

October 2005



**Friends of
the Earth**

**Evidence to House of Commons Environmental Audit
Committee Inquiry “Keeping the lights on: nuclear,
renewables and climate change”**

Friends of the Earth is pleased to submit evidence to this inquiry.

Friends of the Earth has welcomed the UK Government’s emphasis on climate change but is highly critical of the performance thus far achieved to cut the emissions causing the climate change threat. Since 1997 carbon dioxide emissions have risen by 5.5 per cent, and as a consequence the UK is now no longer on track to meet its Kyoto Protocol commitments¹. This failure to control carbon dioxide emissions has occurred during a period when scientists have provided further compelling evidence that the bulk of existing and expected climate change is human induced and that the rate and scale of change poses a grave threat to society, the economy and the environment. The Government’s own Chief Scientist has issued dire warnings of the consequences of the rapid increase in global average temperatures that is now taking place because of greenhouse gas pollution.

It is clear that energy policy, and policies in areas such as transport, must now be driven by the overriding need to reduce carbon dioxide emissions. In this context, the Labour Government must not only meet its Kyoto target to reduce emissions of six greenhouse gases by 12.5 per cent (carbon dioxide equivalent) but also deliver on its manifesto commitment to reduce carbon dioxide emissions by 20 per cent by 2010 compared with 1990 levels (a policy objective that is now supported by the other main political parties).

The divergence from the emissions path needed to meet our Kyoto target, never mind our more challenging domestic goal, means that urgent action is now needed. The means to do that will need to be set out in the Climate Change Programme Review that Government is now conducting. Ministers have stated that this review is the means to get the UK back on track toward meeting its 20 per cent reduction target. The review has, however, been repeatedly delayed and is now not expected until 2006.

Rumours abound of inter-departmental wrangling and delay driven by disagreement about what can be delivered by when. A situation that is all the more disappointing considering that the 20 per cent target has been a manifesto promise that has been repeated at all three of the last General Elections. It is difficult to imagine a clearer

mandate for action, especially from a Government that has enjoyed such strong majorities in Parliament. There is a risk that the new Climate Change Programme Review may not be published until after the first Meeting of Parties of the Kyoto Protocol. This is all the more damaging given that the UK Government has shown international leadership on climate change. This has been vital in keeping global political momentum on this most critical of issues. The UK's leadership role has been especially important since it is effectively unique.

The main reason why domestic targets are not being met, and thus why our international leadership role is being undermined, is because Government does not have an overarching strategy for emissions reductions, let alone the levers that can control them. Rather, there is a piecemeal collection of policies. Many of these are individually positive, but do not amount to a credible programme to meet the targets set. Worse still, individual sectors are cancelling one another out. For example the benefit of wind turbine installation is being wiped out by the current market-driven switch back from gas toward coal.

With this in mind, Friends of the Earth and others are now convinced that a legal duty is needed to require governments to cut carbon dioxide emissions by 3 per cent per year. The vital shift we must make is to have an annual review of performance against an annual target that is allocated across the whole economy, to all sectors and delivered by all Government departments.

We are therefore supportive of and campaigning for, the Climate Change Bill, which was launched with cross-party support earlier this year. The Climate Change Bill, if passed, would require annual reporting on carbon dioxide emissions and corrective action should emissions deviate from the desired reduction trajectory (of the three per cent per year needed to meet the scientifically-determined 75 per cent reduction target needed for greenhouse gas concentrations to remain below 450 parts per million).

Successive governments would be free to decide how the reduction target would be met. The point is that the obligation would be there for years to come and would be an expected and embedded part of the programme of any government – no matter how fashionable the issue happens to be at any one time. Having said that, Friends of the Earth does recommend the introduction of sector targets and in our view it is likely that the electricity supply sector would need to take the brunt of the reductions up until 2020 (appendix one).

Questions raised by the Committee

The Committee has raised a number of questions regarding energy supply, including; whether any generation gap will emerge with the closure of nuclear power stations and some coal stations, the costs involved in generating power more cleanly, and particular questions around nuclear power. Friends of the Earth would like to respond to these questions through introducing to the Committee some energy modelling work that Friends of the Earth is carrying out together with WWF, explaining our thoughts on energy security and through explaining our position on nuclear power.

1. Friends of the Earth's Electricity Model

Friends of the Earth is carrying out electricity modelling so as to investigate the carbon dioxide reduction potential and the electricity demand requirements based on different generation scenarios. We intend to publish this research later this year, but we are pleased to share some preliminary findings with the Committee in advance. The draft model is submitted as an excel spread-sheet form and a draft report will be forwarded to the Committee in due course. The model looks at three scenarios (coal to gas, biomass co-firing/coal retrofit, mix of gas and biomass/coal) and projects potential emissions reductions attainable through closure or conversion of old plant, adoption of higher efficiency plant, biomass cofiring, and carbon capture and storage.

The model firstly aims to identify the likely scale of 'generating gap' caused by the phase-out of much of the existing nuclear and coal stations. This is done by taking available data and/or making assumptions about trends in the following areas:

- A modest reduction in UK energy demand to 380 TeraWatt-hours/year by 2020 (including auto generators)²
- the de-commissioning of the nuclear stations - estimated dates for closure programme
- the commissioning rate for new Combined Heat and Power capacity - CHPA aspirational target of 20 GWe by 2020 selected
- the commissioning rate for renewable electricity capacity - Renewable Power Association target of 100 TWh by 2020 selected
- interconnectors and other (eg. oil - fired capacity) - reducing to net zero as renewable electricity peaks are exported
- possible closure rate of existing Combined Cycle Gas Turbine capacity - retirement of ageing less efficient plant - estimated 20 year life span
- possible phase-out rate for existing coal stations - mainly due to the Large Combustion Plant Directive

The possible commissioning of an IGCC plant is also considered in the model.

The remaining demand after subtracting the above supply categories shows the potential scale of the 'generating gap'. It is then assumed that this gap would be filled, for the purposes of this exercise, by either predominantly new CCGT or coal plant (including retro-fitting existing stations) or a mixture of the two. The scale of the carbon dioxide emissions are then calculated based on available data for existing plant and industry estimates for 'next-generation' CCGT and coal technologies. A reduction in efficiency in load-following operational conditions has been included to account for the increasing renewable capacity and its variable output on the grid system, though increasing Combined Heat and Power capacity may partly offset this.

Friends of the Earth believes that a continuation of a switch from coal to natural gas in electricity generation is desirable for the purpose of reducing emissions in the UK to the levels scientists say is necessary. This does not create as serious a challenge for security of supply as some media coverage and some lobby groups tend to claim (see evidence provided below) because new imports will come from reliable and friendly countries such as Norway and from a variety of other sources thanks to the

construction of new LNG terminals and pipelines. Of course Friends of the Earth believes natural gas is also a bridging fuel rather than the real solution to climate change, as it does produce greenhouse gas emissions (although to a smaller extent than coal) and that the ultimate solution to both security of supply and climate policy lies in the growth of renewable energy and ambitious programmes to reduce demand, where a large economic potential remains untapped.

The main scenario Friends of the Earth would like to submit to the committee proves that it is possible to achieve considerable emission reductions in the power sector with a, “gas growth”. This is a predominantly Combined Cycle Gas Turbine scenario - a programme which would fill the generating gap with next-generation CCGT. Construction times would be around 30 months per station

This scenario replaces coal-fired plant with advanced gas at a fast rate. Existing gas plant is also replaced, reducing emissions from 410g/kWhr from existing plant, to 370g/kWhr for advanced CCGT. Variables in this model include whether carbon capture & storage are used. This model shows that with a healthy uptake of renewables and CHP, significant cuts in carbon dioxide of up to 64% can be achieved by 2020 (reducing the sector’s emissions to 23 MtC from a 1990 baseline of 64.3MtC) with carbon capture and storage able to increase reductions to 83% (11 MtC)

However, the organisation also recognises that considerable dependence on natural gas imports in the long terms is considered by some as undesirable, and that to some extent a switch back to coal burn is already happening because of current price differentials between coal and natural gas and because of overallocation in the Emissions Trading system, which creates insufficient market signals to switch to cleaner fuels. Therefore, based on this realistic assessment of the need to consider ways to make the current coal fired stations more efficient if they remain in operation, Friends of the Earth has decided to analyse the option of reducing emissions in the UK through a variety of options, including increased use of retrofitted coal technologies with considerable biomass co-firing and carbon capture and storage.

This has led to two alternative scenarios based on growth of biomass co-firing/coal retrofit. The scenarios keeps open some of the existing coal-fired power stations but steadily upgrades them through the introduction of more efficient advanced supercritical boilers and feedwater heaters. Upgrades to plant could result in CO2 emissions reductions, from a current level of 943 g/kWhr, to 545 g/kWhr, or as low as 465 g/kWhr with 20% biomass co-firing. However, the emission reductions are somewhat comparable (though still lower) to those achieved through a switch to natural gas only if a 20% biomass co-firing is achieved in these stations.

The main conclusion from all these models, whatever the energy mix, is that the UK can easily move away from nuclear power without suffering from a supply shortage, as long as efforts are made to promote other technologies, especially renewable energy and energy efficiency.

The second conclusion is that Scenario 1 “gas growth” offers greater emissions reductions, and Friends of the Earth currently recommends this as the preferred option for future energy generation. This is mainly because security of supply concerns on

natural gas appear to be often overstated (and coal would have to be imported into the UK as well, some of which may come from potentially unstable countries as well). This scenario also relies on commercial technology as opposed to technologies to clean up coal and burn biomass in coal stations in large amounts, which have not yet been deployed on a large scale. Of course, if optimistic assumptions about the potential for these technologies to reduce emissions considerably and to compete with emission reductions from natural gas prove to be correct, we will change our recommendations.

As stated above, Friends of the Earth prefers for the regulatory environment to promote a switch from coal to gas, as this is a proven way to reduce emissions, unlike so-called “clean-coal” technologies that are either in demonstration phase or have never been implemented on a large scale before. However, if in the light of current market conditions and unsatisfactory regulation, coal stations continue to be higher up in the merit order than they would otherwise deserve, we must ensure that these coal fired plants that continue to operate start co-firing locally sourced biomass and are urgently retrofitted with the best available super-critical technologies to increase efficiency and reduce CO₂ emissions and other pollutants. The model’s default scenario includes 20% biomass co-firing in all coal plant retrofitted with advanced supercritical technology, and coal retrofit also offers the option of biomass fired feedwater heating (not included in the model). Capture and storage of emissions from the biomass component would be carbon-negative as distinct from carbon-neutral

Note that the modelling does not include emissions associated with extraction and transport of the fuels or in the case of gas the energy costs of liquefying it when transporting it by ship. This is due to the lack of reliable data in this area. Emissions from these may change results slightly but are unlikely to alter the position of gas as the least damaging of the fossil fuels and the best option as a bridging fuel leading us towards a low carbon energy economy.

The modelling includes potential additional reductions that could be obtained through carbon capture and storage. Friends of the Earth does not currently support large-scale implementation of carbon capture and storage (CCS) due to the legal, regulatory, permanence and liability issues that still need to be resolved. Also, in Friends of the Earth’s view, there needs to be internationally agreed criteria on storage standards, site selection and acceptable leakage rates (which should be as close to 0 as technically possible).

However, in view of the enormity of the threat of climate change, CCS may end up having a potential role to play, and Friends of the Earth believes that any new gas or coal plant constructed should be built as a ‘capture ready’ plant, i.e. that can easily implement CCS in the future. CCS would require substantial investment in new infrastructure for transport and storage, but this should not receive government subsidies or other forms of public support (which should focus instead on promoting more long-term and cost effective energy efficiency and renewable energy options).

Our modelling does not yet involve an investigation into costs. It is possible that the shift to a more sustainable electricity industry may lead to somewhat higher electricity costs. However, this largely depends on many variables, including the relative price of natural gas and coal (coal prices have been increasing as well as gas prices), and on

the extent to which electricity companies are allowed to pass on additional costs to their customers. In any case these price increases can be largely mitigated through the adoption of ambitious energy efficiency policies³. In this context it is worth noting that there has been a significant reduction in real terms of the cost of electricity to domestic and industrial customers from 1990 levels. In 2004 the average industrial electricity price was the second lowest of the G7 and the fifth lowest in the EU 15⁴. It is also worth noting that any potential costs due to climate policies in general are well below the potential astronomical and incalculable costs our society will face if nothing is done to slow down climate change.

In any event, whatever the generation mix there will be a need to improve energy efficiency, and this will help to reduce costs. Redoubled efforts to reduce the average electricity consumption of products sold to consumers and businesses through European Union product legislation and/or the enforcement of ambitious minimum energy efficiency standards in the UK will be vital in driving up efficiency. Redoubling efforts to promote the development of energy services companies through mandatory energy efficiency targets will also greatly help to tap into the very large potential for reducing energy demand.

As an example, at least 6% of domestic electricity demand and an unknown amount of electricity in the commercial sector in the UK are currently wasted simply to keep products on “standby”, i.e. always switched on despite not being in use. This percentage is rapidly growing. Cost-effective technology to reduce these losses by up to 90% exists, but manufacturers are not using it because there is currently no legislation requiring them to do so. Legislation at EU and UK level on energy efficiency issues such as this would be an overwhelmingly more cost-effective option for overcoming any problems with supply shortfall rather than prolonging the life of nuclear power stations or building new ones. The UK must support current European Union efforts to legislate in this area.

These provisional findings therefore suggest that reductions greater than 60 per cent of CO₂ can be achieved by 2020 from 1990 levels through:

- Bold action in the short term to reduce the growth in electricity demand and, in the medium-term to achieve absolute reductions in demand.
- Ensuring that 25 per cent of electricity requirements, or at least 100 TWhrs/year are produced through renewable power by 2020 (including biomass CHP).
- Boosting combined heat and power (CHP) usage at all scales (from large scale to micro CHP) to 98TWhrs/year by 2020 (excluding biomass).
- A phased switch from existing coal to new gas CCGT generating capacity, with possibly some upgraded coal capacity retained.
- Ensuring that any coal power plants used during this period are upgraded to advanced super-critical technology to boost their efficiency and that the use of sustainably sourced biomass in these plants is increased to the maximum possible extent.
- New or upgraded gas or coal plants should be made “capture & storage ready”.

- These reductions can be achieved at the same time as phasing out our existing nuclear plant. Considerable attention is given to a potential energy gap posed by nuclear phase-out, and this is discussed below.

2. Energy Security

The Prime Minister said in his Labour Party Conference speech “*how much longer can countries like ours allow the security of our energy supply be dependent on some of the most unstable parts of the world?*” He used this to justify a new consideration of the role of nuclear power. When examining this issue it will be important to consider facts and not just rhetoric. According to the Department of Trade and Industry⁵:

- The UK’s chief supplier of piped gas for the foreseeable future will be Norway
- The Netherlands and Norway have around 4 trillion cubic metres of gas reserves (2004 estimate)
- Our import dependency on gas will grow to perhaps 40 per cent by 2010/11
- New LNG terminals are being built to allow a larger diversity of sources of gas in the future (and hence security).

The UK’s Energy Sector Indicators, published in 2005⁶, also provide useful information, such as:

- The UK was only one of six OECD countries to produce more energy than it consumed in 2002. The Netherlands, United States, Switzerland, Germany, Austria, Spain, Japan and Italy are all major energy importers. France, Italy, Germany and Japan have all lived with importing large amounts of energy for the last 25 years.
- Seventy per cent of crude oil imports are from Norway
- The average house in the UK only has an energy efficiency rating (SAP rating) of 51.3 out of a maximum of 120
- Only 55 per cent of potential households had 80 per cent or more of their windows double-glazed in 2003, and only 18 per cent of households full insulation
- Electricity generators lost all but 38 per cent of the energy of their fuel through inefficient technologies, and that does not take into account large transmission and distribution losses.

In Friends of the Earth’s opinion we need to keep energy security issues at front of mind but not overstate any threat so as to promote unsustainable technologies, such as nuclear power. The most sustainable and sensible response to the energy security challenge would, in our view, be to vigorously promote energy efficiency, more actively harness the UK’s sources of renewable power, and ensure maximum efficiency from existing fossil fuel generation. Given increased reliance on natural gas, the UK should reach levels of storage capacity which are at least comparable to those of Western European countries with more experience as gas importers.

In addition, if we are concerned about security of supply, we must ensure that we analyse what the dangers for supply disruptions really are, given that in any electricity market, no matter what the energy mix, temporary supply shortfalls may occur. These dangers, despite rhetoric stating the contrary, have far more to do with inadequate market regulation than with environmental policy. And the answer to these crises (as in the case of California) has been to implement emergency demand response options.

The UK must urgently implement recommendations by the International Energy Agency, which has recently published two reports: “Saving Energy in a Hurry” and “Saving Electricity in a Hurry”⁷. These reports are based on experiences in California, Brazil, Norway, New Zealand and Japan and other parts of the world, where temporary shortfalls in energy supply and/or price spikes have been successfully dealt with through energy efficiency measures. Implementing these efficiency measures appears to be particularly urgent in the UK, in the light of a possible cold winter in 2005-06 and currently high natural gas prices (because of their link to oil prices) at a time of a temporary potential low import capacity because LNG terminals are not yet ready, potentially causing a temporary mismatch between supply and demand..

Some examples from the reports include:

- California encouraged electricity conservation by offering rebates to consumers that cut their electricity use by more than 20% compared to the previous year.
- During a day-long shortage in the winter, Sweden encouraged its consumers to briefly lower thermostats and to postpone non-essential electricity-consuming activities.
- Brazil and California distributed tens of millions of compact fluorescent light bulbs (CFLs) and encouraged consumers to buy more. Each CFL replacement of an incandescent bulb cut electricity demand about 75%. The market for CFLs in California was permanently transformed and continues to be several times larger than in the rest of the United States.
- California replaced almost a million lamps in traffic signals with high-efficiency Light Emitting Diodes (LEDs) and saved over 60 Megawatts - enough electricity to supply 60 000 homes.

In addition to these methods, there are a number of other cost-effective methods for quick demand response that are technically available and only need political support and better regulation in order to be taken-up in the market. Implementing these systems would be far cheaper than spending taxpayer money for nuclear power. One example among many is the concept of dynamic demand⁸.

The UK’s wind resource represents 40 per cent of the total available wind energy resources in Europe, and could theoretically meet the country’s electricity needs eight times over from wind power.⁹ Other renewables deserve much greater attention: it has been estimated that wave power could provide around 15 per cent of UK electricity demand, tidal stream power could provide approximately 6.5 per cent, and tidal lagoon schemes could generate an additional 8-10 per cent. From our scenarios, it is also clear that more efforts need to be made to promote the growth of biomass. This will not only have a positive effect on climate policy, but will also benefit the agriculture and forestry industries.

Combined Heat and Power and other forms of decentralised generation also need to grow at a faster rate than is currently the case. It is worth noting that during serious blackouts which force the entire electricity grid to shut down, Combined Heat and Power and other forms of decentralized power are able to continue producing electricity.

While the UK works towards more ambitious renewables targets, the electricity model referred to above demonstrates how improvements to the efficiency of our fossil fuel use could amply accommodate nuclear phase-out while ensuring security of supply. A 'replacement' new-build nuclear programme for the UK might consist of ten AP1000 stations (1.1 GW capacity) producing 87 TWhrs/yr (equivalent to current UK nuclear output) and would not have a load-following capability. Alternatively, a programme comprising next-generation CCGT technology generating 85 TWhrs/yr would require 12 GW of CCGT capacities. Such a programme starting in Jan 2008 might be completed within five years given a build time of about 30 months.

Even an ambitious coal station retro-fit programme with an increase in biomass co-firing (which, as stated above, may not be necessary) starting in January 2008, would after five years, have completed the conversion of about 7 GW of coal station capacity capable of generating around 86 TWhrs/yr. Such gas or coal plant could be 'capture-ready' and completed by 2013, probably two years before any new-build nuclear power stations could be commissioned.

3. Friends of the Earth and Nuclear Power

Friends of the Earth do not believe that nuclear power is a desirable or necessary source of generation to combat climate change. The scope for emissions reductions through a replacement programme of new nuclear power plants is not that great. Nuclear power is currently responsible for about 22 per cent of our electricity generation. But electricity generation, in turn, is only responsible for about 30 per cent of the UK's carbon dioxide emissions. Carbon dioxide is responsible for 85 per cent of our overall greenhouse gas emissions.

Nuclear's electricity contribution is expected to fall significantly by 2020 and finally reach zero when Sizewell B shuts in 2035. Other things being equal (an extremely unlikely scenario), this would increase greenhouse gas emissions in the UK by about 8 per cent.

Replacing nuclear with nuclear would keep greenhouse gas emissions at their existing level but at the same time:

- **Increase almost five-fold the amount of spent fuel in the UK's radioactive inventory.**

The Committee on Radioactive Waste Management (CORWM) has estimated the impact of replacing nuclear with nuclear on the UK's nuclear waste and materials inventory¹⁰. Using the AP1000 reactor type, it concluded that the tonnage of spent fuel would rise from 4,700 tU to 18,700 tU – an increase of almost 400 per cent.

Spent nuclear fuel is highly radioactive and generates heat¹¹. Once packaged for disposal, the spent fuel created by a new programme of AP1000s would occupy 31,900 m³ – which is substantially more than the combined volume (19,970 m³) of the spent fuel, uranium, plutonium and high level waste already produced or expected to be produced by existing reactors. It would add substantially to Britain's nuclear waste problem.

- **Require substantial subsidies that are better spent on achieving emissions reductions through other means.**

In 2002, the Cabinet Office Performance and Innovation Unit forecast the costs in 2020 of electricity generated by nuclear power. It concluded that electricity from nuclear power was likely to prove more expensive than electricity from on-shore or off-shore wind, many energy crops and micro-CHP. It also demonstrated that overall UK demand for energy could be reduced by 30 per cent by measures that are already cost effective.¹²

Further assessments have been completed since then. The Parliamentary Office for Science and Technology has pointed to the importance of assumptions about discount rates in influencing overall costs¹³. Assumptions about reliability and decommissioning costs are also important. POST concluded “the basic problem in all these comparisons is that the situation is a classic catch-22. Only the construction of a new reactor could verify the cost assumptions made by the nuclear industry.” The scale of the investment required precludes an experiment while in any event this would take years to complete – years during which we will need to be aggressively reducing emissions if we are to meet our short-term, let alone medium and longer term targets.

According to a recent article on Scientific American, delivering a kilowatt-hour from a nuclear power plant costs at least three times as much as saving one through efficiency measures.¹⁴

- **Send a dangerous signal to countries throughout the world.**

Britain prides itself on being a world leader in the fight against climate change. A British decision to use nuclear power in that programme will prompt other countries to follow suit (whether their intent is sincere or otherwise).

This could be highly problematic. Many aspects of the technology used in civilian nuclear power systems are also used in nuclear weapons programmes. Specific examples include uranium enrichment and back-end reprocessing technologies, but even the existence of a nuclear skills base increases the potential for a country to acquire weapons. The on-going cases of North Korea and Iran demonstrate the danger.

Using nuclear power to tackle climate change would substantially increase the risk of proliferation. Climate change is a global problem. Its mitigation will eventually require controls on the emissions of most, if not all, countries. Negotiations over controls already entail discussion of technology transfer. If the UK were to use nuclear power to limit climate change, it would be difficult to deny this technology to

others – especially if we were expecting them to control their emissions. Merely adding concerns over proliferation to already tortuous climate negotiations would make those negotiations more difficult. In this regard it is of note that earlier this year the Iranian Ambassador to London claimed that his country's nuclear power programme will aid the implementation of the Kyoto Protocol.

In terms of energy security there is also the threat of terrorism against nuclear facilities and transports. This threat should not be underestimated. It is worth noting that the 911 Commission in the United States found that the masterminds of the terrorist attacks of Sept 11, 2001, had considered flying planes into nuclear power stations. This was later ruled out but future attacks of this kind cannot be ruled out and contribute to making new nuclear power stations extremely undesirable.¹⁵

Finally, given existing licensing procedures, it will be at least a decade and probably much longer before construction on any nuclear power plants can begin. By contrast, many measures to promote energy efficiency and renewable generation can proceed very quickly.

Appended is a report recently published by Friends of the Earth Australia which covers these issues and others in greater depth.

Conclusions

The present Government is failing in its duty to cut carbon dioxide emissions. The electricity generation sector is a sector where substantial cuts could be made quickly without endangering energy security. There remains scope for reducing electricity consumption and greatly increasing the role of renewable energy. The discussion on whether nuclear power is needed is a dangerous and unwarranted distraction from the urgent priority of establishing a genuinely sustainable energy policy. Action on climate change is desperately needed. Prevarication, dithering and inaction are not.

Appendix 1 – Sector targets for carbon dioxide emissions

Friends of the Earth has suggested sector targets to help drive the required carbon dioxide cuts across the UK economy. Our analysis suggests that some sectors will need to take greater reductions than others, due to technical and political constraints. The suggested sector targets are in the table below.

Sector	1990	2000	2010 target	Friends of the Earth suggested 2020 target
Energy supply	64.3	53.5	38.3	25.72 (60 percent cut from 1990)
Manufacturing & construction	26.6	23.7	23.3	21.3 (20 per cent cut)
Road transport	30.1	32	30.1	26.7 (12.7 per cent)
Aviation	4.6	8.8	4.2	3.2 (30 per cent)
Commercial & institutional	8	8	6	5 (37.5 percent)
Residential heat & gas-fired hot water	21.1	23.3	18.5	16.4 (22 per cent)
Others	9.5	8	7.2	7.2
Total suggested targets			127.6	105.5
Government targets – 2010 20% CO2 cut from 1990, 2020 EU 30% greenhouse gas reduction (equates to 40% CO2)	165.1		132.1	99
Shortfall from target				6.5 (potential to meet from manufacturing and residential)

Appendix 2

Friends of the Earth Australia nuclear power report, September 2005

This report is submitted as a separate PDF report.

The summary document is available at:

<http://www.melbourne.foe.org.au/images/nukesdoc/summaryweb.pdf>

The full report is available at:

<http://www.melbourne.foe.org.au/images/nukesdoc/nukesweb.pdf>

Notes

¹ Figures for primary fuel inputs for inland energy consumption were taken from Digest of UK Energy Statistics, published 25/8/05. (See www.dti.gov.uk/energy/inform/dukes/) Friends of the Earth converted volumes of primary energy consumed in millions of tonnes oil equivalent (Mtoe) to millions tonnes of carbon emissions (MtC)

² Please note that this is a very modest energy demand reduction target. According to a report by ILEX for WWF, energy demand could be reduced to 358 TWh/Yr by 2020, simply through an effective implementation of the Energy White Paper (and this does not take into account potential further reductions than may arise thanks to European Union planned legislation on minimum efficiency standards for all products sold in the internal market)

³ “The power to save our climate”, report for WWF UK by ILEX Energy Consulting, November 2004, pages 24-25

⁴ DTI, August 2005 update to Quarterly Energy Prices.

⁵ DTI, 2005, Secretary of State’s first report to Parliament on security of gas and electricity supply in Great Britain.

⁶ DTI, 2005, UK Energy Sector Indicators 2005

⁷ IEA 2005

⁸ please see <http://www.dynamicdemand.co.uk>

⁹ New Economics Foundation, June 2005 “Mirage and Oasis, Energy Choices in an Age of Global Warming”

¹⁰ Committee on Radioactive Waste Management, 2005, Corwem’s radioactive waste and materials inventory, corwem document 1279, para 5.32-5.34, 6.16-6.22 and page 35

¹¹ Committee on Radioactive Waste Management, 2005, How should the UK manage radioactive waste, second consultation document, p8

¹² Performance and Innovation Unit, 2002, The Energy Review

¹³ Parliamentary Office for Science and Technology, 2002, The nuclear energy option in the UK, POSTNOTE 208

¹⁴ Amory B. Lovins, “More Profit With Less Carbon”, Scientific American special issue, Sept 2005, p.82.

¹⁵ The 9/11 Commission Report, page 245 <http://www.9-11commission.gov/report/911Report.pdf>