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The benefits of nuclear energy

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Анотація

Ядерна енергія – це чисте джерело енергії, яке здатне забезпечити продовження розвитку нашої індустріальної цивілізації при збереженні навколишнього середовища. Ядерна енергія є чистим, безпечним, надійним і конкурентоспроможним джерелом енергії. Це єдине джерело енергії, яке може замінити значну частину викопного палива (вугілля, нафта і газ) які масово забруднюють атмосферу і сприяють парниковому ефекту.

Keywords: *nuclear power, nuclear energy, heat, environment, fuel, energy source, the atmosphere.*

Abstract: *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.*

Ключові слова: *ядерна енергетика, атом, енергія, тепло, екологія, паливо, джерело енергії, атмосфера.*

Keywords: *nuclear power, nuclear energy, heat, environment, fuel, energy source, the atmosphere.*

The only clean, safe energy source capable of ensuring the continuation of our industrial civilization while protecting the environment. by Bruno Comby Introduction and conclusion (previous conclusion elevated to introduction) 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, we must promote the more efficient use of energy, we must use renewable energies – wind and solar – wherever possible, and adopt a more sustainable life style. But this will not be nearly enough to slow the accumulation of atmospheric CO2, and satisfy the needs of our industrial civilization and the aspirations of the developing nations. [1] Nuclear power should be deployed rapidly to replace coal, oil and gas in the industrial countries, and eventually in developing countries An intelligent combination of energy conservation, and renewable energies for local low-intensity applications, and nuclear energy for base-load electricity production, is the only viable way for the future. Tomorrow's nuclear electric power plants will also provide power for electric vehicles for cleaner transportation. With the new high temperature reactors we will be able to recover fresh water from the sea and support hydrogen production. We believe that 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. Present Conditions Resources: Our industrial civilization runs on energy and 85% of the world's energy is provided by the fossil fuels, coal, oil and gas. Coal began to be used extensively in Britain when its forests were no longer able to satisfy the energy requirements of an embryo industrialization. Coal is found almost everywhere and reserves should last several centuries. Petroleum began by replacing whale oil at the end of the 19th century, and its use has grown ever since. Discoveries of new deposits are not keeping up with consumption and production of oil is about to peak. At the present rate of consumption, reserves are estimated to last a few decades, but consumption is growing rapidly. More than half the world's oil production today is located in the fragile and politically unstable area of the Persian Gulf, as is an even greater fraction of our future reserves, Gas was at first a byproduct of oil extraction and it was thrown away. It has since been mastered to become a major source of energy. Reserves are similarly limited and estimated to last for a few decades. These fossil fuels were laid down over geological times and it seems likely they will have been totally exploited over the few centuries from about 1850 to 2100. Environmental Consequences: In burning fossil fuels, we inject 23 billion tons of carbon dioxide every year into the atmosphere – 730 tons per second. Half of it is absorbed in the seas and vegetation, but half remains in the atmosphere. This is significantly altering the composition of the atmosphere and seriously affecting the climate of our planet. We have only this one fragile planet to live on. If we want it to remain livable, to ensure the comfort of our modern lives and indeed the very continuation of our industrial civilization, then we must urgently adopt new lifestyles and find other energy sources. What is

to be done? Conservation and renewables: There are those who tell us we only need to conserve energy and rely upon renewable energies. Solar and wind are the major renewables. I agree, of course, that conservation is highly commendable, even essential. But in the light of the world's growing population, widespread economic development and enhanced life expectancy on the one hand (notably China and India which account for about 35% of the world's population) and finite fossil fuel resources on the other, conservation can only delay the crisis that will arise from the penury of oil and gas. Energy efficiency and alternate sources of energy can and must be developed. Efficient light bulbs produce the same amount of light with 3 to 8 times less energy. Heat pumps can provide 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. Some environmentalists are enchanted by the simplicity of solar cells and the pristine elegance of wind turbines, and they refuse to accept the fact 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 needs of a growing industrial civilization. Let me give an example. To replace just one nuclear reactor, such as the new EPR reactor which France is now building in Normandy, with the most modern wind turbines (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 (about 700 kilometers/400miles). And, even so, they generate electricity only when the wind blows (their average yield is about 25% of their rated capacity). There is much talk about biofuels, ethanol from sugar cane, for example. The entire arable surface of the Earth could not produce enough biofuel to replace present oil consumption. Mineral resources: By 2100, oil and natural gas reserves will likely be exhausted. This leaves coal and nuclear energy. As an environmentalist the idea of developing more coal, the most polluting energy source on the planet, and the greatest contributor to global warming, is simply not acceptable. The process of sequestration or isolating millions and billions of tons of carbon dioxide is nothing but a pleasant dream at this point, still unproven and unlikely to be put into wide-spread practice. Nuclear power: Nuclear power is clean, safe, reliable, compact, competitive and practically inexhaustible. Today over 400 nuclear reactors provide base-load electric power in 30 countries. Fifty years old, it is a relatively mature technology with the assurance of great improvement in the next generation. (Hundreds of nuclear reactors furnish reliable and flexible shipboard power: military ships of course. But the technology is adaptable to civilian maritime transport.) Clean: Nuclear energy produces almost no carbon dioxide, and no sulfur dioxide or nitrogen oxides whatsoever. These gases are produced in vast quantities when fossil fuels are burned. Nuclear waste: One gram of uranium yields about as much energy as a ton of coal or oil - it is the famous "factor of a million". Nuclear waste is correspondingly about a million times smaller than fossil fuel waste, and it is totally confined. In the USA and Sweden, spent fuel is simply stored away. Elsewhere, spent fuel is reprocessed to separate out the 3% of radioactive fission products and heavy elements to be vitrified (cast in glass) for safe and permanent storage. The remaining 97% – plutonium and uranium – is recovered and recycled into new fuel elements to produce more energy. The volume of nuclear waste produced is very small. A typical French family's use of nuclear energy over a whole lifetime produces vitrified waste the size of a golf ball. Nuclear waste is to be deposited in deep geological storage sites; it does not enter the biosphere. Its impact on the ecosystems is minimal. Nuclear waste spontaneously decays over time while stable chemical waste, such as arsenic or mercury, lasts forever. Most fossil fuel waste is in the form of gas that goes up the smokestack. We don't see it, but it is not without effect, causing global warming, acid rain, smog and other atmospheric pollution. Safe: 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, USA) and Chernobyl in 1986 (in the Soviet Union, now in Ukraine). TMI was the worst accident one can imagine in a western power reactor. The core of the reactor melted down and much of it fell to the bottom of the reactor vessel. The radioactivity released was almost entirely confined within the reinforced concrete containment structure, the air-tight silo-like building which houses the reactor – it was designed for that purpose. The small amount of radioactivity which escaped was quite innocuous. As a result, no one at TMI was seriously irradiated nor did anyone die. In fact, Three Mile Island was a real success story for nuclear safety. The worst possible accident occurred, a core meltdown, and yet no one died or was even injured. Chernobyl was different. The reactors at Chernobyl had no containment structure. The reactor's faulty design made it unstable and Chernobyl was operated that night in a way known to be dangerous. In the execution of a test, all the security systems were deliberately bypassed. An uncontrollable surge in power

occurred leading to a steam explosion. The 600-ton graphite moderator then caught fire and burned for several weeks. The smoke carried more than half the radioactive fission products directly into the atmosphere where they were swept far and wide 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 as 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, and successfully treated. Nine fatal cases have been reported. There has been some talk about long term cancers. Some organizations and journalists speculate that there might be tens of thousands of victims still to come, but it should be noted that these are mostly the result of theoretical calculations based on an unsubstantiated hypothesis, the linear extrapolation of the effect of high doses and high dose rates of radiation to the low doses and low dose rates, 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, operated in an experiment with all security systems disconnected, followed by a panicked response by the civil authorities. In sum, far fewer fatalities have occurred in the civilian nuclear power industry in half a century (Chernobyl included), than occurred in any year in the fossil fuel industries. 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. Accidents in high pressure gas pipelines are not infrequent. Just one example among many others is the gas pipeline accident at Ghislenghien, Belgium on July 30, 2004, in which 21 persons died and 120 were injured. Reliable: Nuclear reactors provide base-load power and are available over 90% of the time; intervals between refuelings have been extended and down time for refueling has been reduced. In the USA, these improvements over the years have been the equivalent of adding one reactor a year to the existing fleet. Most reactors are designed for a life of 40 years; many are reaching that age in good condition and extensions of 20 years have usually been granted. [2] Competitive: The cost of nuclear power is competitive and stable. The cost of nuclear fuel is a small part of the price of a nuclear kiloWatt-hour, whereas fossil fueled power, especially oil and gas, is at the mercy of the market. Inexhaustible: Uranium is found everywhere in the crust of the Earth – it is more abundant than tin, for example. Major deposits are found in Canada and Australia. It is estimated that increasing the market price by a factor ten would result in 100 times more uranium coming to market. Eventually we will be able to recover uranium from sea water where 4 billion tons are dissolved. Compact: A nuclear power station is very compact, occupying typically the area of a football stadium and its surrounding parking lots. Solar cells, wind turbine farms and growing biomass, all require large areas of land. Radiation: Fear of the unknown is the merchandise of 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 campaign has been successful only because radiation is a mystery to most people, and very few are aware of the fact that radiation is present everywhere in the environment. The anti-nuclear organizations also exploit 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. In fact a moderate amount of radiation is natural and beneficial, if not essential, to life. Radiation has been bathing our environment since the earliest history of our planet, and it is present everywhere in nature. In fact, our sun and its planets including the Earth 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. [3]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. Our bodies contain about 8000 becquerels (8000 atoms disintegrating every second), about half of which is potassium-40, a chemical element essential for health, as well as carbon-14. Old Fashioned Attitudes: Ecological organizations such as Greenpeace have consistently had an anti-nuclear bias which is more ideological than factual. An increasing number of environmentalists are now changing their minds about nuclear energy because there are very good, solid, scientific and, above all, environmental reasons to be in favor of nuclear energy. TO CONCLUDE, it is our

position that well designed, well constructed, well operated and well maintained nuclear energy is not only clean, but it is also safe, reliable, durable and competitive.

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