



House of Commons
Environmental Audit
Committee

Keeping the lights on: Nuclear, Renewables and Climate Change

Sixth Report of Session 2005–06

Volume I



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Nuclear, Renewables
and Climate Change**

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formal minutes.*

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The Environmental Audit Committee

The Environmental Audit Committee is appointed by the House of Commons to consider to what extent the policies and programmes of government departments and non-departmental public bodies contribute to environmental protection and sustainable development; to audit their performance against such targets as may be set for them by Her Majesty's Ministers; and to report thereon to the House.

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References

In the footnotes of this Report, references to oral evidence are indicated by 'Q' followed by the question number. References to written evidence are indicated by page number as in 'Ev12'. number HC *-II refers to written evidence printed in Volume II, serial number HC *-II]

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Executive Summary

1. By 2016, it is likely that between 15 and 20GW of electricity generating plant will be decommissioned. This amounts to nearly a quarter of total UK generating capacity. Over the next 9 years, therefore, very substantial investment in new generating capacity and energy efficiency will be required if the lights are to stay on—even in the absence of demand growth. Further substantial investment on a comparable scale may be required in the following decade.
2. At the same time, the UK is facing the unprecedented challenge of achieving radical reductions in carbon emissions in an effort to combat global warming—as reflected in the difficulty of achieving the UK 2010 carbon reduction target. The electricity generating sector accounts for nearly a third of total emissions and it will therefore need to play a significant role in achieving such reductions, and indeed the achievement of the 2050 target will depend heavily on the nature of investment in generating capacity over the next two decades. The Energy White Paper of 2003 addressed the need for carbon reductions across the economy but did not set specific targets for the generating sector. However, it endorsed the view set out in the Performance and Innovation Unit (PIU) report that new gas-fired plant, renewables and energy efficiency could make up for the potential generating gap.
3. Over the next ten years, nuclear power cannot contribute either to the need for more generating capacity or to carbon reductions as it simply could not be built in time. The potential generating gap during this period will need to be filled—largely by an extensive programme of new gas-fired power stations, supplemented by a significant growth in renewables. Contrary to popular belief, a further ‘dash for gas’ would result in significant carbon savings. Moreover, it is not clear how much effect the replacement of older coal and nuclear plant by gas will have on the security of total electricity supplies, as we will in any case become highly dependent on foreign imports of fossil fuels for our total energy requirements—including over twice as much natural gas for industrial and domestic uses as we use for electricity generation.
4. By 2016 at the latest, substantial further investment in generating capacity will be needed, and there are a number of different lower-carbon technologies which could contribute on a large scale—including renewables, microgeneration, offshore wind, nuclear, and carbon capture and storage. But there is substantial evidence to show that progress in deploying key technologies—in particular carbon capture and storage, off-shore wind, and microgeneration—is inadequate. The real issue which the Government is failing to address is whether the policy and regulatory framework in place is sufficient to stimulate the growth of lower-carbon generation on the scale required.
5. All lower-carbon generating technologies are more expensive than coal and gas, and will require a long-term funding framework in order to reduce investment risk and

ensure that the necessary investment takes place. The current highly liberalised UK electricity market structure is too short term and fails to provide such a framework. Indeed, it is not clear whether it will even ensure that enough investment takes place to keep the lights on by 2016. There are a number of options open to the Government to address this—including the introduction of some form of capacity payment, the development of low-carbon generation contracts, and the modification of the Renewables Obligation to provide a range of incentives for different technologies. The Government will need to consider what changes to the market structure are required as part of the Energy Review.

6. Nuclear power raises a variety of issues which would need to be satisfactorily resolved before any decision to go ahead is taken. These include long-term waste disposal, public acceptability, the availability of uranium, and the carbon emissions associated with nuclear. There are also serious concerns relating to safety, the threat of terrorism, and the proliferation of nuclear power across the world. Moreover, given the fact that substantial changes in the relative cost of energy technologies are likely to occur over the next 20 to 30 years, it is by no means clear whether investors will wish to commit themselves to 70 years of nuclear generation. There are striking similarities here to the position in 1980 when a similar large scale programme of nuclear new build eventually resulted in the construction of only one new reactor—Sizewell B.
7. A Government decision to support a major programme of nuclear new build must also take account of the impacts on investment in other areas—notably energy efficiency, renewables, carbon capture and storage, and the development of distributed generation systems. The potential of these various technologies over the next 20 to 30 years is immense, and any public subsidies for nuclear must be weighed against the substantial progress towards reducing carbon emissions and ensuring a greater degree of security of supply which these alternatives could achieve with similar subsidies. However, as all forms of lower-carbon generation will require financial support, the Government should accept that the shift to a sustainable energy strategy cannot be based—at least in the medium term—on maintaining low energy prices.
8. The Government should be doing far more to promote progress in these other areas. Carbon capture and storage will, in particular, be of crucial importance in view of forecasts which show increasing use over the next thirty years of fossil fuels—especially in developing countries such as China and India. Renewables and distributed generation could also contribute hugely in both a national and global context—but many of the technologies involved warrant special support to bring them to market and achieve the cost-reductions which will make them competitive.
9. While this inquiry has focussed primarily on supply side issues, we cannot emphasise enough that reducing demand is also a vital component on the path to a sustainable energy strategy. There is, as yet, little evidence to suggest that the Government has succeeded in doubling the rate of energy efficiency improvements as envisaged in the

Energy White Paper. Far more decisive action and political leadership is required, and we would also urge the Government to consider setting absolute targets for reductions in demand as a way of stimulating the growth of energy efficiency and guaranteeing the level of carbon savings achieved.

10. The nature of the current Energy Review is unclear—whether it is specifically fulfilling the Prime Minister’s desire to make a decision on nuclear, whether it is a review of electricity generating policy, whether it is a wider review of progress against the Energy White Paper, or whether it is reopening the broad policy debate which the White Paper itself encompassed. We are also concerned that it does not appear to have resulted from a due process of monitoring and accountability, and that the process by which it is being conducted appears far less structured and transparent than the process by which the White Paper itself was reached.
11. If the Energy Review is focussed mainly on electricity generation and, in particular, a decision on nuclear, then it is unclear what the nature of such a decision could be and the Secretary of State himself was unable to explain this. Indeed, the Government has always argued that its role is not to prescribe the fuel mix, and it has invested much effort in developing a fully liberalised market which will determine for itself such investment decisions. The frequent statements that it must make a decision on energy, and specifically on nuclear, fundamentally conflict with such an approach and would therefore represent a major U-turn in energy policy. Moreover, if the Government does indeed come to a decision on nuclear, it is unclear why it should not also come to a decision on off-shore wind, marine, or micro-CHP – let alone the array of possible measures to support energy efficiency. Yet we never hear Government ministers talking in such terms.
12. If, on the other hand, the Energy Review is a wider ranging review of policy it will fail to command the support of stakeholders, the public and politicians if what emerges is significantly different from the course that was charted in the Energy White Paper without a proper explanation of how circumstances have altered sufficiently to justify such a change and without further wide-ranging consultation on the nature of the change. It is also unsatisfactory that it was launched before the publication of the long-delayed Climate Change Programme Review and will be concluded before the Stern Review has reported. This does not inspire confidence about the extent of coordination within and between different parts of Government.
13. We remain convinced that the vision contained in the White Paper—with its focus on energy efficiency and renewables as cornerstones of a future sustainable energy policy – remains correct. What is now needed is a far greater degree of commitment from the Government in implementing it. Alongside, more attention needs to be given to technologies such as clean coal and carbon capture and storage, both of which may have a significant role to play nationally and globally.

Introduction

1. Our use of energy underpins every aspect of society. It is reflected every day in the need for petrol for road transport, natural gas for domestic heating, and electricity for lighting and appliances. Less visibly, it is embedded within the very fabric of the material world which surrounds us—the buildings we dwell in and the goods we purchase and use. No society can therefore claim to be sustainable unless it is based on environmentally benign and sustainable forms of energy provision. But, given the extent of our current reliance on fossil fuels, the challenge is daunting.

2. In February 2003, the Government published the Energy White Paper.¹ This represented the outcome of three years of intense debate, initiated in June 2000 by a seminal report from the Royal Commission on Environmental Pollution.² It was informed, in particular, by a major inquiry carried out by the Performance and Innovation Unit (now the Strategy Unit), which involved an extensive and detailed consultation on many specific aspects of energy policy.³ Numerous other bodies, including the Environmental Audit Committee (EAC), published their own contributions to the debate. The White Paper itself endorsed the emerging view that renewables and energy efficiency could play a central role in future energy policy, and to that extent it received widespread support. It also set in motion a number of other processes—including the development of a detailed action plan on energy efficiency (subsequently published in early 2004), and the creation of a cross-departmental network—the Sustainable Energy Policy Network (SEPN)—to coordinate implementation of the White Paper and to monitor progress against it. Two annual monitoring reports have since been published, the latest in June 2005.⁴

3. However, by the summer of 2005, energy strategy had once again risen to the top of the agenda for a variety of reasons—including the sharp increases in UK carbon emissions since 2002, concerns about future reliance on imported gas, and greater awareness of the scale of investment required in new electricity generating plant. In particular, the potential contribution of nuclear new build was once again being hotly debated, with proponents arguing that it offered the only credible way of both reducing carbon emissions from the electricity generating sector and ensuring security of supply.

4. It was in this context that we decided to launch an inquiry on energy policy. We focused on the electricity generating sector, and the scale and nature of the investment required to fill the potential shortfall caused by the decommissioning of existing nuclear and older coal plant. Given the need to achieve radical cuts in carbon emissions across the UK economy, a key aspect of our inquiry was the extent to which the existing regulatory and policy framework adequately incentivised investment in lower-carbon forms of generation. An

1 DTI, *Our energy future – creating a low carbon economy*, Cm 5761, February 2003

2 RCEP, *Energy – the Changing Climate*, June 2000

3 PIU, *The Energy Review*, February 2002

4 The annual monitoring reports and Energy Efficiency Implementation Plan are available on the SEPN website

underlying aim was to assess whether the vision set out in the White Paper remained true—namely, that renewables and energy efficiency would be sufficient to address future demand, without recourse to nuclear new build which was in any case then considered uneconomic. Given the debate over nuclear power, we were particularly interested in a number of related issues—including costs and investment risks, the impact of nuclear new build on investment in other areas, the carbon emissions associated with nuclear generation, and a long-term solution to the problems posed by nuclear waste.

5. Following the publication of our press release on 26 July 2005, we received over 100 memoranda and papers. From mid-October to the end of November, we held eight oral evidence sessions in which 21 organisations or individuals were represented. These included Alan Johnson MP, the Secretary of State for Trade and Industry, and Sir David King, the Government's Chief Scientific Adviser. In December, we visited Denmark and Finland to explore further some of the issues arising from our inquiry, the latter being of particular interest insofar as it is the only country with relatively liberalised markets to have commissioned a new nuclear power plant in the last 20 years. Also in December, the BBC Radio 4 programme *You and Yours* focussed on our inquiry and invited views from members of the public—an analysis of which was subsequently forwarded to us in January 2006. The programme also prompted some members of the public to write to us directly setting out their views. We would like to express our thanks to all who have contributed to this inquiry.

6. After the launch of our inquiry, the Prime Minister announced at the Labour Party Conference in September 2005 the Government's intention to conduct an Energy Review. Wide ranging and very general terms of reference were published by the DTI on 29 November, followed by a more detailed public consultation on 23 January 2006.⁵ As this report makes clear, we have concerns over both the rationale for, and the nature of, this consultation. We hope, nonetheless, that the Government will find our work helpful in taking forward its own review.

A potential generating gap?

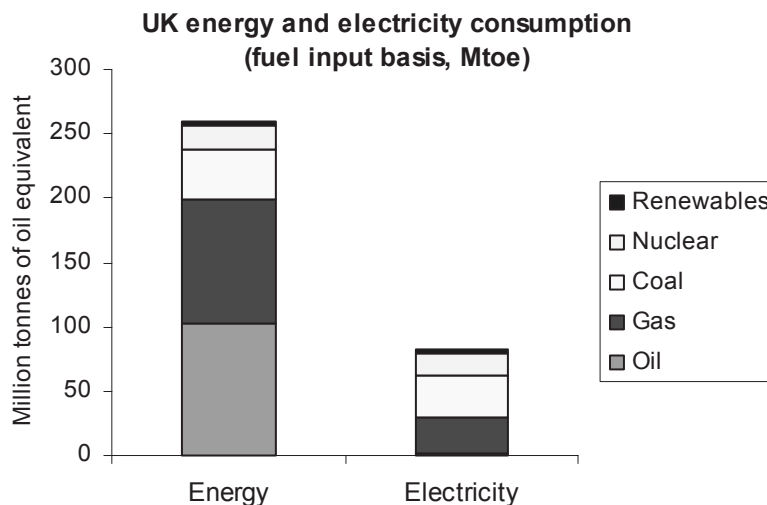
UK energy use and the fuel mix

7. Electricity generation only accounts for a part of total energy use. In view of the current Energy Review and the debate over both security of supply and carbon reduction targets, it is important to understand clearly the relationship between the two. In this section, therefore, we provide background information on total UK energy and on electricity generation.

8. Total UK energy use in 2004 amounted to the equivalent of 247 million tonnes of oil equivalent (Mtoe). The largest single component is oil (102 Mtoe), almost all of which is used for transport fuels. Natural gas (97 Mtoe) is used mainly for domestic and industrial heating, and only about 30% of it (29 Mtoe) is used for electricity generation. Coal (39

5 DTI, *Our Energy Challenge*, 23 January 2006

Mtoe) is used mainly for electricity generation. By contrast, nuclear and renewables provide 18 Mtoe and 3.5 Mtoe respectively 7% and less than 2% of the total.⁶ The following figure graphically illustrates these statistics.



Source: EAC, based on DTI Dukes 2005 tables 1.1 and 5.4

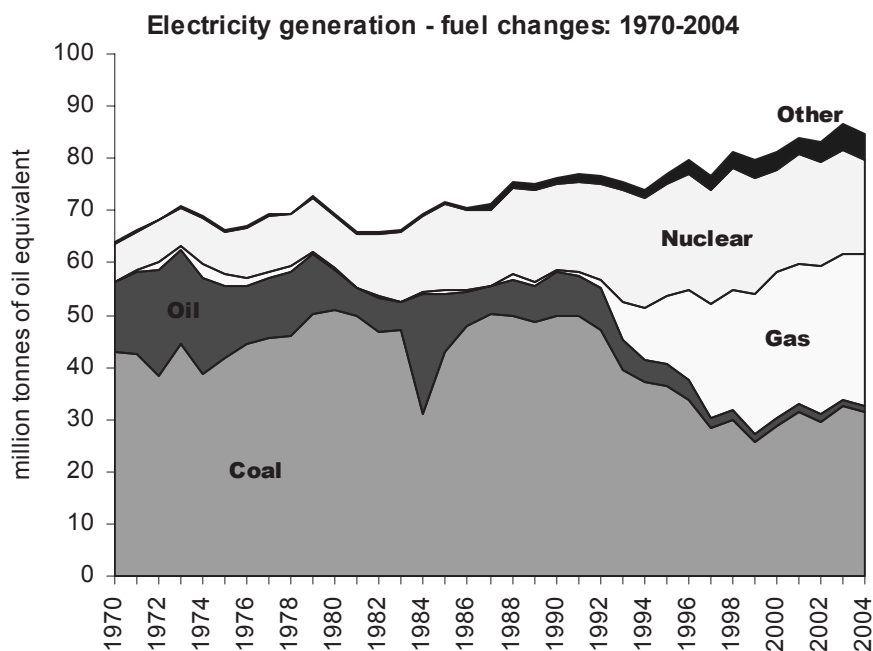
Note: Total energy consumption as shown in the graph is slightly higher than the primary supply figure of 247 Mtoe because it excludes net imports and stock changes.

9. In terms of electricity generation, the picture changes significantly. Total electricity supplied in 2004 amounted to 378,000 GigaWatt Hours (GWh) of which natural gas power stations comprised 40%, coal generation 33% and nuclear 19%.⁷ Renewables contributed only 3.6% of the total mix.⁸ There have also been striking changes in the electricity generating sector since 1970 as the following figure shows. Indeed, in the decade from 1992 to 2002, over 25GW of Combined Cycle Gas Turbine (CCGT) plant was planned and built, radically changing the fuel mix by displacing existing coal fired power stations.

6 DTI Dukes 2005, table 1.1.

7 DTI Dukes 2005, p118 and table 5.6. The figures quoted here are on a gross output basis, and are higher than on a final consumption basis..

8 Figures for the percentage of renewable energy produced vary depending on the basis on which they are calculated. The figure quoted here is on an internationally agreed basis. On the UK Renewables Obligation basis, the figure is 3.1%, while on the EU Renewables Directive basis, it is 4.4%. The differences between these figures relate mainly to the treatment of hydro-electric power, energy from waste, and imports of renewable energy. See DTI Dukes 2005, pp167ff.



Source: EAC, based on DTI Dukes 2005, table 5.1.1

Note: 'Other' includes hydro, renewables, energy from waste and from certain other industrial and chemical processes

10. Total UK energy and electricity demand have continued to increase despite the fact that the energy intensity of the economy has been steadily improving at 1.8% on average.⁹ Over the last five years, for example, the average rate of growth in electricity generation was 1.5% a year, and forward projections by the National Grid suggest that this will continue.¹⁰ While there has therefore been some decoupling in relative terms of economic growth from energy use and carbon emissions, it is disappointing that the UK has not yet managed to stabilise and reduce energy, and particularly electricity, demand in absolute terms. In this respect, certain other countries such as Denmark, have achieved more.

The extent of new generating capacity required

11. An initial objective of our inquiry was to examine the extent of new generating capacity which would be required by 2015 to 2020. Various factors underpin the need for new investment:

- Most existing coal generating plant was built in the 1960s and 1970s and is now reaching the end of its life.
- The introduction of the Large Combustion Plant Directive (LCPD) will impose stringent new emission limits on sulphur dioxide from 2008. In order to conform to the Directive, many coal plants will need to fit flue-gas desulphurisation

⁹ DTI, *Energy White Paper*, February 2003, paragraph 3.3.

¹⁰ DTI Dukes 2005 paragraph 5.31. See also Ev198.

equipment. Where this is uneconomic, plants can continue to operate until 2015 but only at a reduced level.

- The existing fleet of 11 Magnox nuclear power stations were built in the 1960s and are in the process of being decommissioned. Seven have already been closed, and the remaining four (with a total capacity rating of 1.9 GW, and a load factor of approximately 60%) are scheduled to be closed from 2006 to 2010.
- The current fleet of 7 Advanced Gas Cooled (AGR) nuclear power stations, built over a period from the late 1960s to the early 1980s, are reaching the end of their design lives, and are all expected to be closed from 2011 to 2023.

12. In respect of nuclear, about 8GW of capacity is scheduled to close by 2014, increasing to 9GW by 2018 and 11 GW by 2023—leaving only Sizewell B (the UK's only commercial Pressurised Water Reactor) operational after that date. It is possible that British Energy may extend the operational life of some of these reactors as it has done in the case of Dungeness B. However, this is unlikely in view of the operational difficulties which have plagued AGRs and have resulted in poor load factors. Indeed, given the problems being experienced with the graphite cores of these reactors, it is by no means certain that they will reach even their planned operational closure dates.¹¹

13. With regard to coal, various organisations complained that the failure of the Government to confirm its interpretation of the Large Combustion Plant Directive made it difficult to be certain about the amount of coal plant which would remain operational up to 2016, and that this was one reason for the current uncertainty affecting new investment. RWE, for example, estimated that 4 GW of older CCGT or nuclear would close by 2015, and that a further 16 GW of plant (including an unspecified amount of nuclear) would be retired from 2016 to 2020.¹² EDF stated that 19GW of coal plant would close by 2018, though the exact timing after 2008 was uncertain.¹³ The fact that Defra has now issued guidance on the LCPD may help to reduce, though not entirely eliminate, this uncertainty.

14. The overall range of estimates for the extent of the 'generation gap' by 2015 and 2020 was broadly consistent—though most of the evidence we received did assume continuing demand growth. RWE considered that 20GW of new generating capacity would be required by 2015, and an additional 20GW by 2020. EDF estimated that 25 to 35 GW of generating capacity was required by 2018.¹⁴ EON stated bluntly that “By 2015 up to 8GW of nuclear (subject to life-extension decisions) and 19GW of coal and oil-fired plant will need to be replaced.”¹⁵ The overall position was summed up effectively in the memorandum from Scottish and Southern Electricity:

11 Steve Thomas, *The Economics of Nuclear Power: An analysis of recent studies*, July 2005. The paper is available on the PSIRU website at: www.psir.org. It is also interesting to note how nuclear output has varied in recent years due to unplanned outages. On this, see both Thomas and DTI Dukes, 2004.

12 Ev657ff.

13 Ev101.

14 Ev101.

15 Ev410.

The UK currently consumes around 350TWh (terawatt hours) of electricity each year, from around 76GW (gigawatts) of generating capacity. If demand for electricity grows at its current rate by 1.5% per year for the next 15 years, the UK will be consuming around 400TWh of electricity each year by 2020. It is reasonable and prudent to assume that if coal-fired and nuclear power stations are phased out as expected, the UK will have electricity generating capacity comprising around 56GW in 2020, enough to produce just over 200TWh of electricity—barely half of the requirement if demand grows—and this assumes that there will be growth in the capacity of renewable generation in particular.

If, through a radical set of new measures, demand for electricity falls by 1.5% per year for the next 15 years, the UK will be consuming around 280TWh of electricity each year by 2020—which still leaves a shortfall of around 80TWh of electricity production. In summary, the UK is faced with a huge generation gap. The successful implementation of energy efficiency measures to reduce demand for electricity could reduce the size of that gap, but a substantial shortfall would still remain.¹⁶

15. By 2016, it is likely that between 15 and 20GW of electricity generating plant will be decommissioned. This amounts to nearly a quarter of total UK generating capacity. Over the next 9 years, therefore, very substantial investment in new generating capacity and energy efficiency will be required if the lights are to stay on—even in the absence of demand growth. Further substantial investment on a comparable scale may be required in the following decade.

The Energy White Paper

16. The Energy White Paper, published in February 2003, set out four strategic aims for energy policy:

- to put the UK on a path to cut the UK’s carbon dioxide emissions—the main contributor to global warming—by some 60% by about 2050 with real progress by 2020;
- to maintain the reliability of energy supplies;
- to promote competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve our productivity; and
- to ensure that every home is adequately and affordably heated.¹⁷

17. The remit of the White Paper was very broad, covering as it did all aspects of energy use—including transport, domestic energy efficiency, and the scope for progressing more generally towards a low-carbon economy. It famously set out a long-term target for the UK of a 60% reduction in CO₂ by 2050. In terms of electricity generation, it endorsed the 10% renewables target set for 2010 and included an “aspiration” to double this by 2020 but fell

¹⁶ Ev116-117.

¹⁷ DTI, *Energy White Paper*, February 2003.

short of setting a firm target. Similarly, it outlined the potential scope to make radical improvements in energy efficiency, and it gave indicative figures for the potential carbon savings which might be achieved in different sectors—though Ministers were at pains to point out that these did not constitute targets.¹⁸ It confirmed that the current economics of nuclear made it an unattractive option and that there were important issues of nuclear waste to be resolved—though it did not rule out the possibility that nuclear might be needed at some point in the future to meet carbon reduction targets.¹⁹ It also highlighted the contribution that innovative technologies such as micro-generation and CCS (carbon capture and sequestration) could make—and indeed it emphasised the need for urgent action in some of these areas.²⁰ Its weakness, as EAC pointed out, was that it was strong on vision but weak in terms of specific policy instruments, mechanisms, and targets.²¹

18. The Energy White Paper, published in February 2003, addressed the need for carbon reductions across the economy but did not set specific targets for the electricity generating sector. However, it endorsed the view set out in the PIU report that new gas-fired generating plant, renewables and energy efficiency could make up for the potential generating gap left by the decommissioning of older coal and existing nuclear plant.

Carbon reduction targets

19. Underlying the preoccupation with the electricity generating sector is the extent to which it contributes to carbon emissions and global warming. In 2004, estimated emissions from this sector amounted to 47 million tonnes of carbon (MtC)—some 30% of total UK carbon emissions (158.5 MtC).²² We must, however, beware of demonising this sector as it is easy to forget that we consume the electricity generated in domestic and work environments. One of the reasons for the renewed interest in the power sector is the extent to which UK performance against its carbon reduction targets has deteriorated over the last four years, as shown by the following graph:

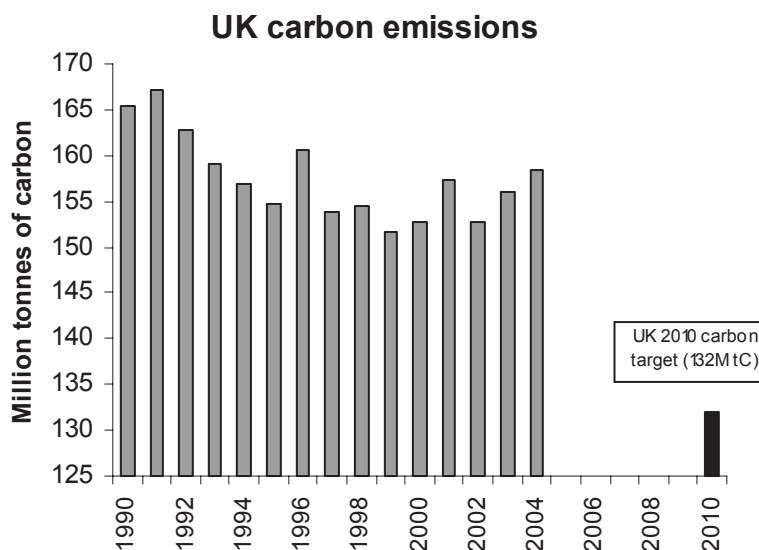
18 A somewhat embarrassing misprint in the White Paper suggested that these figures were indeed targets. Even the Minister for Energy was unclear and had to be corrected by officials. See EAC, Eighth Report of 2002-03, *The Energy White Paper – Empowering Change?*, HC 618, paragraph 38.

19 DTI, *Energy White Paper*, February 2003, paragraphs 1.24 and 4.3.

20 On CCS, see DTI's *Energy White Paper*, pages 89-91 and especially paragraph 6.63. See also paragraphs 50ff below..

21 See EAC, Eighth Report of 2002-03, *The Energy White Paper – Empowering Change?*, HC 628, July 2003

22 DTI, *Energy Trends*, March 2005.



Source: EAC, based on Government data

20. In terms of overall UK performance on emissions reductions, there are a range of targets:

- Kyoto [*International target*]: to achieve a reduction in greenhouse gas emissions by 2008 to 2012 of 12.5% against a 1990 baseline.
- CO₂ [*UK domestic target*]: to achieve a reduction in CO₂ emissions of 20% by 2010 and 60% by 2050 against a 1990 baseline.
- EU Emissions Trading System and sectoral allocations: here, member states are responsible for allocating appropriate targets for overall industrial emissions, and then breaking this down into targets for individual sectors.

21. With the exception of the sectoral allocations within the EU ETS, however, no overall targets in terms of carbon reduction have been set for the electricity generating sector. Indeed, it is worth noting that much of the carbon reductions which the UK has achieved since 1990 have been due to the “dash for gas”, and to a large extent the confidence of the government in terms of achieving further CO₂ reductions relies on tighter targets for this sector. By contrast, emissions from the domestic sector and particularly transport are continuing to rise. It is precisely because of our ongoing concerns about the lack of progress in these areas that we have just completed an inquiry on housing and are now beginning one on reducing emissions from transport.²³

22. Following the Climate Change Programme review and the current Energy Review, the Government should set targets for specific sectors of the economy—including transport, the domestic sector, and the electricity generating sector—for the level of carbon reductions to be achieved by 2020. It should also ensure that such targets,

²³ For housing, see EAC, Fifth Report of 2005-06, *Sustainable Housing: a follow-up report*, HC 779. For transport, see EAC press release, *Reducing emissions from transport*, 19 January 2006.

together with any targets set for absolute reductions in energy demand, are incorporated within departmental business plans and Public Service Agreements in order to ensure that policy development takes full account of the need to reduce carbon emissions.

Forecasting

23. DTI produced its last ‘official’ forecasts of energy consumption and carbon emissions in 2000, in the important paper EP68 which accompanied the launch of the Climate Change Strategy. This forecast that the electricity generating sector was where most carbon reductions would occur. However, it became apparent to the EAC even by 2002 that emissions were deviating significantly from these forecasts. In July 2002, we pointed out that:

Electricity from coal-fired generators rose by 15 per cent in 2000 and a further 8 per cent in 2001 (against a rise of 2 per cent in 2000 and a fall of 1 per cent in 2001 for gas-fired generation). This largely results from the increases in gas prices over the last 2 years. As a result, total carbon emissions from the electricity generating sector have increased by 3 million tonnes, from 41 MTc to 44 MtC. The DTI's important energy policy forecast, EP68, released in 2000, stated that the electricity generating sector was where most carbon reductions would occur. However, the trend is going in precisely the opposite direction to the EP68 projection.²⁴

Since then, carbon emissions from the generating sector have risen still further to 47MTc.²⁵

24. DTI intended to publish updated energy projections in autumn 2003 in preparation for the development of the UK National Allocations Plan (NAP) which would set the UK emissions cap for participation in the EU Emissions Trading Scheme. However, the work was seriously delayed: indicative figures only were published in July 2003, although the DTI committed itself in this working paper to publishing refined projections in November 2003 and a complete set of projections in March 2004.²⁶ These never materialised, however, and another working paper was issued in May 2004.²⁷ The latter was replaced by a third working paper (and a further addendum) published in November 2004 which the DTI included in the memorandum it submitted to us in October 2005.²⁸ Yet the latter failed to take adequate account of the rise in carbon emissions in recent years, and—astonishingly—remained based on the assumption that oil prices will be at or below \$20 a barrel in real

24 EAC, Eighth Report of 2002-03, *The Energy White Paper—Empowering Change?*, HC 628.

25 DTI, *Energy Trends*, March 2005.

26 DTI, *Stage 1 Results – DTI exercise to update energy and emissions projections :Illustrative projection results from initial July 2003 run*, July 2003. The earlier working papers cited below are not grouped together on the DTI or SEPN site, and the web-references cited here are correct as of March 2006. The July 2003 initial projections can be found at: <http://www.dti.gov.uk/energy/sepn/projections.pdf>.

27 DTI, *Updated Energy Projections: Working Paper May 2004*, May 2004. The May 2004 working paper can be found at: <http://www.dti.gov.uk/energy/sepn/uep.pdf>.

28 Ev274ff.

terms over the next 15 years. It was not in fact until February 2006—some two years late—that the DTI published its detailed revision of the energy projections.²⁹

25. These difficulties impacted on the ability of the Government during 2004 to set an emissions cap within its National Allocation Plan for Phase 1. The UK successively increased the cap from 714 million tonnes of carbon dioxide in its first consultation version (January 2004), to 736 million tonnes in the formal submission to the Commission (April 2004), and finally to 756 million tonnes in the revised November 2004 NAP.³⁰ The Government acknowledged that these changes were necessitated by the fact that its previous provisional forecasts of emissions over the period had been understated—though international competitiveness issues may also have played a part.³¹

26. Still more seriously, the inability of the DTI to monitor and forecast in a timely fashion the impact of current and planned policy instruments has also seriously impeded rapid progress on renewables and energy efficiency. The then Energy Minister, Brian Wilson, told us in 2003 that the next 18 months to two years would be critical: *“I think that the credibility of much that is in the White Paper will not be determined in 2010, 2020 or 2050, it will be determined within the next eighteen months to two years whether we do the things across Government which are necessary in order to allow the 2010 target to be met.”*³² Had the Government, and in particular the DTI, perceived more quickly that their energy and Climate Change strategies were seriously off course, more decisive action could have been taken earlier. We also note that the Government appear to have been taken by surprise by the rapidity of the decline in North Sea oil reserves and the fact that the UK has therefore become a net importer of energy sooner than expected. This too appears to reflect weaknesses in forecasting on the part of the DTI.³³

27. We noted that Jonathon Porritt shared our concerns. In arguing for an independent sustainable energy agency, he questioned the degree to which the DTI was or was not genuinely capable of producing a modelling process which gave complete confidence both to the political and to the business communities; and he went on to say *“There are huge concerns about whether the DTI modelling process is currently fit for purpose in a much more complex world.”*³⁴ Indeed, a number of submissions made the case for a genuinely independent sustainable energy agency. It does seem to us, in this context, that one of the key roles such a body could usefully play would be to model future energy and emissions projections, and highlight clearly the extent to which they may be deviating from forecasts.

28. We have serious concerns about the ability of the Government to model reliably and in a timely fashion future energy and emissions forecasts. This is reflected in the fact that the updated energy projections are two years late, the unwillingness to accept earlier that the Climate Change Strategy was seriously off course, and the difficulties

29 DTI, UK Energy and Emissions Projections – updated projections to 2020, February 2006.

30 EAC, Fourth Report of 2004-05, *The International Challenge of Climate Change*, HC 105, paragraph 38.

31 *Ibid.*

32 EAC, Eighth Report of 2002-03, *The Energy White Paper – Empowering Change?*, HC 618, Q4.

33 Trade and Industry Select Committee, Minutes of Evidence, 6 February 2006, Q 42.

34 Q 597.

which the Government experienced in setting an emissions cap for Phase 1 of the EU Emissions Trading System. As a first step, the Government should ensure that it puts in place a transparent and credible system for updating these forecasts regularly every two years. Ultimately, it would be more appropriate for some form of sustainable energy agency—clearly independent of government—to perform this role.

Filling the gap—energy efficiency, renewables, and other low carbon options

29. In assessing progress against the White Paper’s goals, one of the key issues in our inquiry was the whether its focus on energy efficiency and renewables remained realistic. In the course of our inquiry, therefore, we explored the contribution these could make to ‘plugging the gap’ caused by the decline of older coal and nuclear power stations. We survey below four key approaches which could deliver significant carbon reductions within the electricity generating sector without recourse to nuclear new build; and we assess briefly the progress made by Government in each of these. These areas are:

- Energy efficiency;
- Renewables;
- Clean coal and carbon capture and storage;
- Distributed generation (including micro-CHP etc).

30. This section is primarily about the technical potential of the approaches outlined in the Energy White Paper: issues of cost we discuss later in this report in the context of investment risk and Government policies.

Energy Efficiency

31. Any attempt to forecast future demand for electricity (and, for that matter, gas) relies crucially on assumptions about the rate of energy efficiency improvements in the economy. Organisations involved in promoting energy efficiency have argued, for example, that carbon emissions would now be 28MtC greater each year had energy efficiency improvements not contributed to a reduction in demand over the last 30 years.³⁵ Moreover, in study after study, investments in energy efficiency have always been shown to be far more cost-effective, in terms of reducing carbon emissions, than any form of investment in low-carbon generation. Indeed, far from being a net cost to the economy, they yield positive returns.³⁶

32. However, demand for electricity is still increasing at about 1.5% a year,³⁷ and we note that technological advances have generally resulted in increases in consumption rather

35 Ev83.

36 eg, PIU, *The Energy Review*, February 2002, p108.

37 See above paragraph 10.

than reductions. There are particular risks in the growth of electronic equipment and the increasing use of air conditioning in offices and houses. To take one small example, the introduction of television digital set-top boxes in preparation for the digital switch-over in 2012 will contribute to climate change through a 0.4% increase in UK domestic electricity consumption—particularly when they are left on in standby mode.³⁸ The use of a regulatory approach to limit standby power consumption to 1 Watt would help, but the basic point remains. It has yet to be shown that technological development, of itself, will result in reductions in energy and electricity consumption. Indeed, there is a long-standing economic argument to suggest that, while energy efficiency improvements may lead to energy savings at a micro-economic level, they result in additional demand in the economy as a whole. This is because, by making the effective cost of energy cheaper, they promote the development of additional energy-consuming products or services.³⁹ We welcome the fact that the UK Energy Research Centre is now intending to review this theory.⁴⁰

33. The EAC has also pointed out in previous reports that there are fundamental difficulties in measuring the contribution of energy efficiency because of the way that savings are measured against ‘business-as-usual’ projections.⁴¹ It is not easy, for example, to establish the baseline against which savings are to be assessed; while if business-as-usual (BAU) forecasts prove to be underestimated, the expected carbon savings might not be achieved. We note that the Science and Technology Committee of the House of Lords has also expressed its concern about this issue in a report it published last year on energy efficiency.⁴²

34. Despite these conceptual difficulties, we have no doubt that energy efficiency can contribute very substantially to reductions in both demand and carbon emissions. The provision of energy efficient lighting and the use of Combined Heat and Power on both a domestic and community scale, for example, would reduce energy consumption significantly. Indeed, the White Paper itself envisaged that the rate of energy efficiency improvement would need to be doubled and that, if this were achieved, a reduction of 10MtC could be expected by 2010 and the same amount again by 2020. However, progress in this area has been slow. It took a year for the Government to publish its Energy Efficiency Implementation Plan. The various consultations by the Treasury on fiscal instruments for domestic energy efficiency have yielded little in the way of practical results. The review of the building regulations—seen within the White Paper as a crucial opportunity to impose far more challenging energy efficiency requirements, and brought forward for that very reason—has been watered down, as one of our latest reports, *Sustainable Housing: A Follow-Up Report*, clearly demonstrates.⁴³ Moreover, the energy intensity ratio is not included in the suite of 68 sustainable development indicators, and

38 DTI/DCMS, *Regulatory and Environment Impact Assessment: the timing of digital switchover*, September 2005, paragraph 77.

39 For a good overview of the “Brookes-Khazoom” hypothesis, as it is known, see Chapter 3 of the report by the House of Lords Science and Technology Committee, *Energy Efficiency*, Second report of 2005-06, HL 21-I, July 2005.

40 DTI, *The Energy Review*, January 2006, p31 and footnote 22.

41 See especially EAC, Tenth Report of 2003-04, *Budget 2004 and Energy*, HC 490.

42 See footnote 39 above.

43 EAC, Fifth Report of 2005-06, HC 779.

progress against it is not routinely published. While it is too early to measure reliably any change in the trend, data for 2004 does not show any significant improvement and there is no indication that such a change has taken place since then.

35. There is little evidence as yet that the Government has succeeded in doubling the rate of energy efficiency improvements, as envisaged in the Energy White Paper. Indeed, given the importance the Government attaches to this objective, it is surprising that progress against the energy intensity ratio is not regularly reported and that it is not even included in the newly revised suite of 68 Sustainable Development indicators. The Government must address this glaring anomaly.

36. Radical improvements in energy efficiency will require a changed approach to the provision of energy which relies on delivering energy services rather than the provision of electricity or gas alone. In this context, EAC emphasised in its 1999 report, *Energy Efficiency*, the importance of developing a market for energy services, and we are disappointed that so little progress has been achieved since then.⁴⁴ The pilot study to examine the implications of suspending the 28 day rule has still not been completed, but Ofgem was in any case downbeat in terms of the likely results: “*It has not yet been proven that energy services are an effective way of delivering energy efficiency measures. ... The current Energy Efficiency Commitment administered by Ofgem has shown to be a more productive route for the promotion of energy efficiency.*”⁴⁵ In her evidence, Catherine Mitchell pointed out that the NETA regulations were intended to allow for the creation of Energy Service Companies – yet this provision had not so far been utilised. Ofgem were now trialling the concept of Registered Power Zones as a way forward in this area, but only on a very small scale.⁴⁶ Keith McLean of Scottish and Southern Power and Tony White of Climate Change Capital both pointed to the failure to install smart metering throughout the UK—a missed opportunity to develop a truly responsive demand management system which would reduce peak generating requirements through far more sophisticated tariffs and intelligent appliances.⁴⁷ Indeed, Keith McLean argued that we needed to move towards absolute demand reduction targets as a means of revolutionising our approach to energy saving, and various other organisations or individuals also supported such an approach.⁴⁸

37. It is also not clear how effective are the Government’s key domestic policy instruments for stimulating energy efficiency. With regard to business, EAC has in the past expressed concerns about the Climate Change Levy and its associated negotiated agreements—in particular, the failure to increase the rates of the Levy since its introduction and the size of the savings which the Government claims have been achieved through Climate Change Agreements.⁴⁹ The evaluation conducted by Cambridge Econometrics and published a year ago suggested that the Levy was not having a significant impact on industry. It

44 EAC, Seventh Report of 1998-99, *Energy Efficiency*, HC159.

45 Ev240.

46 Q 41 and Ev 240.

47 QQ 259-263, Q 309.

48 QQ 257, Ev3 and Q 8. See also House of Lords Science and Technology Committee, *Energy Efficiency*, Second report of 2005-06, HL 21-1, July 2005.

49 EAC, Tenth Report of 2003-04, *Budget 2004 and Energy*, HC 490.

concluded that energy efficiency improvements within industry might well have occurred in the absence of the Levy, as a result of technological change and the relative decline of UK energy-intensive sectors; and that, if the Levy had had an effect, it was likely that this was simply due to its announcement rather than to the ongoing impact of Levy rates.⁵⁰ The recent Budget has at least increased the rates, though it remains to be seen whether the scale of the increase will have any significant impact.

38. Similarly, the overall effectiveness of the main policy instrument in the domestic sector—the Energy Efficiency Commitment (EEC)—is also unclear. As with the CCL, an underlying concern is the difficulty of assessing the environmental impact of the EEC—particularly as energy supply companies are assessed in terms of outputs (eg number of loft installations) rather than outcomes (reduction in energy demand). The May 2005 report by the Public Accounts Committee of the House of Commons raised significant doubts on this score, stating that “*It is not clear whether energy efficiency measures achieve the intended outcome. Much of the available scientific research implies that assumed savings are overstated.*”⁵¹ In their evidence to us, WWF suggested that the EEC should be transformed into a mechanism based on absolute reductions in carbon⁵²—an option which in our view would be well worth exploring in the context of setting absolute targets for energy consumption.⁵³ EAC has also pointed out that it will not necessarily be easy to achieve the doubling of the target envisaged for 2005-2008—as this would depend on a massive increase in the deployment mainly of loft and cavity wall insulation.⁵⁴

39. The poor performance of the UK in making progress on energy efficiency contrasts strikingly with the commitment of other EU member states. Denmark has an exemplary history of promoting energy efficiency (as well as renewables) through a succession of energy strategies over the last 40 years, and this is reflected in the extent to which it has exploited the potential of combined heat and power (CHP). The recent initiative taken by the German Government to improve the efficiency of existing properties demonstrates a degree of political commitment and financial support which is entirely lacking here.⁵⁵ Indeed, while the many regulatory barriers in the UK certainly need to be addressed, lack of adequate funding is a significant issue and payback periods are often unrealistically long. Indeed, Dieter Helm ascribed the lack of progress on energy efficiency to the fact that the Government had made the mistake of viewing energy efficiency as a no-cost option, and that they were only now beginning to realise that it might require up-front financial support.⁵⁶ In his evidence to us, the Chief Executive of EDF, Vincent de Rivaz, went further and commented on the Government’s failure to accord a sufficiently high priority to this agenda: “*I am simply saying that we, the power industry, cannot solve all these issues*

50 Cambridge Econometrics, *Modelling the Initial Effects of the Climate Change Levy*, March 2005, page xv .

51 Public Accounts Committee, Thirteenth Report of Session 2004-05, *Ofgem: The Social Action Plan and the Energy Efficiency Commitment*, HC 442, paragraph 26.

52 Q8.

53 See paragraph 36.

54 EAC, Tenth Report of 2003-04, *Budget 2004 and Energy*, HC 490, paragraph 65. Cf PAC report, paragraph 30.

55 Energy in Building and Industry, January 2006: *Investing to save approach shows UK the way forward*.

56 Q 504.

*regarding energy efficiency on our own. Where is the national campaign about energy efficiency in this country?*⁵⁷

40. The Environmental Audit Committee has highlighted on previous occasions the failure by Government departments—in particular, the Treasury—to take decisive action on energy efficiency. What is abundantly clear is that it will require a coordinated package of regulatory and fiscal policy instruments which offers much more in the way of both carrots and sticks, and that this must be accompanied by high-profile campaigns to raise awareness among the public. Far greater political leadership is required and far higher priority accorded to energy efficiency if the Government is to achieve the carbon reductions set out in the Energy White Paper. As part of such a strategy, we would also urge the Government to consider setting absolute targets for reductions in demand as a way of stimulating the growth of energy services and guaranteeing the level of carbon savings achieved.

Renewable energy

41. The other key plank of the Government's energy policy—in respect of electricity generation—was to promote a radical increase in the deployment of renewable energy. The Government's main policy instrument for doing so is the Renewable Obligation (RO), a requirement on electricity suppliers to source an increasing percentage of electricity from renewable sources. The RO is supplemented by various capital grants, some of which are available for specific technologies while others are on a 'technology blind' basis. The adequacy of capital grant funding—an issue of significant concern in the context of emerging technologies which are not yet cost-competitive—is an issue which we discuss later in this report.⁵⁸

42. In the case of renewables, various targets exist and are almost all expressed as a percentage of total electricity generated or sold:

- In 1999, the Government set out a target of 5% by 2003 and 10% by 2010—though the latter has now been largely superseded by the targets contained in the RO.
- The RO targets rise steadily each year from 3% in 2002-03 to 10.4% by 2010-11. When the RO was initially launched, no further increase in the target was specified (ie the target remained at that level until the termination of the RO in 2027). However, further increases in the RO to 15.4% by 2015-16 were subsequently approved in address a lack of investor confidence which was threatening the value of Renewable Obligation Certificates.
- The Energy White Paper endorsed the 10% target for 2010, and included an aspiration to double it by 2020—though it fell short of setting this as a firm target.

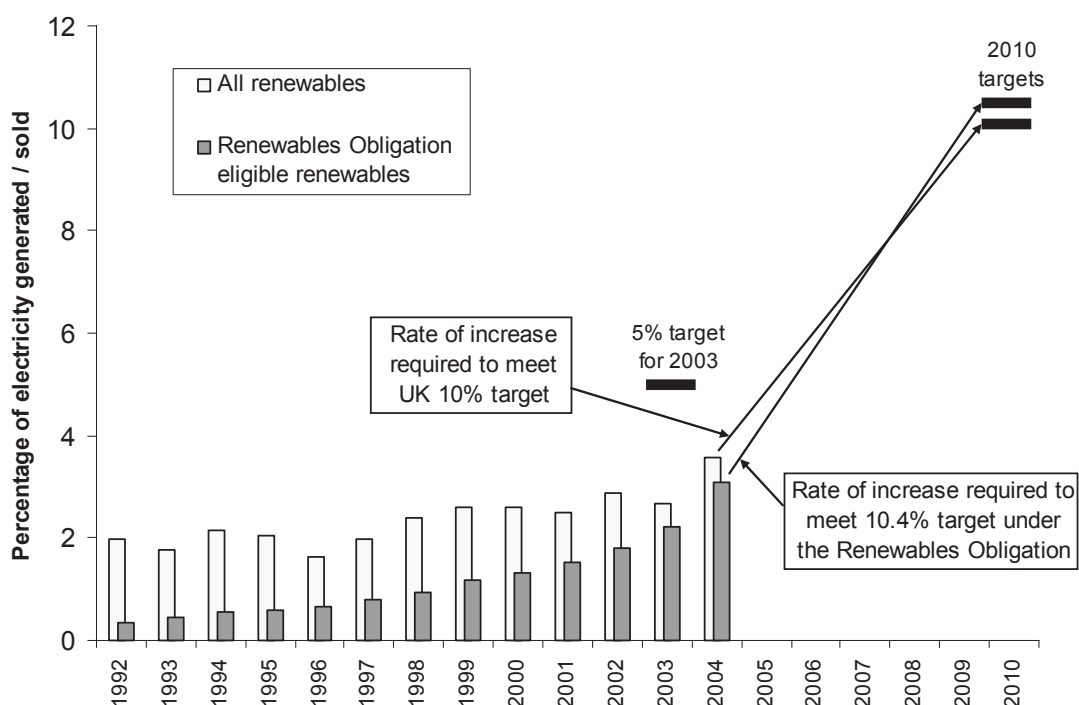
57 Q 250.

58 See especially paragraphs 139-140.

- The EU Renewables Directive sets an overall indicative target of 22.1% by 2010 (12% of overall energy consumption). Under the EU burden-sharing agreement, the UK target is 10%.

43. The EAC has regularly monitored progress against meeting the RO target. The latest available data shows that renewables constituted only 3.1% of electricity supply (on an RO basis) in 2004—up from 2.2% in 2003. However, these percentages are below the RO targets for each year, and the UK is likely to fall well short of the 2010 target. The following graph indicates the overall position.

UK progress against renewables targets



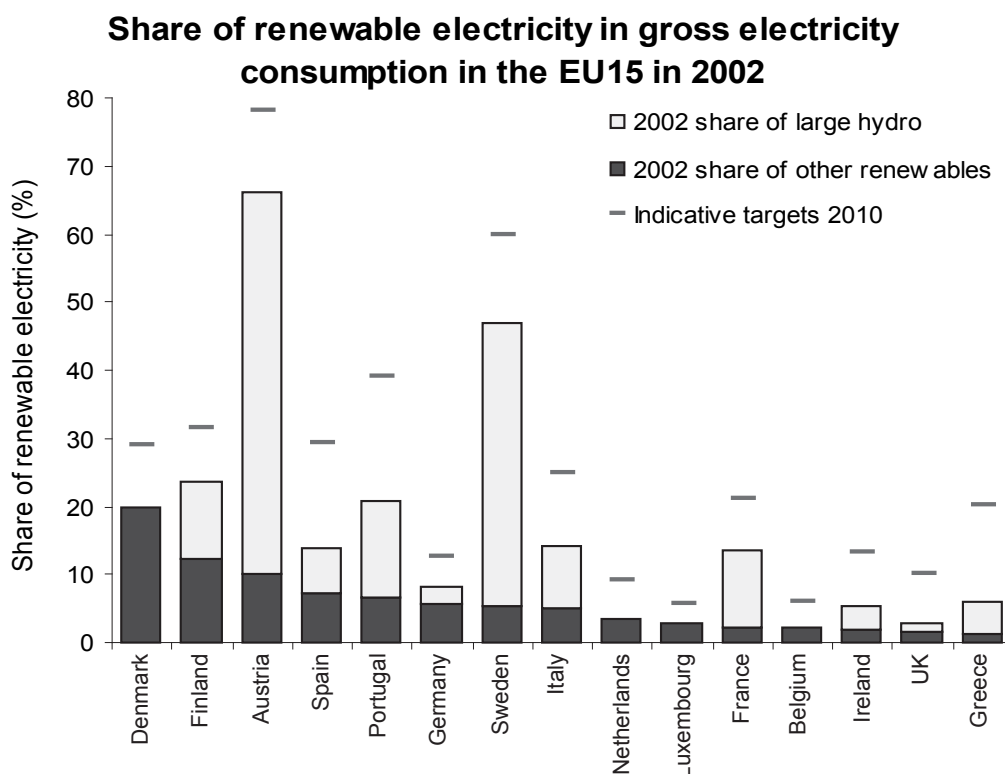
Source: EAC based on DTI Dukes 2005

Moreover, in terms of total renewable electricity supplied in 2004, 84% was generated from biofuels—mainly landfill gas. Of the remainder, hydro contributed over 10% and wind only 4.4%. Indeed, it is striking how wind power – often seen as the main medium term source of renewable energy—contributed only 1,935 GWh—less than 0.5% of the total electricity generated in the UK.⁵⁹

44. Comparisons with other EU member states clearly demonstrate the UK's relatively poor performance in promoting renewable energy in spite of its rich natural resource. In terms of EU-15 rankings and excluding large hydro, the UK is second from the bottom with only Greece below it. Indeed, some of these countries have set more challenging targets than the UK and would appear to be pursuing them far more dynamically.

⁵⁹ Note that these figures are not on an RO basis. Of RO-eligible generation, 63% was from biofuels, 19% from wind, and 17% from small and medium hydro. (Large-scale hydro is excluded from the RO.) See Dukes 2005, Chapter 7.

Denmark, which we visited in the course of our inquiry, already generates nearly 20% of its electricity production from renewables, and is the European leader in co-generation with over 50% of gross electricity production met from CHP.⁶⁰ By the end of 2004, Germany had installed 17 GW of wind power—even though it is significantly less well-placed to exploit this resource than the UK—and it is also investing heavily in photo-voltaic generation.⁶¹ Spain has recently set a target for renewables to supply 12% of total energy needs and 30% of electricity consumption by 2010 (in line with its indicative target under the EU Renewables Directive). Indeed, in terms of wind energy, it has performed so well that it has twice raised its original target for 2010 from 9GW to 13GW and subsequently to 20GW—which would see wind energy alone supplying 15 percent of national electricity consumption.⁶² Sweden has gone even further by announcing that it aims to eliminate the use of fossil fuels by 2020. It is also worth noting at this point the economic opportunities for those countries which establish leadership positions in such technologies. In Germany, for example, the wind industry employs some 120,000 people, while in Denmark it is one of the biggest sectors in terms of export earnings.



Source: European Environment Agency

60 European Environment Agency, *The European Environment – State and Outlook 2005*.

61 *Ibid.*

62 *Renewable Energy Plan for 2005-2010*, 26 August 2005.

45. However, the evidence presented to us demonstrated that the potential for renewable energy in the UK was huge. The British Wind Energy Association (BWEA) pointed out that the deployment of wind was increasing at record rates. They argued that it could generate as much as 7% of electricity demand by 2010; and that by 2020 this might increase to 20%.⁶³ Indeed, the PIU report and the Energy White Paper both emphasised the medium and longer-term potential of renewable energy, and various studies have shown that the extent of both wind and marine energy available to the UK is very large indeed. The Garrad Hassan report, for example, conducted in 2001 for the Scottish Executive, concluded that 45 TWh a year (more than 10% of total UK generating capacity) from on-shore wind could be available by 2010; and that a further 80 TWh of off-shore wind, 50 TWh of wave energy, and 33 TWh of tidal energy could also be available by then—all at a cost of less than 7p per kWh.⁶⁴ The total renewable energy resource calculated in this study would supply over half the UK demand for electricity. Moreover, a subsequent study conducted in 2004 using more conservative assumptions nevertheless found that the practical potential of offshore wind and wave amounted to 100 TWh and 50TWh respectively.⁶⁵

46. Despite the optimism of BWEA, slow progress is being made in exploiting this potential and we regard it as virtually certain that the UK will fail to meet the 2010 Renewable Obligation target—a view shared by the NAO.⁶⁶ This is largely because of the slow progress in developing off-shore wind capacity—on which so much depends for meeting the target. Indeed, there is a real danger that progress may stall completely due to a number of factors:

- the extent of public opposition to on-shore wind farms mainly due to the visual impact they have on the landscape;
- an escalation in the cost of offshore wind projects due to greater experience of the challenges being faced.⁶⁷
- other barriers of a financial or regulatory nature.

47. Indeed, the scale of the development required for wind to contribute up to 20% of UK electricity by 2020 is immense. Assuming the use of 5MW units and a load factor of 30%, it would require 6,000 turbines (30GW in terms of rated capacity)—and more if smaller 3MW units were used.⁶⁸ The physical challenge of installing so many units is huge—though not insuperable as the deployment rates achieved by Germany and Spain

63 QQ 146-156.

64 Ev139

65 Gross, *Technologies and Innovations for System Change in the UK*, Energy Policy 32 (2004) pp1905-1917.

66 NAO, *Renewable Energy*, HC 210 of Session 2004-05.

67 QQ 269-273.

68 A 5MW turbine operating at a load factor of 30% might be expected to produce just over 13 GWh of electricity a year. About 80,000 GWh would be required if wind were to contribute 20% of total UK generating capacity.

demonstrate. Moreover, while on-shore wind farms are economically attractive, the extent of opposition which developers are now facing may limit the scale of generation achievable, unless the Government takes more radical steps to tackle the planning process.⁶⁹ The scope for generating substantial amounts of power is far greater offshore, but progress on the 18 Round 1 projects allocated in 2001 is distressingly slow. These should all have been completed by now, but only 4 are operational, 3 have not even received planning approval yet, and one has been abandoned. The situation with the 15 larger Round 2 projects allocated in 2003—on which so much depends for getting anywhere near the 2010 target and the 2020 ‘aspiration’—is of even greater concern: only 4 have even got as far as making planning applications to the DTI.⁷⁰ Indeed, in its evidence even the BWEA acknowledged that further progress would require some form of additional long-term financial support from Government, and this was corroborated by Keith McLean of Scottish and Southern Power who confirmed that early estimates of the costs of offshore wind were perhaps somewhat optimistic.⁷¹

48. There are also other kinds of barriers which developers are facing. We noted during our visit to Denmark, for example, that a single agency is responsible for all aspects of an application to build an offshore wind farm. This contrasts markedly with the situation in the UK, where a long-standing commitment to develop a ‘one-stop shop’ has never been realised. We also discussed with Danish wind farm developers the issue of the £100 million Final Sums Liability payable to the National Grid in relation to phase 1 of the Thames Array wind farm. The developers were understandably reluctant to commit themselves to this connection charge guarantee until they had been granted planning permission, but if they missed the current application window consideration of the project by the National Grid could slip – thus delaying the entire project substantially.

49. The UK lags well behind almost all other EU-15 countries in terms of the percentage of electricity generated from renewables, and it is now certain—as indeed the EAC has been forecasting for several years—that the Government will fall far short of the 10% renewables target set for 2010. However, the evidence presented to us indicated that renewables can deliver 20% of electricity generated by 2020. In this sense, the vision set out in the Energy White Paper is still achievable, though it will require a far greater degree of commitment in terms of implementation than has hitherto been demonstrated.

Clean coal and Carbon Capture and Sequestration

50. Gas and coal will undoubtedly play a dominant role in electricity generating mix for decades to come. The international aspects of this we discuss later in this report. In terms of the UK domestic market, coal has enjoyed a somewhat unexpected resurgence since 2000—largely because of the increase in the price of gas. It is interesting to contrast the projections offered in EP68 (the DTI Energy Projections paper dating from 2000) with

69 As we were drafting our report, for example, the rejection of the planning application for the proposed Whinash wind farm made newspaper headlines.

70 The Ends Report, *Rising costs hit marine power ambitions*, February 2006.

71 QQ 269-273.

both the outturn and with DTI's most recent forecasts. EP68 forecast that emissions from the power generating sector would steadily decline, largely due to the phase-out of coal which by 2015 might provide only 10% of the market.⁷² In reality, as the EAC pointed out in 2002, EP68's projections proved incorrect: carbon emissions from the generating sector rose steadily from 2000 mainly because of the increased use of coal as a result of higher gas prices. The most recent DTI forecasts now indicate that coal will still constitute 25% to 30% of the total mix in 2015.⁷³

51. Conventional coal-powered generators are inefficient, and per unit of electricity generate far more carbon emissions than CCGT plant. However, a number of submissions we received pointed out that new technologies could increase the efficiency of coal generation substantially. Drax Power, for example, submitted an interesting memorandum which argued that **the retro-fitting of super-critical boilers could enable coal plants to improve their efficiency and contribute substantially to carbon reductions.**⁷⁴

52. **More significantly, the development of carbon capture and storage (CCS) could reduce carbon emissions from coal-fired plant by 80%. Indeed, the Energy White Paper singled this technology out as being of such importance as to warrant an urgent 6 month research project to take it forward.**⁷⁵ The reason for such urgency was the fact that there was only a limited window of opportunity for using depleted North Sea oil fields as a means of sequestering the carbon dioxide. Once they were closed, it would not be worthwhile to reopen them to sequester the carbon; whereas, while they were still in use, CCS could actually assist in recovering more oil from each field than would otherwise have been economically profitable.

53. The White Paper went on to state:

*We will therefore set up an urgent detailed implementation plan with the developers, generators and the oil companies to establish what needs to be done to get a demonstration project off the ground. This study will reach conclusions within six months to enable firm decisions to be taken on applications for funding from international sources as soon as possible thereafter.*⁷⁶

It is now three years after this statement was published. The DTI has issued a number of relevant documents over this period, including a review of the feasibility of carbon capture and storage,⁷⁷ a paper on implementing a demonstration project,⁷⁸ and a carbon abatement strategy.⁷⁹ Moreover, the latest Pre-Budget Report announced a consultation on carbon capture and storage. As EAC has noted before in relation to Sustainable Development, the

72 Based on EP68's CL scenario (table 5.1, page 41). See also EP68 Annex B, which shows that emissions from coal were expected to fall steadily by 10MtC (LH scenario) or 20MtC (LL scenario).

73 DTI, *Updated Energy Projections*, February 2006, tables 27 and 28.

74 Ev400 ff.

75 DTI, *Energy White Paper*, February 2003, paragraph 6.63.

76 *ibid.*

77 DTI, *Review of the Feasibility of Carbon Dioxide Capture and Storage in the UK*, September 2003.

78 DTI, *Implementing a Demonstration of Enhanced Oil Recovery Using CO₂ in the North Sea*, May 2004.

79 DTI, *A Strategy for Developing Carbon Abatement Technologies for Fossil Fuel Use*, June 2005.

plethora of reports creates an impression of activity whilst progress in ‘learning by doing’ appears minimal. **It is scandalous that so little progress in developing clean coal and carbon capture and storage has been made, and even the flagship BP-led DF1 project at Peterhead remains dependent on the establishment of a long-term financial framework which would provide greater confidence to investors.**⁸⁰

54. The Science and Technology Committee of the House of Commons has recently published a detailed report on carbon capture and storage, and we entirely support their overall conclusion that CCS must play a decisive role in reducing emissions both domestically and internationally. Indeed, as we discuss below (paragraphs 155 ff), western efforts to reduce carbon emissions will be entirely negated by the increasing use of fossil fuels in developing states such as India and China. As in the case of renewable technologies, significant economic benefits are likely to accrue to those countries which develop CCS, and it would therefore be grossly negligent on the part of the Government if the UK failed to exploit the historic opportunity afforded by both the availability of the North Sea oil reserves and the need to invest heavily in new generating plant.

Distributed generation and micro-CHP

55. The electricity generating network in the UK is based on a relatively small number of large generating plants situated in remote locations and linked together through the National Grid in order to supply electricity to regional distribution networks and thus to population centres. The flow of electricity is one-way only, from the large generating plants, through the grid, down through distribution networks and to households and businesses.

56. Distributed generation, by contrast, refers to the provision of small-scale generation on a local basis at the point of demand. Flows of electricity can be in both directions depending on the extent of local demand. Any excess electricity generated locally can be flow upwards and be shared with neighbouring local networks, thus creating a web of provision quite distinct to the centralised model. While ‘intelligent’ metering is required, recent research suggests that electricity networks are quite capable of dealing with significant levels of micro-generation. Distributed generation encompasses a variety of technologies including micro-wind, micro-CHP, small-scale biomass generation, and photo-voltaics.

57. Distributed generation offers potentially huge improvements in energy efficiency—particularly in the case of combined heat and power. Electricity losses on the UK grid system are in the order of 10%, while the efficiency of coal power stations can be as low as 35%. The overall efficiency achieved can therefore fall to 30%, and even in the case of the most modern CCGT plant it is only around 45%. There is also very little scope to exploit CHP because most large generating plant is located well away from population centres and because of the cost of fitting it to existing plant. By contrast, electricity losses in distributed systems are far lower, while the scope for using CHP is far greater. If both the electricity and heat load can be utilised, efficiencies of more than 90% can be achieved.

80 Ev118 and QQ 280-284.

58. While all forms of distributed generation offer considerable potential, there has been particular interest in micro-CHP and this was reflected in some of the evidence we received. The Microgeneration Council, for example, pointed out that if half the domestic central heating boilers in the UK were replaced by micro-CHP units, by 2020 the total generating capacity would amount to 13GW—somewhat more than the current capacity of nuclear.⁸¹ Even if micro-CHP units were fitted in only a quarter of the 1.3 to 1.5 million central heating boilers replaced each year, the capacity would still amount to over 6GW.⁸² Micro-CHP would also deliver this capacity in winter evenings at times of peak generating demand. While it would not contribute much during the summer when there is little demand for space heating, micro-generation technologies such as photo-voltaics could balance it and provide an excellent complementary ‘fit’. A range of other organisations—including the Energy Saving Trust, Lower Carbon Futures, and the Sussex Research Group—were also very positive about the potential role which micro-CHP could play, though there was some agreement that it would take at least until 2020 before this technology could begin to achieve widespread take-up.⁸³

59. Given the potential importance of micro-CHP, it is surprising that support within Government appears somewhat lethargic. The technology is reasonably well developed and only needs to be scaled up to industrial production in order to reduce unit costs. The main barriers, therefore, to a more rapid uptake appear to be the investment needed for this to happen, and the physical and regulatory issues surrounding their installation. The Energy Act 2004 provided a statutory obligation on the government to produce a microgeneration strategy, and in June 2005 the DTI released a consultation document to pave the way for publishing such a strategy during 2006. This hardly seems to us to reflect any sense of urgency, while the consultation document itself is disappointingly vague.

60. Distributed generation, in conjunction with renewable technologies, is now being developed in remote parts of the world where the cost of providing electricity through installing a grid infrastructure is prohibitive. Moreover, in some developed countries such as Denmark, there has historically been greater emphasis on local power generation through, for example, community CHP schemes. Germany and Japan have also forged ahead with the deployment of photo-voltaic (PV) cells, and indeed Germany had installed nearly 100 times more PV generating capacity than the UK by the end of 2004.⁸⁴ Several organisations pointed out that a ‘small is beautiful’ approach produces additional benefits as it brings home to consumers the costs associated with energy consumption and the need to manage and reduce it. Indeed, distributed generation requires a different mind-set, and we are aware that little progress might be made here if the Government, large energy companies, and the public alike remain fixated on the concept of large-scale solutions to our energy needs.

81 Ev84 and Q 207.

82 Ev86.

83 Ev20ff, 25ff, 52ff, 82ff, 84ff.

84 794 MW as compared to 8MW. See http://europa.eu.int/comm/energy/res/sectors/photovoltaic_en.htm.

61. We are particularly concerned in this respect with the role of Ofgem. The Sussex Research Group told us that Ofgem had done very little to encourage micro-CHP and had, if anything, gone out of their way to make it more complicated.⁸⁵ Similarly, householders who wish to install photo-voltaic panels are likely to run into an array of bureaucratic problems. It is particularly disappointing that so little progress has been made in eradicating such barriers even though various Ofgem-led working groups have been addressing such issues for at least four years. In their supplementary memorandum, Ofgem also made it clear that the Registered Power Zones initiative was aimed more at enhancing the capacity and the efficiency of the network and would not directly impact on the energy efficiency services being offered by suppliers.⁸⁶ Moreover, Ofgem's remit is primarily focussed on protecting the interests of consumers by maintaining low energy prices.⁸⁷ Although it is now obliged to have regard to sustainable development, this is a secondary duty which is in any case susceptible to a variety of interpretations.⁸⁸

62. Distributed generation could fundamentally alter the structure of electricity networks in the UK. Micro-CHP, in particular, could deliver at peak winter periods as much as the current fleet of nuclear power stations, and could be a key technology for addressing both energy efficiency and fuel poverty. We see no reason why it should not begin to contribute substantially by 2020 and would urge the DTI and Ofgem to take a more proactive approach in developing the microgeneration strategy.

Conclusion

63. With the possibilities afforded by energy efficiency, renewables, distributed generation, and carbon capture and storage, it is abundantly clear that new nuclear build is not the only option for lower-carbon electricity generation within the UK. Indeed, the Government is spoilt for choice. It is all the more disappointing, therefore, that so little has been achieved since the Energy White Paper in developing these alternatives. The failure to do so will exacerbate the potential generating gap and will result in an even greater reliance on gas over the next ten years than would otherwise have been the case.

The nuclear option

64. Various organisations argued in their submissions that a new generation of nuclear power stations was needed both to keep the lights on and to reduce carbon emissions. Indeed, it is largely because concerns on both these scores have recently increased that the issue of nuclear power is once again being vigorously debated—after having been consigned to the margins at the time of the Energy White Paper. In this part of the report,

85 Q 138.

86 Ev240, paragraph 41

87 See, for example, the PAC report on Ofgem (Public Accounts Committee, Thirteenth Report of Session 2004-05, *Ofgem: The Social Action Plan and the Energy Efficiency Commitment*, HC 442).

88 Note EAC's previous comments on the Government's rejection of the Brundtland definition of Sustainable Development, and the favouring of a more economic interpretation instead. See EAC's Thirteenth Report of 2003-04, *The Sustainable Development Strategy: Illusion or Reality?*, HC624, paragraph 16.

we examine various issues relating to the nuclear option—including issues of timing and sustainability—and in doing so we touch upon some financial aspects. However, we discuss the cost of nuclear power later in the report in the context of financial markets and investment risk.

Learning from the past?

65. The history of civil nuclear power in the UK over the last 50 years has been characterised by extensive government subsidies, time and cost overruns, and poor operational performance. While the first generation Magnox power stations built during the 1960s proved somewhat less problematic, the second generation Advanced Gas Cooled Reactors (AGRs) built from the 1960s to the 1980s were beset with difficulties. In the worst case, that of Dungeness B, it took 24 years from the start of construction to commercial operation, and the plant has only operated on average at 37% of its planned generating capacity since then. In operational terms, almost all UK nuclear reactors perform badly in international comparisons.⁸⁹ This is reflected in an overall average load factor for all nuclear plants of 71% in 2004.⁹⁰

66. The poor performance of UK reactors may partly be explained by the fact that, in building the Magnox and AGR plants, the UK was pursuing a unique technological approach. However, even in the case of Sizewell B—the UK's only pressurised water reactor (PWR) which was built in the 1980s to an American design—the construction costs escalated from [£1.8] billion to over £3 billion, while generating costs have been estimated at over 6p per kWh—about twice the current cost of electricity from gas or coal.⁹¹

67. Some of the submissions we received argued that there had been a good track record of delivering nuclear power stations to time and cost in Asia (Japan, China, and South Korea), and that this could be replicated in the UK.⁹² Apart from the difficulty of verifying these claims,⁹³ there are a number of other factors which make such a comparison less relevant. These countries do not operate the kind of liberalised market which exists in the UK, nor are the designs being built those which would be likely to be on offer in the West.⁹⁴ Indeed, many of the nuclear power plants being built elsewhere in the world are also subject to substantial overruns, and some may never be completed.⁹⁵ In their evidence to us, EDF pointed to the successful deployment of nuclear on a large scale in France, and we certainly agree that this does show what can be achieved. But EDF remains a state owned company, and there are significant questions about the amount of government subsidies provided to

89 Thomas, *The Economics of Nuclear Power: Analysis of Recent Studies*, July 2005. The paper can be found at: www.psir.com.

90 Ev271, paragraph 43 and following table.

91 PIU Energy Review Working Paper, "*The Economics of Nuclear Power*", February 2002. See also National Audit Office, *The sale of British Energy*, HC 694, 1997-98.

92 eg Ev162.

93 For example, Steve Thomas suggests that the planning stage in Japan can take up to 20 years.

94 QQ110-111.

95 Thomas, *The Economics of Nuclear Power*, PSIRU, 2005.

the nuclear industry over the last 40 years. Also, issues relating to waste disposal and decommissioning still have to be resolved.

68. The key issue at stake here is to what extent one can expect a new generation of nuclear power stations to be relatively trouble-free in terms of both construction and initial operation. Some of the memoranda we received were optimistic to the point of complacency in this respect. British Energy, for example, stated that a new programme “will not use a prototype technology—the ‘winning’ technologies have emerged (ie the AP 1000, EPR, and Candu designs).”⁹⁶ However, as many have pointed out, no western country has yet built a Generation III power station; and, while they are developed from existing designs, it is by no means certain that technological difficulties will not be encountered. For example the N1 Framatome design (on which the EPR is itself based) was supposed to incorporate lessons learned from the extensive French nuclear programme, but significant problems were experienced for the first four years of operation with load factors averaging only 40%.⁹⁷

69. The joint memorandum submitted by DEFRA and the DTI recognised this issue in relation to the costs of nuclear power. “There is very little evidence on the robustness of cost estimates for new nuclear build as there is currently only one plant being built in Europe. [...] Past experience of cost overruns in non-liberalised electricity markets, however provides no guide to the prospects for new nuclear build in a liberalised market.”⁹⁸ Cost overruns are intimately connected with construction and operational delays, and it is therefore interesting to note that the EPR now being constructed in Finland—the first Generation III reactor to be built anywhere in the world—is already running over six months late, even though construction only began in mid-2005.⁹⁹ The suppliers are confident that they can make up for this delay, but it remains to be seen whether the reactor will in fact become operational in 2009.

70. The past history of the nuclear industry gives little confidence about the timescales and costs of new build. This does not mean that a new generation of nuclear power stations cannot be built to time and cost, but it does mean that investors have little basis for assessing the risks involved and may therefore require a higher rate of return.

Could nuclear be built in time?

71. A key argument put forward by the nuclear industry is that a new generation of nuclear power stations is vital in order to address the potential shortfall in generating capacity resulting from the decommissioning of old coal and nuclear plant. As we have set out above, some 20GW of new electricity generating capacity will be required by the end of 2015, and possibly as much again required by 2025.

96 Ev185.

97 Thomas, *The Economics of Nuclear Power*, PSIRU, 2005.

98 Ev269, paragraph 27.

99 TVO press notice dated 25 January 2006, at <http://www.tvo.fi/757.htm> The delays “are due to delays in detailed engineering and to the need to correct deviations in the manufacture of components.”

72. All the evidence the Committee received indicated that a new series of nuclear power stations could not be built in time to address the need for new capacity by 2016 or even earlier. Those arguing against nuclear power tended to provide more pessimistic assessments such as the timescale for nuclear new build which Tom Burke set out in his evidence to us:

- Government decision in 2008;
- 2 years to draw up detailed design specification (to 2010);
- 2 years for the Nuclear Installations Inspectorate to approve the design (2012);
- 3 years for a public inquiry resulting in construction start in 2015;
- 5 years construction (to 2020);
- 1 year operational testing (to 2021);
- commencement of commercial generating (2021).¹⁰⁰

The Secretary of State himself confirmed that it might currently take from 15 to 17 years before a new nuclear power station could become operational, though his official was quick to point out that this was “*just the kind of issue which the [Energy] review needs to look at.*”¹⁰¹

73. A large part of the time required to build new plant relates to the design and planning stages, including the need to obtain the relevant consents. In the case of Sizewell B, for example, it took 7 years from the decision in principle to the start of construction, with the construction phase itself lasting a further 7 years. Attention has therefore focussed on reducing this timescale by streamlining the planning and consents process, and both BNFL and British Energy suggested in their memoranda that the Government needed to provide greater clarity here. After referring to the past problems of the UK civil nuclear programme, BNFL go on to state:

Today’s deregulated market would bring a very different framework for building new power plants. In addition, the regulatory and approvals processes in place in the past, which allowed delays and re-design to become the norm, would act as a major deterrent to private sector investors. An improved delivery process would be required in future for a nuclear project to become a reality. This is achievable without legislative change but Government leadership is required to provide the necessary resolve. Such a process would retain the rigorous scrutiny and opportunity for democratic participation and challenge, but would have scope and timeframe clearly defined to bring predictability to the overall process. This means that key approvals need to be

100 Ev40.

101 QQ 668-669.

*granted before construction with a well-defined scope and timetable for further approvals during construction and commissioning.*¹⁰²

74. It is not entirely clear what changes BNFL are asking for here, though they go on to suggest that the approvals process should be geared towards the fact that any future UK plant would be an internationally recognised standard design (eg the EPR and AP1000).¹⁰³ Yet, as Professor MacKerron pointed out, every country continues to feel the need to have its own safety regulatory system for nuclear power,¹⁰⁴ and—in the absence of far stronger international frameworks and standards—any move towards a reliance on approvals granted by another country would represent a momentous and unacceptable step. Nor would it be acceptable if there were to be any weakening of the regulatory consents process itself: in the case of nuclear safety issues are of overarching importance, and the past history of the industry in the UK provides various examples of both managerial and engineering failures.

75. One possible approach to shortening the consents process would be to ask the relevant authorities to ‘pre-license’ reactors before sites are selected. The Secretary of State told us that “*As I understand it, you could get moving with pre-licensing pretty quickly and save about three years on the timescale if you were going down this route.*”¹⁰⁵ But the DTI were unable to tell us whether this would require legislative changes, and it pointed out that there was no clear definition of what pre-licensing meant.¹⁰⁶

76. The Government has now commissioned from the Health and Safety Executive an expert review setting out the potential health and safety risks arising from recent and potential energy developments and on the HSE’s approach to ensure that risks arising from these are sensibly managed by industry. While the ostensible purpose of the review may be to examine safety issues arising from increased gas storage, CCS technology, and increased renewables, the terms of reference specifically include “*consideration of a new generation of nuclear power stations and in the event of nuclear build, the potential role of pre-licensing assessments of candidate designs.*” Indeed, in the letter commissioning the review, the Minister of State for Energy specifically wrote:

*On nuclear, we would like an assessment from HSE of how they might go about the appraisal of reactor designs in advance of specific proposals for new build. This will be useful for the Review making a recommendation in taking the decision on whether there is a potential role for a new generation of nuclear power stations to help us meet our medium and long-term energy goals.*¹⁰⁷

102 Ev162.

103 *Ibid.*

104 Q110.

105 Q668.

106 Ev312.

107 Letter from Malcolm Wicks to Geoffrey Podger, 10 January 2006, at <http://www.hse.gov.uk/consult/condocs/energyletter.htm>

77. BNFL also suggest that the timescale from decision in principle to the start of construction should be reduced significantly below 5 years.¹⁰⁸ But even 5 years seems ambitious, particularly when BNFL point out in the previous paragraph that many other proposals for CCGT or wind power have taken longer than this. Given the extent of public concern about nuclear, a pre-construction period of 7 years (as set out by Tom Burke) therefore seems more likely. As overt Government support, either through some form of statement or through a revised policy framework, is unlikely before 2007, it is difficult to see how even the first of a new series of power stations could become operational before 2019 at the very earliest. Various witnesses and organisations corroborated this timescale.¹⁰⁹

78. The Government has committed itself to publishing a White Paper prior to any decision to promote new nuclear build. Even after any “signal” is given, a consortium would need to be formed, tendering undertaken, detailed design specifications drawn up, and various permissions obtained. It is difficult to see how the planning and consents process could be reduced below 5 years without a fundamental reform of regulatory and statutory procedures which might compromise both safety and public accountability. It is worth observing in this connection as an aside that planning procedures affect more than just nuclear, and that other technologies such as wind may also be disadvantaged. Indeed, several years ago the Government proposed a new approach for major infrastructure projects of national significance, but abandoned it in the face of widespread opposition. If the Government wishes to reform the planning system, it must ensure that it does so on a comprehensive and even-handed basis.

79. A further timing issue in relation to nuclear relates to the fact that a programme of eight or ten plants could not all be built at once. An important reason for building a series of reactors is to reduce the overall costs through scale economies and design improvements. The first plant in the series would be more expensive and the planning process significantly longer—as fundamental issues of safety would necessarily have to be addressed in a planning inquiry in a manner which would not apply to subsequent plants of the same design. In their proposals put forward in 2002 the nuclear industry suggested that a gap of 18 months between successive plants could be achieved. Yet this would mean that, for a series of 10 AP1000 reactors, it would take nearly 14 years before the last became operational. Not only would such a time-lag reduce the extent to which nuclear could contribute to the new investment required over the crucial period from 2020 to 2025, but it could also mean that the plants might become technologically outdated by the time the series is completed. Indeed, by 2030 it is likely that a far wider range of renewable technologies will have become more cost-competitive, and that there may be alternative and highly competitive forms of nuclear power available such as the pebble-bed modular reactor.

80. Nuclear can do nothing to fill the need for 20GW of new generating capacity which will arise by 2016, as it simply could not be built in time. The Secretary of State himself

¹⁰⁸ Ev159.

¹⁰⁹ eg Q136.

acknowledged that it might take 17 years before the first of a fleet of new nuclear power stations could become operational. Even if planning, licensing, and construction stages could be reduced to 10 years in total, the earliest possible date for the first of a series would be 2017—still too late to plug the immediate gap. For the period beyond 2017 nuclear could begin to make a contribution—though, given the fact that successive nuclear plants might only come on stream at perhaps 18 month intervals, it might not be until around 2030 that the full generating capacity of a nuclear programme would be available.

Uranium supplies

81. An important issue in respect of nuclear power is the availability of uranium supplies. While it is true that uranium is plentiful—it is found, for example, in extremely weak concentrations even in seawater—energy is required to extract and refine it. The ratio between the energy required for this purpose and the useful energy produced from the uranium is critical, and the availability of high quality uranium ores is therefore of crucial importance in assessing the longer term potential of nuclear power.

82. We received a variety of evidence on this score. BNFL suggested that some 11 million tonnes of uranium was economically recoverable and that this was sufficient to last for around 170 years at current consumption rates. They went on to claim that “*Looking at it another way, this would be enough to provide a lifetime’s fuel for all of today’s nuclear reactors worldwide, plus all those which might be built as far ahead as 2050, even in a scenario where world nuclear capacity were to triple to 1200 GW by that date.*”¹¹⁰ By contrast, other organisations expressed concerns about the uranium resources pointing out that current supplies might only be enough to last 50 years. Indeed, the Oxford Research Group (ORG) provided an interesting supplementary memorandum in which they analysed the BNFL claim of 170 years availability and argued that it misrepresented statements made by the OECD NEA and the International Atomic Energy Authority (IAEA).¹¹¹

83. BNFL’s claim seems also to be at odds with the 2004 OECD/IAEA “red book” on uranium resources, as the following passages show:

At the end of 2002, a total of 441 commercial nuclear reactors were operating with a net generating capacity of about 364 GWe requiring about 66,815 tU. By the year 2020, world nuclear capacity is projected to grow to between about 418 GWe net in the low demand case and 483 GWe net in the high demand case. Accordingly, world reactor-related uranium requirements are projected to rise to between about 73,495 tU and 86,070 tU by 2020.

At the end of 2002, world uranium production (36,042 tU) provided about 54% of world requirements (66,815 tU), with the remainder being met by secondary sources

110 Ev70.

111 Ev151ff.

including civilian and military stockpiles, uranium reprocessing and re-enrichment of depleted uranium.

As currently projected, uranium production capabilities including existing, committed, planned and prospective production centres supported by Known Conventional Resources (RAR and EAR-I) recoverable at a cost of <USD 80/kgU cannot satisfy future world uranium requirements in either the low or high demand cases. Thus, secondary sources, ie excess commercial inventories, the expected delivery of Low Enriched Uranium (LEU) derived from Highly Enriched Uranium (HEU) warheads, re-enrichment of tails and spent fuel reprocessing, are necessary to ensure adequate supplies in the near-term.

However, secondary sources are expected to decline in importance, particularly after 2020, and reactor requirements will have to be increasingly met by the expansion of existing production capacity, together with the development of additional production centres or the introduction of alternate fuel cycles. However, significant and sustained near-term increases in uranium market prices will be needed to stimulate the timely development of resources. Because of the long lead-times necessary to discover new resources and bring them into production (typically in the order of 10 to 20 years or more), there exists the potential for the development of uranium supply shortfalls and significant upward pressure on uranium prices as secondary sources are exhausted.¹¹²

84. Put bluntly, uranium mines only supply just over half the current demand for uranium, and the situation is likely to become more acute as current secondary sources decline in importance. Indeed, the nuclear industry itself expressed considerable concerns about this issue at the World Nuclear Association's (WNA) annual conference in London in September 2005. A presentation of the findings contained in the latest WNA Market Report highlighted the fact that uranium supplies were expected to increase until about 2014, but would reduce slightly thereafter and then remain level until 2030. Moreover, while fuel availability will be sufficient to satisfy demand in the 'low-demand' scenario (a declining percentage of nuclear power globally), it would not be sufficient to satisfy demand in the 'reference' scenario (limited growth of nuclear), and would be far short in the 'high demand' scenario (significant global growth of nuclear). The presentation concluded:

...fuel supply is potentially short beyond 2015, unless the lower demand scenario occurs. ... future uranium supply is now a big issue. Actually, the uranium market has been concerned about it for some time and accordingly, the price has been increasing for the last couple of years. ... One of our concerns is that uncertainties about fuel security in the future may depress possible investors' confidence in the nuclear power industry. This could potentially delay or cancel the nuclear programmes, currently set.¹¹³

112 OECD / IAEA, *Uranium 2003: Resources, Production and Demand*, pp 9-10.

113 World Nuclear Association, 30th Annual Symposium, September 2005, presentation by Haruo Maeda, ITOCHU International.

85. The scale of the problem is illustrated by van Leeuwen and Smith's calculations that a 'global growth of nuclear' scenario, as envisaged by the MIT and in which 1000 new reactors were built, would result in the existing known reserves of uranium being exhausted in only 14 years.¹¹⁴ As a result of such concerns, the price of uranium has trebled in the last few years after two decades of very cheap supplies. It is, of course, possible that further increases in price will stimulate additional investment in production capacity, but the key point which these quotes bring out is that future supplies of uranium—even for only a moderate increase in demand—are anything but assured. While fuel prices are currently not a significant factor in the economics of nuclear power, this situation could change radically as the heavily subsidised secondary sources decline in importance. Moreover, the suggestion that price increases could stimulate a move to different fuel processing cycles (such as the use of MOX, or the development of fast breeder reactors) is doubtful. The MIT 2003 report on nuclear comprehensively showed that alternative fuel cycles are significantly more costly than a straight-through cycle.¹¹⁵ Indeed, the UK's experience in reprocessing spent fuel at Sellafield has been disastrous, while the development of fast-breeder reactors has been beset with difficulties world-wide. Such suggestions can in any case only undermine the argument for investing now in the current designs on offer.

86. Very recently, the Sustainable Development Commission published a report which it commissioned from AEA Technology on uranium supplies as part of its review of nuclear power. We were interested to see that the report corroborated our own view about how serious an issue this is. Indeed, it not only confirms the limited nature of known and estimated reserves available, but also refers to the extent of market failure as reflected in the low price of uranium and the extent of government involvement worldwide in the uranium trade.¹¹⁶ AEA's overall conclusion, however, is surprisingly upbeat: it argued in essence that, as OECD/IAEA 'red book' reserves had increased by 40% over the last 20 years, there was no reason to suppose that such a trend would not continue in future. We agree that this may indeed occur—but then again it may not. And in any event there are likely to be further large price rises.

87. It is also relevant to consider the sources of supply. While Canada and Australia are currently the largest sources of mined uranium, supply is increasingly dependent on other states including Russia, Kazakhstan, Uzbekistan, Namibia, and Niger.¹¹⁷ We find a certain irony in the argument sometimes used to support nuclear new build that the UK should not become so dependent on foreign supplies of natural gas when it may become equally dependent on uranium imports from similar foreign sources. More generally, the situation with respect to uranium supplies mirrors to a surprising degree the current situation with regard to oil and gas reserves—not only in the limited nature of known and estimated reserves, but in the geographical displacement of those reserves.

114 van Leeuwen, *A nuclear power primer*, part 7. See: http://www.opendemocracy.net/globalization-climate_change_debate/2587.jsp#four. See also Ev154 ff.

115 MIT, *Nuclear Power*, 2003.

116 Sustainable Development Commission, *The Role of Nuclear Power in a Low Carbon Economy: Paper 8-Uranium Resources Availability*, March 2006, page 54 (quote from Jeff Combs).

117 OECD/IAEA: *Uranium 2003*.

88. One final aspect of this issue relates to the use of stockpiled military plutonium. In his evidence to us, Professor Sir David King put forward an interesting argument that nuclear power stations using mixed-oxide fuels (MOX) offer an effective way of getting rid of unwanted plutonium while addressing the security of supply issue: *“This is a matter of interest to me as a government advisor, how do we treat the plutonium stockpile that we have? [...] Either we treat the plutonium as an energy source or we treat it as a major waste issue. I think processing it through a nuclear plant is by far the preferable way to go forward.”*¹¹⁸ However, the price of MOX is currently higher than ordinary uranium, and it is unclear how this might change in future. Moreover, we remain concerned about the lack of transparency in the pricing of the plutonium and the possibility of hidden subsidies to promote its use.¹¹⁹

89. Uranium mines can only supply just over half the current demand for uranium, and the situation is likely to become more acute as secondary sources—such as military stockpiles from decommissioned weapons—decline in importance. Such concerns, which are shared by the nuclear industry itself, may depress investment in new nuclear capacity, while the possibility of further large rises in the price of uranium could significantly alter the economics of nuclear power and render it less attractive to investors.

Carbon emissions

90. Integrally linked to the availability of uranium supplies is the issue of the carbon emissions associated with nuclear. It is frequently said that nuclear is a zero-carbon source of power. While this may be true in terms of the operation of a nuclear power plant itself, significant energy is required for its construction and—more importantly—for the mining and fabrication of uranium to provide the necessary fuel, and the conditioning, transport, and final storage of radioactive waste.

91. The evidence which we received on this issue was limited. The nuclear industry cited a range of studies which all tended to show that life-cycle emissions from nuclear were among the lowest of any form of generation—lower, indeed, than wind. British Energy, for example, set out the results of a recent analysis of emissions from its Torness plant, which showed that emissions were just over 5 grams per kWh (g/kWh)—only slightly higher than the 3.3 g/kWh which a similar study carried out by the Swedish company Vattenfall carried out. Such figures contrast with emission levels of 800-950 g/kWh for coal plant and 350—400 g/kWh for gas.¹²⁰ BNFL referred to an IAEA study which suggested slightly higher levels (between 9 and 21 g/kWh).¹²¹ Figures of around 5 g/kWh were cited by other organisations including EDF, the British Nuclear Energy Society, and the Nuclear Industry Association.¹²²

118 Q570.

119 QQ 571-2.

120 Ev192-193.

121 Ev172.

122 Ev108,354,580.

92. By contrast, others argued that these studies understate the carbon emissions from nuclear and are hardly objective as they have been financed by the nuclear industry itself. Greenpeace cited the EU Externe study which suggested that emissions from nuclear, while still very low, were 50% more than from wind.¹²³ A recent paper from the Öko Institut, a leading German environmental and scientific research organisation, calculates nuclear emissions at 33 g/kWh and cited other international studies carried out by the IEA and CRIEPI which have suggested higher figures of between 30 and 60 g/kWh.¹²⁴ What is particularly interesting about the Öko paper is the comparative analysis of emissions across a range of technologies which demonstrates that gas ICE cogeneration is highly competitive with nuclear while biomass based cogen has far lower emissions. Their analysis is that nuclear is by no means the cheapest way of achieving carbon abatement.

93. Even higher figures of up to 120 g/kWh for carbon emissions from nuclear have been produced by van Leeuwen and Smith—about a fifth to a third of the emissions from a normal gas generating plant. They have also argued that, as good quality uranium reserves run out, a move towards lower quality uranium ores would significantly increase the energy required to refine it, and that the energy required can rapidly escalate to the point where more is needed than can be obtained from the use of the fuel. The nuclear industry has fiercely attacked the ongoing work of van Leeuwen and Smith, but the latter have issued detailed rejoinders.¹²⁵ The recent report of the Sustainable Development Commission on the extent to which nuclear can contribute to carbon reductions does not appear to have included consideration of this key issue—perhaps because of their conviction that further high quality uranium reserves would become available.¹²⁶

94. At the very least, this controversy suggests that there is a need for far more objective analysis and discussion. Moreover, the EAC has commented in the past on the difficulty of carrying out thorough life-cycle analyses. The Secretary of State acknowledged that this issue needed to be examined and that it would be included in the Energy Review.¹²⁷ However, what is required here is not a simple desk-based review of existing studies, but an in-depth investigation which could hardly be accommodated within the time-frame set by the Government. Moreover, given the need for objectivity, it would not be appropriate for such a review to be conducted by the Government itself. What is required is an independent authoritative analysis such as that which the Royal Commission on Environmental Pollution could provide.

95. At present nuclear power can justifiably be regarded as a low-carbon source of electricity. However, the extent to which this can be sustained needs to be examined. There is some evidence to suggest that the level of emissions associated with nuclear might increase significantly as lower grades of ore are used. Given the concerns

123 Ev12.

124 Öko Institut, *Comparison of Greenhouse Gas Emissions and Abatement – Cost of Nuclear and Alternative Energy Options from a Life-Cycle Perspective*, January 2006.

125 See, www.stormsmith.nl and www.world-nuclear.org.

126 SDC, *The role of nuclear power in a low carbon economy, Paper 2: Reducing CO₂ Emissions – nuclear and the alternatives*, March 2006. The report lists an extensive range of studies on the carbon emissions associated with nuclear (pages 31-32) but does not refer anywhere to the work of van Leeuwen and Smith.

127 Q 677.

expressed by the nuclear industry itself over the adequacy of uranium supplies after 2015, we regard this as a serious issue and one which can hardly be resolved in the time-frame of the current Energy Review. In view of its importance, the Government should consider asking the Royal Commission on Environmental Pollution to report on carbon emissions associated with all generating technologies.

Safety, terrorism, and proliferation

96. One of the most emotive aspects of nuclear power relates to the potential impact if anything were to go wrong. The major incident at Three Mile Island and the disaster at Chernobyl have resulted in a heightened awareness of the possible environmental, social, and economic costs which could result from either an accident or an act of terrorism. Additional concerns arise because of the close links between the technologies involved in the civil and military uses of nuclear power, and the risk that a ‘nuclear growth’ scenario might well result in the proliferation of nuclear weapons worldwide.

97. Various organisations commented extensively and sometimes passionately on these issues.¹²⁸ Submissions from the nuclear industry tended to focus on the fact that a new generation of nuclear power stations would be inherently safer than existing designs, in terms of both operational reliability and the ability to withstand direct terrorist attacks. But they tended to dismiss other operational risks—such as the risks surrounding on-site storage of spent fuel and the increased transportation of nuclear material around the country. They also did not deal in any depth with the risks of proliferation in the event of a worldwide ‘nuclear growth’ scenario and the possibility of a move towards a plutonium based economy. By contrast, environmental groups acknowledged that new reactors would in themselves be inherently safer than existing designs (particularly the Magnox plants), but they placed greater emphasis on these other associated risks. They also argued that, while the risks may be remote, the impact of a major accident or terrorist attack could be colossal. The Government does in fact recognise the unique position of nuclear power in this respect, as it is the only generating technology to have its own police force.¹²⁹

98. In considering these arguments, we found it difficult to assess the risks associated with nuclear and balance them against competing risks, such as those arising from climate change. At least in the West, the safety record of civil nuclear power plants has generally been good. There are many other chemical plants where accidents or terrorist attacks could potentially result in very serious impacts. This is demonstrated by the disasters at Seveso in Italy (where, in 1976, an explosion resulted in the release of dioxins), and at Bhopal in India (where a release of methyl isocyanate in 1984 resulted in nearly 4,000 deaths and 3,000 serious disabilities). Indeed, to the extent that security may be less onerous at such plants, the scope for terrorist attacks might even be greater. However, the potential scale of impacts resulting from a major accident or successful terrorist attack at a nuclear installation is of a different order of magnitude as the disaster at Chernobyl demonstrates. Calculations provided by the Oxford Research Group indicate that an attack on the high

128 eg Greenpeace (Ev462 ff), Oxford Research Group (Ec 142ff and QQ326 fff), Open University Energy and Environment Research Group (Ev586).

129 The Civil Nuclear Constabulary (formally the UKAEA Constabulary).

level waste tanks at Sellafield would dwarf the scale of the Chernobyl accident and could result in over half a million fatal cancers.¹³⁰ Moreover, the economic effects of such an event would be incalculable.

99. In this respect, the risks attached to nuclear power are indeed of a different order of magnitude to other forms of power generation. This is recognised in international law in the way that the insurance liability of the industry has been capped. The Paris and Vienna international nuclear conventions, negotiated originally in 1960 and 1963 lay down frameworks which shape most national nuclear liability laws and impose absolute but limited liability on nuclear site operators. They embody both financial and temporal limits for a catastrophic nuclear accident. In the UK, the financial compensation limit provided per site is currently £140 million and the temporal limit is 10 years—though the former is due to rise to Euros 700 million as a result of recent amendments to the conventions.¹³¹

100. We were also struck by the fact that the concerns expressed by environmental groups in relation to the proliferation of nuclear materials and technology worldwide appear to be shared at the highest level. The Oxford Research Group, for example, argued that the new Generation III nuclear reactors currently being proposed can use a mixed-oxide (MOX) nuclear fuel, which would allow countries and organisations easier access to plutonium. Moreover, Generation IV reactors (research on which is being conducted by an international collaboration of states, including the UK) would use mainly plutonium and would therefore constitute an even more serious threat. ORG cite a 2004 UN report which warned “*we are approaching a point at which the erosion of the non-proliferation regime could become irreversible and result in a cascade of proliferation.*” While the UN report did not directly address threats arising from civil nuclear power, it did include the following general statement:

*We recognize that nuclear energy, in the view of many, is an important source of power for civilian uses and may become even more crucial in the context of a worldwide effort to reduce dependency on fossil fuels and emissions of greenhouse gases. At the same time, the mounting tension between the goals of achieving a more effective non-proliferation regime and the right of all signatories of the Treaty on the Non-Proliferation of Nuclear Weapons to develop civilian nuclear industries needs to be addressed and defused.*¹³²

101. Such concerns are overtly demonstrated by Western attempts to constrain Iran’s nuclear programme. Indeed, Professor Rogers argued persuasively that we may be on the threshold of a major escalation in the proliferation of nuclear technology. “*Essentially, we are at a point where the nuclear weapons proliferation problem is possibly about to get much worse. That is something which is happening for political and strategic reasons. The problem is that in those circumstances simultaneously you are moving to a more heavily involved plutonium economy. Put that with the political and strategic problems, and you have a really serious issue over the next 10 to 20 years.*” He went on to emphasise that Western countries

130 Q330.

131 Ev582.

132 *A more secure World*, Report of the High-level Panel to UN Secretary-General, paragraph 127.

had no authority to persuade developing states to forego nuclear when they were seen to be saying ‘*Do as we say and not as we do.*’¹³³ As Professor Rogers pointed out, the Director General of the International Atomic Energy Agency, Mohamed ElBaradei, is sufficiently concerned about these issues as to issue a seven point plan in an attempt to shore up the Non-Proliferation Treaty (NPT).¹³⁴ Yet the likelihood of substantive progress is minimal, particularly given the threats to the treaty not only from countries such as Iran (which is at least a member of the NPT), but also from India (which has refused to sign the NPT). Indeed, the recent agreement between the US and India to cooperate on nuclear development further undermines the NPT, and makes it difficult to see how the US can argue with any consistency for upholding it in other cases.

102. In considering these complex issues, however, it is important to acknowledge that other generating technologies also have serious risks—albeit sometimes of a different type—associated with them. In particular, the exploitation of coal resources worldwide has resulted in countless thousands of deaths from mining and associated illnesses such as pneumoconiosis. Indeed, such impacts continue to this day in developing countries such as China and need to be balanced against the possible risks from exploiting nuclear power. Moreover, the development of new technologies—such as a shift to a hydrogen economy—can introduce other potential dangers, and we therefore welcome the review of safety issues which the HSE is now conducting. We trust it will assess the risks associated with all technologies in an objective and even-handed way.

103. The risk of a major accident at a nuclear power plant may be remote but the consequences can be huge. This is reflected in the need for governments to underwrite the industry against losses in excess of Euros 700 million. Moreover, the risks of terrorist attacks on nuclear installations and the risks associated with any further proliferation of nuclear power are serious.

Long-term waste disposal

104. The issue of nuclear waste is also an emotive and unique aspect of nuclear power, and one which is complicated by the historical legacy arising from the past 50 years of nuclear activity in the UK. The Nuclear Decommissioning Authority has now been established to manage the waste legacy, and the costs of doing so are currently estimated to be in the order of £60 billion. It was no part of our inquiry to investigate these issues, but rather to assess the prospects for dealing with waste from a new generation of nuclear power plants.

105. Currently, most spent fuel from nuclear power stations is reprocessed in Sellafield and temporarily stored there.¹³⁵ In 2000, the Royal Commission on Environmental Pollution recommended that no new nuclear power stations should be built until a solution to the problem of nuclear waste is found which commanded the confidence of both experts and

133 Q 341-343.

134 See IAEA staff press release, 2 May 2005:http://www.iaea.org/NewsCenter/News/2005/npt_2005.html.

135 We understand that waste from Sellafield B is now stored on-site and that different arrangements are made for Wylfa.

the public.¹³⁶ The Government subsequently set up the Committee on Radio-active Waste Management (CoRWM) to investigate long-term storage options for high level and intermediate level waste and a final report is due in mid-2006.¹³⁷

106. In their evidence to our inquiry, the nuclear industry argued that the impact of waste from a new series of nuclear new build to replace existing capacity would only increase the existing volume of all nuclear waste—including high level, intermediate, and low-level waste—by 15%, and that the costs of dealing with it would therefore be marginal.¹³⁸ The claimed increase in overall volume is correct and is based on CoRWM inventory data. However, further investigation of the CoRWM data reveals that the amount of high level waste would actually increase by 400%, thus necessitating some increase in the capacity of long-term storage solutions.¹³⁹ We discuss later in this report the financing of waste disposal from new nuclear build, but it is worth pointing out here that CoRWM's work is primarily directed to identifying the most appropriate long-term storage option for existing wastes rather than evaluating issues, including costs, associated with wastes from a new generation of power stations. CoRWM has itself stated that future decisions on new build should be subject to their own assessment process, including consideration of waste.¹⁴⁰

107. Other countries face similar problems in dealing with waste disposal solutions. In France, in the late 1980s there was an abortive attempt to identify long-term disposal sites which resulted in local riots and the imposition of a 15 year moratorium pending further research. This report, like CoRWM's, is now due in mid-2006. Finland has identified a site and is going ahead with construction plans, even though the research reports evaluating the effectiveness of the proposed solution will not be completed until [2009]. These reports are of particular importance because there is no dry deep-storage anywhere in the country. In the US, the much-vaunted facility at Yucca Mountain is unlikely to be able to deal even with all the waste from existing power stations, and the industry is now proposing an additional site at Skull Valley. Moreover, the scale of the problem worldwide in the event of a 'nuclear growth' scenario is daunting as the MIT concluded in 2003 that a new long-term disposal site of the size of Yucca Mountain would need to be built every 3 years. These repositories would also need to last for thousands of years—a lifetime far longer than that of any nation which has hitherto existed on earth.

108. No country in the world has yet solved the problems of long-term disposal of high-level waste. The current work being conducted by CoRWM will not be sufficient to address the issue of waste associated with new nuclear build. In particular, a further study to identify the likely costs of the latter would be required in order to reduce investment risk.

136 RCEP, Energy – The Changing Climate, June 2000.

137 For further information on CoRWM, see <http://www.corwm.org.uk/content-0>.

138 eg. Ev173.

139 This assumes that spent fuel is not reprocessed. The amount of extra high-level storage required is complicated by the fact that the radioactivity of spent fuel decreases relatively quickly.

140 CoRWM, Document 1481, Minutes of Plenary Meeting, 15-16 December 2005.

Generating costs, markets, and policy instruments

109. The previous two parts of this report have examined the practical potential offered by different options for addressing future electricity requirements and reducing carbon emissions. In this part, we discuss the financial aspects of these options and the various considerations which might influence investment in relation to the policy framework in place.

Generating costs and risks

110. A number of studies have been carried out on the costs of different forms of generation, and much evidence was presented to us on this topic. Costs can be expressed in terms of both capital costs per kilowatt of generating capacity and as generating costs in terms of pence per kilowatt hour. The following table sets out some estimates for both drawn from the memoranda provided by several power companies.

Type of generation	Capital cost (£ per kW)			Generating cost (p/kWh)		
	Scottish & Southern	EDF	Centrica	E.ON	EDF	Centrica
CCGT	450	440	400	2.2 – 4.9	3.8 – 4.2	1.9 – 2.6
Coal				2.8 – 5.2	2.5 – 3.9	2.1 – 3.3
Nuclear	1500	1150	1100	2.5 – 4.0	2.3	2.3 – 3.4
Wind: onshore	800	715	850	4.2 – 5.2	3.7 – 5.4	3.1 – 3.7
Wind: offshore		1250	1300	6.2 – 8.4	5.5 – 7.2	5.5 – 7.0
Wave and marine		1750			6.6	6.0 – 7.0

111. Some of these estimates are based on other studies. For example, the low cost of 2.3 p/kWh for nuclear is based on a Royal Academy of Engineering report which claimed that a new generation of nuclear power plants would constitute the cheapest way of generating electricity.¹⁴¹ The variations between different estimates relate to different assumptions including fossil fuel prices, carbon prices, load factors, trends in capital costs of plant, the economic lifecycle of the plant, and the assumed rate of return required on the investment.

112. The value of such tables is, however, limited. Costings may not necessarily reflect the differing values to suppliers associated with the flexibility of the generating technology. Nuclear power, for example, commands a lower price in the market because its primary function is to provide baseload electricity.¹⁴² Indeed, we heard from the Sussex Energy Group how a portfolio approach to generation would bring about a different evaluation of

¹⁴¹ Royal Academy of Engineering, *The Cost of Generating Electricity*, March 2004.

¹⁴² Ev239.

the costs and benefits due to the reduction in overall risk. Then again, some kinds of costs can be difficult to determine on a comparable basis. There has been much discussion, for example, about the costs associated with the intermittency of wind and the consequent need to have backup generating capacity. Yet it is not often realised that substantial spinning reserve is also required in the event of a sudden outage at the largest power stations on the system—Drax and Sizewell B. Indeed, in some respects, as the National Grid pointed out, variations in wind generation up to 12 hours ahead are quite easy to forecast and plan for.

113. More fundamentally still, however, such tables can reflect only present costs and assumptions—which can both, as the events of the last few years have demonstrated, change radically and quickly. Indeed, surprisingly few organisations acknowledged the fundamental point that it is difficult to estimate the future costs of different forms of generation due to uncertainties in world markets for fossil fuels, in the regulatory framework which will apply, and in the pace of technological development—particularly with regard to renewables. The DEFRA/DTI memorandum clearly acknowledged this:

*In particular, the range of possible costs for each technology tends to be so wide that it is very difficult to predict now whether one might be cheaper than another or by what margin. By 2020, however, we would expect a broader range of renewable generation technologies to be commercial.*¹⁴³

Similarly, in commenting on uncertainties in the future regulatory framework, RWE stated:

*In light of such fundamental uncertainties, it is difficult to evaluate the outputs, costs and revenues for investment appraisal purposes with any degree of confidence. Any appraisal would need to factor in a variety of adverse regulatory scenarios or apply a marked cost of capital premium to reflect the risks.*¹⁴⁴

114. What is clear, however, from such tables is that, at least in the medium term and in the absence of far higher carbon pricing, gas and coal are likely to remain the cheapest form of generation. Indeed, the cost of gas in the UK is likely to fall again as the investment in UK gas infrastructure increases—thus confirming CCGT as the preferred choice of investors for new generating plant; while the cost of carbon imposed by the current regulatory framework (in particular, the European Emissions Trading System), although rather higher than initially forecast, is currently insufficient to have much effect.

115. Other forms of low carbon generation—including renewables (with the exception of onshore wind) and carbon capture and storage—remain higher but are likely to fall substantially over the next 20 years. The PIU 2002 study, for example, forecast that, by 2025, on-shore wind would become the cheapest of all forms of electricity generation in the UK, while photovoltaics would fall to 2 p/kWh in sunnier climes and could become cost competitive in global terms.¹⁴⁵ Similarly, the Carbon Trust's recent study on marine energy

¹⁴³ Ev268.

¹⁴⁴ Ev657.

¹⁴⁵ PIU, *The Energy Review*, 2002

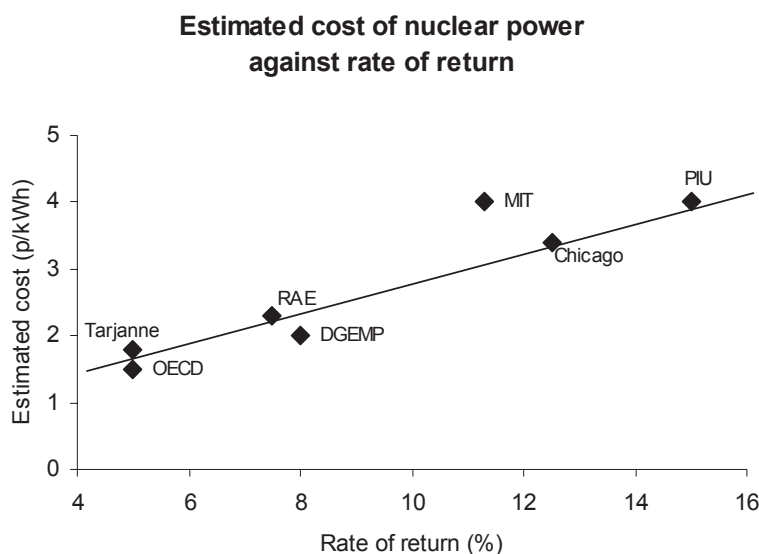
concluded that costs of wave energy could fall from their current levels (between 12 p/kWh and 44 p/kWh) to become competitive with other forms of energy, given sufficient investment and deployment.¹⁴⁶ Furthermore, more radical developments—such as new designs of nuclear reactors and even the possibility of fusion power—may occur within a thirty year timeframe. It is likely, therefore, that we will see significant changes in generating costs of different technologies over the next few decades. In this context, it is worth noting that, in the medium to long term, the future cost of renewable forms of generation will be relatively stable or declining—in marked contrast to the volatility which is likely to affect fossil fuel prices—and the huge market in renewable energy across Europe will indeed be significantly different to current energy markets.

116. Uncertainties in world markets for fossil fuels, in the regulatory framework which will apply, and in the pace of technological development—particularly with regard to renewables—make it very difficult to predict the future costs of different forms of generation. It is likely that we will see significant and perhaps unexpected changes in such costs over the next 20 years, and attempts to produce comparative figures in terms of costs per kilowatt hour are therefore of limited value. In such circumstances, absolute differences in generating costs matter less to investors than long-term certainty with regard to costs and income; while if market and regulatory frameworks cannot provide such certainty, investors will inevitably focus on short-term rewards.

117. Indeed, it is precisely because differing assumptions about risk can affect investment appraisals so radically that there is such a wide range for the estimated generating costs of new nuclear plant. Pro-nuclear organisations emphasised the relatively low cost estimate for nuclear provided by the Royal Academy of Engineering, while others focussed more on the higher estimates provided by the Massachusetts Institute of Technology, the University of Chicago, and the PIU. Perhaps the most illuminating evidence on this score was provided by BNFL who demonstrated as shown below that the estimated price of nuclear power largely depended on the rate of return which had been used.¹⁴⁷ For this reason, it is of little use to ask ‘How much does nuclear power cost?’—the key questions are rather ‘What level of risk are investors prepared to accept?’ and ‘How can the risks to investors be reduced?’ Similar considerations also affect other technologies, such as carbon capture and storage and offshore wind, though not perhaps to quite the same extent.

¹⁴⁶ The Carbon Trust, *Future Marine Energy*, January 2006

¹⁴⁷ Ev162



Source: BNFL

118. No simple answer can be given to the question of the likely cost of nuclear power. The cost will vary depending on the degree of risk which investors perceive is involved. This in turn will depend on a complex web of factors including the nature of the market, and the regulatory and policy framework which is in place. In this respect, there can be radical differences between countries, as the contrast between Finland and the UK demonstrates.

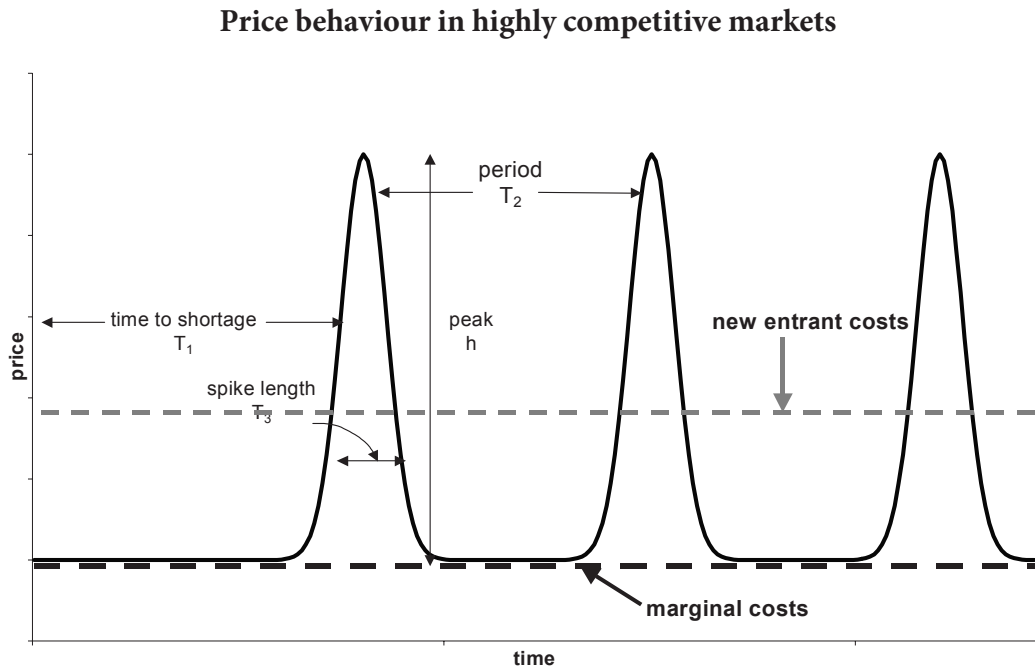
Keeping the lights on

119. One of the major issues which arose in the course of our inquiry was the extent to which the existing highly liberalised UK electricity generating market will provide sufficient investment of any kind in a timely manner. Power generating companies argued forcefully that they could not commit themselves to any new investment at present because of the extent of uncertainty in the policy and regulatory framework.¹⁴⁸ They cited, in particular, the failure to provide guidance on the UK implementation of the Large Combustion Plant Directive, the uncertainty surrounding emission caps to be set for Phase 2 of the EU ETS, and the lack of confidence in the nature of any regulatory targets after 2012. As a result, they suggested that the market might only invest when price spikes reached politically unacceptable levels, and that even then the timing of the investment might fail to guarantee supply. This would create a “boom and bust” cycle as prices peaked and subsequently collapsed following the rapid investment in new capacity.¹⁴⁹ Moreover, they expressed considerable doubt about the extent of likely investment, with Dieter Helm characterising the National Grid’s Seven Year Statement as a “*not a forecast at all. That is what I would call a very informed wish list of plant, and what is more, note that the plant*

148 eg Ev181, 652

149 See especially Ev127 ff.

that was going to come on to the system to maintain the plant margin at about 20 per cent was all gas.”¹⁵⁰



Source: *Climate Change Capital*

120. By contrast Ofgem and the National Grid painted a very different picture and argued that there was no cause to be alarmed. National Grid’s Seven Year Statement showed capacity margins increasing to 37%, while their own more cautious internal analysis suggested that the current capacity margin of 20% would be maintained for at least the foreseeable future.¹⁵¹ The Government has also put in place additional monitoring mechanisms by requiring the Sustainable Energy Policy Network to report progress against the Energy White Paper on an annual basis, and more specifically through the creation in 2001 of the Joint Energy Security of Supply working group (JESS) which must report twice a year to the Secretary of State for Trade and Industry.¹⁵² Moreover, while there are relatively few projects in the planning system at the moment (excluding those projects supported by the Renewables Obligation), very substantial amounts of generating capacity can in fact be built very quickly —as the experience of the 1990s shows when over 25GW of CCGT plant was built within 10 years.

121. Nonetheless, the very short-term nature of the UK market is a matter of some concern. Contracts between generators and suppliers tend to be for a maximum of one year, while the long-term contract market which Ofgem envisaged would arise as a result

150 Q489

151 Ev198 ff, Q448, Ev223 ff, QQ 517-520.

152 See <http://www.dti.gov.uk/energy/sepn/index.shtml> for SEPN, and <http://www.dti.gov.uk/energy/jess/index.shtml> for JESS. It is curious that the latest report available on the JESS website dates from November 2004.

of NETA has never developed.¹⁵³ In this respect, the situation in the UK contrasts sharply with that in much of Europe where the widespread use of long-term contracts has served to hedge investment risks and smooth prices. Indeed, it is with some irony that we note how, several years ago, the UK Government used low UK prices as an argument for the effectiveness of liberalised markets; whereas now, when UK wholesale prices are some 30% above those on the continent,¹⁵⁴ it is complaining about the failure of European states to liberalise their markets.¹⁵⁵

122. We note that a recent report commissioned by the DTI assures the Government that liberalised markets will in fact deliver all the key goals of energy policy – including lower prices, timely investment, and security of supply.¹⁵⁶ On the other hand, the range of witnesses who flatly contradicted this was authoritative—including Dieter Helm, Tony White of Climate Change Capital, Keith McLean of Scottish and Southern Power, and Paul Spence of British Energy—and their views have been endorsed by a recent study evaluating the EU gas and electricity directives.¹⁵⁷

123. Any new investment in generating capacity outside the framework of the Renewable Obligation will almost certainly be in gas, and we will inevitably be dependent on new CCGT plants for most of the 15GW to 20GW of new generating plant we will need by 2016. However, while there may be a certain degree of scaremongering on the part of the industry, it is by no means certain that the current highly liberalised UK electricity market will in fact provide timely investment in new generating capacity and ensure security of supply. Given the central importance of this issue, we find it strange that it is not included in the issues on which the Government is seeking views as part of the current Energy Review. The Government must therefore consider as part of that review whether there is a need to amend the current UK electricity trading arrangements in order to provide some form of capacity incentive and promote longer-term investment perspectives.

Carbon scenarios and CCGT

124. The second key issue raised in the course of our inquiry was whether the liberalised market and existing policy framework would contribute to the challenge of reducing carbon emissions in line with the UK target of a 20% reduction by 2010 and 60% by 2050. It is important to note, however, that the electricity generating sector has already contributed substantially to emission reductions as a result of the replacement of old coal plant by CCGT during the 1990s. Indeed, the fact that the UK will meet its Kyoto target is mainly attributable to this.

153 QQ 483-488. See also Ev234 ff for Ofgem's comments on this issue.

154 DTI, *The Energy Consultation*, January 2006.

155 It is interesting to note that Ofgem have in effect accepted a limited constraint on the operation of liberalised markets in order to promote further investment in gas storage facilities by granting Article 22 exemptions from the EU gas directive. Ofgem denies, however, that this is relevant to electricity markets. See Ev237-238.

156 Ernst & Young, *The case for liberalisation*, January 2006

157 Steve Thomas, *The EU Gas and Electricity Directives*, September 2005. See www.psuru.org

125. Some organisations argued that, even if renewables grew sufficiently to replace nuclear, this would only replace one form of lower-carbon generation by another and would therefore do nothing to reduce carbon emissions from the power generation sector as a whole. Other organisations assumed that an increasing reliance on gas as envisaged in the Energy White Paper would naturally lead to an overall rise in emissions. Yet such views are by no means self-evidently true, and in any case very substantial carbon reductions can be obtained simply by replacing existing coal plant by efficient CCGT. We were surprised that so few organisations in the memoranda they submitted to us considered this issue in any depth or attempted to analyse future generation mixes in terms of carbon emissions.

126. The Friends of the Earth was one organisation which has done pioneering work in this area and indeed published a report in 2002 in which they modelled the scale of carbon reductions which might be achieved under different scenarios. They also argued convincingly in their memorandum for a shift from coal to CCGT as an interim policy for achieving such reductions.¹⁵⁸ The UK Carbon Capture and Storage Consortium (CCSC) also provided helpful evidence on this.¹⁵⁹ They modelled three scenarios, the first of which assumed 20% renewables, new CCGT, and no nuclear or Carbon Capture and Storage (CCS). Under such a scenario they showed that carbon emissions would fall by around 40% from 41MtC in 2000 to 26MtC. The second and third options which they modelled included a limited amount of nuclear new build and CCS, and resulted in carbon reductions of up to 50%. While the UK CCSC figures do not fully take into account the impact of the recent rise in emissions from the generating sector, their conclusions are nevertheless valid in terms of the order of magnitude of the savings which can be achieved.

127. The main reason why such savings are achievable is that modern CCGT generators produce much less CO₂ than older coal plant for the same electrical output. It is an extraordinary fact that nowhere in readily available Government documents could we find a published breakdown of emissions from the electricity generating sector by fuel type. However, it is easy to calculate that coal generates nearly 31MtC—about two-thirds of the 47 MtC which the entire generating sector currently produces—even though it only generates a third of electricity. By contrast, CCGT generates 15 MtC while producing 40% of the electricity. If the entire existing coal sector were replaced by CCGT, carbon emissions would fall by about 18MtC. The electricity generating sector therefore offers a “quick win” in terms of achieving carbon reductions, and it is hardly surprising if the Government was to exploit some of this potential in setting sectoral allocations for Phase 2 of the EU ETS in an effort to get the UK’s carbon trajectory back on course.

128. Achieving emission reductions in this way would of course involve accepting that gas would increase its share of the market substantially—perhaps from 40% to between 60% and 80%. While this does raise issues of security of supply, we agree with the FoE that it would be sensible to exploit at least some of this potential as an interim policy pending the development of other renewable or lower-carbon technologies. In any case, in view of the

158 Ev416 ff.

159 Ev687 ff.

scale of the necessary investment in new generating capacity which will be required by 2015 to 2020, we will be forced to place an increased reliance on gas.

129. It is sometimes argued that a greater reliance on gas, as envisaged in the Energy White Paper, would result in an increase in carbon emissions from the power generation sector as a whole. However, this is not necessarily true as substantial further carbon reductions of up to 40% could be achieved simply by replacing inefficient coal plant with new CCGT.

Incentivising low-carbon generation

130. CCGT can only provide a short-term approach to reducing emissions. For the longer term, the UK will need to deploy low-carbon generating technologies on a large scale if it is to progress towards the 60% carbon reduction target. However, most low-carbon generating technologies are currently more expensive than CCGT or coal. Off-shore wind and CCS are, for example, around 3p and 2p per kWh more.¹⁶⁰ The differentials for other renewables such as PV, biomass, and marine, are significantly higher; while the move to micro-CHP and distributed generation would also incur substantial costs. These relativities may, of course, change over coming decades—but the very short-term nature of the UK market prevents companies from taking much account of that. Indeed, it is precisely because the market fails to provide the right long-term signals that the Government has recognised the need for policy instruments such as the Renewables Obligation and the UK and EU Emissions Trading Systems.

131. There is an additional reason for the Renewables Obligation and the capital grants which support it. A fundamental principle of the Government's approach here is that financial support for new renewables is justified on the grounds that they are emerging technologies which have not enjoyed the investment or government financial support which existing mature technologies such as nuclear have received in the past. Such a 'market pull' mechanism is vital if the anticipated reductions in costs are to be achieved.

132. The EAC has, however, pointed out for the last three years that the Renewables Obligation is an inflexible and inefficient mechanism for bringing to market a range of different renewable technologies due to the single flat rate incentive it provides. It effectively 'picks winners' by rewarding only the cheapest renewable technologies—mainly landfill gas and on-shore wind—and offers little or nothing to bring to market more expensive technologies such as off-shore wind and marine. Such a mechanism contrasts sharply with the feed-in tariffs which have proved so effective in Spain and Germany in incentivising a range of different technologies.

133. The EU Emissions Trading System offers a different approach by directly placing a value on carbon reductions. However, in the absence of more stringent post-2012 reduction targets, the cost of carbon is currently insufficient to provide the long-term investment framework which would enable generating companies to risk investing more heavily in low-carbon options. Dr Dieter Helm argued persuasively that the UK should, in

¹⁶⁰ See paragraph 110.

addition to some form of capacity incentive, adopt an approach based on “carbon contracts” whereby the Government might incentivise the development of low carbon generation.¹⁶¹

134. The issue at stake here is the extent to which policy mechanisms are “technology blind” or whether the Government could more effectively achieve its policy objectives by investing heavily in specific technologies. Our concern with technology-blind approaches, such as Dr Helm’s carbon contracts proposal, is that—if a system of carbon contracts were adopted now—investment might be based on the current economics of different generating options while ignoring the potential for cost reductions in emerging technologies as a result of continuing technological improvements and returns to scale. It might therefore ignore that fact that micro-CHP, photo-voltaics, or marine could well prove to be among the cheapest forms of energy in 25 years time. Dr Helm recognised this issue and argued that it should be tackled by significantly increasing the scale of R&D funding available to emerging technologies—a point with which we entirely agree.¹⁶²

135. We were also concerned that there might appear to be a certain degree of inconsistency in such an approach as it implies that in some areas (ie R&D funding) it is permissible for the Government to pick which technologies to reward while in others (ie market incentive mechanisms) it is not.¹⁶³ Indeed, the Government’s approach here is inconsistent, as it supports a technology blind approach to capital grant funding in certain areas (eg the low carbon building programme) while offering technology-specific grants in others (eg CHP and marine). While we agree with Dr Helm’s overall aim of minimising the Government’s involvement in “picking winners”, such concerns go to show just how difficult it is for the Government not to influence outcomes—even unintentionally—through the kind of market policy instruments and capital grant funding it adopts.

136. The Sustainable Energy Policy Advisory Board (SEPAB) has considered an alternative to Dieter Helm’s carbon contracts approach which remains technology-blind but is considerably simpler:

*A simpler approach would be for the government to announce that it would guarantee the price of tranches of low or no carbon generation to come on stream on an annual basis from 2016, over a period of at least ten years. The qualifying technologies would have to be defined, and would include the five major generic potential sources of no-carbon generation: nuclear, carbon capture and storage, large-scale renewables, small-scale renewables and microgeneration. The task over the next few years for the government should be to develop an understanding of these no-carbon generation sources, issue bids after the next general election for contracts and then put in place a mechanism for bids in 2009.*¹⁶⁴

161 Ev212 ff, QQ 500-507.

162 QQ 511-512.

163 Q515.

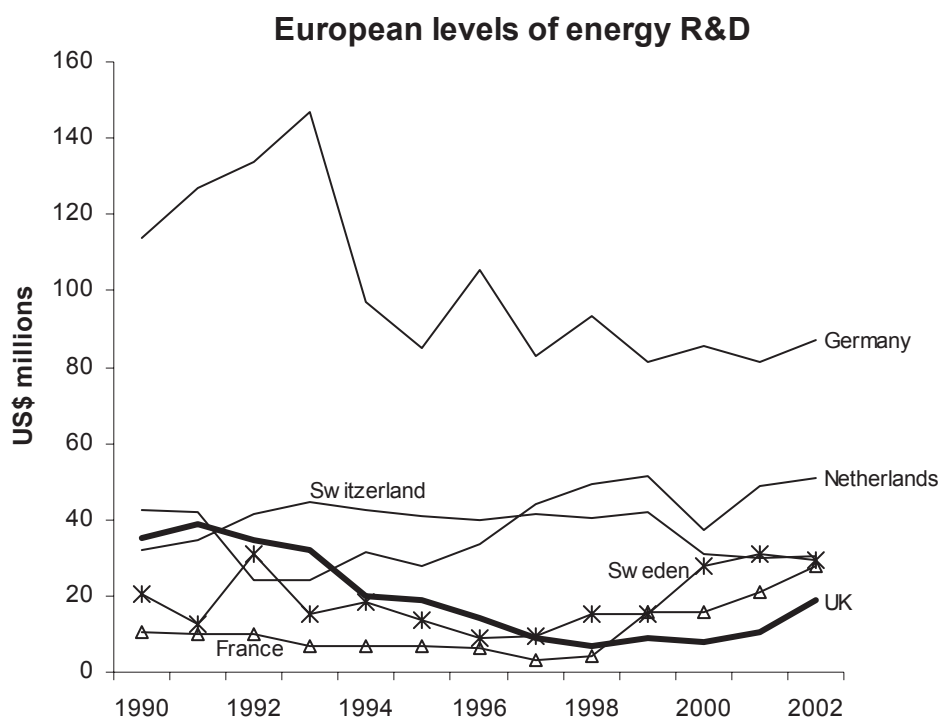
164 SEPAB Minutes of Meeting on 23 November 2005.

As with the concept of carbon contracts, such an approach might need to be accompanied by substantial increases in capital grant funding for technologies which are further from the market. It is also unclear whether it might allow the Government to recoup at least some of its costs through selling the carbon reductions achieved within an emissions trading system—a mechanism which Dieter Helm has proposed in the case of carbon contracts. Despite these concerns, we believe that such a policy instrument could provide the clear market framework and longer-term certainty which is required in order to support investment in low-carbon generating technologies, and we think that it deserves further consideration by the Government as part of the Energy Review.

137. An alternative ‘technology-specific’ approach would be to alter the Renewable Obligation in such a way as to offer a variety of incentives for different forms of technology. This would make it more similar to the feed-in tariffs which have proved so successful elsewhere. The Government might also wish to consider amending the process by which buyout funds are recycled to suppliers, as it is this mechanism which gives rise to some peculiar features of the Renewable Obligation, including its inherent under-performance against targets. While we agree in principle with the need for stability in the policy and regulatory framework, it does not appear to us that the argument put forward by the renewables sector—namely that changes to the Obligation will disrupt investment—is of overriding importance given the fact that investment in all forms of low-carbon generation is faltering. And we therefore believe that this option should also be considered by the Government. It is, of course, a matter of regret that the review of the Renewables Obligation has already been concluded.

138. Other approaches such as the imposition of a carbon tax or the revival of the Fossil Fuel Levy are in themselves unlikely to offer the long-term framework which investors require, though they might nonetheless be useful for other policy goals such as encouraging energy efficiency. They could also raise very substantial amounts of revenue which could potentially be recycled to low-carbon technologies, but there would remain the same difficulty outlined above of deciding on either a technology-blind or technology specific policy mechanism.

139. In any event, the situation is becoming critical. As we have seen above, progress appears to have stalled in certain key areas such as carbon capture and storage and the development of off-shore wind. It is unclear whether the current highly liberalised UK electricity market will indeed support the necessary investment in low-carbon generation, and we therefore believe that the Government must consider the need to introduce significant changes in order to promote such investment. While a secure long-term funding framework does not constitute the entire answer—there are a range of other regulatory barriers which different low-carbon technologies face—it is certainly a major part of it. The extent of capital grant funding is also an issue. Indeed, in both his oral evidence and supplementary memorandum, Sir David King pointed out to us that UK R&D levels of expenditure are among the lowest in Europe—as shown in the graph below.



Source: EaC, based on IEA data

140. The following table sets out actual expenditure on capital grants to support renewable technologies. While we welcome the recent increase in expenditure, it demonstrates that the overall sums made available are often pitifully small and compare badly with the huge spend in the past to support both fossil fuel technologies and nuclear. Over the past 5 years since 2000-01, the total expenditure on renewable technologies has amounted to only £82 million, and £10 million was on fuel cells—which arguably should not be included. As a particular example, we challenged the Secretary of State over the introduction of the Low Carbon Buildings Programme, which had not only been restricted to 3 years (as against the 5 years originally announced) but was less well resourced than the previous programmes it replaced.¹⁶⁵ The Secretary of State acknowledged that funding had been reduced, though the DTI subsequently claimed that comparison was difficult.¹⁶⁶

¹⁶⁵ Clear Skies, and the Major Photovoltaic Demonstration Programme.

¹⁶⁶ Q 688 and Ev313.

Capital grant funding Actual expenditure (£000)

Programme area	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	Total
Bio Wastes	874	1,237	1,158	916	1,235	1,097	593	75	48	25	56	13	42	259		7,628
Biomass	973	1,153	1,961	2,378	2,350	2,313	1,937	1,317	1,076	1,585	1,267	1,333	1,595	1,346	974	23,558
Embedded Generation	0	54	108	463	908	835	647	586	530	596	589	776	1,424	725	1,106	9,347
Fuel cells	155	339	362	827	915	1,172	914	900	1,197	1,168	1,410	1,249	1,200	1,701	4,907	18,416
Geothermal—Aquifers	-8	55	130	143	0	0	0	0	0	0	0	0	0	0	0	320
Geothermal—Hot Dry Rocks	2,579	1,567	1,088	989	245	0	0	0	0	0	0	0	0	0	0	6,468
Hydro	33	122	70	167	148	79	142	57	80	138	60	130	200	85	0	1,511
Solar	2,124	2,354	2,302	2,378	2,067	1,878	1,874	1,660	983	1,278	1,264	1,522	4,485	3,131	1,970	31,270
Tidal	1,860	1,932	1,726	582	220	165	0	0	0	0	27	305	1,996	2,914	1,269	12,996
Wave	388	467	325	196	106	42	50	0	91	11	331	662	748	2,104		5,521
Wind	4,530	6,674	8,694	7,310	2,729	3,370	2,365	1,240	950	801	913	1,248	1,428	1,395	1,460	45,107
Grand total	13,500	15,954	17,924	16,349	10,923	10,951	8,522	5,835	4,955	5,602	5,917	7,238	13,118	13,660	11,686	162,134

Other

Clean coal	10,199	4,108	3,020	6,918	6,876	6,626	5,195	3,100	2,900	2,500	4,300	4,400	3,000	5,000	6,500	68,142
Nuclear	0	73,500	69,200	60,900	12,500	6,000	9,300	1,000	1,600	2,500	0	2,000	2,100	2,100	2,200	244,900
Defra CHP	300	300	300	400	500	500	700	1,000	1,300	1,900	2,500	2,800	1,600	2,500	2,000	18,600
Total	10,499	77,908	72,520	68,218	19,876	13,126	15,195	5,100	5,800	6,900	6,800	9,200	3,700	9,600	10,700	335,142

DTI Capital Grant Programmes

Biomass (DTI and Lottery spend)														10	1,913	1,923
Offshore Wind Capital Grants															15,000	15,000
Clear Skies Community Renewables													200	1,387	2,413	3,800
Major PV Demo Programme													960	2,880	6,450	9,330
TOTAL													1,160	4,277	25,776	30,053

Notes:

1. Above figures are reproduced as printed in Hansard Written Answers, 25 October 2005, Col 297W. This updates similar data provided by the DTI in response to a request from EAC.

141. **Current policy instruments for low-carbon generation are failing to provide a secure long-term funding framework which will offer sufficient confidence to investors. As a result, progress in certain critical areas such as off-shore wind and carbon capture and storage is in danger of stalling. The Government must increase the amount of capital funding available for key low-carbon technologies. It should also consider as part of the Energy Review the possibility of either banding the Renewables Obligation to offer a variety of incentives for different technologies or else introducing guaranteed contracts for tranches of low-carbon generation.**

Financing nuclear new build

142. There are a variety of reasons why nuclear power is considered a particularly high risk investment. These include the high cost of planning applications, the length of time before a nuclear plant may become fully operational, the need to sell electricity generated at a certain minimum price, and the need to cap decommissioning and waste disposal costs. Indeed, much of the debate in the evidence we received concerned how these risks could be reduced by transferring them to the Government.

143. Given the huge up-front capital costs involved and the length of time before a reactor can become operational, the business case is therefore heavily dependent on targets being achieved—both in terms of timescales, and in terms of operational capacity. In this respect, nuclear is more vulnerable than other technologies: any delay in planning or construction, or any reduction in the operating capacity of the plant in its initial years could have an enormous impact on profitability. However, overall profitability is not sufficient: it is also of crucial importance to investors in new nuclear build that the plant is profitable not only on average but on a rolling basis throughout its operational life.¹⁶⁷ If the wholesale price of electricity were to fall below the marginal cost of nuclear generation for several years, the operation could become insolvent—and, indeed, it was just such an eventuality which resulted in the virtual bankruptcy of British Energy three years ago.

144. As the Government has frequently acknowledged, there is nothing preventing power generators from bringing forward proposals for nuclear new build. The reason why this has not happened is that the risks involved are so great that investors would demand a very high rate of return, in the order of 15% or more, thus rendering nuclear power uneconomic.¹⁶⁸ Investment in new nuclear, therefore, will only go ahead if the Government agrees to take on some of these risks, effectively providing a direct subsidy to the industry. It could do so in various ways—including shortening the planning process, sharing the £250 million cost of an initial planning application, ensuring a guaranteed take-up of energy produced, providing capital grants or debt guarantees, and capping the various liabilities involved (insurance, decommissioning, and waste) none of which are known. Indeed, the scale of the investment required is so great—in the order of £10 billion to £20 billion for 10GW of generating capacity—that Oxera has calculated that at least £1.6 billion

¹⁶⁷ Ev129 (paragraph 11) and QQ 307-308.

¹⁶⁸ Oxera has calculated that a rate of return of 14% to 16% would be required. See Oxera, *Financing the nuclear option*, June 2005

of capital grants or as much as £6 billion in debt guarantees might be required in order to increase the rate of return sufficiently to attract investors.¹⁶⁹

145. Given the scale of investment required and its impact on the market, nuclear new build is also likely to require a consortium formed from several of the larger power companies and financial institutions.¹⁷⁰ In its recent inquiry on liberalisation, the European Commission has already expressed some concern about the extent of vertical integration which now exists and the oligopoly exercised by a small number of trans-European utilities. We asked Ofgem specifically how it would react to such a proposal, but the response was equivocal.¹⁷¹ While it has taken so far a relatively relaxed approach to the extent of vertical and horizontal consolidation in the UK, any further concentration of the market might give rise to regulatory concerns.

146. A closely related issue is the extent to which investment in nuclear would ‘crowd out’ investment in other forms of technology, and indeed the Science and Technology Committee in their recent report on carbon sequestration and storage have expressed concern on whether sufficient investment would be available to support the various large-scale lower-carbon generating options. In the memoranda we received, various organisations expressed views either way, but on the basis of very little evidence. We did find it interesting, however, that British Energy considered that a new nuclear programme would impact adversely on investment in CCGT. If this were true, it could have serious implications for security of supply over the next 10 years, as considerable new investment in gas will be required over that period in order to keep the lights on. It is also possible that micro-generation could fare badly in any competition for funds: while the total sums required may be very significant, the diverse and small-scale nature of the various schemes may be less attractive than a major capital project—particularly if the latter had more Government support.

147. In an effort to stimulate new investment in nuclear plant, the US has now put in place legislation involving direct financial subsidies or guarantees totalling approximately \$17 billion (though they are limited in time or in terms of the number of reactors to which they apply). Even so, it is uncertain whether investment in new plant will outlast the funds available.¹⁷² British Energy told us that it was unclear whether a similar package would be required in the UK as there were other areas, such as waste, where potential investors would require a clear framework. By contrast, the Secretary of State for Trade and Industry ruled out any possibility of providing direct or indirect financial support to a new generation of nuclear power stations.

148. The Government has stated that it will not provide any form of direct or indirect financial support for a new generation of nuclear power stations. We welcome this. Nuclear is an established technology which, like coal and gas, has benefited in the past

¹⁶⁹ *Ibid.*

¹⁷⁰ Ev171.

¹⁷¹ Ev236-237.

¹⁷² US Energy Information Administration, *Analysis of Five Selected Tax Provisions of the Conference Energy Bill of 2003*, February 2004, p11.

from very large financial subsidies. In this respect, it contrasts strikingly with emerging renewables such as offshore wind and marine, where financial support is initially required to bring them to market and generate the cost-reductions which will enable them over time to compete with other forms of generation.

149. In the course of our inquiry, we visited Finland as this is the only Western country to have commissioned a new nuclear power station in the last 20 years. We found that the structure of the market was fundamentally different and that this largely explained the commercial decision to go for nuclear. For one thing, Finland imports 20% of its electricity mainly from ageing Russian nuclear power plants, and the insecurity which this gives rise to results in a certain premium on domestic investment. Secondly, we found that there were only two major power companies in Finland, one of which was 51% state owned. The other company (TVO) was a not-for-profit entity owned mainly by energy intensive industries (including the state-owned power company) and some public municipalities (including for example the city of Helsinki); and the electricity generated was not openly traded but sold at cost price to its owners. In committing itself to a new nuclear reactor, therefore, TVO was effectively entering into a long-term contract with its own shareholders—thus offering a guaranteed take-up of the electricity generated at a fixed price. We concluded that the structure of the Finnish market was therefore so totally different to the situation obtaining in the UK as to make comparisons of limited value.

150. It is worth noting that a number of other concerns have been raised about the TVO contract, the details of which are confidential. There is, for example, some suspicion that Framatome may have offered an artificially low price in order to showcase the technology.¹⁷³ As Steven Thomas has pointed out, some US companies came to grief in the 1960s and 1970s as a result of offering fixed-price turnkey contracts and underestimating the costs.¹⁷⁴ Some groups have also argued that the contract may contravene in certain respect EU State Aid rules, and have asked the European Commission to examine this issue.¹⁷⁵ More significantly from the UK perspective, Finnish environmentalists have argued that the decision to invest in a new nuclear power plant has damaged investment in alternative renewable energy sources and in energy efficiency, and indeed the evidence appears to confirm that the progress made on energy efficiency until 2002 has since been partially reversed.¹⁷⁶

Costs to the consumer

151. Much has been made of the costs to the consumer of the costs of supporting renewables—some £1 billion a year by 2010, and as much as £42 billion over the lifetime of the obligation. These figures are somewhat theoretical and they would fall substantially if renewables did indeed become cost-competitive with other major forms of generation to the extent Obligation targets were reached or exceeded. However, the targets are unlikely

173 Ev454

174 Steve Thomas, *The Economics of Nuclear Power*, July 2005

175 Ev 1ff, 441ff

176 Praseg, presentation by Satu Hassi, November 2005

to be reached over the next 10 years and substantial consumer support will therefore be required.

152. More generally, as the evidence we have cited above demonstrates, all major forms of zero- or low-carbon generation are at present more expensive than coal and gas—including carbon capture and storage as well as nuclear (assuming for a moment that the latter is indeed a low carbon source of power). Indeed, four years ago Dieter Helm submitted a memorandum to this Committee in which he stated that *“it is practically inconceivable that such a transition [to an environmentally benign system] could be achieved on the basis of ‘cheap’ energy, as the Prime Minister’s Foreword to the [PIU] report indicates is a priority”*.¹⁷⁷

153. The consumer must inevitably pay, therefore, for low-carbon generation, though not necessarily directly. There are other ways in which the Government can provide financial support—for example, by the use of capital grants funded from tax revenues, and more subtly through the use of loan guarantees. Moreover, the Government has within its power the possibility of using social policy instruments to address distributional issues such as fuel poverty, rather than using energy policy to do so. There is therefore considerable scope for the Government to soften the economic impacts of higher low-carbon energy costs.

154. Governments should make clear to consumers and taxpayers that low-carbon technologies have an explicit price premium: we cannot move to low-carbon power generation on the basis of cheap energy.

The global context

155. The latest forecasts from both the International Energy Agency (IEA) and the US Department of Energy predict that global emissions of greenhouse gases will increase by over 60% from 2002 to 2030 (from 24 billion tonnes of carbon dioxide a year in 2003 to 38 billion tonnes in 2030). Indeed, the rate of increase is forecast to be greater than that we have experienced since 1970. Coal, gas, and oil are projected to supply 83% of total energy needs by 2030—1% higher than the current level. Even on the basis of the “alternative policy scenario” which the IEA calculated—which takes account of increased environmental action by governments—emissions are still forecast to increase by 33% to 32 billion tonnes a year by 2030.

156. Power generation will account for half the overall forecast increase in emissions, with coal and gas the dominant fuels. Indeed, the IEA estimate that \$10 trillion investment in electricity generation will be required over the next 25 years, with a further \$3 trillion in oil. A considerable part of this investment will be in fossil fuel generating capacity and this was graphically illustrated by the evidence we received to the effect that China is now building the equivalent of one new coal generating plant a week. By contrast, renewables share of the electricity generating mix is around 19% and nuclear contributes 17%. Forecasts indicate a moderate growth of renewables over the coming decades but a decline in the

¹⁷⁷ EAC Fifth Report of 2001-02, *A Sustainable Energy Strategy? Renewables and the PIU Review*, HC582, paragraph 66.

percentage share of nuclear. Even under the MIT's "global growth" scenario in which at least 1000 nuclear power stations were built worldwide, the percentage of world electricity generated from nuclear would rise only from 17% to 19%.

157. In a report published a year ago, the EAC highlighted the yawning chasm which existed between such forecasts and the need to stabilise emissions in the next two decades and subsequently reduce them if we are to avoid the possibility of catastrophic climate change.¹⁷⁸ In this context, the scale of emissions from fossil fuels is such that even a substantial growth in renewables would have little effect; while the potential contribution of nuclear is still more limited. The one technology which could, however, make a significant impact is carbon capture and sequestration. Indeed, it would not be an overstatement to claim that, if we fail to implement quickly CCS technology in China and other rapidly developing states, all our other efforts to move towards a low-carbon economy will have little effect.

The Energy Review

158. In September 2005, two months after we launched this inquiry, the Prime Minister announced that there would be an energy review and a press notice with general terms of reference were issued in November. In January 2006, a consultation paper was published with the minimum period of 12 weeks allowed for responses, and the review itself is due to report by the summer.

159. One of the most striking issues surrounding the review is why it is occurring at all. It was announced little more than two and a half years after the Energy White Paper, and only two months after a Government report assessing progress against the objectives of the White Paper. We asked various witnesses whether they felt that a review was justified. Opinions varied. Some cited various changes which had taken place, in particular the rise in UK carbon emissions in the last few years, the big increase in the price of oil and gas, increased concerns about the growing dependency on gas imports, and the lack of radical progress in promoting renewables and energy efficiency improvements. Others felt that there was a degree of scaremongering about some of these factors—in particular, in relation to import dependency—and they suggested that it was too early to assess progress. Witnesses agreed, however, that the review would fail to command confidence if the policy framework which emerged differed significantly from the White Paper.

160. In the course of our oral evidence sessions, concerns about gas imports were highlighted by a sudden spike in gas prices. However, as our colleagues on the Trade and Industry Select Committee have pointed out, this is likely to be a short-term problem due to the lack of past investment in gas infrastructure in terms of pipelines to Norway and Europe, LNG storage and import facilities.¹⁷⁹ Substantial investments have already been made to remedy this situation, and after 2007 the risk of price volatility will be much

178 EAC, Fourth Report of 2004-05, *The International Challenge of Climate Change: UK Leadership in the G8 and EU*, HC 105.

179 Trade and Industry Select Committee, First Report of 2005-06, *Security of Gas Supply*, HC 632.

reduced. Moreover, the latest IEA World Outlook report concludes that supplies of oil and gas are adequate to meet foreseeable demand—though it acknowledged that their use may be constrained by environmental factors.¹⁸⁰ We therefore remain fairly sanguine about the increased dependency on imported gas as envisaged in the Energy White Paper, although such dependency will always carry a degree of price risk.

161. It is notable that the July 2005 monitoring report from the Sustainable Energy Policy Network gave no indication whatsoever of the need for a wide ranging energy review, other than a cursory reference to the Prime Minister's statement that a decision on nuclear needed to be made during this Parliament. This must show either that the Sustainable Energy Policy Network monitoring process is itself flawed, or that there is in fact no need at this stage for a review; and we are therefore concerned that the Review does not appear to have resulted from a due process of monitoring and accountability.

162. We also note that the Government has failed to clarify the nature of the review—whether it is specifically fulfilling the Prime Minister's desire to make a decision on nuclear, whether it is a review of electricity generating policy, whether it is a wider review of progress against the White Paper, or whether it is reopening the broad policy debate which the White Paper itself encompassed. If it is indeed the latter, then the manner in which it is being conducted appears far less structured and transparent than the process by which the White Paper itself was reached. Moreover, it would need to address all aspects of energy consumption—in particular, transport and the domestic sector, in both of which energy consumption is significantly increasing due to the fact that Government policies are diametrically opposed to the 60% carbon reduction target set out in the Energy White Paper. If the review does not cover these issues comprehensively and transparently, then it will have failed.

163. Since the Energy White Paper, we would agree that various changes justify the need for a thorough review of implementation. However, the nature of the Energy Review itself is unclear and the case for a wider ranging review of energy policy has not been made. It will fail to command the support of stakeholders, the public and politicians if what emerges is significantly different from the course that was charted in the Energy White Paper without a proper explanation of how circumstances have altered sufficiently to justify such a change and without further wide-ranging consultation on the nature of the change.

164. On the other hand, the Government has been constantly emphasising the need to make a decision on energy: 'doing nothing is not an option' in the words of Malcolm Wicks.¹⁸¹ Moreover, as the Trade and Industry Select Committee have noted, a disproportionately large proportion of the consultation document relates to the power sector.¹⁸² These factors suggest that the underlying focus of the review is on electricity generation—and in particular, given the Prime Minister's own comments, the role of

180 IEA Energy Outlook 2005.

181 DTI (Wales) press release, 27 February 2006.

182 Trade and Industry Select Committee, Minutes of Evidence, 6 February 2006, Q 14.

nuclear. Yet in the context of the Government's faith in liberalised markets it is unclear what any 'decision' or 'decision on nuclear' would amount to. We put this point repeatedly to the Secretary of State, yet he was unable to offer any explanation.¹⁸³ The real issue facing the Government is in fact whether the current structure of the liberalised market and policy framework will deliver sufficient investment in low-carbon forms of generation in a timely manner. Yet the consultation document does not address this adequately—perhaps because to do so would be tantamount to admitting that the current market structure has failed.

165. A key theme underpinning the review is the Government's argument that a decision on energy, and specifically nuclear generation, has to be made: 'doing nothing is not an option'. But, in the context of the Government's confidence in liberalised markets, we are at a loss as to what the nature of such a decision could amount to, and the Secretary of State was himself unable to clarify matters.

166. We are also concerned more generally about the extent of coordination between the various reviews currently being undertaken. A review of the Renewables Obligation has recently concluded. The Climate Change Programme review has only now been published—some 9 months after the original target. The Energy Review itself is due to report by the summer of 2006, while the Stern review of the Economics of Climate Change will report in the Autumn of 2006. Also of relevance is the delay referred to earlier in this report in the publication by the DTI of the updated energy projections.

167. This hardly impresses us as an example of joined-up government. Had the Climate Change Programme review and the Updated Energy Projections been published on time, they could have better informed subsequent reviews—including, importantly, the public consultations on them. Had the Stern review—which includes in its terms of reference the need to provide "*An assessment of the economics of moving to a low-carbon global economy, focusing on the medium to long-term perspective, and drawing implications for the timescales for action, and choice of policies and institutions*"—come before the Energy Review, it could have more meaningfully informed any decisions to alter the policy and regulatory framework. And had the review of the RO occurred after the Energy Review, it could have been better framed within the context of an overall energy strategy.

168. The Energy Review is only one of a number of important reviews currently being undertaken. It is extremely unsatisfactory, for example, that it has been launched before the publication of the long-delayed Climate Change Programme review. Moreover, the Stern Review of Climate Change is not due to report until the Autumn—after the Energy Review has itself reported—even though logically it should come first. This does not inspire confidence about the extent of coordination within and between different parts of Government.

183 QQ 647-652.

Conclusions

169. By 2016, it is likely that between 15 and 20GW of electricity generating plant will be decommissioned. This amounts to nearly a quarter of total UK generating capacity. Over the next 9 years, therefore, very substantial investment in new generating capacity and energy efficiency will be required if the lights are to stay on—even in the absence of demand growth. Further substantial investment on a comparable scale may be required in the following decade.

170. At the same time, the UK is facing the unprecedented challenge of achieving radical reductions in carbon emissions in an effort to combat global warming—as reflected in the difficulty of achieving the UK 2010 carbon reduction target. The electricity generating sector accounts for nearly a third of total emissions and it will therefore need to play a significant role in achieving such reductions, and indeed the achievement of the 2050 target will depend heavily on the nature of investment in generating capacity over the next two decades. The Energy White Paper of 2003 addressed the need for carbon reductions across the economy but did not set specific targets for the generating sector. However, it endorsed the view set out in the Performance and Innovation Unit (PIU) report that new gas-fired plant, renewables and energy efficiency could make up for the potential generating gap.

171. Over the next ten years, nuclear power cannot contribute either to the need for more generating capacity or to carbon reductions as it simply could not be built in time. The potential generating gap during this period will need to be filled—largely by an extensive programme of new gas-fired power stations, supplemented by a significant growth in renewables. Contrary to popular belief, a further ‘dash for gas’ would result in significant carbon savings. Moreover, it is not clear how much effect the replacement of older coal and nuclear plant by gas will have on the security of total electricity supplies, as we will in any case become highly dependent on foreign imports of fossil fuels for our total energy requirements—including over twice as much natural gas for industrial and domestic uses as we use for electricity generation.

172. By 2016 at the latest, substantial further investment in generating capacity will be needed, and there are a number of different lower-carbon technologies which could contribute on a large scale—including renewables, microgeneration, offshore wind, nuclear, and carbon capture and storage. But there is substantial evidence to show that progress in deploying key technologies—in particular carbon capture and storage, offshore wind, and microgeneration—is inadequate. The real issue which the Government is failing to address is whether the policy and regulatory framework in place is sufficient to stimulate the growth of lower-carbon generation on the scale required.

173. All lower-carbon generating technologies are more expensive than coal and gas, and will require a long-term funding framework in order to reduce investment risk and ensure that the necessary investment takes place. The current highly liberalised UK electricity market structure is too short term and fails to provide such a framework. Indeed, it is not clear whether it will even ensure that enough investment takes place to

keep the lights on by 2016. There are a number of options open to the Government to address this—including the introduction of some form of capacity payment, the development of low-carbon generation contracts, and the modification of the Renewables Obligation to provide a range of incentives for different technologies. The Government will need to consider what changes to the market structure are required as part of the Energy Review.

174. Nuclear power raises a variety of issues which would need to be satisfactorily resolved before any decision to go ahead is taken. These include long-term waste disposal, public acceptability, the availability of uranium, and the carbon emissions associated with nuclear. There are also serious concerns relating to safety, the threat of terrorism, and the proliferation of nuclear power across the world. Moreover, given the fact that substantial changes in the relative cost of energy technologies are likely to occur over the next 20 to 30 years, it is by no means clear whether investors will wish to commit themselves to 70 years of nuclear generation. There are striking similarities here to the position in 1980 when a similar large scale programme of nuclear new build eventually resulted in the construction of only one new reactor—Sizewell B.

175. A Government decision to support a major programme of nuclear new build must also take account of the impacts on investment in other areas—notably energy efficiency, renewables, carbon capture and storage, and the development of distributed generation systems. The potential of these various technologies over the next 20 to 30 years is immense, and any public subsidies for nuclear must be weighed against the substantial progress towards reducing carbon emissions and ensuring a greater degree of security of supply which these alternatives could achieve with similar subsidies. However, as all forms of lower-carbon generation will require financial support, the Government should accept that the shift to a sustainable energy strategy cannot be based—at least in the medium term—on maintaining low energy prices.

176. The Government should be doing far more to promote progress in these other areas. Carbon capture and storage will, in particular, be of crucial importance in view of forecasts which show increasing use over the next thirty years of fossil fuels—especially in developing countries such as China and India. Renewables and distributed generation could also contribute hugely in both a national and global context—but many of the technologies involved warrant special support to bring them to market and achieve the cost-reductions which will make them competitive.

177. While this inquiry has focussed primarily on supply side issues, we cannot emphasise enough that reducing demand is also a vital component on the path to a sustainable energy strategy. There is, as yet, little evidence to suggest that the Government has succeeded in doubling the rate of energy efficiency improvements as envisaged in the Energy White Paper. Far more decisive action and political leadership is required, and we would also urge the Government to consider setting absolute targets for reductions in demand as a way of stimulating the growth of energy efficiency and guaranteeing the level of carbon savings achieved.

178. The nature of the current Energy Review is unclear—whether it is specifically fulfilling the Prime Minister’s desire to make a decision on nuclear, whether it is a review of electricity generating policy, whether it is a wider review of progress against the Energy White Paper, or whether it is reopening the broad policy debate which the White Paper itself encompassed. We are also concerned that it does not appear to have resulted from a due process of monitoring and accountability, and that the process by which it is being conducted appears far less structured and transparent than the process by which the White Paper itself was reached.

179. If the Energy Review is focussed mainly on electricity generation and, in particular, a decision on nuclear, then it is unclear what the nature of such a decision could be and the Secretary of State himself was unable to explain this. Indeed, the Government has always argued that its role is not to prescribe the fuel mix, and it has invested much effort in developing a fully liberalised market which will determine for itself such investment decisions. The frequent statements that it must make a decision on energy, and specifically on nuclear, fundamentally conflict with such an approach and would therefore represent a major U-turn in energy policy. Moreover, if the Government does indeed come to a decision on nuclear, it is unclear why it should not also come to a decision on off-shore wind, marine, or micro-CHP—let alone the array of possible measures to support energy efficiency. Yet we never hear Government ministers talking in such terms.

180. If, on the other hand, the Energy Review is a wider ranging review of policy it will fail to command the support of stakeholders, the public and politicians if what emerges is significantly different from the course that was charted in the Energy White Paper without a proper explanation of how circumstances have altered sufficiently to justify such a change and without further wide-ranging consultation on the nature of the change. It is also unsatisfactory that it was launched before the publication of the long-delayed Climate Change Programme Review and will be concluded before the Stern Review has reported. This does not inspire confidence about the extent of coordination within and between different parts of Government.

181. We remain convinced that the vision contained in the White Paper—with its focus on energy efficiency and renewables as cornerstones of a future sustainable energy policy—remains correct. What is now needed is a far greater degree of commitment from the Government in implementing it. Alongside, more attention needs to be given to technologies such as clean coal and carbon capture and storage, both of which may have a significant role to play nationally and globally.

Annex 1: Conclusions and recommendations

A potential generating gap?

1. By 2016, it is likely that between 15 and 20GW of electricity generating plant will be decommissioned. This amounts to nearly a quarter of total UK generating capacity. Over the next 9 years, therefore, very substantial investment in new generating capacity and energy efficiency will be required if the lights are to stay on—even in the absence of demand growth. Further substantial investment on a comparable scale may be required in the following decade. (Paragraph 15)
2. The Energy White Paper, published in February 2003, addressed the need for carbon reductions across the economy but did not set specific targets for the electricity generating sector. However, it endorsed the view set out in the PIU report that new gas-fired generating plant, renewables and energy efficiency could make up for the potential generating gap left by the decommissioning of older coal and existing nuclear plant. (Paragraph 18)
3. Following the Climate Change Programme review and the current Energy Review, the Government should set targets for specific sectors of the economy including transport, the domestic sector, and the electricity generating sector for the level of carbon reductions to be achieved by 2020. It should also ensure that such targets, together with any targets set for absolute reductions in energy demand, are incorporated within departmental business plans and Public Service Agreements in order to ensure that policy development takes full account of the need to reduce carbon emissions. (Paragraph 22)
4. We have serious concerns about the ability of the Government to model reliably and in a timely fashion future energy and emissions forecasts. This is reflected in the fact that the updated energy projections are two years late, the unwillingness to accept earlier that the Climate Change Strategy was seriously off course, and the difficulties which the Government experienced in setting an emissions cap for Phase 1 of the EU Emissions Trading System. As a first step, the Government should ensure that it puts in place a transparent and credible system for updating these forecasts regularly every two years. Ultimately, it would be more appropriate for some form of sustainable energy agency—clearly independent of government—to perform this role. (Paragraph 28)

Filling the gap—energy efficiency, renewables, and other lower carbon options

5. There is little evidence as yet that the Government has succeeded in doubling the rate of energy efficiency improvements, as envisaged in the Energy White Paper. Indeed, given the importance the Government attaches to this objective, it is surprising that progress against the energy intensity ratio is not regularly reported and that it is not even included in the newly revised suite of 68 Sustainable Development indicators. The Government must address this glaring anomaly. (Paragraph 35)

6. The Environmental Audit Committee has highlighted on previous occasions the failure by Government departments—in particular, the Treasury—to take decisive action on energy efficiency. What is abundantly clear is that it will require a coordinated package of regulatory and fiscal policy instruments which offers much more in the way of both carrots and sticks, and that this must be accompanied by high-profile campaigns to raise awareness among the public. Far greater political leadership is required and far higher priority accorded to energy efficiency if the Government is to achieve the carbon reductions set out in the Energy White Paper. As part of such a strategy, we would also urge the Government to consider setting absolute targets for reductions in demand as a way of stimulating the growth of energy services and guaranteeing the level of carbon savings achieved. (Paragraph 40)
7. The UK lags well behind almost all other EU-15 countries in terms of the percentage of electricity generated from renewables, and it is now certain—as indeed the EAC has been forecasting for several years—that the Government will fall far short of the 10% renewables target set for 2010. However, the evidence presented to us indicated that renewables can deliver 20% of electricity generated by 2020. In this sense, the vision set out in the Energy White Paper is still achievable, though it will require a far greater degree of commitment in terms of implementation than has hitherto been demonstrated. (Paragraph 49)
8. The retro-fitting of super-critical boilers could enable coal plants to improve their efficiency and contribute substantially to carbon reductions. More significantly, the development of carbon capture and storage (CCS) could reduce carbon emissions from coal-fired plant by 80%. Indeed, the Energy White Paper singled this technology out as being of such importance as to warrant an urgent 6 month research project to take it forward. It is scandalous that so little progress in developing clean coal and carbon capture and storage has been made, and even the flagship BP-led DF1 project at Peterhead remains dependent on the establishment of a long-term financial framework which would provide greater confidence to investors. (Paragraph 51-53)
9. Distributed generation could fundamentally alter the structure of electricity networks in the UK. Micro-CHP, in particular, could deliver at peak winter periods as much as the current fleet of nuclear power stations, and could be a key technology for addressing both energy efficiency and fuel poverty. We see no reason why it should not begin to contribute substantially by 2020 and would urge the DTI and Ofgem to take a more proactive approach in developing the microgeneration strategy. (Paragraph 62)
10. With the possibilities afforded by energy efficiency, renewables, distributed generation, and carbon capture and storage, it is abundantly clear that new nuclear build is not the only option for lower-carbon electricity generation within the UK. Indeed, the Government is spoilt for choice. It is all the more disappointing, therefore, that so little has been achieved since the Energy White Paper in developing these alternatives. The failure to do so will exacerbate the potential generating gap and will result in an even greater reliance on gas over the next ten years than would otherwise have been the case. (Paragraph 63)

The Nuclear Option

11. The past history of the nuclear industry gives little confidence about the timescales and costs of new build. This does not mean that a new generation of nuclear power stations cannot be built to time and cost, but it does mean that investors have little basis for assessing the risks involved and may therefore require a higher rate of return. (Paragraph 70)
12. Nuclear can do nothing to fill the need for 20GW of new generating capacity which will arise by 2016, as it simply could not be built in time. The Secretary of State himself acknowledged that it might take 17 years before the first of a fleet of new nuclear power stations could become operational. Even if planning, licensing, and construction stages could be reduced to 10 years in total, the earliest possible date for the first of a series would be 2017—still too late to plug the immediate gap. For the period beyond 2017 nuclear could begin to make a contribution—though, given the fact that successive nuclear plants might only come on stream at perhaps 18 month intervals, it might not be until around 2030 that the full generating capacity of a nuclear programme would be available. (Paragraph 80)
13. Uranium mines can only supply just over half the current demand for uranium, and the situation is likely to become more acute as secondary sources—such as military stockpiles from decommissioned weapons—decline in importance. Such concerns, which are shared by the nuclear industry itself, may depress investment in new nuclear capacity, while the possibility of further large rises in the price of uranium could significantly alter the economics of nuclear power and render it less attractive to investors. (Paragraph 89)
14. At present nuclear power can justifiably be regarded as a low-carbon source of electricity. However, the extent to which this can be sustained needs to be examined. There is some evidence to suggest that the level of emissions associated with nuclear might increase significantly as lower grades of ore are used. Given the concerns expressed by the nuclear industry itself over the adequacy of uranium supplies after 2015, we regard this as a serious issue and one which can hardly be resolved in the time-frame of the current Energy Review. In view of its importance, the Government should consider asking the Royal Commission on Environmental Pollution to report on carbon emissions associated with all generating technologies. (Paragraph 95)
15. The risk of a major accident at a nuclear power plant may be remote but the consequences can be huge. This is reflected in the need for governments to underwrite the industry against losses in excess of Euros 700 million. Moreover, the risks of terrorist attacks on nuclear installations and the risks associated with any further proliferation of nuclear power are serious. (Paragraph 103)
16. No country in the world has yet solved the problems of long-term disposal of high-level waste. The current work being conducted by CoRWM will not be sufficient to address the issue of waste associated with new nuclear build. In particular, a further study to identify the likely costs of the latter would be required in order to reduce investment risk. (Paragraph 108)

Generating Costs, Markets, and Policy Instruments

17. Uncertainties in world markets for fossil fuels, in the regulatory framework which will apply, and in the pace of technological development—particularly with regard to renewables—make it very difficult to predict the future costs of different forms of generation. It is likely that we will see significant and perhaps unexpected changes in such costs over the next 20 years, and attempts to produce comparative figures in terms of costs per kilowatt hour are therefore of limited value. In such circumstances, absolute differences in generating costs matter less to investors than long-term certainty with regard to costs and income; while if market and regulatory frameworks cannot provide such certainty, investors will inevitably focus on short-term rewards. (Paragraph 116)
18. No simple answer can be given to the question of the likely cost of nuclear power. The cost will vary depending on the degree of risk which investors perceive is involved. This in turn will depend on a complex web of factors including the nature of the market, and the regulatory and policy framework which is in place. In this respect, there can be radical differences between countries, as the contrast between Finland and the UK demonstrates. (Paragraph 118)
19. Any new investment in generating capacity outside the framework of the Renewable Obligation will almost certainly be in gas, and we will inevitably be dependent on new CCGT plants for most of the 15GW to 20GW of new generating plant we will need by 2016. However, while there may be a certain degree of scaremongering on the part of the industry, it is by no means certain that the current highly liberalised UK electricity market will in fact provide timely investment in new generating capacity and ensure security of supply. Given the central importance of this issue, we find it strange that it is not included in the issues on which the Government is seeking views as part of the current Energy Review. The Government must therefore consider as part of that review whether there is a need to amend the current UK electricity trading arrangements in order to provide some form of capacity incentive and promote longer-term investment perspectives. (Paragraph 123)
20. It is sometimes argued that a greater reliance on gas, as envisaged in the Energy White Paper, would result in an increase in carbon emissions from the power generation sector as a whole. However, this is not necessarily true as substantial further carbon reductions of up to 40% could be achieved simply by replacing inefficient coal plant with new CCGT. (Paragraph 129)
21. Current policy instruments for low-carbon generation are failing to provide a secure long-term funding framework which will offer sufficient confidence to investors. As a result, progress in certain critical areas such as off-shore wind and carbon capture and storage is in danger of stalling. The Government must increase the amount of capital funding available for key low-carbon technologies. It should also consider as part of the Energy Review the possibility of either banding the Renewables Obligation to offer a variety of incentives for different technologies or else introducing guaranteed contracts for tranches of low-carbon generation. (Paragraph 141)
22. The Government has stated that it will not provide any form of direct or indirect financial support for a new generation of nuclear power stations. We welcome this.

Nuclear is an established technology which, like coal and gas, has benefited in the past from very large financial subsidies. In this respect, it contrasts strikingly with emerging renewables such as offshore wind and marine, where financial support is initially required to bring them to market and generate the cost-reductions which will enable them over time to compete with other forms of generation. (Paragraph 148)

23. Governments should make clear to consumers and taxpayers that low-carbon technologies have an explicit price premium: we cannot move to low-carbon power generation on the basis of cheap energy. (Paragraph 154)

The Energy Review

24. It is notable that the July 2005 monitoring report from the Sustainable Energy Policy Network gave no indication whatsoever of the need for a wide ranging energy review, other than a cursory reference to the Prime Minister's statement that a decision on nuclear needed to be made during this Parliament. This must show either that the Sustainable Energy Policy Network monitoring process is itself flawed, or that there is in fact no need at this stage for a review; and we are therefore concerned that the Review does not appear to have resulted from a due process of monitoring and accountability. (Paragraph 161)
25. Since the Energy White Paper, we would agree that various changes justify the need for a thorough review of implementation. However, the nature of the Energy Review itself is unclear and the case for a wider ranging review of energy policy has not been made. It will fail to command the support of stakeholders, the public and politicians if what emerges is significantly different from the course that was charted in the Energy White Paper without a proper explanation of how circumstances have altered sufficiently to justify such a change and without further wide-ranging consultation on the nature of the change. (Paragraph 163)
26. A key theme underpinning the review is the Government's argument that a decision on energy, and specifically nuclear generation, has to be made: 'doing nothing is not an option'. But, in the context of the Government's confidence in liberalised markets, we are at a loss as to what the nature of such a decision could amount to, and the Secretary of State was himself unable to clarify matters. (Paragraph 165)
27. The Energy Review is only one of a number of important reviews currently being undertaken. It is extremely unsatisfactory, for example, that it has been launched before the publication of the long-delayed Climate Change Programme review. Moreover, the Stern Review of Climate Change is not due to report until the Autumn—after the Energy Review has itself reported—even though logically it should come first. This does not inspire confidence about the extent of coordination within and between different parts of Government. (Paragraph 168)

Conclusions

28. By 2016, it is likely that between 15 and 20GW of electricity generating plant will be decommissioned. This amounts to nearly a quarter of total UK generating capacity. Over the next 9 years, therefore, very substantial investment in new generating capacity and energy efficiency will be required if the lights are to stay on—even in the absence of

demand growth. Further substantial investment on a comparable scale may be required in the following decade. (Paragraph 169)

29. At the same time, the UK is facing the unprecedented challenge of achieving radical reductions in carbon emissions in an effort to combat global warming—as reflected in the difficulty of achieving the UK 2010 carbon reduction target. The electricity generating sector accounts for nearly a third of total emissions and it will therefore need to play a significant role in achieving such reductions, and indeed the achievement of the 2050 target will depend heavily on the nature of investment in generating capacity over the next two decades. The Energy White Paper of 2003 addressed the need for carbon reductions across the economy but did not set specific targets for the generating sector. However, it endorsed the view set out in the Performance and Innovation Unit (PIU) report that new gas-fired plant, renewables and energy efficiency could make up for the potential generating gap. (Paragraph 170)
30. Over the next ten years, nuclear power cannot contribute either to the need for more generating capacity or to carbon reductions as it simply could not be built in time. The potential generating gap during this period will need to be filled—largely by an extensive programme of new gas-fired power stations, supplemented by a significant growth in renewables. Contrary to popular belief, a further ‘dash for gas’ would result in significant carbon savings. Moreover, it is not clear how much effect the replacement of older coal and nuclear plant by gas will have on the security of total electricity supplies, as we will in any case become highly dependent on foreign imports of fossil fuels for our total energy requirements (Paragraph 171)
31. Including over twice as much natural gas for industrial and domestic uses as we use for electricity generation. By 2016 at the latest, substantial further investment in generating capacity will be needed, and there are a number of different lower-carbon technologies which could contribute on a large scale—including renewables, microgeneration, offshore wind, nuclear, and carbon capture and storage. But there is substantial evidence to show that progress in deploying key technologies—in particular carbon capture and storage, off-shore wind, and microgeneration—is inadequate. The real issue which the Government is failing to address is whether the policy and regulatory framework in place is sufficient to stimulate the growth of lower-carbon generation on the scale required. (Paragraph 172)
32. All lower-carbon generating technologies are more expensive than coal and gas, and will require a long-term funding framework in order to reduce investment risk and ensure that the necessary investment takes place. The current highly liberalised UK electricity market structure is too short term and fails to provide such a framework. Indeed, it is not clear whether it will even ensure that enough investment takes place to keep the lights on by 2016. There are a number of options open to the Government to address this—including the introduction of some form of capacity payment, the development of low-carbon generation contracts, and the modification of the Renewables Obligation to provide a range of incentives for different technologies. The Government will need to consider what changes to the market structure are required as part of the Energy Review. (Paragraph 173)
33. Nuclear power raises a variety of issues which would need to be satisfactorily resolved before any decision to go ahead is taken. These include long-term waste disposal,

public acceptability, the availability of uranium, and the carbon emissions associated with nuclear. There are also serious concerns relating to safety, the threat of terrorism, and the proliferation of nuclear power across the world. Moreover, given the fact that substantial changes in the relative cost of energy technologies are likely to occur over the next 20 to 30 years, it is by no means clear whether investors will wish to commit themselves to 70 years of nuclear generation. There are striking similarities here to the position in 1980 when a similar large scale programme of nuclear new build eventually resulted in the construction of only one new reactor Sizewell B. (Paragraph 174)

34. A Government decision to support a major programme of nuclear new build must also take account of the impacts on investment in other areas—notably energy efficiency, renewables, carbon capture and storage, and the development of distributed generation systems. The potential of these various technologies over the next 20 to 30 years is immense, and any public subsidies for nuclear must be weighed against the substantial progress towards reducing carbon emissions and ensuring a greater degree of security of supply which these alternatives could achieve with similar subsidies. However, as all forms of lower-carbon generation will require financial support, the Government should accept that the shift to a sustainable energy strategy cannot be based – at least in the medium term—on maintaining low energy prices. (Paragraph 175)
35. The Government should be doing far more to promote progress in these other areas. Carbon capture and storage will, in particular, be of crucial importance in view of forecasts which show increasing use over the next thirty years of fossil fuels—especially in developing countries such as China and India. Renewables and distributed generation could also contribute hugely in both a national and global context—but any of the technologies involved warrant special support to bring them to market and achieve the cost-reductions which will make them competitive. (Paragraph 176)
36. While this inquiry has focussed primarily on supply side issues, we cannot emphasise enough that reducing demand is also a vital component on the path to a sustainable energy strategy. There is, as yet, little evidence to suggest that the Government has succeeded in doubling the rate of energy efficiency improvements as envisaged in the Energy White Paper. Far more decisive action and political leadership is required, and we would also urge the Government to consider setting absolute targets for reductions in demand as a way of stimulating the growth of energy efficiency and guaranteeing the level of carbon savings achieved. (Paragraph 177)
37. The nature of the current Energy Review is unclear—whether it is specifically fulfilling the Prime Minister’s desire to make a decision on nuclear, whether it is a review of electricity generating policy, whether it is a wider review of progress against the Energy White Paper, or whether it is reopening the broad policy debate which the White Paper itself encompassed. We are also concerned that it does not appear to have resulted from a due process of monitoring and accountability, and that the process by which it is being conducted appears far less structured and transparent than the process by which the White Paper itself was reached. (Paragraph 178)
38. If the Energy Review is focussed mainly on electricity generation and, in particular, a decision on nuclear, then it is unclear what the nature of such a decision could be and the Secretary of State himself was unable to explain this. Indeed, the Government has always argued that its role is not to prescribe the fuel mix, and it has invested much

effort in developing a fully liberalised market which will determine for itself such investment decisions. The frequent statements that it must make a decision on energy, and specifically on nuclear, fundamentally conflict with such an approach and would therefore represent a major U-turn in energy policy. Moreover, if the Government does indeed come to a decision on nuclear, it is unclear why it should not also come to a decision on off-shore wind, marine, or micro-CHP—let alone the array of possible measures to support energy efficiency. Yet we never hear Government ministers talking in such terms. (Paragraph 179)

39. If, on the other hand, the Energy Review is a wider ranging review of policy it will fail to command the support of stakeholders, the public and politicians if what emerges is significantly different from the course that was charted in the Energy White Paper without a proper explanation of how circumstances have altered sufficiently to justify such a change and without further wide-ranging consultation on the nature of the change. It is also unsatisfactory that it was launched before the publication of the long-delayed Climate Change Programme Review and will be concluded before the Stern Review has reported. This does not inspire confidence about the extent of coordination within and between different parts of Government. (Paragraph 180)
40. We remain convinced that the vision contained in the White Paper—with its focus on energy efficiency and renewables as cornerstones of a future sustainable energy policy—remains correct. What is now needed is a far greater degree of commitment from the Government in implementing it. Alongside, more attention needs to be given to technologies such as clean coal and carbon capture and storage, both of which may have a significant role to play nationally and globally. (Paragraph 181)

Formal minutes

Tuesday 28 March 2006

Members present:

Mr Tim Yeo, in the Chair

Mr Colin Challen
Mr David Howarth
Mr Nick Hurd

Dr Desmond Turner
Joan Walley

The Committee deliberated.

Draft Report (Keeping the lights on: Nuclear, Renewables, and Climate Change), proposed by the Chairman, brought up and read.

Ordered, That the Chairman's draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 181 read and agreed to.

Resolved, That the Report be the Sixth Report of the Committee to the House.

Several papers were ordered to be appended to the Minutes of Evidence.

Ordered, That the Chairman do make the Report to the House.

The Committee further deliberated.

[Adjourned to Wednesday 29th March 2006 at 2.30p.m

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Dr Richard Dixon , Head of WWF-Scotland, and Mr David Norman , Head of WWF-UK public affairs.	Ev13
Dr Brenda Boardman MBE , Programme Leader and Dr Mark Hinnells , Senior Research, Lower Carbon Futures; and Dr Catherine Mitchell , Principal Research Fellow, Warwick Business School.	Ev28
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Mr Philip Sellwood , Chief Executive and Dr Nick Eyre , Strategy Director, Energy Saving Trust; and Mr Dave Sowden , Chief Executive, Micropower Council.	Ev88
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Mr Vincent de Rivaz , Chief Executive and Mr Denis Linford , Director of Regulation, EDF Energy.	Ev109
Dr Keith MacLean , Head of Sustainable Development, Scottish and Southern Energy.	Ev121
Dr Anthony White MBE , Head of Policy and Markets Analysis, Climate Change Capital.	Ev132

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Professor Paul Rogers, Global Security Consultant and Professor of Peace Studies (Bradford University), **Dr Frank Barnaby**, Nuclear Issues Consultant, **Professor Keith Barnham**, Energy Security Consultant and Emeritus Professor of Physics (Imperial College London) and **Mr Malcolm Savidge**, Parliamentary Consultant, Oxford Research Group. Ev145

Mr Richard Mayson, Director, Energy Unit and **Mr Adrian Bull**, Head of Energy Policy, British Nuclear Fuels. Ev173

Mr Robert Armour, Company Secretary, **Mr Paul Spence**, Head of Strategy and **Mr Chris Anastasi**, Senior Environmental Adviser, British Energy. Ev193

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Dr Dieter Helm, New College, Oxford. Ev216

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Professor Sir David King, Government's Chief Scientific Adviser. Ev241

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Rt Hon Alan Johnson MP, Secretary of State for Trade and Industry, **Mr Paul McIntyre**, Head of Energy Review Team and **Mr Richard Abel**, Director, Domestic Energy, Energy Market Unit, Department of Trade and Industry; and **Mr Henry Derwent**, Director of Climate, Energy and Environmental Risk, Department for Environment, Food and Rural Affairs. Ev298

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First	Pesticides: The Voluntary Initiative, HC100 (<i>Reply, HC 443</i>)
Second	Johannesburg and Back: The World Summit on Sustainable Development–Committee delegation report on proceedings, HC 169
Third	Annual Report, HC 262
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