John Ritch, Director General, World Nuclear Association

Nuclear Energy For A Clean-Energy Future

The opening years of this century mark the beginning of a new era in which the geo-political struggles of our past will be eclipsed by a wholly different challenge. The task we face is to reconcile humankind's ever more intrusive presence on this planet with the preservation of the conditions that enabled civilisation to evolve. Central to this challenge is the compelling worldwide need to produce clean energy on a massive scale.

As world population swells and economic activity intensifies, we must meet rapidly increasing demand for clean electricity, clean transport fuel and clean water. Hydrogen, as a new means to store and distribute energy, will soon be widely recognised as essential if we are to harmonise human and environmental need.

The need to produce hydrogen cleanly, and on the vast scale beyond the reach of renewables, will make apparent the critical importance of the nuclear-hydrogen nexus. The broad recognition will, I believe, occur quicker than many imagine, as people come to understand that this combination joins a unique, environmentally sound means of producing primary energy cleanly in enormous quantity and a world-changing method of distributing energy cleanly.

Hydrogen is an industry of untold potential labouring to be born. Nuclear is an industry of astonishing achievement, labouring under a cloud of misunderstanding that inhibits its maximum exploitation. Both industries, and the world at large, will profit from the earliest and widest possible recognition of their tremendous potential to combine as engines of a clean-energy future.

Currently we are constrained by political gridlock. On the one hand many people are comfortable with nuclear power but remain sceptical about environmental danger and global warming. On the other many are deeply concerned about the environment but remain sceptical about nuclear power. Energy politics in the UK are a perfect illustration. A nuclear industry that a few years ago seemed robustly expansive now labours under economic duress that derives largely from government policy, and under political duress that derives largely from the absence of government policy.

In a national culture where unexamined and deeply entrenched anti-nuclearism habitually parades itself as high morality, the British Government has been just brave and visionary enough to enunciate admirable goals for clean energy; and just timid and short-sighted enough to shy away from any serious proclamation as to how those goals might realistically be met.

Challenge of sustainability

We must lift our sights to large goals, but meet them with hard realism. In the next 50 years, as the global population grows, human need will multiply and, in the absence of dramatic measures, so too will human misery. As nations try to meet this need, world energy consumption will double or even triple and, in this narrow period alone, humankind will use more energy than in all previous history combined. Along the way we will be hard-pressed to avoid a humanitarian catastrophe arising from a shortage of clean water.

Despite much rhetoric and diplomacy, the global rate of CO_2 emissions – now some 25bn tpa – continues to rise. By mid-century the greenhouse gas concentration is likely to exceed twice the pre-industrial level. It is far from alarmist to warn that pervasive air pollution and a changing, unstable global climate could, in the not too distant future, become threats far more devastating than terrorism or manmade weapons.

To stabilise greenhouse gases global emissions must be cut, within the next 50 years, by more than 50%. Yet, in this same period, developing countries such as China and India will inevitably emit far more greenhouse gases as they struggle to rise from poverty. Thus, the already-industrialised countries must cut emissions by 75% if we are to preserve the biosphere.

No aspect of sustainable development is more elemental than the need to achieve a massive worldwide shift to clean energy technologies. This transformation is a matter of economics, technology and politics. We will not achieve a global clean-energy transformation without the political will to do so.

It is an irony of our age that so many citizens and organisations concerned about the clean-energy problem are fixated on myths, dogmas and sheer fantasies regarding the solution. In fact, nuclear power is the quintessential sustainable development technology. Its fuel will be available for multiple centuries, its safety record is superior among major energy sources, its consumption causes virtually no pollution, its use preserves precious fossil resources for other uses and future generations, its costs are competitive and declining, and its waste is securely contained and managed now, and can be over the long term.

Projections by the International Energy Agency and the World Energy Council point unambiguously to the same conclusion: that our need for clean energy on a colossal scale cannot conceivably be met without sharply increased use of nuclear power.

Those who persist in opposing nuclear power in the name of environmental preservation will surely earn the scorn of history and future generations. The world's environmentalists have performed many valuable services, but they can provide their fellow citizens no greater service now than to discard the fantasy that conservation, solar panels and windmills alone can meet human needs.

Sustainability requires nuclear energy and the path of sound environmentalism today is to embrace, fight for and finance a future in which nuclear power and "new renewables" function as clean-energy partners in a transformed global economy.

A nuclear century

In the century ahead, the world will increasingly recognise its debt to the scientists and diplomats of the last half century whose efforts have paved the way for an era in which the power of the atom will be indispensable to human welfare. In areas of commonly sited concern, the progress has been enormous:

Proliferation

We have met, and are continuing to meet, the challenge of weapons proliferation. The global regime founded on the Nuclear Non-Proliferation Treaty (NPT) constitutes one of the great diplomatic achievements of history. Current challenges to the NPT underscore its contribution in establishing a global norm that, when violated, generates a focused international response.

We cannot erase the danger of illicit nuclear activity, but we have built a global regime of safeguards implemented through the inspection authorities and sensing technologies of the International Atomic Energy Agency (IAEA). In so doing, we have taken enormous strides to ensure that the valuable use of nuclear technology does not lead to the illicit production of nuclear weapons. Indeed, the inspection regime for civil nuclear activity actually provides far greater opportunity to detect illicit activity than we would otherwise have.

Safety

We have met the challenge of safety with a combination of technological advances and safety culture that draws on more than 11,000 reactor-years of practical experience. This global safety culture relies on standards promulgated by the IAEA and reinforced by the World Association of Nuclear Operators (WANO). WANO was created 14 years ago in response to the accident at Chernobyl, and represents an extraordinary achievement in private-sector diplomacy.

Transport

To assure safe transport, today's industry uses highly engineered containers able to withstand enormous impact. To date, more than 20,000 containers of spent fuel and high-level waste have been shipped safely over a total distance of some 30m km. During the transport of these and other radioactive substances for nuclear power, there has never been a harmful radioactive release.

Terrorism

Nuclear reactors and used fuel facilities are robust structures of heavily reinforced concrete

"Environmentalists have performed many valuable services, but they can provide their fellow citizens no greater service now than to discard the fantasy that conservation, solar panels and windmills alone can meet human needs"

and steel that are far less vulnerable than chemical factories. Since the World Trade Centre attacks, computer modelling has shown that a similar assault against US nuclear facilities would result in no release of radionuclides of public safety consequence. A similar degree of impregnability would be found at most power reactors worldwide.

Cost

Nuclear power is the cheapest clean-energy source and it is cheaper than fossil fuel to produce, once a plant is built. True, the lowering of capital costs for nuclear plants remains a challenge, but these seem set to fall through faster construction of simplified and standardised reactor designs. Meanwhile fossil fuel costs will rise, as shortages result in higher prices.

Even now, nuclear wins the cost battle under some circumstances. In Finland, for example, a study published in 2000 showed that nuclear energy would be the least-cost option for new generating capacity. Updated Finnish figures in April 2001 put nuclear costs at 2.40¢/kWh, coal at 3.18¢/kWh, and natural gas at 3.21¢/kWh. The Finnish study also quantified the sensitivity of electricity price to fuel costs as shown in *Figure 1*.

The French Energy Secretariat in 2003 published updated cost figures for new generating plant. The advanced European PWR (EPR) would cost €1,650-1,700 per kilowatt to build, compared with €500-550 for a gas combined cycle plant and €1,200-1,400 for a coal plant. The EPR would generate power at 2.74¢/kWh. This is competitive with gas, which is very dependent on fuel price. Capital costs contributed 60% to the price of nuclear power but only 20% to that of gas.

External costs

Introduction of soundly conceived emissions penalties, whether through trading or taxes, will tilt the balance from fossil fuels to nuclear even faster, enabling nuclear power to dominate any market that imposes a real price for environmental damage. Applying any realistic notion of sustainability will mean that external costs of all energy technologies need to be brought to book. "Clean coal", though an admirable initiative in enabling continued use of one of our great natural resources, will almost certainly be far costlier than nuclear power (*see Figure 2*).

Waste disposal

Environmentalists oppose nuclear energy on the grounds that waste is the insoluble problem of nuclear power. In truth, waste is the greatest comparative asset of nuclear power because the volume is tiny and can be safely managed without harm to people or the environment. Keep in mind that a kilogram of nuclear fuel is the energy equivalent of 100,000 litres of petrol, or 100,000 cubic metres of natural gas, or 130 tonnes of black coal. The waste products are in the same proportion.

Deep geological repositories represent an extremely safe and feasible means of final disposal for nuclear wastes. Only political hurdles remain; and these are now being overcome. Nuclear power manages its tiny volume of waste safely; fossil fuels use the biosphere as a dumpsite.

Hydricity

We are on the threshold of a new era of transport fuels that could transform our world and lift our prospects for a clean-energy future. Hydrogen offers a means to store enormous quantities of energy one step from being electricity, which can be used on demand in transportation and the full range of traditional electrical uses. But hydrogen's environmental value depends on making it cleanly using the clean primary energy that only nuclear power can provide on a vast scale.

Hydrogen provides the bridge by which nuclear power can contribute to the entire spectrum of energy use. With this bridge, it is now possible to envisage a thriving, large-scale, emissions-free industrial economy with nuclear power and renewables providing clean primary energy for direct electricity and for electricity storage via hydrogen. The man whom many have dubbed the father of the hydrogen-fuel cell, Geoffrey Ballard, describes this as an economy operating on "hydricity".

Our great need is for a comprehensive treaty regime in which all nations undertake a binding commitment to use emissions trading as the driving economic incentive for a long-term evolution to a global clean energy economy. Our failure thus far traces ultimately to the lack of a plausible vision as to how a collective commitment to deep emissions cuts might realistically be fulfilled.

The emergence of a technologically feasible, widely understood clean-energy vision could break this logjam, stimulating nations to undertake the commitments that will accelerate the vision's fulfilment. A future in which nuclear power plays a central role in supporting hydricity will not require a radical change but only acceleration in current trends.

Nuclear's expanding role

Although nuclear energy is sometimes described as a dying industry, nothing could be further from the truth. For four consecutive decades nuclear power has been the fastest growing major energy source in the world; and today 31 nations, representing two thirds of humanity, have nuclear power; important nations representing an additional half-billion people are planning to begin to use it for the first time; nations representing half of world population are building nuclear power plants, and the US nuclear industry, owners of the world's largest nuclear fleet, plans 50% growth over the next 20 years.

The essential issue about nuclear power is not *whether* it will grow but how fast. Will it grow fast enough to meet the world's urgent need for clean energy on a massive scale? Will we further strengthen the global infrastructure of people and institutions to guide and promote its growth?

The goal of the World Nuclear Association is to promote that rate of growth and to help build that infrastructure of people and institutions. Representing the many companies that comprise the global nuclear energy industry, we share a division of labour with the IAEA and the OECD's Nuclear Energy Agency in the public sector and with WANO in the private sector. The combined work of these organisations serves to strengthen the technologies, standards, safety culture and skills associated with nuclear power, and to broaden public understanding of this invaluable technology.

As a civilisation we face the unprecedented danger of ruining the very biosphere that nurtured our growth as a species and social order. Yet we now have at hand the tools we need to avert that threat and, instead of succumbing to our own excesses, to build an ever stronger and more successful civilisation. WER

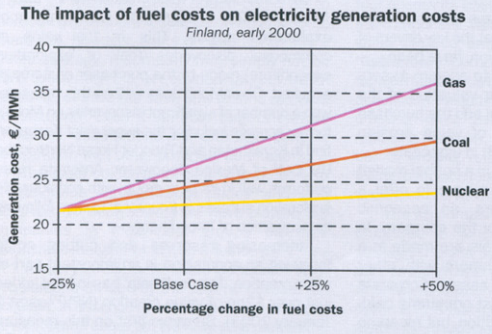

Figure 1

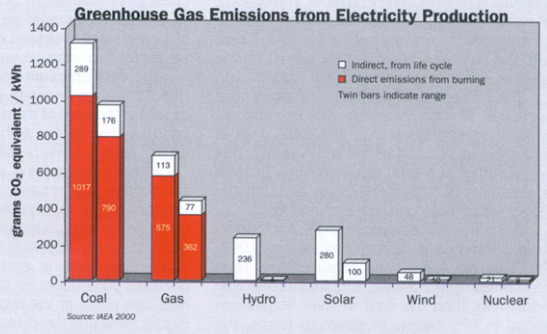

Figure 2