories and educational institutions.

Although he has never participated in the US inertial confinement fusion or magnetic confinement fusion programs, his areas of expertise include thermonuclear fusion and advanced numerical methods for the computer simulation of fusion plasmas and related pulsed power technology. He has published numerous papers in refereed journals and proceedings of major international conferences. He has been involved in a wide range of fusion and high energy density physics programs spanning essentially all of the ten orders of magnitude in density and time space from magnetic fusion energy plasmas to inertial confinement fusion plasmas. An internationally recognized pioneer in the application of implicit, non-split computational methods to magnetohydrodynamics, he has achieved widespread recognition for his large-scale numerical simulations of a variety of fusion and other high-density plasma systems. In addition to his accomplishments in modeling high temperature plasmas, he has formulated a variety of novel pulsed power computer codes that have led to important advances in laboratory programs. His codes have stimulated the development of several types of fast opening switches.

He is a U.S. pioneer in Magnetized Target Fusion (MTF) and performed the first comprehensive survey of the parameter space in which MTF was likely to work. Even before the collapse of the Soviet Union, he recognized that the Soviets had developed advanced technology in the areas of ultrahigh magnetic fields and ultrahigh energy electrical pulse generation that significantly exceeded U.S. capabilities and that were motivated by the Soviet MTF program known as MAGO. In January 1992, he became the first American scientist to present a formal scientific seminar at one of the formerly secret, and still closed, Russian nuclear weapons design laboratories. Dr. Lindemuth played an essential role in establishing the collaboration with VNIIEF, a collaboration that has helped integrate Russian weapons scientists into the global scientific community and that has resulted in more than 300 conference papers and archival publications. The LANL/VNIIEF collaboration, and Dr. Lindemuth's role in it, were featured in the Discovery Channel documentary, *Stockpile*, which first aired in 2001. In 1992, Dr. Lindemuth was the recipient of a Los Alamos Distinguished Performance Award for his work in the formative stages of the LANL/VNIIEF collaboration.

In 2004, he was named a fellow of the Institute of Electrical and Electronic Engineers (IEEE). Dr. Lindemuth currently resides in Tucson, Arizona and is a part-time research faculty member of the Physics Department at the University of Nevada, Reno.

Thesis:
1971 – The Alternating-Direction Implicit Numerical Solution of Time-Dependent, Two-Dimensional, Two-Fluid Magnetohydrodynamic Equations

PAPERS:

A Tutorial on The Parameter Space of Magnetized Target Fusion (MTF) or Magneto Inertial Fusion Invited tutorial presented at annual meeting of American Physical Society Division of Plasma Physics, San Jose, CA, October 31-November 4, 2016

The Ignition Design Space of Magnetized Target Fusion Irvin Lindemuth Ph.D., Dec. 28, 2015

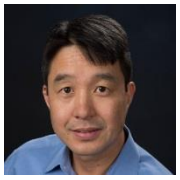
Why Magnetized Target Fusion Offers A Low-Cost Development Path for Fusion Energy, Richard E. Siemon, Ph.D., Irvin R. Lindemuth, Ph.D., Kurt F. Schoenberg, Ph.D.

The Case for Magnetized Target Fusion (MTF), Irvin Lindemuth, Ph.D.

The fundamental parameter space of controlled thermonuclear fusion by Irvin R. Lindemuth & Richard Siemon

Irv Lindemuth Ph.D. Review of Plasma Jet Driven Magneto-Inertial Fusion & Letter to Congress on Fusion Funding includes private correspondence between Dr. Lindemuth and Tom Tamarkin as well as a more comprehensive biography on Dr. Lindemuth.

Dr. Scott C. Hsu
Los Alamos National Laboratories, NM



Dr. Scott C. Hsu is a plasma and fusion research scientist in the Plasma Physics Group of the Physics Division at Los Alamos National Laboratory (LANL) in Los Alamos, NM. He earned a Ph.D. in Astrophysical Sciences (Program in Plasma Physics) in 2000 from Princeton University, where he made experimental measurements of ion heating due to magnetic reconnection, which is an ubiquitous process in both laboratory fusion and astrophysical plasmas. For this work, he was a co-recipient of the 2002 American Physical Society (APS) Award for Excellence in Plasma Physics Research.

After graduate school, Scott was awarded a U.S. Department of Energy (DOE) Fusion Energy Postdoctoral Fellowship to pursue research at the California Institute of Technology on an alternative magnetic fusion concept called the spheromak. There, he also became a pioneer in connecting the physics of astrophysical jets to those studied in laboratory plasma experiments.

In 2002, he went to LANL as a Frederick Reines Distinguished Postdoctoral Fellow to work on magnetized target fusion (aka magneto-inertial fusion or MIF), which is a higher-density and pulsed alternative fusion approach, and also basic laboratory plasma physics and plasma astrophysics. At LANL, Scott also branched out into research in high-energy-density (HED) physics and inertial confinement fusion (ICF).

Presently, Scott is lead principal investigator for a multi-institutional plasma-jet-driven MIF research project, with primary partner HyperV Technologies Corp., sponsored by the DOE Advanced Research Projects Agency–Energy (ARPA-E) under its ALPHA (Accelerating Low-Cost Plasma Heating and Assembly) program. He also conducts experiments and HED research on the OMEGA laser facility at the Laboratory for Laser Energetics at the University of Rochester.

Scott is the author or co-author of more than 60 refereed research publications in plasma and fusion science. In 2009, he participated in the DOE Basic Research Needs Workshops for both Magnetic Fusion Energy Science and High Energy Density Laboratory Physics, and in 2016, he was invited to testify on the status of DOE support of innovative fusion energy concept development to the Energy Subcommittee of the U.S. House Committee on Science, Space, and Technology. Scott was formerly an executive committee member of the APS Topical Group in Plasma Astrophysics, and is presently a member of the Exploratory Plasma Research (EPR) executive committee.

Selected presentations and Congressional testimony of Dr. Scott Hsu

- Plasma Liners and the Potential for a Standoff Magneto-Inertial Fusion Reactor
- 2011 Presentation on PJMIF
- An Overview of Fusion Science – Congressional Energy Subcommittee Hearing; Testimony of Dr, Bernard Bigot, Dr, Stewart Prager, Dr. Scott Hsu
- LANL Plasma Liner Experiment; a first step in demonstrable PJMIF (LANL/HyperV)
- Plasma guns fire into the race for fusion (Dr. Scott Hsu & Dr. Douglas Witherspoon)
- Spherically Imploding Plasma Liners as a Standoff Magneto-Inertial-Fusion Driver ARPA-E Award
- Scott Hsu's Peer-Reviewed Publications (reverse chronological order)

SAVING ENERGY…AND OUR PRIVACY

By: Pat Boone

Reprinted from Nationally Published Columns with permission of the author

December 16, 2013

Several years ago, a flight home from Israel on El Al Israel Airlines changed my life.

I'd taken my wife and granddaughter on a trip to the Holy Land with Governor Mike Huckabee, had a great time, and was returning to California. By what may have been divine intervention, my granddaughter Brittany sat next to Dr. Gerald Schroeder, author of four books on science and one on God.

I was intrigued by his obvious intellect, his grasp of very complex science, and by hearing of a controversial book this former confirmed atheist had written about God, and his discovery that everything in true science points inescapably to the existence of a Creator. We talked all the way to L.A., and I invited him to meet me again at my office to talk further.

Through Dr. Schroeder I met a colleague of his, Tom Tamarkin, head of USCL EnergyCite, and was drawn into their mutually informed concern about the world's looming energy crisis. Not "green energy", not air pollution, not coal vs. gas vs. solar vs. electricity---but *the desperate need to find and develop some source of energy for the world's needs* ---when all known reserves of fossil fuel and other alternative energy sources are all used up.

Before the end of this century. Possibly by 2050.

It's true. As society worldwide moves into the 21st century, becoming more modern and demanding energy for practically everything, all known resources are being depleted at an accelerating pace. All experts predict that combined outputs of solar, tidal, wind, geothermal and hydroelectric power will only provide a small fraction of projected 2050 worldwide energy demand.

Are you hearing anybody talk about this? I hadn't…and though I'm not a scientist by training, I'm a daddy and a granddaddy, and I was suddenly and deeply concerned for the future of my family. And yours. And truly, the family of humankind on this planet.

My new friends, Dr. Schroeder and Tom Tamarkin and others, made me aware of Dr. David MacKay's book, "Sustainable Energy—Without the Hot Air", and factual statements like "50% of the UK's energy needs might be met by biofuels *"if 75% of the UK itself were covered with bio-fuel crops."*
A ridiculous and impossible proposition!

Succinctly, all of this government's tax incentives and subsidies to those producing corn ethanol and all other biofuels are wasteful and ultimately nonproductive. It takes more energy to produce the crops and convert them into liquid fuels than the amount of energy those fuels provide! In time, it's a fatal circle, actually exacerbating the basic problem.

As I studied and learned, I wrote a series of 8 published articles on **nuclear fusion**, stating emphatically that **fusion**, not fission, is "The Last and Best Hope for the World's Energy Needs". Admittedly, I'm a lay person—but I was mentored by Dr. Schroeder and a team of practicing Ph.Ds in the field of nuclear physics and *high energy plasma physics.* My function was, and is, to express scientific truth to ordinary folks in language we all can understand.

And all these articles are archived under my name at this website. http://www.fusion4freedom.com I encourage you to read them, out of mutual concerns for the world's future.

There is a more immediate threat and need to be addressed here, though.

It's the need to individually ..privately and practically..monitor and conserve our own energy uses. The need has been addressed by our government..*but with a serious threat to our family privacy and eventual security! There has to be a better method..and there is.*

Some of the same team that has mentored me, Tamarkin, Schroeder et al, have developed an extremely effective, patented "Smart Meter System" to give individuals and homemakers the means of monitoring and controlling all power uses in home and offices. And I'm broadcasting this information because this administration has promoted another kind of "smart meter" that is already approved by the Department of Energy…and electrical utilities nationwide have already replaced *over 60 million old fashioned electro-mechanical power meters with "modern digital communicating power meters. And by the end of 2015 virtually every former meter in America will have been replaced. In California alone, the three investor owned utilities have replaced over 12 million meters.*

"What's wrong with that?", you ask.

While the original purpose seems genuine, an unexpressed consequence is that *every home in America will be connected to huge remote computer systems available to the government.*

Let that sink in for a moment.

Whereas it was presented to the utility companies for billing purposes, there is genuine concern that these devices can (and will) be used to literally "spy" on people. You can see that, can't you? These gov't approved devices will be able to know when you're home..and when you're away. To know *how and for what* you're using electricity. **Can you spell NSA and IRS? Can you think of any recent instances in which both are apparently already active in "intelligence gathering", unknown to the citizens?** Have I got your attention?

Well, good news. The physics team I mentioned above has already developed and patented another, better "Smart Meter" that has a built-in *data and control "firewall"* between the utility and the inside of your house! After all, the only information the utility really needs is the minimum information needed to generate your bill..even time of use bills or demand based bills. They have no need to know details of how and when you used your power. The EnergyCite meter gives you the energy use information *you* need.. But leaves the government and their "remote computers" out of the picture.

You and I should not be required to provide the government any of that or any other information! You likely have an anti-virus data firewall running on your computer, right? Are you comfortable with having a Big Brother government ..in your house, on your wall…monitoring your comings and goings, your uses of electricity and other utilities…*and with the authority to shut off your uses, disable your devices and in effect isolate you from "the system"?*

I'm sure not. And that's why I want to recommend you come with me to the EnergyCite project Facebook page by clicking here. **Give it a "Facebook Like", and see how you can participate in monitoring your energy use and at the same time keep Big Brother's hands off *your private business!!*** *Please click on: http://www.usclcorp.com/*

Pat Boone is a legendary Hollywood icon in the preforming arts who traces his ancestry to the American pioneer, Daniel Boone. Pat has sold over 45 million albums, had 38 ***top 40 hits,*** *and starred in more than 12 Hollywood motion pictures. Pat graduated from Columbia University in New York City, magna cum laude in 1958. Pat is well-known for his old-fashioned values, which contributed to his fame and popularity in the early days of the rock & roll era to the present. Today he is still active on television and in the motivational speaking circuit. Pat has spent the last few years writing columns and books and runs his own record label named Lion & Lamb. Pat's first book,* ***"Twixt Twelve and Twenty,"*** *Prentice Hall, was a number 1 Best Seller in America. Pat lives with his wife of 60 years, Shirley, in Beverly Hills, California.*

This article is the first of a series of eight articles on fusion power written by Tom Tamarkin and Pat Boone in their collaboration to speak to American citizens…in fact all citizens of the world…on the ill-fated history of fusion power development and the urgent need to resurrect and complete it. The articles were initially written by Mr. Tamarkin and were deemed too scientific and "heavy" for non-scientists. In February 2011 Mr. Tamarkin approached Mr. Boone who agreed to edit and personalize the originals and publish them in his weekly news columns in various media outlets. The articles are based on four years of intensive research and personal interviews with high-energy plasma & fusion scientists and visits to all the leading fusion laboratories.

Fusion: Our 1st, Best and Only Hope

Posted: April 09, 2011

Life is so wonderful. Just when you think you may have experienced virtually everything you're going to, something may pop up so unexpectedly, so "out of the box," that it opens a door to new possibilities or exciting new opportunities. At least it's been like that with me.

I'm a singer, an author, a businessman, a regular though multi-dimensional guy, but I'm certainly not a scientist. I'm aware, like you surely are, that the world is in serious, serious trouble when it comes to our energy needs. We cannot go on depending on fossil fuel, because there's a finite supply and it adds to environmental problems. And absolutely no known alternative can do more than scratch the surface. Even nuclear energy, with all its power, has just demonstrated the dark side of its potential.

But that's nuclear *fission*. I've just been learning about nuclear *fusion*.

They are vastly different. And the latter, nuclear *fusion*, is the answer. It has much greater proven power potential – and none of the negatives. Let me explain what I've learned. And I've learned it from people who know.

World population is projected to rise to over 9.5 billion people by the year 2050. Much of this increase will take place in developing nations. The citizens in these developing nations, along with those of established high-density population nations like China and India, have an absolute right and desire to increase their standard of living to the level of the Western world. Due to the proliferation of the Internet and frequent travel, populations can no longer be subjugated by corrupt regimes and kept from demanding the good things of life. And moral-centric nations like America and Israel feel impelled to help them achieve these things. It's truly in our nature. But how?

The fundamental ingredient required to support mankind is **energy**. If other nations are to enjoy our standard of living, they will require energy resources equivalent to those consumed in the United States and the West, in ratio to their populations. Today the population of the U.S. is slightly more than 300 million, or 4.4 percent of the world's peoples. Yet America consumes 28 percent of world energy production. So for the rest of the world to rise to anything like our standard of living, we'd have to increase world energy production by *15 times.*

Energy production from fossil fuels, by most estimates, has peaked in terms of capacity. We will run out of oil. So a new, much higher flux density source of energy must be found and developed. There is only one realistic source. That is the direct

conversion of mass into energy based on Albert Einstein's law, $E=MC^2$. This law teaches us that a very small amount of matter – even one gram – can be converted into a very large amount of energy equivalent to the burning of 2,500 gallons of gasoline!

So why keep on drilling for energy? Energy is all around us. And the key is described in the opening verse of the Bible. It's the very energy of creation, what many scientists describe as "the big bang," in which indescribable energy erupted from solid mass – and formed the universe as we now know it. Through nuclear fusion.

Can we utilize it? Yes. Has it been tested? Yes. It's the same process by which thermonuclear warheads work. Isn't anything nuclear dangerous? Not necessarily. We're not considering nuclear plants that operate on the principal of fission, the ones that have been functioning in the U.S. and Europe for over 50 years, currently providing Europe 35 percent of its power. As Japan has just shown us, fission has serious drawbacks. It requires expensive, highly radioactive fuels such as uranium and plutonium, which are dangerous and highly sought after by black marketers and terrorist organizations … with deadly intentions.

Fission also produces dangerous radioactive waste, with a half life of 25,000 years. And, as seen in Fukushima and Chernobyl, a fission reactor can melt down under certain circumstances, releasing enormous radioactivity and even explosion.

By contrast, fusion has none of these dangerous drawbacks. It uses simple hydrogen isotopes from the ocean for fuel. It produces virtually no long-term radioactive waste. It cannot go critical, leading to a chain reaction explosion. And *there is an abundant source of fuel to power the world for millions of years, if necessary*. As an added bonus, fusion produces 1,000 times more energy per gram of matter than fission!

Why hasn't this been done? It should have been, and almost was. In 1980 the Congress overwhelmingly passed the Magnetic Fusion Energy Engineering Act, signed by President Carter. The goal was to have demonstration reactors by 1995, and reactors actually feeding the American power grid by 2005. What happened? Nothing. Other things "came up," and the Act was never funded to a level high enough to achieve its goals. Since then, the science has been virtually shoved aside and forgotten by the public and our leaders.

Are there any other answers, any easier or safer "renewable" energy sources? No. Collectively, all the solar, hydro, tidal, bio-fuel, geothermal and wind energy sources *combined* can produce only 4 percent of the projected world energy requirements of 2050, for a population of 9.5 billion.

Fusion is the only possible solution.

How do we achieve it? The U.S. and Israel, with its tremendous scientists, must immediately commission a serious fusion development program, with the same military-like efficiency and focus of a war effort – which it surely is.

We can use shale oil and natural gas reserves to bridge the gap, buying the time necessary to bring fusion to commercial utilization. How much time? That depends on the funding and the sense of urgency, but it may take $25 billion and as much as 20 years, but it is possible in less.

We're clearly living on borrowed time – if we want to preserve life as we've known it, America must be even more insistent about developing nuclear fusion than we have about restoring constitutional government and a sane economy. And we've got to begin now.

I'll write more about this later, while I'm learning more myself. But I'm certain this nuclear fusion is nature's choice for energy, the very essence of Creation itself. And it's our only hope.

*Tom Tamarkin is the founder & CEO of USCL and EnergyCite®. In the 1970s Tom was an undergraduate student at Northern Arizona University majoring in physics with a dual minor of chemistry and applied mathematics. Tom is credited with inventing the electrical utility smart grid-**Smart Meter** in 1991…well before the concept of the smart grid became popular. In 1992, **Public Power Magazine** published an article which has become the basis for the "smart meter" which is now the corner stone of the current U.S. Department of Energy utility stimulus grants program with emphasis on energy conservation and awareness. Tom holds five granted patents on the smart meter system and has numerous patents pending. Tom lives with his wife of 30 years, Emily, in Carmichael, California.*

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Fusion: Nature's Choice for Energy

Posted: May 07, 2011

I hope you realize how special you are.

I do, when I speculate on this spinning ball we inhabit. You're aware, I trust, that our blessed Earth is a unique part of a finely tuned universe and is itself miraculously fine-tuned. As Albert Einstein mused, "This Earth is not an accident; that's scientifically unthinkable."

All our latter-day space exploration has discovered not one other planet fabulously designed with conditions for the formation and development of human life. Mankind, through the attribute of intelligence and the ability to reason, is set apart from all other forms of life. Man controls his life apart from his surroundings, whereas all other forms of life must adapt to their surroundings and are controlled by them.

Fundamental to man's ability to control his life is *access to energy*.

The more people that crowd onto this unique planet, the more energy must be developed and available. Energy is absolutely required for:

- agriculture, in all forms, and production of potable water;
- transportation;
- production of virtually all goods required by humans;
- provision for man's comfort and survival in all weather conditions.

However this planet came to be – whether the lately postulated "Big Bang" or the profound Genesis account of the Creator saying "Let there *be* …" – we know the Earth has three sources of energy, resulting from two fundamental scientific processes. And these sources are *atomic in nature*.

Firstly, the Earth is unique in having life as we know it powered through photosynthesis, from energy produced by the sun. This colossal energy within the sun is provided by the *fusion* of hydrogen into helium – and the associated release of energy. Many scientists describe the Earth as an organic battery, having been "charged" by the sun for as long as both have existed, in what we call the Solar System.

Secondly, the Earth is unique in the large amounts of fissionable heavy elements occurring in nature – like uranium and thorium. These elements are very rare elsewhere in the universe, where hydrogen and helium make up 99 percent of available elements.

Thirdly, the Earth is unique in the large amounts of "deuterons," or heavy hydrogen atoms. Across the universe, approximately 2 in 100,000 hydrogen atoms are deuterons, but on Earth the ratio is 1 in 5,500. The Pacific Ocean alone contains 10 to the 42nd power of these exceptional atoms.

Maybe you're asking right about now … "What's this all about, Professor Pat?" I'll tell you. It's about human survival on this unique planet. I've been studying with a group of scientists and physicists about the three sources of energy on which our future depends. *And only one is our ultimate hope.*

The third choice, the one we're familiar with, but the weakest one, is energy produced by chemical reactions that generate heat by "burning" hydrocarbon fossil fuels. These fuels were created through photosynthesis in combination with the processes of plant and animal life, from the energy provided by the sun. Though some scientists estimate the age of the rock we call Earth at 4.6 billion years –others warn us that the *300 year period we're living in now* will soon have depleted usable fossil-fuel reserves.

It's absolutely imperative that, during whatever time we have left, man must use his intelligence and reasoning abilities to master the second and first choices of energy – because fossil fuels are finite and cannot be replaced or reproduced.

Beginning to get the picture?

The second – and interim – choice is energy produced by the atomic reaction of splitting heavy elements such as uranium, element 92, isotope 235, or thorium element number 90, isotope 232. This is almost "Greek" to me, not my training by a long shot, but I'm motivated to learn what I can, while we can.

Thorium 232 is relatively abundant on Earth. Uranium 235 is far less abundant. It's estimated that there is enough useable thorium 232 on the Earth to provide the energy consumed by the United States, at current usage, for the next 1,000 years. But that's just the U.S., a small part of this planet.

However, the splitting apart of elements in a man-induced atomic reaction is *contrary to nature* and the way our universe was formed. Regardless if you believe the creation was created by the hand of God or a random "Big Bang" event, the Jewish and Christian scientists I am learning from have shown me this creation of the universe and our blessed Earth came to be through the fusion process. The creation is a process of building by combining elements, not splitting them apart.

The splitting of atoms results in many problems such as nuclear radiation, long-term dangerous radioactive waste, possible explosive chain reactions, melt downs of fuel cores (as in Fukushima and Chernobyl) and the ominous uses of atomic energy to wage war and annihilation.

So what's our answer … our only answer?

The first choice and long term our only hope is energy produced by the process of nuclear *fusion*, wherein two light element atoms are fused into a slightly heavier atom, along with a corresponding release of dynamic energy. To scientists (and I'm not one), a well-known and understood example is the fusion reaction of D (hydrogen 2) + T (hydrogen 3) > He4 (helium) +17.6 MeV (energy units) + n (neutron). There are many other fusion reactions, each having distinct advantages and disadvantages.

This appears to be the very process, the "big bang" if you will, by which God initiated – or created – everything we know.

This is also the fundamental process of the sun, which is generating the energy giving us life right now.

Here's the main point: Our earth has enough heavy hydrogen (deuterium) to power the entire world's energy *literally for eternity.*

So controlled nuclear fusion is nature's first choice for energy, because:

- it follows the laws of the creation of the universe;
- it has none of the negative aspects associated with fission, or the splitting of atoms;
- it is virtually an unlimited source of inexpensive power (once it's developed and running), capable of supplying 100 percent of the Earth's annual – and ongoing – energy requirements.

A final thought. Animals and humans were given different natures, in Hebrew "Nefesh" and "Neshamah." Nefesh is the animal instinct toward survival, comfort and reproduction. Neshamah is the higher nature, a reflection of God Himself, that sees the bigger picture and realizes how interconnected – and interdependent – we all are. Actually, we humans have both natures, often in conflict with each other.

As the renowned scientist/author Dr. Gerald Schroeder observes, "When the two natures are in sync, great goals can be reached."

That's my hope in writing this column.

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A Brief History of Nuclear Fusion

Posted: May 28, 2011

In the last few weeks, I've written two columns on nuclear fusion. This is my third … and I intend to offer several more. Though I declared at the outset I'm not a scientist of any kind, I am an intelligent, thinking, open-minded person who can see that the human race is in deep trouble, and we'd better all be concerned about the best source of energy for our future – if we intend to have one.

Let's really start at the beginning – meaning "In the beginning, God ..." Highly respected physicists are telling me they believe this earth was created (regardless of when) utilizing a process we know as nuclear fusion.

It seems scientifically reasonable that a Creator wouldn't use a process that *split* atoms – which is actually against nature – but rather one that would combine, or fuse, His building blocks, the atoms. The sun itself is a monumental nuclear reactor, radiating light and enabling all forms of life on our planet. And the scientists I've been studying with are totally convinced we can access the unimaginable power of the atoms in matter … through fusion.

I'm fortunate to have been included in ongoing, very informed and constructive discussions between some of this nation's leading fusion research scientists on what they, and now I, believe is "nature's choice for energy." Although many nations, including the U.S., have endorsed and developed nuclear *fission* as the hoped-for endless source of affordable and abundant energy for this world's needs, we've all become painfully aware of its negative and very dangerous side effects. In addition to the ever-present threat of nuclear war, the waste products that can remain radioactive for generations and the recent meltdowns of nuclear reactors with still undetermined consequences, there is the widespread visceral sense that anything this powerful and potentially destructive is almost too dangerous to embrace, long term.

Isn't there, can't there be, a better alternative? Yes – nuclear *fusion*.

None of my scientist friends are anti-fission. In fact, I quoted some earlier, saying that fission is clearly the bridge to get us to fusion. But there are practical reasons to move away from fission as soon as possible. As we're using up all fossil fuels at an alarming rate, we're also amassing nuclear waste, with its destructive contamination. Not good.

A little history now. In June 1970, Noble Prize laureate Dr. Glen Seaborg, then chairman of the Atomic Energy Commission, wrote an article in the ***Bulletin***

of the Atomic Scientist projecting that the first fusion power plant would be on line in June 1995. That was *10 years before President Carter signed into law* the **Magnetic Fusion Energy Engineering Act** (October 1980) that articulated that goal and *mandated the funding* to achieve it. We were on our way!

In the mid '70s, leading scientists advocated development of fusion as soon as possible. In 1976, the Energy Research and Development Administration, or ERDA, the predecessor of today's Department of Energy, published a chart with fusion funding levels and corresponding time lines for completion. Again, America's independence from oil and its creation of an inexhaustible, affordable energy source for all the world was just a matter of time and adequate funding.

The most aggressive "level V" proposed a budget of $600 million per year, leading to a working demonstration reactor by 1990. How different would our world be today if that level had been approved and enacted?

"Level I" called for $150 million a year (1976 dollars) – and was called by active scientists ***"fusion* never,"** because it would not adequately fund the research needed to overcome all challenges. Its presidential champion at the time, Jimmy Carter, was not re-elected, and the U.S. fusion program has been at that "fusion never" level, or lower, for the past 30 years.

That lack of progress in U.S. fusion has left us behind China, Japan, South Korea and the EU. At one time, we were the world leader. In 1974, the magnetic fusion energy R&D budget was $43.4 million; by '77, that increased to $316.3 million. In July 1978, Princeton Plasma Physics Labs reported their Large Torus Tokomak (test fusion reactor) produced temperatures of *60 million degrees*, exceeding the fusion ignition temperature of 44 million degrees required for a sustained fusion reaction.

Friend, we were at the door of a new, nuclear fusion age!

In an interview with Susan Spencer on ***"The CBS Evening News, with Walter Cronkite,"*** Dr. Stephen Dean, director of the Magnetic Confinement Systems Division of the U.S. Department of Energy, stated: "The question of whether fusion is feasible from a scientific standpoint has now been answered."

The reaction was electric. The Princeton fusion breakthrough became front-page news in papers all over the world.

The redoubtable Rep. Charles Rangel, D-N.Y., said, "This breakthrough compels us to redirect our energy and focus and funnel further funds and attention to this highly promising and vitally important fusion research. The solution to the world's energy needs is now before us."

But not everyone was excited by the breakthrough. Some people were alarmed that the announcement would lead policymakers to think that fusion would solve our energy problems too soon and derail efforts to fund other nearer-term energy projects. Lobbyists, investors and other vested interests really had personal and perhaps political reasons to postpone fusion. In fact, the president of Princeton University, Dr. William Bowen, was called by the secretary of energy and asked to tone down the announcement.

But Dr. Bowen refused, and the announcement stood. Rep. Mike McCormack, D-Wash., elected after a 20-year scientific career, took his Magnetic Fusion Energy Act through Congress in record time with record votes. We were on the very brink!

However, *one week before introducing the bill*, he spoke at a conference in Washington, D.C., on nuclear safety. Energy Undersecretary John Deutch played

down the Princeton results and stated that nuclear power must be the energy source of "last resort." He stated that the Department of Energy would like to minimize nuclear energy … and maximize the use of coal and oil! (Of course there was no differentiation of fusion versus fission and the average politician would not understand it anyway; nor would the person on the street.)

Rep. McCormack countered by saying nuclear fission and coal would be the bridge to get to *fusion by the year 2000*. His Act would authorize the construction of a fusion test reactor facility by 1987 and an actual, working demonstration reactor by 2000. It would cost perhaps $20 billion, over 20 years.

Not insignificant money, but less than we spent on going to the moon and back. The story gets exciting – and troubling – in my next column.

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The Holy Grail of Energy: Nuclear Fusion

Posted: June 04, 2011

The mythological Holy Grail, it was believed, was the chalice from which Jesus and his 12 disciples drank the Passover wine, in the upper room, on the night he was betrayed. According to some versions of the tale, Joseph of Arimathea, in whose new tomb Jesus was interred, caught some of the blood still seeping from Jesus' horrible wounds … in that same chalice.

As the legend continues, that chalice, which came to be known as the Holy Grail, was lost for centuries and then pursued by Sir Lancelot of King Arthur's knights, certain that whoever held that sacred vessel would have special favor and endowment from God, *empowered* to do great and magnificent things for mankind.

Beautiful as that legend was, it was only a fable. Nuclear fusion is real. Modern science has established, through solid research and factual evidence that properly developed nuclear fusion is the Holy Grail of energy and can empower this and all future generations.

I'm completely convinced of it, and that's why I want to make all who will listen with open minds aware of how far we've come toward this magnificent empowerment, what has delayed it, and how we can go on to achieve it.

In my previous column, I briefly traced the history of this quest here in America, through the phenomenal breakthrough accomplishments at Princeton and the McCormack MFEE bill, which raced through Congress in record time, actually envisioning an on-line demonstration reactor by year 2000. But I also detailed *resistance*, for political and special-interest reasons, from the Department of Energy!

In 1980, Rep. McCormack wrote a report for President-elect Reagan, stating, "The hardest battles are yet to come. There must be continual authorizations and appropriations of funds. … it will take tremendous vigilance and determination on the part of our nation to carry through the 20 year development plan to make fusion a reality."

But our new president was confronted with a huge federal deficit and was pressured by advisers to *cut* energy R&D. In December 1981, his science adviser, George Keyworth, publicly stated: "The U.S. cannot expect to be pre-eminent in all scientific fields, nor is it desirable." And the official position of our government became "it is not the government's responsibility to conduct energy R&D and pursue energy independence. It is the responsibility of *private industry*."

In the fall of 1983, Dr. Stephen Dean warned Congress that "the U.S. is no longer the unquestionable world leader in fusion development. The USSR, Europe and Japan have comparable accomplishments, facilities and momentum. The dramatic rate of our fusion progress at this time," he stressed, "is based on capital investment commitments made in the 1970s."

But too few paid heed.

Now get this! Even with meager funding but with undimmed zeal, in July 1986 the Princeton TFTR reactor generated a record *200 million degree* plasma temperature and produced a peak fusion power of 10.7 Mw (10.7 million watts of fusion power). In 1987, a record *500 million degrees* was attained! Absolutely astounding! Heat and power beyond the imagination … but real!

What happened next? The program funding was cut by $50 million.

Attention was diverted to other things – in this country, but not abroad. Currently, world records of accomplishment are being routinely set in Japan. In Europe. In South Korea. China, of course, has been quick to see the opportunity and enter the picture, with almost unlimited resources. ITER (International Thermonuclear Experimental Reactor) has been thought by many to be the best, most logical solution. It started with the U.S. as a 25 percent partner – but lacking funding, the U.S. is now only a 9 percent stakeholder and has been seen as an unreliable partner because we've been "in and out" several times.

So the quest for the Holy Grail continues. The reactor is being built in France by Russia, China, India, Japan, South Korea and, oh yes, America. Europe is paying almost half the cost.

During the 1990s, our magnetic fusion budget collapsed to the $200 million-per-year level. Yes, that's a pile of money … but we've been shoveling *billions* in foreign aid to many countries that, in some cases, are our outright enemies and vote against us in the U.N. consistently. Fusion funding today equals less than one-third of the 1977 level, in inflation-adjusted dollars. Yet in the last year, we have spent over 90 billion dollars on medical research!

There are conflicting opinions among scientists, as always, about the best approaches to take to achieve our goals, but American and Israeli scientists are capable of ironing out and resolving the differences – if our government "gets it" and commits the funds, not wasting billions on nonproductive and even counterproductive commitments. You may remember hearing about our famous Superconductor Collider Center in Texas, which was scrapped a few months after it was built at huge expense. Today the Swiss are making the new particle discoveries with their “atom smasher” which should have been ours located in our country.

One Mirror Fusion Test Facility, developed at Lawrence Livermore National Labs in the 1980s, took over 10 years and nearly $150 million to build and was shut down on the day testing was to begin. Why? A shortage of funds. Or was it the likely completion to other projects if its radical and innovative design worked?

Between 1996 and 2000, the Fusion Energy Sciences Advisory Committee (FESAC) recommended a vigorous program in Innovative Confinement Concepts to explore several practical alternative paths. It was never funded – and after the U.S. *re*joined the ITER program (in minority position), the ICC program is essentially scrapped. Dead end.

And now the bottom line of this too brief history. Fusion research coordinator Tom

Tamarkin met with Princeton Plasma Physics Lab director Dr. Stewart Prager and was told: "America is on its way to becoming a Third World nation in energy … hence in all things," and that our president, on being advised of the cost of taking *leadership* in fusion development, has decided that the U.S. should meekly join the ITER program (with 9 percent participation).

Why does all this matter? Why should you and I care? Because *energy is fundamental to the future of this world*. The future of our children and grandchildren depend on it. The leader in energy becomes the leader of the free world, and the one capable of freeing the world from dependence on rapidly disappearing sources. I believe this must be done with the moral character, kindness and generosity of the United States. And our faithful ally and gateway to the Middle East, Israel, with its proven technological and scientific genius, should be of great assistance in achieving this goal. Our destinies are linked in many ways.

America showed our leadership in World War II, saving Europe and rebuilding Japan. We showed our leadership by conquering space and reaching into the vast universe. Now it's time for us to show our leadership in solving the world's desperate need for endless energy … through fusion. We can't, and should not, leave this to others with lesser motives.

My next article on fusion will suggest a way forward to rebuild America and its global stature, to reverse our decline in education and infrastructure, and to re-establish our pre-eminence among our peers by developing the final, perfect power source, for the entire world.

For me, it's the real Holy Grail.

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There Is Hope for the World

Posted: June 11, 2011

I knew a man named John Lennon.

I first met him with his buddies, Paul, George and Ringo, in Las Vegas when they were just fresh, funny and talented young kids from Liverpool.

I and my daughters visited with them backstage between their two shows in the Thomas Mack Arena and found them charming and energetic, relishing their new and sudden stardom.

Like the rest of the world, I watched as their careers blossomed and assumed fantastic proportion. Each record, and then each movie, eclipsed the last … until they had become the greatest singing group in music history. It will never be equaled.

Many years later, I visited with John and producer Phil Spector in a nice health-food restaurant while they were working on a new album. As we compared notes and stories about our experiences, I asked John what he thought was the main reason for the Beatles' incredible success. He thought a minute behind his little round glasses and answered, "Imagination."

Imagination. As Ted Kennedy quoted his brother, Robert: "He thought of things that never were, and asked 'why not?'"

And young Walt Disney – at a time when the "cartoons" he and a couple others were successfully producing cost an average of $5,000 – told his incredulous brother, Roy, he envisioned a full-length feature film, *in total animation,* and estimated it would cost $1.5 million! It seemed unthinkable. But it was imaginable, and it became a worldwide sensation: "Snow White and the Seven Dwarfs," a timeless classic.

Imagination. It's much more powerful than most realize. In fact, hardly anything of value has ever been accomplished without beginning as an idea, which is really imagination. In Genesis 11, a group of mere humans imagined a city and a tower reaching into heaven, and they began to actually build it. The Lord God said, "Indeed the people are one and they all have one language, and this is what they begin to do; *now nothing that they propose to do will be withheld from them*."

"Come, let us go down and there confuse their language, that they may not understand one another's speech." And the Tower of Babel came to a halt.

But now the language barrier has been erased and, as Walt Disney said, "If you can dream it, you can do it." Man can do virtually anything he can imagine.

That's why I have written five of my recent columns here on nuclear fusion. I'm not a scientist, as I said at the outset, but I have a wonderful imagination. And so do a great number of scientists who have not only envisioned a world empowered by an inexhaustible, eternally available energy source, but have come very close to making it available to humanity.

Guided by physicists and other scientists who've been personally involved at various levels, I've given a sketchy but detailed history of the early experiments and the discoveries that *proved* the theories of nuclear fusion; described the work and research in a number of American universities, and the funding allocated by our government during the Carter & Reagan administrations, that led to amazing breakthroughs; and I've cited the miraculous, almost inconceivable heat levels achieved at Princeton that ached to be used in creating the plasma that would create nuclear fusion as the ultimate energy source.

But I've also detailed the unexpected resistance to this amazing progress in various departments of our own government, including the Department of Energy! Who, and why? It shouldn't be a surprise that various vested interests, powerful lobbying interests who wanted oil and gas and coal and electricity and, yes, even nuclear fission to be utilized *first*, prevailed.

So the funding, and much of the almost triumphant technology, dwindled and ground nearly to a halt. But we can still imagine, and the goal still can be attained.

I want you to imagine with me. Imagine a world where oil is mainly a lubricant and a base for manufactured products, a world where there is plenty of clean, fresh water for drinking, irrigation and sanitation. We already have the technology and tools to desalinate and purify water for every community in the world – but we don't have the energy source or funding for it.

Fusion can do it.

Imagine a world where food doesn't have to be scarce anywhere and hunger can vanish. With petroleum no longer needed to power cars, the price of oil would plummet. We use oil to make plastics, and clear plastics make greenhouses. Inexpensive greenhouses can be manufactured, warmed and lighted by the endless supply of energy from fusion – and food can be grown anywhere. Can you imagine it?

"Global warming" can be a non-issue when fusion gives us a world where humanity leaves only a small carbon footprint. All the natural sources of energy are frighteningly finite, but fusion is infinite.

The physicists with whom I've consulted are certain that if we make a very focused, concerted and adequately funded effort, *bringing fusion to the world is 100 percent certain*. There are others who are more pessimistic and say there may only be a 20 percent chance, at least in the foreseeable future.

But ask yourself: If your family was on the verge of starving and you had evidence that there was a 20 percent chance that unlimited food was just over the next hill, what would you do? Wouldn't you look at your hungry children and start climbing? You'd climb a mountain, if you had to.

This isn't a pipe dream. There is unlimited food and water, unlimited energy and unlimited opportunity for the human race – just over the next hill.

We've got to use our imaginations, millions and millions of us. We've got to involve our government through our elected representatives, all the way to the president. We've got to use the energy we have *and vote for the future just over the hill*. Please visit the Fusion 4 Freedom website. http://www.fusion4freedom.com

In the months just ahead, scientists will be meeting, organizing, holding workshops with top fusion and plasma leaders, military strategic planners in the model of Admiral Hyman Rickover, who led the development of the nuclear submarine, and major philanthropists. The goal? A clear plan leading to the demonstration of a working fusion test reactor *by the end of this decade*. This year is the 50th anniversary of John Kennedy's challenge to America to put a man on the moon and bring him safely home to earth.

We did it then. And we can do it now – if we harness the skills and brilliance of American and Israeli scientists. *I imagine we can!*

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Urgent Energy Alert for America, Part 1

Published 04/20/12

Almost exactly a year ago, I began a series of five articles on ***"Our First, Best, and Only Hope."*** Hope to restore America's economy through the development of new energy sources and services *that can be shared profitably throughout the world to pay down our current (and mushrooming) $16 trillion national debt*. Hope for all mankind to thrive in today's world … and for generations to come. Read my five-part series: Article 1, Article 2, Article 3, Article 4 and Article 5.

The solution, of course, is for America to correctly solve energy needs once and for all by developing a virtually inexhaustible, environmentally perfect source of power. It's not solar, wind or any type of fossil fuel. And it's been known in the scientific community for decades!

It's controlled fusion energy.

I started by admitting I'm not a scientist. But I'm a concerned citizen; I'm curious and creative; I was born with a high IQ and active intelligence; and I made it my business to seek logical answers to the looming world energy crisis. I've been schooled and mentored by several real scientists – and I've been complimented by many in the scientific community for making very complex topics understandable to non-scientists like me. (I'm supplying some links in blue text in this column in this column for those who want to check on what I'm saying.)

And, pursuing "The Holy Grail of Energy," there has been some exciting, promising progress!

First, note the recent announcement of Chinese Premier Wen Jiabo in his March 5, 2012, government report that China will cease its blind expansion in solar and wind power and concentrate on nuclear and hydro energy sources. Why? Because solar and wind power have proven to be far too unpredictable and expensive to use "on the power grid." The State Grid of China has now calculated that *less than 1 percent of China's electric power* could be obtained from solar. Get it? China looks at all this realistically … and so far, we don't.

As objective scientific enquiry and free enterprise take hold in China, these practical people are changing course dramatically. There were less than 300,000 cars in Beijing in 2005; there are over 5 million today! And it is projected that if all these cars were electric, it would require over 115 square miles of solar panels to operate them, just three hours a day, six days a week!

Do you understand the connection between electricity and transportation? Oil, gas and coal are the "drivers," and even the source of electricity for batteries. *And this world will*

inevitably run out of all of them. At best, it will likely take 20 years to develop a major new source of power, and long before then petroleum will be very expensive to provide and distribute. Knowing that, China has announced it will expend $15 billion to initiate an electric-car industry within its borders. And Renault's "Better Place" in Israel is working toward replacing most of Israel's gas autos with its Renault ZE, a Honda Accord-sized practical family car … electric.

Alarmingly, America is becoming woefully behind the curve. We're slow to realize a new source of energy must be found very soon, not just for the United States, but for the entire world.

Yet the solution is not new. Millions of school kids have heard the answer; they just don't know it. $E=MC^2$ is probably the most commonly recited scientific formula in the country by non-scientists. Yet what does it mean? It means Mass and Energy are simply different forms of the same thing – and can be converted from one form to another. And it means that a little bit of mass, or matter, can be converted into huge amounts of *energy*. That is what controlled fusion energy is all about: *converting a very small amount of matter into huge amounts of energy*. Click here for Albert Einstein's own words and voice (MP3.)

Has this ever been done? Certainly. "Show me," you say. OK. On Oct. 30, 1961, the Russians triggered a *fusion reaction* that generated enough energy to power the entire city of Las Vegas for over two and a half years! The "fuel" was about 23 kilograms of hydrogen and lithium isotopes.

This followed Nikita Kruschev's promise to show the U.S. a "Kuz'kina Mat" ("we'll show you") at the 1960 U.N. General Assembly. Russians referred to this event as the "Tsar Bomba," or "king of bombs," although the actual device was never intended as a tactical bomb, too heavy and complex. Nonetheless, it generated unbelievable energy – and remarkably clean in terms of any unintended byproducts, including radioactivity.

And America had already done something similar, on a smaller scale, in March of 1954 when it tested the first deployable "hydrogen bomb" called "Castle Bravo."

Unfortunately, both of these events – demonstrating that man could vastly multiply available resource through the fusion of light elements, as opposed to the *fission* of plutonium and heavy radioactive elements – occurred in a military and weapons context. And that derailed and delayed the development of the far more desirable fusion.

Fusion of light elements and its ability to serve as an energy source was first predicted by Atkinson & Houtermans in 1929 in a groundbreaking paper published in Berlin. In 1939, Hans Bethe showed how fusion powers the sun and stars and received the 1967 Nobel Prize in Physics for his work. In 1942, American physicist Dr. Edward Teller had called for academic discussions on peacetime uses of fusion energy before the Los Alamos lab was operational. Then in 1950, Russian physicists Andrei Sakharov and Igor Tamm collaborated – leading to the early concepts of *magnetic confinement fusion* and the tokomak, based on a letter sent to the Soviet leadership by an army sergeant named Oleg Lavrentyev.

Then things got badly complicated, with a number of "flies in the ointment": the end of World War II, the rapid rise of Communism, and the arrests of Julius and Ethel Rosenberg in the U.S., who were conveying military and atomic weapons secrets to the Soviets. Both Dr. Sakharov in Russia and Dr. Teller in America were conscripted by their governments to develop thermonuclear weapons, employing fission to trigger fusion. Teller swiftly developed the Teller-Ulam hydrogen bomb design used in the Castle Bravo test.

Wildly productive *fusion* power was being elbowed aside for wildly destructive *fission-fusion weapons*. It was the world's – and civilization's – loss.

Still seeking peaceful uses of nuclear energy, Sakharov in 1962 proposed the use of lasers in what would become a branch of fusion development called Inertial Confinement Fusion, or ICF. More about that later.

In America, Dr. Teller developed an important principle involving the use of X-rays to implode hydrogen targets, thereby triggering fusion reactions. Though he used it in his hydrogen-bomb design, he also knew this could be the secret to the peaceful deployment of controlled fusion for energy production. His discoveries in fusion ignition eventually led to his founding the Lawrence Livermore National Laboratories along with Ernest Lawrence in 1952.

Work on fusion development was also going on in the U.K., but the Rosenberg spy scandal and other intrigues involving German-British scientist Klaus Fuchs quickly caused all fusion work in the U.K. to be "classified," and the U.S. followed suit. But Teller strenuously objected, writing his fellow Hungarian physicist Leo Szilard: "Our only hope is in getting the facts before the people. This might help convince everybody that the next war will be fatal (for all of mankind) … and this responsibility must in the end be shifted to the people as a whole and that can be done only by making the facts known."

And that's exactly why I, and my mentors, feel these articles are so vitally important. If Americans can come to understand how crucial fusion energy is, and will exercise the power of the people, America can win our future. If we don't … we will be a Third World country.

Please don't miss the next two articles.

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Urgent Energy Alert For America, Part 2

Published 04/27/12

OK, now the plot is thickening. For a year now, I, Pat Boone – not a scientist, just an ordinary citizen who can sing and read and think for myself – have been here in this space, begging my countrymen and women to look at the obvious, most desirable and desperately needed answer to the energy needs of America and, in fact, the whole world.

You ask, "Well, Boone, if this answer, this God-gift, is so 'obvious,' why isn't the scientific community all over it? Why aren't scientists and physicists and even our Department of Energy doing whatever it takes to utilize it, to bring it to a world running out of answers? And what is this miracle energy source again?"

It's **nuclear fusion** – and I'm about to answer the rest of that question.

As the Cold War grew more and more ominous and tensions between the two world's superpowers intensified, both the U.S. and the Soviet Union spent huge sums of money developing more-advanced thermonuclear weapons. The fear of the awesome power of nuclear weapons deepened, and virtually all this work was "classified" by the military in both countries. Though the general public knew little of it, feverish progress was being made toward harnessing nuclear power for destruction.

But physicist Edward Teller in this country had a different vision. Some have conjectured that he was the inspiration for Kubrick's "Dr. Strangelove," a maniac wanting to see demonic devastation unleashed on mankind, but nothing could be further from the truth.

In addition to his founding and leadership of the Lawrence Livermore National Laboratories, Teller also supported a laboratory on the campus of Princeton University to pursue *non-military* fusion research. Rather than pursuing man's power to destroy through fission – he saw nuclear *fusion* as man's hope for survival.

Again, let me emphasize that fission splits atoms, the very material of creation; fusion can *combine* elements, releasing virtually limitless energy, with negligible negative effects. The sun itself is a huge nuclear fusion reactor, energizing the whole solar system.

It's a God thing.

At Princeton, a first effort toward peaceful use of this awesome energy was Project Matterhorn, out of which was born the Princeton Plasma Physics Labs (PPPL). Plasma is the term given to matter when

heated to extremely high temperatures and can be harnessed to release huge amounts of energy. And PPPL was also utilizing concepts developed by Russian physicist Sakharov. While America and Russia were deadly enemies on one level, a couple of their leading scientists were trying to achieve peace through science on another.

It was a terribly daunting, near impossible goal. But so was developing machines and technology that could send human beings to walk on the moon. And that was moving forward, too.

In 1954 Teller made a memorable presentation at the "Gun Club" on the Princeton University campus. Addressing the problems associated with the fusion plasma instabilities at incredible thermonuclear temperatures, he said, "Trying to confine plasma with magnetic field lines is like trying to hold a blob of jelly with rubber bands." And these comments stimulated a controlled-fusion giant, Lyman Spitzer, to invent the Stellarator approach to magnetic confinement – the necessity of containing and focusing unimaginable heat on the plasma. Princeton was making progress!

And at the Lawrence Livermore National Laboratories, now home to the NIF project, scientists were developing Teller's "magnetic mirrors" concept, another approach to intensifying and directing sun-like temperatures. The Magnetic Mirror Fusion Test Facility was designed and built at a cost of over $150 million. It was tremendously promising, exciting … so what happened next?

Nothing.

The project was canceled and shut down by the government the very week it was to "go live" and testing was to begin! Why?

Because, while exhilarating progress was being made toward fusion energy, there was also frightening progress being made toward nuclear weapons – and a growing "anti-nuclear" movement was spreading worldwide. Starting in the mid-1950s, after the Castle Bravo test and accelerating in reaction to various nuclear weapons tests conducted by both superpowers, tremendous political pressure created various nuclear test ban treaties beginning in 1963.

Once these treaties were in place, the U.S. could no longer actively test nuclear weapons above ground. And since that time, many incremental bans on nuclear testing have been put into place, including the beginning of the START process. And once an "anti-anything" movement gains power, it tends to grind anything remotely connected with it to a halt. Today, though much of Europe and the Far East are increasingly turning to nuclear fission for peaceful energy, the eruptions at Chernobyl and Three Mile Island and lately Fukushima have enflamed the anti-nuclear forces to new vehemence.

Our government's response was to *close down* the Atomic Energy Commission, which previously ruled over all nuclear affairs, civilian and military, and in its place create at least three more regulatory authorities to, in various time-consuming ways, "collect, assemble, evaluate, and analyze energy." Now the Department of Energy has nuclear weapons stockpile stewardship authority under its NNSA with a $9 billion budget just to maintain what we already have.

Get the picture?

The anti-nuclear group was successful at creating conditions that effectively quadrupled the costs associated with nuclear power, using lawsuits, public testimony and requirements for endless permits – to the point where *atomic power in the United States has been at a standstill for the last 30 years.*

Not so the semiconductor or cellular telephone or computer industries, all of which have flourished *under the control of*

private enterprise. What a concept … private enterprise, private funding and huge benefits to all mankind!

This is really the point of all my writing on this vast, crucial subject.

If a government has virtually total control, and if it doesn't want to pursue a goal, it will go nowhere. This administration in particular is openly committed to energy – but the scarce, ineffective and impractical kind. Meanwhile, new possibilities in fission power, like Thorium fuel rather than the more dangerous Uranium and Plutonium, have languished *because private industry is intimidated and reluctant to fund it.*

And guess what? China has already lifted its one-year hold on nuclear power, since the Fukushima disaster, and plans to graduate over 2,000 Ph.D.-level students to focus on fusion energy. Europe, India and Japan, along with Russia and China, are expensively working on a cooperative fusion reactor program – ITER – and American scientists are pleading for the funding to maintain our measly 9 percent of that project.

Just 9 percent! This unfortunately is what happens when a blind, politically driven government is in control.

Friend, our nation's future hangs in the balance. The EPA is on record saying it wants to "crucify" our oil, gas and coal producers, while billions are squandered on hopeless projects like Solyndra and other solar, wind and algae fantasies. It's a nightmare.

But in my third – and last – article on this subject, I urgently want to spur us to action, with hope for tomorrow.

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America's Urgent Energy Alert, Part 3

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This is my eighth – and likely final – column on the absolute necessity of America's reassuming the lead in developing nuclear fusion (not fission) as the last best hope for our own energy supply, and that of the whole world.

If you haven't read any of the first seven, I hope you will. They're archived here. My basic point is this: While we and our government fumble around debating the pros and cons of oil, gas, coal, solar, wind – and algae, for Pete's sake! – we're running out of all fossil fuels, and before the end of this century they'll be used up.

That's just fact.

Then what? Currently, a world powered by nuclear *fission* – with the constant threat of meltdowns, malfunction, megatons of radioactive waste and questions about the earth's supply of the necessary fuel (uranium, thorium, etc.) for thousands of fission plants – paints a bleak, dangerous Orwellian picture.

So, what's the answer?

Look up. Whether cloaked by clouds or shining ever brightly, *the sun is supplying light and energy not just for our planet, but the whole solar system*. And it is a nuclear fusion reactor, pure and simple!

For untold millennia, this giant fireball in the heavens has been furiously fusing various forms of hydrogen, combining them – fusing them – into helium, and releasing unimaginable heat, creating and sustaining life anywhere it is found.

As detailed earlier, American scientists, sometimes working with counterparts in Russia and elsewhere, have been seeking the way to create and harness this vast, inexhaustible power source for all of us. For over 50 years, brilliant visionaries like Dr. Edward Teller have made significant strides, utilizing Einstein's $E=MC^2$ and proving that that energy and mass are interchangeable – and that when (not if) we can apply and control sufficient heat to the process, a little bit of solid matter can be converted to massive amounts of usable energy!

America was always the "lead horse." Terrific labs such as Los Alamos National Laboratories, Sandia National Labs and Lawrence Livermore National Labs were focused on the use of lasers to produce X-rays, to implement Teller's concept of triggering fusion reactions in hydrogen. Excitement was building.

Inspired by Dr. Teller's work, and his prophetic warning to keep people informed, a Michigan physics professor named Dr. Keeve (Kip) Siegel formed the first and only *private-sector company to pursue controlled fusion research using lasers.* In the early 1970s, he formed KMS Industries, with the goal of successfully achieving laser inertial fusion energy.

With private funding, on May 1, 1974, KMS carried out the world's first successful laser-induced fusion reaction in the laboratory,

using deuterium-tritium in pellets. His breakthrough was acknowledged by our Energy Department and leading scientists around the world, including France and Russia. In December 1974, Forbes Magazine published a story about KMS … and *the government's attempts to shut it down!*

What? You heard me. Shut it down. Because of pressure from rabid anti-nuclear groups (and the government's insistence this should be controlled by them, not private industry), Dr. Siegel was brought before Congress to testify on what he and his company had proven in the area of nuclear fusion power and his research. It was not the most hospitable environment – and Dr. Siegel, only 52 years old, *died of a stroke, in the hearing*, before he could complete his testimony before the American people.

Since that day, almost 40 years ago, our progress toward controlled fusion has slowed to a crawl. And the clock keeps ticking toward doomsday.

Oh, our government has spent billions over those years, creating the Department of Energy Organization Act of 1977, combining efforts of a host of organizations and experiments, and consolidating all of it into the U.S. Department of Energy (DOE). Well-meaning and all, but almost every bureaucracy grows large, complex and grinds exceeding slow.

Since 1999, the NNSA, a DOE sub-agency, has controlled nuclear stockpile stewardship programs, spending roughly $11 billion a year watching over the huge pile of nuclear weaponry, which we thankfully have never used and have no intention of using unless provoked unavoidably.

Isn't it obvious? If we spent far less than that, say $1 billion a year – *we could create a nuclear fusion supply of energy for us and the whole world!* Might that not be a better peacekeeping program than continuing to store enough weaponry to destroy mankind?

If our government saw the light (no Einstein pun intended), it could retake the lead in fusion development. But it's not going to happen. The Obama administration, while adding trillions to our national debt in other areas, is trying to force DOE cutbacks, shutting down MIT's fusion program altogether in 2013, halting work for the 100 highly trained staff members and 30 graduate students. A letter from directors of MIT, Princeton Plasma Physics Laboratory, and General Atomics, with other U.S. fusion scientists, stated: "If implemented, the $49 million cut will result in the layoff of hundreds of fusion scientists, engineers, graduate students, and support personnel" and "will demote the U.S. program to a *second-tier player* in the world fusion effort."

We move to the back of the bus.

Meanwhile, China, seeing an incredible opportunity to control energy forever, has mandated that its University system graduate 2,000 Ph.D.-level scientists specifically in high energy physics and plasma fields to build China's already robust internal *fusion* development programs. Do you get it now?

In my fifth article, "There is Hope for the World," I mentioned scientists coming together at a workshop. In December 2011 a presentation was made by Los Alamos National Laboratories physicists on a very promising branch of fusion called Pulsed Jet Magneto Inertial Fusion or PJMIF. This may be a migration path to lower-cost fusion as the LANL presentation included a budget and time line for a Demonstration PJMIF power station at a cost less than $1.5 billion and in 15 years.

Guess what? Just a few days ago, April 27, the physicists were informed by the Office of Fusion Science Energy (DOE), their project is *canceled effective May 31!*

This, just as Lawrence Livermore National Labs National Ignition Facility (NIF) is making breakthroughs using lasers to compress hydrogen in pellets using pulsed power – Dr. Siegel's vision! NIF is close to fusion "ignition," the brief but sustained release of energy resulting from the fusion process. In a recent meeting, the director of Laser Fusion Energy and Photon Science at NIF, Mike Dunne, told my friend Tom Tamarkin: "Ignition is the point at which the fusion fuel no longer needs an external source of energy. It's like kindling to a long-burning wood fire, necessary to get it started … after which the fire no longer needs the ignition. …"

Friend, fellow citizen, America – and indeed, the world, the earth and its people – hangs in the balance. Two choices. We as an informed and aroused citizenry can prevail on our leaders who have billions and trillions of our tax money to direct, to get back on track and push America to the head of the line, so that *we* control future energy, not China. Or we must reach our industrial leaders, the actual geniuses who birthed and grew the Internet, cellular communication, atomic energy, supersonic travel to the moon and outer space … with and without governmental help. It's up to us. Social media like Facebook's energy awareness can help.

I believe in the latter course. It's reliably estimated now that less than $30 billion expended over 10 years, with our already proven scientists and techniques will bring nuclear fusion to the world; some say less than $10 billion.

Other governments are moving diligently to do it; ours likely won't. Bill Gates and Warren Buffett together could do it and still have billions left over. But will they?

"Now is the time for all good men to come to the aid of their country." Which of our good and capable visionaries will come to our aid, while there's still time?

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