



## The Future of Nuclear Energy in an Era of Environmental Crisis and Terrorist Challenge

Remarks  
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Mr. Chairman, distinguished colleagues:

Before the seismic events of September 11, the world nuclear industry had begun, with increasing confidence, to embrace the theme of a renaissance in nuclear power. My purpose today is to examine this expectation. In closing, I will speculate as to how nuclear power might be affected by the world's new focus on international terrorism.

### *A Backdrop of Pessimism*

The theme of nuclear renaissance arose in the late 1990's against a backdrop of doubt as to whether there was any future at all for a technology once heralded as the energy of tomorrow. This pessimism was centred in Western Europe and North America, where nuclear power originated but where nuclear construction has been curtailed for two decades.

On analysis, the actual cause of this hiatus has been mainly economic – market saturation and the availability of cheap fossil alternatives in an extended era of environmental laissez-faire. But, in common perception, the problem has been public acceptance.

Public attitudes have, for certain, been a problem. If in America nuclear energy has faced scepticism, in Western Europe the anti-nuclear movement has become entrenched and quasi-religious. In both regions, instead of contemplating the vast potential of the atom to alleviate threats to the biosphere, environmentalists have responded by nurturing a romantic passion for renewables that has only intensified their animosity to nuclear power.

As a result, public debate has moved toward gridlock, wherein those most concerned about the environment have often been the most rabid opponents of the major technology available for a large-scale global strategy to preserve it.

### *Factors in the American 'Renaissance'*

In this context, the theme of a nuclear energy rebirth has gained cogency from two developments: an increasing public recognition that the biosphere does indeed face dire dangers requiring real solutions and an emergence of practical factors favouring the use of nuclear power.

Within the United States, where the term 'nuclear renaissance' was coined, one can identify at least ten such factors.

- **Increased Operating Efficiency.** A fundamental factor has been steadily increased operating efficiency resulting in greater nuclear output and lower costs. In the 1990's, without a single new power plant, the U.S. nuclear industry increased its production by some 28% – the equivalent of building more than 20 new 1,000 MW reactors in that decade. Whereas deregulation had been expected to worsen nuclear power's problems of comparative cost, the actual response to market pressure was a sharply improved capacity factor – an intensification of operations that was achieved in parallel with, not at the expense of, improved operational safety. Thus, in a decade that saw a major expansion in U.S. electricity consumption, nuclear maintained its 20% share while building of record of highly efficient performance.
- **Improved Public Opinion.** A second factor is more favourable public opinion, attributable to a diminishing memory of Three Mile Island and Chernobyl, an absence of other nuclear incidents, and the replacement of romance with realism in the discussion of national energy policy. The effect of the California energy crisis was to weaken the role of populist ideology and to fortify energy planners who promise to deliver reliable supply.

- **Wiser Deregulation.** A third, related factor is a widening recognition that deregulation schemes must provide for long-term base-load planning – not just spot markets – a stipulation that will benefit nuclear fundamentally.
- **Less Burdensome Regulation.** A fourth factor is a more streamlined regulatory climate for both nuclear operations and new construction. The NRC has now pre-approved three advanced power plant designs, so that a new reactor will no longer be subject to legal challenge regarding safety of design. Before construction even begins, utilities will be able to obtain a single license to construct and operate.
- **Reduced Confidence in Alternatives.** A fifth factor is generalized worry over future price and availability of natural gas. From a national defence perspective and in the outlook of a utility planner, energy security is a growing concern.
- **Improved Industry Planning.** A sixth factor is the increasing consolidation of ownership in the nuclear industry, which is producing new economies of scale and an unprecedented focus on efficiency and long-term planning in this single technology. For a nuclear utility, a reactor is not just one technology on a smorgasbord but the very essence of the business.
- **Lower Construction Costs.** A seventh factor is expanding confidence in the affordability of new reactor construction. The holy grail is \$1,000 per kilowatt, and cost projections for new designs are slowly shrinking toward that goal. Those engaged in developing the pebble-bed modular reactor already forecast attaining this goal if and when PBMR's are built in multiple numbers. Other reactor designs, such as those now being studied by this Agency, may also eventually meet that goal.
- **Pro-Nuclear Government.** The eighth factor – which arrived compliments of some famously low-tech voting machinery in Florida – has been the advent of an explicitly pro-nuclear Administration with many allies in Congress. The Bush-Cheney energy plan and related legislation have provided both substantive support and psychological uplift to the entire U.S. nuclear industry.
- **A Solution to the 'Unsolvable' Problem.** A ninth and closely related factor is the prospect of a solution to the long-standing question of permanent waste disposal. After years of political procrastination and scientific study, an affirmative presidential decision on the planned geological repository at Yucca Mountain is expected in the months just ahead. An already legislated fast track scenario should ensure that such a decision, if made, is implemented without legislative or legal roadblocks.
- **Favourable Environmental Policy.** A tenth and overarching factor is a genuine and growing concern – in Congress and among the American people – about the global environment. Despite the impression created by President Bush's initial stance on Kyoto, this concern will eventually be reflected in American domestic and foreign policy. In policy on both fronts, the real-world environmental value of nuclear energy will be recognised and rewarded.

These factors combine, I believe, to make the American nuclear renaissance not just an industry theme but a very real prospect.

#### *On the World Scene: A Continuing Expansion*

The advent of new build in America would surely have trend-setting implications for nuclear energy worldwide. But nuclear power has already been advancing, more than is generally realized, on a broad-based global plane.

This distance between perception and reality bears emphasis. Western journalists and policymakers tend to assume that nuclear power has been in widespread decline. But ethno-centricity creates illusion. While people in Europe and America often debate nuclear power as if their decisions will determine the global future, nuclear energy has been expanding worldwide through the work of decision-makers elsewhere who could hardly care less about the theologies flitting through the mind of a green energy minister in Brussels or Berlin.

As evidence for this broader trend, several facts and factors may be cited.

1. *Positive Trends in Consumption.* The first of these is the worldwide pattern in energy consumption. Over the last four decades, nuclear energy has, in percentage terms, been the fastest growing energy source in the world. This trend continued in the 1990's, when nuclear energy output grew by 30% worldwide, increasing its share of global primary energy supply from 6.5% to 7.6%. In the 1990's, nuclear energy grew in Asia by 70% and even in Europe by over 20%; and in the countries of the former Soviet Union, nuclear power was the only energy source to grow rather than decline.
2. *Widespread Construction.* Second, new nuclear construction is alive and well not only in much of Asia and Eastern Europe but also in Latin America and South Africa. In the last five years, 24 reactors with 12,000 MWe have been commissioned, and 36 new reactors totalling over 30,000 MWe are now under construction. If, as we may reasonably expect in the not distant future, 'new build' is approved in Britain as well as America, advanced nuclear power reactors will be under construction in every region of the world. Such widespread construction of new reactors will break a barrier of perception, shifting the question – everywhere – from 'whether' to 'how many?'

3. *Action on Waste Disposal.* Third, on the chronic issue of waste disposition, historic progress on repositories and long-term storage is occurring simultaneously on a broad front that includes not only America but also Sweden, Finland and Russia. These advances will break another barrier of perception, ending forever the common allegation that nuclear waste is an 'unsolvable' problem.
4. *A Useful Political Debate.* Fourth, nuclear energy's battle with green ideology has not in fact gone badly. In Sweden and Germany, the entry of greens into government has produced something like an inoculation effect, generating a public debate through which citizens have come to recognise the real long-term consequences, both economic and environmental, when green dogma is converted into public policy. The phenomenon of minority green parties with a hostage-hold on coalition governments will continue to amplify green influence in several European countries – the most recent example being Belgium. But political posturing must be distinguished from political outcomes. Ultimately, it is difficult to imagine that any West European country, faced with energy needs and environmental constraints, would actually abandon a successful program of civil nuclear power.
5. *A Better-Organized Market.* Fifth, the limits of deregulation are being widely recognized. It has become clear from painful experience that policies that satisfy consumer populism in the short term can jeopardise consumer interests over the longer term, bringing shortages and price spikes. Increasingly, governments everywhere understand that long-range supply-and-purchase arrangements represent prudent planning and yield needed investments.
6. *An Improved Context for Affirmative Decision.* The sixth factor is a change in underlying economics and in the outlook of those who make energy decisions. For example, in Europe as in America, fundamentals are changing. In the decade ahead, Europe's energy market will eliminate over-capacity, and the age structure of Europe's power plants will require decisions on new build. Meanwhile, consolidation is producing ever-larger power companies that are willing and able to make large, long-term investments. Facing a future in which natural gas supplies and prices are uncertain and in which carbon emissions are likely to be penalized, these energy investors will surely see merit in new nuclear designs that are long-lived, even safer than today's, and also cheaper and quicker to build. Their decisions will be economic – but with a long-term view shaped by nuclear energy's improved competitiveness and by considerations of environmental and energy security.
7. *Constructive Integration of Environmental and Energy Policy.* A final and overarching factor is that nuclear power is inexorably benefiting from increasing public recognition of the enormous stakes embodied in the question of how humanity produces energy in the 21<sup>st</sup> century. Understanding is spreading that the only way to save our environment is to infuse economies with incentive systems that motivate environmentally benign behaviour and deter activities that are damaging to the local environment and the biosphere.

The principal market-based tools will be 'green taxes' on emissions and tradable permits to pollute. But whatever the policy technique, the goal will be to harness the power of the market for the sake of the planet's health. As this transformation occurs – as environmental policy is assimilated into the very bloodstream of the international economy – it will constitute nothing short of a revolution.

Inevitably, this revolution will benefit nuclear energy – not by subsidising it, but by attaching to the use of fossil fuel a cost increment that reflects the true burden of that energy source on man and environment. Even without taking climate effects into account, the EU's 'ExternE' study has shown just how great that burden is and that when true costs are assessed nuclear is cheap.

### *Battles Still to be Fought*

These favourable factors do not preclude some difficulty for nuclear power in the years ahead. In Britain, the coming debate over new-build is likely to produce a dramatic political spectacle, and many other political dramas may unfold – in Belgium, Germany, France, on the Austro-Czech border, in Italy's flirtation with a return to nuclear, and so on.

These battles must be fought, for there is no greater issue at stake in the world today than the question of whether humankind can reconcile the economic advancement of its proliferating numbers with the preservation of the environment that allowed civilization to evolve. Under any realistic scenario, this reconciliation requires the widespread use of nuclear energy.

Central among these battles is the shaping of a rational climate change regime to which the entire global community can subscribe and adhere. In the Kyoto process thus far, green efforts to stigmatise nuclear energy have temporarily carried onto the global stage two European idiosyncrasies: the inordinate influence of small political minorities and adamant opposition to the one technology best equipped to achieve the desired result.

These early green successes in shaping the climate regime seem sure to be transitory because the outcome thus far – which is essentially the result of a backroom collaboration among national delegations led by environmental ministries – is too perverse to stand. The climate challenge arises from the economic activity of a rapidly expanding global population; and the preponderance of human numbers and economic activity is represented by governments – China, India, Russia, Japan, Korea, the United States, Brazil, Britain, France – that hold a favourable view of nuclear power and that perceive the environmental benefit. A climate regime that seeks to deny this is at odds not just with scientific – but also with geopolitical – reality.

President Bush's withdrawal from the Kyoto process has been widely lamented as an abdication of world leadership. But in supplying leadership, the Bush administration or its successor may yet have a positive role to play. Earlier, it was the Clinton Administration that insisted on the use of market mechanisms as the only realistic and efficient means to achieve global greenhouse gas reductions. At such time as the U.S. re-enters the climate negotiation, the American administration will be well positioned to introduce another dose of realism by insisting on equitable treatment of nuclear power.

Bringing the global climate change regime into congruence with the very goals it is meant to achieve is one obvious imperative. A corollary goal should be to harness the great multilateral development institutions in support of nations that include nuclear power in their strategies for sustainable development. Today, policy in the development institutions is skewed – as in the climate talks – by political correctness, bureaucratic timidity, and lowest common denominator decision-making that exaggerates minority influence. This status quo should be challenged in the interest of seeing nuclear power realise its full worldwide potential as an urgently needed clean energy technology.

### *The Factor of Terrorism*

In my analysis, such steps would serve only to accelerate a worldwide expansion of nuclear energy that is already in progress.

The topical question today is how that progress might be affected by a new factor – concerns about international terrorism that must be regarded as legitimate, that are already the subject of media treatment, and that greens have quickly seized on as a new argument against nuclear power.

In an important sense, of course, the industry has been through this before, having for years been haunted by concern that still another reactor incident might worsen the psychic legacy of Chernobyl – with negative implications for nuclear energy everywhere. Starting in 1989, this worry was turned to constructive action by the World Association of Nuclear Operators, which has taken its place by the IAEA as a pillar of the nuclear industry. Just as IAEA safety standards and safeguards are indispensable to nuclear power's long-term future, WANO's global network of technical exchange and peer review is now essential in ensuring the highest feasible levels of operational safety.

No civilised person could hope for the current state of fear. But just as Chernobyl spurred positive action, we in the nuclear industry and those in this Agency can do no better today than to use the opportunity to reapply ourselves, with new resolve, to a duty already on our agenda: that of identifying and correcting those aspects of the nuclear fuel cycle that may be vulnerable to extreme and malicious acts. We may pray that current fears subside. But while they exist, this Agency and the world industry should seize the moment to institute added precautions that will stand nuclear power in good stead for decades to come.

In the process, the industry and this Agency must walk a fine line between downplaying the danger and inadvertently exacerbating it. The public must not be deceived. But care must be also taken to avoid an exaggerated perception of vulnerability. The worst of all worlds would be to inflate both public fear and terrorist temptation beyond what the facts merit.

Terrorism may occur at any moment at any place. But under realistic analysis, nuclear reactors are subject to decreasing levels of probability – starting with the limited likelihood that terrorists would choose the known tactic of hijacking a jumbo jet to assault a robust structure with few occupants instead of a vulnerable location with many occupants. That level of probability diminishes through a series of 'if's': success in the hijacking, success in navigating a large jet onto a small target, success in breaching the containment, success in releasing radiation that would do more damage than the crash itself. As to the possibility that a nuclear reactor could be made to erupt in a mushroom cloud, the public must be reassured that the probability is zero – an educational task that faced us even before September 11.

In contrast, facilities for reprocessing and spent fuel storage have greater vulnerability, and the industry must work with this Agency and national governments to achieve fully adequate defence. In some cases, improved physical barriers may be warranted. Such measures could be on-site, such as moving facilities underground or erecting strong open-air geodesic frameworks above. Meanwhile, current concerns are likely to underscore the importance of achieving permanent or long-term burial of spent fuel in a limited number of well-prepared sites.

This argument will not go unopposed. In Nevada, a local congressman has already declared that the transport of spent fuel to Yucca Mountain has now become too dangerous to risk. But in the final analysis, the counter-argument – that the sooner spent fuel is underground the better – is more likely to prevail.

Viewed in a broader perspective, the current sense of terrorist danger – and the larger and more ominous fear of a clash of civilisations – is likely to strengthen an argument that can only redound to the benefit of nuclear power: the importance of energy security. This factor, always one of nuclear energy's great assets, may become increasingly important.

With this factor in the balance, the current crisis will probably strengthen, rather than weaken, the impetus toward nuclear power.

But even before September 11, the world faced crisis enough to justify a vast worldwide expansion of nuclear technology. If humankind is to meet the threat posed to the biosphere by our very existence, the world will need advanced nuclear reactors not just by the hundreds but by the thousands.

In the century ahead, virtually all such reactors will incorporate principles of proliferation resistance and inherent safety. This will enhance our confidence but it will not diminish this Agency's role. Indeed, in any rational world we can foresee, the IAEA will have crucial and expanded responsibilities. Even after all of its travails, nuclear energy remains today as it began – the energy of the future – and to return to the subject of this conference, the work of this agency in verification and nuclear materials security remains a growth industry.

