Is nuclear power a solution to climate change?

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1. Introduction

In February 2003 the UK Government published a radical Energy White Paper entitled "Our Energy Future – creating a low carbon economy".[1] It set out to put the UK on a path towards a reduction in carbon dioxide emissions of 60% by 2050. This goal will be achieved mainly by promoting renewable energy and energy efficiency. While the White Paper did not rule out the possibility of building new nuclear power stations at some point in the future if it proves 'necessary' to meet the UK's carbon targets, it said that current economics make it an unattractive option and there are important issues of nuclear waste to be resolved.

At the launch of the White Paper, the then Energy Minister, Brian Wilson, said:

"*If renewables and energy efficiency can prove themselves over the next five years there will be no need for new nuclear power stations.*"[2]

Confusingly, less than a year later on 4th December 2003, the next Energy Minister, Stephen Timms, told the UK Nuclear Industry Association Annual Energy Choices Conference in London that the Government would review its position on nuclear new build in 2006.[3] Sir David King, the Government's chief scientific adviser, says the nuclear question needs to be tackled sooner rather than later and Ministers will have to take a decision within five years on whether to build new nuclear power stations if Britain is to reach its targets for cutting greenhouse gases.[4]

Reflecting internal disagreements within the Government, Margaret Beckett, the Secretary of State for Environment, Food and Rural Affairs, told ITV's Jonathan Dimbleby Programme in October 2004 that building nuclear power stations would risk landing future generations with 'difficult' legacies, and rejected demands from a growing pro-nuclear lobby saying:

"*The long and short of it is we certainly do not need extra nuclear power in anything like a 10, 15-year cycle.*" [5]

The Energy White Paper promised that before any decision to proceed with building new nuclear power stations, there would be a public consultation and the publication of a new White Paper setting out the Government's proposals.[6] So it might have been reasonable to expect the Energy White Paper to have drawn a line under the arguments about whether the UK needed a new generation of nuclear reactors in order to meet its climate objectives, at least until after the next General Election, expected in Spring 2005.

Instead the debate about new nuclear build has continued unabated. New costings for nuclear electricity were released by the Royal Academy of Engineering[7] and the David Hume Institute.[8] Trade Unions at British Nuclear Fuels' (BNFL's) Chapelcross nuclear station, which closed in June 2004, launched a campaign for a second station to be built on the site.[9] Professor James Lovelock, doyen of the Green movement, who conceived the Gaia theory – that the Earth is in effect a single giant super-organism – said nuclear power is the only answer to climate change.[10] Sir John Houghton, former head of the Met Office and the UN's intercontinental panel on climate change, and Sir Crispin Tickell, former UK ambassador to the UN, who famously convinced Margaret Thatcher that Climate Change is a problem, both added their voices to the call for new stations.[11]

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[1] DTI (February 2003) ' Our Energy Future – Creating a Low Carbon Economy,' Cm 5761, http://www.dti.gov.uk/energy/whitepaper/ourenergyfuture.pdf
[2] Guardian 25th February 2003, 'Green Power – Five years to prove its worth' by David Gow. http://www.guardian.co.uk/guardianpolitics/story/0,3605,902411,00.html
[3] http://www.dti.gov.uk/ministers/speeches/timms041203.html
[4] Times 4th October 2004 http://business.timesonline.co.uk/article/0,,8209-1292846,00.html
[5] Observer 19th September 2004 http://observer.guardian.co.uk/uk_news/story/0,6903,1308043,00.html
[6] DTI (Feb 2003) para 4.68
[7] PB Power for the Royal Academy of Engineering (March 2004) 'The Cost of Generating Electricity', http://www.raeng.org.uk/news/publications/list/reports/Cost_of_Generating_Electricity.pdf
[8] David Hume Institute (April 2004) 'Tilting at Windmills: The Economics of Wind Power' by Professor David Simpson, http://www.davidhumeinstitute.com/DHI%20Website/publications/hop/Wind%20Power%20paper.pdf
[9] BNFL World, April 2004, 'The case strengthens for Chapelcross II'. See also: http://www.nuklear21.com/resources/Issue1.pdf
[10] James Lovelock, Independent 24th May 2004 'Nuclear power is the only green solution' http://comment.independent.co.uk/commentators/story.jsp?story=524230
[11] John Vidal, Guardian 12th August 2004, "Nuclear Plants Bloom" http://www.guardian.co.uk/life/feature/story/0,,1280884,00.html

Nor were Friends of the Earth (FoE) immune. The former Bishop of Birmingham, Rt Rev Hugh Montefiore, was forced to leave FoE's board because of his support for nuclear energy to tackle global warming.[12] In an opinion piece in *The Independent*, Montefiore said the advantages of nuclear power far outweigh the dangers.[13]

Lord May, President of the Royal Society, and chief scientific adviser to the Government 1995-2000 writing in the *Daily Telegraph*, said that the UK would struggle to reduce its carbon emissions without nuclear power. He accused the Government of a "disappointing that a lack of political courage". With many nuclear power stations reaching the end of their lives in the next few years, our capacity in 2015 will be about half what it is today. Given that it takes about 10 years from the commissioning of a nuclear power station to it providing electricity, we need to start now just to ensure the status quo. Endlessly postponing a decision today is as good as saying no to nuclear power. Lord May agreed that we need a strategy for dealing with the waste, but we do not necessarily need to have a solution in place before making a decision about building new nuclear stations.[14]

The aim of this briefing is to examine the arguments in favour of new nuclear build. Section 2 looks at how quickly a new nuclear programme could be started, and Section 3 examines the likely cost of nuclear electricity and asks whether the huge sums of money involved could be spent more effectively. Section 4 looks at the non-economic hurdles to a nuclear revival, while Section 5 examines the contribution nuclear power could make towards achieving our climate change objectives. Section 6 looks at the alternatives to nuclear power. In Section 7, having concluded that we don't need nuclear power to meet our climate change objectives, we ask whether the Government is doing enough to avoid going down the nuclear road. Finally, in Section 8 we draw these threads together and conclude that, far from being a fall-back position we can adopt to fill any gaps left by failure of government to implement its policies on renewable energy and energy efficiency, nuclear power will severely damage our climate change objectives.

[12] Michael McCarthy Independent 22nd October 2004 "Global warming row goes nuclear as bishop quits Friends of the Earth" http://news.independent.co.uk/uk/environment/story.jsp?story=574850

[13] Hugh Montefiore, Independent 22nd October 2004, "We need nuclear power to save the planet from looming catastrophe" http://comment.independent.co.uk/commentators/story.jsp?story=574787

[14] Lord May, Daily Telegraph 15th September, 2004 "We need more nuclear power stations, not wishful thinking". http://portal.telegraph.co.uk/opinion/main.jhtml?xml=/opinion/2004/09/15/do1501.xml&sSheet=/opinion/2004/09/15/ixop.html

2. When could a new build programme start?

The Energy White Paper says:

"*Before any decision to proceed with the building of new nuclear power stations, there will need to be the fullest public consultation and the publication of a further white paper setting out our proposals*"[15]

According to Dr Catherine Mitchell – of Warwick Business School, and a member of the Cabinet Office's energy review team, the earliest this could be published is 2008-9. Optimistically it might take five years for the licensing and planning debates, and then another five to eight years for construction. So the earliest that a new nuclear generation could start coming on stream is 2018-21.[16] This timetable assumes that everything goes well. In practice, everything rarely goes well and the earliest realistic date for delivery of power from a new UK reactor is around 2020.[17]

Licensing & planning

In order to replace existing the electricity output from existing reactors the nuclear industry has proposed building a fleet of ten AP1000 reactors. This is a new reactor designed by British Nuclear Fuels' (BNFL) US subsidiary, Westinghouse. It is a reactor type which has yet to be constructed and operated and is not yet licensed anywhere in the world.

To familiarise itself with new reactor technology, the safety regulator, the Nuclear Installations Inspectorate (NII), normally conducts pre-licensing reviews prior to the formal licensing process. The NII would then scrutinize preliminary safety and pre-construction reports to ensure general compliance with UK safety regulation. This would form the basis of a license to construct a nuclear power plant.[18]

In 2001, British Energy (BE) and BNFL asked the NII to start a pre-licensing review for the AP1000. The NII declined because of lack of adequate staffing. In autumn 2002, the NII anticipated asking the government for resources to set up a division for pre-application review of new reactor types, but this has now been put on the back-burner.[19] The NII has stated that, until the government signals its intention to seek new nuclear build, it will make no bids for additional resources for pre-licensing of new reactor designs. The NII has had limited exposure to the development and assessment of new reactor designs to date. Thus, gaps in in-house knowledge would take time to fill and so limit the pace at which new nuclear build could be developed in the UK.

The NII is known to be maintaining "a watching brief" on AP1000s by staying in regular contact with the US Nuclear Regulatory Commission (NRC), which is currently undertaking a design certification process for the AP1000. The NRC issued a final safety evaluation report and design approval for the AP1000 in September 2004. The last step in the certification process requires NRC to conduct a consultation. The agency anticipates issuing a standard design certification by December 2005, or possibly by up to five months earlier.[20] However, the final design approval (FDA) and final safety evaluation report removes the final barrier to Westinghouse marketing its reactor abroad. At the end of September 2004, China called for bids to build two pairs of reactors, and Westinghouse has confirmed that it will enter a bid with its AP1000 design.[21]

It is unclear how long the licensing process would take in the UK, but Westinghouse applied to the NRC for design certification in March 2002, so by the time the process is complete in December 2005, it will have taken almost four years.

When Sizewell B was planned, the ensuing public inquiry took almost four years. The nuclear industry has argued that the public inquiry process should be streamlined, as it presents an additional risk for private investors. Indeed the Energy Act (2004) which received Royal Assent in July 2004 provides for a re-organisation of public inquiry

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[15] DTI (February 2003) para 1.24
[16] Catherine Mitchell, "Action Stations" Guardian 8th September 2004 http://society.guardian.co.uk/societyguardian/story/0,7843,1298972,00.html
[17] MacKerron, G (September 2004) 'Nuclear Power and the Characteristics of Ordinariness – the Case of UK Energy Policy' NERA Economic Consulting.
[18] POST note no. 208 'The Nuclear Energy Option in the UK', December 2003 http://www.parliament.uk/documents/upload/postpn208.pdf
[19] Platts Nuclear News Flashes Thursday 27th February 2003, 'The UK's Energy White Paper does not address pre-licensing reviews.
[20] Platts Nuclear News Flashes, (September 13, 2004) 'Westinghouse is celebrating'.
[21] Nucleonics Week, Volume 45,Issue 41 (October 7, 2004) 'China opens bidding on Sanmen and Yangjiang advanced reactor projects'.

procedures for new power station proposals, so that lead inquiry inspectors can be assisted by further inspectors to share the work and allow issues to be considered concurrently rather than sequentially as at present. Nevertheless expecting the planning and licensing process to be completed in five years appears to be extremely optimistic.

Even assuming everything goes well and that many of the issues, such as the consultation on the new White Paper and licensing, can be carried out concurrently to allow construction of the first reactor to begin around 2010, the industry would need to be ordering one reactor every eighteen months to allow a replacement ten reactor programme to be up and running by 2025. This illustrates the scale of the task required.

Nuclear waste

The Energy White Paper simply says "*there are important issues for nuclear waste to be resolved*"[22] The Scottish Executive Partnership Agreement, which is a joint statement of policy by the two coalition parties in the governing coalition, goes slightly further:

"We will not support the further development of nuclear power stations while waste management issues remain unresolved."[23]

A new independent body, the Committee on Radioactive Waste Management (CoRWM) has been appointed by Ministers to review options for the management of solid, higher level, radioactive waste in the UK. Its work programme submitted to Ministers envisages making recommendation on options in July 2006.[24] But CoRWM will not make recommendations about selection of a site or sites, only on which management option or combination of options it recommends (See Section 4).

It is not clear how the Government will decide when the nuclear waste issue has been resolved. However, the Government's September 2001 consultation paper on nuclear waste envisaged a further one or two years of consultation after a waste management option has been recommended, and this does not allow any time for decisions about a site or sites.[25] This gives further credence to the idea that the earliest a White Paper on new build could be produced is 2008-9.

Of course, it is quite possible that CoRWM's recommendations may not be enough to resolve the issue of nuclear waste. It is likely that the public and Parliament may want to wait until the proposed facilities succeed in securing planning permission, or even until the facilities have been built and begun to receive waste. According to Nirex, the body which advises industry, government and regulators on the long-term management of nuclear waste, it could be 25 to 40 years before a nuclear waste facility is in place.

[22] Para 4.68
[23] http://www.scotland.gov.uk/library5/government/pfbs-00.asp
[24] Committee on Radioactive Waste Management, June 2004, Work Programme 2004 – 2006
http://www.corwm.org/PDF/Programme%20of%20work%20-%20for%20presentation%20to%20Ministers.pdf
[25] DEFRA (Sept 2001) 'Managing Radioactive Waste Safely'
http://www.defra.gov.uk/environment/consult/radwaste/default.htm

3. The economics of nuclear power

The then Energy Minister, Stephen Timms MP, told a House of Commons Standing Committee looking into the Energy Bill on 25th May 2004 that:

"…*at present the economics* [of nuclear power] *are very unattractive.*"[26]

Patricia Hewitt, the Secretary of State for Trade and Industry, repeated this in a letter to The Times on 18th September 2004, calling new nuclear build "an unattractive option".[27] Even Conservative Party leader, Michael Howard, asked after his 'green speech' on 13th September if the government should expand Britain's nuclear plants said "*nuclear power is expensive*".[28]

Yet nuclear supporters point to a report published in March 2004 by the Royal Academy of Engineering (RAE), written by PB Power, which estimates the cost of electricity from new nuclear plant at 2.3p/kWh, and up to 5.4p/kWh for onshore wind.[29] How can there be such a divergent view about the costs of nuclear electricity?

Dr Catherine Mitchell of Warwick Business School and member of the Government's Policy and Innovation Unit (PIU) Energy Review Team, speaking at the Friends of the Earth "Meeting Scotland's Energy Needs" Conference in Edinburgh on 21st May 2004 provides an explanation:

"*The PIU examined the cost of nuclear power, both current and future, in great depth. It concluded that the figures put forward by the nuclear industry are extremely optimistic and PIU's own figures were much higher. Now, bodies such as RAE are giving the cost of nuclear power as those put forward by the nuclear industry without including other evidence based analyses, such as the PIU. It is extremely depressing that after 2 years of evidence based analysis by the Government, energy institutions continue to provide out of date and probably wrong information".*

RAE's figures are basically the same as numbers submitted by British Energy[30] and BNFL[31] to the Policy and Innovation Unit's (PIU) Energy Review in 2001. The nuclear companies told the PIU that they expected to be able to generate electricity from new reactor designs (the Canadian CANDU or the Westinghouse/BNFL AP1000) at between 3p/kWh for the first unit and 2.2-2.5p/kWh across a large programme of ten reactors. These figures overlap with the cost of generating electricity from Combined-cycle Gas Turbines (CCGTs) and are, therefore potentially competitive without any support mechanism. But nobody within the investment community is anywhere near regarding nuclear power as a close competitor with CCGTs.[32]

The PIU expressed scepticism regarding these optimistic projections.[33] No nuclear power plant has started construction in the UK for 15 years. In today's money the estimated the cost of electricity from the most recent nuclear station, Sizewell B, is around 6p/kWh. No nuclear plants have been started elsewhere in Europe or North America for ten years. There is a history of serious appraisal optimism in the nuclear industry, and the two reactor-types which the industry expects to deliver power at 2.2p/kWh to 3p/kWh have yet to be built anywhere in the world. So the industry's cost predictions are pure speculation, and depend on achieving construction costs below the bottom end of the International Energy Agency's estimates and quicker construction-to-commissioning times than have been achieved in the past.[34] For example, it is claimed that adoption of modular construction techniques will make it possible to build advanced reactors in a time frame ranging from 30 to 44 months, compared to the typical 100 months required to build another Sizewell-

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[26] House of Commons Standing Committee B, Tuesday 25th May 2004 (morning), Column 92 http://www.publications.parliament.uk/pa/cm200304/cmstand/b/st040525/am/40525s01.htm

[27] Letter from Patricia Hewitt to The Times, 18th September 2004. http://www.timesonline.co.uk/article/0,,59-1267700,00.html

[28] UK Must Lead on Climate Change, BBC 13th September 2004. http://news.bbc.co.uk/1/hi/uk_politics/3651052.stm

[29] PB Power for the Royal Academy of Engineering (March 2004) 'The Cost of Generating Electricity', http://www.raeng.org.uk/news/publications/list/reports/Cost_of_Generating_Electricity.pdf

[30] British Energy (2001) 'Replace Nuclear with Nuclear' Submission to the Government's Review of Energy Policy. http://www.british-energy.com/corporate/energy_review/energy_submission120901.pdf

[31] BNFL (2001) 'Submission to the Performance and Innovation Unit's Review of UK Energy Policy' http://www.bnfl.com/library/upload/docs/001/135_1.pdf

[32] MacKerron, Gordon (September 2004) 'Nuclear Power and the Characteristics of Ordinariness – the Case of UK Energy Policy' NERA Economic Consulting.

[33] Performance and Innovation Unit (February 2002) "The Energy Review" , para 6.48 p103 and Annex 6 para 44, p195 http://www.number-10.gov.uk/su/energy/1.html

[34] See Greenpeace International (2004) Sea Wind Europe, p36. http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/6204.pdf

type station. The economics also relies on being able to run reactors for 60 years, (compared to Sizewell B, which it is assumed will run for 40 years). There is similar optimism in estimates for power generation, operations and maintenance (O&M) costs. Cost reductions are assumed to derive from improvements in maintenance and greater availability of the plant.

The PIU concluded:

"…it seems unlikely that construction cost and performance guarantees can be as firm for nuclear as for CCGTs [Combined Cycle Gas Turbines]; operating performance will be difficult to guarantee at the level suggested; there is no certainty that a 10 [reactor] programme could be completed in an orderly way; and the economic results are sensitive to changes in several of the above parameters".[35]

The PIU estimated that a cost of 3-4 p/kWh for new nuclear electricity is more credible.

Another reason why investors regard nuclear power so sceptically is the long planning and construction times. British Energy estimates that the planning/licensing/construction time for a new nuclear plant would be around ten years. This could perhaps be brought down slightly if the Government gave full support through the planning and regulatory system, but the lead time for a CCGT is only two years. Any return on investment in new nuclear power stations is therefore postponed.

Uncertainties about construction costs are made more serious by the fact that capital costs represent over 70% of the total generating cost for nuclear power. Consequently total generating costs are particularly sensitive to any escalation in constructions costs or time.[36] Even using the nuclear industry's figures, the lower end of the generating cost estimates – 2.2p/kWh – would only be achieved if a programme of ten reactors is ordered. Nuclear economist, Gordon MacKerron, says attempting to persuade investors to commit to 10,000MW of new capacity all at once is virtually unimaginable. In theory it might be possible to get around this problem by building ten reactors in a number of different countries under a common international licensing regime, but there is currently no sign that such a regime is feasible.

Given the long construction and planning times, reactors generating electricity at 2.2p/kWh could not be on stream until 2025 at the very earliest. By that time it is reasonable to expect renewable technologies, via learning and technical progress, to have substantially reduced generating costs compared with today. Nuclear power is a mature technology, so the potential for cost reductions is small. In contrast renewable energy is a new technology, with huge potential for cost reductions. According to PIU onshore and offshore wind has the potential to become among the cheapest low carbon options.

All this means the RAE's presentation of nuclear costs is seriously misleading. Private investors judge that the economics of nuclear power are substantially poorer than alternatives, and there are no serious proposals from investors for new nuclear construction.[37]

Wind costs

RAE compared the cost of generating electricity from new nuclear power stations with the cost of wind-generated electricity. The analysis assumed everything goes well for nuclear and everything goes badly for renewables.

With regard to the costs of wind energy RAE has taken current costs (5.5p) whereas the PIU looked at costs in 2020. PIU estimated the cost of onshore wind at around 1.5-2.5p/kWh; offshore wind at around 2-3p/kWh. Wind energy prices are continuing to fall as the technology develops. Some wind farms are already generating at less than 2p/kWh.

RAE has added an additional cost to its estimate for the cost of wind for stand-by power when the wind isn't blowing. How this cost is derived is not clear. Stand-by power is only required when the level of intermittent power on the grid is greater than the inherent variability in the grid. This is unlikely to be reached until wind is about 20% of UK supply. Taking this into account most commentators add somewhere in the range of 0.2p – 0.3p to the cost of wind to cover standby, whereas RAE has added 1.7p/kWh.

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[35] PIU(2002) Annex 6, para 45.
[36] MacKerron (2004). Also see Beck, P & Grimston, M (April 2002) 'Double or Quits?: The Global Future of Civil Nuclear Energy' RIIA Briefing Paper. http://www.riia.org/pdf/research/sdp/Nuclear_Double_or_Quits.pdf
[37] Stephen Timms told the Nuclear Industry Association on 4th December 2003 that "I haven't yet met anyone who wants, in the near future, to build new nuclear capacity" http://www.dti.gov.uk/ministers/speeches/timms041203.html

A good summary of recent energy costings is available in the Greenpeace, Sea Wind Europe report by Garrad Hassan. These use the most authoritative figures available – those from the PIU review and the IEA world energy outlook.[38]

The Government has already considered the relative merits of nuclear versus renewable technologies in preparation for the Energy White Paper and concluded that:

"…technologies such as onshore and offshore wind and biomass are potentially... the most cost effective ways of limiting carbon emissions in the UK".

Since RAE figures for nuclear generating costs are not new, there is no reason for this conclusion to change. That there is a considerable amount of scepticism about the claims made by the industry of new low-cost nuclear technologies is hardly surprising. In his review of its history Helm concludes that the UK nuclear programme has proved

"*…probably one of the biggest investment mistakes since the Second World War … Not once since the first White Paper in 1955 had the nuclear option delivered what was promised.*"[39]

The cost of new reactors.

There can be massive differences given for capital costs for reactors. Similarly, massive uncertainty exists over waste costs. This is particularly true for the UK as a there is no final waste disposal route with the result there is no final cost for intermediate level waste, high level waste or spent nuclear fuel disposition.

The lowest cost estimates, provided by the nuclear industry, put the capital cost of an AP1000 reactor at between US$1.1bn-$1.5bn.[40] The Congressional Budget Office (CBO) in the US has challenged these figures, estimating that the first plant could cost between $2.1 and $3bn.[41] According to BNFL/Westinghouse, construction costs would be significantly less for the 3rd and subsequent reactors. The CBO estimates that costs could come down to $2.3bn by 2011. Using the currently available range of figures, based on today's prices and current exchange rates, we can however provide rough estimate the costs for a new build program in the UK. Ten AP1000 reactors, to replace most of existing reactors, would entail capital expenditure of £4.22bn – £6.33bn (industry figures) or around £8.86bn to £12.65bn (CBO'S figures).

A program of 'only' ten reactors would involve huge capital outlay. Private investors would not want to expose themselves to such a massive risk. Senior city analysts and market advisers say that the city would not be prepared to invest in new build and this would have to be undertaken by the Government.[42] The CBO states that there is a high risk of a company involved in construction of a new reactor defaulting on government loans.

Thomas Capp, chief executive of US nuclear generator Dominion Electricity told a conference in Washington in May:

"*If you announced you were going to build new nuclear plant, Moody's and Standard Poor's [credit rating agencies] would assuredly drop your bonds to junk status … no company in our industry is large enough to take on this risk.*"[43]

Should nuclear power be subsidised?

The idea that UK Government should subsidise new nuclear power stations has been a recent theme of some UK commentators. Simon Jenkins, a noted supporter of privatisation, writing in *The Times*[44], the day after a major speech on climate change by Tony Blair, said only nuclear technology is currently a solution. He complained that no one is coming forward with plans for nuclear power stations because the Government will not subsidise them.

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[38] GPI (2004) Sea Wind Europe, Greenpeace International p36. http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/6204.pdf

[39] Helm, D, (2003) Energy, the State and the Market: British energy policy since 1979. Oxford University Press.

[40] Platts Nuclear News Flashes (3rd September 2004) 'Westinghouse expects to receive NRC Certification for its AP1000'. This gave Westinghouse costs of US$2.2-2.7 billion for two reactors. The International Herald Tribune, (2/9/04)'*China looks abroad for nuclear help*' quoted Westinghouse as giving a figure of US$1.5bn per reactor.

[41] Congressional Budget Office Cost Estimate May 7, 2003 S. 14 Energy Policy Act of 2003 As introduced on April 30, 2003. http://www.cbo.gov/showdoc.cfm?index=4206&sequence=0

[42] Annual Utilities Market Convention, organized by the Energy Information Centre (Birmingham, 5th October 2004).

[43] Andrew Taylor, Political Focus Switches Back to Field of Fission, Financial Times 15th September 2004. http://news.ft.com/cms/s/00be9c88-06b3-11d9-b95e-00000e2511c8.html

[44] Simon Jenkins 'Our Future is Nuclear: the rest is only Wind' The Times 15th September 2004. http://www.timesonline.co.uk/article/0,,482-1262433,00.html

A study by Castellano et al of the University of Chicago's Department of Economics, the Graduate School of Business, and the Harris School of Public Policy, shows that, in the absence of US Government financial policies aimed at the nuclear industry, the first new nuclear plants coming on line will produce electricity at a much higher cost than coal- or gas-fired plants. The study argues that after the first few nuclear plants have been completed, there is a good prospect that lower costs can be achieved which would allow nuclear energy to be competitive in the marketplace. The study suggests financial policies that could help make early nuclear plants more competitive including loan guarantees, accelerated depreciation, investment tax credits, and production tax credits.[45]

Nuclear power has already received massive subsidies. Most recently, the privatised nuclear company, British Energy (BE), was forced to approach the Government in September 2002 for financial support. Under a restructuring plan now agreed by the European Commission, the Government is planning to accept financial responsibility for up to £5bn of BE's nuclear liabilities (waste management and decommissioning costs). This follows the privatisation of BE's eight stations in 1996 for just £1.5 billion – effectively a "buy one, get seven free" deal, since the Sizewell B reactor in Suffolk alone cost £2.6 billion to build only one year earlier. The Nuclear Decommissioning Authority (NDA), which the Government established in April 2005, will take on the liabilities of BNFL and the United Kingdom Atomic Energy Authority (UKAEA). These are thought to amount to around £48bn.[46] A small part of this will be funded by money accrued by BNFL, and some of the liabilities will be defence related. However, the NDA's £2bn annual budget gives an indication of the scale of the subsidy.

Worldwide, according to the World Council on Renewable Energy:

"*The deployment of nuclear energy is the result of gigantic mechanisms of subsidization and privilege. Before 1973, OECD governments spent over $150 billion (adjusted to current costs) in researching and developing nuclear energy, and practically nothing for renewable energy. Between 1974 and 1992, $168 billion was spent on nuclear energy and only $22 billion on renewables. The European Union's extravagant nuclear promotion efforts are not even included in this calculation. French statistics are still being kept secret. The total state support amounts to at least a trillion dollars, with mammoth assistance provided to market creation and to incentives for non-OECD countries, above all the former Soviet block. Only $50 billion has been spent on renewable energy*".[47]

Dr Tony White and Graham Meeks, of the specialist merchant banking firm Climate Change Capital, writing in the Guardian said:

"*It is difficult to foresee the Treasury paying the billions required for new nuclear power stations and nearly impossible to see the money coming from private finance*".[48]

However, if it were a question of saving the planet from the disastrous affects of climate change, then presumably the public would want the Government to at least consider subsidising this 'low-carbon' energy source. However, research carried out for the Department of Trade and Industry (DTI) prior to the Energy Review failed to provide any support for large-scale Government intervention in the market to enable the construction of new nuclear power stations.[49]

Unless nuclear is the cheapest way to meet our energy needs, paying for it will actually make climate change worse. As Amory Lovins, explains:

"*If we suppose pessimistically that saving a kilowatt hour costs as much as 3 cents, while generating a new nuclear kilowatt costs optimistically as little as 6 cents, delivered … then each 6 cents you spent on such a nuclear kilowatt hour could have bought two efficiency kilowatt hours instead. Therefore, by buying the costlier instead of the cheaper option first, you generated an additional kilowatt-hour from, say, coal that would have been avoided if you'd bought the cheapest things first*".[50]

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[45] University of Chicago (August 2004) 'The Economic Future of Nuclear Power' http://nuclear.gov/nucpwr2010/NP2010rptEconFutofNucPwr.html

[46] See for example Clayton Hirst, Independent on Sunday 10th October 2004 'European probe could scupper Britain's £48bn nuclear clean-up' http://news.independent.co.uk/business/news/story.jsp?story=570455

[47] Scheer, H (19th September 2004) 'Nuclear Power belongs in the technology museum' World Council on Renewable Energy. http://www.wcre.org

[48] Tony White and Graham Meeks, Guardian, 20th September 2004 "Blair's missing the point on financing renewables: fossil volatility costs more". http://www.guardian.co.uk/business/story/0,3604,1308151,00.html

[49] IPPR, UKCEED, NEF and Dialogue by Design on behalf of the DTI (September 2002) 'Integrated Public and Stakeholder Consultation to inform the Energy White Paper: Summary Report'.

[50] "Why Nuclear Power's Failure in the Marketplace is Irreversible (Fortunately for Nonproliferation and Climate Protection)" by Amory Lovins, Rocky Mountain Institute, Transcription of a presentation to the Nuclear Control Institute's 20th Anniversary Conference, "Nuclear Power and the Spread of Nuclear Weapons: Can We Have One Without the Other?," Washington, DC, April 9, 2001. http://www.nci.org

In other words, to tackle climate change most effectively we must choose the cheapest forms of carbon abatement first. Provided there are still energy efficiency gains to be made, these will almost always be a more financially effective way of spending public money than subsidising new nuclear power stations.

According to the PIU, the current cost effective potential for energy efficiency amounts to approximately 30% of final energy demand. And, as we have seen, the Government's Energy White Paper considered various renewable technologies to be "*... the most cost effective ways of limiting carbon emissions in the UK.*"[51]

In a letter to *The Times* on 16th September 2004, the Chief Executive of the Government's Energy Saving Trust, Philip Sellwood said:

"*To present nuclear power as one of the main ways of combating climate change is short-sighted ... nuclear power simply does not represent a viable option at present. Given the costs associated with nuclear power and current uncertainties surrounding the problems of dealing with nuclear waste, making the UK more energy efficient is a far safer, cheaper and more realistic solution...*"[52]

As long ago as 1989 an advert by Greenpeace[53], signed by 100 of the country's leading scientists, doctors and engineers, including 6 Emeritus Professors and 2 Nobel Prizewinners, said "nuclear power is not an answer to greenhouse effect".

[51] DTI, ' Our Energy Future – Creating a Low Carbon Economy,' Cm 5761, February 2003. para 4.13 http://www.dti.gov.uk/energy/whitepaper/ourenergyfuture.pdf

[52] Letter from Philip Sellwood, Chief Executive Energy Saving Trust to The Times 16th September 2004 http://www.timesonline.co.uk/article/0,,59-1264441,00.html

[53] http://www.no2nuclearpower.org.uk/articles/greenpeace_advert_se72.php

4. The hurdles to nuclear revival

The hurdles to a nuclear renaissance go far wider than a lack of commercial competitiveness. The Energy White Paper highlighted the issue of nuclear waste, and Tony Blair, in his evidence to the House of Commons Liaison Committee on 6th July 2004 highlighted public acceptability, safety and perhaps inadvertently, proliferation. He said:

"…*people* [need to] *understand the science and, in particular ... the difference between a nuclear power station and the development of nuclear weapons* …"[54]

Public attitudes to a range of issues, especially those related to nuclear waste, nuclear safety and proliferation will be crucial to the success of any proposed new nuclear programme. Indeed society has changed considerably since the last nuclear power station was ordered in the UK (Sizewell B in the early 1980s). It must now at least be questionable whether nuclear power fits at all with modern society's new demands for consultation and participation.[55]

Nuclear waste

As we have seen, the Government's Energy White Paper talks of "*important issues of nuclear waste to be resolved*"[56]

Research carried out for the Department of Trade and Industry to inform the preparation of the Energy White Paper concluded that:

"*Waste Management was a dominant issue for all shades of opinion on nuclear power* …"[57]

But it is not clear what the public might consider to be a 'solution' to the long-term management of radioactive wastes, or when it might consider that policy implementation has proceeded far enough.[58] This could, for example, be when (and if) a political consensus has been reached on a nuclear waste management option, or alternatively might need to wait until planning consent for new facilities has been secured, or even construction of the facility, or a period of successful operation. Alternatively, it may be that the prevailing public viewpoint is that the nuclear waste management option, selected by the Government, is only acceptable on condition that no further nuclear waste is produced. Some evidence for this view was provided by the Ministry of Defence's consultation on the disposal of nuclear submarines – Project Isolus – which recommended that:

"*The appropriate bodies should be informed of the strength of feeling against building further nuclear powered submarines, especially in relation to the absence of a final disposal route for the radioactive wastes*."[59]

There is also evidence from Sweden that the public acceptability of waste management proposals can be increased by setting a limit on the amount of nuclear waste which can be produced in future. For example, the 1980 referendum in Sweden, which resulted in the adoption of a policy to end nuclear power generation by 2010, created the context in which better progress could be made in establishing disposal facilities. This suggests that any future waste management proposals should be combined with a well-defined nuclear closure programme so that an unambiguous picture of the type and scale of waste arisings can be presented to the public.

The Committee on Radioactive Waste Management (CoRWM) is a new independent body appointed by UK Government Ministers to review options for the management of solid, higher level, radioactive waste in the UK. Its work programme submitted to Ministers envisages making recommendation on options in July 2006.[60] CoRWM will not make recommendations about selection of a site or sites, only on which management option or combination of options it recommends. There will then have to be further public consultation on the proposed option and how it should

[54] House of Commons Liaison Committee Minutes of Evidence 6th July 2004, Q202 http://www.publications.parliament.uk/pa/cm200304/cmselect/cmliaisn/310/4070605.htm

[55] See for example Ekins, P "Step changes for decarbonising the energy system: research needs for renewables, energy efficiency and nuclear power", Energy Policy Vol 32 No 17 (November 2004) pp1891-1904

[56] Paras 1.24 & 4.68

[57] DTI (Sept 2002) "Integrated Public and Stakeholder Consultation to Inform the Energy White Paper: Summary Repoer", IPPR, UKCEED, NEF and Dialogue by Design on behalf of the DTI.

[58] The Nuclear Free Local Authorities, in their publication '*New Nuclear Monitor*' lists public acceptability issues, which they say need to be explored. http://www.nuclearpolicy.info/

[59] 'Project ISOLUS: Front End Consultation Final Report. Report to the MOD' CSEC, Lancaster University, September 2001 [See http://www.lancs.ac.uk/users/csec/isolus2/isolus6m.htm] Recommendation 3.

[60] Committee on Radioactive Waste Management, June 2004, Work Programme 2004 – 2006 http://www.corwm.org/PDF/Programme%20of%20work%20-%20for%20presentation%20to%20Ministers.pdf

be implemented, which could take a further two or three years.[61] Whichever management option is ultimately selected by the Government, it is likely to be some considerable time, at least a decade or two, before a facility, or facilities, becomes available.[62] So the nuclear waste problem, which the White Paper said needs to be resolved, will not even approach resolution until the Government decides on the best management option, say around 2008/9, and may indeed not be sufficiently resolved until waste is actually placed in a facility perhaps between 2020 and 2040.

Decommissioning & lower level wastes

According to *The Times*, accelerating decommissioning timetables will help the industry make the case for building new reactors.[63] Clearly being able to demonstrate an ability to decommission and dismantle existing nuclear power stations might help the public feel better about building new ones. But decommissioning nuclear facilities and decontaminating nuclear sites is going to generate huge volumes of lower level nuclear waste, which is not even being considered in the CoRWM process, and Government policy on how to deal with this waste is in disarray.

Government disarray

The Radioactive Waste Management Advisory Committee, which has now been put in abeyance by the Government, while CoRWM is in operation, lists nine issues and priorities, but it only has confidence that three of these issues are being addressed. Several of the issues not being addressed concern lower level solid wastes.[64]

The former head of the Government's Liabilities Management Unit, Alan Edwards, estimates that the volume of lower level wastes expected to arise during the decommissioning of the UK's existing nuclear facilities would be sufficient to fill 15 facilities the size of Drigg (the low-level waste dump near Sellafield in Cumbria).[65]

In 1999, the House of Lords Science and Technology Committee recommended that plans should be made for the establishment of a new low-level waste (LLW) disposal facility to open before the existing facility at Drigg closes.[66] Although it is currently assumed that Drigg will not be full until around 2050, because much of the waste from decommissioning will arise later, this date is subject to considerable uncertainty, and could be much sooner.

The Government has no clearly defined policy on the standards of clean-up required for nuclear sites following decommissioning. Consequently the management of lower level wastes is currently being dealt with in a piecemeal fashion, which is likely to simply fuel controversy.

There are non-Drigg disposal options for some lower level waste including landfill sites and incinerators. Some waste from BNFL's Springfields and Capenhurst plants is disposed of at the Clifton Marsh landfill site near Preston, and waste from the two nuclear sites operated by Rolls Royce in Derby was sent to Hilts Quarry, in Derbyshire, until October 2002, when the practise was ended due to public opposition.[67] Amersham plc and Devonport Royal Dockyard are also authorised to send small amounts of waste to burial at other sites.

The 1995 Review of Radioactive Waste Management decided not to encourage greater use of landfill because of opposition from local authorities and the public,[68] and the Environment Agencies (EA and SEPA) have indicated an

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[61] DEFRA (September 2001) 'Managing Radioactive Waste Safely' http://www.defra.gov.uk/environment/consult/radwaste/pdf/radwaste.pdf This document envisaged a programme of action for reaching decisions: Stage two, which was expected to be completed by 2004 was 'Research and public debate to examine the different options and recommend the best option (or combination). This was to be followed by Stage Three in 2005 "Further consultation seeking public views on the proposed option"; Stage Four, 2006, "Announcement on the chosen option, seeking public views on how this should be implemented" and Stage Five, 2007 "Legislation if needed".

[62] Radioactive Waste Management Advisory Committee (September 2004) "Review of current issues and priorities in radioactive waste management" http://www.defra.gov.uk/rwmac/reports/issues/rwmac-issues.pdf

[63] Angela Jameson, Windscale to be Clean 30 years Early, The Times 5th April 2004 http://business.timesonline.co.uk/article/0,,8209-1063261,00.html See also Speedier, cheaper clean-up raises prospects of nuclear energy by Mark Milner, Guardian 12th October 2004. http://society.guardian.co.uk/environment/news/0,14129,1325166,00.html

[64] Radioactive Waste Management Advisory Committee (September 2004) "Review of current issues and priorities in radioactive waste management" http://www.defra.gov.uk/rwmac/reports/issues/rwmac-issues.pdf

[65] Alan Edwards (25th March 2005) Speaking at the 6th Irish and UK Local Authorities Standing Conference on Nuclear Hazards, Glasgow.

[66] House of Lords Select Committee on Science and Technology (March 1999) 'Management of Nuclear Waste' para 8.20 http://www.publications.parliament.uk/pa/ld199899/ldselect/ldsctech/41/4101.htm

[67] BBC 4th October 2002 'Quarry Protestors Celebrate Victory' http://news.bbc.co.uk/1/hi/england/2299361.stm

[68] HMSO (1995) 'Review of Radioactive Waste Management Policy: Final Conclusions' Cmnd 2919, para 180

unwillingness to encourage the extension of this practice, although any application would be considered on its merits.[69] Public opposition has also prevented the commissioning of LLW incinerators at Bradwell and other nuclear sites. This has resulted in the near cessation of incineration operations by the nuclear sector, although some forms of low activity waste, for example contaminated waste oil, are still transferred to commercial incinerators, and a new incinerator is planned for the Dounreay (Caithness) nuclear site for contaminated oils and solvents.

However, given the large volumes of lower level wastes, and the high cost of disposal at Drigg (disposal at Drigg costs about £5,000 per cubic metre, so the cost of disposing of the currently estimated future arisings will be around £7.5bn[70]) there may be pressure to increase the amount of wastes going to landfill or incineration sites, as well as pressure to lower standards for site remediation in an attempt to reduce the volumes of waste generated and their associated disposal costs. With significant quantities of potentially valuable metals arising from decommissioning, there could also be pressure to allow increases in the levels of radioactivity allowed in scrap metal. These issues are likely to raise whole new areas of controversy.

Piecemeal policy approach – Dounreay

One example of an upcoming controversy, which is likely to feed public concern about the failure to solve the nuclear waste problem, is the plan by the UK Atomic Energy Authorities (UKAEA) to transfer low-level waste (LLW) from Dounreay in Caithness to Drigg. Until recently, all Dounreay's low level waste was disposed of in the Dounreay pits, but these pits are now virtually full. UKAEA has applied to the Scottish Environment Protection Agency (SEPA) to transfer LLW to Drigg while it investigates a longer-term management strategy. There is also concern that the waste already disposed of in the Dounreay pits may have to be excavated because the condition of the waste might not sustain a rigorous post-closure safety assessment. Not only does all this put further pressure on Drigg, but there is also a worry that by beginning the transportation of waste to Drigg, the UKAEA is setting a precedent for the transfer of higher activity wastes from Dounreay to Sellafield.

Meanwhile, both Copeland Borough Council and Cumbria County Council, local authorities often supportive of the nuclear industry, have expressed opposition to transports of low level waste from Dounreay to Drigg.

Public mistrust

A major problem in the development of standards for decommissioning, decontamination, recycling and the re-use of decommissioning waste is the legacy of public mistrust in the industry, which would have to be overcome before even 'clean' waste could be exported from a nuclear licensed site for disposal. For example, in August 2003 public opposition prevented the UKAEA disposing of 'exempt' waste from Dounreay at a landfill site near Falkirk.[71] This mistrust will have to be overcome first, before we can deal with the nuclear waste we have already created, let alone consider whether it is sensible to create yet more waste in a new generation of nuclear reactors.

A sustainable decommissioning policy must be based on a clear set of environmental principles, in particular: the polluter pays principle, the concentration and containment principle and the proximity principle. Concerns about rising volumes of lower activity wastes should not be used to distract from the need to implement the Best Practicable Environmental Option (BPEO).[72] Guidance on how the BPEO should be identified needs to be developed after wide consultation with local and national stakeholders. This will all take time. A focus on accelerating decommissioning timetables alone will not work, if the Government wants the public's support to deal with the legacy of waste we have already created. For the nuclear waste issue ever to be declared 'resolved' (assuming for a moment that this is possible)

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[69] Clive Williams of the Environment Agency speaking to the Local Government Association Special Interest Group on Radioactive Waste Management & Nuclear Decommissioning in May 2004.

[70] Jackson, I (21st June 2004) response to 'HSE's Proposed No Danger Criteria for De-Licensing Nuclear Sites. http://www.jacksonconsult.com/downloads/HSC_Delicensing.pdf

[71] Sunday Herald, 13 July 2003, "Falkirk knocks back Dounreay waste" By Rob Edwards http://pqasb.pqarchiver.com/smgpubs/358753721.html?did=358753721&FMT=ABS&FMTS=FT&date=Jul+13%2C+2003&author=Rob+Edwards&desc=Falkirk+knocks+back+Dounreay+waste

[72] A BPEO is generally assumed to be a reference to the concept developed by the Royal Commission on Environmental Pollution (RCEP) which provided the following definition:"…the outcome of a systematic consultative and decision-making procedure which emphasises the protection of the environment across land, air and water. The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefit or least damage to the environment as a whole, at acceptable cost, in the long as well as the short term". The RCEP's view was that "…the procedure should be open [and] there should be the widest possible opportunity for others who may be affected to contribute to the decision … where the trade-offs are difficult or controversial, the selection of BPEO cannot be left to scientists, industrialists and regulatory experts alone. Public involvement is needed so that the public values underlying the choice of BPEO are identified … there must be appropriate and timely consultation with people and organisations directly affected".

these issues concerning decommissioning and lower activity wastes will also need to be addressed, as well as the higher activity wastes being addressed by CoRWM.

Nuclear Decommissioning Authority

The Government has established a new Nuclear Decommissioning Authority (NDA) to deal with the legacy of dangerous waste left by the nuclear industry. Unfortunately this new body, which started operating on 1st April 2005, offers a virtual blank cheque to the industry to continue producing yet more nuclear waste, and has no overriding environmental objectives which could mean further unnecessary radioactive contamination of our environment.

The proposal to establish the NDA first emerged in November 2001 when Patricia Hewitt, the Trade and Industry Secretary, announced that state-owned British Nuclear Fuels plc (BNFL) had liabilities which exceed its assets by £1.7bn. In other words, it was bankrupt. As a consequence the NDA was to be established to take control of the situation. A White Paper, "Managing the Nuclear Legacy", was published in July 2002[73], and a Draft "Nuclear Sites and Radioactive Substances Bill was published for consultation in June 2003[74]. The Energy Act, which incorporated the provisions in the Draft Nuclear Sites and Radioactive Substances Bill received Royal Assent in July 2004.[75]

The NDA (a Non-Departmental Public Body) became almost fully operational in April 2005 when it will took ownership of virtually everything owned by the UKAEA and BNFL, including Sellafield, Dounreay and the Magnox nuclear station sites[76]. But it will not directly manage the sites. It is also envisaged the NDA may eventually take over handling waste from Ministry of Defence operations e.g. decommissioned nuclear submarines.

The Energy Act was designed to introduce competition, which it is hoped will reduce costs. Contractors, including the rump of BNFL and the UKAEA will compete for contracts to manage the sites and carry out individual decommissioning and clean up projects.

The establishment of the NDA certainly appears to be focussing attention on the need to reduce the huge costs associated with nuclear decommissioning, and speeding up the time needed. The estimated bill to clean up the Dounreay nuclear site has already been cut by £1 billion with the job now scheduled to be completed 11 years earlier than expected. The UKAEA now expects completion of the programme to return the Caithness complex to a near greenfield site by 2036 and the cost reduced from £3.6 billion to £2.6 billion. The revised forecasts are contained in long-range plans submitted to the government and regulators in preparation for the launch of the NDA.[77]

But, whilst speeding up decommissioning might help the nuclear industry make the case for building new nuclear power stations, the NDA's role in continuing to produce nuclear waste, particularly by continuing with the reprocessing of spent nuclear waste fuel, can only help to maintain the controversy surrounding the nuclear industry,

and the public's antipathy towards it. Despite its name, the NDA will oversee the following operations, all of which involve the production of yet more nuclear waste:

1. The continued operation of BNFL's ageing Magnox reactors until the last one, Wylfa, closes in 2010.
2. The continued operation of the Magnox reprocessing plant at Sellafield until it closes around 2012.
3. The continued operation of the Thermal Oxide Reprocessing Plant at Sellafield which reprocesses spent fuel from British Energy's Advanced Gas Cooled Reactors and foreign light water reactors.
4. The continued operation of the Sellafield MOX Plant which is intended to manufacture plutonium fuel from weapons-useable plutonium extracted from spent nuclear waste fuel during the reprocessing process.

If these were not enough to damage public confidence in the new body, since the White Paper was published the proposed responsibilities of the NDA have been extended to cover waste liabilities (and potentially decommissioning) for the struggling privatised nuclear generator, British Energy as part of the Government's controversial bail-out.

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[73] http://www.dti.gov.uk/nuclearcleanup/pdfs/whitepaper.pdf
[74] http://www.dti.gov.uk/nuclearcleanup/pdfs/print-05publication.pdf
[75] http://www.legislation.hmso.gov.uk/acts/acts2004/20040020.htm
[76] Chapelcross, Dungeness A, Sizewell A, Hinkley A, Hunterston A, Berkeley, Bradwell, Trawsfynydd, Wylfa
[77] John Ross, Nuclear Shutdown Fast Tracked, Scotsman 11th October 2004
http://thescotsman.scotsman.com/scotland.cfm?id=1182382004
Andrew Taylor, Nuclear Agency promises faster and cheaper reactor clean-ups, Financial Times, 11th October 2004
http://news.ft.com/cms/s/1dd57440-1b21-11d9-9fe4-00000e2511c8.html

The White Paper claimed that: "T*here is no direct connection between the White Paper and the Government's attitude towards new build*"[78]. It went on to say that the NDA's focus is "*squarely on the nuclear legacy*".[79]

But the provision in the Energy Act which allow the British Energy bail-out mean that rather than simply cleaning-up and decommissioning the legacy of an already problematic industry, the NDA could also facilitate the continuation or even expansion of the private nuclear sector as the Bill doesn't rule out the possibility of future new nuclear operators being given the same subsidies.

This failure to rule out the facilitation of nuclear activities from the NDA's role is compounded by the failure to include in the Bill an overarching objective or environmental principles for the NDA. If it did, then it would flow that the continued operation of the ageing, loss-making, Magnox reactors and the highly polluting reprocessing plants would cease. For example, if the Bill contained a principle that called for waste avoidance or minimisation then waste-making plants would shut.

With the NDA simply required to 'meet regulatory requirements', and not work to a clearly defined set of environmental principles, enshrined in legislation, this could lead to a myriad of problems arising and environmentally hazardous proposals being promoted. Unfortunately, the Government has missed a valuable opportunity to clarify policies with regard to decommissioning and waste management, so policy will continue to be developed 'on the hoof'[80] with national policy effectively being pre-empted by specific regulatory/site decisions. This could lead to, for example:

1 Decommissioning used as an excuse for continuing or even increasing discharges of radioactivity into the marine environment.
2 Continued production of nuclear waste compounding the problems the NDA is supposed to be being set up to deal with.
3 Inappropriate methods of nuclear waste management, such as incineration, which leads to the dispersal of radioactivity throughout the environment.
4 Unnecessary transports of nuclear waste from one site to another.
5 Failure to prioritise those wastes which represent the biggest hazard.

The legacy of public mistrust in the nuclear industry needs to be taken into account as the NDA and the rest of the industry develops its plans for dealing with existing nuclear waste. Decommissioning activities should give primacy to *environmental and sustainability concerns,* rather than commercial or economic ones e.g. concentration and containment of waste rather than dilution and dispersal during its operations. In order to create an organisation that can become a world-leader in decommissioning and nuclear clean up, the NDA needs to have ingrained in it a clear objective to protect health and safety, and the environment, from the harmful effects of radiation during the decommissioning and clean up of those nuclear sites, for which it is responsible.

The Government may have said that there is no direct link between the creation of the NDA and any future proposals for new nuclear capacity,[81] but it is being established in a way that adds to concerns that cleaning up the nuclear legacy is being planned with one eye on enabling nuclear new build rather than prioritising environmental protection. Accelerating decommissioning timetables increases these concerns. Suspicions that the establishment of the NDA is simply an exercise in 'clearing the decks' to prepare the ground for new build will not be dispelled until the Government sets out a clear set of environmental objectives for the new Authority.

[78] DTI (July 2002) 'Managing the Nuclear Legacy' para 1.11 http://www.dti.gov.uk/nuclearcleanup/pdfs/whitepaper.pdf
[79] DTI (July 2002) para 1.12 http://www.dti.gov.uk/nuclearcleanup/pdfs/whitepaper.pdf
[80] See RWMAC (March 2003) Advice to Ministers on Management of Low Activity Solid Radioactive Wastes within the United Kingdom, (http://www.defra.gov.uk/rwmac/press/p030324.htm) paras 6.38, 6.13 and A3.21
[81] DTI (July 2002) 'Managing the Nuclear Legacy: A Strategy for Action'. FAQ 2. http://www.dti.gov.uk/nuclearcleanup/pdfs/whitepaper.pdf

Plutonium and proliferation

Tony Blair, told the House of Commons Liaison Committee on 6th July 2004 that he wanted people to understand the difference between nuclear power stations and the development of nuclear weapons.[82] Unfortunately, at least until Sellafield stops separating plutonium from spent nuclear waste fuel, nuclear power and the potential to make nuclear weapons will remain intimately connected.

On 31st December 2001, there were over 60 tonnes of UK separated civil plutonium stockpiled mostly at Sellafield. This stockpile could climb to over 100 tonnes by about 2012.[83]

As already noted, Britain has absolutely no use for this plutonium. Some countries now use plutonium, mixed with uranium oxide (known as mixed oxide or MOX fuel) to partly fuel some of their conventional nuclear reactors, but Britain has never done this. It would be possible to use MOX fuel in the Sizewell B reactor, but the economics have so far put BE off the idea. It might be feasible to convert the two youngest AGRs, Torness and Heysham 2, to burn MOX. Sizewell could feasibly use up around 12 to 18 tonnes of plutonium, plus an extra 5 to 7 tonnes if its life were extended ten years to 2045. Heysham 2 and Torness could use up around 10 tonnes between 2015 and 2023. But even with all three stations converted to use MOX, there would still be an unused surplus remaining at Sellafield.

There have recently been suggestions that at least some of this plutonium should be treated as nuclear waste.[84]

In addition to the UK stockpile, there are also almost 17 tonnes of plutonium at Sellafield owned by BNFL's foreign customers at Sellafield. This could grow to 37 tonnes by 2012. These overseas electricity companies will need to decide what they want to do with their plutonium. Some companies may decide to ask BNFL to covert it into MOX fuel in the Sellafield MOX Plant.

The UK's plutonium stockpile is at the very best an embarrassment. We cannot, as a nation, persuade other countries to forego the production of plutonium and highly enriched uranium, both of which can be used to manufacture nuclear weapons, when we have such a large stockpile of plutonium ourselves and no plans to deal with it.

Some nuclear industry advocates argue that civil grade plutonium is no use for manufacturing nuclear weapons. However, a successful nuclear weapons test was conducted in 1962 in Nevada using reactor-grade plutonium.[85] The US Department of Energy says:

"*Virtually any combination of plutonium isotopes … can be used to make a nuclear weapon*"[86]

While a bomb using reactor-grade plutonium might not produce as efficient a weapon as one made using weapons-grade plutonium, it would still be "*a potentially fearsome explosive*".[87]

Even if there were global controls which managed to maintain plutonium in secure conditions, and the nuclear industry were restricted to transporting Mixed plutonium and uranium oxide fuel (MOX) from country to country, this would still present an unacceptable proliferation hazard.

"*MOX fuel remains a material in the most sensitive category because plutonium suitable for use in weapons could be separated from it relatively easily*".[88]

Mohamed El Baradei, Director-General of the International Atomic Energy Agency, in a recent interview with Newsweek said that:

"*…eventually not having any plutonium or highly-enriched uranium is really the way to go*".[89]

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[82] House of Commons Liaison Committee Minutes of Evidence 6th July 2004, Q202
http://www.publications.parliament.uk/pa/cm200304/cmselect/cmliaisn/310/4070605.htm
[83] http://www.the-environment-council.org.uk/docs/PuWG_Report_Mar_03.pdf
See Annex 2, Page 3.
[84] http://www.defra.gov.uk/environment/consult/radwaste/pdf/radwaste.pdf
[85] US Department of Energy (1999) DoE Facts "Additional Information Concerning Underground Nuclear Weapon Test of Reactor-Grade Plutonium".
[86] US DoE (January 1997) "Nonprliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Excess Plutonium Disposition Alternatives"
[87] ibid
[88] ibid
[89] Newsweek 20th May 2004

Plutonium-burning reactors

According to Bill Wilkinson, president of the British Nuclear Industry Forum, speaking in Brussels in 2000, the UK plutonium stockpile "*is causing national and international concern*" because of the risk that some could be stolen and made into nuclear bombs. [90] BNFL has been known to be interested for some time in building an AP1000 or two to utilise the large stockpile of UK plutonium. These reactors, unlike most other conventional reactors, could probably use 100% MOX fuel, but they are likely to be inherently more dangerous. By burning plutonium in this way BNFL would generate income from electricity sales, and hopes to be seen to be proactively tackling one of the biggest public concerns in the U.K.[91]

Wilkinson estimated that two new 1200-megawatt reactors would take 25 years to convert 90 tonnes of plutonium into radioactive spent fuel, which cannot easily be used for weapons. Wilkinson claimed that because the reactors would also generate power, they would save more than £1 billion compared with developing a technology to 'immobilise' the plutonium as a waste form. However, a study carried out by Mike Sadnicki and Fred Barker disputed this and concluding that the cheapest option, would be to use the Sellafield MOX Plant (SMP) to fabricate what the authors call "low-spec" or 'dirty" MOX fuel which would not be appropriate for loading into reactors. That material could be placed in a waste facility.[92]

By the time the Energy White Paper was about to be published in early 2003, UK Government 'sources' were telling Nucleonics Week Magazine that a couple of plutonium-burning reactors were the only nuclear stations likely to be built in the UK over the next ten to fifteen years.[93]

BNFL has given the impression that if it were able to build two plutonium-burning reactors, they would be located at Sellafield. But there must be some doubt over whether West Cumbria would have the required grid connections for two 1,000MW power stations. Building MOX burning reactors elsewhere, or indeed utilising MOX in existing reactors, would require armed convoys to transport the fuel from the Sellafield MOX plant to the reactor-site. Witnessing such a sight on the UK's roads is not going to endear the public to the idea of a new nuclear programme.

A new generation of reactors

Following the Three Mile Island (TMI) and Chernobyl incidents in the US and former Soviet Union the public might be expected to demand the highest possible standards of safety for a new generation of reactors. This might be defined, for example, as there being no physically credible events which could require off-site actions. Additionally, since September 11th 2001, the public is also likely to demand much greater resistance to terrorist attack. This would require the development of reactor designs that could survive the total absence of coolant and withstand high impact external events, such as the deliberate crashing of a commercial jet airliner.

Perhaps, in anticipation of this sort of demand, nuclear vendors have tailored their new designs around a number of design concepts for advanced reactors. These new designs rely on so-called 'passive' safety systems. The BNFL/Westinghouse AP1000 design, the reactor type most likely to be built in the UK is one of these designs. The industry claims that because AP1000 reactors employ passive safety features, they are considered to be *inherently safe.* But there is nothing *inherently* safe about highly hazardous plant, which has a highly radioactive fuel core. The radiological hazard presented by the reactor fuel core of an advanced reactor will be about the same, if not greater than the present generation of reactors, because of the planned longer fuel burn-up margins. Unless it can be demonstrated that there is absolutely no means by which the containment can be breached, then there remains a finite risk of radioactive release.

In fact, the suspicion is that the AP1000 design is more about saving money than improving safety. In September 2000 James Winters of Westinghouse, stated:

"*Reducing the construction costs of commercial nuclear power plants is essential to the future of nuclear energy*"[94]

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[90] New Scientist (11th November 2000) 'Stash or burn: Should Britain build new reactors to dispose of its plutonium?' by Rob Edwards

[91] Nuclear Fuel April 2nd 2001.

[92] Barker, F & Sadnicki, M (April 2001) 'The Disposition of Civil Plutonium in the UK'. See also Nucleonics Week (2nd November 2000) 'Uk Study says Immobilization is Cost-effective for Pu'

[93] Nucleonics Week (30th January 2003) Vol44 No.5 Some extracts from "UK Government doesn't see new nuclear plants anytime soon"

[94] Winters, J W "The AP600 – Designed Certified and Ready to Build" Nuclear News, September 2000, p39

The response was to cut "*excessive hardware solutions*" [95] to plant safety.

An AP1000 is basically a type of "Pressurised Water Reactor" (PWR), like the Sizewell B reactor. In PWRs water is pumped past nuclear fuel rods where it is heated up. It then goes through a 'steam generator' where it boils a separate system of water that provides steam to generate electricity. The reactor water goes back through the fuel.

The safety of PWR-type reactors centres around keeping the core and the nuclear fuel sufficiently cool at all times to prevent the fuel melting down. The reactor water must not boil because if it turned into steam it would be much worse at cooling the fuel rods and so they could get too hot and melt. This could lead to a meltdown and the release of radioactivity. The working temperature of the water is around 320 degrees Celsius[96] so it must be kept under a pressure of around 150 atmospheres to prevent it from boiling.[97] The worst group of accidents involve some part of the complicated reactor cooling circuit failing. In a few fractions of a second, the pressure drops allowing the water to flash into steam and making it unable to cool the nuclear fuel sufficiently. Unless checked, the overheating fuel will melt and control of the nuclear fission reaction will be lost. This means that the reactor water circuit is extremely vulnerable to cracks or pump failures of any other failures of the circuit that could lead to release of water. These are known as "Loss of Coolant Accidents" (LOCAs).

In March 1978, just such an accident happened in a PWR at Three Mile Island, Pennsylvania, 240 kilometres from New York. An initial failure of a pump that sent water past the fuel was followed by failures of other equipment together with errors in judgement by the staff. This led to the overheating of the core and some of it actually melted.[98]

In order to cope with the possibility of nuclear accidents there are fundamental design principles which are meant to ensure that a dangerous sequence of events does not lead to a catastrophe. The principles of nuclear safety were set out in the conclusions of the public inquiry into the proposal to build the Sizewell B PWR (The Layfield report). The report sets out two important principles: redundancy and diversity.[99]

- ***Redundancy*** requires having more than one item that can do the same thing so that if one fails there is a back-up.

- ***Diversity*** requires having more than one way of doing the same thing so that if there is a generic failure that applies to all of the same type of equipment, then there is also back up for that.

The main differences between the original PWR and new AP1000 design concern the emergency safety systems, particularly the emergency core cooling systems.[100] The passive safety concept does not adhere to the redundancy and diversity principles. Instead it relies on gravity and convection, or so-called "passive" safety systems. In the present design of PWRs there are a series of valves and pipes designed to supply an "emergency core cooling system". The AP1000 design relies upon natural means, including gravity fed water from tanks, to transfer heat from the fuel. This means that the AP1000 relies heavily on the assumption that these alternative emergency response mechanisms will work.

Compared with the original PWR, the AP1000 design has many of the safety systems stripped out, both to save money, and avoid reliance on operators and power during an emergency situation. The design aims to achieve a reduction in the number of valves and components that could go wrong by simplification of the design. The AP1000 has 50 percent fewer valves, 83 percent less piping, 87 percent less control cable, 35 percent fewer pumps and 50 percent less seismic building volume than a similarly sized conventional plant. These reductions in equipment and bulk quantities lead to major savings in plant costs and construction schedules.[101]

For final heat dissipation the advanced reactor relies upon air-cooling using atmospheric air. To do this, the structural integrity of the reactor dome has been sacrificed. This means the "secondary containment system", which is supposed to stop radioactivity escaping in a meltdown, actually has a huge hole in it.[102]

Westinghouse relies on theoretical calculations and computer models, to predict the kinds of emergency situations which might arise. In order to avoid relying on nuclear operators to deal with emergency situations, passive systems

[95] Westinghouse AP1000, Executive Summary
[96] Westinghouse Presentation to NRC Staff, 9 May 2002, Slide 12
[97] UKAEA "The Pressurised Water Reactor", November 1985
[98] Sumner D et al "Radiation Risks" Tarragon Press , 1991
[99] Layfield (1987) 5.52
[100] US Department of Energy (2001), Nuclear Energy Research Advisory Committee, "A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010", 31 October 2001
[101] http://www.ap1000.westinghousenuclear.com/
[102] Winters, J W "The AP600 – Designed Certified and Ready to Build" Nuclear News, September 2000, p 38

deal with the most likely emergencies by building systems into the design. But it is by no means certain that real nuclear power stations will behave in ways the scaled-up theoretical calculations say they will. There is a trade-off in trying to remove human error. What if the emergency event has not been predicted by designers and requires intelligent intervention by the operators? Reliance on passive safety systems could result in a worsening situation with the plant workers left with no means to do anything about it.

"Where reliance is placed solely on inherent safety features or on purely passive engineered safety features, it would not be possible for an operator to select or even influence the final condition of the plant."[103]

Resistance to terrorist attack

As a consequence of sacrificing some of the structural integrity of the dome, the AP1000 reactor will be less able to withstand natural hazards, such as earthquakes, and accidents and deliberate actions such as aircraft impact and nearby explosion.
"... many new reactor designs are actually more vulnerable to terrorist attacks than existing designs. For example, the Westinghouse AP[1000] has only a single instead of a double containment so that heat would be removed more quickly in the case of a loss of coolant accident. Increasing the containment thickness to protect against aircraft collisions would put the safety design of this "inherently safe" reactor back on the drawing board."[104]

After September 11th one might have expected that new reactors would be designed to be less vulnerable to terrorist attack. With the AP1000 design, the reverse is the case.

Radiation standards

The health effects of discharges of low levels of radioactivity into the environment from nuclear facilities has been controversial for many years. Debate on the current radiation risk models has raged since the discovery in 1983 of an excess of childhood leukaemias and other cancers in the village of Seascale, near Sellafield. Following the report of the subsequent enquiry by the Black Advisory Group in 1984, the Government established the Committee on Medical Aspects of Radiation in the Environment (COMARE) in 1985 to examine the matter further. The COMARE First Report in 1986 concluded that the estimated radiation doses, calculated from Sellafield's recorded releases and from measured radionuclide concentrations in the environment were too small by a factor of about 400 to account for the increased incidence of leukaemia. Most environment groups and some scientists have not accepted the view that the occurrence of a pronounced leukaemia cluster adjacent to one of the world's largest sources of radioactive discharges was due to coincidence or some other unidentified factor. In their view, a more straightforward explanation was that the risk models were incorrect and that a re-evaluation of these models was indicated. This view was reinforced by the observation of leukaemia clusters near certain other nuclear establishments. Indeed at some nuclear establishments there is even disagreement about whether a raised level of cancers exists or not.

The public might be expected to require a minimum level of expert agreement about the risks of low-level radiation, before agreeing to new nuclear power stations. Even if discharges from a new generation of reactors will be much lower than from existing reactors, unplanned discharges during accidents will also be of concern.

COMARE established the Committee Examining Radiation Risks of Internal Emitters (CERRIE) in December 2001. In October 2004, CERRIE published its final report on the risks of internal radiation. It concluded that uncertainties about the risks mean that in some cases we might be exposed to 10 times the risk previously thought. This will require policy makers and regulators to adopt a more precautionary approach when dealing with applications from the nuclear industry for authorisation to discharge radioactivity into the environment.[105]

The impact of the report on the regulation of new nuclear power stations remains to be seen, but whether the report represented a sufficient amount of agreement between experts to re-assure the public appears doubtful. Two members of the Committee issued a dissenting report. These two have highlighted alleged raised levels of cancer, particularly around the Hinkley and Bradwell nuclear power station sites, which other scientists, including COMARE, dispute.[106]

In the absence of clear agreement between experts the obvious response from a risk averse public would be to avoid accepting any future discharges of radioactivity into the environment from new nuclear facilities.

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[103] Karlheinz Orth, Siemens AG, quoted in "Outlook On Advanced Reactors," Nucleonics Week, Mar 30, 1989, pp1-20
[104] WISE News Communique (1998), "New generation: The AP 600", (492.4881), May 22, 1998, http://www.antenna.nl/wise/492/4881.html
[105] CERRIE (2004) Report of the Committee Examining Radiation Risks of Internal Emitters. http://www.cerrie.org
[106] See for example http://www.llrc.org

The polluter pays principle

As a consequence of British Energy's financial difficulties, public confidence that nuclear power is capable of funding its own liabilities, without public subsidy, will have been severely damaged. The Government is being forced to accept financial responsibility for up to £5bn of BE's nuclear liabilities (waste management and decommissioning costs) despite the fact that the arrangements for a nuclear decommissioning fund were set out in BE's original share prospectus ten years ago. It might have been expected that the Government would use the opportunity presented by the Energy Act to include legislation which made it more difficult for private nuclear operators to avoid their responsibilities to set aside funds for decommissioning costs.

Indeed, the House of Commons Trade and Industry Committee called for:

"…a statement of policy by the DTI that approval of any proposal from the private sector for new nuclear plant would be conditional, amongst other factors, upon the establishment and maintenance of a segregated fund to meet the costs of clean-up at the end of its useful operational life."[107]

As we have seen, DTI research failed to identify public support for Government subsidies for new nuclear power stations.[108] The Nuclear Free Local Authorities argue that the 'polluter pays' principle leads to a vital pre-requisite for new build:

"… all the liabilities associated with the life-cycle of a reactor, including long-term waste management, should be adequately costed, and arrangements put in place to ensure that the costs will be met by the company concerned. This is necessary to remove the risk that public subsidy will ultimately be required to meet long-term costs".[109]

Yet, while the Government theoretically supports the 'polluter pays' principle, it appears to have downgraded its policy on segregated decommissioning funds raising the prospect of future private nuclear operators ending up in the same mess as British Energy. Government policy set out in the 1995 policy document[110] is explicit about how funding should be provided for decommissioning and states:

"The government believes that it is right that, for those parts of the industry which are privatised, segregated funds for decommissioning should be established".

However, this policy has recently been replaced by DTI documents which downgrade the requirement for a segregated fund. A consultation document on the proposed new policy said:

"The Government expects that all operators will take the steps necessary to ensure that their decommissioning work is adequately funded. ***No nuclear project should be started*** *unless it is clear that sufficient funds will be available to complete decommissioning in as safe and secure way, which represents BPEO for the site".*[111] [emphasis added]

In the finalised policy document this was downgraded even further to:

"…***No stage of a decommissioning project should be started*** *unless it is clear that sufficient funds will be available to complete decommissioning of the stage in question …"*[112] [emphasis added]

So there is now no mention at all of a requirement to organise the provision of a decommissioning fund before construction of a nuclear facility begins.

In a debate in The House of Lords on the Energy Bill in January 2004, the Government spokesperson, Lord Whitty, told the House that in principle the Government supports the idea that future nuclear operators should meet the costs of decommissioning, and the 'polluter pays principle', but:

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[107] Trade and Industry Committee, (29th October 2003) The Nuclear Decommissioning Authority Pre–legislative Scrutiny of the Draft Nuclear Sites and Radioactive Substances Bill. Seventeenth Report of Session 2002–03. Para 20 http://www.publications.parliament.uk/pa/cm200203/cmselect/cmtrdind/968/968.pdf

[108] IPPR, UKCEED, NEF and Dialogue by Design on behalf of the DTI (September 2002) 'Integrated Public and Stakeholder Consultation to inform the Energy White Paper: Summary Report'.

[109] Nuclear Free Local Authorities (July 2001) *New Nuclear Monitor No.1* http://www.nuclearpolicy.info

[110] HMSO, 1995 "Review of Radioactive Waste Management Policy" [Cmnd 2919 paras 120-131]

[111] DTI (November 2003) 'A Public Consultation on Modernising the Policy for Decommissioning the UK's Nuclear Facilities'. Para 13

[112] DTI (September 2004) 'The Decommissioning of the UK Nuclear Industry's Facilities'. Para 14 http://www.dti.gov.uk/consultations/files/publication-1365.pdf

"... there may again be circumstances in which a private sector operator cannot meet its nuclear obligations ... we must retain the possibility of the Government meeting such costs ... in certain circumstances, it is inevitable that the operator will not have sufficient funds to cover those costs ... Ultimately there may be some liability to be borne by government ... using the NDA as a conduit or interface for any future British Energy-type crisis should not be prevented by this legislation".[113]

Thus, not only has the Government failed to produce the policy statement requested by the House of Commons Trade and Industry Committee, but it has also held out the possibility that future nuclear operators could be bailed out. In other words it has failed to '*remove the risk that public subsidy will ultimately be required'.*

The danger is that investors in new nuclear stations (should a decision be taken to go-ahead with their construction) would be more favourably disposed towards new build now that the provisions in the Energy Act have become law. This is because, in principle, the provisions would enable the owner of new nuclear stations to reap profits for directors and pay out to shareholders whilst under-providing for its liabilities in the knowledge that, should the liabilities become unmanageable, there exists mechanisms to allow the Government to bail the company out.

Terrorism

This is an unknown quantity, but after 9/11 it is now widely acknowledged that nuclear power plants, nuclear waste and spent fuel transports, and waste facilities should all be regarded as terrorist targets. Recent studies in the US put the health impacts of an attack on a reactor at 44,000 immediate fatalities with 500,000 long-term health impacts, including cancers. The impacts of any attack would, of course, be dependent on how much radioactive material was released and the plants situation (facilities near large centres of population pose a greater risk). Due to transmission issues the industry has proposed that most new plants be built at existing sites in the South or South East of England.[114]

Since September 11th 2001 there has been a global debate about the security threat presented by nuclear power stations. Initially commentary focused on the possibility of a breach of nuclear containment by the impact of an aircraft being deliberately crashed into a reactor. Different studies have come to different conclusions about the extent of a radioactive release following such an attack. However, it is clear that existing nuclear stations have not been designed to withstand a deliberate aircraft attack.

The US Magazine*, The Nation,* on 19th September 2001 called the nuclear industry's description of the new generation Pebble Bed reactor, as 'so safe it won't even need a containment building', "*ghastly and ridiculous*". A country that has nuclear power, it said:

"…*has handed over to 'the enemy' a quasi-nuclear military capability*".

David Lochbaum of the Union of Concerned Scientists noted that same week that no-one was asking about terrorist threats to windmills.

Conclusion

On 13th September 2004, Tony Blair told Radio One's Newsbeat that the problem with nuclear power is that "*you've got to know what to do to store the nuclear waste*". If the Government and the nuclear industry believe that the nuclear waste problem will be miraculously solved on the day CoRWM reports on waste management options in July 2006, they are seriously deluding themselves. Not only will there still be siting issues to be decided, but there will also be growing problems associated with dealing with the huge volumes of lower level wastes to be resolved.

In addition, the NDAs insistence on continuing to operate waste producing facilities, particularly at the notorious Sellafield site, will continue to fuel the nuclear controversy until at least 2012. Blair's desire to separate nuclear power from nuclear weapons in the public's mind will not be achieved until Sellafield stop separating weapons-useable plutonium from spent nuclear waste fuel.

The fear that hosting a nuclear facility makes a community a target for terrorists is one that has largely arisen since September 11th 2001. But the industry will not win public support for renewed nuclear construction by proposing a reactor-type which is even more vulnerable to terrorist attack than existing designs.

A sceptical, risk-averse public will not accept new nuclear stations which may result in risks from radiation which are uncertain and which leave open the possibility that taxpayers may once again be called upon to pick up the tab for decommissioning and waste management costs. And why should they, when there are a range of alternatives already available which don't come with such a host of intractable problems.

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[113] House of Lords Hansard, 15th January 2004, Column GC170.

[114] Parliamentary Office of Science and Technology (July 2004) "Assessing the risk of terrorist attacks on nuclear facilities". http://www.parliament.uk/documents/upload/POSTpr222.pdf

5. The contribution nuclear power could make to reducing carbon emissions

We have seen that nuclear power would be an expensive way of tackling climate change, with an extensive list of hurdles which would need to be crossed before the technology could be revived. Despite all this, there are still those that argue nuclear power is essential if we are going to meet our carbon targets. This section examines whether nuclear power could actually do what these supporters say it would do.

On 24th May 2004, Professor James Lovelock, creator of the Gaia hypothesis of the Earth as a self-regulating organism, writing in *The Independent*, claimed that nuclear power is the only solution to climate change[115]. Lovelock, an honorary member of Environmentalists for Nuclear Energy[116] cited new evidence that climate change could be far more serious than previously thought to support his call to environmentalists "*to drop their wrongheaded objection to nuclear energy*".

"[T]*here is no chance that the renewables, wind, tide and water power can provide enough energy and in time. If we had 50 years or more we might make these our main sources*", he said, "*We have no time to experiment with visionary energy sources; civilisation is in imminent danger and has to use nuclear – the one safe, available, energy source – now or suffer the pain soon to be inflicted by our outraged planet*".

The seriousness of climate change is not at issue, but Lovelock says opposition to nuclear power is irrational, and it has proved to be the safest energy source of all. This chapter examines the contribution which nuclear power could make to the problem of climate change, and asks whether, with all its associated problems, nuclear power is an effective solution?

Nuclear power and climate change.

Although there is currently a glut of uranium on world markets, due to slack demand by the nuclear industry and a large quantity of surplus weapons-grade uranium coming onto the market, if we were to massively expand nuclear generation, as Lovelock suggests, the adequacy of uranium resources would be a concern.

Latest figures suggest that the world's total recoverable reserves of uranium are around 4.6 million tonnes[117]. There may be another 10 million tonnes in undiscovered or low-grade ores. The world's current nuclear reactors require some 75,000 tonnes of uranium oxide every year.[118] Thus our present recoverable reserves are enough to last the world's current nuclear capacity only 60 years.

All activities, even generating electricity with nuclear power, result in the emission of carbon dioxide due to the combustion of fossil fuels. So, although nuclear power does not emit carbon dioxide directly, associated emissions occur during construction, the manufacture of components and the operation of the nuclear fuel cycle. As the grade of uranium ore falls, the amount of energy used in mining and processing rises, and hence the amount of carbon dioxide released. Consequently if the grade of ore being mined falls below a certain level we could find the nuclear power cycle releasing almost as much carbon dioxide as a fossil fuelled power station.[119]

If the UK were to build a programme of ten new reactors, with an expected life of 60 years, and which began operating around 2020, although carbon emissions may be low at the beginning of their life, towards the end of their life they may be forced to rely on poorer and poorer quality uranium ores for their fuel. Thus a programme of

AP1000s could, in fact, be storing up large carbon emissions for the period 2060-2080 when we should be approaching extremely low emission levels.

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[115] James Lovelock, Independent 24th May 2004 'Nuclear power is the only green solution' http://comment.independent.co.uk/commentators/story.jsp?story=524230

[116] http://www.ecolo.org/base/baseen.htm

[117] The Asahi Shimbun, 25th May 2004 "Estimates may snag nuke plans" By Tomoji Watanabe. This Japanese news report was reporting on an OECD Nuclear Energy Agency report which has yet to be published. Earlier reviews of world uranium reserves gav a figure of 3.93 million tonnes. http://www.nea.fr/html/general/press/2002/2002-10.html

[118] http://www.world-nuclear.org/education/ne/ne3.htm#3.3

[119] Dr Nigel Mortimer (1989), Proof of Evidence to the Hinkley C Inquiry (FoE9), "Aspects of the Greenhouse Effect". See also Dr Nigel Mortimer, World warms to nuclear power" SCRAM Safe Energy Journal December 1989/January 1990 (http://www.no2nuclearpower.org.uk/articles/mortimer_se74.php) and Jan-Willem Storm van Leeuwen and Philip Smith, Nuclear Power: The Energy Balance http://www.oprit.rug.nl/deenen/

Fast reactors

Many nuclear supporters accept that uranium resources are limited, but cite fast reactors as the way forward. These reactors are generally fuelled by plutonium, but at the same time as generating electricity they convert non-fissile (the useless portion) uranium into more fissile plutonium.

However, Fast Reactors have been a disaster world-wide – economic realities, problems associated with reprocessing (separating plutonium from spent nuclear fuel), concerns over nuclear proliferation, serious technical problems and the risk of catastrophic accident have all come together to stop the development and construction of commercial scale fast breeder reactors. One major difficulty with fast reactors is that they use liquid metal as a coolant – usually liquid sodium, which explodes on contact with air. Currently, only one FBR of commercial scale in the world is operating--the Beloyarsk BN-600 FBR in Russia. India is only intermittently operating its Fast Breeder Test Reactor (FBTR) at Kalpakkam. The UK has closed down its Prototype Fast Reactor at Dounreay in Scotland. The French closed down their Superphénix Fast Reactor in 1996 after it had achieved an average capacity factor of less than 7% over eleven years' of operation. It had repeated shutdowns, the longest of which lasted four years. Japan's fast reactor has been shut since a leak of liquid sodium coolant in 1995.[120]

Generation IV

The PIU pointed out that there is an international collaboration research and development project on a so-called 'Generation IV' reactors which may turn out to be more cost effective than the current generation of reactors. One of the reactor types this programme is attempting to revive is the fast reactor, but this is not expected to come to commercial fruition for at least 15 to 20 years. In fact, former Energy Minister Brian Wilson, has said he doesn't expect Generation IV reactors to be deployed until 2030.[121]

Nuclear power and greenhouse gas emissions

Total UK emissions are around 150 million tonnes of carbon (MtC) per year. In 2003, the biggest sources of carbon dioxide emissions were power stations (30%), industry (23%), transport (22%) and the domestic sector (16%).[122] But carbon dioxide is not the only greenhouse gas. Energy production and use causes around 83% of total UK greenhouse gas emissions, so electricity represents only around 25% of the total problem.

British Energy said in its 2001 submission to the Energy Review that nuclear power was displacing around 13.5MtC per year. This assumed a nuclear output of 80TWh. The amount of CO_2 emissions displaced by nuclear power will depend on the level of emissions from an alternative fuel mix. Emissions from power stations have been going down since 1990 whilst electricity consumption has been rising. In fact CO_2 emissions were 31.5% lower in 2003 than they would have been if CO_2 produced per kWh had stayed the same as 1990. About one half of this was due to changes in the mix of fuels used in the power stations (a combination of an increased use of gas and nuclear energy) and the other half to the introduction of technologies such as flue-gas de-sulphurisation and more efficient power stations (combined heat and power and combined cycle gas turbine).

Government energy scenarios assume that the amount of carbon produced per kWh will continue to fall until 2010 despite a fall in nuclear generation to around 66TWh. Consequently, CO_2 emissions displaced by nuclear power will also fall, partly as a result of falling nuclear electricity production, but also as a result of the fall in CO_2 produced per kWh by an alternative fuel mix. Compared to a baseline nuclear output of 66 TWh in 2010, the Government has examined a scenario in which nuclear generated electricity is only 45TWh, and concludes that CO_2 emissions would be some 2 MtC higher than the baseline. Alternatively if the output were 74TWh, then emissions would be some 0.7 MtC lower than in the baseline. So we can estimate that a new 10,000MW nuclear power programme would reduce emissions by around 6 – 8 MtC depending on the output (ie around 1MtC per 10TWh of output).[123]

Putting this 6-8 MtC into perspective, it represents around 4 – 5% of total carbon emissions or around 3 – 4% of total greenhouse gas emissions. It is, for example around half of the increase in emissions expected from the transport sector by 2020. Other policies set out in the Energy White Paper aim to reduce emissions by 15 – 25MtC by 2020.

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[120] Nuclear Control Institute Press Release, 20th December 2001, 'Closure of DOE's Fast Flux Test Facility is a long-overdue death sentence for US Plutonium Breeder Reactor Program'. http://www.nci.org

[121] The Observer, December 8, 2002, 'Britain enters new nuclear age' by Oliver Morgan http://observer.guardian.co.uk/business/story/0,,855747,00.html

[122] Energy – its impact on Environment & Society 2004 Update http://www.dti.gov.uk/energy/environment/energy_impact/2004update.pdf

[123] DTI (2000) Energy Paper 68: 'Energy Projections for the UK' http://www.dti.gov.uk/energy/inform/energy_projections/index.shtml

	Estimated MtC reductions
Energy efficiency in households	4-6
Energy efficiency in industry, commerce and the public sector	4-6
Transport; continuing voluntary agreements on vehicles; use of biofuels for road transport	2-4
Increasing renewables	3-5
EU Carbon trading scheme	2-4
Total	**15-25**

The 10MtC difference between the upper and lower ends of this target also puts the 6 –8 MtC potential contribution from nuclear power into perspective.

Security of supply

Security of supply has certainly risen up the political agenda since a BBC TV drama documentary: 'If … The Lights Go Out".[124] The scenario painted by the programme was of a United Kingdom heavily reliant on gas imported via a single pipeline from Russia, which is attacked by terrorists. This leads to widespread power cuts with severe social consequences.

Martin O'Neil MP, chair of the House of Commons Trade and Industry Committee since told a conference in Edinburgh that the chances of a major problem in the UK in the next 4–5 years is fairly remote, and in any case our dependence will not be on a single gas pipe from Russia, which has been a reliable supplier to other European countries for at least twenty years. All other G8 countries, apart from Canada, are major importers of energy.[125] The PIU did not foresee any immediate major threat to the UK, although there may be potential future risks. However, provided these risks are kept under review and the PIU's recommendations, for example on gas supply infrastructure and diversity of supply, are carried out, there should be few problems.

Jonathan Stern, who leads a research group on gas at the Oxford Institute for Energy Studies, says the fact that gas supplies will be coming from overseas in future does not necessarily mean we will be more prone to supply disruptions. He says there is a touch of xenophobia in some of the scare stories. For at least the next decade we will be importing from Norway, Belgium and the Netherlands. In the longer term there may be a need to import from Gulf Countries and Russia. Most major disruptions to gas supplies in other countries over the past 20 years have been caused by domestic problems. [126] Since privatisation the UK has not invested in gas infrastructure. The country has a 15-day gas storage capacity compared with 50-60 days in most continental countries. So we may see short-term increases in our bills while the UK invests in new infrastructure but this will help insure us against emergencies in the future.

The argument that large inflexible nuclear power stations which must be run as base-load stations somehow increase our security of supply is entirely bogus. During the late summer of 2002, at the height of British Energy's financial difficulties, five of its eight stations had either one or both reactors closed. If our current fleet is replaced by ten new reactors, as suggested by the industry, built using modular construction techniques, they will all be exactly the same design. This would leave us vulnerable to generic faults which could require all ten reactors to close at the same time for repair. This type of problem has occurred in France where factory production line techniques have been used to build components for several reactors at the same time. France's nuclear reactors away from the coast, which relied on rivers or canals for cooling water, also struggled to find sufficient cooling water during the heat-wave of summer 2003.

Future risks to our security of supply of both gas and electricity will be *significantly* reduced by implementing an energy-efficiency programme and a diverse renewable strategy which can reduce our dependence on gas beyond 2020.[127]

Opportunity costs

Another issue, rarely considered, is the amount of political time and energy which needs to be invested in any one particular strategy. If government Ministers and Civil Servants are spending much of their available time trying to push

[124] Screened on Wednesday 10th March 2004. http://news.bbc.co.uk/1/hi/programmes/if/default.stm
[125] Martin O'Neil was speaking at the Friends of the Earth "Meeting Scotland's Energy Needs" Conference in Edinburgh on 21st May 2004.
[126] Observer Special Report: The Future of Energy, 3rd October 2004; See also Stern, J 'UK gas security: time to get serious' Energy Policy Vol 32 No. 17 (November 2004) 1967-1979
[127] Performance and Innovation Unit, February 2002, 'The Energy Review' para 4.111 http://www.number-10.gov.uk/su/energy/1.html

through a nuclear revival, they won't have time and energy left for other more effective solutions to climate change. Nuclear power is one of the least efficient ways of reducing carbon emissions in terms of pounds spent per tonne of carbon saved.[128] Diverting attention from more efficient ways of dealing with climate change can actually damage our efforts. Amory Lovins of the Rocky Mountain Institute says:

"*Each dollar invested in electric efficiency displaces nearly seven times as much carbon dioxide as a dollar invested in nuclear power, without any nasty side effects. If climate change is the problem, nuclear power isn't the solution. It's an expensive, one-size-fits-all technology that diverts money and time from cheaper, safer, more resilient alternatives.*"[129]

The Secretary of State for Trade and Industry, Patricia Hewitt, speaking at the Energy & Environment Ministerial Roundtable in London in March 2005, said at the time the 2003 Energy White Paper was published it was very clear that if the Government had committed itself to a new generation of nuclear power stations, "then we would never have been able to get the priority for energy efficiency that we wanted."[130]

In Finland, before the decision in parliament to give the permission to the Finland's fifth reactor, politicians, industry and trade unions were agreed that climate change is the biggest threat to the environment. There was wide agreement on a coal phase out and that effort should be devoted to energy efficiency and renewables in order to meet Finland's Kyoto targets. But once permission was granted for construction of a new nuclear power plant, many people believed this wasn't necessary anymore. Two years after the nuclear decision, heavy industries and big energy producers, backed by trade unions have organized a noisy campaign against carbon emission trading; the coal phase out is off the agenda; targets for energy efficiency will be missed – in fact electricity consumption is growing at around 6 % per annum; plans to phase-out electric heating have been forgotten; and targets for wind and biomass energy will be missed. As a result Finland was still producing greenhouse gases at 17% above its Kyoto target in 2003.[131]

In other words, the decision to build a fifth nuclear reactor in Finland has not propelled the country into the forefront of the global effort to reduce carbon emissions, quite the reverse – the decision created a dangerous illusion that in Finland the climate change problem was solved.

Conclusion

Building new nuclear power stations could actually damage the Government's efforts to reduce the UK's carbon emissions by diverting scarce resources and effort when these resources could be much more effectively spent elsewhere. The contribution even ten new reactors could make would be small in comparison to the overall problem, and emissions from the nuclear life-cycle will almost inevitably increase towards the latter half of the century as we are forced to rely on poorer and poorer grades of uranium ores.

[128] Energy Policy, December 1988, Vol 15, No. 6 pp538-561 'Greenhouse Warming. A Comparative Analysis of Nuclear and Efficient Abatement Strategies' by B. Keepin & G. Kats.
[129] Guardian 12th August 2004, "Nuclear Plants Bloom" by John Vidal, http://www.guardian.co.uk/life/feature/story/0,,1280884,00.html
See also "Why Nuclear Power's Failure in the Marketplace is Irreversible (Fortunately for Nonproliferation and Climate Protection)" by Amory Lovins, Rocky Mountain Institute, Transcription of a presentation to the Nuclear Control Institute's 20th Anniversary Conference, "Nuclear Power and the Spread of Nuclear Weapons: Can We Have One Without the Other?," Washington, DC, April 9, 2001. http://www.nci.org
[130] Nucleonics Week, Volume 46, Issue 11, March 17, 2005, "Official says reviews needed before new U.K. nuclear built".
[131] Personal Communication with Greenpeace Finland.

6. The alternatives to nuclear power

James Lovelock says there is no way renewables can provide enough energy in time. Yet wind energy capacity has been growing at almost 33% per year since 1990 in the EU. At the start of 2003 there was an installed capacity of 23GW, exceeding most predictions, even those of the wind industry itself. The UK's first offshore wind farm opened in November 2003 off the coast of North Wales. With a total installed capacity of 60MW, the North Hoyle windfarm took only eight months to build. The next farm, at Scroby Sands off the coast of Great Yarmouth, is expected to be commissioned in autumn 2004. The government has given the go-ahead for an ambitious programme of offshore wind farms to be developed around the UK coastline, which could power 1 in 6 households by 2010.[132] By 2020, up to 30% of the current demand in the EU 15 could be met by offshore wind alone. [133]

A number of companies in the UK are already marketing domestic micro-CHP boilers, rooftop turbines and solar energy systems. Micro-CHP can replace domestic central heating boilers and generate electricity as well as heat, using less energy than the standard heating boilers of today.[134] Projections suggest a rapid take-up of micro CHP, with some 5-12 million units installed by 2020. This scale of market penetration could replace over half of the UK's nuclear capacity, and generate electricity more cheaply.[135]

By 2020, Britain will have a very different energy system from today. Much better standards of efficiency will be used in new and refurbished buildings. Energy supply companies will become energy service companies, which can make a profit by selling less electricity and gas.[136] Millions of homes and offices could have their own electricity generators, such as solar roofs, roof-top wind turbines and micro-CHP (Combined Heat and Power). Electricity supplies will come from renewables, some decentralised, some offshore. Input from nuclear and coal will have declined and gas will remain the most popular fuel for heat and electricity.[137]

This is not an "*experiment with visionary energy sources"* as Lovelock calls it, but a realistic prediction of how the energy system is likely to develop in a liberalised market, aided by regulation and government targets for renewable energy and carbon reductions, using technology that is already available.

So rather than renewables being the 'visionary energy source' we don't have time to experiment with, it is cost-effective nuclear power, with a sensible waste management strategy, which is.

Resources

The British Isles has some of the best wind resources in Europe, a large wave and tidal resource and the potential for a considerable contribution from energy crops and direct solar energy in the form of building integrated photovoltaics (PV). The UK's current electricity demand is around 320TWh (terrawatt hours) per year. Robert Gross of Imperial College, using mostly DTI figures gives the technical and practicable potential by 2025 as shown in the table below.[138]

Technology	Technical potential (TWh/yr)	Practicable Potential by 2025 TWh/yr)
Building Integrated PV	250	37
Offshore Wind	3000	100
Onshore Wind	317	8*
Biomass (energy crops)+	140	~30
Wave	700	50
Tidal stream	36	1.8
Small hydro	40	3
Total	4483	229.8

*assumes constrained build rate and no network reinforcement
+these figures are based on quite conservative assumptions about land availability.

[132] DTI Press Release 14th July 2003, http://213.38.88.221/80256CAC005CC584/Search/E5FB18E70F205F8080256D630034F27A?opendocument
[133] Sea Wind Europe, Greenpeace International (2004) http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/6204.pdf
[134] See for example Guardian, 12th June 2003 'PowerGen markets boiler that generates electricity' by Paul Brown http://www.micropower.co.uk/content1.cfm?pageid=98
[135] Hewitt, C (2001) "Power to the People: Delivering a 21st Century Energy System" IPPR. http://www.ippr.org.uk/publicationsandreports/publication.asp?id=152
[136] Independent 29th May 2004, 'Long term deals to tempt energy savers', by Michael Harrison. http://news.independent.co.uk/business/news/story.jsp?story=526035
[137] For a scenario for 2020 see Hewitt, C (2001)
[138] Gross, R, 'Technologies and innovation for system change in the UK: status, prospects and system requirements of some leading renewable energy options', Energy Policy Vol 32 No 17 (November 2004).

Clearly there is a very large potential resource for several renewable technologies. Whilst we might expect there to be competing land uses, which will constrain onshore wind, energy crops and PV, there are less constraints on offshore wind. The UK Government has recently identified three prospective strategic regions for the development of offshore wind. The total theoretical resource in these three areas amounts to 1,000TWh/yr at less than 30m depth, with another 2,000TWh/yr at less than 50m depth. Developing only 3.5% of these areas would deliver 100TWh/yr, and wind farms occupying 15% of the area could deliver total UK electricity demand. There are many other areas off the coast that could be developed, so the technical potential given in the table above does not give the full picture, and similar considerations suggest the same is true for wave and tidal.

Clearly renewable resources are available to meet our climate objectives, provided that the Government has the right support mechanism in place.

The role of nuclear power

The Government's projections of future energy demand – Energy Paper 68 (EP68) assume that no new nuclear plants will be built over the projections period. Generation from nuclear plants decline post 2000 as plants gradually retire from the system. By 2010, nuclear generation still forms a relatively high proportion of total generation – around 17 to 18% in the two central cases, compared with 23% or so in 2000, but nuclear generation falls to 7% of the total by 2020.[139]

The table below shows one of the projections given in EP68 using the Central (low prices) scenario. These projections do not include provision for policy measures listed as additional to the baseline in the UK Climate Change Programme. These measures amount to a reduction in carbon emissions of 17.75MtC by 2010.[140]

Emission Projections (at source), MtC

	1990	1995	2000	2005	2010	2015	2020
Power Stations	54.1	44.1	40.5	33.5	33.5	35.9	37.1
Refineries	5.1	5.9	5.1	6.1	6.4	6.6	6.6
Residential	21.5	21.7	22.5	22.7	23.1	23.7	24.3
Services	8.4	8.8	9.6	9.5	9.6	9.7	9.9
Industry	35.2	34.3	33.9	33.5	32.7	32.4	32.2
Road Transport	29.8	30.2	32.0	35.0	37.6	40.1	42.6
Off-road	1.6	1.5	1.3	1.3	1.4	1.4	1.4
Other transport	3.6	3.2	3.1	3.1	3.1	3.1	3.2
Total	159.3	149.6	147.8	144.9	147.5	152.9	157.3

The Government's First Annual Report on the Implementation of the White Paper says:

"*On the basis of policies current at the time of the White Paper including the full impact of the Climate Change Programme, our carbon dioxide emissions might have amounted to some 135 Million tonnes of Carbon (MtC) in 2020. To be on track for our longer-term goals, we will aim for cuts in carbon of 15-25 MtC below that level by 2020.*"[141]

The Review goes on to say that:

"*A prudent analysis shows that carbon emissions will have reduced by some 21 to 22 MtC in 2010 compared to 1990 levels. In percentage terms we are already on course for a 13 to 14% reduction over this period. We will need to review existing policy measures and assess the potential for strengthening these and introducing new ones to meet our climate change objectives in the light of the emerging risks and in the context of the expected impact of the EU ETS. Through the review of the Climate Change Programme later this year we will be looking carefully at what further action will be needed over the next 5 years to manage these risks.* "

The Government's scenarios already take into account BNFL's plans to close its remaining Magnox stations by 2010. Energy Paper 68 also takes into account the expected closure date for British Energy's eight nuclear power stations but assumes the company is successful in achieving life extensions for three of its stations. By 2020, even with some life extensions, only Torness, Heysham 2 and Sizewell B are likely to remain open.

[139] http://www.dti.gov.uk/energy/inform/energy_projections/index.shtml
[140] DEFRA (Feb 2001) 'Climate Change: The UK Programme, Section 2 Chapter 9. http://www.defra.gov.uk/environment/climatechange/cm4913/index.htm
[141] DTI & DEFRA (April 2004) First Annual Report on the Implementation of the Energy White Paper http://www.dti.gov.uk/energy/sepn/annualreport/firstannualreportfull.pdf

Conclusion

The Energy White Paper First Annual review re-iterates the Government's policy of keeping the nuclear option open, but assumes that no new nuclear power stations will be built unless other policies fail to deliver the reductions in carbon emissions projected. Government energy scenarios already assume that the contribution from nuclear power will gradually fall from the current capacity of 12,858 MW to 3,974MW in 2020. Renewable Energy and energy efficiency resources are available in sufficient quantity to both replace nuclear power and meet our climate objectives, provided the Government has the right policies in place.

7. Is the Government doing enough?

Prime Minister, Tony Blair, gave a major speech on climate change on 14th September 2004. While he referred to nuclear power saying the government would turn to it if necessary, he pledged funding for on-site renewable projects in every one of the new schools in the current huge building programme; building regulations will be changed to make new homes and offices more energy efficient; and the new Thames Gateway development will be sustainable in both transport and energy use to demonstrate what is possible.

The following day, Lord May, President of the Royal Society, and chief scientific adviser to the Government 1995-2000 writing in the *Daily Telegraph*, said that the UK would struggle to reduce its emissions of carbon dioxide without nuclear power.

"*Renewable energies are currently nowhere near being ready to step up to fulfilling a major proportion of our energy needs. Most experts agree that even the British target of generating 10 per cent of electricity from renewable sources by 2010 is, although an admirable aspiration, already very ambitious*".[142]

A major part of the pro-nuclear argument is that renewable energy will not be able to delivery what the Government expects it to. Clearly the counter argument, that renewables and energy efficiency are perfectly capable of meeting our climate change objectives relies on the Government doing what it has said it would do. So the obvious question is: 'is the Government doing enough, to promote energy efficiency and renewable technology or is it simply waiting until after the next General Election before it approves new nuclear construction?

Energy efficiency: Is the Government doing enough?

Philip Sellwood, Chief Executive of the Energy Saving Trust, in a letter to *the Times*, said that presenting nuclear power as one of the main ways of combating climate change is short-sighted – it simply does not represent a viable option at present. Given the costs associated with nuclear power and current uncertainties surrounding the problems of dealing with nuclear waste, making the UK more energy efficient is a far safer, cheaper and more realistic solution, as outlined in last year's energy White Paper. Energy-efficiency measures can be taken immediately, whereas the construction of new nuclear reactors would cost the UK billions and take several years to deliver any carbon savings. Government must take the lead, for example by making its own estate energy-efficient.[143]

Energy efficiency plan

The White Paper sets out a programme to achieve cuts in emissions from the domestic sector of 5MtC by 2010. But the Energy Efficiency Action Plan launched in April[144] watered this down to 4.2 MtC. The Association for the Conservation of Energy (ACE) described the new target as "*wholly unacceptable*".[145] A majority of MPs signed an Early Day Motion backing the original 5MtC target.[146] The Energy Savings Trust told the Environmental Audit Committee that it does not agree with the new 4.2MtC target.

The Government has basically scrapped policies that could easily make up the extra 0.8MtC. For example, the White Paper expected savings of 0.4MtC from increasing the uptake of A-rated household appliances. This in itself was a reduction from the 1MtC suggested by the Energy Savings Trust.[147] In the Energy Efficiency Plan this was mysteriously dropped to 0.1MtC with no explanation.

Similarly, the Government's Efficiency Plan does not expect efficient gas condensing boilers to corner the market until 2009, despite the fact that the new Building Regulations are expected to require only A or B-rated boilers to be installed. The slow up-take appears to reflect an expectation that the new regulations will be weakly enforced. The

White Paper expected installation of around 5 million gas condensing boilers to save around 0.6MtC. The contribution from gas condensing boilers in the EEP also appears to have been lowered.

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[142] Lord May, "We need more nuclear power stations not wishful thinking", Daily Telegraph 15th September 2004 http://portal.telegraph.co.uk/opinion/main.jhtml?xml=/opinion/2004/09/15/do1501.xml&sSheet=/opinion/2004/09/15/ixop.html

[143] Letter from Philip Sellwood, Chief Executive of the Energy Saving Trust, The Times 16th September 2004 http://www.timesonline.co.uk/article/0,,59-1264441,00.html

[144] http://www.official-documents.co.uk/document/cm61/6168/6168.pdf

[145] http://www.ukace.org/pubs/press/ST040426.pdf

[146] http://edm.ais.co.uk/weblink/html/motion.html/EDMI_SES=03/ref=96

[147] Evidence to the Environmental Audit Committee 19th May 2004, Q371 http://www.publications.parliament.uk/pa/cm200304/cmselect/cmenvaud/490/4051908.htm

In drafts of the Plan, a saving of 0.1MtC was listed for domestic combined heat and power (micro-CHP), but this was dropped from the final plan and policies to promote micro-CHP are listed as providing nil savings, despite the fact that the budget agreed to reduce VAT on micro-CHP. The BG Group is pioneering micro-CHP, which can produce around 50% of a households electricity needs as well as central heating and hot water. BG Group says micro-CHP could potentially achieve cuts of around 5.4MtC.[148]

The White Paper and the Energy Efficiency Plan also sets a target of achieving cuts of around 4 – 6 MtC from both the domestic and business/public sectors. Clearly re-instating the 5MtC target for savings from the domestic sector, as well as setting ambitious targets for the domestic and business sectors for the period 2010-2020 would be sufficient to replace the carbon savings which might accrue from a replacement nuclear programme.

Renewables: Is the Government doing enough?

On whether the Government is doing enough to promote renewable energy, a scathing report by the House of Lords Science and Technology Committee published in July[149] concluded that it could fall 40% short of its 10% renewable energy target for 2010. Chairman Lord Oxburgh, said it could not avoid the conclusion:

"*…that the government are not taking energy problems sufficiently seriously*".

It deplored the minimal sums going into research and development of renewable energy sources, pointing out that they were less than a twentieth of that spent in the US. The Committee singled out the Ministry of Defence for criticism, saying that some of its arguments around new wind farm developments were "*extraordinary*" and "*implausible*".

Lord Oxburgh concludes:

"*The government seems to believe that market forces alone will prevent the lights going out – we're not so sure.*"

The committee said it:

"*… found almost no one outside government who believed the white paper targets were likely to be achieved*",

and too much emphasis is placed on wind farms when a more diverse portfolio of renewable energy is needed. It said:

"*Government may have no option but to follow the lead of other countries and accept that new nuclear build might be necessary*".

Offshore wind

Offshore wind is widely predicted to experience a very rapid development across Europe over the next few years. A study commissioned by Greenpeace from wind energy consultants, Garrad Hassan, showed that it is possible for offshore wind to supply 30% of electricity demand in the original 15 EU countries by 2020 – 720TWh/yr.[150]

Some commentators have suggested that both on- and offshore wind could face serious constraints on build rates. Offshore wind farms can only be installed in calm weather between May and September, and modelling scenarios developed for the Energy Review indicate that offshore wind would have to be installed at a rate of at least 1GW per year after 2010 if it is to contribute substantially to the UK's target of producing 20% of our electricity supplies from renewable energy by 2020. However, Richard Goss says there is little reason to believe that this is not feasible. A study for Greenpeace by AEA Technology showed the feasibility of just one region – East Anglia – providing 25% of UK electricity supplies (89TWh/yr) by 2020 from 30GW of offshore wind.[151]

Wave and tidal

By comparison to most other renewables wave and tidal stream energy are in their infancy. Currently around 2MW of wave energy devices is installed worldwide – mainly demonstration projects and many UK based. A 500kw device is operating on the island of Islay in the Inner Hebrides, and two further devices, one 750kw and one 2MW are scheduled

[148] The Parliamentary Monitor December 2003.
[149] http://www.publications.parliament.uk/pa/ld200304/ldselect/ldsctech/126/126.pdf
[150] Sea Wind Europe, by Garrad Hassan Greenpeace International 2004
http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/6204.pdf
[151] Sea Wind East by AEA Technology, Greenpeace July 2002,
http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/5040.pdf
See also Offshore Wind: Onshore Jobs by Energy for Sustainable Development, Greenpeace, October 2004
http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/6702.pdf

to begin operating this year in Scotland. Similar sized devices are scheduled for operation soon in Ireland and Portugal. There is only one tidal stream device above model scale operating in the world, in Scotland, and second is due to begin operation in Devon soon.

The Department of Trade and Industry recently announced a £50 million fund to make Britain the world leader in wave and tidal power technologies.[152] However, private financiers and politicians have criticised both Westminster and the Scottish Executive for not going far enough to ensure the dominance of the UK's fledgling industry, estimated to have the potential to create 7000 jobs in Scotland. Venture capital firm 3i, which has invested in Scottish firms Ocean Power Delivery and Wavegen, said the Government should have pledged between £100-150m. Britain has leading expertise in wave and tidal generation but Portugal, Spain and Ireland are pulling ahead because their governments are willing to back ambitions with far more cash. Many in the industry are campaigning for additional support to accelerate the commercialisation of marine energy technologies. The Marine Energy Group said that some form of revenue support, where developers are rewarded for actual marine energy output by way of a new tariff or through additional Renewable Obligations Certificates, would be necessary to attract more investors. Portugal and Spain already offer a marine energy tariff, while Ireland is considering one.[153]

The Energy White Paper expects onshore and offshore wind to be the largest contributors to the Government's target of supplying10% of electricity from renewables by 2010. However, after 2010, wave and tidal energy, along with biomass are expected to make an increasing contribution. But unless the funding gap between the research and development stage, and the supported commercial stage is filled now, these technologies will not be in a position to contribute next decade.[154]

Biomass

Biomass energy is expected, in the Energy White Paper, to become economically viable in the mid-2010s and make a major contribution to the 2020 target. The resource currently available from forest and agricultural residues is small relative to the scale of renewable generation required to meet the 20% target, but a range of factors are currently hindering the establishment of a significant domestic energy crop industry. The advantage of biomass energy is that it is flexible and be used to generate electricity at any time. It can be used to balance intermittent supplies from wind energy. (Although the National Grid can be operated effectively with up to 20% of the electricity capacity being provided by variable energy sources such as wind[155]).

Solar PV

On 15th September 2004, the new Energy Minister, Mike O'Brien announced that schools, houses and commercial buildings would benefit from £8.5million extra new funding to encourage more energy production from solar panels and small-scale renewables. This brought the total funding for solar projects under the Major Photovoltaics Programme to £31 million and enabled a further three funding rounds to take place in 2005/06.[156]

The Government says its stated is to build a renewables industry to rival those in Germany and Japan.

Mike O'Brien said:

"In future, energy generation will often be small scale and local. We need to change the way we think about energy. That starts at grass roots level – in our homes and communities"

The Government's £31 million, four year Major Demonstration Programme is a welcome development, but will deliver paltry results in comparison to European competitors. Under its government's scheme Japan will have 370,000 solar PV installations and Germany 140,000 by 2005. The UK is highly unlikely to have more than 5000. Government is not taking solar PV seriously enough and has so far treated it as a demonstration level technology when actually it is well proven. Other countries – such as the USA, Germany and Japan – have high levels of commercial development. The UK is going to have to do a lot more if its PV industry is to compete. PV should be helping to deliver the UK's

[152] DTI Press Release 7 September 2004 'Wave and tidal renewable energy steps up'. http://www.gnn.gov.uk/environment/detail.asp?ReleaseID=128810&NewsAreaID=2&NavigatedFromDepartment=False
[153] Sunday Herald 15th August 2004 'Triple funds to capture energy wave'; 3i warns marine power needs more cash' BWEA Press Release 18th May 2004 http://www.bwea.com/media/news/intotheblue.html
[154] Climate Change Capital (May 2004) 'Into the Blue: Financing the future of the emerging wave and tidal power sector', BWEA. http://www.bwea.com/marine/intotheblue.pdf
[155] For further 'de-bunking of myths' about Wind Energy see http://www.yes2wind.com
[156] DTI Press Release 15th September 2004 http://www.gnn.gov.uk/environment/detail.asp?ReleaseID=129713&NewsAreaID=2&NavigatedFromDepartment=False

renewables and carbon targets today. But solar electricity won't play a significant role in the UK's future, unless the capacity and impetus to deliver our potential is put in place now.

Germany has nearly 400MW of solar power PV installed, but the UK has just 6MW. Earlier this year, California's state government announced plans to install solar power systems in a million homes over the next 10 years. The UK, meanwhile, has quietly reduced its target of installing solar power units on 3,000 domestic roofs to 2,000 roofs.[157]

Greenpeace has called for an expansion of the current demonstration project to become a serious effort at commercialisation of solar PV in the UK. At least £30 million a year for ten years should be made available in a 50% matched funding grant scheme to domestic solar customers. This will deliver 100,000 solar roofs in ten years.[158]

Conclusion

Clearly the resources are available to allow the UK to meet its climate change objectives without resorting to nuclear power. Any suggestion that the Government might countenance new nuclear power stations would be an admission on its part that it had not been doing what it said it would do to promote energy efficiency and renewable energy. The problem is that by switching the focus within Parliament and Whitehall from current plans to develop a more sustainable energy system towards promoting new nuclear power stations, the Government would almost certainly damage the prospects of meeting its climate change objectives.

[157] Guardian 3rd November 2004 'Solar Eclipse' by Martin Hodgson
http://society.guardian.co.uk/environment/story/0,14124,1341698,00.html
[158] This figure is an estimate by Solar Century.