The Importance of Nuclear Energy in the Global Economy

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Aperture

This essay is addressed to the general public, environmental associations, students and scholars who want to be updated in this issue. With the price of crude oil affecting everything- from basic food prices, the cost of living and transportation- and the promising options of renewable energy, it is wise to illustrate "all those who need to know" about the importance of nuclear energy in the global economy. The main idea is to place "hot issues" in perspective and place the nuclear industry in the position it deserves. Because so much energy leaves only a small amount of manageable waste, Uranium has been called nature's gift to clean economic development. In contrast, fossil fuels waste is too large and unmanageable to be contained and must be dispersed into the environment. This is the main difficulty that we are facing today. In addition to provide clean, cheaper, electricity a dazzling array of nuclear technologies helps to improve medical diagnosis, protect livestock health, develop water resources (i.e. desalination), preserve food, promote agricultural productivity, cure human illness, enhance human nutrition, advance environmental science, eradicate virulent pest and strengthen industrial quality control.

"There is no more sensible alternative than Nuclear Energy if we really want to sustain our civilization".

James Lovelock. World leader in popularization of environmental issues.

Overview

In the Earth's atmosphere, the warming effect of "greenhouse gases" is an undisputed phenomenon. Without it the globe would be covered in ice. For thousand of years, a fairly constant level of greenhouse gases created the moderate environment in which civilization evolved. Over one third of human induced greenhouse gases come from the burning of fossil fuel to generate electricity, run factories, power vehicles and heat homes. In the next 50 years, the global population will use more energy than the total consumed in all previous history. Humanity faces a future of radical change- either in the way we produce energy or in the health of our planet. Fossil resources- coal, oil and natural gas- are being consumed so fast as to be largely exhausted during the 21st Century.

Nuclear Power Plants do not emit greenhouse gases. New reactor design, radiation safety and transportation and improved, more efficient mining, is placing nuclear energy back in the scene. The UN report on climate change is important because it is adopted by consensus, meaning countries to accept the underline science and cannot disavow its conclusions. While it does not commit

governments to a specific action, it provides a common scientific baseline for the political talk.

And even for those scientist who do not accept that the global climate is being changed by mankind, or who argue that mankind is incapable of taking the necessary steps to stop climate change, it should at least be clear that nuclear energy produces significantly less atmospheric pollution than burning fossil fuels.

Global Population on the Rise

We live in a world that is just beginning to consume energy; China and India are wining to Europe and America in the race of for "per capita" energy consumption. Of today's 6 and a half billion people, they represent about one third of the global population. In the next 50 years – as world population expands to 9 billions today's vast unmet human needs could multiply severely. According to studies and projections made by International Organizations, humanity will consume more energy than any record in previous history. Economic development is imperative not only to alleviate human misery but also to create conditions necessary to stabilize global population. In much of the developing world a surging drive to meet these needs is generating an enormous rise in the use of energy. By 2050, global energy consumption will double.

Humanity cannot go backwards. A burgeoning world population will require vast amount of energy to provide fresh water, energize factories, homes and transportation and support infrastructures for nutrition, education and health care. Meeting these needs will require energy from "all sources". But the world's energy "mix" must quickly evolve- away from indiscriminate use of fossil fuel. Reducing consumption of fossil fuel will preserve the environment- and irreplaceable resources- for future generations. Conceivably, tomorrow's mega-cities could function with few direct emissions- by using electricity, electrically charged batteries and fuel cells using electrically hydrogen. But electricity is only a way of distributing energy. *The key is to generate vastly expanded supplies of electricity cleanly*.

Realism about Energy

Clean energy from "new renewables" –solar, wind, biomass and hydroelectric power- deserves strong support. But the collective capacity of these technologies to produce electricity in the decades ahead is limited. The International Energy Agency projects that, even with continued subsidy and research support, these new renewables can provide only around 6% of world electricity by 2030.

Environmentalists have played a valuable role in warning that catastrophic climate change is a real and imminent danger. It is crucially important that they be equally realistic about solutions. Even with maximum conservation- and a

landscape covered by solar panels and windmills- we would still need large-scale source around-the-clock electricity to meet much of our energy needs.

This is why nuclear energy is important to countries that do not use nuclear energy themselves. We all share the same planet and we should encourage large industrialized countries to use clean nuclear energy in a safe manner as a means of limiting global pollution.

Nuclear power- like wind, hydro and solar energy- can generate electricity with no carbon dioxide or other greenhouse gas emissions. *The critical difference is that Nuclear Energy is the only option to produce vastly expanded supplies of clean electricity on a global scale*. Far from being competitors, nuclear power and new renewables' are urgently needed as partners if the world's immense clean energy needs are to be met. Keep in mind that the sun not always shines and that wind not always blows.

Electricity is of paramount importance for economic development. Industries and all world communities require electricity for daily needs. On the other hand, hydroelectric energy requires of the flooding of vast extensions of land and the displacement of large amount of people; the best places are already taken. These hydroelectric also depend on climate changes: a couple of years of drought and the energetic matrix based on water would be unbalanced.

The International Energy Agency and the OECD (Organization for Economic Co-operation and Development) are the intergovernmental bodies that analyses global energy demand. In the private sector, the World Energy Council performs similar assessments. The projections by both organizations point inexorably to the same conclusion: "*our world cannot meet its expanding energy needs-cleanly- without a sharp expansion of nuclear energy*".

Looking at energy security as a strategic national objective, the Zanelli Commission, in Chile, reported that, in addition, energy autonomy and efficiency could play a big role with the use of nuclear energy.

The Zanelli Commission was tasked with studying the potential use of nuclear energy in Chile and published its final report on November 9, 2007. "After examining all information available to the group, the use of nuclear energy cannot be ruled out" according to the country's National Energy Commission.

If Chile proceeds with the development of nuclear energy, the country would have actively to aid in the development of human capital capable of running advanced reactors; anti-earthquake technology and engineering can guarantee an acceptable level of safety, the report adds.

Chile's President Michelle Bachelet has said her government will proceed with all the necessary studies for nuclear power, adding her administration will not make the final decision.

Biocombustibles: fuel for cars or hunger?

In a recent report, the United Nations warns that "the fever" for biocombustibles could bring hunger to the highest level in a short run if the governments do not think seriously about its extensive application. It says that the fast idea of converting food- like corn, sugar, palm oil and wheat- into combustibles is a recipe for disaster. A serious risk exists on creating a battle camp between food and combustibles that could affect the poor of developing countries, paying higher prices for nourishment, because of the rapid increase in price of land and water. This is the strong point of the report on "the right for food" presented to the UN General Assembly on October 24 2007.

More than 20,000 people around the world die each day simply because they are too poor to stay alive. (Jeffrey Sach, economist, special advisor to the UN Secretary General).

The report adds that the efforts for the production of bio-fuels is important because it helps to control the climate change, but considers unacceptable that the right for food for humanity be jeopardized. Higher prices for food are expected if the best land is used to nourish cars instead of human beings. The specialists believe that many agro-industries would like to obtain more land, increasing the competence for property and multiplying forced evacuations. Keep in mind that large extensions of land are needed to convert biocombustibles from the crops of corn, cane sugar, wheat, palm oil, and others.

In his recent journey through the globe Brazilian President Lula da Silva, promoted, enthusiastically, the use of biocombustibles and the success of its application in his country (mainly alcohol from cane sugar). President Bush had a meeting with car industries to accelerate the conversion to biodiesel and ethanol. The reaction of the Consumers Union (non profit publisher of Consumers Reports) did not wait: it reported that the use of biodiesel and Gasol in several American cars was disappointing; the engines consume more biocombustibles than gasoline increasing transportation cost. The promising savings are "fictitious" they quote.

Let us place this technology in perspective:

The process of producing ethanol, for example, gives off large amounts of carbon dioxide, and that's where ethanol's "green label" starts to brown. Most ethanol plants burn natural gas or, increasingly, coal to create the steam that drive the distillation, adding fossil-fuel emissions to the carbon dioxide emitted by the yeast. Growing the corn also requires nitrogen fertilizer, made with natural gas,

and heavy use of diesel farm machinery. Some studies of the energy balance of corn ethanol- the amount of fossil fuel needed to make ethanol versus the energy it produces- suggest that ethanol is a loser's game, requiring more carbon-emitting fossil fuel than it displaces. Others give it a slight advantage. But however the accounting is done, corn ethanol is no greenhouse panacea.

Look at what is happening in areas such as Indonesia: extensive deforestation is now taking place to support this industry which is not nearly as "green" as it appears at first sight. If we do a little research about deforestation, we will learn on the damage caused to the areas involved, and at the same time, the impact in climate change.

We hope that the voracity of the automotive industry is kept under control; with the price of crude oil hovering near $100 per barrel, this is the easiest way to cope with the crisis.

But once and again things can change. With the discovery of the biggest deep-water oil field off the southeastern coast of Brazil, this has the potential of transforming this country into a global energy powerhouse and to reshape the politics of this energy-starved continent. It announced on November 8, 2007 that the field held some five to eight billion barrels of crude oil and natural gas. The announcement has everyone in the region, and beyond, taking notice. A field that size- the biggest in the world since a discovery in Kazakhstan in 2000- is a potential game-changer for Brazil. In the next five years it is conceivable that Brazil could move ahead of Mexico and Canada in total oil reserves, becoming second only to Venezuela and the United States in the energy pecking order of the Americas.

Nuclear Power Today

Nuclear generation began about 50 years ago and now generates as much global electricity as was produced then by all sources. Some two-thirds of world population lives in nations where nuclear power plants are an integral part of electricity production and industrial infrastructures. Half the world's people live in countries where new nuclear power reactors are in planning or under construction. Thus a rapid expansion of global nuclear power would require no fundamental change- simply an acceleration of existing strategies.

It is also worth mentioning that the International Atomic Energy Agency (IAEA) is celebrating 50 years of foundation this year (August 1957). Celebrating this event the publication of the book: "Atoms for Peace- a pictorial history of the IAEA" represents a summary of research, development, innovation, leadership and intensive diplomacy in the field of nuclear technology. In October 2005 the agency and its director received the Nobel Peace Prize. Their mission: to promote safe, secure and peaceful nuclear technologies. In the Cold War's aftermath, a key activity is the removal of nuclear material from weapons and its

conversion to fuel for civil nuclear power. I do have a copy of the book and consider it a collection item.

Today nearly 440 nuclear rectors produce electricity around the world. More than 15 countries rely on nuclear power for 25% or more of their electricity. In Europe and Japan, the nuclear share of electricity is over 30%. In the USA, nuclear power creates about 20% of electricity. Many countries have a strong commitment to nuclear power. Among these are China, India, USA, Russia and Japan, which together represent half of the world population. Other nations-such as Argentina, Brazil, Canada, Finland, South Korea, South Africa, Ukraine and several other countries in Central and Eastern Europe- are acting to increase the role of nuclear power in their economies. Key developing nations without nuclear power- such as Indonesia, Egypt and Vietnam- are considering this option.

Nuclear Power provides energy independence and security of supply.

France, with 60 million people, obtains over 75% of its electricity from nuclear power and is the world's largest net exported of electricity. Italy's 60 million people have no nuclear power and are the world's largest importers of electricity.

Chernobyl: Myths and Reality

The 1986 nuclear disaster at Chernobyl, in Soviet Ukraine, spawned widespread fears about the safety of nuclear power. But the Chernobyl reactor had an acutely flawed design- one which would never have been allowed to be built outside the Soviet Union. It also had weak safety features that failed to guard against human error.

In contrast, the US Three Mile Island Incident (1979) was confined by the extensive protective systems that are now worldwide industry standards. Reactors with Chernobyl's severe shortcoming have been eliminated and will never be built again.

Using the world top experts, the UN has conducted exhaustive studies of the health effects of Chernobyl- beyond the original death toll of 31. Of around 4,000 thyroid cancer cases attributed to the accident, nearly all were successfully treated. Beyond this- after 20 years- there is no scientific evidence of any increase in cancer incidence at locations near or far.

The UN's authoritative findings do not minimize the gravity of what happened at Chernobyl. But they do refute many sensationalized reports and help to place that singular event in perspective. The greatest health impact from over-use of fossil fuel comes from air pollution. The World Health Organization (WHO) estimates that such pollution causes nearly three million deaths each year. Medical scientists predict that the fossil fuel mortality rate will triple by the year 2025. These devastating health effects-, which equates 600 "pollution

Chernobyl's'" each day in the near future-, overwhelm even the most distorted myths about nuclear power.

A Superb Record of Nuclear Safety

Although Chernobyl blemished the image of nuclear energy, the accident's positive legacy is an even stronger system of nuclear safety worldwide. In 1989, the nuclear industry established the World Association of Nuclear Operators (WANO) to foster a global safety culture. Through private-sector diplomacy, WANO has built a transnational network of technical exchange that includes all countries with nuclear power. Today every nuclear power reactor in the world is part of the WANO system of operational peer review. The aim of WANO's peer-review system standards set by the UN's International Atomic Energy Agency (IAEA).

Advances in safety practice are unmistakable. At most plants worldwide, safety related events are now near zero. National and International insurance laws assign responsibility to nuclear plant operators. In the USA for example, reactor operators share in a "pooled" private insurance system that has never cost taxpayers a penny.

Today, nuclear power plants have a superb safety record- both for plant workers and the public. In the transport of nuclear material, highly engineered containers- capable of withstanding enormous impact- is the industrial norm. More than 20,000 containers of spend fuel (used nuclear fuel) and high-level waste has been shipped safely over a total distance exceeding 30 million kilometers. During the transport of these and other radioactive substances- whether for research, medicine or nuclear- there had never been a harmful radioactive release.

It is worth to mention that "radiation" is release naturally from the ground and atmosphere in all places on Earth. This "natural background radiation", which varies considerably from region to region, is part of the environment to which all humans being are conditioned. Like many things, radiation can be both beneficial and harmful. Large doses are dangerous. Abundant evidence indicates that small doses are harmless.

The radiation produced within the core of nuclear reactors is similar to natural radiation but much more intense. At nuclear power plants, protective shielding isolates this radiation, allowing millions of people to live in safety nearby. Typically, the radiation people receive comes 90% from nature and 10% from medical exposure. *Radiation exposure from nuclear power is negligible*.

Safeguard Against Weapons

A nuclear reactor is not a potential bomb, and its fuel is not explosive. The raw material in nuclear weapons can only be made by a substantial military project.

Nine nations have developed nuclear weapons. More than 190 governments have committed not to develop such weapons- and have accepted IAEA inspections designed to detect a nuclear weapon project. All nuclear material requires rigorous care. But the use of nuclear energy to make electricity has not contributed to the danger of nuclear weapons or their proliferation.

In addition to safety, power plants are extremely robust in design. Indeed, they rank among the strongest structures ever built. For external protection, these natural defenses are fortified with security controls and guard forces. As a matter of grim realism, terrorist intent on carnage could achieve theirs aims far more reliably, and with greater effect, against a wide range of alternative targets.

As part of the US Department of Energy (USDOE) the Global Nuclear Energy Partnership (GNEP)- a consortium of nations with advanced nuclear technologies- would provide fuel and reactors sized to meet the grid and industry needs of other countries. By participating in GNEP, growing economies can enjoy the benefits of clean, safe nuclear power while minimizing proliferation concerns and eliminating the need to invest in the complete fuel cycle (e.g. reprocessing and enrichment).

In cooperation with the IAEA, participating nations would develop international agreements to ensure reliable access to nuclear fuel.

The international consortium is a critical component of the GNEP initiative to build an improved, more proliferation-resistant nuclear fuel cycle while increasing energy security. This approach would permit increased access to the benefits of nuclear energy while enhancing global security. The challenge stems from the fact that certain technologies use to produce nuclear fuel, or separate out Plutonium from used fuel, could be used to produce material for a nuclear weapon.

Fuel for Nuclear Power Plants and Waste Disposal

The great advantage of nuclear power lies in the vast amount of energy that can be extracted from a mere handful of the element Uranium, which is found in great concentrations underground. The waste from nuclear power retains the same tiny volume and can be safely returned to the Earth for underground storage.

Because so much energy leaves only a small amount of manageable waste, Uranium has been called nature's gift to clean economic development. In contrast, fossil fuel waste is too large and unmanageable to be contained and must be dispersed into the environment.

Under present policies, fossil fuels and nuclear energy operate under different rules. For fossil fuel waste, governments- under public pressure for "cheap energy" – have allowed the environment to be used as a free dumpsite.

Meanwhile, in most countries the price charged for nuclear power includes an allocation set aside for the cost of storing and disposing of its waste permanently and safely.

Due to effective shielding and containment, waste from civil nuclear power has never caused harm to any person or to the environment. For nuclear waste that is highly radioactive, well-designed long-term storage is needed while its radioactivity decays to natural levels.

Radiation scientists, geologists and engineers have produced detailed plans for safe underground storage of nuclear waste. A stable geological formation constitutes a highly reliable barrier. Extra layers of protection come from “multiple engineered barriers”, including the ceramic fuel itself and robust containers built for high-longevity. Geological repositories are designed to ensure that harmful radiation would not reach the surface even with severe earthquakes or the passage of time. Waste can be retrieved if new technologies offer ways to reuse the material or hasten radioactive decay.

Nuclear Competitiveness for the Future

Nuclear power plants currently cost more to built than power plants using coal or gas. This difference is narrowing, as long experience with nuclear power helps to shrink construction periods and extend plant lifetimes. Already, due to low cost fuel and improved efficiency, nuclear plants- once built- can be less expensive to operate. Thus, even in a marketplace that does not credit its virtues, nuclear power is increasingly competitive.

Putting a tag on harmful emissions would quickly make nuclear power the cheapest option- as well as the cleanest- for generating increasing energy in the global scale.

Today nuclear energy provides about 16% of world electricity. With sound public policy, this percentage could grow rapidly- supporting global economic prosperity without greenhouse gases and pollution. Fortunately, the Uranium that fuels nuclear power is found in great quantity in both Earth and Sea Water. Uranium’s worldwide availability at economically viable cost is a key factor that would allow a sharp expansion in nuclear power.

The nuclear power industry is preparing a new generation of reactors. Simpler, standardized designs will expedite licensing and reduce the time and cost of construction- even while maintaining the highest standards of protection against accident, earthquake or terrorism attack. Advanced reactors will also cost even less to operate, and produce less waste. A key innovation will be the incorporation of “inherent” or “passive” safety features- the use of natural physical principles as a substitute for active controls.

Beyond producing clean electricity, the clean energy from nuclear power could be used to distill salt water on a massive scale. “Desalination” plants would help to meet the desperate shortage of fresh water that could afflict more than half the world’s people by 2025.

Nuclear Power and Sustainable Development

Nuclear power is a “sustainable development” technology because its fuel will be available for multiple centuries, its safety record is superior among major energy sources, its consumption causes virtually no pollution, its use preserves valuable fossil resources for future generations, its costs are competitive and still declining its waste can be securely managed over the long term.

China and India, which alone constitute about 35% of humanity, are fast advancing economically. Each nation has vast quantities of coal and a small but technologically sophisticated nuclear power industry that has begun to grow. No question belongs highest on the world agenda than how these and other developing countries will meet their rapidly intensifying energy needs. At stake is the future of the biosphere. Stabilizing the accumulation of atmospheric gases requires that worldwide emissions be cut by 50%.

The challenge is made even greater by the need to raise living standards in poorer countries. Even if developing countries embrace conservation and clean-energy technologies, their enormous population will soon emit more greenhouse than the existing industrial world.

Conceivably, tomorrow’s mega-cities could function with few direct emissions- by using electricity, electrically charged batteries and fuel cells using electrically produced Hydrogen (as mentioned nuclear power plants can produce large amounts of Hydrogen). But electricity is only a way of distributing energy. The key is to generate vastly expanded supplies of electricity cleanly.

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