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On Nuclear Power

by

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This is a position paper which has recently been distributed for discussion among Members of the Club of Rome. Publication in these Proceedings opens the discussion to Members of CACOR and to all the National Associations for the Club of Rome who receive this publication. Ed.

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The world is likely to experience another doubling of its population (hopefully the last) before eventual stabilisation within the 21st century, at the level of 11-12 billion human beings.

Economists and energy experts predict, for the next several decades, a continuing increase of energy demand in the industrialised countries, and, much more pronounced, in the Third World. For example, the World Energy Council's Report entitled "Energy for Tomorrow's World" estimates that by the year 2020 the total energy demand will be from a low limit of 11.3 billion tons of oil equivalent to a high limit of 17.2 billion tons of oil equivalent, to be compared with an actual demand of 8.8 billion in the year 1990.

It is important.....to create the conditions for a major comeback of nuclear power. This, together with efforts to promote and diffuse high energy efficient technologies and to develop and diffuse renewable energy sources would be a pillar of an energy policy world-wide that would allow sustainable development.

Currently, about 80% of total energy supply is represented by fossil fuels, that is oil (36%), coal (24%), natural gas (20%). Oil is still the main energy source, but in terms of proven reserves coal is by far the most abundant amongst the fossil fuels, as reserves amount to nearly 240 times the present yearly production.

Against this background stands the increasing preoccupation on global warning attributed to the emission of greenhouse gases, the principal of which is carbon dioxide, in the atmosphere. Although a cause-effect relationship between emission of greenhouse gases - largely linked to the energy cycle - and climate warming has not yet been reached, the evidence is mounting, as concluded by the UNCED Conference in Rio de Janeiro (1992) and by the recent Climate Conference in Berlin (April 1995). Incidentally, it should be noted that the two most heavily populated developing countries, China and India, rely largely on coal for their energy supply. The combustion of coal, however, generates the highest emission of carbon dioxide for a given quantity of energy produced.

There is abundant reason for the developed and developing countries to adopt "no regret" energy policies, that rely essentially on efforts to improve energy efficiency in all areas of energy use, and on the replacement of fossil fuels with non-fossil energy sources that do not lead to emission of carbon dioxide in the atmosphere.

It is in this context that nuclear energy should be assessed. At present, about 420 nuclear power plants generate over 2 trillion kwh of electricity a year, meeting more than 6% of global energy demand and 17% of electricity demand (but over a third of the demand of electricity within the European Union). These percentages are all the more impressive if we bear in mind that nuclear power, which is an energy source "invented" by man, entered the market as recently as in the 1960s. Nonetheless, nuclear energy has not lived up to the perhaps excessively high hopes originally placed in this new source, as expressed, for example, in President Eisenhower's speech to the United Nations on "Atoms for Peace" (1953).

The costs of nuclear power have grown much more than expected, in good part because of increasingly strict safety and security requirements. At present, only about 25 countries operate electro-nuclear power plants, others have frozen operations temporarily or decided to abandon this resource altogether. Today only about 60 new plants are under construction, compared to over 100 in 1980. If one considers that plants built in the 1960s and early 1970s are approaching the end of their lifetimes, nuclear generation capacity may well diminish sometime after the beginning of the next Century, unless some new development reverses the trend.

The catastrophic accident at Chernobyl has affected social acceptability of nuclear power and has had serious repercussions on the nuclear industry throughout the world, though it eventually became clear that the accident was due to the dilapidation reigning throughout the Soviet technological, economic and political system. In a closed, technocratic society, not given to self-appraisal or exposed to international scrutiny, what happened at Chernobyl was only to be expected.

Today it is plain that the West's modern nuclear power plants are infinitely safer than the Soviet plant at Chernobyl. But not even in the most advanced country can mathematically absolute safety, that is, zero probability of accident, be guaranteed. And it is difficult to make the general public understand the meaning of extremely small numbers. If it is stated, for example, that the likelihood of a serious accident is one per ten million reactors per year, people simply perceive that an accident is not absolutely impossible and are alarmed. What will hopefully be possible is to ensure that, in case of a severe accident, no significant amount of radioactivity is released outside the plant. This. as we shall see later requires improvements in reactor technology.

But it should kept in mind that no source of energy is entirely without risk, hence the soundest policy is to preserve flexibility of choice among a plurality of sources and technologies, keeping a sufficient number of options open at all times.

The possibility that plutonium to build nuclear weapons could be generated in civilian reactors, or that plutonium be diverted from the civilian cycle in case of reprocessing, is a real one. Safeguards implemented by the International Atomic Energy Agency since its creation in 1957 are intended precisely to avoid this possibility; although they are not one hundred percent effective, they have proved able on the whole to greatly reduce the possibility of a covert nuclear weapons programme in a country that is subjected to safeguard controls. On the other hand, specific military programmes independent of civilian nuclear power can represent an easier route to proliferation. This was the case for China and, to a large extent, for Iraq. Since nuclear technologies cannot be "disinvented", the only effective solution is a political one: namely, to create conditions by which no country has incentives to acquire or maintain a nuclear-weapons capability. This solution is, however, not at hand, as the discussions on the renewal of the Non-Proliferation

Treaty have shown, and as the difficulty in obliging declared nuclear weapons states to end weapons testing confirms.

Uranium resources to feed nuclear stations are not running short, the price of natural (as well as of enriched) uranium on the international market is much lower than 15 years ago and there is no short- or medium-term prospect of a reversal of this trend. In addition, a large quantity of highly enriched uranium from nuclear weapons is likely to become available from the reduction in the number of nuclear devices originating from the peace process. Therefore, there is no immediate need to exploit more fully the energy value of uranium (and eventually of thorium) by recycling the spent fuel and utilising the plutonium. This option, coupled with the development of breeder reactors, should be left open for the longer-term future as an alternative or complement to the development of fusion reactors and/or to large-scale deployment of renewable energy sources

It is important, in view of the serious risk of a severe alteration of the planet's climate that increasing use of fossil fuels would bring about, to create the conditions for a major comeback of nuclear power. This, together with efforts to promote and diffuse high energy efficient technologies and to develop and diffuse renewable energy sources would be a pillar of an energy policy world-wide that would allow sustainable development. Renewable sources of energy, in particular, are already competitive with conventional energy sources when particular conditions are present (as for instance a high average-velocity wind regime); however, they are particularly interesting for decentralized and dispersed energy generation, and therefore constitute a complementary source to the concentrated power sources offered today by nuclear fission and, hopefully tomorrow, by nuclear fusion.

For a significant comeback of nuclear power to take place, some actions are recommended:

- Incremental improvements in reactor technology, with conceptual simplification of safety design criteria, but aiming at total containment of radioactive products within the reactor, hence not calling for extraordinary emergency plans involving the population in the region surrounding the site. These step-wise technical improvements would eventually lead to passively, if not inherently, safe reactors.
- As for radioactive wastes, particularly high level ones, the ultimate objective should be that of burning them in the reactors. Meanwhile, spent fuel reprocessing should be concentrated in a few sites to avoid aggravating the risk of proliferation and careful "direct disposal", without reprocessing should be explored as a temporary solution.
- Progress in organising institutional criteria for plant standardisation and licensing, which would enable factory production in series and scale economies.
- Greater economic competitiveness: today nuclear power is competitive for utilities that operate existing plants and have already amortised much of their original investment. The outlook for new plants is not encouraging, particularly in a financial climate that privileges short-term returns on investment, and that neglects long-term environmental and climatic risks associated with fossil fuels, not to mention problems of security of supply and price instability.

The proposed, but hitherto not widely implemented, carbon tax on fossil fuels would make nuclear power more competitive, and most important, would work against market pressures that lead to wasteful and ever greater energy use. In any case, we are convinced that the complexity of nuclear technology makes it most appropriate for industrial countries that have efficient technostructures in place and well functioning regulatory and control Authorities.

A renewed effort in nuclear power today would also contribute to keep alive and credible the longer term objective of developing controlled nuclear fusion, which, together with advanced solar technology, offer high hopes of providing Mankind with the energy sources it will need in the centuries to come.