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The benefits of nuclear energy

The only clean, safe energy source capable of ensuring the continuation of our civilization while protecting the environment; and why environmental opposition to nuclear energy was a major mistake

by Bruno Comby

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Ecological organizations such as Greenpeace and the WWF have an anti-nuclear standpoint. But it is more ideological than fact-based, and an increasing number of environmentalists are now turning in favor of nuclear energy because there are, in fact, awe will see below, very good, solid, scientific and, above all, environmental reasons to be in favor of the many benefits of nuclear energy.

Our world is sustaining itself today on the burning of fossil fuels (85% of the world's energy is from coal, oil and gas).

The war in Iraq reminds us how fragile our supply of oil is. More than half of the world's oil production today (and an even greater proportion of the future reserves) is located in the fragile and highly undemocratic area of the Persian Gulf.

Just imagine what would happen if this supply were suddenly blocked: no gasoline for cars of course, but also no more heating in many houses, an immediate collapse of the world's economy, no tractors or fertilizers to grow our foods. . . . A giant nightmare taking humanity back to the middle-ages in a matter of a few months. Of course there is a high probability that this will not happen rapidly but over a period of perhaps a few years, but the result might be the same. In the most optimistic case, supposing the Persian Gulf countries (Saudi Arabia, Ira, Iran, Kuwait and Arab Emirates) do continue to let us take the oil from their underground (or that the United States will be successful in forcing them to do so), with the oil production peak about to be reached in the coming years, the oil production will in any case start declining soon, and entire portions of the planet will then be simply derived from oil, whatever price they might be willing to pay for it, as the major oil fields become dry.

The burning of all this oil we are pumping out from the inside of the Earth today throws out into the atmosphere 25 billion tons of carbon dioxide every year (800 tons per second!), which is significantly altering the chemical composition of our atmosphere and seriously affecting the climate of our planet.

We are burning in just 50 years the oil that nature took 100 million years to fabricate. If we wanted this to be sustainable, we need 2 million planets like the Earth.

But we have only one fragile planet to live on. If we want it to remain livable and in order to ensure not just the comfort of our modern lives but, in the close

future, the continuation of our civilization, it is therefore urgent to move very rapidly to new lifestyles and other energy sources.

It should be understood in this regard, that converting the energy infrastructures takes at least 15 years (if not more), and we already know that great tensions on our supplies of oil and gas will come long before then. It is therefore VERY URGENT to act in this regard, and it is already too late to avoid a world major energy crisis—it is now inevitable and will lead to homelessness and starvation for a large portion of humanity, and not just in those countries who are poorer today. But it is still time to anticipate it and soften its consequences.

We are very lucky that in fact there are solutions to global warming and the end of oil, as we will see. And we should seize this chance before it is too late, or nature and history will wipe us out of the scene in a few years if we aren't clever enough to see what's ahead of us and to take the right decisions.

Until now, energy consumption has continuously increased almost everywhere on the planet, and most politicians continue to base their current predictions on eternal growth. However, in a finite world (we have only one planet) growth cannot go on forever.

Energy efficiency and other sources of energy can and should urgently be developed. Efficient light bulbs produce the same amount of lighting with 3 to 8 times less energy. Heat pumps can produce the same amount of heat with 2 to 5 times less energy. Solar heat and geothermal energy can and should be developed to a much greater extent than they are today.

There are those who have fallen in love with the simplicity of solar cells and the pristine elegance of wind turbines but who refuse to accept that they are quantitatively incapable of supplying the energy required by an industrial civilization. I do not mean to say that these renewable energies should be excluded; they are useful and have important niche roles to play in remote locations and under special circumstances, but they can make only a marginal contribution to the energy demands of an industrial civilization. The entire cultivable surfaces on Earth would not suffice to produce enough biofuels to replace oil, and obviously these surfaces are also needed to produce the food we eat.

To replace just one nuclear reactor such as the new EPR reactor that France is now building in Normandy with the most modern windmills (each of them being twice as high as Notre-Dame, the Cathedral of Paris), they would have to be lined up all the way from Genoa in Italy, to Barcelona in Spain. And, even so, the electricity would be available only when the wind blows (i.e. one day in three).

It is clear that we need another major energy source to replace oil and gas and to power our cars and the large cities, to run our factories and to produce our foods.

With oil and natural gas reserves soon to be exhausted, we are left with coal, which unfortunately is an even greater contributor to global warming, or nuclear energy.

As an environmentalist the idea of developing coal, the most polluting energy source, and the greatest contributor to global warming, more than it already is, is simply not acceptable, and would of course greatly worsen the global warming trend. The sequestration of carbon dioxide is nothing but a pleasant dream, quite impossible to put in practice. It certainly isn't an easy program to sequestrate billions of tons of CO2, and in any case, this could not reasonably be applied to individual transportation (cars)in a feasible manner.

In all cases another clean and massively available energy source is needed to avoid (or soften) a major crash of our civilization in the years to come.

Nuclear power consumes only very little amounts of uranium (and thorium in the future), which is (unlike oil and gas) abundant everywhere in the Earth's crust, and especially abundant in Canada and Australia.

Nuclear energy produces (almost) no carbon dioxide and no sulfur dioxide or nitrogen oxides. On the contrary, these gases are produced in vast quantities when fossil fuels are burned.

Unlike solar cells, wind turbine farms and growing biomass, all of which cover large areas of land and are intermittent, a nuclear power station is very compact; it occupies typically the area of a football stadium and its surrounding parking lots and it produces the energy continuously, when it is needed.

France, for example, has the cleanest and cheapest electricity in Europe: 80 per cent of its electricity is nuclear and 15 per cent is water power.

It is interesting to compare the CO2 emissions in France and other countries. The CO2 emissions in France are 6 tons of CO2 per person per year—considerably less than the 15 – 20 tons per person in the United States and Canada. This difference largely results from the nuclear production of electricity in France. Shouldn't all countries do the same?

Well-designed, well-constructed, well-operated and well-maintained nuclear energy is not only clean, it is also safe, reliable, durable and competitive. Let me discuss these points.

Nuclear power is safe, as proven by the record of half a century of commercial operation, with the accumulated experience of more than 12,000 reactor-years.

There have been only two serious accidents in the commercial exploitation of nuclear power: Three Mile Island in 1979 (in Pennsylvania, US) and Chernobyl in 1986 (in Ukraine when it was part of the Soviet Union). TMI was the worst accident one can imagine in a western power reactor: the core of the reactor melted and much of it fell to the bottom of the reactor vessel; but the radioactivity released was almost entirely confined in the reinforced concrete containment structure, the air-tight, silo-like building that houses the reactor. It was designed for that purpose, and as a result the amount of radiation that went out into the atmosphere was a million times less than at Chernobyl. The small amount that escaped was quite innocuous, and as a result no one at TMI was seriously irradiated nor died. In fact, Three Mile Island was a real success story for nuclear safety: the worst possible accident occurred (core meltdown), and yet no one was injured or killed.

Chernobyl was different. The reactors at Chernobyl had no containment structure. The reactor was unstable (faulty design), and was operated that night in a way known to be dangerous (ironically, in order to do a safety test they bypassed all the security systems), provoking a surge in power and a water-vapor explosion. The 600 tons of graphite moderator then caught fire and burned for several weeks. The smoke carried more than half of the radioactive fission products directly into the atmosphere where they were swept hither and yon by the winds. Fewer than 32 persons died within a few months, and about 200 more were severely irradiated but survived. The inhabitants of the exclusion zone were also victims for they were hurriedly uprooted, evacuated and resettled elsewhere. They lost their jobs and suffered psychological and social trauma in the dissolving Soviet Union. Their lives were disrupted and shortened. Since 1986, some 4000 cases of thyroid cancer have been diagnosed in the surrounding regions (all of which except 9 fatal cases have survived as thyroid cancer is usually not fatal).

Then there are discussions about long term cancers. Some organizations and journalists pretend that there might be tens of thousands (sometimes even millions) of victims still to come, but it should be noted that these are either imaginary or the result of theoretical calculations based on an untrue hypothesis, the linear extrapolation of the effect of high doses of radiation to the low doses, applied in this case to populations in millions having received only low doses. It is scientifically well established that this linear extrapolation does not apply to doses below 100 mSv, and therefore these calculations are not relevant, except perhaps for those persons who were exposed to high doses above 100 mSv. Chernobyl was the perfect example of what not to do with a nuclear reactor: a faulty design, an unstable reactor, operate it in a forbidden way, and disconnect all security systems before doing so.

In sum, considerably fewer fatalities have occurred in civilian nuclear power industry in half a century (Chernobyl included), than occur in any year in the fossil fuel industry. Coal mine accidents are common occurrences and often cause tens or hundreds of fatalities, reported one day and forgotten the next, adding up to about 15,000 per year worldwide, 6,000 of which are in China. The same may be said for oil field accidents. Oil tankers go aground or break up, accidents occur in refineries, oil and gas platforms have been lost with all hands, etc. Accidents in high pressure gas pipelines are not infrequent. Just as one example among many others, the gas pipeline accident at Ghislenghien (Belgium) on 30 July 2004 killed 21 and injured 120.

There are those who urge us to conserve energy and I agree, of course, that conservation is highly commendable, even essential, especially for those advanced countries that are highly dependent on massive imports of oil.

But in the face of the growth of the world's population and their enhanced expectations, notably China and India, which account for about 35% of the world's population, and in the face of finite fossil fuel resources, conservation can only delay the crisis soon to be triggered by the end of oil, by a few years or a few decades.

One gram of uranium yields about as much energy as a tonne of coal or oil—it is the famous "factor of a million" effect. Nuclear wastes are accordingly about a million times smaller than fossil fuel wastes. Most fossil fuel waste are gases that go up the smokestack and we don't see it, but it is not without effect, causing global warming, acid rain, smog and other atmospheric pollution.

The volume of nuclear waste produced is very small. In his whole lifetime, the volume of highly active vitrified waste that is produced by a typical French citizen is only the volume of a golf ball.

The nuclear wastes are confined (which is easy because they are solid, not gaseous), and they are not rejected into the biosphere (therefore the impact on the ecosystems is absolutely nil). Another interesting feature of nuclear wastes is that they spontaneously decay over time, unlike stable chemical wastes, which last forever, such as arsenic or mercury.

Of the spent fuel, roughly 5% is radioactive fission products, 1% is plutonium, and the other 94% is uranium. In the USA and in Sweden, the spent fuel is simply stored away. Elsewhere, it is reprocessed to separate the fission products, which are vitrified for safe and permanent storage, and to recover the plutonium. The latter, mixed with about 30% of the uranium, is made into new fuel elements and thus recycled to produce more energy. The rest of the

uranium is stored for use in future advanced reactors.

Fear of the unknown is the merchandise of the anti-nuclear greens. They preach fear of radiation in general, fear of radioactive waste in particular, fear of another major accident such as Three Mile Island or Chernobyl, and fear of nuclear weapons proliferation. Their campaigns have been successful only because radiation is quite mysterious to most people, and very few are aware of the fact that radiation is present everywhere in the environment. The anti-nuclear organizations also take advantage of the widespread but mistaken interpretation of the studies of the health of the survivors of the Hiroshima and Nagasaki bombing: that even a small amount of radiation is deleterious to health (the LNT hypothesis), and the related concept of collective dose. The fact is that moderate amount of radiation is natural and beneficial, if not essential, to life.

Radiation has been bathing our environment and is present everywhere in nature since the early history of our planet (in fact our sun and its planets, including the Earth today, are the remnants of the giant explosion of a supernova). Everything is radioactive around us in nature (and already was even before radioactivity was discovered), and this radiation spontaneously decreases with time. When life first appeared on Earth, the natural radiation levels were about twice as high as today.

Most people are totally unaware of the fact that the human body itself is naturally radioactive. It contains about 8000 becquerels (8000 atoms disintegrating every second), about half of which is potassium-40 (potassium is a chemical element essential to health - many people eat a banana a day to assure an adequate supply) and most of the rest is carbon-14.

Nuclear energy is a clean, safe, reliable and competitive energy source. It is the only source of energy that can replace a significant part of the fossil fuels (coal, oil and gas), which massively pollute the atmosphere and contribute to the greenhouse effect.

If we want to be serious about climate change and the end of oil, more efficient use of energy and self-sustainable life styles should be promoted, but this will not be enough (by far), and to ensure the survival of our civilization, nuclear power should also be deployed rapidly in all developed countries, especially those who are today burning large amounts of oil and coal.

An intelligent combination of energy conservation, together with renewable energies for local low-intensity applications, and nuclear energy for base-load electricity production, is the ONLY viable way for the future.

Tomorrow, nuclear energy will also be the key to clean transportation (electric vehicles), desalination of sea water, and hydrogen production with the new high temperature reactors.

The opposition of some environmental organizations to civilian applications of nuclear energy will soon be revealed to have been among the greatest mistakes of our times.

In 1996, the not-for-profit Association of Environmentalists For Nuclear Energy (<www.ecolo.org>) was created to inform the public in a complete and straightforward way about sources of energy and their environmental impact.

One of EFN's enthusiastic supporters is Professor James Lovelock, a hero in the environmental community. Considered the father of environmental thinking since the 1960's (see <www.ecolo.org/lovelock>), he is the author of the Gaia theory, which considers the Earth as a self-regulating organism that maintains the conditions fit for life on its surface.

Patrick Moore, one of the initial founders of Greenpeace in 1971, who was the Director of Greenpeace for many years, is the Honorary President of EFN-Canada.

Other members of EFN are environmentalists and ordinary citizens who feel concerned about the future of our planet and want to do something about it.

I encourage all our friends and readers, in all countries, to join EFN, to become local correspondents, and to develop a branch of EFN in your locale.

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