**BRITISH NUCLEAR INDUSTRY FORUM**
**SUBMISSION TO THE ENERGY POLICY REVIEW**

## CONTENTS

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*The British Nuclear Industry Forum (BNIF) welcomes this opportunity to submit its views to the Government's Energy Policy Review conducted by the Performance and Innovation Unit (PIU). BNIF is the trade association and representative organisation for over 60 companies involved in the UK civil nuclear industry companies including the operators of the nuclear power stations, engineering and construction firms, nuclear equipment suppliers, the nuclear research facilities and companies engaged in decommissioning, waste management, nuclear liabilities management and all aspects of the nuclear fuel cycle. BNIF also acts as the UK industry's representative and liaison point in relations with nuclear industries and organisations abroad, and is therefore able to bring an international dimension to its activities and information.*

# Introduction

This submission to the PIU principally concerns the role and contribution of nuclear energy in the UK's long-term energy strategy and policy; it describes the current important role of nuclear energy in the UK, and highlights both the risks to the nation of the removal of nuclear from the energy mix and the sorts of policy measures that will be required to maintain the UK nuclear option. Some of BNIF's member companies – including the two major operators, British Energy and BNFL - will be making their own submissions which will reflect their corporate concerns and provide valuable detailed information about their activities and projected plans. BNIF's submission provides a broader pan-industry view taking account of the interests of BNIF's total membership.

BNIF believes it is the right moment to look at the UK's long-term energy strategy after just over a decade in which policy has concentrated on creating a competitive market in electricity, and during which time the UK has benefited from the emergence of a 'balanced' energy supply derived from indigenous sources. While the whole of the OECD has benefited from steadily falling world oil prices in real terms for two decades, the UK has particularly been favoured by its emergence as a major oil producer and net exporter from 1980 onwards, and its tripling of natural gas production over the same period. During the 1990s as the electricity market was liberalised, gas emerged as the major new competitive source of electricity generation.

Meanwhile, improvements in nuclear performance in the 90's were dramatic. Output increased by 49% from 1990 to 1999, and combined with the gas entry this enabled the UK to improve its environmental performance and become one of the few countries likely to meet its Kyoto targets for reducing greenhouse gas emissions to counteract the impact of climate change.

However, indications have been provided by government and repeated in the PIU scoping document that the UK's period of oil and gas abundance will not prevail, and that action will be needed to maintain and fulfil the Government's energy policy objectives of diverse,

secure and sustainable sources of energy at competitive prices over the decades to the middle of the century. The indications are that Britain will become a major importer over the next decade or two of both oil and gas, and as early as 2010 it seems likely that continental developments will determine UK gas - and therefore electricity - prices.

Further increased dependence on imported gas - Government projections indicate that between 55%-90% of total consumption could be imported by 2020 - will only exacerbate this effect. This exposes the UK to considerable risk, particularly when it is borne in mind that about 38% of world reserves are in the Former Soviet Union and a further 35% in the Middle East, neither of which regions has histories of political stability. In addition, the history of hydrocarbon prices over the past three decades has been one of extreme instability at a world and even UK level. Just in the past year European gas prices have risen by 59%, North American gas prices by 81%, and world oil prices by 60% in real terms. Such fluctuations should encourage a cautious view of trends in hydrocarbon prices over a fifty-year horizon.

Meanwhile, over the next twenty years almost all of Britain's presently operating nuclear power stations will have closed, half of existing plant capacity in the next ten years. This removes from the generating mix a reliable and carbon-free source of about a quarter of the UK's current electricity needs. These factors in combination have implications for the security and diversity of the UK's future energy supplies, and with continued reliance on market forces, (but omitting the 'polluter pays' principal) – the nation is heading for a degree of reliance on external sources of electricity fuel that has never existed before.

Moreover, there are important implications for the UK's future environmental performance as the electricity generating system is likely to become more carbon intensive, which the Government itself has acknowledged in its Climate Change draft UK programme. This rise in carbon emissions will be taking place at a time when, according to the Report of the Royal Commission on Environmental Pollution, *Energy – the changing climate* (CM4749), Britain should be aiming to reduce carbon dioxide emissions by up to 60% by 2050 to stabilise atmospheric concentrations of carbon dioxide at 550 parts per million per volume (ppmv) as part of global efforts to combat the threat of climate change.

BNIF agrees with the PIU scoping document that fundamental action is needed to fulfil the Government's energy policy objectives of diverse, secure and sustainable sources of energy at competitive prices over the decades to the middle of the century and, at the same time to achieve its environmental performance targets. The UK Government has to resolve the conflicts between these interacting policies in the lowest risk manner. In some quarters it is envisaged to meet the challenge with as yet unproven technologies: clean coal, micro gas-turbines, hydrogen, some renewables, and energy efficiency technologies that have been mainstays of energy policy for decades and have been shown to have their own limitations. (Of these, only renewables have the potential for carbon-free generation, but in general without reliability of supply). Meanwhile, the future contribution of nuclear energy - the only proven technology capable of producing large-scale, continuous and reliable sources of electricity with negligible emissions of carbon dioxide - is frequently discounted, often for ideological reasons. BNIF believes that decisions on future nuclear projects will require public involvement and acceptance, but maintains that perceived public attitudes towards nuclear energy should not inhibit a thorough examination of nuclear's long-term

contribution to Britain's energy supply. Identifying and managing the policy risks associated with future scenarios is, therefore, an integral and important part of policy development.

Against this background of increasing risk in the nation's future energy and environmental policies, early decisions by Government on some key issues will have to be taken, not avoided, if Britain is to achieve a sustainable long-term energy policy. In BNIF's view the Government's hitherto tacit acceptance of an inevitable decline in the contribution of nuclear energy needs to be urgently re-assessed since the potential loss of the UK nuclear option is a critical factor in determining the scale and severity of the policy risks the Government will face in the next half century.

## The Energy Review

The Energy Review provides an opportunity to contribute to a Government approach aimed at developing a 'joined-up' energy policy that will resolve three key challenges: -

- managing potential conflict between market and environmental objectives
- ensuring continued security and diversity of energy supply
- keeping important energy options open

The requirement is to develop policies and measures to maintain long-term energy security and diversity at internationally competitive prices over a fifty-year horizon, while at the same time achieving Government targets for reducing $CO_2$ and other greenhouse gas emissions by up to 60% by 2050 on the Royal Commission on Environmental Pollution's (RCEP) recommendations, in the context of the following factors and challenges: -

- Gas import danger. Projected to reach 15% by 2006, and between 55%-90% by 2020
- Oil import danger. Projected net importer by 2006/7
- The current plateau and then sharp decline in the nuclear contribution to electricity supply in period to 2020
- Lessons from California where the regulatory regime gave no incentive for investment in new generating capacity, causing energy shortages and interruptions in supply across the world's seventh largest economy
- Tension between social policy objectives relating to the abolition of fuel poverty and environmental initiatives to reduce emissions by fiscal means.

The greatest contribution to the UK's improved environmental performance in the past decade has been made by the electricity supply industry. A strong improvement in nuclear performance and output and the displacement of coal by gas significantly reduced carbon emissions – nuclear generation currently saves the emission of between 12 and 24 million tonnes of carbon a year (43-86 $MtCO_2$).[*] The electricity supply industry cannot realistically deliver the same scale of emissions reductions again. In fact, under the current scenario with no replacement nuclear build as existing units reach end of life carbon emissions will

[*] Depending on which fossil fuel is assumed to have been replaced.

increase because Britain's nuclear capacity is likely to be replaced by gas. This is true even with the very ambitious planned contributions from renewable plant and conservation measures.

While this submission will focus on the role and contribution of nuclear energy against the background sketched above, it is important to emphasise that in BNIF's view nuclear energy is one of a raft of technologies and measures that are either available or could be developed to fulfil the Government's strategic energy policy and environmental objectives. While BNIF cautions against placing undue reliance on or confidence in the claims made for alternative technologies, we fully support measures to encourage the development of other low and non carbon emitting energy sources, such as renewables, as well as the creation of emissions trading schemes and/or the introduction of fiscal measures to reduce emissions.

However, BNIF has serious concerns and reservations about the ways in which market pressures under NETA in fact disadvantage low and carbon-free sources of electricity generation. In addition, some of the fiscal measures that have been introduced, such as the Climate Change Levy (CCL), discriminate illogically against nuclear energy and large-scale hydroelectric schemes, thus failing to recognise and reward their carbon-free qualities. Large, long-term investments are particularly disadvantaged by regulatory uncertainty and changing market conditions. NETA represented a major shift from the Pool arrangements of the previous ten years, and it must be assumed that further radical changes will accompany wider European energy market integration.

Beyond the electricity supply industry, policy attention will also have to be given to other - more challenging - sectors of the economy. In particular, strong measures are needed to deal with emissions from transport, which is the most rapidly growing sector and is projected to account for almost 40% of $CO_2$ emissions by 2020. This will be crucial to the success of the Government's strategy. The replacement of oil-burning propulsion systems with hydrogen and electricity systems will only be of use if the mechanism for generating these "new fuels" is, in itself, a low carbon emitter.

> ***BNIF believes that any overall policy that can realistically be expected to address all the competing challenges must support and encourage the transition to a low carbon energy economy, and has to include a continued long-term significant contribution of nuclear electricity generation to energy supply in the UK.***

## The Current Role of Nuclear Energy in UK Energy Supply

Nuclear power currently safely supplies around a quarter of the electricity in the UK, contributing to security and diversity of supply with negligible emissions of greenhouse

gases, and avoids the emission of around 12 to 24 million tonnes* of carbon (43 to 86 $MtCO_2$) a year. Nor do nuclear stations emit the oxides of sulphur and nitrogen that cause acid rain and urban smog. In terms of lifecycle emissions associated with the construction, operation and decommissioning of various energy technologies, nuclear power emissions are lower even than some renewable technologies such as solar energy, and significantly lower than either gas or coal.

The performance and output of Britain's nuclear power stations improved very substantially in the 1990s largely in response to the creation of a competitive electricity market in 1989/90, and the transfer of assets to dedicated nuclear companies. The companies that were to form British Energy, which operates the AGR stations and the Sizewell B PWR, were proved to be sufficiently competitive to enter the private sector in 1996. The older Magnox stations have remained in the public sector, and are operated by BNFL. It is, however, accepted that the majority of economically viable gains in terms of increased output and extensions to operating lifetimes for the Magnox and AGR plant have either been achieved or are accounted for in projections of nuclear's future contribution to Britain's electricity supply. Prospects exist for extending the operating life of the Sizewell B PWR.

Nuclear energy is a long-standing part of the diverse British electricity supply industry. The UK's nuclear power industry has been built upon a mature (50 years of expertise) and continuously improving technology. The UK industry as a whole provides direct employment for a highly technically skilled workforce of about 30,000 throughout the UK, which in turn directly generates work for about another 30,000 people over a fairly wide geographic spread in the UK.

The British Nuclear Industry also has an important international dimension. Many of BNIF's member companies have significant business in non-nuclear sectors and are also involved in overseas work and investments. Extensive experience and skills in areas such as reactor design and construction, reactor operation, maintenance and inspection, and in waste management decommissioning technology carries considerable export business and potential in an increasingly global nuclear market. There are almost 440 operating nuclear power stations in the world, and the British industry is winning a valuable share of the business to enhance and upgrade these units to improve safety, especially in Central and Eastern Europe. It is also winning component contracts in support of new nuclear construction in those regions and in Asia Pacific. The global market for fuel services, waste management and decommissioning, in which British companies are world-leaders, is estimated at an annual value of £13.5bn. The industry's exports were worth about £700m in 2000**.** The UK nuclear industry is an important sector both in its manufacturing, and in its science and technology, bases. The annual turnover is approximately £5bn, and it contributed an estimated £3.3bn to national GDP in 2000. Many of the skills developed in the nuclear field offer technology transfers to other industrial sectors, such as medicine, and nuclear energy can be used in valuable development work such as desalination of water supplies.

* Depending on which fossil fuel is assumed to have been replaced.

The signs are that nuclear power, after two difficult decades, is experiencing a recovery in a number of important world markets, for example nuclear energy is moving high up the agenda of business opportunity in North America where UK companies have a significant stake. British Energy has invested in nuclear plant operations in the USA and Canada and BNFL owns one of only three major global reactor technology companies. Many companies in the UK supply chain are also integrated into the worldwide market.

This resurgence of nuclear energy is based on large global improvements in nuclear productivity and safety, as well as the emergence of higher fossil fuel prices. The World Association of Nuclear Operators (WANO) records an improvement in load factor from 77% to 86% (rounded) in the decade from 1990 to 2000 for the nearly 440 units operating worldwide. These performance improvements were accompanied by improvements in conventional and nuclear safety standards.

> ***The British nuclear industry provides significant energy supply, economic and environmental benefits to the UK, and is well placed to take advantage of an international resurgence of business opportunities.***

## The Future Role of Nuclear Energy in UK Energy Policy

Nuclear energy has made great strides forward in the last decade. It contributes significant benefits to the UK's energy supply and economy, through efficient and competitive electricity generation and, at the same time, confers environmental advantages through its minimal operating emissions. A recently published study by the European Commission on the external costs to health and the environment of various energy sources (the ExternE study) confirms the very low pollution caused by nuclear energy in contrast to burning fossil fuels. One of the main findings is that the cost of producing electricity from burning coal or oil would double if external costs were taken into account in EU countries. Making the same adjustment for gas would mean a 30% increase in electricity production costs.

> ***BNIF believes that the benefits of nuclear energy should continue to be available; and that, as existing nuclear capacity is lost, the lowest risk option to ensure that the security and environmental challenges are met is to replace it with new nuclear generation.***

There are a number of important issues relevant to that possible scenario: -

- economics
- public opinion
- waste management
- safety and regulation
- skills, expertise and infrastructure

***Economics***

*Existing nuclear*

Nuclear power stations are the cheapest UK generators when costs are compared with other base load generators on an avoidable cost basis. However, following the sharply lower baseload electricity prices from March 2000, existing nuclear power stations were not profitable on a total cost basis i.e. when amortisation of capital costs is taken into account. For this reason British Energy has embarked on a further round of savings to reduce costs by another £150m per year over the next three years.

In other countries such as the USA nuclear power fares better for several reasons: -

1. fuel management costs - US nuclear stations have a standing contractual arrangement with the US Government for the management of their used fuel. That arrangement is advantageous to US generators and gives certainty in relation to their costs
2. rate of return - in states where deregulation has not taken place, nuclear assets are able to earn a regulated rate of return based on their original capital cost
3. "write-downs" – in states that have deregulated the capital value of nuclear plants is normally written down to an economic value that reflects the lower prices that deregulation brings.

*Replacement/New build*

New nuclear power stations will benefit from having low operating costs when compared with gas-fired and coal generators. This is a result of the low unit cost of primary fuel – uranium, which is in abundant supply - compared to gas and coal. It should also be noted that electricity generation by nuclear is far less sensitive to fuel prices than gas generation. A doubling of uranium prices would increase costs by about 6% compared with an increase of about 70% for a doubling of gas prices. This in turn makes the total cost of nuclear power more stable than that from gas-fired generators who are significantly exposed to the volatility of the oil and gas markets, as evidenced recently in California (and other areas).

However, nuclear power stations have had much higher construction costs and longer construction periods than those typical for a combined cycle gas turbine facility.

Although nuclear technology and construction methods have advanced considerably since Sizewell B was brought on line, the total lifetime cost of constructing and operating a new nuclear plant in the UK would not be viable with electricity prices at their mid 2001 level, combined with the existing regulatory and planning regime and current treatment of carbon abatement. As a result there are no current plans for new nuclear build in the UK, whilst ~ 7 GW of gas-fired capacity has planning consent.

It is interesting, though, to note that a recent application for construction of a nuclear power station in Finland was based on unit generating costs which, at 2.15 eurocents per kWh, were lower than those for gas generation at 2.6 eurocents per kWh.

The economic issues for new nuclear plant are quite complex. Their relative profitability depends heavily on future price scenarios of competing fuels, on market structure, and on the way in which environmental 'externalities' will eventually be brought into play. For example, mechanisms that recognise and reward carbon free electricity – such as Climate Change Levy or carbon tax – could include nuclear and would help provide that bridge. This would also have the benefit of correcting the current policy anomaly whereby carbon free nuclear is treated exactly the same as major polluting fossil-fuel plant.

The high capital cost of a nuclear power station (it is not unique in this respect), and the risk of having capital tied up for long periods during which time there could be construction and/or political risks would appear to discourage private investment in nuclear projects. However, these and other potential barriers can be overcome if certain conditions are met. These conditions are examined in more detail below in the section *A stable and predictable scenario for energy sources* (page 17-18)

If a decision were made to commence a programme of replacement build to fill the "nuclear energy gap" caused by the retirement of existing stations, the equivalent to between 8 and 12 water reactors depending on the size of plant would be required to be on-stream progressively over the next twenty-five years. With such a series build, learning curve principles would apply and could be used to estimate the prospects for further reductions in generating costs, just as lessons learned from overseas and the UK assisted in the last two AGRs at Torness and Heysham 2 being built to time and cost, as was Sizewell B to the time and cost budgets inherited by Nuclear Electric in 1990.

All but one of Britain's nuclear power stations is of gas-cooled design and many of them are of unique design, meaning that the benefits of series build and replication have never been achieved in Britain as they have elsewhere. In contrast, the internationally proven technology of water reactors means that from a technical point of view, these are the only likely option for replacement build in the near future. Assuming, conservatively, that stations have a 40 year operating life, any stations contemplated in the near future would be operating in 2050, and although there appears to be good promise in new reactor types like the South African Pebble Bed Modular Reactor (PBMR) - in which BNFL has a minority stake - realistically any early replacement reactors will utilise established or evolutionary developments of water reactor technology.

France, where almost 80% of electricity is generated from nuclear energy, has benefited significantly from standardisation of design and series build. A recent evaluation by Electricite de France (EdF) of size and series effects on generating costs using models with learning rates of approximately 10% for the series effect, with a much greater improvement rates (approximately 30%) when moving on from "first-of-a-kind".

The combination of advanced technical features with factors such as series build (typically 2 or more units built simultaneously), lower discount rates, and high availability has led to estimates of the generating costs for the new generation of reactors – such as the BNFL/Westinghouse AP 600 and AP 1000 and the Canadian CANDU NG – of between 2.2p – 3p per kWh.

In the longer term, both the US Department of Energy's (DoE) Generation IV International Forum and the International Atomic Energy Agency's (IAEA) Innovative Reactor Project are investigating the R&D requirements for reactors that will be competitive - with lower construction costs of around $1000/kW (about £700/kW), equivalent to generating costs of around 3c/kWh (about 2p/kWh); provide exceptional safety through the incorporation of passive safety features; and minimise waste production. The UK nuclear industry is involved in both projects.

> ***The replacement of the UK's existing fleet of nuclear stations with new reactor designs, incorporating passive safety features, could, with the benefits of series build, deliver competitive nuclear generation costs.***

***Public opinion***

The industry understands and accepts that future nuclear developments will depend upon transparency, and stakeholder acceptance, especially by the public. In the past, the nuclear industry had an unfortunate image of secrecy. Much of this derived from its military origins, and from the culture that the military programme required. The nuclear industry was slow to address public concerns about openness and acknowledges that this created an impression of arrogance. However the industry has made stringent efforts for over a decade to improve openness and transparency by actively engaging with a wide range of stakeholders who have an interest in and are affected by the industry's activities. The 'stakeholder dialogues' initiated by BNFL and Nirex, the visitors centres at nuclear sites, and the educational materials and information provided on nuclear industry websites, continue to give evidence of the industry's commitment to involving and informing the public.

Government, too, has a responsibility in respect of stakeholder acceptance. The hitherto tacit acceptance by Government of an inevitable decline in the significant contribution made by nuclear energy to electricity supply and environmental objectives has been both short sighted and timid in the face of the serious environmental consequences of climate change, and the threats to energy security posed by an increased reliance on imported sources.

What is required is a balanced debate involving views and opinions of all parties including the public. The nuclear industry is keen to take its part of the responsibility to ensure that the public is well informed about all aspects of nuclear energy, the alternatives, the benefits of retaining the nuclear option and the risks associated with any removal of nuclear energy from the equation.

For example, it is important to create a distinction in the public mind between the "historical nuclear legacy" issues that intertwine military and civil nuclear activities and the environmental impacts that could be expected from a replacement nuclear power programme, undertaken for purely commercial ends and designed from the outset to minimise environmental damage.

Great care has to be taken in gauging public opinion. Vociferous minority groups or loaded questioning can give a misleading impression of the real thoughts and concerns of the general public. Evidence from opinion surveys conducted in the UK and USA indicate that public opinion on nuclear energy is not as negative as might be assumed, and that opinions can improve substantially in the light of events and information.

In 1999 MPs questioned by MORI thought that only 2% of the UK population were in favour of nuclear energy, whereas the actual figure was 28%; similarly, they thought that 83% would be very unfavourable, when the actual figure was 25%. This not only suggests that public opinion may not be as intractable as many people think, but also challenges the notion that there are 'no votes' for politicians in the issue.

Very recent experience in the USA shows how rapidly public opinion can change in the light of events, in this case power cuts in California and the threat of power shortages elsewhere. Since the crisis in California, support for the construction of new nuclear power stations among the American public has risen to 66%, a 15% increase on January 2001, and a 24% increase on October 1999. The largest increase was in western USA where 62% wanted new plant, compared to 33% in 1999.

Poll data over recent years from Sweden and Germany is also positive, and the significance is that these two countries have had very thorough public discourse on nuclear energy for many decades coupled with having to think hard about the implications of moving away from nuclear.

> ***BNIF believes that an open, transparent, balanced, well-informed and rational public debate initiated by Government about <u>all</u> aspects of energy usage – environmental, economic, sources of supply – is overdue.***

***Waste management***

The industry suffers currently from the absence of a clear government policy. One common objection to replacement nuclear capacity is the lack of an agreed route for the ultimate disposal of intermediate and high level nuclear waste. Last year's Royal Commission on Environmental Pollution report, while recognising nuclear energy's benefits as a carbon-free source of electricity, calls for a "…solution of the waste management problem, to the satisfaction of both the scientific community and the general public, before new nuclear power stations are constructed". The long-awaited Government consultation document on a waste management strategy in response to the comprehensive and authoritative House of Lords' Select Committee Report of 1999 is likely to be published later this year by the Department of Environment, Food and Rural Affairs, and will mark an important step in that process of decision-making.

It is a fact that nuclear wastes exist in the UK, are currently stored safely at licensed sites and can continue to be stored for many decades pending agreement on a longer-term solution. Technical solutions for ultimate disposal are available, and have gained public acceptance in other countries. In Finland, for example, a policy decision by the State Council in 1983 set out the objectives and schedule for a repository programme and final

site selection for spent fuel and high level waste. Bedrock exploration has been continuing for more than twenty years and technical solutions for disposal have already been developed. A final site has been selected, the public consulted, funding provisions have been made, and in May 2001 the Finnish Parliament approved the next stage towards a repository. Construction is likely to begin in 2010, with operation beginning in 2020. Sweden has an underground hard-rock laboratory in operation, and France has confirmed that work should proceed on two underground laboratories, one in clay and one in granite. The Americans are developing facilities for a repository at Yucca Mountain, and have an existing Waste Isolation Pilot Project (WIPP) facility at Carlsbad, New Mexico, which actively involved the public in the decision-making debate.

However, it is also a fact that in the UK Government decisions are required to enable existing UK wastes to be put into permanent disposal. Acknowledging the public concerns on this issue, BNIF contends that the biggest obstacle is the lack of policy, not of technical solutions. Also the diffuse responsibilities between Ministries seem to be a source of delay for the resolution of key issues, thus creating unhelpful uncertainty.

It must be emphasised that the bulk of the UK's inventory of intermediate and high level waste is part of a 'historical legacy' and is not an accurate indicator of future trends of material from civil nuclear electricity generation. Replacement nuclear stations of world standard will generate significantly lower quantities of waste per unit of electricity produced. For example, replacing the current nuclear fleet with LWRs would add only about one tenth of existing waste volumes for lifetime operation.

Moreover, while reprocessing is essential for Magnox fuel, it is merely an option for water reactors and decisions on whether or not to reprocess will be based on commercial, rather than technical and safety, considerations.

> ***BNIF believes that a process of decision-making involving public information and involvement which is seen to be leading towards an acceptable solution for waste management is essential, but the physical existence of the preferred solution should not be seen as a prerequisite for future nuclear development.***

### *Safety*

Safety has been, and remains, the number one priority for nuclear electricity generation in the UK. The UK safety record is excellent compared with other electricity generating systems and industrial sectors. The same applies throughout the world where there has been a steady improvement in safety over the last decade. In their joint report, *Nuclear Energy – the future climate* (1999), the Royal Society and Royal Academy of Engineering summarised the record of the worldwide civil nuclear industry programme over the past 45 years as "certainly one of remarkable safety". Because that record had been achieved during a "learning period", the expectation is that safety will improve still further. Indeed, an analysis entitled *Trends in Nuclear Safety* (April 2000) by Professor John Gittus that is based on international data on nuclear safety and performance concludes that on all the chosen indicators (criticality accidents, initiating events, core melt accidents, events reported on the International Nuclear Event Scale), "nuclear safety, reliability and

performance have improved over the last 10-20 years. Recent events, such as the Tokai Mura accident, do not go against this favourable trend".

Continuing with the same commitment, designs for replacement reactors have and are being developed with even higher levels of safety. For instance, passive safety features that rely on the forces of nature rather than engineered safety features are being incorporated into evolutionary LWRs, thus reducing the complexity (and cost) of the new generation of reactors. Such features are also being researched and developed in relation to 'fourth generation' plant, thus increasing confidence that nuclear safety will continue to improve.

Although the risks to health and life from the full cycle of nuclear electricity generation are far less per kWh produced than for fossil fuelled electricity generation, the nuclear industry cannot be complacent about safety standards. The impact of the Chernobyl disaster amply demonstrates this. The Chernobyl design of reactor could not have been licensed (let alone built and operated) in the West. Also the Chernobyl accident can be explained as an aberration insofar as it was an unauthorised experiment that involved deliberately shutting down safety systems, and took place in a restricted and secretive Soviet culture that was immune from outside scrutiny. However, the damage it caused, and the profound effect it has on the public perception of nuclear safety, serves to underline the requirement for the highest safety and regulatory standards to be applied wherever nuclear energy is deployed.

Several international safety initiatives involving peer review and exchanges of best practice have been taken by the IAEA, the World Association of Nuclear Operators (WANO) (formed following the Chernobyl accident), and the Convention on Nuclear Safety to ensure continuous improvements in nuclear safety and regulatory standards worldwide. Reports show safety improvements going hand in hand with significant performance and output improvements.

Concern about nuclear safety is undoubtedly a factor influencing public perception. The industry is committed to the open disclosure of information about safety and incidents that occur at nuclear sites through the INES system, and through its relations with its regulators and other stakeholders, for example in the local community, and the shareholders of private companies. The air of secrecy associated with the early days of the industry's history has no place in today's environment.

> ***Nuclear energy has an excellent and constantly improving safety record worldwide. The nuclear industry provides balanced information and facts about nuclear and conventional safety standards and performance. This, coupled with confidence in a responsible industry and a stringent regulator, should improve public opinion on nuclear power.***

***Skills, expertise and infrastructure***

A requirement of the Nuclear Site Licenses held by the operators (Licensees) is that there should be a sufficient resource of qualified personnel to manage the installation safely in all circumstances. The Licensees and their supply chain are therefore concerned to maintain a satisfactory resource of qualified and skilled staff through recruitment and training from

universities, colleges and from other employers. The prospect according to current plans is of declining numbers of qualified nuclear and skilled personnel, as the older element retires and recruitment is reduced in tune with the demands of the industry. As power stations are to be decommissioned, there is a reduction in employment.

There are a few specialist skills within the nuclear industry where absolute shortages are possible, but the main issue is much simpler; it is to recruit and retain staff of the appropriate quality. There is a general shortage of qualified physicists and engineers which combines with the more immediate appeal of visibly and rapidly innovating industries, such as information technology, biotechnology and finance that the nuclear industry finds hard to match. Although the problem may be more acute with the nuclear industry, we suspect that it will also be a factor across the range of energy and environmental industries.

BNIF and the nuclear industry recognise that it is essential to maintain resources of skilled and qualified people to fulfil the needs of the industry (which under all scenarios extends decades into the future). The main need is for a continuing resource of good quality engineers and scientists. Clearly, a factor that would improve the attractiveness of the industry to young people would be a commitment to and recognition by Government of a continuing future of nuclear power generation, offering a career prospect in the longer term.

Another important issue is ensuring adequate indigenous regulatory capacity as part of a facilitating package to maintain the nuclear option, particularly if there is to be a requirement for the licensing of a future reactor.

A replacement build programme that would maintain a significant nuclear component within the timescale required depends upon the availability in the UK of competent qualified nuclear professionals of all kinds, and the ability of the industry and the educational and training infrastructure to provide an adequate cadre to provide for licensing, construction and operation, and regulation of such units into the future.

The existence of this pool of competence into the future is under threat. Following the withdrawal of a proposal to build a sequel PWR after Sizewell B at the time of British Energy's privatisation in 1996 the team capable of handling follow up build quickly and efficiently was largely disbanded. The prospective closure of units and absence of adequate conditions for replacement build effectively discourages individuals from choosing a career in the nuclear industry, and in turn inhibits higher education provision and the industry's long term manpower plans.

Re-instating an industry from a very low or run down manpower base will always be possible – the accelerated French nuclear programme from 1973 gives one good example. However, it is evident that "stop-go" policies are both inefficient and would significantly delay and add to the costs of reintroducing the option if required at a later date.

***BNIF believes that in order to secure a nuclear option for the UK in terms of indigenous skills, expertise and infrastructure a clear supporting position from Government is required. The***

***price of inaction now may be the loss of a UK nuclear option, and attendant significant delay and cost in reintroducing the option if required at a later date.***

## Other Issues Pertinent to the Energy Policy Review

Assuming that there was broad political and public acceptance of the need for replacement nuclear capacity, there would still remain several issues that would need to be resolved before an actual project was likely to get off the ground. These are: -

- A stable and rational electricity market
- A stable and predictable nuclear regulatory framework
- A stable and predictable scenario for investment in energy sources
- A recognition of the strategic and environmental benefits of nuclear energy, as part of a mix of low and non-carbon energy sources

### *A stable and rational electricity market*

UK energy policy in the past decade has concentrated on the liberalisation of markets, and the introduction of competition into what were previously monopoly sectors. The process of restructuring in the electricity supply industry since its privatisation in 1989, and the operation of the electricity Pool for setting wholesale electricity prices followed by its replacement earlier this year by NETA, has been a volatile period, and the commercial fortunes of the nuclear generators in the past few years have fluctuated wildly. Britain's nuclear stations operate as base load whereas current market arrangements encourage flexible generation. If wholesale electricity prices were to remain at current historically low levels for a significant time into the future that would be likely to result in lower profits for nuclear generators unless compensating savings are found, or other forms of fiscal support that recognise and reward the environmental benefits of nuclear are introduced. Possible options include: exemption from the CCL; the introduction of a carbon tax; inclusion in the emission trading scheme; exclusion from the renewables obligation; (perversely, NETA also appears to penalise renewable energy schemes at a time when Government is committed to encouraging their development).

Modern water reactor technology can be operated more flexibly than the Magnox and AGR stations, so nuclear's base load characteristics should not of themselves be seen as a barrier to future nuclear development.

Although the logic of liberalised markets is for Government to withdraw from decision-making, the important strategic, economic, environmental and social impacts of energy markets mean that Governments retain certain regulatory and strategic responsibilities in relation to issues such as diversity, security safety and environmental protection, in addition to creating and monitoring market structures that ensure competition and deliver affordable energy to consumers. BNIF argues that free market mechanisms alone will not deliver the energy policy objectives of security, diversity, and sustainability. Nor do they incorporate the "polluter pays" principle that each major political party supports.

Government should therefore consider what form and scale of other market solutions are required to deliver its objectives. BNIF believes that economic instruments set at the correct level and giving proper market value to the strategic benefits of low carbon energy sources would encourage investment in R&D and production in those energy sources without the need for potentially costly and distorting administered interventions.

> ***BNIF believes that reliance solely on current market mechanisms will not guarantee the long run energy policy objectives of security, diversity, and sustainability. Government should therefore consider what form and scale of market-led solutions can deliver its objectives and what other policy areas (e.g. "polluter pays") should be addressed.***

### *A stable and predictable nuclear regulatory framework*

Government should balance the pursuit of competition, competitive prices and consumer choice through market liberalisation with a judicious mix of regulation and economic instruments to deliver a secure, diverse and sustainable long-term energy policy. The BNIF hopes that the energy policy review will eventually result in a clear statement of long-term energy strategy to form the context in which regulators can operate. The strategy should incorporate objectives relating to:

- security and diversity of supply
- promotion of competition
- protection of consumer interests
- development of low carbon energy sources and encouragement of energy efficiency
- environmental and sustainable development goals.

It should also take account of the consequences of further European energy market integration to ensure that UK market structures are not left isolated.

In addition to these factors, and of particular importance to the nuclear industry, is the regulation of safety. In the UK at present there are three main regulators of the nuclear industry – covering economic regulation (OFGEM), environmental regulation (Environment Agency, EA for England and Wales and SEPA in Scotland) and licensing and safety regulation (HSE/NII). Their demands are often incongruent and sometimes conflict, and their combined demands can be contradictory and therefore crippling. This is a major barrier to operation, let alone innovation.

For example, for new nuclear projects the NII is generally the lead regulator during the design and construction phases, but approval from the EA is needed before NII can approve the start of construction. Design and construction of a new nuclear power plant involves a major financial commitment, but after completion of the plant, when that commitment has been made, the EA must again approve the environmental impact of the project before it can be operated. The result of these institutional uncertainties is that no commercial

organisation will be prepared to make the large capital investments required for nuclear projects that could be put at risk at a second phase of authorisation after construction has been completed.

Mechanisms should be introduced for regulators to meet, preferably with industry, to try to resolve such issues. It is also desirable that industry works closely with regulators in the initial stages of the design of new technologies to minimise future conflicts. Ideally, full approval to build and operate should be given at the start of the project.

These issues are especially acute in the nuclear industry, but almost certainly apply elsewhere. If other industries, notably other energy industries, the chemicals industry and the oil industry, were to be regulated in the same way the effects on the UK economy could be disastrous.

Market and regulatory uncertainty are significant barriers to investment. Another, which is within the purlieu of Government, is the present system of planning consents for power station and other large projects that can add years and significant additional cost to a project. In this context, BNIF welcomes recently introduced proposals to streamline the planning system for infrastructure projects of national importance.

> ***BNIF believes that the energy policy review has to result in a clear statement of long-term energy strategy that provides the context in which regulators can operate in a congruent and co-operative manner, and provide the stable regulatory and planning context in which investment in low and non carbon energy sources will be encouraged.***

### *A stable and predictable scenario for investment in energy sources*

At present, with no new nuclear projects in prospect, it is not surprising that the financial community has not focused on the conditions and circumstances that would encourage private investment in nuclear energy. Attitudes in the financial community are still heavily influenced by memories of nuclear performance before the advent of the competitive market, but in fact there is little direct experience of assessing nuclear investments among the current generation of large project investors as most of the individuals involved in the British Energy privatisation have moved on to other things.

In present circumstances the City would be unlikely to favour financing a nuclear investment without some indication of support for such a move from Government. The principal drawbacks they see are the very large up-front capital costs, lengthy and uncertain periods of planning and construction, uncertainties about back-end issues like waste management, anxieties about public opinion and regulatory risk, relatively low levels of profitability at present UK electricity prices, and over-capacity in the generating market.

So long as these and other barriers to investment remain, the prospect of applications for replacement nuclear plant remains remote in the UK. However, if Government policy decided that replacement nuclear capacity was in the interests of national energy policy, and measures were taken to reduce the uncertainties and potential delays and provide fiscal

incentives to energy sources that reduce carbon emissions, the likelihood is that investment would be forthcoming. BNFL's own soundings of the financial community confirm this statement.

Recently, at a meeting of the Nuclear Energy Institute (NEI) in Washington, the Chairman of Goldman Sachs' Global Power business told delegates, "Investors today are not scared of nuclear power … Both the operating and the financial performance have been terrific in recent years. In stock market performance, utilities involved in nuclear have consistently out-performed other utility groups. Capital has also been abundant for nuclear companies. You have hard solid assets at a time when we seem to be moving back towards an old world economy".

A primary requirement for investment in replacement nuclear build in the UK is that nuclear stations are competitive in an open, liberalised market. Furthermore, market value should be placed on low carbon technologies, including nuclear energy, that contribute to environmental objectives to mitigate the threat of global climate change. More specifically, measures should be considered to: -

- provide regulatory and political support to minimise the risk of unexpected changes during construction
- alleviate regulatory pressure to fragment suppliers to allow the emergence of a viable project sponsor
- facilitate long-term contracts for supply
- provide greater certainty on radioactive waste management

> ***BNIF believes that capital-intensive projects such as nuclear, hydro generation schemes and some renewables technologies will attract the support of City institutions when there are supporting mechanisms (including Government initiatives) in place to reduce the perceived financial and political risks of such investments.***

***A recognition of the strategic and environmental benefits of nuclear energy, as part of a mix of low and non-carbon energy sources***

To ensure a balance between potentially conflicting sets of interests – for example the commercial instincts of electricity generators to take advantage of the relatively low fossil fuel costs (notably natural gas) to switch to gas at the expense of other, more sustainable and less environmentally damaging fuels and sources which the Government is keen to encourage – policy-makers may consider some degree of intervention to be necessary. BNIF recommends that Government examine appropriate market-based fiscal measures to encourage the transition towards a low carbon energy economy. Such measures might include: -

- availability of special taxation features – allowances etc – for low carbon electricity production
- embodiment in the market of rewards for low carbon electricity production
- tradable permits schemes providing a market mechanism for carbon dioxide reductions

- Government supported loans for R&D into low carbon energy sources.

BNIF believes that the combination of measures to remove uncertainty and reward environmental benefits would create the market conditions in which the option to build replacement nuclear capacity became commercially attractive. The prospect of replacement nuclear build will inspire the British nuclear industry to provide the capability and attract the financial investment to make the prospect a reality.

> ***BNIF believes that Government should develop appropriate market-based fiscal or innovative measures to encourage the transition towards a low carbon energy economy. It is essential that a dependable carbon-free base load supply of electricity is part of the energy mix.***

## Nuclear Energy's Longer Term Contribution to Energy Policy

The PIU has identified four possible policy positions that the UK could adopt towards nuclear power. These are, to quote the PIU nuclear scoping document:

- "ANTI – this would involve a commitment to early closure of existing stations and a commitment not to permit new stations in the UK for the foreseeable future.
- NEUTRAL – this would involve broadly the continuation of current policy. Nuclear stations would be treated in the same way as fossil stations and decisions on closures and new build would be left to the private sector operating in the competitive electricity market. This option is unlikely to lead to new build.
- WEAK SUPPORT – this would allow nuclear to be treated more favourably than fossil stations on the grounds of its contribution to carbon reduction. Decisions on closures and new build would depend in part on the degree of support.
- STRONG SUPPORT – this would involve a clear commitment to new build. This could be secured by some sort of obligation or perhaps by direct financial support from Government."

In BNIFs opinion, it is artificial to identify policy positions specifically for nuclear energy as if it existed in isolation from the broad range of considerations that policy makers face in devising a comprehensive energy policy. This submission has sought to demonstrate that there are significant risks attached to losing the nuclear option whether it be through design as under the hypothetical 'anti' policy scenario, or by default as a result of maintaining the current 'neutral' policy whereby nuclear stations are treated in the same way as fossil stations, and derive no credit for their environmental benefits.

If the UK is to avoid the risks to energy security and the environment associated with a heavy reliance on imported gas as the primary fuel for electricity generation, and moreover is to stand any chance of achieving carbon dioxide reductions approaching 60% by 2050, strong measures will need to be introduced to encourage and support <u>all</u> low and non carbon energy sources, including nuclear energy. Strong support of the type identified in

the previous sections would send the right market signals to encourage investment in low carbon energy sources, and pave the way for the achievement of the Government's energy and environmental policy objectives.

***Government should recognise the important role of nuclear energy and give strong policy support to ensure its future contribution to the achievement of energy policy and environmental objectives.***

## SUMMARY OF PRINCIPAL CONCLUSIONS

The arguments presented above lead BNIF to conclude that:

- any overall policy that can realistically be expected to address all the competing challenges must support and encourage the transition to a low carbon energy economy, and has to include a continued long-term significant contribution of nuclear electricity generation to energy supply in the UK.

- the replacement of the UK's existing fleet of nuclear stations with new reactor designs, incorporating passive safety features, could, with the benefits of series build, deliver competitive nuclear generation costs.

- a process of decision-making involving public information and involvement which is seen to be leading towards an acceptable solution for waste disposal is essential, but the physical existence of the preferred solution should not be seen as a prerequisite for future nuclear development.

- to secure a nuclear option for the UK in terms of indigenous skills, expertise and infrastructure a clear supporting position from Government is required. The price of inaction now may be the loss of a UK nuclear option.

- reliance solely on current market mechanisms will not guarantee the long run energy policy objectives of security, diversity, and sustainability. Government should therefore consider what form and scale of market-led solutions can deliver its objectives and what other policy areas should be addressed (e.g. "polluter pays").

- capital-intensive projects such as nuclear, hydro generation schemes and some renewables technologies will attract the support of City institutions when there are

supporting mechanisms (including Government initiatives) in place to reduce the perceived financial and political risks of such investments.

## RECOMMENDATIONS

**BNIF recommends that:**

- **Government should develop appropriate market-based fiscal or innovative measures to encourage the transition towards a low carbon energy economy. It is essential that a dependable carbon-free base load supply of electricity is part of the energy mix.**

- **Government should recognise the important role of nuclear energy and give strong policy support to ensure its future contribution to the achievement of energy policy and environmental objectives.**