



Nuclear Industry Association

Whitehall House
22a St James's Square,
London
SW1Y 4JH

Tel: +44 (0)20 7766 6640
Fax: +44 (0)20 7839 1523
E-mail: info@niauk.org

Response by the Nuclear Industry Association to the Stern review on the economics of climate change

The Nuclear Industry Association (NIA) is the trade association and representative voice of Britain's civil nuclear industry. It represents over 100 companies including the operators of the nuclear power stations, those engaged in decommissioning, waste management, nuclear liabilities management and all aspects of the nuclear fuel cycle, nuclear equipment suppliers, engineering and construction firms, nuclear research organisations, and legal, financial and consultancy companies. Among NIA's members are the principal nuclear power station operators – as well as companies engaged as contractors and manufacturers in the forefront of nuclear technology.

Several NIA member companies will be making their own submissions to the review.

1.0 The global context

The impact of climate change caused by the emission of greenhouse gases through man-made activity is widely recognised as one of the world's most serious environmental challenges. Unless global warming can be checked, climatic turbulence over the coming decades could cause rising sea levels, flooding, famine, disease and unprecedented human dislocation.

The bulk of the emissions that cause climate change come from mankind's insatiable appetite for energy, and the demand for energy - with the greatest demand for electricity - is driven by population growth, economic growth and technological developments. World population is projected to grow from 6 billion today to 9 billion in 2050, with most of this growth occurring in developing countries. Electricity plays a vital role in meeting a range of basic human needs – for clean air and water, food, shelter, heat, light and power. Even now, two billion people – about one third of the world's population – still have no access to electricity. If the legitimate aspirations of those in the developing world even for the basic provisions that electricity can provide, let alone the benefits and luxuries that we in the west take for granted, are to be met there needs to be a massive expansion in global electricity production. Demand for primary energy is projected to rise by over 50% by 2025, and the demand for electricity almost double in the same period according to the US Energy Information Administration's International Energy Outlook, 2004. If those predictions turn out to be correct, there would be a consequent rise in carbon dioxide emissions of 72% over 1990 levels. Worldwide the electricity generating sector is already responsible for over 30% of carbon dioxide emissions. While this is the most significant contributor, a quarter comes from the transport sector.¹

The Kyoto protocol was a tentative first step towards addressing the challenge posed by climate change. Developed countries have agreed to an overall 5% reduction of emissions of a basket of greenhouse gases, relative to 1990 levels, by the Kyoto period of 2008-2012. However, although the protocol has now been ratified, it does not apply to

developing countries. By 2020, carbon dioxide emissions in the developing world (including China and India) are expected to surpass those in the industrialised countries, even though developing countries are projected to use less total energy than industrialised countries at that time. It is clear that much more ambitious targets will be needed beyond the Kyoto period. Studies by the Intergovernmental Panel on Climate Change (IPCC), and by the Royal Commission on Environmental Pollution, suggest that a reduction of about 60% on 1990 levels will be required by the middle of this century if atmospheric concentrations of carbon dioxide are to be stabilised.

To halt the march of widespread global damage, while at the same time maintaining and incentivising economic activity, requires significant cuts in the worldwide emissions of greenhouse gases and carbon dioxide (as the overwhelming contributor) in particular. This can only be achieved by a concerted global strategy to increase the use of clean-energy technologies – renewables and nuclear energy – and improve the efficiency with which energy is produced and used. Tackling the growing emissions from transport is another priority, and in this respect the potential for a hydrogen economy should be vigorously explored.

Nuclear energy currently contributes around 7% of world primary energy and 17% of world electricity². There are over 440 reactors operating in 31 countries, and 30 reactors under construction around the world, mainly in Asia. Nuclear energy makes a valuable contribution to the avoidance of greenhouse gas emissions.³ In the UK, where it supplies over 20% of electricity, nuclear avoids over 60 million tonnes of carbon dioxide a year, or about 12% of total UK emissions, compared to the same amount of generation from a mix of coal and gas.⁴ In Europe, where nuclear supplies around 35% of electricity, it avoids releases of about 1108 million tonnes of carbon dioxide a year⁵. Worldwide, nuclear energy saves the planet from the emission of 2500 million tonnes of carbon dioxide every year⁵. Nuclear energy also avoids the emission of other harmful gases, including the oxides of sulphur and nitrogen that cause acid rain.

Nuclear energy is the one technology capable of generating very large quantities of carbon free electricity. Developments in nuclear technology are producing inherently safe, simpler, more efficient and cheaper reactor designs. Longer term developments offer the prospect of co-generation of electricity and hydrogen, thus enabling the emergence of a hydrogen based transport economy.

2.0 The UK

The UK intends to set itself on the route to providing sustainable, secure and affordable energy for the long term. The UK aims to continue to show leadership in the challenge to tackle global warming. Clear decisions have to be taken to implement options to deliver such a future.

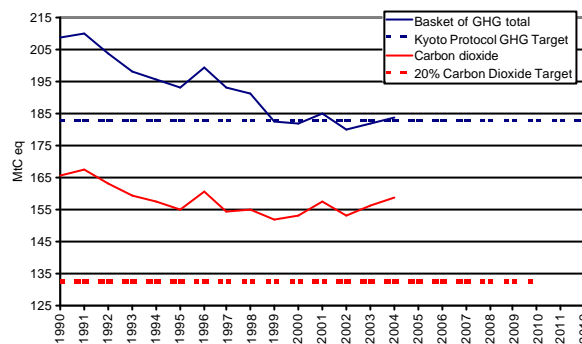
The energy policy set down in 2003 was a first step: firmly establishing the importance of renewable energy and energy efficiency, whilst keeping other options, such as nuclear and clean coal, open. NIA is very supportive of the Government's review of this policy announced by the Prime Minister on 29 November. Much has changed in geopolitically in the past two years: growing evidence of climate change, increasing global oil and gas demand and increasing oil and gas prices, further uncertainty over Middle East stability. The UK environment is changing also: the nation is becoming a net importer of gas, there is growing awareness of the need for new baseload capacity, carbon emission levels are rising, several nuclear stations are reaching the end of their lives, as

well as the prospect of coal station closures. Not all of these changes were foreseen at the time of the 2003 White Paper which is one of the principle reasons for the Government’s announcement of an energy review

Action is needed now if we are to have choices to deliver on our environmental commitments and provide the new baseload capacity needed in the next decade.

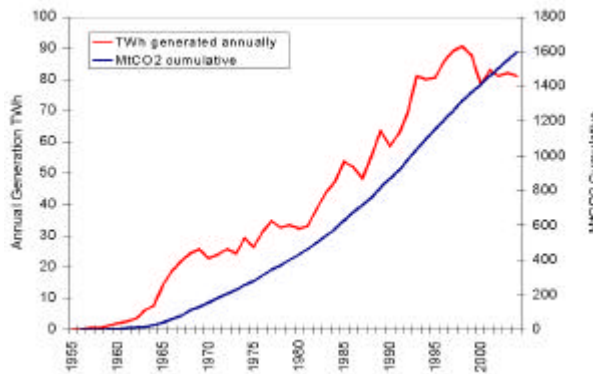
3.0 Cutting carbon dioxide emissions

Despite good early progress, UK carbon dioxide emissions are now higher than they were a decade ago. It has already been conceded⁶ that the Government target for reducing emissions by 2010 is unlikely to be met.



UK greenhouse gas and CO₂ emission levels and associated targets⁷

Nuclear energy is the most significant proven large-scale source of low carbon electricity in the UK, and makes a major contribution to avoiding carbon dioxide emissions. Over the coming 10-15 years, reducing CO₂ emissions will become more difficult as a substantial reduction in the existing nuclear generation capacity is inevitable.

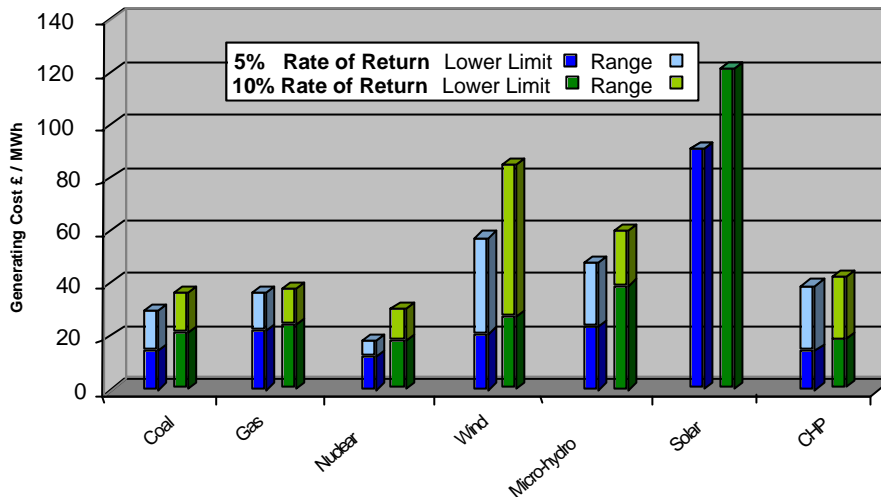


Annual power generated and cumulative carbon dioxide emissions avoided through UK nuclear generation

The contributions to date from renewable energy and from energy efficiency savings have been less than hoped for, and it is increasingly clear that other low carbon technologies, including nuclear, have a role to play alongside renewables if the UK is to keep on a realistic track towards its longer-term targets and ultimately achieve a 60% cut in emissions by 2050.

3.1 The economics of nuclear in meeting our climate change objectives

Electricity prices have risen noticeably in the recent past, in part driven by the global rise in gas prices. It has been shown that the overall generating costs of nuclear energy can be competitive with fossil-fired generation if there are no artificial barriers, such as those currently posed by UK-specific planning risks. Nuclear energy could become more competitive in the future if, as is projected, gas prices remain high and the costs associated with carbon dioxide emissions will begin to play a larger role. Nuclear energy is consistently shown to be much cheaper than the leading renewable alternatives.



OECD analysis of power generating costs for different technologies⁸

	MIT (2003)	PIU (2002)	Chicago (2004)	RAE (2004)	DGEVP (2003)	Finland (2003)	OECD (2005)	
Generating cost (p/kWh)	3.9–4.0	3.0–4.0	3.1–3.6	2.26–2.44	2.0	1.7	1.3–1.9	1.8–3.0
Rates of return	11.5%	8% & 15%	12.5%	7.5%	8%	5%	5%	10%
Capital cost	\$2000/kW (£1150/kW)	\$2000/kW (£1150/kW)	\$1500/kW (£865/kW)	\$2000/kW (£1150/kW)	€1413/kW (£990/kW)	€1900/kW (£1330/kW)	\$1000-\$2000/ kW (£610-1210/kW)	
Load factor	85%	75–80%	85%	>90%	>90%	>90%	85%	
Economic life	15 yrs	20 yrs	15 yrs	25 & 40 yrs	35 - 50 yrs	40 yrs	40 yrs	
Construction period	5 yrs	Not identified	5–7 yrs	5 yrs	5	5 yrs	4-6 yrs	

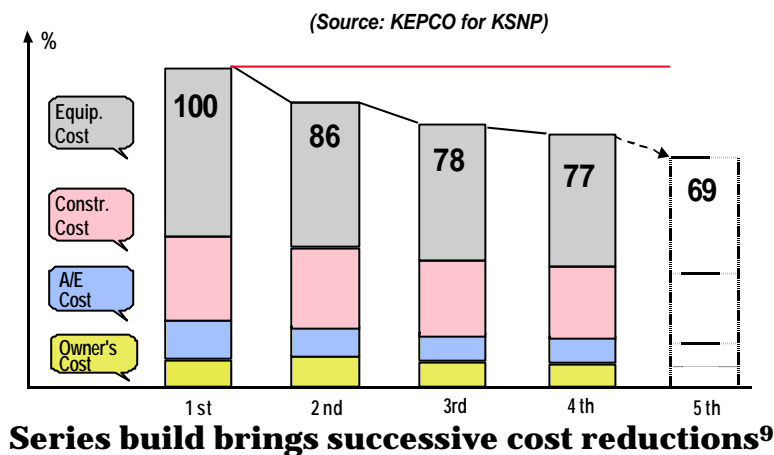
Projected costs of nuclear energy from different studies

Nuclear energy is relatively insensitive to changes in the price of the raw uranium fuel and provides an element of stable cost generation in the generating portfolio. This is helpful in keeping overall prices to consumers low. This contrasts with gas-fired generation, where the cost of raw gas can represent 60% or more of the total generating cost.

3.2 Financing and delivery to meet our climate change commitments

Under an appropriate market pricing regime, and with the right arrangements for sharing risks and returns, a new generation of nuclear plant in the UK could be financed through the private sector. In this way, future nuclear build could avoid some of the pitfalls which have characterised major infrastructure projects in the past, including some previous nuclear plants. Private sector disciplines of project management and financial control will help to ensure focused and timely delivery.

This approach to future nuclear build would need to emulate new build currently taking place overseas based on internationally developed and standardised designs offered by a few global vendors. International experience further demonstrates that the benefits nuclear energy offers will be delivered most economically if a series of new generation of near-identical stations is constructed.



A key factor in the effective delivery of nuclear plant will be the development, by regulators and the industry, of the current licensing and approvals processes to ensure timely and predictable delivery of all regulatory clearances and planning consents.

4.0 Other benefits

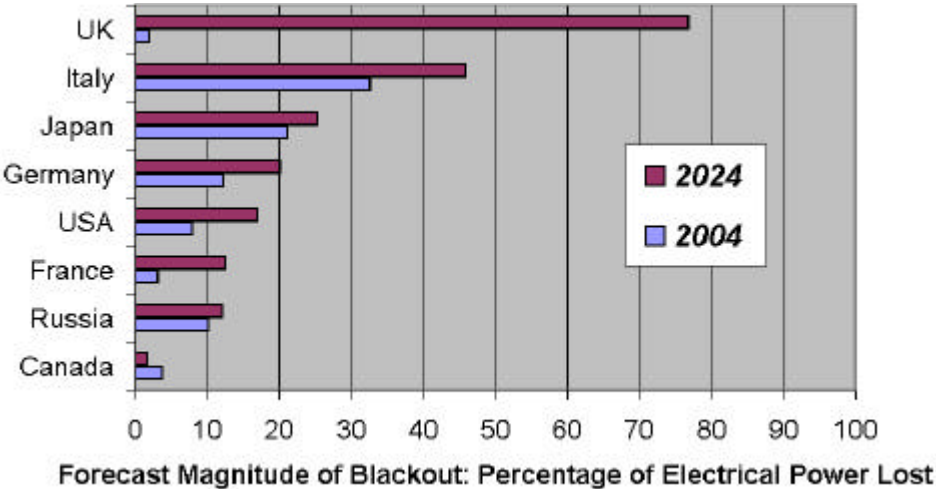
There are of course other benefits to the use of civil nuclear power. Some of the principle ones are given briefly below:

4.1 Reliability of supply

Recently, UK electricity supply reliability has not been a problem, as the rapid shift towards gas-fired power plants has been underpinned by substantial domestic reserves of gas. However the UK is now a net gas importer, and is expected to be reliant on imported gas to meet at least 65% of demand by 2020. Worldwide demand for gas, in common with all fuels and many other commodities, looks set to rise sharply over the medium term. This is largely driven by the fact that major economies such as China and India are experiencing rapid economic growth, with the associated rise in energy demand.

Key sources of gas for the UK will in the short-term include Norway, and in the longer-term Russia, Algeria and Qatar. Surface pipelines will pass over very long distances, and

through many other countries, en route to the UK, raising concerns over the prospect of interruptions to the supply of gas to the UK, and consequent disruptions to power supplies. UK electricity security of supply is projected to go from being the best in the G8 to the worst within two decades. If we attempt to mitigate this by the use of Liquefied Natural Gas then we will also increase our carbon emissions as the emissions released through liquefaction, transportation and re-gasification mean that a power station run on LNG has emissions equivalent to the best of the coal stations. This would take the electricity sector back to our 1990 emissions levels.



Magnitude of blackouts of more than one day’s duration forecast to occur with 2 - 5% annual probability in the G8 nations – 2004 and 2024¹⁰

Concerns are also growing over shorter-term interruptions due to the intermittent nature of key renewable technologies – in particular wind – which are targeted to provide 20% of UK generation by 2020. Against this backdrop, nuclear energy provides reliable baseload generation, fuelled by uranium which is plentiful and which carries minimal risk of supply interruption.

4.2 Nuclear benefits the UK economy

The nuclear industry also plays a key role in the UK economy, employing 40,000 people directly and supporting many additional jobs. Many of these are skilled jobs in areas where these are scarce, and future nuclear build would offer opportunities to maintain and develop the role played by the industry in this respect.

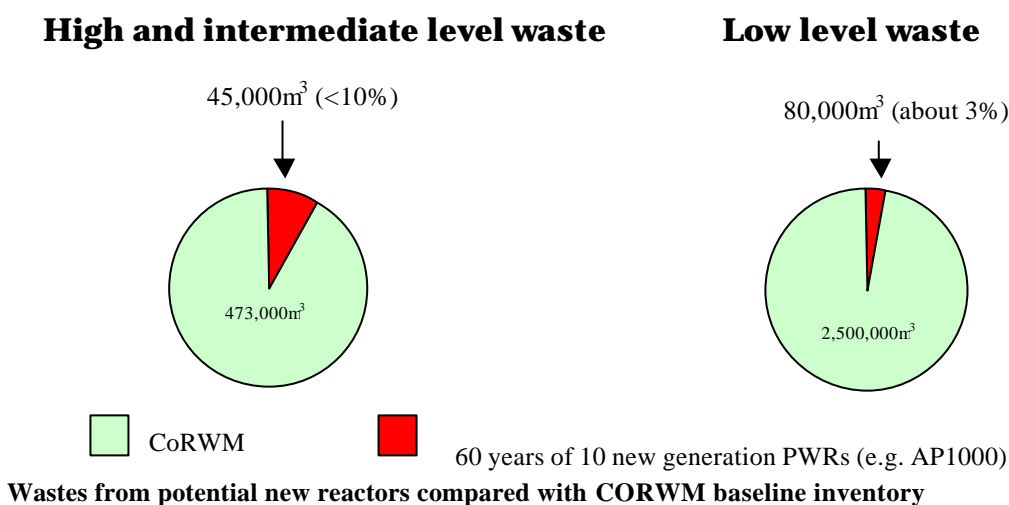
A new generation of nuclear stations would also benefit the UK in terms of GDP and balance of payments, for instance through reducing gas imports. The benefit in GDP terms of a programme to replace the current nuclear fleet has been assessed in a recent independent study¹¹ at around £4 billion per year once the stations are all operational. Part of this benefit is due to the reduced need for gas (which increasingly would be imported) if the UK retains a significant nuclear capability.

5.0 Other issues

We recognise that there are other issues which need to be addressed if the public and key stakeholders are to have confidence in a new generation of civil nuclear power stations.

5.1 Nuclear waste management and decommissioning

The long term management and disposal of nuclear waste is an issue on which greater clarity is required. The UK, through the Nuclear Decommissioning Authority, is now addressing as its highest priority the management of those legacy wastes generated prior to 1990, most of which were created outside the civil nuclear power programme. More recent wastes are dealt with safely and effectively as they are produced, and the same will be true of any wastes from future nuclear stations. The historic legacy has to be dealt with, with or without new generation nuclear build. Wastes associated with modern reactor designs would be much smaller in volume, and are already treated and prepared for long term storage. Therefore UK historic liability provisions are not an indicator of waste management and decommissioning costs for new generation nuclear build. Furthermore, any solution put in place for dealing with legacy wastes could readily accommodate the wastes from a new generation of nuclear plants.



Progress is also being made towards defining a way forward for long term storage/disposal through the Committee on Radioactive Waste Management (CoRWM). Implementing a way forward when CoRWM reports next year will help secure public and investor confidence.

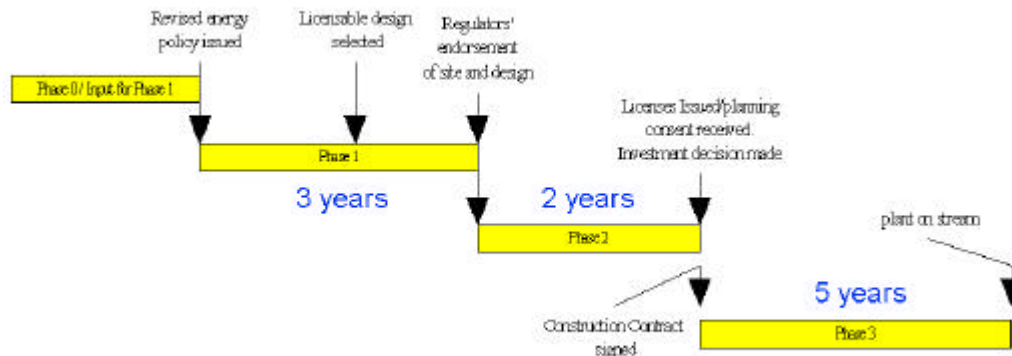
Countries such as Finland, Sweden and the US are putting in place technical solutions for waste management and disposal, and in doing so have addressed public acceptance concerns. Likewise, ways to provide surety on the financial provisions for waste management and decommissioning through a levy on nuclear operators have been successfully established elsewhere in the world. These could be applied in the UK. It is essentially a political rather than a technical issue.

5.2 Safety and security

The nuclear industry has an exemplary record in respect of safety and security, with rigorous standards in place. Modern reactor designs have advanced safety features, which bring further confidence in their safe operation, and security procedures at nuclear facilities have been fully reviewed in the light of the evolving climate of global security.

5.3 Action is needed now

Modern nuclear reactors take around five years to construct. However, it would take perhaps an additional five years to get to the point where the industry could start construction. Thorough scrutiny of prospective reactor designs and sites by the safety, environmental and security regulators is required before investment decisions can be made. This represents a hurdle – unique to the nuclear industry – which must be overcome before a firm commitment to progress to construction can be made. A suitable regulatory framework must be developed in order to allow this to happen in a timely manner.



It would therefore take about a decade to bring the first of a new generation of nuclear stations on line. There is a compelling case for the UK to put itself on route to a secure, low carbon, affordable energy mix for the long term. Nuclear has a major role to play in that mix, but it can only do so if steps are taken now towards replacing baseload capacity coming to the end of its life by 2015.

We welcome the Government's review of the UK's energy policy as well as this investigation which we assume will inform the policy review. Steps to take the nuclear option forward include:

- A clear indication from Government that it would welcome (or at least not object to) a new generation of nuclear stations to replace the existing nuclear contribution to the UK energy mix.
- Regulators and the nuclear industry working with government to develop planning and other regulatory approvals processes so as to avoid unnecessary delay and uncertainty. This includes setting down clear practicable public consultation processes.
- Setting - and moving to implementing - policy on the management of radioactive wastes.
- Providing appropriate market mechanisms to stimulate investment in a new generation of nuclear build, addressing both the lack of long term pricing signals in the UK market and the perception of risk among investment institutions. Such actions must address the need to fund the early phases of pre-construction activities.

In addition, simple steps can be taken within the bounds of existing energy policy, to become better informed about future nuclear options and their UK implementation. Such steps include:

- The appropriate regulators (NII, EA, SEPA and OCNS) could carry out a review of nuclear reactor designs which are being considered for deployment worldwide today. The UK should have a view on candidate reactors.
- The nuclear regulators could address how modern nuclear reactor designs might go through planning and regulatory processes (nuclear specific and general) in the UK. Well over a decade has elapsed since a new reactor was licensed in the UK, in which time the global market and regulatory framework have changed significantly.

6.0 Conclusion

The evidence suggests that climate change is accelerating and our response must be to accelerate cuts in carbon dioxide emissions. Given the sheer scale of the cuts required and the time scale in which they need to be made, it seems inconceivable that we can do without the contribution from nuclear energy, and irresponsible to pursue policies which advocate its removal from the range of available clean energy sources. Nuclear energy alone cannot conquer climate change, but to take this established and cost-effective technology out of the equation would present an insurmountable obstacle in an already daunting global environmental challenge.

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- ¹ International Energy Agency, CO₂ Emissions database 1995
 - ² International Energy Agency, Key World Energy Statistics – 2003 edition
 - ³ World Nuclear Association, 2003
 - ⁴ Department of Trade and Industry, DUKES 2003
 - ⁵ IAEA, 2001, for electricity generation figures then using as basis 1 billion kWh would require 409,000 tonnes black coal with 67% carbon. The Europe figures include Russia.
 - ⁶ ‘As of where we are now, on the trajectory we are on, we will not meet our domestic target which we set ourselves’; Margaret Beckett, Secretary of State for Environment, Food and Rural Affairs; BBC Radio 4 “Today”, 22 April 2005
 - ⁷ “Provisional 2004 UK Climate Change Sustainable Development Indicator and 2003 Air Pollutant Emissions Final Figures”; DEFRA; March 2005
 - ⁸ “Projected Costs of Generating Electricity”; OECD / NEA / IEA; 2005
 - ⁹ [Data converted to sterling based on £1 = \$1.65. Data also excludes Japan and the Netherlands
 - ¹⁰ for which estimated costs differed significantly from the average]
 - ¹¹ BNFL/Westinghouse AP1000 – The Reactor Technology Ready Now”; BNFL submission to DTI Energy Policy Consultation; September 2002
 - ¹² Comparison of the Security of Electricity Supplies in G8 Countries, 2004 to 2024" Prof J H Gittus; Power UK, February 2004
 - ¹³ “Macroeconomic Analysis of Nuclear Plant Replacement”; Oxford Economic Forecasting; March 2005