BREAKING THROUGH EDITORIAL

Manhattan or Kyoto

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In the July 2007 issue of the journal *Physics World*, Chi-Jen Yang, a prominent member of the International Affairs Department of Princeton University, wrote about tackling global climate change under the headline "Manhattan versus Kyoto."[1] (*Physics World* is the membership journal of the British Institute of Physics.) The first paragraph of Yang's article reads:

> In advance of the G8 summit held in Germany last month, U.S. President George Bush reiterated his view that to tackle global climate change is through technology, rather than by regulating emissions of green house gases. . .He is not alone in this view. Indeed political leaders of all persuasions, including U.S. Senators Hillary Clinton and Charles Schumer, as well as many scientists, are arguing that global warming can only be solved through a crash research and development programme similar to the Manhattan or Apollo projects.

The Bush administration is unlikely to launch a Manhattan project, addressing energy, during its last year in office. For the time being we will have to live with the Kyoto protocol, a political approach which does not preclude major advances in new energy research. In the long run, however, a Manhattan-type of R&D program deserves serious consideration.

The words Energy Crisis assumed their threatening connotation when the Arab nations imposed an oil embargo in 1973. Gas lines formed overnight in the United States and other countries of the western hemisphere. Petroleum prices rocketed and the news media suddenly realized how dependent human society had become on the ready availability of fossil fuels in particular and energy in general.

There was much talk about alternative fuels and renewable energy sources. The U.S. government formed the Department of Energy with the cabinet position of a Secretary of Energy to marshal the scientific and economic resources of the world's leading industrialized nation and make America independent of foreign oil. The bureaucracy has been in place for some time, but its performance has been disappointing. Man went to the moon, proudly demonstrating his technological skills, while most electric power plants are stuck with coal, oil, and natural gas combustion. It seems to have been the co-coordinated and intense Apollo program which made the difference in succeeding with a new technology.

In recent years the energy crisis assumed a new dimension in the form of global warming. A majority of scientists now believe that environmental temperatures all over the globe increase at an alarming rate which ultimately will endanger the existence of the human race. The cause of global warming, and associated climate changes, is said to be an accumulation of carbon dioxide and other greenhouse gases in the atmosphere. They may be responsible for retaining more of the energy that arrives from the sun than the amount of energy that is radiated back into space.

It is argued that the annual production of carbon dioxide on earth has to be reduced by 40% to stabilize global temperatures. This is about the amount of carbon dioxide exhausted by all the fossil fuel burning electric power plants worldwide. Our civilization without electricity is unthinkable. The best answer to the energy crisis is to drive the electricity generators of the world with water. It would be wrong to call water a fuel because it does not burn carbon, but there is plenty of usable energy stored in the hydrogen bonds between water molecules.[2]

The success of the Manhattan project was, in no small measure, due to the well-defined objective of producing an atomic weapon based on the experimental discovery of nuclear energy. Today—in the energy field—we have to make a choice between different scientific discoveries which have opened separate avenues to new sources of energy. The best choice of a particular line of energy research to be pursued by a Manhattan-type organization is by no means obvious.

The Kyoto protocol has the great advantage that no choice has to be made. All reasonably economic energy sources, not involving fossil fuels, are acceptable. Energy conservation measures are equally attractive. In fact it is not necessary to develop new technology, but innovation must not be ruled out. A mix of renewable energy from wind turbines, photo-voltaic cells, solar heating, geothermal power, and biomass fuels can certainly be used. The expansion of existing technologies, without the imposition of taxes on the populations of the world, to pursue research is a great

incentive of the Kyoto treaty. It should be continued and strengthened even if one or more Manhattan enterprises to develop new sources of energy come into existence.

The problem with Kyoto is that after a few decades it may become clear that all the voluntary measures, nurtured by public opinion and government encouragement, fell short of arresting global warming and did not lead to oil independence. The worldwide enthusiasm which now upholds Kyoto may ultimately wane, because it requires too many small sacrifices. The voluntary contributions to the Kyoto system by industrial nations may then appear to be an idle burden. In that case nobody may be able to control the ever-growing energy crisis. If this should happen, the Manhattan approach becomes mandatory.

Controlled thermonuclear fusion received generous support from the U.S. government for at least 25 years. For all practical purposes the fusion reactors, known as tokomaks, represent a Manhattan project. This effort has been bogged down by technological difficulties of confining deuterium and tritium plasmas in a metallic vacuum chamber. It has not stopped a consortium from going ahead with the building of an International Thermonuclear Experimental Reactor (ITER) at Cardarache, France, at a cost of $10 billion.[3] Contributions to this project are made by China, the European Union, Japan, Russia, South Korea, and the United States. Energy researchers at large around the globe are skeptical of the future of ITER. On the other hand, the project does demonstrate that the lobbying power of a large body of scientists and engineers can mobilize national governments to spend billions of dollars on a scientific venture.

Apart from controlled thermonuclear fusion, there are, in my opinion, three other new energy proposals ripe for consideration as Manhattan projects. Dr. Randell Mills, the founder of BlackLight Power, Inc., in New Jersey, claims that he gains heat and electromagnetic radiation energy from the conversion of hydrogen atoms to what he calls hydrinos. This is a new brand of atomic particles which are not compatible with quantum mechanics. In this class of atoms the single electron of the hydrogen atom orbits the proton nucleus at a shorter distance than what is said to be the ground state of the hydrogen atom. Therefore the hydrino atom stores less potential energy than an ordinary hydrogen atom. The difference in energy is liberated as heat or radiation energy in the transition from the ground state of hydrogen to the lower hydrino state.

BlackLight Power asserts that they have proved the hydrino production with a number of experiments which have been successfully repeated in several competent and independent laboratories. The generation of more heat energy than the electrical energy expended in these experiments is treated as confirmation of the hydrino hypothesis. The BlackLight experimental results have been published in several scientific journals over a period of 15 years. Since no contradiction of the energy gain measurements has been forthcoming, it seems proven that Randell Mills' new energy technology is producing the claimed results. Whether or not this confirms the hydrino theory is of no practical consequence.

The other two candidates for Manhattan support have been extensively discussed in our *Infinite Energy* magazine. They deal with (1) the Pons and Fleischmann cold fusion phenomenon, and (2) the liberation of hydrogen bond energy from water.

Eighteen years after the famous Utah press conference, cold fusion is now usually referred to as low energy nuclear reactions[4] or condensed matter nuclear reactions.[5] After the initial announcement by Pons and Fleischmann, the physics establishment and U.S. government scientists said cold fusion reactions were scientifically impossible. Eugene Mallove, the founding editor of our magazine, and others called for a second look at cold fusion. This challenge was taken up by many scientists around the world and has given rise to 13 international conferences. The latest of these conferences (ICCF13) was held in June 2007 at Sochi in Russia.[5] The large number of energy researchers who have contributed their experimental and theoretical findings to these conferences have established that cold fusion produces excess heat. This heat represents a new source of clean energy which consumes heavy water of the oceans. Some of the best experiments have been performed by Dr. Mitchell Swartz, as reported by Chubb and Frazier.[6]

Twenty-three years of experimental research of water arc explosions have led to the gainful liberation of hydrogen bond energy from water. This research has been summarized in a booklet *Unlimited Renewable Solar Energy from Water* (available from *IE*).[2] It describes the work of research teams at the Massachusetts Institute of Technology, Oxford University, and the Hathaway Consulting Services Laboratory in Toronto, Canada. Nine peer-reviewed papers from physics and engineering journals are reproduced in the booklet.

Experiments with water arc driven turbo-generators of electricity have been started.[7] It is now clear that the development of suitable pulse turbines for the collection of hydrogen bond energy is a major technology challenge requiring substantial R&D funding. A Manhattan-type approach to solving the pulse turbine problem would offer a chance of arresting global warming and make the United States independent of foreign oil. We must not ignore the plentiful and benign chemical energy stored in ordinary liquid water which is available, almost everywhere on earth, free of carbon dioxide and other greenhouse gases.

In the past 12 months, an exciting new aspect of water science has come to the fore. The tensile rupture of hydrogen bonds, which requires far less energy than the thermal rupture of the same bonds by evaporation, can also be produced by viscous drag on the water surface. On further reflection it was found that this drag mechanism is likely to liberate most of the water energy which drives hurricanes.[8] Large amounts of water being pushed through the turbines of hydroelectric plants are probably subject to similar drag forces which rupture hydrogen bonds. The energy released by these unexpected bond ruptures may help to drive the turbines and increase their overall efficiency.

On examination of the published[9] efficiencies of hydroelectric turbines it was found that for large turbines this is quoted to be as high as 85-95% percent. It is far superior to the efficiency achieved with steam turbines of fossil fuel driven power stations. There exists a possibility that hydrogen bond energy contributes to the measured efficiencies and already generates some of our electricity. If this happens unintentionally, the effect can probably be enhanced by engineering design.

Furthermore, it came as a surprise to find that the gravi-

tational energy of water driving hydroelectric generators is so much smaller, per unit volume of the liquid, than the potential energy stored in the weak hydrogen bonds of the same volume of water. The gravitational head of a hydroelectric plant is the height of the top of the dam above the inlet of the turbine at the bottom of the dam. In existing plants this is usually less than 1,000 m. One liter of water has a mass of one kilogram. Then with a head of 1,000 m, the water stores 9,810 J of gravitational energy or approximately 10 kJ/kg. Compared to this, the hydrogen bond energy stored in one kilogram of liquid water is likely to be of the same order as the latent heat, or 2,360 kJ/kg, which is more than 200 times as large as the gravitational energy. If only a very small fraction of the hydrogen bonds passing through the turbine is ruptured to set their bond energy free, it could easily double the energy available in the turbine to drive the electricity generator. This stunning result demands a major investigation of what is actually happening in existing hydroelectric plants.

Here is what we know now. Three quantities have to be measured to determine the efficiency of a hydroelectric installation. First, the gravitational input energy is a function of the height of the dam above the turbine and the mass flow (kg/s) through the turbine. Normal means of optical surveying will deal with the gravitational energy per kilogram of water. The mass flow can presumably be measured with flow meters in the inlet pipe (penstock) of the turbine. The gravitational energy input is the product of the mass flow and the head of water. Secondly, existing instrumentation of the power plant tells us reliably what the electrical energy output is. Thirdly, to calculate the overall efficiency it has to be known how much kinetic energy is carried away by the effluent of the water turbine. This latter quantity is very difficult to determine because every drop of water leaving the turbine may travel in a different direction with a different velocity! So how have the published efficiency figures been justified?

The chances are that in some of the efficiency determinations the energy discharged in the form of water kinetic energy has simply been ignored. If this is true, then the 85-95% efficiencies are an underestimate. It is not impossible there exist cases where the allowance for discharged energy may drive the efficiency figure over 100%. This would not be acceptable because it violates energy conservation, unless an unknown energy source comes into play in the rotating turbine.

How could something as important as hydrogen bond energy liberation in water turbines have been overlooked? The blame lies with the chemistry textbook writers and teachers. After the discovery of hydrogen bonds by the famous American chemist Gilbert Lewis in 1923, the chemistry establishment simply failed to explore the effects which hydrogen bond energy has on chemistry experiments and how it may be related to the latent heat of water. This historical omission, in 2007, gives us the opportunity to introduce a "new" source of energy.

Recognizing the inevitability of hydrogen bond rupture in water turbines, every effort should be made to exploit this discovery for electricity generation. The first task is to investigate how turbo-generators can be modified to double their electrical energy output for the same gravitational energy input. Should a concerted R&D effort be successful in attaining this objective, it becomes feasible, worldwide, to increase electricity generation by about 10% without any major civil engineering work and any changes in the means of water collection and storage. This would outstrip the benefits that can be gained by future installations of wind turbines.

How can the turbine adaptation to bond energy liberation be approached? As the hurricane mechanism suggests,[8] we should encourage viscous drag between the water and internal turbine surfaces. The streamlined design of the popular Francis turbine has the opposite aim of achieving smooth flow conditions which are expected to reduce turbulence and foster efficiency. Sharp edges and uneven surfaces cause the breakage of hydrogen bonds and set up flow losses. The question arises what is greater, the bond energy gain or the flow energy loss?

An alternative to the upgrading of hydroelectric turbo-generators is to drive the water turbine with an electric motor. The turbine would then have to be supplied with water from a river, or lake, or even the ocean. The purpose of the drive motor would be to furnish the tensile energy it requires to break hydrogen bonds. This should liberate bond energy and torque for stepping up the electrical energy of the generator.

Before dreaming further, I would like to consider how hydrogen bond energy research could be organized within the Kyoto and the Manhattan frameworks. Success with the new water technology would benefit society at large and not just a small sector of industry. Nothing is likely to happen if we simply hope that commercial incentives and the profit motive will set technology research in motion. The first paper entitled "Gaining of Energy from Ordinary Water"[2] was presented at the World Renewable Energy Congress IV in June 1998 in Denver, Colorado. This paper was recommended for presentation to the congress by a scientist from the U.S. Department of Energy. The U.S. government, therefore, has known of the availability of hydrogen bond energy from water for at least nine years. The Congress venue was chosen because of the vicinity of Denver to Golden, Colorado, where the National Renewable Energy Laboratory (NREL) is located. The conference organization was largely in the hands of NREL scientists.

It is easier to arouse interest in a new energy science than to stimulate the development of means of utilizing the new energy. A number of individuals have taken up experimenting with water arcs, but not with the development of fog turbines or reciprocating engines in mind. Water science and water technology require very different backgrounds and skills. It does not help that turbine engineers are not familiar with basic chemistry and the concept of stored intermolecular bond energy. In fact, many chemists do not know of the existence of hydrogen bond energy. Choosing between the Kyoto protocol and the Manhattan approach does not appear to be an immediate problem.

This reluctance to move forward enthusiastically in the energy field is not new. Take wind turbines for an example. They seem to be breaking new ground at the beginning of the twenty-first century. Their ability to drive mills and water pumps has been known for centuries. New life into wind turbine research was instilled by the 1973 energy crisis. It has taken 30 years to finally produce significant practical applications.

At present the Kyoto protocol depends largely on energy

conservation measures and CO_2 disposal technology. While energy conservation measures are making inroads internationally with, for example, hybrid and electric cars, no effort seems to be made to promote research on entirely new sources of energy. No indication has come to light which shows that the Kyoto protocol encourages such developments. There appears to be no good reason to argue against the Kyoto program, but it lacks the promise to lead to novel energy sources which could replace all fossil fuels for electricity generation.

Drastic and far-reaching methods of halving the worldwide emission of greenhouse gases into the atmosphere may have to wait for a Manhattan-type effort. This is most likely to be launched by the government of an advanced industrial nation. Before this could happen, a powerful group of scientists, engineers, and business executives have to collaborate in canvassing appropriate government agencies for supporting such a Manhattan-type project.

Even during wartime and the dire need for advanced weapons, it took several years to convince President Roosevelt to start the Los Alamos laboratory. Successful lobbying requires public awareness. The news media have to do their part in educating and stimulating the public and, ultimately, apply political pressure on the government.

What kind of research team would it take to make the case for water-based hydrogen bond energy? It would certainly require some chemists to prove to their own profession and others that there is plenty of hydrogen bond energy stored in ordinary water and that this kind of energy can be liberated in a variety of ways. The bulk of the development will have to be done by mechanical engineers who specialize in turbine design. Finally, it will require electrical engineers who are familiar with water arc explosions and can deal with generators and power transmission technology. A team of this composition could draw up proposals to be made to the U.S. Department of Energy comprising the National Renewable Energy Laboratory with a staff of over one thousand. The team could also write explanatory articles for the press and television to garner public support for the project.

Unless NREL would make its ample facilities in Colorado available, the most likely institutions which could host and administer a Manhattan energy research team would be universities. Once the funding has been assured, team members could be housed under one roof in a separate research institute. The hydrogen bond energy group would be far smaller than Los Alamos. Everybody concerned could be proud to serve a humanitarian cause.

We have the urgent call from the United Nations to parry the global warming threat. Foreign oil independence remains a cherished goal of the U.S. government. A new and plentiful clean energy source has already been found in common water. There is enough of this water energy to drive all the electricity generators in the world. No great economic and environmental hurdles stand in the way. Being renewable, the water energy permits population growth and improved standards of living. There is no reasons to delay!

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