CHECK AGAINST DELIVERY

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World Nuclear Association

GETTING ENERGY RIGHT:
THE CRUCIAL CHALLENGE OF SECURITY AND SUSTAINABLE GLOBAL DEVELOPMENT

Statement to the Economics and Security Committee
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Ladies and gentlemen, I appreciate the opportunity to be with you today. Allow me to begin on a personal note. I am neither a scientist nor a nuclear industry professional. I came to my convictions on energy and the environment while serving for 7 years as President Clinton's ambassador to the IAEA and other UN agencies in Vienna. Since then, I have helped to create and build the World Nuclear Association as a way of converting these beliefs to action. To me, there is no more urgent business on the world agenda today than the challenge we will now discuss.

My topic is energy and security. Together with human skills and education, energy is the most fundamental building block for advanced and developing economies alike.

As commonly used, the phrase "energy security" means ensuring affordable supplies of fossil fuels for our cars and electricity. Democratic governments naturally want to avoid queues at the pump and blackouts on the grid.

A Broad Concept of Energy Security

My premise today is that we have reached a point in history when traditional national interests in securing affordable energy supplies must now be pursued in light of new global realities that have broadened the meaning of energy security:

- First, future adequacy of affordable global energy supply is now in doubt. The conceit that new oil and gas reserves will always be found to meet ever increasing world demand has evaporated from conventional wisdom. Fossil reserve experts now foresee only limited resource discoveries. Meanwhile, exploding global demand – led by China and India – will foster a ruthless competition for access and constant upward pressure on price. In sum, neither availability nor affordability of key fossil resources may any longer be taken for granted.

- Second, unmet energy need continues to grow. We may wish to assume that prosperity is gradually trickling outward and downward from the developed nations. But any such phenomenon is being overwhelmed by the sheer growth in human numbers. Today our planet has more human beings in hopeless poverty than the Earth's entire population just 50 years ago. For these desperate multitudes, energy security would mean access to any energy at all.

- Third, energy consumption itself has become a grave security threat to all societies. The first two factors – increasing fossil scarcity and unmet human need – are quantitative changes with policy implications. This third factor represents the advent of an entirely new policy consideration. Future historians will marvel at our lassitude in the face of this danger. For our best Earth scientists now warn, with increasing certainty, that current global patterns of fossil fuel consumption will soon carry us across a threshold into irreversible, catastrophic climate change with the severest consequences for extreme weather events, sharply changing temperatures, rising sea levels, species extinction, flooding, drought, and epidemic disease that could combine to disrupt all civilization.

These three factors – endangered access to affordable energy supply, the upsurge in unmet energy need, and environmental danger emanating from energy consumption itself – compel us toward a new way of thinking about energy security:

- The first factor points us toward a national imperative: that modern economies must focus more carefully than ever on maximizing energy autonomy by minimizing dependency on resources with unpredictable price and vulnerable availability.

- The second factor points us toward a moral imperative: that the interests of humanity require worldwide dissemination of affordable, sustainable energy technologies on a vast scale.

- The third factor points us toward a collective survival imperative: that we must, as a matter of urgency, achieve a sweeping worldwide transformation to clean-energy technologies.

Nations must use domestic policies and diplomacy to respond to all three imperatives if humankind is to achieve energy security in the new, broader sense. The future of the developed and developing worlds depends on it.

Human and Environmental Imperatives in Conflict

The changed meaning of energy security results from the larger, overarching truth that our world is now locked in a potentially fatal conflict between two momentous global trends. The first vector is the explosive growth of world population and, with it, of human needs and aspirations. The second is the destructive effect of humankind's expanding economic activity on the same environmental conditions that enabled civilization to evolve.

All public policy must now be shaped by the need to reconcile this conflict. As matters stand, we have hardly begun.

Between now and 2050, as world population swells from 6.4 billion toward 9 billion, humankind will consume more energy than the combined total used in all previous history. Under current patterns of energy use, the results will prove calamitous. The resulting pollution will be suffocatingly harmful to tens and likely hundreds of millions of citizens, mainly in the developing world. Far worse, the rising accumulation of greenhouse gases will carry across the point of no return as we hurdle toward climate catastrophe.

Today the world economy is producing greenhouse emissions at the rate of 25 billion tonnes per year – 800 tonnes per second – a rate still growing despite rhetoric and negotiation. The Kyoto Protocol, even if implemented, would make barely a dent in the problem.

Our best Earth scientists tell us that, if are to avert climate catastrophe, we must by mid-century achieve a 60% cut in global greenhouse emissions – and we must accomplish this reduction even as world energy consumption triples. In the sheer scope of this challenge, we face nothing less than a global emergency.

To help calibrate its dimensions, let us look first at the human aspect of the crisis, then at the dynamics of the climate danger, and finally at what can be done to reconcile the imperatives of human need and environmental preservation.

The Human Dimension: A World of Extremes

This crisis originates not in human evil, but in human success: humanity's accumulating, accelerating success in acquiring, disseminating, and applying science-based knowledge. It is this success – taking form in agriculture, industry, commerce, and medicine – that has spawned the growth in human population. Viewed through history's eye, this success has come in a sudden burst.

Through virtually all of the 50,000 years since humans first appeared, world population never exceeded 10 million. Then, at some point only in the last 2,000 years, something happened. To take a phase from nuclear science, humanity's technological inventiveness reached critical mass, and advance led to advance with increasing speed.

These gains brought amazing enlightenment and prosperity – and also an ominous consequence. Before, humanity's effect on Earth and its ecosystems was as a flea on a camel – wholly inconsequential. But in just the 200 years we call the Industrial Age humanity became an influence on Earth's fundamental mechanisms. Now this impact – this anthropogenic impact – threatens to ruin the very environmental conditions that enabled human success.

This impressive map sequence illustrates humanity's growth over the past two millennia. It shows the suddenness and size of our proliferating numbers – reaching 6.4 billion people today and a projected 9 billion by the year 2050.

Viewing this population through an economic lens serves to describe the human condition. What we find is a world of extremes.

At one end of the scale are the OECD countries, where global prosperity is centred. We represent a mere one-seventh of humanity. At the other end are the world's poorest. Here an even larger number of people – 1.1 billion – live in destitution with constant hunger, no clean water, the death of a child every 3 seconds, and virtually no income or prospect of improvement.

Back at the richer end of the spectrum, if we add the 400 million people of the former Soviet bloc, we find that 1.3 billion persons – just 20% of world population – account for 86% of global economic consumption. This means that 80% of the world's people subsist on just 14% of world production of goods and services.

The 80% of humanity in the poor and developing world continues to increase. The rate is 20,000 per day. Think of it as the birth of a new city of 6 million people once each month. Our problem is not shrinking.

The poorest 1.1 billion people are categorized as being in "extreme" poverty. Another 1.6 billion are classified as being in "moderate" poverty – just a small step above abject misery. They have little sanitation and virtually no money. They survive amidst pollution and disease.

The energy dimension of poverty is fundamental. Conditions of poverty correlate so closely to the absence of electricity that access to electricity is the best single gauge of a person's standard of living. In today's world of 6.4 billion, a full 2 billion people have no electricity, and 2 billion more have only limited access. In other words, fewer than 40% of the world's people can easily switch on the lights.

Numbers on the same scale apply to clean water. Today, world water tables are falling under the demands of expanding human consumption. As this crisis emerges, we can expect the growing shortage of potable water supplies to produce thirst, disease, and water wars – in other words, a deadly combination of human suffering and human strife. As a remedy, we have one available tool: worldwide desalination of seawater, an energy-intensive process that will compound global energy demand and that we must accomplish cleanly is we are not to exacerbate climate dangers.

Finally, we have the great mass of humanity positioned between poverty and prosperity. This population, poised for advance, will be the engine of our world's future economic development.

As energy users, the human condition divides us into three categories: those with energy access who will continue to use it, those with none who desperately need it, and those poised in between, whose drive for economic advance is already producing an expanded use of energy and, with it, an intensified outpouring of greenhouse emissions.

The growing environmental impact of this central group cannot be overstated. Twelve years from now, annual greenhouse emissions from developing nations will exceed emissions from the countries we now call developed.

The Dynamics of Climate Change

Let us turn now to the effects of those emissions.

A starting point is to recognize just how narrow is the arena of Earthly life. When we look upward either in the daylight or under the stars, it is a natural human instinct to think of the sky as an unlimited expanse. In fact, our atmosphere represents little more than a thin coating on the Earth's surface. In full, the atmosphere extends reaches 350 miles high. But most of the atmosphere – more than 99% of its molecules – is concentrated far lower, in the troposphere and stratosphere, no more than 30 miles high. The biosphere is even narrower, just 12 miles in bandwidth.

If you take an ordinary soccer ball and coat it with just a few layers of varnish, the thickness of that coating will represent the biosphere. If you apply several more coats, the thickness will represent most of the atmosphere above us, including the canopy of greenhouse gases. This thin shell of atmosphere is a very small rubbish bin indeed to hold the massive volumes of fossil waste we continue to spew into it.

To recognize the thinness of life's arena is to appreciate its potential fragility. Assessing just how fragile is the work of the world's leading Earth scientists, who pool their knowledge through the UN's Intergovernmental Panel on Climate Change.

Earth scientists may never achieve the precise predictive powers of short-term weather forecasting. But they have reconstructed the interactive processes and great cycles that have governed conditions on our planet for millions of years. They have achieved this historical record by gathering ice cores, tree rings, fossils, and deep sentiments in the world's lakes and oceans and by applying exquisitely sophisticated techniques of chemical and isotopic analysis.

The resulting database – and their understanding as to cause and effect – is now extensive enough to support elaborate computer modeling of how our biosphere has worked and how it may respond when Earth's most basic mechanisms are altered by human activity.

No mechanism is more fundamental to events on Earth's surface than the carbon cycle, the processes by which all carbon atoms on Earth circulate through our planet's living and non-living matter in land, water, and air. One such process is photosynthesis, whereby plants convert carbon dioxide to oxygen. The carbon cycle is fundamental to life.

Over the very long term, the carbon cycle is also integral to the great ebbs and flows by which the Earth has experienced, through hundreds of millennia, a fairly regular alternation between ice ages and what are called interglacial ages.

The stimulus for these great cycles is found in periodic changes in the angle of Earth's rotational axis and in the shape of its orbit around the sun.

Through millions of years, these changes have triggered great cycles between ice ages and interglacials. What Earth scientists have come to understand is that once an era of warming or cooling begins, the processes of the carbon cycle act to accentuate it.

This kind of "positive feedback" occurs, for example, in a cooling climate when cooler temperatures enable both the oceans and also Earth's soil to absorb more carbon. This greater carbon absorption, by drawing down the level of carbon dioxide in the atmosphere, reduces the greenhouse effect and adds further to Earth's cooling.

For Earth science, it is now a fundamental principle that such positive feedback makes CO_2 and temperature mutually reinforcing, both on the way up and on the way down. Through the periodic ice ages and interglacials of last 400,000 years, this phenomenon is especially well documented. Indeed, during those cycles Earth's temperature has moved in almost perfect correlation with the level of CO_2.

It is this mechanism – the most fundamental of Earth systems – with which humanity is now tampering.

We can measure this tampering in terms of atmospheric concentration of greenhouse gases. Over the past 400,000 years, this density has oscillated between 175 and 275 parts per million. When the Industrial Revolution began, the greenhouse concentration happened to be at the top of this range and could have been expected to fall gradually in the absence of human effect.

Instead, greenhouse density is racing upward and off history's chart. Today greenhouse density stands at an unprecedented level of 380 parts per million.

This density is growing at the rate of 2-3 ppm per year. Earth scientists believe that somewhere between 450-550 ppm the build-up of greenhouse gases will become irreversible, at least for thousands of years.

While the driver in this process is fossil fuel use, a main contributing factor is the drastic reduction in Earth's carbon absorption capacity because so much of our planet's fertile surface has been converted from forest to farmland to feed the expanding population that is producing those emissions.

This pair of factors alone constitutes a full-blown global emergency. But the danger is compounded by scientific concern that a combination of positive feedback phenomena could not only accelerate the warming process but also create tipping points of enormous instability and violent climate change:

1) First is reduced reflectivity. The loss of Artic, Greenland, Antarctic and other ice will reduce Earth's reflectivity. Also, in Siberia and Canada, snow covered land will be replaced by heat-absorbing boreal forests.

2) Second is a loss of cooling from algae in the sea. Warming seas, by stratifying, become inhospitable to algae, reducing their huge role as a CO_2 absorber and as a producer of protective clouds. The clouds result from the algae's release of the chemical DMS -- dimethyl sulfide.

3) Third is the loss of cooling from tropical forests. As hotter temperatures destabilize the ecosystems of tropical forests, turning them to desert and scrub, they will cease to absorb CO_2 and to produce protective cloud-cover. The same land will instead become a heat-absorbing surface.

4) Fourth is methane release from thawing tundra. In Serbia and Alaska, thawing tundra will release massive amounts of methane, a greenhouse gas 24 times more potent than CO_2.

5) Finally, there will be a collective release of CO_2 from dying algae and forests, and from fires that will sweep across the vast plains of dried tundra.

At least some negative feedback – to slow global warming – is also expected. For example, turbulent weather could help to roil the seas, preventing stratification and the loss of algae. And in a warmer climate, greater growth of moss on rocks could add to CO_2 absorption. But Earth science evaluates negative feedback effects as weak against the more powerful effects of positive feedback.

It is the "locking-in" effect of positive feedback that yields the prediction by Earth science that global warming will become irreversible at a greenhouse density of about 500 ppm.

A wildcard for Earth scientists is what impact global warming may have on the great ocean currents that influence climate by transferring heat throughout our world. This flow is driven by wind and by disparities in water temperature and salinity. In particular, much investigation is focused on whether and when the flooding of the north Atlantic with fresh water from melting ice could begin to blunt the Gulf Stream.

If this occurred, either suddenly or gradually, global warming could have the paradoxical effect of plunging temperatures in Europe and North America. But any such chilling effect from reduced heat transfer would be regional only. If and as London and Paris descended into the frigid climate of Lapland, an even sharper temperature rise would occur somewhere else. Inside the greenhouse, there is no escape.

The Gulf Stream question illustrates the unknowable in climate change. But what we do know is that the sharp rise in global temperature now projected has no precedent in human history, either in suddenness or in severity. We know too that our best Earth scientists are now warning, as a matter of informed judgment, that the global consequences will be sweeping and disastrous in scope.

The Crucial Premise for Action

Given the stakes, our response to this crisis must derive from a simple application of the precautionary principle and from simple logic. We must achieve a clean-energy revolution. Indeed, the urgency of a global transformation to clean-energy technology should now be apparent to any literate person not in a state of psychological or political denial.

Our starting point for action must be agreement on a basic premise that emerges from every authoritative analysis:

> *Humankind cannot conceivably achieve a global clean-energy revolution without a huge expansion of nuclear power – to generate electricity, to produce hydrogen and battery power for tomorrow's vehicles, and to desalinate seawater in response to the world's rapidly emerging fresh-water crisis.*

To view this as even a close call is to ignore all available evidence and to succumb to the taboos and unexamined mythologies of institutionalized environmentalism.

Under fair and dispassionate examination, nuclear power is indeed no less than the quintessential energy resource for sustainable development:

- Its fuel will be readily available for multiple centuries
- Its presence confers energy autonomy
- Its safety record is superior among major energy sources
- Its consumption causes virtually no pollution or greenhouse gases
- Its use preserves fossil resources for future generations
- Its capacities are scalable, from smaller reactors to large
- Its costs are competitive and declining
- Its waste can be secured over the long-term
- Its operations are manageable in developed & developing nations.

> *Note that these characteristics also meet the challenge of energy security in the new and broader sense. Nuclear power is not only clean but also confers affordable, widely adaptable energy autonomy to developed and developing nations alike.*

Most certainly, renewables such solar and wind and tidal and geothermal must have a role. So too must energy conservation and higher energy efficiency. But none of these tools can alter the central fact that nuclear power offers the one available technological workhorse to energize a thriving economy without destructive environmental impact.

Recognition of this truth, and action based upon it, is now reflected in a worldwide nuclear renaissance that is gathering speed and momentum.

This renaissance has not begun from a standing start. For four consecutive decades, nuclear power has been the world's fastest-growing major energy source. Some 31 nations representing two-thirds of humanity already have nuclear power, and their use of it produces one-sixth of global electricity.

The nuclear revitalization represents a confluence of developments:

- Continuing evolutionary advance in reactor technology
- Multinational research efforts to produce quantum leaps in technology
- Unprecedented levels of efficiency and capacity utilisation in key countries
- A robust and accumulating record of operational safety, backed by the emergence of a global nuclear safety culture

- Political progress in implementing the scientifically sound concept of waste disposal using deep geological repositories
- And the truest barometer – expansive growth planning for nuclear power in major nations in both the developed and developing worlds.

In some two dozen countries representing the preponderance of world economic activity and world population – from North America across much of Europe to Russia and on to the leading countries of South and East Asia – the value of nuclear power has been reviewed and reaffirmed.

Major countries without nuclear power – such as Poland, Turkey, Vietnam, Indonesia, and Kazakhstan – stand on the threshold of introducing nuclear energy for the first time.

Even on continents with little or no nuclear power, the political context for nuclear energy has changed. The South African government has formally embraced nuclear power and now seeks a role of international leadership in reactor technology innovation. And in Australia, with its world-leading reserves of uranium but a long-standing policy of shunning nuclear power, politicians have begun a serious national debate.

To be sure, anti-nuclear convictions can still be found:

- In the mythologies that motivate many environmental groups
- In the assumptions of environmental journalists and bureaucrats
- In the rhetoric emanating from small countries like Denmark and Austria, whose credibility must be weighed against their reliance on the importation of nuclear electricity, and
- In the case of Germany, in the declaratory policy of a major country which remains bizarrely captive to an outdated anti-nuclear ideology even after the election victory of a pro-nuclear party.

But all of these reactionary forces, taken together, are receding under the onslaught of facts that are too strong to be forever distorted or denied.

All around the world, old-school anti-nuclear environmentalism is being eclipsed by a new realism that recognises nuclear energy's essential virtue: its capacity to deliver cleanly generated power safely, reliably, and on a massive scale.

For the nuclear industry – from uranium miners to technology vendors to plant constructors – this expansive outlook offers a promising future.

But for serious environmentalists, current projections can provide little comfort – not because nuclear energy is growing but because it is not yet growing fast enough to play its needed role in the clean-energy revolution our world so desperately needs.

We must ask two crucial questions:

- First, where do industry and government stand in meeting legitimate public concerns about nuclear energy?

- Second, what must now be done to accelerate the nuclear renaissance?

Meeting Legitimate Public Concerns

As to the "public concerns" so often cited in daily journalism, a fair assessment shows that not one poses a reasonable obstacle to a global expansion of nuclear power.

1) Proliferation. Nuclear proliferation, of course, remains a global concern, and much can be said about how best to deal with the few rogue nations that may seek atomic weapons by constructing facilities that can produce weapons-usable material. The industry stands ready to work with the IAEA and national governments in exploring ways to curtail this risk.

But the essential truths are these:

- The proliferation danger inheres in nuclear knowledge and the intent of governments
- The global non-proliferation and safeguards system effectively curtails any link between civil and military programmes, and actually helps to detect and deter illicit nuclear activity, and
- Most fundamentally, whatever proliferation risk we face would be unaffected even by a 20-fold increase in the global use of safeguarded nuclear reactors to produce clean energy.

2) Operational Safety. Second, the industry has met the challenge of operational safety through technological advance and a global nuclear safety culture that draws on some 12,000 reactor-years of practical experience.

Just as the NPT is a great feat in traditional diplomacy, the creation of WANO – with its network of safety cooperation encompassing every power reactor worldwide – represents an historic attainment in *private-sector* diplomacy.

The nuclear industry's greatest responsibility is to maintain and build on its already impressive record of nuclear safety.

3) Cost Reduction. On the cost front, the industry's steady reductions in both operational and capital costs are fast carrying us into a future in which nuclear power will emerge as a clear winner on the field of affordability.

These gains have occurred even without any consideration of environmental effects. Once governments begin to introduce serious emissions penalties – through emissions trading or carbon taxes – the balance will tilt even faster. Today nuclear power can easily dominate any market that imposes a real price for environmental damage.

4) Waste Management. As to waste, industry and government have the joint task of building public recognition that, contrary to common perception, waste is nuclear power's greatest comparative asset – precisely because the volume is minimal and can be safely managed without harm to people or the environment.

For its part, the industry has amassed an impressive record that includes:

- Safe disposal of all low-level waste
- Safe interim storage of all other end products from nearly a half century of nuclear power plant operations
- Safe transport of radioactive waste, with more than 20,000 containers of high-level waste and used fuel having travelled safely over a total distance of 20 million miles without a single instance of a serious radioactive release.

Where major responsibility lies now is with governments. A strong scientific consensus favours deep geological repositories as a safe and affordable means of achieving long-term storage of nuclear waste and used nuclear fuel. It is the duty of governments – following the lead of Finland, Sweden, Russia, and the USA – to summon the political will to implement this crucial component of the nuclear fuel cycle.

Accelerating the Nuclear Renaissance

Meeting legitimate public concerns about nuclear energy is clearly necessary – but not nearly sufficient to drive a nuclear renaissance that must attain global dynamism if we are to achieve a clean-energy revolution.

In three distinct areas, governments must take decisive action to grow an industry that now stands – in terms of operational and technological maturity – fully primed for the major growth our environmental challenge so clearly demands.

1) Construct a Comprehensive Global Regime. The first necessity is to move beyond Kyoto to construct a truly comprehensive, long-term climate regime that yields strong political signals – and economic incentives – for a worldwide transformation to clean-energy technology.

To be both effective and politically feasible, any such treaty must include all major nations, developed and developing, and must embody some variation on the principle of "contraction and convergence".

"Contraction" means that the agreement must produce, over a span of decades, a global reduction in greenhouse emissions on the order of 60%. "Convergence" means that the agreement must adopt the principle of equal per-capita emission rights.

The principle of equal emission rights is far from utopian:

- First, as a matter of political reality, it is the only feasible principle for a global agreement, and actually involves a concession from South to North by taking as "water under the bridge" the considerable environmental damage already done by the developed countries.

- Second, the gap between actual emissions and emissions rights provides the potential for a dynamic international trading mechanism that will promote universal efficiency in clean-energy investment while producing a large net flow of such investment from North to South.

From a Northern perspective, this economic assistance will be the most cost-effective in history if it helps to prevent the globally destructive growth in greenhouse emissions that might otherwise occur in the developing world.

This regime will no doubt be the most complex in history to negotiate. And indeed the task could prove beyond the wit of man. But the very process of negotiation toward the regime's clean-energy goal will send powerful investment signals to the entire world.

For years, economists have developed models of "win-win" welfare maximisation among parties with very different characteristics. A global climate change regime must now apply this body of learning to produce collective action aimed at the most dangerous security challenge ever faced by humankind.

2) Elevate Nuclear Investment to a National and International Policy Priority. The second necessity is to shape national policies and international institutions to directly support nuclear investment.

Over the long-term, nuclear power is competitive. But two factors now weigh against nuclear investment: the short-term bias of deregulated energy markets and the fact that 21st century nuclear reactors have not been built in sufficient numbers to achieve economies of scale.

As a strong step toward their own energy autonomy and as a strong response to our world's urgent environmental imperative, national governments should act to incentivize immediate nuclear investments. This pump priming can be achieved by temporary production subsidies, loan guarantees, or investment tax credits.

The goal, it bears emphasis, is not to subsidise long-term nuclear operations but simply to accelerate the nuclear renaissance for reasons of national interest and the global environment.

A similar rationale applies, at the international level, among the global institutions we established a half-century ago to meet urgent developmental needs. Today it is a fundamental failing of the UN system that, at this crucial juncture, all of its major development institutions continue to embrace, or to be intimidated by, old-school anti-nuclear environmentalism. The IAEA stands isolated and alone in working to promote the peaceful uses of nuclear energy. While an unprecedented global crisis intensifies, others fiddle in a safe cocoon of political correctness.

Governments must now direct the World Bank and the UN Development and Environment Programmes to act in pursuit of a clean-energy vision in which nuclear power holds a central role.

*3) **Preparing the Nuclear Profession for a Nuclear Century.*** A third imperative on which governments must act is to apply the concept of nuclear investment to the human level – by actively stimulating and supporting enrolments in the study of nuclear science and technology. The nuclear profession must be readied for a nuclear century.

There is today an enormous disparity between the fact of the unfolding nuclear renaissance and the pace at which we are educating a new generation of nuclear scientists and engineers. In many nations, the decisions of students choosing career paths are not yet being informed by recognition of the value of nuclear energy and the inevitability of its sharply expanding use worldwide.

Eventually, market forces will rectify this disparity between the demand and supply for skilled nuclear personnel. But a failure to be pro-active in stimulating nuclear education will make the correction inefficient and thereby delay the nuclear renaissance.

To help point the way toward a globalising nuclear profession, the World Nuclear Association has worked with the IAEA, WANO, and the NEA to create the new World Nuclear University. The WNU is a worldwide partnership of leading institutions of nuclear learning. Its aims are:

- To enhance nuclear coursework at participating institutions worldwide
- To establish widely accepted global standards in academic and professional qualification, and
- To inspire young professionals and to elevate the prestige of the nuclear profession.

To support this institutional cooperation, what is urgently needed is a major global infusion of scholarship funds for study in nuclear science and technology. Governments around the world should marshal their own resources – and summon the support of the great philanthropies – if we are to build the professional global cadre that can apply nuclear technology successfully to meet a desperate world need.

At a Perilous Point in History, a Technology and a Profession of Indispensable Value

My summary is this: If history is a river, we have reached the white water. We face a challenge unprecedented in human experience.

This challenge has arisen from the untrammelled consequences of technological progress, and humanity must meet it with an adroit technological response. Doing so will require every ounce of political will and human ingenuity we can muster through the combined forces of industry and government.

Let us attach numbers to the challenge we face. Today nuclear energy is using 440 reactors to produce one-sixth of the world's electricity. From an environmental perspective, it will not be adequate if the nuclear industry simply doubles, or triples, or quadruples its capacity in this century. Indeed, it will not be adequate to meet the needs of a global clean-energy revolution even if we multiple nuclear generation by a factor of ten in this century.

We must place ourselves on a trajectory for a 21st century nuclear industry that achieves the deployment of nothing less than 8,000-10,000 Gigawatts of nuclear power – a twenty-fold increase. To plan for anything less would be to invite environmental disaster.

In the early 1930's, recognizing an impending world threat of an entirely different kind, Winston Churchill called for British rearmament as the only hope of forestalling it. "Never," he said, "has an insurance so blessed and so fertile been procurable so cheaply." Today the same could be said of nuclear power.

Another great Englishman, George Orwell, saw life as "a race between education and catastrophe". Today this adage applies to all humankind. Our world is in dire peril, the race between education and catastrophe is underway, and we have no time to lose.