Strategic Technology Institute

From the Archives –

Energy Alternatives

By Blake White

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It does not require a clever brain to destroy life. In fact any fool can do that.

But it takes brains -and extraordinarily brilliant brains -to create conditions for human happiness and to make life worth living.

-Kwame Nkrumah

Speech at the Academy of Sciences Accra November 30, 1963

Industrialized societies rely on cheap energy in much the same way as humans require air. Every facet of our daily lives, from our toasters to our factory jobs and our precious automobiles, are inextricably linked to energy sources. In America, the cheaper the energy the better. With this fact established it is no wonder that we have grown to despise those who would raise the price of say, crude oil. Our Arab, Nigerian and South American contemporaries who regained control over their sovereign birthrights - the oil under their lands -sought to use these resources to boost their national economies and influence the policies of the "Developed" countries. Their creation of OPEC (The Organization of Petroleum Exporting Countries) caused America to view itself for what it is -an energy addict -and the Third World let us know that they were the only suppliers in town.

It was America's addiction to cheap oil that put us in such an embarrassingly dependent position and it was OPEC that taught us a lesson with their 1973 and 1979 embargoes. As a result, we consumed less imported oil (the United States having dropped imports from 8.4 million to 4.5 million barrels per day), we downscaled our cars, put more emphasis on conservation and mass transit, replaced our industrial energy sources, improved the efficiencies of our machines, homes and factories. We sought out lighter materials, upgraded equipment, and insulated homes. More importantly, OPEC forced a worldwide, multi-year recession, which in turn kept us from wasting energy in the amounts or ways in which we were accustomed before their price increases. They also evoked a vow from Americans that we would never again be so hooked on external energy sources nor would we use so much in the first place.

How soon we forget!

Alarming signals are being sounded throughout our economy. These signals are not as overt as gas lines or big fin-equipped cars; indeed they are quite subtle. As OPEC scrambles to save their cartel we see what is apparently an oil glut. Oil prices are beginning to drop, albeit slowly, and OPEC's poorer countries continue to break ranks with the richer ones (such as Saudi Arabia) by lowering prices, further weakening the cartel.

What is America's response? Instead of remembering our vow of independence and energy thrift we once again take the short-term view and follow market prices. Concentrating on market prices, reflecting only immediate supply prospects, has caused the shortsighted leaders of our economy to become apathetic with regard to energy threats. Consumers are also becoming complacent conservers and domestic energy producers are increasingly hesitant to invest in alternative sources. Recently a Big Three automaker alluded to American consumers' returning demand for big cars and as such they could potentially see a retooling to meet that demand. Ridiculous! The American auto manufacturers barely escaped death from the Japanese competition in the small car market with help from a protectionist government and corporate bailouts in the form of billion dollar loans at taxpayers' expense. Are they so ignorant (or is it just arrogance) that they fail to heed the warnings of the past decade? Big cars are out! High energy consumption is out!

We must not be fooled by temporary oil gluts. Our commitment to energy independence and conservation must be reinforced and as such America must not be lulled into ignoring our vulnerability as we seemingly have by our abandonment of funds for energy related research and development. Our rapid growth in government-sponsored research that characterized the 1970's has come to an end, dragged down largely by reduced efforts and by the Reagan Administration's budget cuts for the U.S. Department of Energy.

Indeed the entire Western world's investments have decreased. The International Energy Agency (IEA), which includes the U.S., France, West Germany, Italy, the United Kingdom, and Japan, to name a few, increased energy R & D funding by 14 percent between 1977 and 1978, by 11 percent in 1979, and by only 6 percent in 1983. Since the U.S. accounts for over 48 percent of the total spent by all IEA countries, it is obvious that the Administration's return to the glory days signifies unwise complacency. Make no mistake about it; the U.S. considers energy important enough that is justifies war; why forget its importance in the budget? This is a problem that will not solve itself. Disregarding our commitment prepares us for a very rude awakening.

Have we forgotten that with only 6 percent of the world's population, the U.S. currently consumes over one-third of its energy? Even the energy consumption in other highly developed nations pales in contrast to America's. In Sweden and West Germany, for example, per capita consumption of energy is only half that of the U.S. even though their standard of living is comparable to ours. The U.S. consumes more energy annually than all the countries of Western Europe combined, even though their population exceeds ours by 75 percent. Our energy flow-through was more in 1970 than the world's four other consuming nations combined -the Soviet Union, Japan, West Germany, and Great Britain.

When America's energy consumption is compared to that of poor Third World nations, the figures become so disparate that comparisons become practically obscene. How do we justify the relative energy advantage of the U.S. when a country like Haiti consumes the equivalent of only 68 pounds of coal per capita per year, while the equivalent American consumption is 23,000 pounds per capita annually? How can we possibly forget that our consumption of electricity for air conditioning during the three summer months alone accounts for more than that of all the electricity needs of the People's Republic of China during the same period? And, China has four times the number of people!

If this weren't bad enough, consider how we waste all that energy. Most automobile engines are only 15 percent efficient; turbines are 30 percent, jet propulsion engines 65, and fuel cells 80 percent efficient. Due to inefficiently designed equipment and buildings, the overall mechanical efficiency of the U.S. economy in the 1980 was only 5 percent. We waste 95 percent of the energy we consume! 5

In addition to our inefficient systems, we are inherent burdens upon global society. Every engineer knows that the ratio of energy output to input expresses efficiency. 6 On a global scale, this means that every human owes the Earth the commitment to minimize the input of energy while maximizing his or her contributions to society. Otherwise, that person becomes a global burden. Well, the geologist Francois de Chardenedes wrote a scenario of the technology of nature's production of petroleum. It derived the cost to the world of a gallon of oil. He disclosed that the energy employed by nature as heat and pressure for the amount of time required to produce a gallon of oil, if charged at the 1980 market prices, would cost well over a million dollars a gallon. Combine that information with the discovery that approximately 60 percent of employed Americans are working at tasks that are not producing any life support and you can see why Buckminster Fuller claims that we do more benefit to the environment to pay all present jobholders a billionaire's lifelong $400,000-a-day fellowship to stay at home. After all, we each spend $4 million a day to commute to work and our jobs are typically inspectors of inspectors, jobs with insurance companies that induce people to bet that their homes are going to be destroyed by fire, underwriting of insurance underwriters by other underwriters, people checking up on one another in all the departments of the Treasury, Internal Revenue Service, CIA, FBI, and GSA. 5 Americans cost more to the world than we return in beneficial services. If it weren't for food, medicine and educational exports we would be totally parasitic.

America's energy dependency will continue to increase, as will the rest of the world's. The Department of Energy projects world energy demand to increase by 58 percent, reaching 384 quads (quadrillion British Thermal Units) by 1990. Per capita energy consumption is projected to increase everywhere. The largest increase, 72 percent, is in the industrialized countries other than the United States. The smallest increase, 12 percent, is in the centrally planned economies of Eastern Europe. The increases for the U.S. and Third World are the same, 27 percent, but actual per capita energy consumption is quite different. By the year 2000, U.S. per capita consumption is projected to be about 422 million BTU (British Thermal Units) annually, where the Third World's consumption will be only 14 million BTU, up from 11 million in 1975. 7 And, as this drastic demand increases, so will fossil fuel prices.

While prices for oil and other commercial energy sources are rising, wood - the poor person's oil - is expected to become far less available than it is today. The Global 2000 Report to the President, Commissioned by the Carter Administration, ignored by the Reagan Administration, and written by the Council on Environmental Quality and the Department of State estimates that the demand for firewood in the Third World will increase at 2.2 percent per year; leading to local firewood shortages by 1994 totaling 650 million cubic meters -about 25 percent of the total need. Scarcities are now local but are expanding. In the arid Sahel of Africa, firewood gathering has become a full-time job requiring in some places 360 effort-days of work per household annually. Where demand is concentrated in cities, surrounding areas have already become barren for considerable distances -50 to 100 kilometers in some places.7 Urban families, too far from collectible wood, spend 30 percent of their income on wood in some West African cities, just as poor Americans spend 30-40 percent on fuel during the winter months. 8

The energy problem is still with us. Don't let temporary oil gluts fool you. It sure seems to make sense that we confront it now before the real crisis arises.

As we begin to address our energy alternatives, we must beware the trap of believing so religiously in the power of science. Indeed, science and technology are clearly integral components of any short or long-term solution, however, the nature of our energy problem transcends pure technology. We cannot expect to continue to use energy in the same obscenely wasteful ways and wait for technology to save us in the nick of time. Our solution must include technology but more importantly we cannot escape the reality of our social, political and economic institutions and our individual and collective conservation habits (or lack thereof). Any solution will require both sides of our brains: the linear analytical left and the humanistic right. Science and technology can't do the job alone but they can be indispensable aides.

The way in which technology can help this crucial situation is by giving us viable alternatives for supplies and conservation. The choices are typically tough ones, with negative consequences inherent in each and die-hard advocates and opponents dogmatically standing their ground. From the extreme optimism of Buckminster Fuller, who sees a transition to a worldwide network of power stations, hydroelectric and solar in nature, by which our entire worldwide economy would be based upon the value of the sun's energy; to the pessimism of Jeremy Rifkin, who contends that because of the Entropy Law (energy always moves from an available to an unavailable state) we cannot avoid totally exhausting all energy sources; to the narrow mindedness of those who advocate abandonment of all modern lifestyles in favor of returning to an agrarian existence; to the pro-nuclear forces who claim that there are more health hazards by not converting to nuclear power, it becomes very fuzzy as to which alternative is best.

It is clear that technology can improve our chances of finding and conserving the precious little oil we have. Improved scientific geological methods and satellite surveys can be expected to enhance drilling operations but as Robert Stobaugh and Daniel Yergin state in the conclusion of their Harvard Business School Energy Project report:

"There is little likelihood of a substantial increase in the production of domestic oil and gas. U.S. oil production will almost surely decline, and the nation will be fortunate if natural gas output remains at current levels. Entrepreneurs have searched the continental United States for so long (more than 120 years), and so thoroughly (over 2 million wells), that is would be foolish to base a national policy on the supposition, advanced by some forecasters, that the absolute quantity of oil and gas will increase beyond what it is today." 9

So, we better not put our faith in oil. With the 58 percent global increase in demand for oil by 1990 and the proven advantages of oil as a transportable fuel, the remaining supplies will be subjected to political conflict and pressure. 7 In this context, the Middle East will be joined by hotly disputed offshore territories such as Spitzbergen (Norway and the Soviet Union), the Aegean Sea (Greece and Turkey), and as we have already seen, the Falkland Islands (Argentina and Britain).10 A wise energy strategy would de-emphasize oil and emphasize other technological resources.

Coal-Based Synthetics

Among the new technologies that provide alternative energy sources is synthetic oil. Roughly 90 percent of the world's fossil fuel resources are contained in coal, tar sands, and shale.11 Barring some sort of breakthrough in other sources or technologies, it therefore seems almost inevitable that liquids from these sources will play a significant role in our energy future. Synthetic fuels from shale and tar sands have been put on hold while the technology of coal liquefaction proceeds in relation to coal's importance as the world's 80 percent recoverable resource base. This is especially important in the United States, since America has a plentiful supply of coal (at least for now). With these facts before us, it is easy to see why the two different approaches to coal liquefaction hold promise.

The first approach involves gasifying coal to carbon monoxide and hydrogen and then synthesizing hydrocarbons from the gas. This is the technology used by South Africa. The other method called EDS (Exxon Donor Solvent) requires the direct hydrogenation of coal by chemical means, rather than thermal, to produce liquid fuel. EDS is expected to be more thermally efficient and lower in cost than indirect liquefaction in the long run. Over the 15-year development history of EDS, a pilot plant now exists with a coal feed rate of 250 tons per day and plans for commercial plants are being considered. 11

Hydrogen

Two of Earth's most abundant resources - water and sunshine - may be combined to fuel machines, factories, homes, and all manner of vehicles in the future. The key to the process lies in the two atoms of hydrogen locked in each molecule of water.

Hydrogen gas has long been touted as a potential power source but the problem has been that it is extremely difficult to extract hydrogen from water in large quantities. But this may be changing, albeit slowly.12 In separate developments, scientists at the Lawrence Berkeley Laboratory in California and Texas A & M University have improved the existing method for splitting water molecules into their constituent atoms and yielding quantities of usable hydrogen gas. Both methods are refinements of the same basic setup: using semiconductor electrodes to photochemically produce hydrogen.

Christofer Leygraf, of Berkeley, uses a pair of iron oxide electrodes immersed in water. The water is charged by means of chemicals added to the system. Charging makes the water molecules separate. Next, the water is exposed to sunlight, which causes it to absorb more energy thus ionizing hydrogen and oxygen.13 The gases edge apart toward opposite electrodes and the water breaks down into two independent gases.12 The prototype system can easily produce four liters of hydrogen per hour but with an efficiency of only 0.05 percent.13 .

John Bockris of Texas A & M has developed a system that works on principles similar to Leygraf's. Based upon silicon, the primary component of today's microchips and photovoltaic cells, Bockris' method produces hydrogen at 13 percent efficiency and is touted as being competitive in price to gasoline, especially in the future. Bockris expects that his method could produce hydrogen at the 1993 equivalent of one dollar per gallon (relative to 1993 gasoline prices).13

Both hydrogen generation methods are promising but even the most optimistic supporters don't foresee commercial applications before the turn of the century.12

Geological Resources

Geological, or Earth-based, renewable energy supplies also hold optimistic promise. Geothermal, wind, and wave power are being seriously considered.

Geothermal energy derives from the internal heat of the Earth's core and is an attractive source for producing steam for power plants. Favorable regions for the exploitation of natural geothermal energy are those where the Earth's crust is thin or fissured, particularly volcanic regions. Steam fields have been established along the African rift valley, the Azores, Italy, the Balkans, the Middle East, Indonesia, India, China, and some of the Caribbean Islands. Small- scale commercial exploitation of geothermal energy is not new. Indeed, it dates back to Italy in 1904, Iceland in 1928, and New Zealand in 1958. By 1974 about 1,200 megawatts were generated worldwide by geothermal sources with the main emphasis in countries like Iceland concentrated on space heating and hot water production. About 60 percent of Iceland's population uses steam heating in district schemes and that number is expected to increase to 90 percent in the near future.10

According to the World Energy Conference, naturally occurring geothermal resources may amount to the thermal equivalent of 150 billion tons of coal to a depth of 10 kilometers. About four percent of this total can raise steam of sufficient quality to produce electricity. Because of advances in oil drilling technology, there should be no problem in reaching these supplies.

Windmills could conservatively provide up to 20 million megawatts of electricity and have been shown to be technically feasible and economically attractive. Advances in helicopter rotor design make wind power's contribution in certain remote localities, where the cost of conventional electric power lines is high, a permanent blessing.10

Wave power can be considered the hydraulic derivative of wind. Although no assessment of total exploitable world resources of wave power appear to be available, a recent report indicated that some 900 miles of wave generators off the north-east coast of Scotland would produce sufficient energy to meet about half of Britain's electricity requirements.10 Similar extrapolations may be drawn for other coastlines around the world from Japan to Hawaii, from Aruba to the Ivory Coast. However, many technical problems remain concerning the stability of structures in such hostile environments, the form of energy transmission, and dangers to shipping.

Tidal power, wave power's cousin, is driven by the gravitational forces of the moon and is estimated at being able to provide 64,000 megawatts worldwide. The Rance power station in France, others in the United Kingdom, the Netherlands, the U.S. and Canada provide small amounts of electricity but face potential problems. Such schemes which involve building large barges across wide estuaries could involve large, unforeseeable costs to the environment and are inherently inefficient due to the extreme fluctuation in tides.10

Hydroelectric Power

Hydroelectric power (HEP) provides turbine-produced electricity at upper limits of 90 percent, compared with a maximum of about 35 percent possible from fossil fueled plants. At present only 14 percent of the world's HEP potential is being exploited with the best sources, the most dire needs, and the least used potential concentrated in the world's poor countries.

The World Energy Conference estimated the 1974 resources as being quite abundant; however, capital costs are high, the building of dams leads to the evaporation of water (something the Third World is already short of), seasonal variations in water flow slow down volume going over falls, and HEP typically has distinct disadvantages as it competes with fishing, navigation and irrigation. 10

Waste Heat

Waste heat is wasted or useless only because it is not seen as economically practical to use it. As we further deplete our traditional supplies of fuel while we continue to produce waste, that waste will, sooner or later, become a practical energy source. The accumulation of wastes in an industrial society such as America, with our 160 million tons of garbage, if burned efficiently, could produce 10 million kilowatts or 2.5 percent of the U.S consumption of electricity. 6

Solar Energy

According to the World Energy Conference, the solar energy reaching the Earth's surface each year is thermally equivalent to 130 trillion tons of coal, four orders of magnitude greater than the world's commercial consumption each year. With two-thirds of this amount being absorbed or reflected back into space, it is not surprising that our future renewable supplies of energy must be derived from the inexhaustible (on a human scale) supply of sunlight. 10

Solar collectors can convert sunlight directly into electricity by using semiconductor technology in a process known as photovoltaic conversion. These devices can be made from the world's most abundant mineral, silicon, and have steadily improved in efficiency as new models have been developed.

Nuclear Energy

Perhaps no debate occupies the American scene today as much as nuclear power - with the obvious exception of nuclear weapons. The proponents and opponents argue their points of view vehemently, are armed to the teeth with statistics and conflicting scientific experts, and evoke the fears of the general public. Talking to any of them is typically a one-sided conversation with the truth lying somewhere between their extremes.

It is true that nuclear power has the potential for being one of the least expensive methods of producing large commercially available supplies of electricity. The possibilities of energy from nuclear fission grew directly out of the discoveries of 20th century physics. A naturally occurring isotope Uranium 235 (U-235), occasionally splits into two portions emitting considerable energy, as well as two or three neutrons, which can in turn be made to split further U-235 atoms. Natural or enriched uranium are the fuels for so-called fission reactors, which ultimately drive steam turbines to produce electricity. 10

Nuclear fusion power is the reverse of fission. Instead of splitting apart one nucleus, as in fission, fusion slams together (fuses) two nuclei from different atoms. This is the same process that is constantly taking place in the Sun, releasing the life sustaining energy that we enjoy. It is also the basis for the immense energy unleashed by a hydrogen bomb. Scientists hope to harness this huge amount of energy by containing the explosion within a fusion plant.4 Fusion power is especially attractive because it is supposed to regenerate its own fuel supply and leave little, if any, radioactive wastes. Fusion holds the hope for the panacea - the cheap, inexhaustible, safe energy supply.

Well, the battle over nuclear power rages so violently that benefits are forgotten; so are hazards. The nuclear industry is quick to point out that nuclear waste radiation from plants is well below "officially acceptable limits." Who are they kidding? When you lie down in bed with a dog you can expect to get fleas. I contend that those who set the "official" limits are philosophically, if not monetarily, in league with the utilities industry. They hardly ever consider the real health aspects of such decisions.

The anti-nuke fanatics are no better. Their objectivity is equivalent to paranoia. They claim that any radioactivity is too risky and therefore the whole technology should be scratched. They, albeit correctly, assert that one radioactive particle invading one cell is enough to cause cancer. They conveniently ignore the radiation from the Sun that constantly bombards them.

My point here is one of the irrationality of both sides of the nuclear argument. This irrationality will be the death of a potentially valuable technology.

The anti-nuke ignorance and paranoia is fueled by the absolute greed of those who propose reactors. It will take more than the anti-nukes coming to an understanding that the radiation of 'which they are afraid occurs naturally in the environment to give nuclear power a fighting chance.14 Nuclear power must be freed from greed.

Because of the greed of hundreds of subcontractors working on a particular nuclear plant, the facility too frequently suffers from slipshod, cheap, substandard materials. In an effort to meet budgets that were sometimes knowingly low-bidded just to obtain the contract and make extra profits at the consumers' expense, contractors are giving nuclear power a bad name. They scan the engineering blueprints, build with concrete that crumbles, use smaller pipes than specified, and their construction workers take liberties with the quality of welds.

Jim Mintz, reporting for the American Association for the Advancement of Science's popular journal, *Science 83*, claims that engineers and contractors are the ones sinking nuclear power, not fears of meltdowns. For example, Mintz, interviewing Nunzio Palladino, Chairman of the U.S. Nuclear Regulatory Agency, found that, at some sites:

* Reactor supports were built 45 degrees out of position.

* Backward blueprints caused earthquake supports and braces for a reactor building to be placed opposite their correct position.

* The concrete surrounding the core of a plant was honeycombed with air bubbles.

* A 420-ton reactor vessel was installed backwards. The error went undetected for months.

* Loose soil has caused the sinking of buildings.

The complete list is longer but we can summarize the data by noting that of 43 plants under construction in 1981, the NRC rated seven "below average" in quality, 36 "average", and none "above average". 15

Mintz notes that quality assurance at some plants is seen as just "window- dressing" for Washington. No wonder the opponents of nuclear power are paranoid.

This public paranoia is not merely concentrated on the issue of meltdowns for Three Mile Island type accidents. Genuine concern over nuclear waste is valid. When breeder reactors use up their fuel, radioactive wastes, such as Plutonium (the stuff bombs are made of) are generated. Such wastes must be transported and stored in permanent sites, ideally natural salt deposits. The genuine concerns revolve around transportation routes, the safety of containers, disposal sites, and security of the Plutonium after burial. These are reasonable concerns and the public is owed reasonable explanations and decision-making authority over these issues.

We must be technically literate enough to know that:

1. It is utterly untrue that no method of waste disposal is available

2. It is utterly untrue that nuclear power poses the greatest health hazard to the population

3. It is utterly untrue that nuclear power adds to the radioactivity of the Earth.

As to my first point, that of waste disposal methods, let me first state that the process I will describe is not being practiced now in the U.S. Instead, real dangers are mounting as nuclear wastes are being piled up on the site of the plant. They are not being disposed of at all!

Ideally, a fuel rod containing uranium oxide pellets is replaced after about three years of service. The reason for its replacement is not that its energy is used up, but that the fission products block the flow of neutrons necessary for an efficient chain reaction. These rods are not only thermally "hot" but contain highly intense short-lived radioactive substances. The short-lived components are the dangerous ones, since their short lives are spent radiating away their energy more rapidly and in concentrated forms. (They are also dangerous for additional reasons - for example, iodine 131 is trapped by the thyroid gland, giving rise to cancer.) For this reason, they are placed in ponds onsite.

After the rod has cooled in the pond for at least 6 months, they should be taken to a reprocessing plant. Here they are cut up into small pieces and dissolved in nitric acid in order to extract the remaining fissile uranium and plutonium for recycling to produce fresh fuel. Only after reprocessing, with most of the uranium and virtually all of the plutonium extracted chemically by the acid, do there remain the high-level wastes, which are responsible for 99 percent of the radioactivity but one percent of the volume. (So we are talking about a small amount of highly radioactive waste).

The high-level wastes are solidified and sealed into a permanent boron-silicate container, which is itself sealed in a stainless steel container. After more years of radioactive cooling in interim facilities, the waste is buried in deep (1,500 to 1,800 feet) stable geological formations, typically remote salt beds, according to University of Colorado Professor, Petr Beckman.14

If these safeguards were followed, waste depository would be a mere headache, not a paranoid nightmare. If 100 percent of the U.S. power capacity were nuclear, the annual increase would amount to less than 100 acres. Love Canal's chemical dump was larger than that. Ah, but water could seep into the salt deposit. Well, the very existence of the salt over some 100 million years shows that no water has been present, or they would be dissolved by now. Terrorists or saboteurs? There certainly would be no better place for them than 1,500 feet below the surface, threatened by searing radioactivity if they penetrate the shielding, and stuck with no way of getting the wastes to the surface. 14

My second point - that nuclear power is not the most hazardous energy source - can be proven by examining the facts. America's power plants burn over 480 million tons of coal per year, about 913 tons per minute. Since Einstein's celebrated equation E=MC2 applies not only to atomic energy, but to all energy, a subtle message is hidden in it. Specifically, the absence of mass annihilation by coal and other fossil fuels means that the matter that goes in a plant must be exactly the same as that which comes out. Therefore, since no mass is destroyed, the 480 million tons of coal matter must end up somewhere: a landfill, the atmosphere, your drinking water, or your lungs. There are no exceptions to physical laws.

The smokestack of the typical 1,000-megawatt power plant emits:

- 600 pounds of carbon dioxide per second with an environmental impact through a Greenhouse effect of climatic changes;
- 30 pounds of sulfur dioxide per second, linked to lung, heart and bronchial diseases;

- As many nitrous oxides as 200,000 automobiles running simultaneously, producing photochemical smog and resultant cancers;
- 18 pounds of fine particulate matter passes through the filters. Such carcinogens, mutagens and toxins, some of which if sprayed in a jet can cut metal, is disposed of in your lungs.

According to Professor Beckman, since electric power generation accounts for 77.5 percent coal use, 37,293 premature deaths can be attributed annually to our current electricity production.14 So, energy production as we practice it now is an exchange of lives. We only haggle over the numbers. He further asserts, that when you consider that the 0.01 percent by weight of nuclear waste is actually radioactive and with remote burial, the victims of nuclear waste will be comparably negligible to the 37,000 victims of coal generated power.14

Finally, nuclear power does not add to the radioactivity of the Earth. The uranium is already here and already decaying. Since the real danger lies in being too close to concentrations of it, we should place our power plants away from people. Some schemes allude to floating them on ocean platforms or orbiting them in space. These methods probably won't come to fruition but we would be wise not to have a plant or a burial site in our backyard either.

It seems apparent that if the appropriate safeguards are taken with quality assurance enforced and proper profit motives managed, with further research on the effects of radiation, nuclear power might have a fighting chance.

The Case for Sanity

The energy mess that we face is of our own making but technology can help. The sane approach - one that respects people, puts the responsibility back on us, and eliminates undue vested interests - is being advocated by Robert Stobaugh and Daniel Yergin of Harvard and the staff of the Science Policy Research Unit. The approach suggested is an integrated, distributed one. In addition to advocating more funds for making nuclear power safe, finding more oil, using other forms of oil (synfuels), and exploiting our reserves of coal and natural gas, they say that no sane society would put all of its hope in one resource, or even a central supplier like big utility companies. They imply wind power, hydroelectric and solar collection as being feasible for either adding to consumer's supplies directly or incorporating a consumer's windmill generated power back into the overall electric grid, with a reduction in the electric bill for the consumer. They also advocate small, distributed sources, geared toward the specific needs of consumers in, say, remote areas where low grade geothermal, wood, waste, dung, passive solar, and solar collectors on homes are reasonable.9 Their point is one of using every available resource and the technology to make it "over the hump".

More importantly, they all emphasize conservation. The Harvard group is firm in their belief that "conservation is the principal additional energy source for the 1980's." They assert that by conserving, the U.S. can use 30 to 40 percent less energy than it currently does, with virtually no penalty for the way Americans live, with billions of dollars saved, a less strained environment, less dependent on OPEC oil, and more time to study nuclear energy. 9

This balanced perspective is the best approach to an insane addiction problem. Not only will America benefit by having alternative sources of energy, but it also will be forced to think conservation, which in the long run is immensely more beneficial. This balanced approach is especially important to low income, rural, and populations in developing countries since it stresses independence from big utilities. Some Americans spend up to 40 percent of their income on fuel during the winter months.8 Applying various technologies such as geothermal, wind, passive solar, and solar panels, in conjunction with traditional sources can reduce the overall cost and loosen our energy chains.

Resources

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Blake White is the Founder & President of the Strategic Technology Institute, a San Francisco Bay Area network of management consultants and futurists. STI provides technology assessment consulting, corporate development services, and online publishing with a focus on the business and societal implications of emerging technologies. He is also the publisher of ***Quantum Leap****, the journal and newsletter of the Strategic Technology Institute and is the author of* ***The Technology Assessment Process: A Strategic Framework for Managing Technical Innovation****, published by Greenwood Press.*