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Nuclear Energy in the 21st Century

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When I addressed the Uranium Institute in the autumn of 1997 as retiring Director-General of the International Atomic Energy Agency, I thought I was saying farewell after sixteen years of excellent cooperation. Having been elected Honorary Chairman of the World Nuclear Association this year, I realize that it was not a farewell but an *au revoir*. I feel honoured and stimulated by the distinction conferred upon me and I assure you that I shall be glad to assist in whatever modest way I can to further the mission of the organization. While this mission is certainly to serve the collectivity of its members, it is also one that, in my view, serves the international community. The mission is a greater use of nuclear energy and nuclear technology for exclusively peaceful purposes, specifically sustainable global development.

Some people shudder at the mere mention of the words ‘uranium’, ‘nuclear’ or ‘atomic’, as if we were talking about evil supernatural forces. Yet, as we know, ionizing radiation is as natural as sunshine. It is no more unnatural to make use of nuclear power than to make use of solar power. It is the duty of scientists, engineers, teachers, knowledgeable opinion formers and of this organization to spread this understanding. I can see no more rational international programme than that of ‘Atoms for Peace’, which was launched by President Eisenhower and which sought to harness nuclear energy for the benefit of humankind and, at the same time, to prevent its military use.

Nuclear energy is not alone in being susceptible to both peaceful and military uses. Airplanes can be used for transportation - and to drop bombs. Explosives can be used to blast ores in mines - but also to destroy cities. Indeed, a simple knife can be used for good and for bad. It depends upon us how we use nuclear energy. As we know that nuclear weapons could destroy human civilization, it is certainly a rational task to work for both the non-proliferation and the elimination of these weapons.

Furthermore, realizing that much more energy, notably electric energy, will be needed by a growing world population, it is equally rational to work for the acceptance, regulation and prudent use of nuclear power as one peaceful application of nuclear energy. It is, indeed, difficult to see how the world could pursue sustainable development on a large scale without a much expanded reliance on nuclear energy.

Regrettably, this is not a message that has been very audible in the last two decades. Rather, the dominant message has been, and still is, that sustainable development can and

should rely on further energy saving and on a greater use of solar and wind power and biomass.

No one denies the importance of energy saving, and solar and wind power and commercial biomass have their niches in which they make welcome contributions. However, the energy of wind and sunshine is very dispersed. To harvest it on a large scale, large installations are required. It has been calculated that to achieve the capacity of a large power plant - say a 1000 MW(e) nuclear or coal plant - by using solar cells, an area of more than 20km² would have to be covered by such cells. If you were to rely on windmills, you would need wind farms covering more than 50km². Let me also recall that the energy contents of

- 1 kg of firewood corresponds to about 1 kWh of electricity
- 1 kg of coal and oil correspond to respectively 3 and 4 kWh of electricity,

while

- 1 kg of natural uranium corresponds to about 50.000 kWh of electricity and
- 1 kg of plutonium corresponds to about 6.000.000 kWh of electricity.

To me the suggestion that wind power, solar power and commercial biomass are rational answers to the world's need for sustainable energy is about as plausible as suggestions that it would be rational to handle transports on the high seas by sailing ships rather than by diesel powered ships. Further, it is one thing to point out that a large part of mankind, especially in the developing world, today gets its energy to cook and to keep warm from firewood or other biomass. It is another thing to suggest that the growing number of energy hungry megacities in the urbanizing developing world can rely on biomass from energy plantations to generate the heat and electricity they need.

The inevitable conclusion is that at the present time nuclear power is the only viable potential source of vast amounts of additional energy that is sustainable. It has the potential to provide electric power to our households, industries and means of mass transportation. But it has also the potential to provide industrial heat and to produce hydrogen. A comprehensive study carried out by the European Union in cooperation with the US department of Energy and concluded in 1998 showed convincingly how low the environmental - external - costs of nuclear power were compared to those of fossil fuel based power. Moreover, as we are all aware, if breeder reactors were used at some stage in the future, the uranium resources of the world would enable us to fuel a vastly expanded nuclear power sector for an indefinite time.

These facts and thoughts are not unfamiliar to you. It is also well known to all of us that nuclear power is becoming more competitive in many places. With better operation, maintenance and equipment replacement many nuclear plants run more days per year and more years, making them more economic. New types of plants may become even more economic, while fossil gas is likely to go up in price. With the gradual implementation of an international nuclear safety culture and the phasing out of older types of power reactors, large accidents should be excluded. Even the issue of the disposal of high-level nuclear waste - which we know is a political rather than technical problem - is beginning to see solutions in several countries.

Why is it then, it may be asked, that with a few exceptions, governments and political parties, who should know all this, avoid clearly recognizing the need for nuclear power and explaining the reasons to the public? Pushed by green movements and parties they continue, seemingly without much conviction, to endorse increments in the use of renewable sources of energy, and they continue liberally sprinkling subsidies on these sources and on stimulating some measures of energy saving. It is left to competent leaders and institutions like the World Energy Council to explain the need for nuclear power - and left to green parties and movements to deny this need.

In my view, the holding pattern in which many governments in industrialized states seem currently to be circling, like an airplane unable to land, may remain politically convenient to accommodate a green opinion without alienating the main stream voters, but only so long as the conservation-cum-renewables recipe does not have to be tested on a large scale. The moment of truth is likely to come when there is a need for a sizeable expansion of the power sector without collisions with environmental and economic conditions. In several industrialized countries that moment has been deferred by an earlier oversupply of power or by an increased reliance on fossil gas. It might be still further deferred by a stagnant power demand during the current economic downturn. Yet, the moment will come.

In politics, as in business, timing is of crucial importance. When the timing is right there must be a readiness to use the opportunity. Fortunately, the nuclear power sector has used the past two difficult decades well to improve itself to be able to seize the opportunity when it presents itself. If the competitiveness of nuclear power slipped during the years of falling oil and gas prices, it has much improved since then. In the field of safety much has happened since the TMI accident and the Chernobyl disaster. The last RBMK unit at Chernobyl has been closed and a reliable shelter should be in place over the ruined reactor in a few years. The wound of Chernobyl is not healed but it is gradually being closed. Remaining RBMK type reactors and older types of reactors have been reviewed and given greater safety. INPO and WANO have been prompters, helpers and catalysers. The IAEA has vastly expanded and strengthened the international regulatory framework. Availability figures are up, unplanned stoppages and radiation doses down. One day nuclear power will be rediscovered.

Let me tell you the story of a scientific expedition that lost its navigation equipment in the Pacific. Despairing about which direction they should go, they asked the advice of a crew-member from Bora Bora. He pointed unhesitatingly in one direction and, lo and behold, after a few days they happily sighted the island. They asked him how he know Bora Bora was there and his answer was: "Bora Bora always was there". Well, nuclear power has been here all the time during a long period in which many have not found their way to it. Today it should appear even more attractive to lost navigators in search of sustainable energy sources.

However, the navigators need advice and more articulate and rationally based advice than the scientists obtained on the ship. The World Nuclear Association, if adequately funded and with a broad membership could - and should - provide such advice.