

Energy:

the policy climate

IOD POLICY PAPER

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1: Summary

1.1 Summary

- ❏ The Energy White Paper produced by the United Kingdom Government in 2003 ¹ set out policies that are based in very large part on environmental considerations around the effects and possible effects of global warming. These have clear implications for business.
- ❏ This report examines some of the key issues. It looks at the wider issue of "the environment", environmental interest groups and their influence on public policy, including government and international policies. The views of members of the Institute of Directors (IoD) on some energy-related issues are included.
- ❏ Changing climate is a constant feature of Earth's existence. A body of knowledge has developed after intensive scientific study in the last few decades. This new science still has uncertainties. Public response to climate change has altered in recent years. Worries about human influence on climate change have surfaced.
- ❏ Pressure to "do something" has risen, from environmentalists and others. This has led to a certain political and regulatory milieu.
- ❏ With regard to energy policy, some ideas are proposed, touching on security of supply, diversity of energy sources and the desirability of proceeding with new investment in energy research and development. Nuclear power is a policy issue that the Government should return to soon.

Energy is such a huge and encompassing issue that no attempt has been made in this Paper to cover all its aspects. A particular focus is placed on some of the environmental influences on energy policy (which have also influenced the Government) - especially the subject of climate change - and how this has led to a number of policy and regulatory reactions that have a palpable effect on business and society at large.

Recommendations for policy-makers include:

- ❏ Although environmental considerations are very important, it is critical that the Government and European Union (EU) adopt a pragmatic, rather than, ideological approach to delivery of energy policy.
- ❏ Whatever the aspirations, serious thought may need to be given to alternatives to the Kyoto Protocol on greenhouse gas reductions. For example:
 - ❏ The idea of seeking a multinational agreement on research and development to accelerate progress on new energy technologies;

- ❏ Greater emphasis on alleviating the effects of climate change;
- ❏ The need to avoid too much reliance on the Precautionary Principle in energy-related policy;
- ❏ The Government should not delay considerations around nuclear power;
- ❏ The need to address skills shortages in the energy and related sectors;
- ❏ Support for a Government review of publicly funded programmes and sources of advice on energy efficiency and related matters;
- ❏ Rather than move to compulsory corporate reporting on energy and environmental performance, a voluntary approach to reporting should be taken;
- ❏ A recognition that others - such as the public and customers - have a role to play.

2: Our Energy Future - *the UK Government's Energy White Paper of 2003*

2.1 Main issues

The Government published an energy White Paper in 2003. It covers a number of topics, but its very title (Our energy future - creating a low carbon economy) reveals the influence of the climate change debate, or more specifically the various greenhouse-gas reduction targets that came out of the international Kyoto Protocol that was agreed in 1997.

The White Paper looks at:

- ❑ "Cleaner" energy, in the sense of lower carbon dioxide (CO₂) emissions and the future energy system of the United Kingdom.
- ❑ Environmental issues.
- ❑ Energy efficiency.
- ❑ Low-carbon energy sources.
- ❑ Low-carbon transport.
- ❑ Reliability of energy supplies.
- ❑ Economic matters: productivity, competitiveness and innovation.
- ❑ Social effects of energy policy.
- ❑ Delivery of energy policy via partnerships.

We examine certain aspects of these in turn. Chapters 3, 4 and 5 focus on the underlying concerns with climate change, its effects on the environmental debate and consequences in terms of regulations and challenges. Other issues such as water, which are clearly of vital importance, are not addressed in the present Paper.

Before proceeding, the following table contains some interesting statistics on energy sources:-

Source	Proportion of total
Gas	38%
Coal	32%
Nuclear	23%
Oil and other	4%
Renewable energy	3%

Source: Department of Trade and Industry (DTI), 2003 Energy White Paper

The energy sector accounted for 21% of all industrial business investment in 2001.²

When it comes to use of energy it is instructive to note the parts played by sectors of society:-

Source	Proportion of total
Transport	36%
Domestic	30%
Industry	21%
Other	13%

Source: DTI, 2003 Energy White Paper (based on provisional DTI data for 2000)

This possibly conflicts with a popular view that industry is the great consumer of energy and that tackling business consumption will largely solve the problems.

2.2 The Government's policy objectives

It is worth stating the Government's four objectives of its energy policy, as explained in the White Paper:³

- ❏ Setting out to reduce UK carbon dioxide emissions by about 60% by the year 2050, with real progress by 2020.
- ❏ Maintaining reliable energy supplies.
- ❏ Promoting competitive markets in the UK and beyond, raising sustainable economic growth and improving UK productivity.
- ❏ Ensuring all homes are adequately and affordably heated.

These might perhaps be dubbed the Integrated Energy Policy, by analogy with the Government's "Integrated Transport Policy". Any policy-making may involve potentially conflicting goals and aspirations, so one need not be surprised that it may not be possible to achieve all four policy objectives at once.⁴ It is pleasing to see this admission in the White Paper itself.⁵

In the Queen's Speech in November 2003 the Government also announced its intention to publish an Energy Bill:

"My Government will also introduce legislation on energy matters, establishing a Nuclear Decommissioning Authority and promoting secure, sustainable supplies and a safer environment."⁶

The Energy Bill, since published in 2004, is intended to implement commitments laid down in the Energy White Paper:

- ❏ create a single wholesale electricity market for Great Britain (GB), bring greater choice for consumers in Scotland and provide all electricity generators and suppliers with access to a GB-wide market;

- ❏ establish a Nuclear Decommissioning Authority as a new public body to ensure the decommissioning and clean-up of civil public sector nuclear sites;
- ❏ set up a Civil Nuclear Police Authority to oversee a reconstituted nuclear constabulary (the present United Kingdom Atomic Energy Authority Constabulary), directly accountable to the Secretary of State for Trade and Industry;
- ❏ establish a comprehensive legal framework to support offshore renewable energy developments such as wind farms;
- ❏ implement provisions aimed at ensuring secure and reliable supplies, including for example, an administrative regime for gas transportation, electricity transmission and distribution companies facing real or potential insolvency.

"Cleaner" energy

The White Paper states that the UK "has one of the most open energy markets in the world".⁷ This is a view that the IoD supports, and is an important issue for the economic success of the UK in the international world - and for that matter within the EU.

It goes on to state that the Government believes it is possible to mitigate the effects of climate change, and intends to pursue policies to reduce global carbon dioxide (CO₂) emissions within the United Nations Framework Convention on Climate Change (UNFCCC).⁸ Furthermore, it has accepted the recommendation of the Royal Commission on Environmental Pollution (RCEP) that the UK should go down the road of CO₂ emission reduction of 60% by the year 2050. On the other hand, the White Paper states, "We cannot escape some climate change".⁹ In the opinion of the Government, such a steep reduction is seen as setting an example to other countries. The problem is that - as the Government has found out in other areas in which target setting has been a mainstay of public policy - targets as such do not necessarily lead to outcomes, or at least the desired outcomes.¹⁰ On the other hand, the White Paper states that the Government does not propose to set targets for the share of total energy to be met from specific sources, instead preferring to rely on the creation of a market framework, together with long-term policy instruments.¹¹ The Government had, however, already set a target for renewable energy's contribution to the UK total, of 10% by the year 2010.¹²

It is estimated that the economic costs to the UK economy of meeting the RCEP target would be about 0.5-2.0% of gross domestic product (GDP), but that these would be offset by savings from reduction in risks, for example, of flooding, if that target were to be met.¹³

One policy instrument is carbon emissions trading. The UK already has a voluntary trading scheme. From 2005 electricity generators, oil refineries and other industrial sectors are being expected to sign up to a much larger EU carbon emissions trading scheme.¹⁴ The UK Government thinks that emissions trading alone will not achieve its environmental goals.¹⁵ Thus pursuit of energy efficiency measures by energy suppliers and their customers is to be encouraged. New Building Regulations for new and refurbished buildings (which apparently account for 40% and more of the EU's greenhouse gas emissions) are also planned: the Energy Performance of Buildings Directive is already EU law.¹⁶ EU member states have until January 2006 to introduce the new requirements, although they will have until 2010 to decide how to implement the energy rating systems that they will need to apply. The focus is on offices, shops and hotels.

Environmental issues

These are focused on later, in chapters 3 to 5.

Energy efficiency

The White Paper admits that energy efficiency is likely to be the "cheapest and safest" way of tackling all four of the Government's objectives. This is very telling, and a point to which we shall return later in this paper.

Low-carbon energy sources

The Government aims to focus on renewable energy and combined heat and power (CHP).¹⁷ This not only includes energy supply but energy efficiency measures such as those in relation to buildings, referred to earlier. Nuclear power is currently excluded as far as new-build for power plants is concerned, but the Government does intend to keep its options open.¹⁸

Renewable electricity generation according to the Energy White Paper

This is defined¹⁹ as including the following sources:

- ☐ biomass (energy from crops or forestry)
- ☐ geothermal (from heat flow from the ground)
- ☐ hydro (water-flow derived, although "large hydro" schemes tend to get left out of any considerations for expansion)
- ☐ solar, including solar photovoltaics (PV)
- ☐ tidal
- ☐ wave
- ☐ wind.

Here is another area where target thinking raises its head again. To achieve one target (the RCEP one on 60% CO₂ reduction by 2050) the Government wants another to be achieved. This is to have renewable energy sources contributing at least 30%-40% of the UK total electricity generation by 2050.²⁰ There was already the target, set in the year 2000, of renewables being the basis of 10% of UK electricity supply in 2010. The IoD expressed scepticism about that at the time.²¹ Note that the DTI itself had the caveat, "subject to the costs being acceptable to the consumer".²²

Carbon contradiction?

"Government is not equipped to decide the composition of the fuel mix used to generate electricity",²³
DTI, Department for Transport (DfT) & Department for Environment, Food and Rural Affairs (DEFRA), 2003

"In this white paper we set the ambition of doubling renewables' share of electricity generation [in the decade after 2010]",²⁴

DTI, DfT & DEFRA, 2003

One point the DTI makes is that the UK does not rate highly by comparison with other European countries' electricity production from renewables. Excluding "large hydro", the UK had a 1.3%

contribution from renewables in 2000, compared with about 3% in Germany and Spain, 4% in the Netherlands and nearly 17% in Denmark.²⁵

A hugely ambitious intention lies behind the Government's targets. To even attain the 10% target by 2010 would require 10 000 MW of renewables supply capacity, when only 1 200 MW existed so far (again excepting large hydro).²⁶ The Government is keen to point out that the UK coast provides an offshore wind potential in excess of a third of that for all of Europe.²⁷ There are agreements for land leases to offshore wind farms having a total capacity (1400 MW) enough to supply a city the size of Greater Manchester.²⁸ It has been estimated that a further 3000-4000 MW offshore capacity could be created by 2010.²⁹

The Government has in place a renewables capital grant scheme up to 2005-2006.³⁰ It also wants to encourage local community ownership of new renewable schemes, again with capital grants schemes to act as an incentive.³¹

One thing is almost certain, and with which we would agree with the Government's views. Innovation, and research and development (R&D) will be crucial to the achievement of enhanced and more efficient practical renewable energy sources.³² Solar PV, and wave and tidal power, are areas identified as ones where increased investment in R&D may lead to the big improvements that would be needed.³³

CHP has run into difficulties affected by lower prices in wholesale electricity market, and increased prices in the wholesale gas market. Thus price changes were awaited before CHP could progress in line with the Government's plans.³⁴ Another barrier arises for smaller operators: difficulty of connecting to existing distribution networks.³⁵ The Office of Gas and Electricity Markets (OFGEM) has been looking at this problem.³⁶ The Government has also said that it will need to ensure that the New Electricity Trading Arrangements (NETA, which came in in 2001) do not act against smaller electricity generators, including those running renewable or CHP plant.³⁷ Another target may creep in somewhere along the line; in considering whether to encourage the public sector to use electricity derived from CHP.³⁷

British Electricity Trading and Transmission Arrangements (BETTA) is another new acronym and proposed scheme. It signifies plans for the Government to create by April 2005 at the latest an electricity distribution network for Great Britain that will fit in with the environmental aspirations of the Energy White Paper.³⁸

Planning procedures can often be an obstacle to many things, even to environmental matters. That is to say, the land use planning regime can often act against intentions to site new renewable plant.³⁹ This is a task that has been left to the Office of the Deputy Prime Minister, the Scottish Executive and the Welsh Assembly to try to sort out.⁴⁰ It is one that often crops up in consideration of wind turbines in local landscapes.

Whatever happens as to a "low carbon future" there is one particular curiosity of the Government's energy aspirations, that should not go unnoticed. This is the tacit recognition of the importance to the UK economy and to the Government's social policies of a large source of greenhouse gases. Coal mining, thought likely to have run out of economic reserves (at least in the deep pits) within a decade, is to be the subject of expansion, via an "investment aid scheme to help existing pits develop new reserves".⁴¹ This followed UK negotiation with the EU to breach the European Union's rules disallowing state assistance for industry. This even gives a new meaning to the term low carbon, perhaps.

"We recognise that coal producers can make positive contributions to areas that are often economically and socially disadvantaged ... and ... [have] shown ... [themselves] able ... to compete successfully both with other fuels and with imports" ⁴²

DTI, DfT & DEFRA, 2003

Low-carbon transport

Transport of all modes collectively contributes around a quarter of the UK's carbon dioxide emissions, with road transport making up most of this (85% of the transport total, with passenger cars being responsible for about 50%).⁴³ Clearly this is a major factor in energy policy.

Driving things forward

The Government plans to address this aspect of its energy policy to include taxation measures (the graduated Vehicle Excise Duty linked to a car's CO₂ emissions, and similar moves in relation to company cars),⁴⁴ various R&D programmes around vehicle efficiency and CO₂ emissions (such as the DTI's Foresight Vehicle Programme) and new fuels such as biomass-based liquid fuels.⁴⁵ There is also R&D on hydrogen-powered fuel cell cars,⁴⁶ as there is in the USA.

Political considerations are also very much to the fore. With taxation and initiatives such as congestion charging, some might argue that the UK Government is addressing this head on, or as much as it can without losing votes. One concern would then be that business could become an easy target for Government policy.

Air and sea

The Government admits that demand for air transport is rising (by about 4% annually, internationally). This is of clear importance to the UK: the Government also wants there to be sustainable long-term development of aviation. It is also concerned at the fact that greenhouse gas emissions from aircraft are not included in international totals. In the meantime, British Airways has joined the UK emissions trading scheme for its domestic flights.⁴⁷

The International Maritime Organisation is working on a scheme for reducing greenhouse gas emissions. The UK Government supports this and has extended Freight Facility Grants to switch from road transport to other modes, to include coastal and short sea journeys.⁴⁸

Security of supply

The decline in oil, gas, coal and nuclear energy sources in the UK is addressed in the White Paper. It is estimated that, by 2020, the UK could be dependent for 75% of its primary energy requirements on imported sources. To tackle this, the Government reckons that the way ahead is greater energy diversity: of suppliers and supply routes.⁴⁹ Additionally, the UK's energy infrastructure needs updating.⁵⁰ Recent large-scale power failures in London, Italy and North America have helped focus thinking here, although the general issue of security of supply in relation to potential terrorist attacks must also come to mind.⁵¹

Despite intermittent (or perhaps permanent these days) United States concerns about the political and other threats to oil in the Middle East, the citizens of the USA do not in general face the same more immediate diminution of a major source of energy supply in their back yard as do the people of the countries of Europe. For Europe it is not the back yard, it is offshore. North Sea oil and gas will run out, both in physical capacity, and as far as economically extractable reserves are concerned. In the next 20 years the UK, for instance, will become a net energy importer, rather than exporter.⁵² For gas this may happen from about 2006, and for oil by 2010.⁵³ It was only in the 1960s that oil began to flow to power European business and society, and it will only have been decades before it ceases to play a major role for the economies of Norway and the UK. (This is on a much lesser timeframe than that which concerns those who are worried at the prospects and effects of climate change.)

In fact, one reason for the apparent rise in concern about the natural environment in Europe, as compared with the USA, for instance, may have something to do with responses to decline in reserves of oil and natural gas in the European arena. (Although to counter this suggestion is the fact that only Canada and the UK of the G7 nations have been net exporters of energy.⁵⁴) There is greater pressure in Europe from environmental organisations, and seemingly more awareness about environmental issues than in the USA. Businesses must take account of their stakeholders in the normal course of events.

Apart from leading to big changes ahead in energy sourcing for the UK, the North Sea factor must also be a driver as far as firms having operations in Britain are concerned. Businesses involved in fossil fuel extraction have made moves in diversifying, funding work on alternative and renewable energy sources in some cases.

Energy reliability

The White Paper uses the term "energy reliability" to cover all aspects of energy security.⁵⁵ Thus it includes disruption of supply caused by technical failure, terrorism or weather-induced overloads, as well as planning for such factors as diminution of North Sea oil and gas over the next two decades.⁵⁶

The Government has made a commitment not to intervene in energy markets "except in extreme circumstances, such as to avert, as a last resort, a potentially serious risk to safety".⁵⁷

On the international scene, geopolitics must be constantly monitored.⁵⁸ Within the EU, the UK has been pressing for the opening up of competition in the energy sector for several years.⁵⁹

Domestically there is a problem by the look of it. At the end of 2002 the UK had a typical 16% capacity in excess of what it needed for electricity supply. This had actually fallen from its previous level of 25%. The Energy White Paper gives figures of some 27% "plant margin" (excess capacity) in 2001-2002, falling to about 20% in the following financial year. The Government, in fact, states that the decline has partly been caused by generating plant being mothballed, and that recently mothballed plant could be reactivated "at relatively short notice".⁶⁰

However, energy economist Dr Dieter Helm of Oxford Economic Research Associates has said that many developing countries have their energy infrastructures in better state than does the UK. This covers not only electricity, but also gas supply infrastructure, which he thinks may be in a worse condition than the former. Chronic underinvestment is the main reason. The public focus on lack of railway investment may switch to paucity of investment in the energy sector as a topic of British conversation, perhaps.⁶¹

"We will work with producer nations and the private sector to promote the conditions for investment in energy infrastructure",⁶²

DTI, DfT & DEFRA, 2003

David Porter, Chief Executive of the Association of Electricity Producers, has commented that many people in the generating sector were not convinced that there would not be electricity blackouts in the UK in the Winter of 2003-2004. Being pessimistic does not necessarily mean impending doom. Yet it has been reported that the National Grid had approached some of Britain's biggest businesses to ask whether they were prepared to sign up for Winter electricity rationing (in exchange for cheaper power prices).⁶¹ Winter went by yet the problem may not have receded.

Now, the Energy White Paper admitted that the experience in California in 2000 had already shown the importance of governments monitoring reliability of energy supply.⁶³ There is clearly a continued challenge here.

Productivity, competitiveness and innovation

The Government intends that its energy policy encompasses not only energy per se, but also:⁶⁴

- ☐ a competition regime that will encourage business innovation and cost minimisation
- ☐ promotion of business enterprise
- ☐ improvement of skills via education and training,
- ☐ support for science and engineering R&D, and
- ☐ encouragement of investment in physical infrastructure.

The Energy White Paper states that competition has already led to a price fall in real terms for domestic and business users, and that electricity prices were at a 20-year low.⁶⁵

To be sure, in R&D concerning what may turn out to be the energy-related products and power generation technologies of the future, there could be very many lucrative opportunities for UK business and research.

As for cost minimisation, the IoD has previously commented that there is a confusing plethora of sources of advice, especially considering small and medium-sized enterprises (SMEs). The Government's Strategy Unit (formerly known as the Performance and Innovation Unit - PIU) proposed that there should be a fundamental review of government-supported programmes aimed at working with business (particularly the Carbon Trust and the Energy Saving Trust⁶⁶) although the White Paper view was that some of those agencies were too new to be reviewed yet: they would be subject to review before the end of 2004, nevertheless.⁶⁷ The IoD has advocated rationalisation of publicly funded support bodies for business in other areas, so we would support such a review.

It was pleasing to see that the Government agrees⁶⁸ with another IoD suggestion; over the shortage of skilled people to work in trades in the energy sector (such as gas equipment installers⁶⁹).

The Government also agreed with the recommendation of an expert group led by the Government's Chief Scientific Adviser, which was given to the PIU; that UK spending on energy R&D should be increased. This followed extra public allocations to R&D, including renewables, and other energy policy objectives. The Government has endorsed the priorities put forward by the expert group:⁷⁰

- ❑ CO₂ sequestration (i.e. CO₂ storage)
- ❑ energy efficiency
- ❑ hydrogen production and storage
- ❑ nuclear (emphasising nuclear waste)
- ❑ solar PV
- ❑ tidal and wave power.

Work is also being supported internationally, including through the EU, and areas such as fusion power: via Euratom (the European Atomic Energy Community) and the International Thermonuclear Experimental Reactor (ITER).⁷¹ Work on fusion might lead to usable power plant within 25-30 years.

Energy and the vulnerable

The Government has set out to try to eradicate "fuel poverty" in the UK by 2016-2018, "as far as reasonably practicable"; situations where basic energy costs a disproportionate amount of income to heat the home properly.⁷² This it aims to achieve by a mixture of programmes including improved home insulation, more efficient heating, draught exclusion and energy pricing. According to its definitions (including the threshold for fuel spend being over 10% of household income) the Government says that there are about three million households which are fuel poor. It also wishes to help improve access to energy services via its international development programmes.⁷³

Partnerships

One of the buzzwords of the Government is "partnership". So it is no surprise to see this crop up in energy policy.

Partnerships are being set up across government and devolved government bodies, of course.⁷⁴ To these are added the other usual ones: local government and English Regional Development Agencies.⁷⁵

Business also features on the list, in particular with regard to two issues.⁷⁶ These are environmental reporting and encouragement of energy efficiency by customers.

Calls have been made for companies to report publicly on environmental performance (voluntarily, but with the Government's Company Law Review having sought to make it compulsory to report where "relevant" to an understanding of the business). An independent group of experts was appointed by the Government to advise on guidance to directors on how they can decide "whether an item is material and would have to be included in the annual report". The IoD has already expressed qualms about compulsory reporting. It can encourage lowest common denominator behaviour, or meaningless box-ticking, apart from anything else.

Retailers already work within the Energy Efficiency Partnership on ways of promoting more efficient products to consumers.

3: Background (1): a climate of change

Global warming or hot air?

In June 1998 we reviewed some of the current issues around climate change and 'global warming', the scientific background and some of the policy and practical implications for business.⁷⁷ The work of bodies such as the Intergovernmental Panel on Climate Change (IPCC) had led to governments around the world setting public policies based around climate change.

Five years may be a long time in policy-making terms but not in the history of the Earth and its climate. The Appendix to this paper looks at some of the scientific issues around climate change.

Despite such evidence, the Government's 2003 Energy White Paper does slightly overstate things, when it remarks that the observed warming can "only" be explained by greenhouse activities caused by human activities.⁷⁸

Modern developments

The United Nations (UN) Environment Programme and the World Meteorological Organisation set up the IPCC in 1988. It has brought together the work of thousands of scientists and others to investigate, evaluate and forecast possible effects of human-induced climate change. The IPCC concluded in its second assessment report that:

"the balance of evidence suggests a discernible human impact on the global climate"⁷⁹
IPCC, 1995

From examining data from a variety of different sources, covering the interval since 1860, it seems after careful analysis the Earth's mean global surface temperature has increased by between 0.3 °C and 0.6 °C.⁸⁰

According to the IPCC, global warming is driving plants and animals closer to the colder regions of the Earth's poles. Two recent studies have added evidence in favour of this observation.⁸¹

o The IPCC view is that mean global temperature is likely to go up by 2.0 °C (statistically speaking, between 1.5 °C and 3.5 °C) over the next 100 years given current trends with such factors as CO₂ emissions.

Notwithstanding the scientific unknowns, it is in the fields of economics and politics that many of the practical difficulties arise. While this is understandable, it is no comfort to individuals or to business leaders when there are calls for practical action being made by the IPCC, by governments and by environmental groups.

4: Background (2): environmental turbulence

Growing greens

One thing that has been rising in recent years is the influence of various environmental non-governmental organisations (NGOs). Hobbies such as birdwatching attract a tremendous following, and the Royal Society for the Protection of Birds (RSPB) is one of the largest membership bodies in the UK. Matters of more general environmental interests are taken up by NGOs such as Greenpeace and Friends of the Earth.

Apart from these organisations' devotion to the actual subject matter around the natural environment, they have come to hold great sway in the political arena, espousing policies to governments, local councils and international bodies alike. Political parties both green in theme and in name have also grown alongside the NGOs as such.

Doom and gloom?

"As the evidence piles up - climate change, desertification, pollution - we are beginning to understand the threat that this poses to our future in the form of conflicts over scarce resources, waves of refugees from environmental disasters, famine and disease",⁸²

Forum for the Future

Much of the talk by green activists and NGOs is in rather heady language, such as "threat ... to our future" (see the box above). Add to that some emotive language: "waves of refugees" and throw in some phrases from the past ("disasters, famine and disease"), and it can all add up to a pretty pessimistic view of life. Put alongside this such scientific-sounding terms as "upsetting the balance of nature" and it becomes a consistently gloomy scenario.

There is a choice of other possible catastrophes for humanity and the rest of the world. These include overpopulation.⁸³

An evolving view

Nature is not static. Life is not static. Life on Earth has been an ever-changing set of species living in habitats that change with the passage of time.⁸⁴ The best scientific evidence is that the panoply of life is ever-evolving. That has been going on for thousands of millions of years. This is no excuse for complacency; for thinking that the continuation of life is inevitable. However, it is interesting to set things in perspective.

'... misunderstanding of the natural world can be summed up in a phrase we constantly hear from the media, environmental groups, politicians and in casual conversation: "the balance of nature". The idea that nature is, or should be, "in balance" is deeply ingrained. But there is not, and never has been, a balance of nature.'⁸⁴

Graham Martin, School of Biosciences, University of Birmingham

The end of the world is nigh! (were this ever so)

If one were to take all the predictions made over the ages about the impending End of the World (or at least some components of it, such as humans and their world) one might conclude that:

- (a) we are invulnerable;
- (b) one of the constants of (human) nature is to dote on impending global catastrophe.

Now, neither of these may be true. On the one hand survival to date is not a truly reliable predictor of continued life on Earth or of humans' part in it (our share of luck may go down as well as up). On the other, just because enough people assert something does not mean it will come to pass. That is to say, millions of people may believe in things that are based on little or no evidence (like astrology) yet that fact (of belief) does not mean that the thing is necessarily true. Science - including environmental science - is not a democratic process. One cannot decide the laws of nature by getting a majority vote after holding a referendum.

Yet in one sense the views of the more extreme environmentalists have come to produce real effects. These may well be around perceptions, but people's perceptions can produce real results. This general factor is one that is well known to all businesses.

"Perceptions are facts because people believe them",⁸⁵
Epictetus, Greek philosopher, circa two thousand years ago

Is there an over-Precautionary Principle putting business at risk?

One real result is the incorporation of the "precautionary principle" in a variety of situations. These have included the European Union's Treaty of Maastricht.

A risk-averse culture exists. It sometimes degenerates into fear of the "unknown". Health and environmental scare stories abound, many based on the flimsiest of evidence (or even none at all). The mere assertion that some development could be harmful can mean calls for delay or cancellation.

Any idea that things can never have a down side is not realistic. There is of course no way to show unequivocally, for all time and under all circumstances, that something is absolutely safe. One implication for business could actually be a constraint on innovation, development and on new products and services.

The Precautionary Principle

When it comes to rules and regulations that business must obey, the application of the Precautionary Principle⁸⁶ is becoming increasingly prevalent. It has arisen in particular on discussions on environmental matters, including climate change and its effects. The Principle is now used as a basis within many of the proposals for regulations at European Union level, having been enshrined into the Maastricht Treaty. Examples include current deliberations around the deliberate release of genetically modified organisms (GMOs)⁸⁷ and a Directive on Environmental Liability.⁸⁸

It seems that the most strident advocates of the Precautionary Principle appear to cling to the notion that absence of evidence of harm must be taken as proof of the need for action to halt proceedings - now. A good example of current trends is provided by GMOs.⁸⁹ There should be adequate assessment of risk from deliberate release of GMOs into the environment. However, this ought to be on a case by case basis, rather than trying to judge the technology as a whole.

Businesses in particular must deal with public perception all the time. Businesses that totally ignore public perception of their products, their message and their image are highly unlikely to survive very well or very long. Even though people's attitudes may change over time, businesses must still deal with public opinion as a matter of course.⁹⁰ Another problem that confounds the issue is of general distrust of "big business", especially "the multinationals" - and it very big agrochemical firms with global operations that are involved in GM technologies.

The IoD supports high standards of health and safety, to ensure that products and services do not pose undue threats to people or to the natural environment. However, overzealous application of the Precautionary Principle could lead to delayed or stifled innovation. Governments and society have always had to weigh up the likely costs and benefits when considering whether to proceed with new projects. There could be occasions when, by not introducing novel products and processes, net harm (or foregone benefits) will result. The loss will not be just to entrepreneurial and business activities in benefits foregone. The loss will be to society at large.

We hope that the UK Government and supranational institutions such as the EU will be persuaded to take a pragmatic rather than an ideological approach to such issues. Current trends at EU level are not encouraging, however.⁹¹ In the final analysis it is the outcomes that will matter:

"The government's priorities are to protect people and the environment. But we must do so in ways that do not deny to people the healthcare, environmental and other benefits that flow from technological advances. That would be an abdication of the responsibility placed on government".⁹²

Labour Party, 1999

Discussions (or the lack of them) about nuclear power have surely been influenced by a precautionary approach - to the extent that it seems to be taken as given by many public commentators that nuclear power is no longer on the policy agenda. This seems to be something that is simply assumed in some quarters.

Environmental certainty?

It can seem, on occasion, that some environmentalists talk as if they had a fairly good knowledge of future events, in the sense of stating that if action **a** happens it will definitely lead to outcome **b**. The world, and the complexity of environmental interactions, shows that the link between influence and outcome is often not so straightforward. It might make for more rational debate for some environmentalists to also admit that they do not have perfect knowledge of the future, any more than do scientists or business people. In the meantime, the fervour of no doubt well-intentioned views on the environment can display some of the characteristics of religious views. That may account for some of the emotion, at least, in debates on views that challenge the "accepted" litany of (extreme) environmentalism.

When computer models led to forecasts of rise in the mean temperature of the Earth's atmosphere from 1.4 °C to 5.8 °C, certain environmentalists seized on the upper figure. The actual statistical distribution of the temperatures forecast is skewed towards 2 °C. This was the most likely forecast rise at that time. Some climatologists reckon that humanity could cope with the effects resulting from such an increase in global average temperature.⁹³ We shall see.

5: Background (3): regulations and risks ahead

Moving back to practical issues: the UK Government has talked of market measures. It has also stated that, where regulation is "required", it will endeavour to minimise burdens, particularly on small and medium sized business.⁹⁴

The Royal Society has proposed replacement of the Climate Change Levy by a different tax or permit system.⁹⁵ One of its criticisms is that the Levy does not cover fossil-fuel use by households, or transport. Additionally, the Society stated that renewable energy sources such as wind power, are unfairly penalised.⁹⁶ A new system should both encourage energy conservation and renewable energy. Then it might be more consistent with the Government's stated intention to support developments in renewable energy.⁹⁷

A flood of legal claims?

A physicist at the University of Oxford has floated the idea that it might at some stage in the future be possible to sue over liability for climate change.⁹⁸ Apparently some climate change lawsuits have already been filed. These relate to technical legal matters such as whether climate change considerations should be included for an environmental assessment to be considered adequate. It would of course be well nigh impossible to apportion blame, but he raised the prospect of class actions being taken against the oil companies, for example. Apart from anything else it would depend on much more precise science. Nevertheless, given the importance accorded to environmental law and the rising tide of litigation in general, it is not a notion to dismiss lightly, perhaps.

The European angle

A new European Union constitution, once - eventually - agreed, would be another factor affecting energy policy. There is no consistent EU-wide energy policy. Some EU member states believe that it is possible to achieve Kyoto (ratified or otherwise) greenhouse gas reduction targets and security of energy supply without nuclear power. In others the call for increased contributions from renewable sources is clear. But all are involved in expansion of gas as a source.⁹⁹ Periodic problems of energy supply exist. These are connected to the fact that oil and gas output is concentrated in a small number of countries worldwide. The Middle East is responsible for 26% of production, and has more than half of the Earth's conventional oil reserves: around half of the world's natural gas reserves lie in Russia and Iran.¹⁰⁰ European nations import 56% of their total domestic crude oil needs, plus 34% of total volume of natural gas used.¹⁰¹ This could be a source of considerable risk when considering security of future supply.

Both the European Commission and the European Environment Agency have noted that, under existing policies and practices in within the EU, the European Union as a whole is likely to reduce its greenhouse gas emissions by 0.5% from 1990 levels by 2010.¹⁰² Their work also indicated that even additional measures identified by the EU's member states would also lead to a shortfall on the

EU targets. The Commission has responded with the intention of issuing a Communication during the first half of 2004 to develop further options under the European Climate Change Programme. It has also urged member states to transpose existing EU measures into national laws and to consider more measures of their own, although additional work for the EU (accession of new member states, European Parliament elections and Commissioner changes in 2004) were all expected to slow down Programme progress.¹⁰³

The EU's Kyoto targets and action by individual member states

The European Commission's own assessment of the EU's progress on Kyoto targets does not give confidence that the EU as a whole is on course to achieve greenhouse gas emissions reduction targets under the Kyoto Protocol.¹⁰⁴ With the report that only Sweden and the UK are on course to meet these targets come some serious potential implications for not only the EU but also individual member states.

A survey in 1998 of IoD members¹⁰⁵ showed up concerns about unilateral policy measures by the UK that could disadvantage British competitiveness. Only 7% of respondents thought that the UK should introduce measures to meet its targets before other countries had done the same. Forty nine per cent thought that the UK should be participating in action taken by all countries, and 29% that the UK should only act in conjunction with other developed countries.

This perspective is unlikely to have changed greatly since. Therefore, separate from the question as to whether even the reduction targets in CO₂ emissions by 2010 could actually achieve truly beneficial effects on climate change, the differential effects on the UK economy, as compared with other countries (and even other EU countries having less stringent emission reduction targets) must be considered. The UK should not go it alone.

The EU's Kyoto Protocol targets, and competitiveness

The same points as above relate to the EU in the world economy.

Even if matters connected with climate change are understood, there are other barriers to action. Surveys tend to show that levels of actual public actions around practical measures on environment-related issues are generally lower than levels of expressed concern.¹⁰⁶ The challenge for the EU of achieving the kinds of changes such as less frequent use of cars should not be underestimated. Individuals often understandably put immediate economic concerns ahead of considerations around climate change.

This presents a clear challenge in a pan-EU context.

EU Emissions Trading Scheme

The IoD favours market mechanisms, but at present we have not done any detailed work on the Scheme. However, a few points from an IoD member survey may be of interest. The April 2003 issue of IoD Policy¹⁰⁷ carried a questionnaire on aspects of the Government's Energy White Paper. Some ten per cent of respondents (mainly those employing over 250 people) indicated their organisation's involvement in the UK greenhouse gas voluntary emissions trading scheme. About a third might, or

were very likely, to get involved in the present or any future scheme. Just over half thought it unlikely or very unlikely that they would. Several commented that their organisation was too small to get involved. One member commented: "We are not convinced that emissions trading leads to overall reductions. We will continue to pursue reductions but not through trading."

Pragmatism and the details of the EU Scheme will clearly be of crucial importance. We hope that it will be pragmatic.

The EU and international negotiations on climate change

It is important to be realistic. The Kyoto Protocol will only come into force if 55 countries ratify it - and if these countries account for 55% of the 1990 CO₂ of the industrialised countries listed in Annex I of the United Nations Framework Convention on Climate Change.¹⁰⁸ The former figure has been reached, but not the latter. The UK's emissions amount to about 2% of the global total, and the Government admits that unilateral reductions by the United Kingdom would have "no impact on climate change unless they are part of a concerted international effort".¹⁰⁹ That same advice can be taken as applying to the EU as a whole. The USA, Russia and Australia have not ratified the Kyoto Protocol, although Australia decided to limit greenhouse gas emissions as if it had so ratified the Protocol.¹¹⁰

One important intention is stated in the UK Government's Energy White Paper: "We will work with producer nations and the private sector to promote the conditions for investment in energy infrastructure".¹¹¹ There are opportunities for EU member states to benefit by exporting or licensing commercial technologies, in the area of energy efficiency and renewable energy technologies.

There are many links between climate change policy, environmental aspirations and world trade. The UK Government's Department for International Development (DFID) has said that it takes "seriously developing countries' concerns about the potential for the misuse of environmental measures for protectionist purposes".¹¹² University of London Emeritus Professor of Biogeography Philip Stott used the phrase "climatic colonialism",¹¹³ which seems rather appropriate. Other commentators have emphasised the importance of not advocating utopian positions in relation to proposed reform of international trade, "such as a return to localised economics and self-reliance", which could be more damaging for developing countries than the present systems.¹¹⁴

One piece of advice from the Secretary General of the United Nations, Kofi Annan, is apposite in this context. He has remarked that it is not globalisation that is a threat to developing countries: it is being excluded from globalisation that presents a danger to them. These sorts of considerations should also be taken account of by EU international negotiators.

Some commentators have remarked that the Kyoto agreement is effectively dead, not least because of the refusal of Russia and the USA to ratify. Even if the commentators are not correct, one alternative is certainly worthy of scrutiny. This is the idea of seeking a multilateral agreement on R&D to accelerate development of new energy technologies to assist the reduction of greenhouse gas emissions.¹¹⁵ The EU should seriously consider such options as part of its deliberations on climate change policy.

6: Clouds on the horizon

Can the IPCC's proposed reduction of greenhouse gases actually be achieved globally? If so, will it make a difference? Could the costs of extra restrictions and regulations actually lead to a net cost on society, rather than a benefit? There is surely nothing wrong with asking the question as to whether it will make economic sense. (That is actually one of the main points being made by Bjørn Lomborg (see the Appendix, p 40).

If one had been aboard the sinking Titanic in 1915 and, having become aware of the dire circumstances, begun bailing out water with the aid of a teaspoon, would it have made any difference? No. The fact that certain environmental interest groups may not want to hear that international agreements such as the Kyoto Protocol will very likely not lead to any meaningful outcomes¹¹⁶ is neither here nor there. Environmentalists should not only address scientific matters. They should also consider practical politics and human psychology much more realistically.

On the Government's Energy White Paper the Royal Society commented that it was difficult to see how a large decrease in CO₂ emissions could come about without reducing reliance on coal, gas and oil.¹¹⁷ A recent forecast from the University of Uppsala in Sweden has suggested that the Earth's supplies of oil and gas may actually be exhausted for even the most conservative of the IPCC's temperature increase forecasts.¹¹⁸

Even though the USA has not ratified - and seems unlikely in the short term to ratify - the Kyoto Protocol, there have been developments in that country with regard to greenhouse gas emission reductions, for example by the 37 major corporations which have joined the Pew Center's Business Environmental Leadership Council. Nevertheless, developing countries can be reluctant to take on binding commitments if developed countries are not seen to take action on their own commitments or stated aspirations.¹¹⁹ Note also that Russia may not ratify the Protocol, in case it would stifle that country's economic growth.¹²⁰ If Russia does not ratify it would spell the end of the Kyoto Protocol in its existing form. Australia has decided not to ratify the Protocol at present but aims to cap its CO₂ emissions at 108% of its 1990 levels over the period 2008-2012.¹²¹ In the meantime a Bill failed to pass in the US Senate in October 2003 (by 55 votes to 43), that would have led to immediate cuts in emissions from public utilities and other industries.¹²² The US Department of Energy had estimated that the Bill would have led to a cutback in GDP growth from 3.04% to 3.02%.¹²³

"Erecting trade barriers in the name of protecting the world's environment is counterproductive. By slowing the pace of economic development, such barriers perpetuate poor local working conditions, especially back-breaking subsistence agriculture",¹²⁴

Julian Morris, Institute of Economic Affairs

"While developing countries must work to enforce acceptable conditions, developed nations must recognise that standards will reflect the local economy and that poor countries cannot equal rich countries' pay and conditions. Strong consumer pressure can be a positive force for change. But it can damage those it seeks to help",¹²⁵

DFID

'Dogmatic environmentalism ... is "in some ways as narrow and selfish as the imperialism of old."' ¹²⁶
Claude Martin, Director-General of WWF International

7: The long-range forecast

The IoD had previously called on the Government to give more emphasis to alleviation of the damaging effects of flooding, etc. Thus it is welcome that the Environment Agency, for example, has called for a "wide-ranging re-think of public policy to 'climate-proof' England and Wales against the impacts of global warming in the coming decades".¹²⁷ This seems to be a more pragmatic policy than merely having aspirations.

"It's time to accept that climate change is unstoppable, but working out how to adapt to it won't be easy",¹²⁸

New Scientist, 2003

There are most certainly implications for the insurance sector - and those taking out insurance - as a result of the effects of climate change. For example, the flooding that occurred in parts of the UK in the year 2000 is estimated to have cost £1 billion. Rising sea levels around the UK coast could continue to threaten the country.¹²⁹ If the average global temperature does continue to rise there will be very costly considerations for both the insured and the insurers.

"Even if all the science were certain and it could be demonstrated that reducing greenhouse gas emissions would alleviate or reverse global warming, it is fairly clear that even quite drastic changes would not have a noticeable effect on global climate for many decades, even though they may avert some of the most extreme possibilities. Some adaptation to climate change will still be necessary",¹³⁰

IoD, June 1998

The Energy White Paper does quite rightly point out that climate-induced changes such as increased extent and severity of coastal flooding would disproportionately affect poor people living in developing countries.¹³¹

Without denigrating that analysis, it is the situation already that poorer people tend to experience disastrous effects, including flooding but also many other catastrophes such as deadly diseases, hunger and displacement. This is well in advance of the effects of sustained global warming. One of Lomborg's contentions is that it would actually make more economic and humanitarian sense to help people who are already living in conditions that put them at such risk, if international agreements meant that aid could be given to them now. His economic point is that pursuit of the international climate change agreements (Kyoto Protocol and any successors), even were they to be ratified and actually put into practice, could well turn out to be less cost effective than if aid were granted now to assist people in alleviating present and coming environmental effects. In some ways it may be disingenuous for environmentalists and others to rely too heavily on putting the case for the poor; the (sad) fact is that very many of the existing problems of poor people and countries are known about in minute detail by the advanced nations and international agencies. Not alleviating some of these depredations could very well have implications for the planet as a whole on account of famines and future wars, yet very little is done, in the scheme of things, to tackle many of these

issues. It seems that it is only climate change that excites the interest of some.

The White Paper states that there will still have to be some adaptation to the effects of climate change (whatever action is or is not taken nationally or internationally around climate change carbon reduction aspirations).¹³² The IoD had already commented to the Government that it should do more around alleviation, in response to its climate change policy proposals in 1999. The Government's view is also that, even if atmospheric greenhouse gas concentrations can be stabilised (at some as yet internationally unagreed level) there would still be negative effects for most people on Earth.¹³³

Most of the intended reduction of carbon emissions prior to 2020 is believed by the Government to be achievable at costs lower than or comparable with the likely costs of damage were emissions not controlled in this way.¹³⁴

Business is meant to be encouraged by a combination of mechanisms including price, environmental taxes and carbon trading permits.¹³⁵ The Government wants to work with business to achieve gains related to energy efficiency and also new market opportunities in lower-carbon and renewable energy technologies.¹³⁶

On the nuclear front the Government's Energy White Paper states that if innovation in low-carbon technologies did not make enough impact, then costs of cutting carbon emissions would be higher. It is of significance to note that they would also be higher if improved energy efficiency savings were not to be made, or if both new nuclear power capacity and carbon capture and storage did not materialise in the long term.¹³⁷

8: Pragmatic outlook

"There seem to be two main fronts when it comes to global environmental impacts:

- ☐ those who believe that we must make changes now to turn the 'super tanker' of global climate change around
- ☐ those who point to humankind's innate ability to innovate to resolve the problems that face us." ¹³⁸

Adrian Campbell, Arup, South Africa

Looking on the sunny side

The Government's energy White Paper of 2003 has sought to promote energy efficiency measures and renewable energy sources as the main means of reducing the UK's carbon dioxide emissions. Scepticism has been forthcoming, not only from environmental groups but also from energy experts. For example, by rejecting nuclear power and not investing enough in renewable sources some have said that this will not do enough to move away from reliance on oil and gas.¹³⁹ Jeremy Leggett, the chief executive of Solar Century, a solar cell business, has asserted that the government funding (£348 million) to be made available for renewables is an order of magnitude less than in other European countries such as Germany.¹³⁹

In the USA FutureGen is a ten-year project aimed at building a coal-fired power plant that will trap its carbon dioxide emissions underground.¹⁴⁰ This has not been received with absolute enthusiasm by everybody, however, and the thinking around this has been criticised as being too unfocused.¹⁴¹ In Germany and the UK there have been examples of using energy from methane in disused coal mines.¹⁴² This is not counted in the renewable targets in the UK; the schemes are indeed not making use of renewable energy. Yet methane is a more potent greenhouse gas than is carbon dioxide. Here is an interesting example of having to weigh up different policy objectives.

The President of the USA launched a programme intended to produce "pollution-free" cars, fuelled by combining hydrogen and oxygen to produce water.¹⁴³ The President also wants to reduce research into renewables and energy efficiency, while investing in clean coal technologies, nuclear research, and sequestration of CO₂ from the burning fossil fuels to prevent it entering the atmosphere.¹⁴⁴ Investment in the 'hydrogen economy' proposed by the USA may evolve via a combination of government energy policies, rather than the market, perhaps.¹⁴³ It takes more energy to extract hydrogen from its sources than is available to the user of energy, and it could require an enormous construction programme, equivalent to doubling the present US national average power capacity, based on current technology. In the USA the energy to make the hydrogen is likely to come from coal and from nuclear power.¹⁴⁵ The UK Government also has aspirations around hydrogen fuel cells, including use of hydrogen to power buses and other public transport vehicles.¹⁴⁶ There is a note of caution: some scientists have begun to outline the potential environmental hazards of reliance on hydrogen; for example, harming Earth's ozone layer, and perhaps contributing to global warming.¹⁴⁵

"At the moment, solar panels are like the Model T Ford - there are few design options",
Dan Davies, engineer at Solar Century (a renewable energy company), London¹⁴⁷

Solar selling

"While there are so many efficient and more adaptable sources of stored solar energy available, it is hardly likely that the direct application of solar heat for this purpose will find favour" ¹⁴⁷
F. J. Sellers, former director of Solar Section, British Astronomical Association, 1953

Free solar energy has been around for thousands of millions of years. Large-scale practical use in power systems has not had a long history. Practical ways of capturing it exist, including passive rooftop water heating systems. One of the challenges in the context of the current energy debate is around PV and perhaps other technologies.

Even in generally sunny Australia, and in spite of growing government subsidies, the payback time for solar cell panels is currently about 30 years.¹⁴⁸ Although the situation in the Outback is different, this is still indicative of present state of the economics of silicon solar cells, even in such a favourable location as Australia. However, technological breakthroughs seem quite likely to change this in due course.^{149, 150, 151}

"... what's stopped us from putting solar panels on every city rooftop in Australia is cost - they're bloody expensive."¹⁴⁸
Ken Eastwood, Australian Geographic

It seems unlikely that British industry will meet the Government's target of producing 10% of electricity from renewable sources by 2010.¹⁵² Five per cent may be more likely. Add to that the improbability of attaining the 20% reduction in CO₂ emissions by 2010. Engineering issues around energy storage raise their head - wind is generally intermittent, for example. Even for offshore wind farms there are still huge issues of transmission from sea to shore to be addressed (although the oil and gas industry may be able to advise on some of the engineering aspects, such as construction). Taken as a whole, probably all renewables are at present uneconomic (they get subsidies, as well as do other sources) and offer a long-term return on investment. Whatever the future spin-offs from R&D, this does need to be taken into account.

A group of 18 energy analysts in the United States believe that none of the power-generating now being developed would be able to control emissions of greenhouse gases.¹⁵³

Directors' outlook on some aspects of the Energy White Paper

The April 2003 IoD Policy carried a questionnaire on aspects of the Government's energy White Paper.

Some 60% of the 136 respondents indicated that the organisation of which they were a director had a policy on waste reduction. This was about the same proportion (58%) as those having a policy on improving energy efficiency. Thirty four per cent had a policy on reducing greenhouse gas emissions.

Of those without such policies, over twice as many thought it likely or very likely that they would become involved in waste or energy efficiency issues in the next three years as thought it unlikely or very unlikely. The situation was reversed for greenhouse gas reduction. Twice as many indicated that they were unlikely or very unlikely to engage as were likely or very likely to.

Monitoring by the board of directors was done in 40% of organisations for waste and energy efficiency, and 32% for reduction of greenhouse gas emissions.

When asked what would most likely affect their organisation's energy use in practice, the highest ranked (after the perhaps obvious price and tax) was customers (67% of respondents). Competitor behaviour was ranked equally with concern about climate change: by 35%. Environmental NGOs came lowest (11%).

About half of directors' organisations actively encouraged their customers or clients to be energy efficient: about half did not. This was associated with whether or not they were in the business of giving energy efficiency or environmental advice: 97% compared with 35%, respectively.

Some ten per cent (mainly those employing over 250 people) indicated their organisation's involvement in the UK greenhouse gas voluntary emissions trading scheme. About a third were either likely, or very likely, to get involved in the present or any future scheme. Just over half thought it unlikely or very unlikely that they would. Several commented that their organisation was too small to get involved.

One member commented: "We are not convinced that emissions trading leads to overall reductions. We will continue to pursue reductions but not through trading."

When asked whether the standards of manufactured products should be changed (voluntarily or by regulation) to improve energy efficiency, 77% thought so, 14% disagreed and 8% were unsure. For those in favour, the top two preferred tools for influencing standards were improved product information to consumers, followed by organisations' own procurement and purchasing policies.

There was no clear majority view in support of compulsory corporate reporting of environmental performance and energy use. Thirty two per cent favoured reporting for all organisations (public and private sector), 26% for very large businesses only, 9% for the public sector only, and just 1% for all private businesses only.

Directors were asked for a personal view about nuclear power in the UK. Eighteen per cent thought it would be phased out, 38% that it would stay at about its present level, 25% that it would come to play a bigger role and 15% did not know.

The nuclear option

In the USA at least, nuclear-fission generated electricity currently costs twice as much as that produced from coal and gas.¹⁵⁴ On the other hand, nuclear power scores highly on the environmental impact front (particularly the CO₂ front), and its supply is ensured for perhaps 500 to 1000 years from now.¹⁴³ Fusion power may have been cracked by then as a practical power supply proposition, or even within the next few decades.¹⁵⁵

According to Sir Alec Broers, President of the Royal Academy of Engineering, renewable energy will neither prevent global warming nor power blackouts: "I think we need both [nuclear and renewable energy]".¹⁵⁶ At least a decision ought to be made one way or another about the future of nuclear power, apart from anything else because of the long lead-time needed to bring such new engineering projects into operation.^{100, 157, 158} Here we are talking about periods of ten years and more. The Government should proceed with its White Paper intention of having a full public consultation and debate around nuclear power.¹⁵⁹ This should not only include the 2003 Queen's Speech promises around decommissioning old nuclear power stations.

The British Energy Association view is that the UK Government's carbon dioxide reduction targets will not be achieved without an expansion of nuclear power.¹⁶⁰ In the meantime we are left with the statement in the White Paper:

"If new nuclear power plant is needed to help meet the UK's carbon aims, this will be subject to later decision."¹⁶¹

Other considerations around renewables revolve around subsidies.¹⁶² Wind energy, which accounts for 2% of European energy needs, is the fastest growing of the renewables¹⁶³ and may be the cheapest of the renewables, yet there are subsidies. Planning objections also abound on land: it may be at sea that the better prospects exist. Energy crops require large amounts of land, although there are already localised small-scale landfill gas plants and poultry manure plants. Most hydroelectric dam sites may be already taken up. Wave energy is still at the research stage, in the main. Offshore tidal turbines may come into their own eventually. Solar power is still uneconomic in the UK, although costs have fallen 90% since the 1970s, to around US \$4.50 per watt (compared with US \$3 per watt for grid electricity - although the \$3 does not include environmental costs or hidden subsidies of the grid).

According to the World Alliance for Decentralized Energy, distributed generation (with an array of "micropower" technologies such as small gas turbines and solar panels) accounts for 7% of total electricity production worldwide in the past three years.¹⁶³ Ultimately such localised technology could include hydrogen from fuel cells.

Public expectations of business

The Government expects business to play its part in delivering UK energy policy. One important area is that around energy efficiency. The Government wants its "market" signals to encourage investment, and to help UK manufacturers to develop green technologies.¹⁶⁴ It wants businesses to use energy more efficiently, reduce CO₂ emissions and lower costs.¹⁶⁵ It does want to provide support, not only by market mechanisms, but also through such means as the sector skills network to inculcate the skills needed by industry.

"We will depend on businesses, supported by the research community, to adapt and deliver a low carbon future",¹⁶⁶

UK Energy White Paper, 2003

The IoD has argued that there has been too much emphasis on expectations of business to address¹⁶⁷ environmental issues - and that customers (individually and collectively) - can play a major role. Strong advocate of the mitigation route to cope with climate change, US participant in the IPCC, Dr Kevin E. Trenberth, has also said that the onus should come on the consumer.¹⁶⁸ He has suggested that the USA introduce: a tax or rebate based on a vehicle's fuel efficiency; an increase in petrol tax and a reflection of the costs of fossil fuels in their price. Education also has a part to play.

"the EPI [Ethical Purchasing Index] shows that ethical consumers still command only a 1.6% share of the marketplace across seven sectors. This ... is a fraction of the ... three-quarters of consumers who tell pollsters that they ... sometimes purchase ethical products"¹⁶⁹

The Guardian, August 2002

Nevertheless, energy efficiency is an area that involves factors amenable to business intervention.

The Government wants over half of the carbon emissions reductions it is seeking to come about via energy efficiency measures.¹⁷⁰ This is estimated to require a doubling of the rate of improvement achieved over the last three decades.¹⁷¹

The UK Government brought in an energy efficiency commitment in April 2002 for suppliers of energy for domestic use. Each such supplier has an energy saving target, which may be complied with by encouragement of householders to undertake energy saving. The Government reckons that suppliers are doing well on their targets, though it wants to extend (and possibly expand) the scheme beyond the current cut-off in 2005.¹⁷² It may also seek to extend the energy efficiency commitment beyond the domestic sector, after consultation on whether this would be appropriate.¹⁷³ The IoD has worked with the government-funded bodies Envirowise and Action Energy, helping advise IoD members on associated issues.

A new EU Directive on energy performance of buildings came into effect in January 2003. Member states were given three years to implement the Directive, with an extra three years to introduce requirements concerning certification and inspection of boilers and air conditioning. The Directive also contains a requirement for building standards to be reviewed every five years.¹⁷⁴ A Better Buildings Summit was to be convened by the Office of the Deputy Prime Minister, DEFRA and the DTL.¹⁷⁵ This was meant to bring together representatives from the construction sector, the Housing Corporation and others, to explore the issues associated with the Directive, and with refurbishment of existing developments as well as new buildings. A new Housing Bill was to seek a requirement for home sellers to produce a seller's pack containing information on energy performance, in line with the Directive.¹⁷⁶

Referring to the IoD survey in 2003 about issues around the Energy White Paper, the Government intends to explore higher product standards, including voluntary agreements, "when these will

deliver earlier or higher standards than mandatory measures alone".¹⁷⁷ In the meantime the European Commission has announced that it wants to have a new framework directive setting standards for a wider range of products than currently covered, as well as to revise energy labelling (which currently applies only to household appliances).¹⁷⁸ Thus there are likely to be further issues addressed at business, both at UK and EU level.

Whatever the public expectations of business, business is clearly going to be part of the solution.

Directors' views on energy efficiency in SMEs

A questionnaire on this topic was included in the March 1999 issue of the IoD Policy newsletter.

Of those resource-saving measures that had been made, energy savings were the most common (49% of the 180 respondents), followed by transport fuel (23%) and water savings (22%). Ten per cent indicated that their SME had not made any saving.

Of those savings that could be made, the ranking was the same (with 36% citing energy savings). Two per cent indicated that no savings could be made.

For savings that had been made, the most popular reason indicated was that there were clear benefits in making the savings (49%), followed by an indication that the company was running as efficiently as possible (14%). Eight per cent of the directors indicated that the expected savings were not justified by the initial outlay, and 2% were unaware of possible savings. Two per cent indicated other reasons behind their approach to energy saving.

For savings that could be made, the most popular reason indicated was that there were clear benefits in making the savings (21%), followed by an indication that they were unaware of possible savings (16%). The reason that the company was running as efficiently as possible, and that the expected savings were not justified by the initial outlay were each given by 14%. Again, 2% indicated other reasons.

For those SMEs who were reported to have had an energy efficiency policy, the areas that it covered were:-

AREAS COVERED BY THE ENERGY EFFICIENCY POLICY

Action	Proportion of respondents
Switching off electrical equipment when not in use	77%
Monitoring use of energy	61%
Recycling paper	60%
Recycling materials other than paper	51%
Didn't know	1%
82 respondents	

As to measures thought likely to encourage change in behaviour:-

MEASURES CONSIDERED MOST LIKELY TO ENCOURAGE ENERGY, FUEL OR WATER CONSUMPTION

Possible measure	Most likely
Tax relief or credits either for resource use reduction or investment to reduce resources used	44%
Free energy audits or advice	39%
Funding to stimulate the development of low carbon technologies for possible use by the SME (e.g. solar power to provide heating)	18%
Other	6%

Percentages of 180 respondents

The "other" possible measures included direct energy grant aid.

When asked about sources of advice that could help, financial advice on costs and payback times was given by 48% of the respondents, more or less equally preferred to leaflets from an independent source (47%), then seminars (24%), a telephone helpline (16%) and other sources (3%).

We also asked about obstacles to giving consideration to energy efficiency issues:-

MAIN OBSTACLES TO THE SME IN CONSIDERING ENERGY EFFICIENCY ISSUES

Reason	Proportion of respondents
Too busy with other business issues	69%
Lack of authoritative information	43%
Cost of implementing new measures	41%
Too much information available to select the best choices	8%

172 respondents. They could choose more than one reason.

This is telling. Being too busy (69%) was the most commonly indicated reason, followed by lack of authoritative information (43%) and the cost of implementing new measures (41%), then that there was too much information available (8%).

Personal transport provides one of the best examples of the practical issues that would need to be resolved. As the IoD commented in relation to the Government's transport plans as set out in a 1998 White Paper:

"concerns about adverse effects of car use are not likely to be accompanied by voluntary individual action to reduce road traffic in favour of other modes of transport."¹⁷⁹

Businesses need to have practical information, for example about likely consequences. The UK Climate Impacts Programme is very much involved in this. Climate change is a source of uncertainty for all: government, business and the public. Policy and decision-makers should be aware of the need to be adaptable in the face of both change and uncertainty.¹⁸⁰

The UK Government has also recognised the importance of voluntary instruments, certainly in terms of complementing other measures.¹⁸¹

"The pressure for change can come in the form of the buying power of the public",¹⁶⁸

Dr Kevin E. Tremberth

One of the whole problems with pursuit of public policy on energy and climate change is that of timescales. What the Government, the IPCC, UNFCCC, environmental NGOs and others are trying to do is something on timescales beyond a human lifetime.

"Without economic growth there would be no profits, hence no taxes, no public services, no pensions or state benefits ..."¹⁸²

John Wright, Department of Earth Sciences, Open University

9: Conclusions

- ❏ Energy policy touches on many and complex considerations. It is also an area with long timescales. It is not surprising that there will be trade-offs between matters such as environmental policy, as well as business issues around productivity. Nevertheless, some decisions about the future of energy need to be taken sooner rather than later.
- ❏ Environmental policy is likewise an important topic, of concern to many, including businesses. It is important to recognise that - as with energy policy - there has been a great deal of influence arising from sources such as a Precautionary Principle approach to life. This is particularly true for EU policy, but currently for the UK's approach to energy policy.
- ❏ Whatever the serious and large-scale effects of global climate changes, issues of security and reliability of supply need to be addressed for present generations. Society and business will not want to see any major repetitions of power cuts and shortages - and people will not want the lights to go out. Renewables alone cannot solve such problems.
- ❏ Support for new technologies and energy efficiency should indeed form an important part of public policy around science, technology and R&D. The UK economy actually depends on more people and investment in such technological areas.
- ❏ Notwithstanding the progress that may be made over time periods of years and decades, the Government needs to seriously consider the contribution made by nuclear power. Apart from its zero CO₂ contribution to greenhouse gas emissions, there is the fact (see Table 1) that it makes a major contribution to the energy scene at present. This may be a politically difficult issue, but the long-term investment and build time (10-15 years) for nuclear power stations implies a matter of urgency for present policy-makers.

10: Appendix:

*Some of the scientific issues around climate change*¹⁸³

Weather and Climate

In simplified outline, the Sun's heat radiation warms the land and the sea, which then warm the overlying atmosphere. Absorbed solar energy drives the large-scale atmospheric convection, which together with the Earth's daily rotation on its axis produces the large-scale wind patterns. The actual topographic and oceanic features of the planet cause local and global variation that lead to variations in weather (on short time scales) and in climate.

Thus there are differences in surface texture and topography, cloud cover, ice caps, and amounts of ocean or freshwater in different parts of the world. The oceans themselves have convection currents of water. These interact with the atmospheric circulation. There is also dust suspended in the atmosphere. This influences the amounts of absorbed energy and the extent of cloud formation. Some of this dust is from volcanic eruptions, some from human industry.

Various gases in the atmosphere also have an effect on temperature. The most talked about in the context of climate change are the 'greenhouse gases'. The presence or absence of vegetation influences the amount of energy that is absorbed and reflected.

Higher concentrations of greenhouse gases tend to raise surface temperatures. Greater cloud cover tends to reflect more incident solar energy to space and tend to reduce temperature. The situation is complicated by the fact that more greenhouse gases (hence generally higher temperatures) may lead to more evaporation and therefore greater cloud cover (lower temperatures). There are other factors including atmospheric aerosols (some of which result in part from human activity, such as sulphur dioxide). Their effect is to tend to lower temperatures. Gases known as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) reduce the amount of high-level atmospheric ozone (ozone itself being a greenhouse gas).

- ❑ Taking all these influences together, there is not a single, simple, explanation of climate, climate change or indeed weather.

The Greenhouse Effect

The Earth's atmosphere is made up largely of gaseous nitrogen (78% by volume) and oxygen (21%).¹⁸⁴ The other 1% includes water vapour, carbon dioxide, methane and nitrous oxide. Water vapour (ranging from about 0% to 2%) and carbon dioxide (approximately 0.04% by volume) are major components of this residual.

In the simplified scenario described above solar energy passes through the Earth's atmosphere until reaching the surface (actually some will be absorbed on the way, and encounters with clouds will tend to reflect it back towards space). The absorbed energy warms the surface, which radiates heat energy. This re-emitted radiation interacts with the atmosphere. Some of it is absorbed, in particular

by gases such as CO₂. This absorbed energy is then re-emitted in all directions, some of it being radiated back towards the Earth's surface. The net effect of all this is to cause a higher temperature in the lower atmosphere than would be the case if these particular gases were absent.

In fact the mean near-surface temperature of the Earth would actually be well below 0 °C if it were not for these so-called greenhouse gases. They were called greenhouse gases because of an analogy with a greenhouse. Solar energy passes through the glass of a greenhouse and warms the soil inside. This then re-emits energy whose physical properties are such that some of it is absorbed and re-emitted by the glass, although a portion is re-radiated back inside the greenhouse. The overall result is that incoming heat energy passes through the glass but some of the outgoing heat energy cannot escape through the glass. It gets trapped. This leads to higher temperatures than would exist without the glass enclosure. In the Earth's atmosphere carbon dioxide and the other greenhouse gases play a similar role to the heat-trapping effect of the greenhouse. Some greenhouse gases are listed below.

SOME OF THE GREENHOUSE GASES IN THE EARTH'S ATMOSPHERE	
Name	Chemical formula, or abbreviation
Water vapour	H ₂ O
Carbon dioxide	CO ₂
Methane	CH ₄
Nitrous oxide	N ₂ O
Chlorofluorocarbons	CFCs
Hydrochlorofluorocarbons	HCFCs
Sulphur hexafluoride	SF ₆
Ozone	O ₃ [greenhouse effects in lower atmosphere, converse in upper atmosphere]

Source: Global Warming: The Complete Briefing, 2nd edition, John Houghton.¹⁸⁴

Not all greenhouse gases have the same effect; for example, a given number of methane molecules will have a higher warming potential than the same number of carbon dioxide molecules.¹⁸⁴ This is why for purposes of discussing global warming, amounts of the various greenhouse gases are expressed in terms of how much CO₂ would produce an equivalent degree of warming.

Even though it makes up such a small proportion of the Earth's atmosphere, CO₂ is sufficient to make such a vital difference to the Earth. Vital, because were there no natural greenhouse effect then life as we know it would not exist on our planet.

Humans and other animals breathe in and combine some of the oxygen in the air with carbon to make CO₂. Plants take in CO₂, retain carbon and give out oxygen. The amount and state of wellbeing of, for example, forests, affects the quantity of CO₂ in the atmosphere. Generally, more forests mean less atmospheric carbon dioxide and thus less greenhouse effect. There is a whole

range of natural biological and physical processes that proceed and interact to determine the total amount of atmospheric CO₂ and hence the greenhouse effect.

The greenhouse effect is a natural phenomenon and indeed one that we depend on for our very existence. Concern has arisen because although some of the greenhouse gases have existed for millions of years, human activity (anthropogenic influences) has altered the levels of such gases as CO₂, for example from emissions by industrial processes and transport. Other gases - such as HCFCs - have been entirely produced by human industry.

Although the concentrations of the greenhouse gases in the Earth's atmosphere are very low, small changes in these amounts have the potential for quite large alterations in the mean atmospheric temperature.

Discussion about climate change and the likely effects of raised concentrations of anthropogenic carbon dioxide are not new; they go back many decades.¹⁸⁵

What is it about temperature change?

Quite small temperature variations - taken over the Earth as a whole - can lead to some very large effects, when considering the amounts of energy and energy changes involved.

According to some meteorologists, if there were a relatively large sustained temperature change then not only the general patterns of climate will alter but also the frequency of extreme conditions. (Although, presumably, as mean temperature rises, events associated with higher mean temperatures would become more frequent, and those linked to lower mean temperatures would diminish.) So, the idea goes, a rise in global temperature may cause gradual melting of polar ice and a general rise in sea level, but it may also increase the number of storms and droughts. The consequences may include flooding of low-lying land, destruction of buildings, crop failure and deaths.¹⁸⁶ Just as with the Earth's present climate, things would not be uniform across the globe.

The IPCC and others have noted that both the rate of increase of amount of atmospheric CO₂ and the rate of rise in sea level are at their highest known levels. Carbon dioxide levels are at their highest concentration since life began, it seems. As mentioned previously, climate change is part of the norm over geological and historical time. What the IPCC is saying is that the big difference this time is that temperature change would be more rapid than any time in the previous ten thousand years.¹⁸⁴ The IPCC is concerned that the rate of change is a key concern. It is concerned at the ability of life - human, animal and plant - to adapt.

But not everybody accepts either the scientific case agreed by the IPCC or its recommendations for practical action. Such is scientific debate.

Is there a solar constant?

There has been much talk over the years as to whether the Sun itself has a constant output. Leaving aside nuclear decay, the Earth's internal heat and certain cosmic rays, the Sun is the ultimate source of all the energy on Earth. If it were to alter its output it would be expected that there would be some consequential effects on our planet.

The Sun is a star. Many stars are variable in their energy output, some by quite large amounts. Fortunately for us, it does not appear that there is any large change in solar output. Theories of solar variability and its influence on weather and climate are not so developed as, for instance, theories of greenhouse gases and climate change. Yet there have been effects on business. For example, wheat prices in medieval England soared and that seemed to be linked to changes in the Sun's activity.¹⁸⁷ Also, while not the same mechanisms as influence on climate change, solar variation with regard to its subatomic charged particle emissions affects such things on Earth as air traffic control systems and electrical power grids - as during the periods of enhanced activity.

In the period 1100-1300 the Romans were able to grow vines as far north as York. During the years 1400-1850 the River Thames froze from time to time in winter. Ice fairs were then held in London. This period - the Little Ice Age - also apparently affected all of Europe and North America. It may have been linked to altered solar activity.

Solar influence on the climate may come to greater prominence if evidence comes to light about increase in the Sun's radiative output. It has already been suggested that a possible 0.1% rise in solar output since 1980 could account for half of the 0.3 °C increase in global mean temperature.¹⁸⁸

When worlds collide ... one or two myths

One thing is certain. Some people are not prepared to listen to alternative views in the environment debate. The most recent example of this revolves around the reactions to a Danish statistician. Bjørn Lomborg wrote a book called *The Skeptical Environmentalist*.¹⁸⁹ A former Greenpeace activist, Bjørn Lomborg looked at some of the assertions and evidence around many environmental issues, and concluded, among other things, that all was not necessarily always clear cut. His work attracted opprobrium, from environmental activists and NGOs (including one or two things thrown at him, literally), but also from many scientists working on environmental research. *Scientific American* carried an unprecedented set of attacks on his ideas.

The Danish Committee on Scientific Dishonesty criticised Bjørn Lomborg's book as "contrary to the standards of good scientific practice" (although not deliberately misleading).¹⁹⁰ The Committee's criticism was itself severely criticised in an editorial in the scientific journal *Nature*: "this episode leaves everyone little wiser, and the waters surrounding Lomborg even muddier".¹⁹¹ Furthermore, it is quite probable that many of the detractors of Lomborg's views have effectively created a "witch-hunt"¹⁹² against him. The Danish Government then began a re-examination of the Committee's decision.¹⁹³

11: Notes and references:

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2. *Ibid.*, p 105, para. 7.38.
3. *Ibid.*, p 11, para. 1.18.
4. It is interesting that - outside of the sphere of the publicly funded Commission for Integrated Transport - such language as having an "integrated" policy does not tend to occur. This is probably a good thing. The Government's and various interest groups' talk around transport in 1997 and 1998 seemed to suggest that transport problems would go away if they could somehow be labelled as integrated. Thankfully, energy is even more important for anybody to think that it will go away if handed over to a quango to sort out. A new public body (a national energy research centre) has been set up, but one that is meant to target research and development in relevant sciences, both physical and social (Our energy future - creating a low carbon economy, DTI, DfT and DEFRA, Cm 5761, TSO, February 2003, p 15, para. 1.38).
5. *Ibid.*, p 11, para. 1.20.
6. "Queen's Speech", Parliamentary Debates (Hansard) House of Commons Official Report, 26 November 2003, column 5. At the time of writing, the Energy Bill 2004 was still proceeding through Parliament.
7. Our energy future - creating a low carbon economy, DTI, DfT and DEFRA, Cm 5761, TSO, February 2003, p 6, para. 1.4.
8. *Ibid.*, p 8, para. 1.9.
9. *Ibid.*
10. For instance, the IoD submitted written evidence to the House of Commons Public Administration Committee on the subject of public service targets and league tables. "Target setting may have become an end in itself ...", "Government & European Union Consultations", IoD Policy, in IoD News, April 2003, p 10.
11. Our energy future - creating a low carbon economy, DTI, DfT and DEFRA, Cm 5761, TSO, February 2003, p 11, para.1.21.
12. This was decided in 2000: *ibid.*, p 12, para.1.22.
13. Our energy future - creating a low carbon economy, DTI, DfT and DEFRA, Cm 5761, TSO, February 2003, pp 8-9, para.

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15. *Ibid.*, p 14, para.1.31.
16. Graham Sprigg, "Boosting best energy use", *EnvironmentBusiness*, January/February 2004, p 16.
17. Our energy future - creating a low carbon economy, DTI, DfT and DEFRA, Cm 5761, TSO, February 2003, p 44, para. 4.2.
18. *Ibid.*, p 44, para. 4.3.
19. *Ibid.*, p 44, box.
20. *Ibid.*, p 44, para. 4.5.
21. Letter dated 28 May 1989, from the IoD to the DTI in response to DTI's New and Renewable Energy Prospects for the 21st century (London, March 1999).
22. Our energy future - creating a low carbon economy, DTI, DfT and DEFRA, Cm 5761, TSO, February 2003, p 45, para. 4.6, citing DTI, Conclusions in response to the public consultation - New and Renewable Energy: Prospects for the 21st century, London, 2000.
23. Our energy future - creating a low carbon economy, DTI, DfT and DEFRA, Cm 5761, TSO, February 2003, p 87, para. 6.47.
24. *Ibid.*, p 12, para. 1.22.
25. *Ibid.*, p 45, para. 4.9.
26. *Ibid.*
27. *Ibid.*, p 44, para. 4.2.
28. *Ibid.*, p 54, para. 4.45.
29. *Ibid.*
30. *Ibid.*, p 46, para. 4.13.
31. *Ibid.*, pp 52-53, paras 4.35-4.37.
32. *Ibid.*, p 46, paras. 4.14-4.15.
33. *Ibid.*, p 46, para 4.15.
34. *Ibid.*, p 47, para. 4.16.
35. *Ibid.*, p 48, para. 4.21.
36. *Ibid.*, p 49, para. 4.24.
37. *Ibid.*, p 47, para. 4.18.
38. *Ibid.*, p 49, paras. 4.25, and p 51, para 4.28-4.29.
39. *Ibid.*, p 51, para. 4.30.
40. *Ibid.*, p 51, para. 4.31 and footnote 17 on that page.
41. *Ibid.*, p 94, para. 6.72.
42. *Ibid.*, pp 93-94, para. 6.71.
43. *Ibid.*, p 63, para. 5.1.
44. *Ibid.*, p 65, box.
45. *Ibid.*, pp 65-70, paras 5.11-5.19.
46. *Ibid.*, p 70 para. 5.18, and p 71.
47. *Ibid.*, p 72, paras 5.22-5.23.
48. *Ibid.*, p 73, paras 5.24-5.25.
49. *Ibid.*, p 9, para.1.13-1.14.
50. *Ibid.*, p 11, para.1.16.

51. It has been suggested that it is only a matter of time before computer "worms" cripple the control systems of a power station or the electricity grid itself: Duncan Graham-Rowe, "Electricity grids left wide open to hackers", *New Scientist*, 30 August 2003, p 5. A nuclear power plant (in Ohio, United States) was hit in 2003, disabling a safety monitoring system for five hours.
52. Our energy future - creating a low carbon economy, DTI, DfT and DEFRA, Cm 5761, TSO, February 2003, p 76, para. 6.4.
53. *Ibid.*, p 78, para. 6.13.
54. *Ibid.*, pp 78-79, para 6.14.
55. *Ibid.*, p 76, footnote 1.
56. *Ibid.*, p 76, para. 6.4.
57. *Ibid.*, p 77, para. 6.7.
58. *Ibid.*, p 79, para. 6.16, and pp 80-81, paras 6.20-6.25.
59. *Ibid.*, pp 81-82, paras 6.26-6.29.
60. *Ibid.*, p 85, para. 6.39.
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63. *Ibid.*, p 88, para. 6.53
64. *Ibid.*, p 95, para. 7.3.
65. *Ibid.*, p 95, para. 7.5, and p 96, para. 7.7.
66. The Carbon Trust works with business, the Energy Saving Trust primarily with the domestic sector.
67. Our energy future - creating a low carbon economy, DTI, DfT and DEFRA, Cm 5761, TSO, February 2003, p 98, para. 7.16.
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69. Ruth Lea, Education and training A business blueprint for reform, IoD Policy Paper, IoD, London, July 2002.
70. Our energy future - creating a low carbon economy, DTI, DfT and DEFRA, Cm 5761, TSO, February 2003, p 104, para. 7.32.
71. *Ibid.*, p 105, box, and para. 7.37. The UK Government's Chief Scientific Adviser is optimistic about the future prospects for fusion power. He has commented that, until recently, experimental nuclear fusion reactors took in more energy than they gave out. Recent developments at the Joint European Torus fusion facility in Culham, Oxfordshire, and other developments in Japan (at the JT60 facility) have breached that barrier; achieving energy output equal to the input. There is still a long way to go, and the engineering issues are difficult, but ITER could be key in achieving a breakthrough (David King, "Fast forward to fusion", *New Scientist*, 10 April 2004, p 20). A decision was still awaited as to whether to place ITER in France or in Japan.
72. Our energy future - creating a low carbon economy, DTI, DfT and DEFRA, Cm 5761, TSO, February 2003, pp 107-108, paras. 8.2-8.4.
73. *Ibid.*, p 109, paras 8.11-8.12.
74. *Ibid.*, p 113, paras. 9.3, and p 115, para 9.18 and box.
75. *Ibid.*, pp 116-117, paras. 9.19-9.24.
76. *Ibid.*, p 119, para. 9.25.
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84. Graham Martin, "Unbalanced view of a dynamic world", in "Correspondence", *Nature*, Vol. 423, 115, 8 May 2003. Should all species be preserved forever? Maybe not. Some have suggested that the Scottish wildcat and the Australian dingo have so interbred with their relatives, the domestic cat and dog, that it is not sensible to try to preserve them as separate species. See Rachel Nowak, "Wildcats and dingoes 'not worth protecting'", *New Scientist*, 6 August 2003, p 6. One scientist suggested that looking at an animal's "function" would be better than attempting a blanket approach to conservation: "You can't bring [pure-bred animals] back. That would be like bringing back dinosaurs and having them run around the paddock", Laurie Corbett of the environmental consultancy Earth-Water-Life Sciences, Darwin, Australia, *ibid.* Such considerations should be placed alongside an estimate, also from Australia, that extinction rates of animals and plants will rise if there is continued global warming: according to Stephen Williams and colleagues (James Cook University, Townsville), "Extinctions hot up", *ibid.*, p 24.
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158. The Energy White Paper also states that the expectations being placed on energy efficiency and renewables are not only extremely ambitious, they are also "uncertain": Our energy future - creating a low carbon economy, DTI, DfT and DEFRA, Cm 5761, TSO, February 2003, p 12, para. 1.23.
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