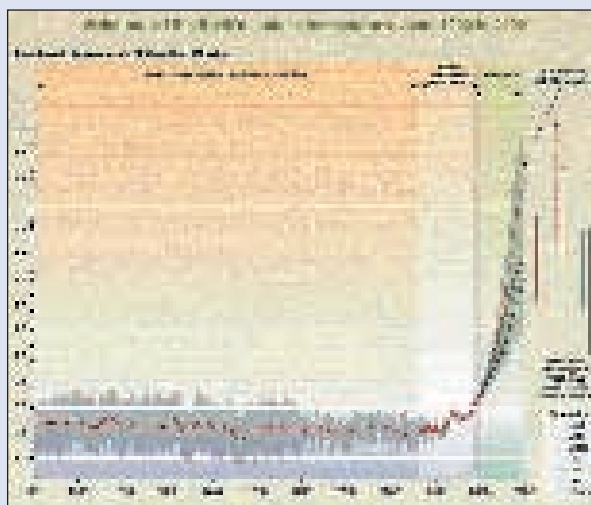


Chapter 1 Cleaner, smarter energy

- 1.1 Our country needs a new energy policy. Despite the improvements we have made over the last five years, today's policy will not meet tomorrow's challenges. We need to address the threat of climate change. We must deal with the implications of reduced UK oil, gas and coal production, which will make us a net energy importer instead of an energy exporter. And over the next twenty years or so we will need to replace or update much of our energy infrastructure.
- 1.2 With these challenges, however, come new opportunities. The opportunity to shift the UK decisively towards becoming a low carbon economy where higher resource productivity - producing more with fewer natural resources and less pollution - will contribute to higher living standards and a better quality of life. The opportunity to develop, apply and export leading-edge technologies, creating new businesses and jobs. And the opportunity to lead the way, in Europe and internationally, in developing environmentally sustainable, reliable and competitive energy markets that will support economic growth in every part of the world.
- 1.3 From heating and lighting to transport, industry and communications, energy is fundamental to almost everything we do. We expect it to be available whenever we want it, to be affordable, safe and environmentally sustainable. It is only when something goes wrong - for instance, when families are left without heating and light after severe storms or when the lights go out in California - that we realise how much modern industrialised countries depend upon extremely complicated energy systems.
- 1.4 Until the 1990s the energy system in the UK - as in most other countries - was largely owned and controlled by Government. Today the UK has one of the most open energy markets in the world. Open and competitive markets will remain vital to delivering the energy we need. But it is Government's responsibility to set the overall goals for UK energy policy and to ensure that our energy markets and other policies deliver those goals. Energy producers, investors, business and consumers need a clear, settled, long-term framework within which they can plan and make decisions with confidence.
- 1.5 The new energy policy that we set out in this white paper is designed to provide this. It reflects, and will reinforce, our wider commitment to sustainable development¹ which challenges us to find ways to achieve economic, social and environmental objectives at the same time.
- ## The challenges we face...
- 1.6 The first challenge we face is **environmental**. Climate change is real. Levels of carbon dioxide (CO₂) in the atmosphere, one of the main causes of climate change, have risen by more than a third since the industrial revolution and are now rising faster than ever before. This has led to rising temperatures: over the 20th century, the earth warmed up by about 0.6°C largely due to increased greenhouse gas emissions from human activities. The 1990s were the warmest decade since records began.

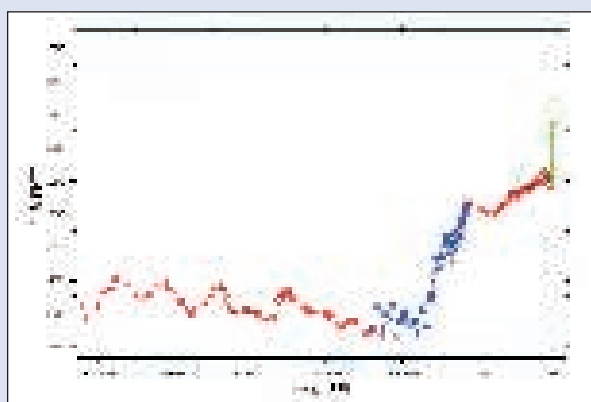
¹ Our sustainable development policy is set out in *A better quality of life: a strategy for sustainable development for the UK*, May 1999.

Chart 1.1
Variations of the Earth's Surface Temperature: Years 1000 to 2100



Variations in the earth's surface temperature from year 1000 to 2000. Line shows 50-year average.² "SRES envelope" refers to the range of emission scenarios used as a basis for the climate change projections in the IPCC Working Group I contribution to the Third Assessment Report.

Chart 1.2
Carbon Dioxide Levels over the last 60,000 Years



Source: University of Berne and National Oceanic and Atmosphere Administration.

² Source: IPCC 2001. Climate change 2001: Synthesis Report. A contribution of Working Groups I, II and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

1.7 The rise in temperatures has been accompanied by changes in the world around us:

- ice caps are retreating from many mountain peaks like Kilimanjaro;
- global mean sea level rose by an average of 1-2mm a year during the 20th century;
- summer and autumn arctic sea ice has thinned by 40% in recent decades;
- global snow cover has decreased by 10% since the 1960s;
- El Nino events³ have become more frequent and intense during the last 20-30 years;
- usage of the Thames Barrier has increased from once every two years in the 1980s to an average six times a year over the past 5 years; and
- weather-related economic losses to communities and businesses have increased ten-fold over the last 40 years.

1.8 In this century, without action to reduce emissions, the earth's temperature is likely to rise at a faster rate than any time in the last 10,000 years or more. In the UK, the risks of droughts and flooding are likely to increase. Sea levels will rise, so that extreme high water levels could be 10 to 20 times more frequent at some parts of the east coast by the end of the century. Worldwide, the consequences could be devastating, especially in the developing world where many millions more people are likely to be exposed to the risk of disease, hunger and flooding. In addition, there is a risk of large scale changes such as the shut-down of the

³ El Nino events change the weather patterns experienced in the regions around the tropical Pacific. This can affect rainfall patterns, and people living in the region can find themselves having to deal with unusually wet or dry conditions.

Gulf Stream or melting of the West Antarctic ice sheet, which although they may have a very low probability of occurring, would have dramatic consequences.

- 1.9 We cannot escape some climate change. But the worst effects can be avoided if greenhouse gases in the atmosphere are stabilised instead of being allowed to go on increasing. The UNFCCC³ and its Kyoto Protocol demonstrate that it is possible to reach global agreement on action, but far more needs to be done. The UK will continue to show leadership but it cannot solve this problem alone. UK emissions of carbon dioxide currently account for only about 2% of the global total. Our own actions will have no impact on climate change unless they are part of a concerted international effort. A wider effort is also necessary, for example in bringing forward technological changes, to keep down costs to the UK and to avoid compromising our competitiveness.

We will therefore continue to work with other countries to establish both a consensus around the need for change and firm commitments to take action to reduce carbon emissions world wide within the framework of the UNFCCC. A key objective of the UK's foreign policy in future will be to secure international commitment to this ambition. We also need to continue to develop our understanding of climate change, so that we can forecast with greater precision the effects which must be mitigated. We are investing in climate change research and recognise that this is a crucial underpinning of the knowledge base which informs our energy policies.

- 1.10 Our ambition is for the world's developed economies to cut emissions of greenhouse gases by 60% by around 2050. **We therefore accept the Royal Commission on Environmental Pollution's (RCEP's) recommendation that the UK should put itself on a path towards a reduction in carbon dioxide emissions of some 60% from current levels by about 2050⁵.**

Until now the UK's energy policy has not paid enough attention to environmental problems. Our new energy policy will ensure that energy, the environment and economic growth are properly and sustainably integrated. In this white paper, we set out the first steps to achieving this goal.

- 1.11 We can get to a 60% cut in emissions by 2050 in a number of ways. But leaving action until the last minute is not a serious option. If we do not begin now, more dramatic, more disruptive and more expensive change will be needed later on. We need early, well-planned action to provide a framework within which businesses and the economy generally, including the jobs and skills base, can adjust to the need for change. This will for example allow business to plan to act in the course of normal capital replacement cycles. It will also encourage new technologies to come forward to help to meet the challenges we face.

- 1.12 We have analysed carefully the likely impacts on the UK economy of cutting emissions by 60% by 2050. A good deal of caution is needed in looking at economic changes over such a long period and given the sensitivity

5 RCEP's recommendation of putting the UK on a path to 'reducing carbon dioxide emissions by some 60% from current levels by about 2050' was based on a more detailed calculation of 58% reductions from 1997 levels. This would lead to 2050 emissions of 64 million tonnes of carbon (MtC). The Kyoto Protocol, and the UK's current domestic targets, use 1990 as a baseline. A precise reduction of 60% in emissions from 1990 would result in emissions of 65.8 MtC in 2050. As the RCEP recommendation implies, absolute precision five decades before 2050 is not possible. This white paper uses 'around 65 million tonnes' to describe the level of carbon emissions which a 60% cut would deliver by 2050.

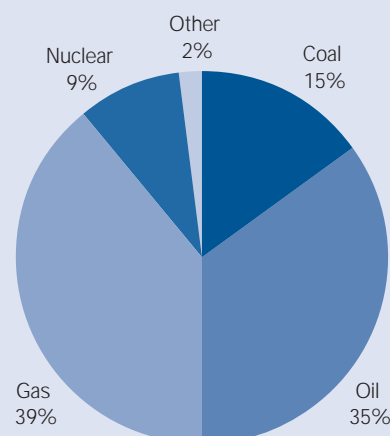
4 United Nations Framework Convention on Climate Change.

of the analysis to the assumptions made. But an extensive review by the Intergovernmental Panel on Climate Change suggests that action aimed at stabilising carbon dioxide atmospheric concentrations at no more than 550ppm would lead to an average GDP loss for developed countries of around 1% in 2050⁶. This figure should, however, be more than offset by the reduction in the risks, eg of flooding, associated with climate change. The outcome of our UK analysis is consistent with that review, assuming that the world's leading industrial nations act together. It suggests that the cost impact of effectively tackling climate change would be very small - equivalent in 2050 to just a small fraction (0.5-2%) of the nation's wealth, as measured by GDP, which by then will have tripled as compared to now.

1.13 The second challenge is the **decline of the UK's indigenous energy supplies** - oil, gas, nuclear and coal. Our current demand for primary energy (ie before transformation, eg into electricity) is shown below. Already we import nearly half the coal we use. Much of the UK's economically viable deep mined coal is likely to be exhausted within ten years. By around 2006 we will also be a net importer of gas and by around 2010 of oil. By 2020 we could be dependent on imported energy for three quarters of our total primary energy needs.

1.14 As we shift from being a net energy exporter to being once again a net energy importer we may become potentially more vulnerable to price fluctuations and interruptions to supply caused by regulatory failures, political instability or conflict in other parts of the world. But being an energy importer does not

Chart 1.3
Primary Energy Demand in 2002, UK



Source: DTI provisional 2002 data based on Digest of UK Energy Statistics, table 1.1

necessarily make it harder to achieve energy reliability⁷. Of the world's leading industrial nations only two - Canada and the UK - are net energy exporters. The others have all achieved economic growth as energy importers. We will be able to do the same - just as we did before North Sea oil and gas. The best way of maintaining energy reliability will be through energy diversity. We need many sources of energy, many suppliers and many supply routes. Renewables and smaller-scale, distributed energy sources - eg micro-CHP⁸ and fuel cells - will help us avoid over-dependence on imports and can make us less vulnerable to security threats.

1.15 Norway will be a major source of our gas imports over the next decade. But we will also need to look for supplies from elsewhere eg from Russia, the Middle East, North Africa and Latin America. This trade in energy will involve relationships of mutual dependence -

⁶ Report of Working Group III of Intergovernmental Panel on Climate Change, Mitigation, 2001.

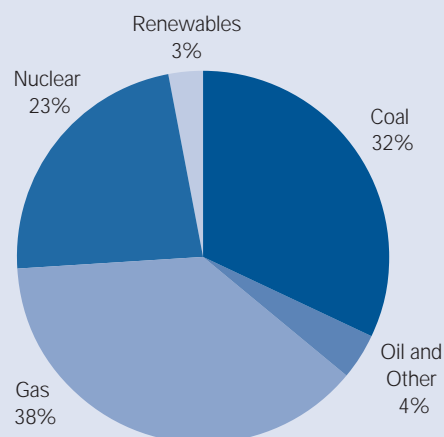
⁷ The phrase energy reliability is used in this white paper to encompass all aspects of energy security of supply.

⁸ Combined Heat and Power plant.

their energy being as important to us as their income from us is to them. Our growing interdependence also means that securing reliable energy supplies will need to be an increasingly important part of our European and foreign policy. We will work internationally to promote regional stability, economic reform, open and competitive markets and appropriate environmental policies in the regions that supply most of the world's oil and gas - Russia, the Middle East, North Africa and Latin America. We have already secured a commitment to energy liberalisation in the European Union for industrial customers by 2004 and overall by 2007. This is vital not only to improve our own access to diverse sources of supply but also to allow UK companies to compete in wider markets.

1.16 Our third challenge is the need to **update much of the UK's energy infrastructure** over the next two decades. During the 1990s there was significant new investment in generating capacity, especially for gas-fired plant. This was a response to the high electricity prices and market structure of the time. Some generating capacity has since been mothballed and interest in building new plant, other than renewables, has declined. But looking ahead, there are further changes in prospect. European measures to limit carbon emissions and to improve air quality are likely to force the modernisation or closure of most older coal-fired plant. In the absence of new build or life extensions, nuclear power's share of electricity production will shrink from its current level: there would be only one plant still operating by 2025. And renewables will become a more significant source of electricity as we seek to tackle climate change. Our current generation mix is shown in chart 1.4 below.

Chart 1.4
Electricity Generation in 2002, UK



Source: DTI estimates for 2002 on gross supplied basis, based on Digest of UK Energy Statistics, table 5.6.

1.17 Over the coming years, substantial investment will also be required in other parts of our energy infrastructure. The electricity distribution networks - designed for one-way transmission from large, centralised power stations to consumers - will need to adapt to more renewables often in peripheral parts of the country or offshore and to small-scale, decentralised power generation in homes and businesses, sometimes drawing from the grid, sometimes contributing to it. As we adapt to becoming a net gas importer we will need additional connections to supplies of both piped and liquefied natural gas (LNG) from a range of sources. In the longer-term, as we potentially move to different fuels for vehicles (eg compressed natural gas or hydrogen), major investments will be needed in the fuel delivery infrastructure.

The goals of our new energy policy...

1.18 As we address these three challenges, we will have four goals for our energy policy:

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

1.19 We believe these four goals can be achieved together. As far as possible we will ensure that the market framework and policy instruments reinforce each other to achieve our goals. Energy efficiency is likely to be the cheapest and safest way of addressing all four objectives. Renewable energy will also play an important part in reducing carbon emissions, while also strengthening energy security and improving our industrial competitiveness as we develop cleaner technologies, products and processes.

1.20 There will inevitably from time to time be tensions between different objectives. For example, extremely high energy prices would undoubtedly promote energy efficiency and thereby help to reduce carbon emissions. But they would also have a negative effect on people on low incomes and on business. There is no simple mechanism for

determining the relative 'weights' of differing objectives. But our approach is guided by the following considerations:

- significant damaging climate change is an environmental limit that should not be breached. We need to keep the UK on a path to 60% cuts in carbon dioxide emissions by 2050;
- reliable energy supplies are fundamental to the economy as a whole and to sustainable development. An adequate level of energy security must be satisfied at all times in both the short and longer term;
- liberalised and competitive markets will continue to be a cornerstone of energy policy. Where the market alone cannot create the right signals (for example on the environment) we will take steps that encourage business to innovate and develop new opportunities to deliver the outcomes we are seeking; and
- our policies should take account of impacts on all sectors of society. Specific measures will be needed for particular groups of people (for example to support those for whom energy bills form a disproportionate burden).

The fuel mix...

1.21 We do not propose to set targets for the share of total energy or electricity supply to be met from different fuels. We do not believe Government is equipped to decide the composition of the fuel mix. We prefer to create a market framework, reinforced by long-term policy measures, which will give investors, business and consumers the right incentives to find the balance that will most effectively meet our overall goals.

- 1.22 We recognise, however, that this approach is not enough on its own. In particular, specific measures are needed to stimulate the growth in renewable energy that will allow it to achieve the economies of scale and maturity that will significantly reduce its costs. In January 2000 we announced our aim for renewables to supply 10% of UK electricity in 2010, subject to the costs being acceptable to the consumer. We introduced the Renewables Obligation (which requires suppliers in England and Wales to obtain an increasing proportion of electricity from renewables year on year) in April last year. We also exempted renewable generation from the Climate Change Levy. By 2010 these measures will provide the renewables industry with support worth around £1 billion a year. This is designed to deliver the required expansion in renewables by then. In this white paper we set the ambition of doubling renewables' share of electricity generation in the decade after that. In order to achieve this and to ensure that renewables make a growing contribution to the fuel mix in the longer term it will be essential to maintain a healthy research base.
- 1.23 In reducing carbon dioxide emissions, our priority is to strengthen the contribution of energy efficiency and renewable energy sources. This white paper sets out the policies we believe are necessary to achieve that. They mean energy efficiency and renewables will have to achieve far more in the next 20 years than they have until now. We believe that such ambitious progress is achievable. But it is uncertain.
- 1.24 Nuclear power is currently an important source of carbon-free electricity. However, its current economics make it an unattractive option for new, carbon-free generating capacity and there are also important issues

of nuclear waste to be resolved. These issues include our legacy waste and continued waste arising from other sources. This white paper does not contain specific proposals for building new nuclear power stations. However we do not rule out the possibility that at some point in the future new nuclear build might be necessary if we are to meet our carbon targets. Before any decision to proceed with the building of new nuclear power stations, there will need to be the fullest public consultation and the publication of a further white paper setting out our proposals.

- 1.25 Coal fired generation will also have an important part to play in widening the diversity of the energy mix provided ways can be found materially to reduce its carbon emissions. We will continue to support relevant research projects, including internationally, to develop options for cleaner coal technologies and for carbon capture and storage. Domestic coal production is likely to continue to decline as existing pits reach the ends of their geological and economic lives.
- 1.26 However, where there is the potential for coal companies to make worthwhile investments, they have to date been prevented by EU rules from seeking government help in doing so. In 2002 we negotiated the flexibility we require at an EU level to correct this anomaly. We now propose to introduce an investment aid scheme to help existing pits develop new reserves, where they are economically viable and help safeguard jobs.

How we will achieve our goals...

- 1.27 To achieve our goal of **reducing carbon emissions** we need to continue to decouple economic growth from energy use and pollution. Since 1970, overall energy

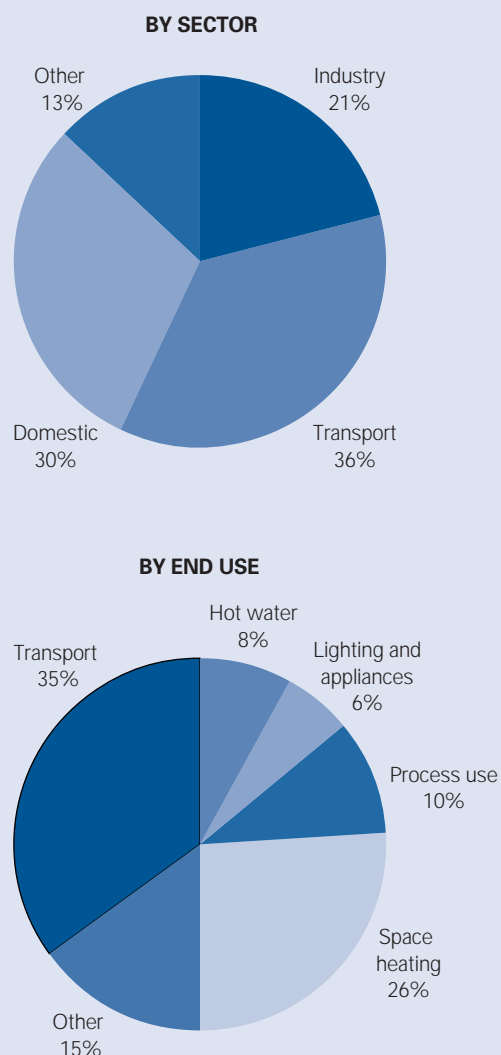
consumption in the UK has increased by around 15%, while the size of the economy has doubled. In future we need to continue and accelerate this trend.

1.28 Discussions under the UNFCCC to tackle climate change beyond 2008-12 will start soon. On the basis of existing policies, including the full effect of our current Climate Change Programme, we would expect UK carbon dioxide emissions of some 135 million tonnes of carbon (MtC) in 2020. To be consistent with demonstrating leadership in the international process, we expect to aim for cuts in carbon of 15-25 MtC below that by 2020.

1.29 We believe it is possible to achieve this goal by reducing the amount of energy we consume, together with a substantial increase in renewable energy. Our current energy use is illustrated in chart 1.5 below. By making our intentions clear we aim to provide the signals needed for firms to invest - and to help British manufacturers to be ahead of the game in developing the green technologies that we expect to play a large part in the world's future prosperity. In this white paper, we set out measures to implement the objectives for 2010 set out in the existing Climate Change Programme, and to provide a foundation for the further carbon cuts we will need by 2020.

1.30 Central to the future market and policy framework will be a carbon emissions trading scheme. We have already launched our own voluntary trading scheme in the UK. But from 2005 electricity generators, oil refineries and other industry sectors are expected to be part of a much larger Europe-wide scheme. By setting caps on emissions the scheme will provide clear incentives for investment in energy efficiency and cleaner technologies

Chart 1.5
Final Energy Consumption in 2002, UK



Source: DTI, provisional, data for 2000. End use data for 2000.

at the lowest cost. We will be encouraging expanded opportunities for emissions trading at all levels. In particular, we will work with our European partners to extend where appropriate the coverage of the EU scheme in due course. We will consider the issues involved in the linkages between tax and tradeable permit schemes further as the position on the EU emissions trading scheme becomes clearer.

- 1.31 On its own emissions trading will not be enough to deliver our environmental goals. We will need additional measures, for example to stimulate further energy efficiency in business, in the public sector and in households. Policies to raise the energy efficiency of products and buildings will have an important role. We will develop the present energy efficiency commitment, which requires electricity and gas suppliers to encourage their domestic customers to invest in energy efficiency measures such as cavity wall insulation. We will aim to bring forward to 2005 the next revision of the Building Regulations to raise standards for energy efficiency in new buildings and refurbishments. We will push in Europe for higher energy efficiency standards in tradeable goods such as fridges and personal computers. We will encourage improvements in efficiency and lower carbon fuels in transport. We will provide further encouragement for renewable energy and infrastructure investment through measures such as capital grants and a more supportive approach to planning. To this end, we are increasing the funding for renewables capital grants by £60 million, additional to the £38 million of extra funding announced in the 2002 Spending Review. And we will set an example throughout the public sector by improving energy efficiency in buildings and procurement.
- 1.32 Our second goal is to **maintain the reliability of our energy supplies**. This requires action on many fronts. We need the right infrastructure and regulatory system at home and liberalised energy markets within the European Union. We will also pursue closer international relationships to promote regional stability and economic reform in key producing areas, mutual understanding of the functioning of markets, and conditions for foreign direct investment to facilitate further infrastructure investment in the world's diverse gas and oil regions.
- 1.33 In liberalised markets, forward prices will send signals about the need for future investment. Suppliers will act on these signals, and on their own assessments of risk and opportunity, to innovate and plan to meet those needs. For example, in response to current market signals some companies are already planning to increase the amount of gas we can import through our existing pipeline to Belgium; others are exploring options for gas storage and new LNG importing facilities.
- 1.34 These developments help to provide reassurance that the market will invest in the capacity we need to provide reliable energy supplies - in particular to meet peak demand in exceptionally cold weather. Our market is not like the market in California in 2000, where overregulation undermined the ability of suppliers to respond effectively to market signals. However, a totally unregulated energy market would be unlikely to deliver sufficient security. So the Secretary of State and the regulator - OFGEM⁹ - both have duties to ensure that reasonable demands for electricity and gas are met. These duties are in turn carried forward into a number of conditions in the licences held by generators, suppliers, electricity transmission and distribution operators and gas transporters. We look to OFGEM to enforce these conditions in a manner consistent with their duties. With OFGEM we will continue and expand our monitoring of energy security. We will also continue to improve our contingency planning and resilience in dealing with major incidents, including terrorism, which could affect critical energy infrastructure.

9 The Office of Gas and Electricity Markets.

1.35 Thirdly, we are determined to promote **competitive energy markets**, in the UK and beyond. This will help to raise the sustainable rate of economic growth and support our industrial and business competitiveness through reliable and affordable energy. Energy makes a significant contribution to the economy, and represents a key input into all other sectors. A competitive energy sector is therefore important to the whole economy's competitiveness and productivity. We need greater resource productivity in business so that our firms use energy more efficiently, reduce carbon dioxide emissions and cut costs at the same time. To do that we will encourage firms to innovate and minimise costs and to deliver better quality goods and services. We will continue our commitment to competitive energy markets and use market-based instruments to deliver our wider energy policy goals. And we will work with business to help them prepare for the low carbon economy of the future and to seize the opportunities that it provides. Through our new sector skills network we will work with the energy industry to develop the skills that industry needs.

1.36 Our final goal is to **ensure that every home is adequately and affordably heated**.

In 1996, 5½ million households had to spend more than 10% of their income on heating their homes adequately (the normal definition of fuel poverty). Already, falling prices and higher social security benefits have helped reduce this number to around 3 million.

1.37 And alongside our policies to cut poverty we also need to tackle the problem of old, poorly insulated, draughty homes, where much spending on energy is simply wasted. In 2001 our fuel poverty strategy set out policies to

end fuel poverty in vulnerable households in England by 2010. We further aim that as far as reasonably practical nobody in Britain should be living in fuel poverty by 2016-18. Grant schemes and the energy efficiency commitment are already improving homes through better insulation, more efficient heating systems and minimising draughts. Later this year we will review the results of these policies and decide what more needs to be done to achieve our fuel poverty objectives.

Innovation is fundamental...

1.38 Technological innovation will have a key part to play in underpinning all our goals and in delivering a low carbon economy cost-effectively. We will support research, development and innovation both to encourage the development of new, longer-term options (for example in respect of the hydrogen economy) and where necessary to enable emerging technologies (such as renewables and new energy efficiency technologies) to demonstrate their potential. A new national energy research centre will be established by the Research Councils, targeted at research and development in the appropriate physical, environmental and biological sciences and including social and economic studies. Through the EU we are strongly backing the international development of fusion power for electricity generation. We will promote the development of homes and communities that combine energy efficient technologies and renewable energy to reduce radically their demand for energy from the grid. More widely, we will encourage UK business to make the most of the opportunities presented both here and overseas by moves towards a low carbon economy.

1.39 In all of this we will work both through our own national programmes and through a range of international collaborations and multilateral programmes which will enable us to maximise the return on our participation. We will work actively with partners in the G8 and the EU to develop climate change technologies which will be of benefit not only in helping us meet our own carbon reduction ambitions but also in helping others, especially in the developing world, to meet theirs. Capacity building programmes in appropriate areas of science, engineering and technology will be increasingly important in this process.

Looking to the future...

1.40 It will be clear from this white paper that we believe we need to prepare for an energy system that is likely to be quite different from today. It will be for the market to develop and invest in this. But we need to set clear goals and a strategy within which the market has the confidence, ability and sense of long-term commitment to do so. This white paper sets the way forward. In particular it is based on the following key principles:

- energy investments are generally long-term. Energy companies, industry and business and domestic consumers need us to set clear goals and a strategy that supports them in making the long-term investments they need to make in energy efficiency and supply;
- the cheapest, cleanest and safest way of addressing all our goals is to use less energy. We have to improve energy efficiency far more in the next 20 years than in the last 20;

- because a well-designed, transparent and open energy market is the best way of achieving efficient outcomes, we will wherever possible use market instruments to achieve our goals. In particular, emissions trading will be at the centre of our energy markets from 2005 onwards;
- we will need to continue to use trading as well as other measures to reduce carbon, in particular for the millions of domestic and smaller business consumers not covered by trading, along with measures to drive up energy efficiency in homes, products and transport;
- the nationwide and local electricity grids, metering systems and regulatory arrangements that were created for a world of large-scale, centralised power stations will need restructuring over the next 20 years to support the emergence of far more renewables and small-scale, distributed electricity generation;
- the future energy system will require greater involvement from English regions and from local communities, complemented by a planning system that is more helpful to investment in infrastructure and new electricity generation, particularly renewables. Strong links with the Devolved Administrations, who are already fully engaged on a wide range of energy issues, will continue to be essential;
- diversity is the best way of protecting ourselves against interruptions of supply, sudden price rises, terrorism or other threats to reliability of supply. As the UK becomes a net importer of energy we will need many sources, many suppliers and many routes. International relations in Europe and worldwide will be increasingly important to achieving our overall energy aims;

- we will seek out the best ways to influence outcomes in line with the principles of better regulation, maximising use of market based and/or voluntary mechanisms, promoting regulations only where they are clearly necessary and well designed. Where regulation is required we will work to make sure it takes account of the impact on key stakeholders to minimise the burdens particularly on smaller and medium sized enterprises; and
- when designing new energy policies, we will consider their impact on all of our energy policy objectives, in line with our overall approach to sustainable development.

1.41 We have applied these principles throughout this white paper.

Working with others...

- 1.42 We will need to work with others to deliver the ambitious goals we have set in this white paper. We will depend on businesses, supported by the research community, to adapt and innovate to deliver a low carbon future. We will rely on local authorities and regional bodies, working with the private sector and voluntary groups, to help to deliver real change on the ground, reflecting the needs of their different communities.
- 1.43 Many policies in this white paper cover the UK as a whole. But significant aspects of energy policy in Northern Ireland, Scotland and Wales are the responsibility of the Devolved Administrations, so that decisions are made in the light of each country's particular circumstances. Where matters are devolved, the distinctions in responsibilities are made clear. We will be keen to work with

the Devolved Administrations to address the energy challenges that we face.

- 1.44 Many of the challenges are international in scope and will need to be addressed through international collaboration. Addressing climate change and securing access to energy requires concerted international effort. The innovation necessary to address the long-term challenge of shifting to a low carbon economy also requires greater international collaboration. We will ensure that our domestic energy strategy is fully consistent with our international energy strategy and other international Government objectives.

What sort of energy system might we envisage in 2020 and beyond?

- 1.45 A broad vision of the energy system of 2020 is described below. This is a scenario. It draws on several sources, including modelling work for the white paper, the DTI's Foresight programme and other scenarios. It does not in any way close off options for the future. Innovation will give us options that we cannot even imagine now. The scenario will need to be updated in the light of experience.

The energy system in 2020...

We envisage the energy system in 2020 being much **more diverse** than today. At its heart will be a much greater mix of energy, especially electricity sources and technologies, affecting both the **means of supply** and the **control and management of demand**. For example:

- Much of our energy will be **imported**, either from or through a single European market embracing more than 25 countries.
- The backbone of the electricity system will still be a market-based **grid**, balancing the supply of large power stations. But some of those large power stations will be **offshore marine** plants, including **wave, tidal** and **windfarms**. Generally smaller **onshore windfarms** will also be generating. The **market** will need to be able to handle intermittent generation by using **backup capacity** when weather conditions reduce or cut off these sources.
- There will be much more **local** generation, in part from medium to small local/**community** power plant, fuelled by locally grown **biomass**, from locally generated **waste**, from local **wind sources**, or possibly from local **wave and tidal** generators. These will feed local **distributed networks**, which can **sell excess capacity** into the grid. Plant will also increasingly generate **heat** for local use.

- There will be much more **micro-generation**, for example from **CHP** plant, **fuel cells** in buildings, or **photovoltaics**. This will also generate excess capacity from time to time, which will be sold back into the local distributed network.
- **Energy efficiency** improvements will reduce demand overall, despite **new demand** for electricity, for example as homes move to digital television and as computers further penetrate the domestic market. Air conditioning may become more widespread.
- New homes will be designed to need very little energy and will perhaps even achieve **zero carbon emissions**. The existing building stock will increasingly adopt energy efficiency measures. Many buildings will have the capacity at least to **reduce their demand** on the grid, for example by using **solar** heating systems to provide some of their water heating needs, if not to generate electricity to sell back into the local network.
- **Gas** will form a large part of the energy mix as the savings from more efficient boiler technologies are offset by demand for gas for CHP (which in turn displaces electricity demand).
- **Coal fired generation** will either play a smaller part than today in the energy mix or be linked to **CO₂ capture and storage** (if that proves technically, environmentally and economically feasible).

A strategy for the long term...

- 1.46 In this white paper we set out a long-term framework to deliver our environmental, security of supply, competitiveness and social goals. Because energy requires very long-term investment we look ahead to 2050 to set the

overall context. We review what we will need to have achieved by 2020 if we are to be confident we are moving in the right direction, fast enough, to deliver our aims for 2050.

- The existing fleet of **nuclear** power stations will almost all have reached the end of their working lives. If new nuclear power plant is needed to help meet the UK's carbon aims, this will be subject to later decision.
- **Fuel cells** will be playing a greater part in the economy, initially in static form in industry or as a means of storing energy, for example to back up intermittent renewables, but increasingly in transport. The **hydrogen** will be generated primarily by non-carbon electricity.
- In **transport**, hybrid (internal combustion/electric) vehicles will be commonplace in the car and light goods sectors, delivering significant efficiency savings. There will be substantial and increasing use of **low carbon biofuels**. Hydrogen will be increasingly fuelling the public service vehicle fleet (for example buses) and utility vehicles. It could also be breaking into the car market.
- **Nuclear fusion** will be at an advanced stage of research and development.
- People generally will be much more aware of the **challenge of climate change** and of the part they can play in **reducing carbon emissions**. Carbon content will increasingly become a commercial differentiator as the cost of carbon is reflected in prices and people choose lower carbon options.

1.47 This white paper seeks to define a long-term strategic vision for energy policy. We set out long-term strategies and, against that background, shorter-term policies to put us on the path we need to be on. In particular, renewables and energy efficiency are and will remain high priorities. We do not, however,

seek to define every detail of the policies we need to pursue over the next twenty years and beyond. That would simply not be realistic. We need to be prepared, within a firm and clear strategic context, to review the impact of policy changes and to update and amend our detailed policy measures in the light of experience. We believe, for example, that technological innovation will have an important contribution to make in helping to deliver our long term vision.

This will bring new opportunities and possibly new challenges that we cannot imagine now. We have to be prepared to adapt and evolve our policies in the light of those opportunities and wider changes in society.

1.48 In recognition of this, we set out at the end of this white paper arrangements for strengthening our capabilities in the field of energy policy. These new arrangements will include annual public reports both on progress towards the aims we set out in this white paper and the steps we are taking to ensure we remain on track. This will not be the last major strategic statement on energy policy. But it sets a new direction, and a new determination, to deliver very significant changes in both the short and longer terms. It is a massive challenge. But it is one that has to be met. And one we believe we can meet.

Inputs to the white paper...

Many of the policies set out in this white paper take as their starting point the Energy Review published by the Cabinet Office's Performance and Innovation Unit (now the Strategy Unit) in February 2002. In publishing the review, the Prime Minister said that he wanted to launch a thorough debate on the issues it raised. In February 2002 the Trade and Industry Committee published a report on Security of Energy Supply and the House of Lords Select Committee on the European Union published a report on European energy issues (*Energy Supply: how secure are we?*). The Committees' recommendations have been taken into account in drawing together our conclusions in this white paper.

Following the PIU report, we launched a major stakeholder and public consultation in May 2002. This:

- stimulated a wide range of workshops, meetings, conferences and seminars, some run by stakeholders, some run by Government departments and other public bodies;
- prompted over 2500 written submissions to the team working on the white paper;
- launched a wide-reaching and innovative public consultation process commissioned by the DTI, involving focus groups, deliberative workshops, outreach to school students and a web-based questionnaire; and
- provided the basis of a web-based stakeholder debate.

In total over 6500 individuals and groups have had input to the consultation. This represents the most significant consultation on energy policy ever undertaken in the UK. It has provided an immensely rich source of views and information to help guide the development of policy options. We are very grateful to all those who participated in the consultation.¹⁰ In the future, outreach to stakeholders and the wider public will continue to be an important part of the follow up to the white paper.

1.49 This white paper is based on a large amount of analysis and modelling. We are publishing separately documents which form part of that work, on estimates of the cost and potential for various long term low carbon options; on the background outlook for energy demand and emissions between 2000 and 2050; an initial assessment of the impact of the policies as set out in this white paper; and background calculations to achieving carbon cuts of between 15-25 million tonnes of carbon in 2020.¹¹

10 Most of the material submitted to the white paper team can be found on the DTI's website at www.dti.gov.uk/energy/developpep, except where those submitting information asked for it not to be made publicly available. The website also includes reports on meetings held during the consultation.

11 This work is available at www.dti.gov.uk/energy/whitepaper/