THE ENVIRONMENTAL AUDIT COMMITTEE INQUIRY

Keeping the Lights on: Nuclear, Renewables, and Climate Change

Memorandum by
Green Party of England & Wales

Introduction

Perhaps a better title for this Inquiry might have been "Learning to turn the lights off when they're not needed". This may seen trivial, but behind the comment lays the serious point that a major culture change is needed, that continuing wasteful energy use is unsustainable, and that energy reduction and efficiencies have a vitally important part to play in reducing carbon emissions and combating global warming.

This memorandum is in three parts. Part One is a general overview with key material considerations for the committee's consideration. Part Two directs itself toward the Inquiry issues, whilst Part Three contains reports, public-domain source material and notes.

This submission argues that now is the time to recognise both the challenges of global warming and the dangers inherent in the UK's continuing reliance on oil, the supply of which is vulnerable in political and military terms. Now is the time for an environmental leadership that sees these circumstances as an opportunity for a sea change to sustainable, local and renewable low carbon energy systems that do not leave a hazardous nuclear legacy for future generations.

Fossil fuels are not the only thing in finite supply. So is cash. The astronomical costs of a new nuclear power programme would divert money away from creating a low-carbon economy, the real solution to global warming.

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PART ONE - Overview

Economic concerns

1.1 Nuclear power is expensive in comparison to other forms of generation, once the state subsidies have been removed.

1.2 The construction, reprocessing and decommissioning costs of nuclear power stations are enormous. The same resources invested in renewable energy generation will generate equivalent power without creating nuclear waste that no one knows how to dispose of.

1.3 The AP1000 reactor has never been built; no first-hand operating experience exists. This would inevitably lead to unforeseen and unquantified 'learning-costs'.

1.4 There are historic construction cost overruns in previous nuclear power station projects.

1.5 The extended design and build phase means that new power stations would not be operational for 10/15 years from commissioning

1.6 The high risk of nuclear power generation is evidenced by no commercial insurer being able to provide affordable cover, leading to government needing to underwrite power stations

1.7 The government subsidises nuclear power creating a false competitive advantage at the expense of alternative methods of generation.

Power demand and handling

1.8 Greater emphasis needs to be placed on reducing demand for power. Projected energy growth assumptions of 3% per annum would mean a doubling of production and consumption every 25 years. This is not sustainable, either in terms of resource use or climate change.

1.9 In considering new reactors serious note should be taken of the power losses during transmission. Far better to have smaller generating sources serving local communities.

Regeneration opportunities offered by renewable energy over nuclear

1.10 By focusing resources on a small number of new power stations there is a lost opportunity to invest and invigorate the renewable energy sector. Proactive government measures could attract investment and create employment in product development/manufacture/installation. Both social and employment regeneration as well as export market potential exists in UK.

1.11 Government should use taxation and a proactive regulatory framework to enable development and encourage business to invest in renewable energy research, development and production

Environmental concerns

"At least three million children in Belarus, Ukraine and the Russian Federation require physical treatment [due to the Chernobyl accident]. Not until 2016 at the earliest will we know the full number of those likely to develop serious medical conditions." Kofi Annan, UN Secretary General, July 2004

1.12 There is no agreed, proven or demonstrably safe storage method for radioactive materials. Creation of nuclear waste bequeaths an expensive and dangerous legacy that future generations have to deal with.

1.13 Nuclear production carries with it unacceptable accident risk. Chernobyl, Three Mile Island, Thorp and Drigg have all been sites of accidents and/or leakage

1.14 Many UK nuclear power stations are sited in coastal areas, some in acknowledged high flood risk areas. As global warming takes effect, coastal power stations become more vulnerable.

1.15 Commissioning, operation and decommissioning of nuclear power stations carries inherent long term environmental risks and major expense. Set against renewable power generation the nuclear option equals high capital costs and major long term irreversible impacts, versus low impact sustainable regeneration, the effects of which are reversible

1.16 Identifying sites and securing planning permission for new nuclear power stations will be politically damaging and difficult

1.17 There are finite reserves of uranium

1.18 Electricity produced by nuclear power is not carbon free

1.19 In using renewables we're living off income, not capital

Health

1.20 Routine discharges from nuclear power stations carry adverse health impacts, as well evidenced by cancer and leukaemia clusters around reactors. (see note 1). Additionally there are major health risks from accidents and spillage.

Security

1.21 Expansion of "breeder" technology would create large amounts of plutonium that can be used in nuclear weapons. With increased quantities of plutonium, there is an increased risk of nuclear weapon proliferation

1.22 Nuclear power stations, and the transit and storage of nuclear materials are a target for terrorist attack

1.23 In the medium term, the effects of Peak Oil and Peak Gas will serve to increase energy prices. This will increase the potential for political, commercial and possible military conflicts over the control of those resources and means of distribution. By remaining largely reliant on foreign fossil fuels, over the supply of which we have no direct control, the UK runs the risk of becoming a 'hostage to fortune'. A prudent government would move to identify and develop local energy supplies under UK ownership and control.

PART TWO - Inquiry Issues

A: The extent of the 'generation gap'

2.1 (Inquiry question 1) What are the latest estimates of the likely shortfall in electricity generating capacity caused by the phase-out of existing nuclear power stations and some older coal plant? How do these relate to electricity demand forecasts and to the effectiveness of energy efficiency policies?

Electricity demand is increasing by 1% p.a. on average (700 MW p.a.). When all 12 UK nuclear stations close down, 12,000 MW of generation out of 74,000 MW will be lost. In the next 10 years, 19,000 MW will have to be found at current consumption projections, or 12 000 MW if electricity demand can be kept flat.

However in fixing estimates of demand, insufficient account is taken of the effect of rising fossil fuel costs, including 'Peak Oil/Gas' effects. Additionally as the resultant electricity prices rise and with the increasing needs to reduce carbon emissions, there will be added incentives for low carbon energy generation. An important part of national strategy must concentrate on demand management and reduction. The regulatory framework should be employed to require and enable energy efficiency measures, rather than for government to merely champion them.

The Performance & Innovation Unit (PIU) (later renamed the Cabinet Office Strategy Unit) report for the 2001 energy review (see note 2) confirmed that energy efficiency measures have either negative or low costs because of significant resource savings.

B: Financial costs and investment considerations

2.2 (Inquiry question 2) What are the main investment options for electricity generating capacity? What would be the likely costs and timescales of different generating technologies?

A construction programme of eight AP1000 stations would be in the order of £8bn, and each one would produce 1,100MW. An additional £300m per year is required for fuel re-processing costs, and decommissioning could well top £100bn.

By comparison the latest solar thermal or micro wind turbine installations cost in the region of £2 000 with each one generating a (conservative) 1kW. To match the 8,000MW anticipated power output of eight AP1000 reactors, fitting either of the two renewable options to 8.8m UK homes would cost £17.6bn (if economies of scale are totally ignored).

That would be the same level of power generation with no fuel re-processing required and no nuclear decommissioning required.

It is as economically plausible to give away, at the taxpayer's expense, a renewable energy installation to half the homes in the country, and let them keep the free electricity, as it is to build nuclear power stations to a new design that has never been tested in production. It is probably more popular as well.

The bottom line of all this is that even setting aside its accident risks, proliferation dangers and waste problems, nuclear power is just plain too expensive and in all likelihood always will be.

> **"Because it's so expensive, investing in nuclear power makes climate change *worse,* and because capital is finite; sinking it into an expensive solution means it's not available for cheaper ones. In the United States, 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".**
> **(Source Rocky Mountain Institute - see note 3)**

2.3 (Inquiry question 2 - Bullet 1) What are the likely construction and on-going operating costs of different large-scale technologies (e.g. nuclear new build, CCGT, clean coal, on-shore wind, off-shore wind, wave and tidal) in terms of the total investment required and in terms of the likely costs of generation (p/kWh)? Over what timescale could they become operational?

Construction and on-going operating costs of different large-scale technologies should not be the only major considerations. Regeneration, export and employment potentials exist through developing and operating renewable energy systems. On the negative side the long lasting risk and expense of nuclear waste storage together with the risk of terrorism, weapons proliferation or accident are difficult to quantify in purely economic terms.

Comparative costs and timescales

	Construction £/kW	**Estimated p/kWh**	**Timescale**
Nuclear new build	500–3000 *PSIRU*	3.4 – 8.3 ***NEF***	10-15 years
CCGT	280	2.3 *PSIRU*	1 – 2 years
On shore wind	650 – 850 *BWEA*	1.5 – 2.5 *NEF*	6-12 months
Off shore wind	1000 – 1200 *BWEA*	3 – 4 *NEF*	6-12 months

PSIRU - Public Services International Research Unit
BWEA - British Wind Energy Association
NEF - New Economics Foundation

The conclusion that may be drawn from looking at these comparative costs is that wind turbines, both on and off shore offer economic savings within a short timescale. CCGT produces an economically viable supply, and can be regarded as a lower carbon emitter but still depends on finite resource raw materials, and therefore subject to supply and price uncertainties. CCGT would be an acceptable short-term measure, certainly in comparison to new nuclear generation.

An additional attraction of developing wind turbine generation is UK experience in offshore engineering. Added to new employment and social regeneration an expansion of this sector would bring, there is a thriving potential to export technology and expertise.

2.4 (Inquiry question 2 - Bullet 2) With regard to nuclear new build, how realistic and robust are cost estimates in the light of past experience? What are the hidden costs (e.g. waste, insurance, security) associated with nuclear? How do the waste and decommissioning costs of nuclear new build relate to the costs of dealing with the current nuclear waste legacy, and how confident can we be that the nuclear industry would invest adequately in funds ring-fenced for future waste disposal?

According to the PIU report, (see note 2) the final cost of Sizewell B power station was twice the original budget. Such cost overruns are not unusual, as estimates for other projects have proved to be notoriously inaccurate. Construction costs are crucial in determining the final cost of generated power because capital repayments have to be factored in as an operating expense.

An additional important factor to consider is that an AP1000 reactor has never been built, and the estimated construction and operating costs are not robust, in the view of the Public Services Institute Research Unit report. (See note 4)

Currently The Vienna Treaty 1963 (amended 1997) imposes a limit on nuclear operators' liabilities and in the UK, the Energy Act 1983 set a limit of liability for particular installations. In 1994 this limit was increased to £140 million for each major installation, so that the operator is liable for claims up to this amount and must insure accordingly. UK government underwrites risks in excess of £140m.

Considering the Chernobyl disaster, where the costs may be in the order of hundreds of £bn, conventional cover would probably not be available, and where it was offered may not be credible as a major accident would bankrupt the insurance companies.

There is much uncertainty about the true cost of decommissioning and the treatment of waste. In fact, regarding the storage, handling and disposal of waste the only apparent certainty is that there is no agreement whatever on identifying safe solutions.

Another certainty is that it will ultimately be government that has to step in to safeguard communities in the event of the commercial failure or underprovision in funding for decommissioning or waste handling. The question of waste and decommissioning funding is too important to be left to the vagaries of politics and the market. As an example the government subsidy 1990-96 described by Michael Heseltine as "to decommission old, unsafe nuclear plants" was in fact spent as cashflow by the company owning the generating plant.

Considering the serious risks and uncertainties that surround nuclear power, there is an overwhelming case against a new nuclear programme.

2.5 (Inquiry question 2 - Bullet 3) Is there the technical and physical capacity for renewables to deliver the scale of generation required? If there is the capacity, are any policy changes required to enable it to do so?

At this time annual electricity generation from onshore wind power is 1,100Mw, with 300Mw being added during the last year under the current minimal government intervention programme. According to the British Wind Energy Association, (See note 5) offshore wind has huge generating capacity potential; they state that wind power has the potential to generate 590,000 MW, or 8 times the UK's electricity needs.

Taken with the generative potential of micro-wind generation, domestic solar heating, domestic PV electricity, low carbon local CHP generators etc., there is no doubt that renewables can deliver the scale of generation required.

Realising this renewable energy supply will require political will and a supportive regulatory framework. Tax incentives can be used to create and stimulate investment opportunities, which will lead to increased employment. Embedding renewable energy generation requirements in Planning Policy Guidelines and development control protocols will help deliver the required 'culture change' in the business sector and at the public level.

2.6 *(Inquiry question 2 - Bullet 4) What are the relative efficiencies of different generating technologies? In particular, what contribution can micro-generation (micro-CHP, micro-wind, PV) make, and how would it affect investment in large-scale generating capacity?*

A major relative efficiency of micro-generation over grid-supplied power is a saving on distribution losses. Grid distribution loses electricity as heat, noise, or as theft on distribution networks as it is transported through the grid. In UK this accounts for approximately 6.5 per cent of electricity (valued at around £900 million). (see note 6)

Mention is made of the intermittent nature of some renewable energy generators, and the PIU report (see note 2) considered this. It concluded "the design and operation of the electricity network can be modified to accommodate increasing levels of intermittent power". There is no inherent obstacle to variable output generators, but there are two significant components that have to be addressed as renewable outputs increase – the ability of the system to balance variable supply and demand, and the allocation of costs to achieve the equivalence of "firm" power.

With an evaluation of how our energy needs are to be met, and bearing in mind the strictures imposed by the need to reduce carbon emissions there is an opportunity to move toward a more flexible, decentralised model of energy generation, as envisaged by the Energy White Paper (note 7).

There is little consensus on the costs of new nuclear power with estimates of between 1-6p/kWh. Best estimates in the Green Alliance (note 8) report put costs for renewables at 4.6-7p/kWh for micro wind.

For Solar PV, the PIU forecast a sustained cost reduction from the present high of 70p/kWh to 10-16p kWh within a twenty-year time frame.

Micro CHP (mCHP) boilers can be installed in homes instead of conventional boilers. They cost about £500 more than a standard boiler and provide electricity as well as heat. The PIU report estimates mCHP costs at 3.5p/kWh, perhaps falling to 2.5p/kWh as the market grows. Although gas fired, and therefore not renewable, they can be regarded as low carbon in view of their efficiency. Every year 1.3m boilers are replaced – if at least some of these could be mCHP there would be a steady decrease in grid power requirement and carbon emissions.

An alternative scenario for energy creation

Taken that 8 AP100 reactors would cost £8.8bn plus fuel processing costs of £300m pa and generate 8,800MW, an alternative scenario could be;

mCHP - If half the 1.3m boilers replaced annually (650,000 units) were mCHP there would be a cost of £325m, or £6.5bn for 13m units over 20 years. Assuming a capacity of 1kW per unit this results in 13GW capacity (i.e. 13,000Mw)

Solar PV – A £3bn investment at £6000 per kW capacity would yield a further 500Mw. In practice solar PV operates at a fraction of this capacity.

Micro wind - £3.25bn invested in 2.17m micro wind turbines would provide over 2GW capacity. Although as for solar PV, micro wind operates at a fraction of this capacity.

It can be demonstrated therefore that an investment of £12.75bn over twenty years could yield up to 15.5GW of renewable energy, compared to an £8.8bn construction cost plus £6.4bn fuel processing charges totalling £15.2bn producing 8.8GW of nuclear power.

2.7 **(Inquiry question 3)** ***What is the attitude of financial institutions to investment in different forms of generation?***

NO RESPONSE

2.8 **(Inquiry question 3 – Bullet 1)** ***What is the attitude of financial institutions to the risks involved in nuclear new build and the scale of the investment required? How does this compare with attitudes towards investment in CCGT and renewables?***

Financial institutions are risk averse, and unlikely to offer significant investment without comprehensive underwriting and indemnities from government, particularly relating to issues around waste and accidents. Where the regulatory framework leads, the market will follow. An example of this is the way in which the CCGT sector has improved after government signposted it offered the prospects of an improved rate of return on investment.

2.9 **(Inquiry question 3 – Bullet 2) How much Government financial support would be required to facilitate private sector investment in nuclear new build? How would such support be provided? How compatible is such support with liberalised energy markets?**

NO RESPONSE

2.10 **(Inquiry question 3 – Bullet 3)** ***What impact would a major programme of investment in nuclear have on investment in renewables and energy efficiency?***

The astronomical costs of a new nuclear power programme would divert money away from the real, long-term solutions to global warming. Conservation measures are far more efficient on a monetary basis than nuclear power investment. Renewable energy sources can be exploited - wind, tides, geothermal heat and solar influx will not run out, unlike uranium.

If government directs investment toward the nuclear industry, the willingness of the private sector to invest in efficiency or renewables will be diminished. Investment (or government subsidy) in nuclear power will distort the energy market by artificially depressing electricity prices whilst increasing the financial burden on the taxpayer.

C: Strategic benefits

2.11 (Inquiry question 4) *If nuclear new build requires Government financial support, on what basis would such support be justified? What public good(s) would it deliver?*

Any attempts to justify a new build programme will ultimately fail, both in terms of short-term energy security or longer-term strategic objectives.

2.12 (Inquiry question 4 – Bullet 1) *To what extent and over what timeframe would nuclear new build reduce carbon emissions?*

Contrary to popular belief, electricity produced by nuclear power is not CO2 free. Construction of the station itself would be a major carbon emitter and to keep it running requires the burning of fossil fuels in mining and refining the ore, with extra emissions from operating the station, and reprocessing and storage activities.

Carbon emissions from mining and refining will increase as the uranium ore quality diminishes. A report by Jan-Willem Storm van Leeuwen and Philip Smith (See note 9) concludes "The use of nuclear power causes, at the end of the road and under the most favourable conditions, approximately one-third as much CO2-emission as gas-fired electricity production. The rich uranium ores required to achieve this reduction are however so limited that if the entire present world electricity demand were to be provided by nuclear power, these ores would be exhausted within three years. Use of the remaining poorer ores in nuclear reactors would produce more CO2 emission than burning fossil fuels directly."

2.13 (Inquiry question 4 – Bullet 2) *To what extent would nuclear new build contribute to security of supply (i.e. keeping the lights on)?*

Amongst the main considerations in fuel security is the sensitivity and potential vulnerability of existing oil and gas supplies to the UK. To enhance and protect national security, we need to reduce our dependence on finite resources and foreign resources.

Further we need to commit to transferring clean technology to developing countries free of charge. By doing so we will play an important part in shifting the global economy toward low-carbon power generation.

2.14 **(Inquiry question 4 – Bullet 3)** ***Is nuclear new build compatible with the Government's aims on security and terrorism both within the UK and worldwide?***

UK security should be based on securing continuing, stable and sustainable local energy supplies. In striving to achieve this, priority should be given to ensuring the methods of generation which are as benign as possible. Further, those measures should not create or increase vulnerability to terrorist attack.

Since conventional nuclear fission can make only a short lived and minor contribution to world energy supply, advocates of nuclear energy look to "breeder" technology as the solution. Some of the vast amounts of plutonium - the material for nuclear weapons - that would be created in a breeder programme would inevitably leak into the hands of terrorists. In a plutonium breeder economy, the hope of curtailing the proliferation of nuclear weapons would be gone forever.

2.15 **(Inquiry question 5)** ***In respect of these issues [Q 4], how does the nuclear option compare with a major programme of investment in renewables, microgeneration, and energy efficiency? How compatible are the various options with each other and with the strategy set out in the Energy White Paper?***

Government endorsement and investment in a nuclear new build programme will undermine progress in developing the renewable energy sector. As such, a decision to endorse the nuclear option would be contrary to the aspirations and vision of the Energy White Paper.

Extracts of the White Paper's vision for the energy system of 2020 include:-

- That the backbone of the electricity system will still be a market-based grid, balancing the supply of large power stations. But some of those large power stations will be offshore marine plants, including wave, tidal and windfarms. Generally smaller onshore windfarms will also be generating. The market will need to be able to handle intermittent generation by using backup capacity when weather conditions reduce or cut off these sources.

- There will be much more local generation, in part from medium to small local/community power plants, fuelled by locally grown biomass, from locally generated waste, from local wind sources, or possibly from local wave and tidal generators. These will feed local distributed networks, which can sell excess capacity into the grid. Plant will also increasingly generate heat for local use.

- There will be much more micro-generation, for example from CHP plant, fuel cells in buildings, or photovoltaics. This will also generate excess capacity from time to time, which will be sold back into the local distributed network.

- Energy efficiency improvements will reduce demand overall, despite new demand for electricity, for example as homes move to digital television and as computers further penetrate the domestic market. Air conditioning may become more widespread.

- New homes will be designed to need very little energy and will perhaps even achieve zero carbon emissions . The existing building stock will increasingly adopt energy efficiency measures. Many buildings will have the capacity at least to reduce their demand on the grid, for example by using solar heating systems to provide some of their water heating needs, if not to generate electricity to sell back into the local network.

- Gas will form a large part of the energy mix as the savings from more efficient boiler technologies are offset by demand for gas for CHP (which in turn displaces electricity demand).

- Coal fired generation will either play a smaller part than today in the energy mix or be linked to CO2 capture and storage (if that proves technically, environmentally and economically feasible).

- The existing fleet of nuclear power stations will almost all have reached the end of their working lives. If new nuclear power plant is needed to help meet the UK's carbon aims, this will be subject to later decision.

- Fuel cells will be playing a greater part in the economy, initially in static form in industry or as a means of storing energy, for example to back up intermittent renewables, but increasingly in transport. The hydrogen will be generated primarily by non-carbon electricity.

- In transport, hybrid (internal combustion) vehicles will be commonplace in the car and light goods sectors, delivering significant efficiency savings. There will be substantial and increasing use of low carbon biofuels. Hydrogen will be increasingly fuelling the public service vehicle fleet (for example buses) and utility vehicles. It could also be breaking into the car market.

- Nuclear fusion will be at an advanced stage of research and development.

- People generally will be much more aware of the challenge of climate change and of the part they can play in reducing carbon emissions. Carbon content will increasingly become a commercial differentiator as the cost of carbon is reflected in prices and people choose lower carbon options.

This vision of energy in 2020 paints a picture of a range of diverse options for generation. We would argue that in this diversity lies security.

Further it should be noted that currently research is being conducted by Southampton University to investigate the feasibility of 'microgrids' (a collection of small generators for close proximity users) to provide peer-to-peer energy. The lead researcher, Dr Tom Markvart concludes that microgrids could make substantial efficiency savings and cuts to carbon emissions of 20-30 % without major changes to lifestyles. (see note 10)

D: Other issues

2.16 **(Inquiry question 6)** ***How carbon-free is nuclear energy? What level of carbon emissions would be associated with (a) construction and (b) operation of a new nuclear power station? How carbon-intensive is the mining and processing of uranium ore?***

Nuclear power is responsible for considerable carbon emissions from every stage of its production, apart from fission itself. Carbon emissions from construction will be on a par with other major projects, and there will be an increasing amount of carbon emitted in mining the necessary raw materials.

This is because nuclear power depends on a supply of uranium ores from scarce, rich deposits, which face a depletion problem every bit as serious as that of oil and gas. That rich ore will soon no longer be available. The poorer grades of ore that would then have to be used take more energy to process than they yield.

As uranium-rich ores reduce (see note 10), extractors will have to use raw materials with lower uranium content and be reduced to milling soft ores (sandstone) with a uranium oxide content of just 0.01 per cent - 10,000 tonnes of ore to be mined, milled and disposed of for every tonne of uranium oxide extracted. It is with ores at these grades that nuclear power hits its limits; this is where the energy balance turns against it. Therefore carbon emissions will increase (by virtue of the fossil fuel energy required for extraction) as uranium richness decreases. If ores any poorer than this were to be used, while at the same time maintaining proper standards of waste control in all operations, nuclear power production would go into energy deficit: it would be putting more energy into the process than it could extract from it.

2.17 **(Inquiry question 7)** ***Should nuclear new build be conditional on the development of scientifically and publicly acceptable solutions to the problems of managing nuclear waste, as recommended in 2000 by the RCEP?***

Yes. The amount of radioactive waste currently in the UK is enough to fill one of the Great Pyramids at Giza in Egypt - 2.3 million cubic metres (see note 11). A new generation of power stations as being envisaged will double the amount of waste. No publicly acceptable way of dealing with this waste has been found as yet, and it would be an act of gross irresponsibility to proceed with a new programme in the anticipation that an acceptable storage method will be developed at some point in the future.

PART THREE – Notes and Supporting Information

Notes

1 The Low Level Radiation Campaign http://www.llrc.org/index.html

2 Performance & Innovation Unit (Cabinet Office Strategy Unit) http://strategy.go.v.uk/2002/energy/workingpapers.shtml

3 Rocky Mountain Institute http://www.rmi.org/sitepages/pid642.php

4 Public Services International Research Unit www.psiru.org

5 British Wind Energy Association http://www.bwea.com/

6 Offgem http://www.ofgem.gov.uk/ofgem/microsites/microtemplate1.jsp?toplevel=/microsites/edist00&assortment=/microsites/edist00/edist08

7 The Energy White Paper http://www.dti.gov.uk/energy/whitepaper/wp_text.pdf

8 Green Alliance http://www.green-alliance.org.uk/publications/PubSmallOrAtomic/

9 Jan-Willem Storm van Leeuwen and Philip Smith report http://www.oprit.rug.nl/deenen/

9 World Nuclear Association http://www.world-nuclear.org/info/inf11.htm

10 Royal Academy of Engineering's Ingenia magazine http://news.bbc.co.uk/1/hi/sci/tech/4245584.stm

11 2001 National Inventory - Nirex Report N3/99/01

Supporting information

1 World Nuclear Industry Status Report 2004 (M Schneider & A Frogatt. Commissioned by the European Parliament's Greens EFA Group) http://www.greens-efa.org/pdf/documents/greensefa_documents_106_en.pdf

Plus public-domain reports:

2 The Economics of nuclear power: an analysis of recent studies (S Thomas. Public Services International Research Unit) www.psiru.org

3 Nuclear Power: Economics and climate-protection potential (A Lovins. Rocky Mountain Institute) www.rmi.org/sitepages/pid171.php@EO5-08

4 Is nuclear energy needed? (Green Alliance briefing) http://www.green-alliance.org.uk/publications/PubIsNuclearEnergyNeeded/

5 Small or Atomic? Comparing the finances of nuclear and micro-generated energy (R Willis. Green Alliance briefing) http://www.green-alliance.org.uk/publications/PubSmallOrAtomic/

6 Green Party's Alternative Energy Review (D Toke & D Olivier. Green Party of England & Wales) http://www.greenparty.org.uk/files/reports/2003/aer_2003.pdf