

CLIMATE CHANGE

THE UNITED KINGDOM PROGRAMME

The United Kingdom's Second Report under the Framework Convention on Climate Change

Presented to Parliament by the Secretaries of State for the Environment and the Foreign and Commonwealth Office, the Chancellor of the Exchequer, the President of the Board of Trade, the Secretaries of State for Transport, Defence, National Heritage and Education and Employment, the Chancellor of the Duchy of Lancaster, the Secretaries of State for Scotland, Northern Ireland and Health, the Minister for Agriculture, Fisheries and Food, the Secretary of State for Wales and the Minister for Overseas Development by Command of Her Majesty.
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FOREWORD

BY THE SECRETARY OF STATE FOR THE ENVIRONMENT

Climate change threatens our world and our childrens future. There is no doubt that developing countries and small island states face the most serious challenges. But in the United Kingdom and other temperate countries, there will be major changes, many of which were identified in the 1996 report of our Climate Change Impacts Review Group. Most of us will see the effects within our lifetimes.

We have a clear message from the Intergovernmental Panel on Climate Change that global climate change needs global action now. We must all face up to the reality of the threat and look to what we can do as individuals, as businesses and as governments.

The United Kingdom signed the Framework Convention on Climate Change at Rio in 1992 and, along with other developed countries, agreed to return our emissions of greenhouse gases to 1990 levels by 2000 – a necessary first step. We did not enter that commitment lightly and we shall honour it. Indeed we hope to do better, as this report shows, reducing carbon dioxide emissions to 8% below 1990 levels, methane to 22% below and nitrous oxide to 62% below.

That is a better performance than most other countries have achieved. Those which are not on course to meet their targets need to do more. However, even if all countries could do as well as the United Kingdom that would still not be enough - much more needs to be done for the future. The parties to the Convention will meet in Kyoto in December 1997 to seek agreement on targets for beyond 2000. Those targets need to be challenging and I have called for all developed countries to reduce their greenhouse gas emissions to 5-10% below 1990 levels by 2010.

A realistic target presupposes that we all achieve it. Even so, we may well need to go further. At the moment, the world has neither produced a timetable nor agreed a sufficient reduction in greenhouse gases to prevent even further change in the world's climate. If we act effectively we can confine the impact of change within a containable measure. If we do not, the effect could make the lives of our grandchildren immeasurably more difficult and perhaps threaten the future of the planet itself.

John Gummer

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EXECUTIVE SUMMARY

This is the United Kingdom's second report under the United Nations Framework Convention on Climate Change. The first report was submitted in January 1994. A progress report on carbon dioxide emissions was produced in December 1995.

Carbon dioxide is the most important man-made greenhouse gas in the UK accounting for 81% of the direct global warming potential from national greenhouse gas emissions in 1990. Methane emissions contributed 12% (counting both the direct and indirect global warming effects) and nitrous oxide a further 5%. The remaining 2% was due to emissions of hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride all of which have high global warming potentials but low levels of emissions. Ozone, formed in the troposphere from reactions involving man-made pollutants such as nitrogen oxides, volatile organic compounds and carbon monoxide, is also a greenhouse gas.

The UK is on track to meet its commitment under the Convention to return greenhouse gas emissions to 1990 levels by 2000. Emissions of carbon dioxide are projected to be from 4-8% below 1990 levels in 2000 with methane emissions 22% below 1990 levels and nitrous oxide emissions 62% below. The total global warming potential of all greenhouse gas emissions in 2000 is projected to be of the order of 10% below the 1990 level see Figure A.

CARBON DIOXIDE

Total carbon dioxide emissions in 2000 are projected to be some 4-8% below the 1990 level. Central scenarios show emissions in 2000 of 157.6 MtC compared to 166.6 MtC in 1990: these figures include revised estimates of emissions from the loss of carbon from processes related to land use of 7.5 MtC in 2000 and 8.4 MtC in 1990.

The widespread introduction of competition into the UK's energy markets has led to improvements in electricity generation through:

- the switch from oil and coal to gas, which has a lower carbon intensity, and the use of more efficient combined cycle gas turbines; and
- improvements in the productivity of the nuclear sector.

Together, these are projected to save about 20 MtC a year by 2000.

The Government's strategy of increasing road fuel duties by an average of at least 5% a year in real terms since 1993 is projected to save about 3 MtC a year by 2000.

Achieving the Government's target of 5,000 MW of combined heat and power (CHP) capacity by 2000 is projected to save 3.5 MtC a year. The Government is also stimulating the development of new and renewable sources of energy and working towards 1,500 MW of new capacity by 2000 which is projected to save about 2 MtC a year.

The Government continues to encourage the take up of energy efficiency measures through the Energy Efficiency Best Practice Programme which is projected to achieve savings of about 4.5 MtC a year in industry (including 1.5 MtC towards the CHP target) and about 0.5 MtC a year in the residential sector.

METHANE

Annual emissions of methane are projected to fall from 4.4 Mt CH₄ in 1990 to around 3.4 Mt CH₄ in 2000, a reduction of over 22%. The global warming potential of that projected reduction is equivalent to 5.6 MtC (taking account of direct and indirect global warming effects).

The most important savings come from an anticipated fall in emissions from coal mining and landfill waste. Recent developments include the publication of the National Waste Strategy for England and Wales in December 1995 and voluntary action by the gas distribution network, coal mining and offshore oil and gas industry to reduce emissions.

NITROUS OXIDE

Annual emissions of nitrous oxide are projected to fall from 112 kt N₂O in 1990 to 43 kt N₂O in 2000, a reduction of 62%. The global warming potential of that projected reduction is equivalent to 5.8 MtC.

The major source of the projected fall is a 95% cut in emissions of nitrous oxide from the manufacture of adipic acid which is used in the production of nylon. Agricultural emissions are also expected to fall.

OTHER GREENHOUSE GASES

The UK has extended its inventory to include emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆). Total emissions of these gases are projected to fall by 58% from 1990 to 2000, on a global warming potential weighted basis, which is the equivalent of 2.4 MtC.

The Government has concluded voluntary agreements with industry to minimise the use and emissions of HFCs.

The Draft National Air Quality Strategy published in August 1996 sets targets for reduced levels of tropospheric ozone, nitrogen dioxide and carbon monoxide.

IMPACTS AND ADAPTATION

In July 1996, the United Kingdom Climate Change Review Group published its second report on the potential effects of climate change in the UK. The UK is now considering the results of a scoping study on how to develop an integrated assessment of the impacts of climate change and intends to take this forward during 1997.

RESEARCH, SYSTEMATIC OBSERVATION AND SCIENTIFIC ASSESSMENTS

The UK has a comprehensive programme of global environmental climate change research. The focus of UK climate change and science is the Hadley Centre for Climate Prediction and Research. The UK is a strong supporter of the Intergovernmental Panel on Climate Change, funding the technical support unit for its Working Group I which is co-chaired by Sir John Houghton.

FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

The UK's bilateral aid programme committed some £77 million in 1995/96 to projects that are either wholly or partly concerned with energy efficiency, both in developing countries and countries in transition. The UK is the fifth largest contributor to the Global Environment Facility, the interim financial mechanism of the Convention, with a commitment of £130 million. The UK contributes \$3.67 billion to the World Bank, part of which is used for the Energy Sector Management Assistance Programme.

EDUCATION, TRAINING AND PUBLIC AWARENESS

The UK has national public information campaigns on energy efficiency, seeking to raise awareness and change behaviour in the domestic sector. The Energy Saving Trust's Energy Efficiency marketing campaign is intended to provide a highly visible and consistent brand image for energy efficient goods and services.

The UK published its National Indicators of Sustainable Development (which included climate change indicators) in March 1996 and continues to publish annual White Papers on sustainable development.

CHAPTER 1

INTRODUCTION

1.1 This is the United Kingdom's second report under the United Nations Framework Convention on Climate Change (the Convention).

1.2 It reports the UK's progress in implementing its Climate Change Programme (the Programme) and gives a projection of what the Programme is expected to deliver by 2000. For information, the report projects forward what the current Programme could achieve beyond 2000 but, in doing so, it does not reflect any revisions to the Programme that may be agreed for the period after 2000.

THE IMPORTANCE OF CLIMATE CHANGE

1.3 The UK takes seriously both the threat posed by climate change to the human and natural world and its responsibility to respond to that threat. The UK's response takes two main forms.

1.4 First, the UK wishes to improve understanding of how the climate works. This means taking account of the natural variability of the climate and identifying the influence of human activity through the release of greenhouse gases in extracting and burning fossil fuels and by changes in land use and forestry which affect carbon sinks.

1.5 The UK is a leading supporter of, and contributor to, the scientific work of the Intergovernmental Panel on Climate Change (IPCC). Chapter 7 explains the UK's contribution through its research programme. The IPCC's Second Assessment Report, published in June 1996, is the most authoritative and comprehensive assessment of the science of climate change. An important message of the report is that the balance of evidence suggests a discernible human influence on global climate. The IPCC predicts that if no actions are taken to limit greenhouse gas emissions, temperatures will rise by about 2C (1C-3.5C) by the end of the next century. To limit any further increase would require a halving of global CO₂ emissions by late in the next century and a significant reduction in emissions of other greenhouse gases.

1.6 The changes in climate associated with such an increase could lead to major adverse impacts on the natural world and human society, far outweighing any benefits. The adverse consequences could be greatest in developing countries and small island states. But the July 1996 report of the United Kingdom Climate Change Impacts Review Group (CCIRG) concluded that such changes in climate could lead to significant impacts even for a developed, temperate nation such as the UK.

1.7 The CCIRG report is based on a scenario consistent with the science of climate change in the IPCC report, which envisages an increase in average temperatures in the UK of about 1°C by the 2020s and 1.5°C by the 2050s. This scenario suggested that there would be significant and accentuated regional differences, with a drier south which would be more prone to droughts and a wetter and stormier north. There could be some beneficial impacts for forestry, pastoral agriculture (especially in the north west), tourism and recreation. However, these are likely to be outweighed by the adverse effects to soils, wildlife, water resources, arable agriculture in the south, coastal regions, the insurance sector and human health. The UK would also be affected by changes in world trade patterns for food and other goods due to the effect of climate change in other parts of the globe.

1.8 The UK proposes to build on the CCIRG report to improve its understanding of the potential impacts of climate change and, where appropriate, to start to take adaptive measures.

THE CLIMATE CHANGE PROGRAMME

1.9 The need to make significant reductions in global emissions to avoid dangerous interference with the climate system, underpins the second part of the UK's response which is to take cost-effective, precautionary measures to reduce emissions of greenhouse gases.

1.10 Climate change is a global problem: the UK produces only around 2% of total emissions of greenhouse gases so unilateral action would have little effect. The UK, therefore, strongly supports the Convention and plays an active role in its processes, both as an individual state and as a member of the European Union.

1.11 As a developed country Party to the Convention, the UK is committed to returning greenhouse gas emissions to 1990 levels by 2000. The UK is on course to achieve that commitment and expects emissions of carbon dioxide to be from 4-8% below 1990 levels by 2000; emissions of methane are expected to be 22% below the 1990 level; and nitrous oxide 62% below. The total global warming potential of all greenhouse gas emissions in 2000 is projected to be of the order of 10% below the level in 1990. However, many countries are not on track to meet their targets and more needs to be done. There will also have to be further significant reductions in emissions in the future. As part of the Berlin Mandate process to agree targets to reduce emissions beyond 2000, the UK has proposed that all developed countries should reduce total greenhouse gas emissions to 5-10% below 1990 levels by 2010.

1.12 The UK set out its Climate Change Programme in its first report under the Convention in January 1994. A progress report relating to carbon dioxide emissions was issued in December 1995. This report now provides an update on the full Programme as of January 1997 and has been drawn up in line with the guidelines and timetable produced by the Convention.

1.13 There is a wide range of cost-effective, precautionary measures to reduce greenhouse gas emissions which can be taken now to avoid the need for mitigation or adaptation in the future, which could prove more expensive. The Programme takes advantage of the scope that exists to take such “no regrets” measures and makes use of a variety of policy tools. These include economic instruments, regulatory and deregulatory measures, voluntary action and public information programmes.

1.14 For example, liberalisation of the energy markets has provided incentives to improve efficiency at all stages of energy production, transmission, distribution and supply. In particular it has encouraged electricity generators to invest in efficient, combined cycle gas turbine technology which has a lower carbon intensity than that of the mainly coal-fired power stations which are being replaced. The longer term strategy of increasing road fuel duty by an average of at least 5% a year in real terms is encouraging savings in the use of road fuel and therefore lower CO₂ emissions than otherwise. And the waste strategy and the introduction of the landfill tax will divert more waste from landfill leading to a reduction of emissions of methane and possibly more production of energy from waste.

1.15 Some of these measures were already being, or would have been, implemented for other policy reasons but have the added benefit of being effective for reducing greenhouse gas emissions. In drawing up the Programme and keeping it under review, the UK identified a number of areas where there was scope for additional action, for example through the fuel duty strategy or the increased targets for combined heat and power or renewable energy. These measures give added value to the Programme.

1.16 The Programme will deliver significant savings in emissions over the period to 2000. However, CO₂ emissions in a number of sectors, in particular transport, will continue to increase, albeit at a slower rate than otherwise. And, based on current measures, overall CO₂ emissions are projected to rise by 2010.

1.17 In the energy markets, the continued reduction in emissions could be partly offset by price reductions that may follow full liberalisation and also by growth in underlying demand linked to economic growth. Competitive energy markets result in the most efficient use of fuel and do not preclude the Government from adopting policies and measures to reduce energy consumption. The potential effect of market liberalisation will continue to be taken into account in future projections of greenhouse gases and decisions about future policy to mitigate greenhouse gases.

1.18 In May 1995, the Government published the conclusions of its review of the prospects for nuclear power in the UK. This concluded that building new nuclear generation capacity would not be a cost-effective way to meet possible future targets for reducing greenhouse gas emissions since estimates for economy-wide CO₂ abatement costs are substantially lower than the cost of new nuclear capacity in the shorter term (2005 to 2010) and given the underlying uncertainty about what the long term need for action might be, the advantage lies with more flexible measures.

GREENHOUSE GAS INVENTORY

1.19 Carbon dioxide is the most important anthropogenic greenhouse gas in the UK accounting for 81% of the direct global warming potential from national greenhouse gas emissions in 1990. Methane emissions contributed 12% (including both the direct and indirect global warming effects) and nitrous oxide a further 5%. The remaining 2% was due to emissions of hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride, all of which have high global warming potentials but low levels of emissions.

1.20 Ozone is also an important greenhouse gas. This gas is not emitted directly into the atmosphere as a result of human activities, but is formed in the troposphere from reactions involving anthropogenic pollutants such as nitrogen oxides, volatile organic compounds and carbon monoxide. In addition to their role in the formation of low level ozone, these gases also alter the oxidising capacity of the atmosphere which affects the concentrations of direct greenhouse gases such as methane and hydrofluorocarbons. Current limitations in the understanding of the photochemical processes involved mean that these indirect effects cannot be accurately quantified at present.

1.21 Annual UK greenhouse gas inventories for 1990 to 1994 are summarised in Annex 4. All the major direct and indirect greenhouse gases are included (except those controlled by the Montreal Protocol) and the inventory is consistent with the Intergovernmental Panel on Climate Change guidelines for estimating national greenhouse gas emissions and sinks. A detailed description of the methodologies and data used in the inventory is published annually as a technical report, the most recent being the UK Greenhouse Gas Inventory 1990 to 1994, by the National Environmental Technology Centre (NETCEN).

1.22 Trends in national greenhouse gas emissions and sinks to 2000 and beyond have been estimated in consultation with appropriate government departments, industry sectors, research bodies and other organisations. Wherever possible these projections take into account the effect of current and planned policies and measures aimed at reducing emissions and enhancing sinks.
National circumstances

1.23 The UK covers 24.3 million hectares (ha) of land most of which is in commercial use. Agriculture accounts for about 18.4 million ha; forestry for about 2.4 million ha; and the remaining 3.5 million ha is largely urban. The proportion of land used for agriculture has declined over the past 20 years and that for forest and urban woodland has increased. The UK has a strong system of land use planning and encourages new development to reuse brown-field sites wherever possible.

1.24 The UK's climate is maritime: variably cool, moist, temperate and with a moderate annual temperature and limited ranges. Space heating is needed in buildings throughout the winter months. There is limited need for air conditioning but it is increasingly used in offices and factories throughout the year.

1.25 The UK's population grew by 3% over 20 years to reach 57.6 million in 1991. The population is expected to grow by a further 6% over the next 20 years whilst the size of the average household is expected to fall resulting in a 23% increase in the number of households. This trend will exert increasing pressure on land and housing, energy supplies and transport into the next century and future climate change policies will need to address these challenges. The pressures will be felt most in the English south east and midlands which are among the most densely populated areas of the world. The Scottish Highlands, parts of Wales and the north and south west of England, are sparsely populated. The Government published a Green Paper, *Household Growth: Where Shall We Live?*, in November 1996 to stimulate debate on how the projected demand for housing could be met in a sustainable way.

1.26 The UK is a major producer of natural gas and coal and is a net producer and exporter of oil. These fuels, together with nuclear power, are the UK's primary sources of energy. Renewable sources of energy, excluding large scale hydroelectricity, accounted for 2.3% of the UK's electricity capacity in 1995. New and renewable sources are being encouraged to enter the competitive energy markets.

1.27 There has been a significant shift in the balance of fuel used to produce power since 1990. This has been associated with the liberalisation of UK energy markets which should be completed in 1998 when full competition will

be introduced in the domestic electricity and gas supply industries. There has been a major restructuring of the coal industry as part of privatisation and the removal of subsidies. Almost all of the electricity generation and supply industry has been privatised, most recently British Energy which operates the UK's most modern nuclear reactors.

1.28 The energy intensity of the UK economy has been declining for the past century. Recent falls have been due to a combination of structural changes in the economy, changes in technology and the greater efficiency with which energy is converted, distributed and used. Technical estimates show that there is considerable scope in all sectors for further improvements in energy efficiency.

1.29 There has been rapid growth in total passenger and goods transport, almost all due to growing road transport, bringing economic and social benefits as well as health and environmental problems. The use of private cars almost doubled between 1970 and 1990 whilst public transport's share of the number of passenger and freight journeys has declined over recent years.

UNITED KINGDOM ADMINISTRATION

1.30 The Department of the Environment is responsible for UK policy on climate change. Within the Department, there is a specific Global Atmosphere Division which coordinates the UK Programme, its research and its contribution to the Convention process and other international bodies. Some of the policies and measures within the Programme are the responsibility of the Department of the Environment. However, other government departments, including the Department of Trade and Industry, the Department of Transport, the Ministry of Agriculture, Fisheries and Food, the Overseas Development Administration, the Forestry Commission and Her Majesty's Treasury have the lead on specific policies and measures. The Scottish, Welsh and Northern Ireland Offices have related interests in many of these policies and measures.

1.31 The Environment Agency and the Scottish Environment Protection Agency were set up in 1996 to protect and enhance the environment, taken as a whole, so as to make an appropriate contribution towards achieving sustainable development. They have important roles in meeting the UK's climate change obligations: on the one hand they are responsible for regulating and enforcing pollution control which can help mitigate greenhouse gas emissions; on the other they will be key players in assessing and preparing for the impacts of climate change on the UK.

CHAPTER 2

CARBON DIOXIDE

KEY DEVELOPMENTS

Carbon dioxide (CO₂) emissions are projected to be 4 - 8% below 1990 levels by the year 2000. On central assumptions, the following measures are expected to contribute the given carbon savings in 2000.

The widespread introduction of competition into the UK's energy markets which has led to improvements in electricity generation, through:

- the switch from oil and coal to gas, which has a lower carbon intensity, and the use of more efficient combined cycle gas turbines. Expected to save 17 million tonnes of carbon (MtC) per year by 2000.
- improvements in the productivity of the nuclear sector. Expected to save 2.9 MtC per year by 2000.
- Increases in road fuel duties by an average of 6.5% to 8.5% in real terms each year since 1993. Expected to save 3 MtC per year by 2000.
- Achieving 3,000 MW of combined heat and power capacity towards a target of 5,000 MW by 2000. Expected to save 3.5 MtC per year by 2000.
- Continued stimulation of the development of renewable energy sources. Achieving 1,500 MW from new renewable energy sources by 2000 would save 2 MtC per year.
- Encouraging energy efficiency measures by industry, in buildings and transport, through the Energy Efficiency Best Practice Programme. Expected to save 5 MtC per year by 2000, including a 1.5 MtC contribution to the target for Combined Heat and Power.

EMISSIONS ESTIMATES AND TRENDS

The United Kingdom's anthropogenic emissions of carbon dioxide in 1990 were estimated at about 611 Mt CO₂, containing about 167 MtC. About 92% of emission came from burning fossil fuels; a further 5% from emissions from land use change; 2% from industrial process emissions; and 1% from fugitive emissions from oil and gas production.

- Emissions can be divided amongst the main sectors of the economy, with emissions from power stations, refineries and industrial processes either separately identified, as in Figure 2A, or attributed to end users, Figure 2B. Sinks, which in line with IPCC guidelines have not been subtracted from emissions in these gross emissions data, removed an estimated 2.8 MtC from the atmosphere in 1990.
- UK CO₂ emissions estimates are published annually, and are consistent with the IPCC Guidelines for National Greenhouse Gas Inventories. Research undertaken since the UK's first National Communication has resulted in an upward revision of estimated emissions from land use change and this is reflected in both the inventory and the projections data given here.
- Despite some variations due to year-on-year temperature fluctuations and the business cycle, Figure 2C shows that the inventory estimates to 1995 are consistent with the national emissions projection for CO₂ to 2000 under central assumptions on economic growth and energy prices.

Electricity generation and energy supply

2.1 Competition has been introduced into the UK energy generation and supply industries. The process of transition from monopoly to free markets is still in progress, but it has already stimulated significant structural changes and improvements in efficiency and innovation in the energy sector.

2.2 Competition provides clear incentives for generators and suppliers to seek the most efficient means of meeting customers' requirements. The result has been to improve the efficiency with which energy is produced, transmitted and distributed in the UK. The ultimate aim is to have open competition between all forms of energy production.

2.3 To introduce open competition and encourage efficiency has required:

- the removal of Government financial support for the production of fossil fuels, which provided an inducement to use more energy and from less efficient sources; removing this support also presents customers with prices which better reflect the full economic costs of the fuel;

- privatisation of existing state-owned generators, distributors and suppliers; and
- deregulation and liberalisation of energy markets, within a legal and regulatory framework that protects health, safety, the environment and promotes competition and energy efficiency.

2.4 In England and Wales the electricity generation market is already fully competitive and the supply market will be by 1998. At present, supply to small users is still in the hands of local monopolies. Great Britain is in the final stages of gas market liberalisation with the extension of competition into the domestic supply market being phased in between 1996 and 1998. It is not yet known to what extent there will be any interim regulation of the energy supply markets after the introduction of competition, but in the longer term it is anticipated that this activity will not be subject to price controls or other regulatory devices.

2.5 Under a competitive regime there are possibilities for energy suppliers to evolve into energy services companies (ESCOs), seeking to capture additional value by selling services rather than just units of electricity or gas. In a market where the product is indistinguishable each company will want to devise a selling point which marks it out from its rivals, which may be a wider range of energy efficiency services. Furthermore, if there are potential savings for consumers from investment in demand side management (DSM) then independent companies have an incentive to access a share of these savings. ESCOs can sell a package of services, including DSM measures, and do not concern themselves with lost electricity or gas sales. As its profit is related to the performance of efficiency measures in saving energy there is an incentive for savings to be sustainable. Furthermore, the commercial environment is producing better informed consumers who are more interested in managing their energy consumption. They will become increasingly able to do so with the development of more sophisticated meters that allow time of use charging and other market innovations.

2.6 The introduction of competition provides other benefits for the consumer, in the first instance through price reductions, although the largest consumers lost their price subsidies on privatisation. Lower prices would tend to lead to an increase in overall demand for energy with a consequential increase in CO₂ emissions. However, consumers may not respond as much to a price fall as to a similar price rise because of previous investment in energy efficiency measures such as insulation and acquired energy saving habits.

2.7 Full liberalisation, planned for 1998, will extend to the domestic sector the opportunity and competitive pressures for new services including energy efficiency services. There is important potential for joint ventures between ESCOs and local authorities, including initiatives to introduce new Combined Heat and Power and community heating schemes.

2.8 The independent Energy Saving Trust was set up in 1992 to develop and manage new programmes to promote the efficient use of energy by domestic and small business consumers. It is supporting two pilot schemes to explore the possibilities for new energy efficiency services. The Trust is pump priming The Energy Club, a private sector venture which will offer households in private sector dwellings energy efficiency advice, energy efficiency home improvements, and best value gas and electricity supplies. It is also contributing to Total Oil's energy services company project, which will provide energy efficiency and heating improvements for private sector householders in areas where mains gas is not available in the south east, midlands and north of England.

2.9 The Government is discussing ways of promoting the further development and availability of energy services with the recently launched Energy Services Association, the Energy Saving Trust and others, including the industry regulators.

2.10 The regulators of the electricity and gas industries- OFFER (the Office of Electricity Regulation) and OFGAS (the Office of Gas Supply)- take into account the effect on the physical environment of the activities of the industries. The regulators also have a statutory duty to promote energy efficiency.

Electricity Industry

Generation

2.11 By 2000, Combined Cycle Gas Turbine (CCGT) plant is projected to have the largest share of the UK generating mix and the UK will also have more renewable energy and a more productive nuclear sector than in 1990 (see Figure

2E). These trends will produce lower emissions from electricity generation in 2000 than in 1990, despite increased consumption. Inventory data to 1995 are consistent with the projections (see Figure 2F) despite some fluctuations from year to year due to plant availability.

2.12 The introduction of competition in the electricity generation and supply industry has spurred both the newly-privatised and independent electricity generators to switch to gas as the fuel of choice for new plant. In particular, there has been major investment in the new technology of Combined Cycle Gas Turbines. CCGTs generate electricity more efficiently than conventional plants. This enhanced efficiency together with the lower carbon content of gas, means that these plants produce 50% less carbon dioxide per unit of electricity generated than coal-fired plants. The growth in CCGT generation has been matched by a fall in less efficient coal and oil-fired generation; especially as old plant is retired. By 1995, CCGTs generated 16% of UK electricity, compared to almost none in 1990. Investment in new plant continues whilst the fuel efficiency of combined cycle technology continues to improve. It is forecast that up to 38% of electricity will be generated by gas by 2000 resulting in savings of around 17 MtC per year.

2.13 Since electricity privatisation, an electricity trading pool has been established which sets prices that reflect marginal costs and thus operates in a way which is likely to improve the use of existing generating capacity by helping to trim demand peaks and reduce the need for additional 'peaking' plant. The effect is to move demand from plants with typically low efficiencies, burning carbon intensive fuels, towards more efficient plants running on cleaner fuels.

2.14 The introduction of commercial disciplines has led to substantial improvements in the productivity of the nuclear power industry, notably Advanced Gas-cooled Reactors (AGRs). These improvements have resulted in significant increases in the total amount of electricity generated from nuclear sources. By 1995, nuclear accounted for 27% of electricity generated (compared to only 20% in 1990) but this is forecast to decrease slightly to 26% by 2000. Nuclear power generation produces no direct CO₂ emissions. Growth in output from existing stations and the construction of a new Pressurised Water Reactor (PWR) nuclear station has obviated the need for additional fossil-fuel based generation and will lead to carbon savings of about 3 MtC per year by 2000. However there are currently no plans to build any more nuclear power stations.

2.15 The privatisation in 1996 of British Energy which operates the AGRs and PWR should provide further incentives to raise energy efficiency. Whilst in the public sector, the nuclear industry strived hard to achieve tough targets and sell its output in the competitive market. Now privatised and fully subject to market pressures there will be further incentives for British Energy to enhance output and so improve profitability, whilst maintaining strict safety standards.

2.16 The Government also stimulates the development of new and renewable energy sources. In keeping with the move to competitive, open markets, support is concentrated on technologies which have prospects of being economically viable, as well as environmentally acceptable. Policy was set out in Energy Paper 62, *New and Renewable Energy: Future Prospects in the UK*.

2.17 The UK is working towards 1,500 MW of new renewable electricity generating capacity by 2000. This will principally be achieved by encouraging the market through the Renewables Orders- the Non Fossil Fuel Obligation (NFFO) in England and Wales, the NI-NFFO in Northern Ireland, and the Scottish Renewables Obligation- which place legal requirements on the Public Electricity Suppliers to sign contracts with generators of electricity from renewable sources. Under these contracts, generators receive guaranteed prices above that paid for electricity from fossil fuels, for a number of years of operation. However, to win contracts, renewable energy generators have to bid increasingly lower prices for support under successive orders which is encouraging them to reduce their costs and become more competitive.

2.18 Currently over 400 MW of renewable capacity is in place with a further 900 MW under contract. This is the result of the first three Renewables Orders in England and Wales, two in Northern Ireland and one in Scotland; a fourth order is in preparation for England and Wales (with a fifth planned) and a second order is in preparation for Scotland.

2.19 However, although the Renewables Orders provide a guaranteed market for their electricity, successful bidders must still raise the necessary finance and gain planning permission to construct their plants. Table 2I is a summary of progress as at 30 September 1996. It shows the number and generating capacity of the contracted and commissioned projects.

Table 2.1 Contracted and commissioned projects under Renewables Orders (September 1996)

Technology	Contracted		Commissioned	
	No.	MW	No.	MW
Hydro	79	57	35	22
Landfill gas	99	57	68	118
Municipal and Industrial Waste	35	561	7	100
Sewage Gas	31	34	26	33
Wind	133	323	42	87
Biomass	13	133	0	0
Other	8	76	5	58
TOTAL	398	1360	183	418

Transmission

2.20 Transmission, the transfer of electricity in bulk across the country, is a natural monopoly run by the privately owned National Grid Company (NGC) in England and Wales and regulated by the regulator of the electricity industry-OFFER. In a number of ways the NGC ensures that transmission losses are minimised.

2.21 The location of power plant has a significant impact on the amount of electrical energy expended from the transmission system in the form of losses. NGC's use of system charges includes regional variation designed to encourage new generating plant to be located closer to demand and for major new sources of demand to locate closer to existing power plant.

2.22 NGC devised a scheme to reduce the cost of a number of services it purchases on behalf of suppliers from electricity generators. As part of this scheme suppliers or large customers can be contracted to manage the load where this produces savings.

2.23 The Regulator has a duty to take into account, in exercising his functions, the effect on the physical environment of activities connected with the generation, transmission or supply of electricity. The proposals for revised transmission price controls issued by OFFER in October 1996 describe two measures to further enhance energy efficiency. Under the new proposed transmission loss charging system there will be greater incentives for generators to take account of losses when bidding their plant in the electricity trading pool and when deciding on the location of new plant. In addition, NGC will have greater financial incentives to minimise the level of transmission system losses.

Distribution

2.24 Distribution, the delivery of electricity over local networks, is controlled by the twelve Public Electricity Suppliers (PESs) in England and Wales and regulated by OFFER. Distribution companies have incentives to invest in demand saving measures as an alternative to investment in the distribution system wires when this is more cost effective.

2.25 OFFER's new distribution price controls, proposed in 1994 and subsequently tightened in 1995, contained two measures to improve energy efficiency. The previous price control was based on units distributed and it was widely argued that this gave the companies an artificial incentive to sell more electricity. In the new proposals, the basis of the price control was split equally between units distributed and customer numbers. In OFFER's view, 'this should avoid any artificial disincentive in the distribution price controls to the companies' pursuit of energy efficiency, whilst at the same time retaining an appropriate marketing incentive. 'the previous price controls allowed the companies to retain a proportion of the benefit from reduced losses, instead of having to pass all of it to consumers in the form of lower prices. The new proposals doubled this proportion.

2.26 Whilst the supply of electricity is not yet fully competitive, OFFER also regulates this part of the electricity industry. OFFER sets energy efficiency standards of performance (SOPs) which require the PESs to achieve specified levels of energy saving. Since 1 April 1994, (1 April 1995 in Scotland), the PESs have been required to explore the

potential for low cost, demand side management projects and to promote the efficient use of electricity by undertaking projects in liaison with the Energy Saving Trust. Under the supply price controls, the PESs are allowed to recover about £25 million per year from customers between April 1994 and March 1998 to meet the cost of such projects. The Regulator has been considering whether energy efficiency SOPs should continue after liberalisation in 1998. In January 1997 he announced that he proposed to extend the existing efficiency standards on PESs for a further two years (to the end of March 2000). He is consulting further on the shape and level of the standards appropriate from 1998.

European Union Programmes

2.27 The UK participates in the EU ALTENER and JOULE-THERMIE programmes. ALTENER promotes renewable energy sources with a particular objective of limiting CO₂ emissions. JOULE-THERMIE supports the research, development and demonstration of energy technologies, one of its main objectives being to reduce the impact of the production and use of energy, in particular the emission of CO₂.

Gas Industry

2.28 The Gas Act 1995 has enabled the final liberalisation of the gas market by creating the licensing framework for new entrants into the domestic market. The Government intends to introduce competition in the domestic market on a phased basis between 1996 and 1998. The first phase comprises a pilot scheme covering half a million homes in the West Country. The scheme will be extended to a further 1.5 million homes during 1997 as a precursor to nationwide competition in 1998. In a number of ways the liberalisation of the gas market has produced incentives for the implementation of energy efficiency measures.

2.29 As in the electricity market, suppliers may wish to distinguish themselves from competitors by offering energy efficiency services. Measures have been taken, as part of the new regulatory framework, to provide for the promotion and encouragement of efficient gas use and also to continue the duty of the gas regulator to promote its efficient use. In addition, the draft standard conditions of gas suppliers' licences contain a requirement for gas suppliers to provide advice to consumers on energy efficiency. Although the regulator has set no standards of performance, she has agreed voluntary schemes run by a number of suppliers to promote energy efficiency, currently to a value of around £2 million a year.

2.30 The current tariff formula for controlling gas prices allows expenditure by British Gas on approved energy efficiency schemes to be recovered in the tariffs charged to gas consumers. This has provided funds for two schemes run by the Energy Saving Trust. This scheme will end with the introduction of competition.

2.31 A natural gas supply is being introduced to Northern Ireland for the first time. The industry expects to penetrate the domestic, industrial and electricity generation markets and displace the less fuel efficient traditional energy sources such as coal and oil. A study is underway into the construction of a gas interconnector between Northern Ireland and the Republic of Ireland, so further extending the gas supply.

2.32 The regulator of the new natural gas industry in Northern Ireland also has a statutory duty to promote the efficient use of gas. There is a requirement for gas suppliers in Northern Ireland to provide energy efficiency advice to customers.

Transport

2.33 Road transport is responsible for about 80% of all transport emissions and is the fastest growing source of UK emissions of carbon dioxide, and the only major sector for which emissions are forecast to grow by 2000 (see Figure 2H). Road transport's share is forecast to increase from around 20% of emissions in 1990 to about 25% in 2000. Government policies have had a useful impact in slowing the growth of emissions, nonetheless the trend has not been reversed or stabilised, due largely to the strong link between the growth of road and aviation transport and the growth of incomes.

2.34 The Government published its Green Paper for England Transport: The Way Forward in April 1996 and a statement on transport priorities in Northern Ireland in October 1995- the Secretaries of State for Scotland and Wales intend to publish their own transport statements in due course. The Green Paper recognises that the environmental

impacts of the growth in road traffic may be a threat to sustainable development and emphasises the need to reduce those impacts.

2.35 Three key themes to emerge from the Green Paper are:

- improving fuel efficiency of road transport, for example through increases in road fuel duties;
- reducing car dependency, especially in urban areas, through better planning and promotion of public transport, cycling and walking; and
- recognising that measures may be needed to manage or restrain road traffic, especially in urban areas.

2.36 The Government is also concerned about the environmental impacts of the rapid growth of air transport. Improving fuel efficiency

2.37 A key element in improving fuel efficiency and indeed total fuel consumption is to send the right price signals. To provide a clear, consistent signal to consumers and manufacturers, the Government announced in 1993 its commitment to a long-term strategy of annual increases in road fuel duties. Since 1994, this commitment has been to raise duties by an average of at least 5% a year in real terms. In fact, since 1993, fuel duties have risen by an average of 6.75% for unleaded petrol, 7.75% for leaded petrol and 8.25% for diesel per year in real terms.

2.38 The expectation that the increases will continue gives consumers and manufacturers an incentive to respond. This fiscal measure works because higher fuel costs encourage manufacturers to improve the fuel efficiency of vehicles and also encourage road users to take action to conserve fuel, for example by buying a more fuel efficient vehicle, by driving less or changing their driving style, and for fleet users by managing their operations (freight or car) more effectively. There is evidence to suggest that the fuel consumption of new petrol cars has been falling since 1993, in contrast to an increase between 1987 and 1993- the sales weighted average has fallen from 7.74 litres per 100km to 7.55 litres per 100km (a reduction of 2.5%).

2.39 Stricter vehicle emission standards including the fitting of catalytic converters to passenger cars play a key role in the attainment of local air quality targets. Catalytic converters are able to reduce noxious emissions by over 80% but are only able to operate at stoichiometric fuel-air mixtures which may limit the scope of car manufacturers to reduce emissions of CO₂. However, the fuel consumption of new vehicles has fallen since the introduction of catalysts because of the need to control precisely the flow of fuel.

2.40 Growth in the use of diesel fuelled vehicles has had benefits in reducing emissions of CO₂ but this has been at the expense of local air quality.

2.41 It is estimated that in 1996 the fuel duty strategy saved between 1.5 and 2 MtC. It is expected to deliver savings of 3 MtC a year by 2000. This will represent a saving of about 8% of total CO₂ emissions in road transport that year.

2.42 The fuel duty strategy is reinforced by a range of initiatives to raise public awareness and to change the behaviour of individuals and businesses. These include the Greener Motoring Forum and the Energy Efficiency Best Practice Programme through which a number of guides have been published to assist managers of freight and car fleets. They include fuel consumption guides to assist in benchmarking performance, case studies of particular transport companies and fuel management guides containing practical assistance. The programme also supports specific industry initiatives and will promote examples of best practice in other areas such as local authorities.

2.43 The Energy Saving Trust is supporting the development of markets for alternatively fuelled vehicles by running a series of pilot projects, and will follow these by setting up several vehicle procurement groups which the Trust will subsidise.

2.44 For the future, the European Union is developing a strategy to achieve substantial improvements in CO₂ emissions from new passenger cars by 2005 - 2010. The centrepiece of the strategy is a voluntary agreement with manufacturers to improve the fuel efficiency of new cars. This will be underpinned by increases in minimum road fuel duties and measures to increase consumer information. The UK supports the voluntary approach and the UK car industry has responded positively to the Government's request to contribute to a voluntary agreement.

Reducing car dependency, improving transport choices and restricting vehicle use

2.45 The better integration of transport planning and land use planning offers the prospect of making more efficient use of the transport infrastructure and reducing dependency on road transport. The Government has therefore published planning guidance in England and Wales which aims to:

- reduce the growth in the number and length of motorised journeys;
- encourage use of alternative means of travel; and
- reduce reliance on the private car.

2.46 The guidance encourages development in urban areas close to travel links. Most of the impacts will be long-term but some new developments can have significant immediate impact. The Government has also been considering proposals to integrate more closely strategic land use planning with the planning of trunk roads in England and Wales. In Scotland, trunk road planning and land use planning are already closely integrated.

2.47 Improving the integration of the transport network is also encouraged in other ways. Since 1993 local authorities in England have been encouraged to put together broad packages of measures which promote alternatives to the private car when seeking Government funding for transport projects. The guidance emphasises the importance of less environmentally damaging transport such as cycling, walking, and public transport. In 1996/97, 53 bids were funded under this 'package approach' and a total package allocation of £78.7 million was made.

2.48 The Transport Green Paper announced that there would also be a switch in Government emphasis from roads to public transport. As in the energy sector, there has already been a substantial programme of liberalisation and privatisation of transport to improve the efficiency and scope of public services:

- buses have a vital role to play in urban transport. Nearly all local bus services are now run by private operators, opening the way for innovative services and great improvements in efficiency. A number of initiatives are underway to raise the profile of bus services and further encourage bus use.
- Privatisation of the railways is almost complete. It is already leading to significant investment which will increase efficiency and the development of services which are more responsive to customers and matched more closely to their needs. Improving the attractiveness of the railways is already having an effect in the form of new freight traffic. Passengers are being protected by a stringent cap on fare increases. These measures will all have an important longer term impact on increasing the use of railways by both passengers and freight.

Congestion or air pollution, can also have some impact on CO₂ emissions. Some measures, such as speed limits, are already in place and the Government is looking at options for local powers to restrain access to sensitive areas, and to introduce parking restrictions and congestion charging.

Air transport

2.51 Civil air transport is responsible for about 2% of global CO₂ emissions. Aircraft also contribute emissions of NO_x which may have a heightened global warming potential when emitted in the upper atmosphere. Air transport grew by 38% in Europe from 1991 to 1996 and is forecast to continue growing at a similar rate over the next few years. Aviation fuel demand is expected to grow by 3.1% per annum over the next decade. The existing Programme contains no measures to address this growth in emissions. However, the aviation industry has made and continues to make improvements to its fleet and operations which result in emissions growth being significantly less than the growth in air traffic demand. Nevertheless the UK supports proposals to end the current tax exemption for international aviation fuel and is working within the International Civil Aviation Organisation to try to achieve this on an international basis.

Industry, Commerce and the Public Sector

2.52 There are many cost-effective opportunities to reduce waste, including wasted energy. This can reduce CO₂ emissions, increase the profits and competitiveness of business, and reduce the cost of public services. The industrial, commercial and public sectors therefore have an incentive to invest in cost-effective energy saving measures. However, energy costs are usually only a small proportion of an organisation's total costs, and may not be given full consideration. Technical estimates suggest that up to 30% of CO₂ emissions could be saved cost effectively in these sectors. To encourage industry to identify and then exploit the potential for such energy savings, a mixture of different approaches is used:

- to provide information and guidance;
- to encourage action;

- to support research and development of new technologies; and
- to directly improve the energy efficiency of government institutions.

Information and technical advice on energy efficiency

2.53 The main programme to stimulate the take up of energy efficiency technologies and techniques in business, the public sector and housing is the Energy Efficiency Best Practice Programme (EEBPP), launched in 1989. It is aimed at energy users, building designers and managers of industrial processes, buildings and transport operations, and at designers of industrial plant, buildings and their services.

2.54 The EEBPP prepares and disseminates authoritative information, guidance and case studies in order to show decision makers that cost-effective measures can reduce energy consumption and costs. Many of the EEBPP's dissemination activities are managed jointly with third parties such as trade associations and professional institutions. In addition, the EEBPP part funds collaborative research and development projects with industry to bring forward the development of new efficiency technologies. The EEBPP has a target to stimulate annual energy efficiency savings equivalent to 5.0 MtC a year by 2000, 4.5 MtC of which is in this sector and 0.5 MtC in the residential sector. By the end of 1995 it had stimulated savings leading to a reduction of around 3.0 MtC a year. The information produced by the EEBPP also underpins other Government energy efficiency initiatives. About 1.5 MtC of the projected EEBPP savings in 2000 will contribute to the target for combined heat and power described in paragraph 2.60.

2.55 Further technical advice is provided through specialist programmes, such as the Energy Design Advice Scheme, and the Energy-Related Environmental Issues programme, which aim to reduce emissions from buildings. Encouraging Action

2.56 Given the potential benefits for industry of investing in energy efficiency, the UK puts an emphasis on voluntary action. The EEBPP supports the efforts of signatories to the Making a Corporate Commitment campaign, a promotional programme which seeks top management commitment to energy efficiency, with some 2,000 participants to date.

2.57 Taking voluntary or negotiated action gives industry the flexibility to adopt the most cost-effective measures. There is therefore scope for voluntary agreements, especially with the more energy-intensive industrial sectors, to improve energy efficiency and reduce CO₂ emissions. The Government is discussing such an approach with the chemical industry which would aim to deliver additional savings beyond 2000.

2.58 Within industrial sectors, voluntary schemes to encourage the adoption of good standards are used to further stimulate competitiveness and energy saving. The EC Eco-management and Audit Scheme gives companies public recognition for good environmental and energy management. To encourage the participation of smaller companies in the scheme, grants are available through the Small Company Environmental and Energy Management Assistance Scheme.

Combined Heat and Power

2.59 Within the UK, there is a large number of small electricity generators, mainly supplying their own needs. Many of these use Combined Heat and Power (CHP) plants- specially designed energy systems which produce electricity and use the heat that is normally wasted, making them more fuel efficient and cost-effective. CHP systems typically run at thermal efficiencies of 85% or more, compared with conventional power stations' efficiency of around 35%.

2.60 In 1990 the Government set a target of 4,000 MW of installed CHP capacity by 2000, doubling the capacity at that time. In 1993 this target was increased to 5,000 MW as part of the Climate Change Programme. Achieving this 3,000 MW increase in CHP capacity will save a total of 3.5 MtC a year. In 1996, CHP capacity reached 3,500 MW on around 1,300 sites. The Government published A United Kingdom Strategy for Combined Heat and Power in June 1996. This outlines how the Government will maintain the growth of CHP through research, information and promotion, and with the involvement of the Energy Saving Trust and the Combined Heat and Power Association. The Government is currently reviewing the potential for CHP and further carbon savings beyond 2000, to inform the future shape of the CHP strategy, and provide the basis for setting post - 2000 targets. Preliminary indications are that the potential technical capacity for cost-effective CHP could be 10,000 MW or more.

2.61 The liberalisation of the electricity industry and changes in the regulatory structures have removed barriers to the use of CHP. Existing Public Electricity Suppliers as well as new entrants are increasingly offering CHP. Recent amendments to the licensing regime have exempted more CHP operators from licensing requirements and from the payment of Non-Fossil Fuel Levy, and have made it easier to export surplus power from CHP installations. The fourth round of the Non-Fossil Fuel Obligation for the first time allows municipal waste-fired CHP community heating schemes to qualify for support.

Public Sector

2.62 To provide an example to others, UK government institutions have set themselves demanding energy-saving targets.

2.63 For Central Government, a target was set of a 15% energy efficiency improvement over the five years to March 1996. Performance is monitored using stringent cost based indicators and an improvement of about 14.5% has been achieved. Increased electricity demand (arising from increased use of air conditioning and a large increase in IT) was offset by considerable efficiency improvements, particularly on the military estate. Total CO₂ emissions fell by 17%, saving over 0.2 MtC per year. The Government has now set a target of 20%, relative to the same baseline, for March 2000, and this is expected to save over 0.3 MtC per year.

2.64 Local authorities continue to work towards their own energy efficiency targets in buildings outside the residential sector. Strategies to improve energy efficiency, on the lines of the initial 15% initiative adopted by central Government, have been endorsed by the local authority associations and a survey in 1994 carried out by the Department of the Environment and the associations indicated that many authorities were already on course to achieve a 15% improvement. Several authorities were embarking on a further phase of activity. The Government continues to work with local authorities through the Central and Local Government Environment Forum (CLGEF) to promote energy efficiency.

2.65 The National Health Service is also working to similar energy efficiency targets and is committed to maintaining the momentum from the last five years by embarking on a further phase to improve energy efficiency by 20% by 2000.

2.66 The continuing trend towards outsourcing of the provision of energy services has grown with the liberalisation of UK energy markets. The Government is actively encouraging the contracting of energy services within the public sector because it leads to a greater focus on and investment in energy efficiency, reduced use of energy and reduced emissions. It published Energy Service for the Public Sector- a Working Guide in December 1996, and this is being followed through with a programme of seminars covering Government departments, agencies, local authorities and other public bodies.

Residential

2.67 Year-on-year temperature fluctuations have a significant effect on emissions from the residential sector but the actual emissions data to 1996 are consistent with the general downward trend to 2000 expected in the national emissions projections- see Figure 2M. As with other sectors, there are also economic benefits in improving energy efficiency in housing. These opportunities are not always exploited due to barriers in the market such as high initial capital costs and lack of public information. Technical estimates suggest that up to 25% of CO₂ emissions from housing could be saved cost effectively. The Government, therefore, aims to overcome these barriers and realise this potential improvement by:

- encouraging domestic consumers to be more energy efficient; and
- raising the standard of the building stock.
-

Encouraging Energy Efficiency in Households

2.68 A series of national campaigns has been run to raise awareness of the link between energy use and climate change, and to encourage action to improve energy efficiency in the home.

2.69 The independent Energy Saving Trust (the Trust) was set up in 1992 to develop and manage new programmes to promote the efficient use of energy by domestic and small business consumers. The Trust aims to act as a catalyst,

improving energy efficiency by raising awareness, providing information and advice, and working with others to encourage the provision of energy-efficient products and services.

2.70 The Trust's schemes include:

- a major marketing programme called 'Energy Efficiency', supported by manufacturers, retailers, installers, trade and consumer groups, and providing information to help consumers make the right energy efficiency choices for their home;
- a network of Local Energy Efficiency Advice Centres;
- projects to encourage young people and schools to take an interest in energy efficiency;
- price incentives for energy efficient products such as condensing boilers, heating controls and cavity wall insulation; and
- The Energy Club, a private sector venture which will offer households in private sector dwellings energy efficiency advice, energy efficiency home improvements, and best value gas and electricity supplies.

2.71 The original Programme expected the Trust to run a major programme of energy efficiency measures, to achieve savings of 2.5 MtC a year by 2000, funded by levies on gas and electricity consumers. However, the industry regulators did not feel that a levy approach was appropriate on the scale originally envisaged. Instead the Government plans to provide up to £71.5 million of public expenditure for the Trust for the four years 1996 to 2000. The Trust's revised programme of activities is expected to save 0.5 MtC a year by 2000.

2.72 The market for energy-efficient products is also boosted by measures to improve consumer information. EU-wide schemes such as energy labelling and ecolabelling of domestic appliances allow consumers to choose the most energy-efficient products. The efficiency of new domestic appliances is also being improved, where necessary, by the introduction of EU-wide regulations setting minimum energy efficiency standards. Minimum standards have already been introduced for new central heating boilers, fridges and freezers. In the UK, these are expected to save 0.35 MtC by 2000.

2.73 The message to consumers that they need to be more energy efficient is reinforced by price signals. Value Added Tax (VAT) on domestic fuel and power was introduced at 8% in April 1994. This encourages more economical use of fuel and provides further stimulation to consumers to buy more energy-efficient products. This should save 0.4 MtC by 2000. In December 1994 the UK Parliament decided not to proceed with the Government's proposal to increase the VAT on fuel to the standard rate of 17.5% and so limited any further effect of this policy on emissions.

2.74 For those on low incomes, who cannot afford the initial costs of energy efficiency measures, grants are available through the Home Energy Efficiency Scheme (HEES). HEES is a successful and well-regarded scheme which has improved living conditions for over 2 million of the most vulnerable households. About £350 million has been spent on it over six years. Recent research demonstrates the value for money of HEES measures, with people saving an average of £45 per annum (if heating patterns are maintained) as a result of the insulation of their homes. Changes to the scheme, proposed for Spring 1997, will offer greater benefits and more choice. The present range of basic insulation measures will be extended, allowing the scheme to offer the measures best suited to individual homes. Energy rating techniques will be used to monitor the scheme's overall performance.

2.75 Also at the discretion of local authorities, house renovation grants towards the cost of heating and insulation works may be available to low income owners and tenants of private housing. In Northern Ireland householders who are pensioners or are on low incomes can have their homes insulated and draught proofed under the Domestic Energy Efficiency Scheme. The scheme also provides free advice on making the best use of energy.

Improving the Building Stock

2.76 Without market pressures the construction industry cannot be expected to invest wholeheartedly in improving the energy efficiency of new buildings. As well as targeting clients who commission buildings and professionals who design them, regulation is necessary to ensure that action is taken now. Minimum legal requirements for the energy performance of new buildings have been in force since 1965, with the standards tightened regularly every few years. The latest revised building regulations, which came into force in July 1995, raised the minimum standard so that new buildings must now be 25-35% more energy-efficient than before. The regulations are expected to save a total of 0.25 MtC by 2000.

2.77 The Standard Assessment Procedure (SAP) is the Government standard for home energy rating. Under the revised building regulations, new dwellings and conversions in England and Wales are required to have a SAP rating. The Government is working with mortgage lenders to encourage them to incorporate home energy rating and energy efficiency advice into their survey reports and to offer “green loans” or other financial services to improve energy efficiency. The Government is also working with the housebuilding industry under the SAP 80 Plus Initiative which aims to promote the achievements of those housebuilders already building to high standards of energy efficiency and to encourage other housebuilders to follow their example.

2.78 Around 20% of existing housing is owned by local authorities and energy efficiency is already an integral part of their various housing improvement programmes.

2.79 The Home Energy Conservation Act 1995 is now fully in force. It requires local authorities to identify measures to bring about a 30% improvement in domestic energy efficiency over the next 10 to 15 years amongst all the housing in their areas. The first reports under the Act were produced and published by local authorities in late 1996.

2.80 The Energy Efficiency Best Practice Programme (EEBPP) underpins all of these activities by helping the establishment of new performance standards, and by assisting suppliers to meet or exceed these standards. Annual savings in the residential sector achieved directly by the programme were at least 0.3 MtC by the end of 1995 with a target of 0.5 MtC by the end of 2000. The work of the EEBPP includes:

- helping the Housing Corporation to set targets in excess of building regulations for new housing association properties and standards for existing stock;
- working with housing associations to help them achieve the standards;
- working with housebuilders to produce practical designs well in excess of current building regulations and thereby giving the industry confidence to accept even higher standards when building regulations are next revised; and
- assisting local authorities to meet the energy efficiency standards for their housing when they bid for Government funding.

FORESTRY, AGRICULTURE AND CARBON RESERVOIRS

2.81 The Government aims to preserve and enhance sinks and reservoirs of carbon (forests and soils) to secure an annual increase in the total stock of sinks.

Afforestation

2.82 Tree cover has doubled this century to 2.4 million hectares (ha). There are a range of incentive schemes for new planting which are increasing cover by about 20,000 ha per annum. The Farm Woodland Premium Scheme, which replaced the pilot Farm Woodland Scheme, encourages farmers to convert productive agricultural land to woodland and makes annual payments to help offset the agricultural income foregone. Around 46,000 ha of new woodland have been approved in the UK under these two schemes. This amounts to some 50 million trees. The Woodland Grant Scheme is operated by the Forestry Commission and offers establishment grants for new woodland and management grants for existing woodlands. The Forestry Commission is responsible for operating felling controls for existing woodland and offering grants to assist and encourage the proper management of mature forests.

2.83 In its 1995 White Paper Rural England, the UK Government said it would like to see a doubling of woodland in England over the next half century. To take forward this objective, the Forestry Commission and the Countryside Commission have published a discussion paper to develop the debate about the priorities for woodland creation and stimulate thinking about how the target could be achieved.

Other agricultural land-use changes

2.84 For agriculture, the Government has several policies which encourage extensification (less intensive resource use) of agricultural production where they are appropriate to environmental aims. Examples of these policies include voluntary agri-environment schemes such as: Countryside Stewardship, Environmentally Sensitive Areas, Nitrate Sensitive Areas, the Habitats Scheme and the Moorland Scheme, which aim to promote environmentally sensitive farming. Measures include the promotion of more extensive forms of crop production and the conversion of arable land to permanent extensive grassland or lower livestock densities. Research on the effects of these policies, although

subject to uncertainties, has indicated that the overall impact is to decrease emissions and increase sinks for greenhouse gases.

2.85 There have been a range of other changes to land use which are expected to increase the carbon reservoir, including non-rotational set-aside - part of the reform of the EU Common Agricultural Policy - under which most farmers must set aside (ie take out of production) a percentage of their arable land (10% in 1996 reducing to 5% in 1997). Since 1 July 1995, farmers entering eligible land into certain agri-environment and forestry schemes have been able to count this land against their set-aside obligation under the Arable Area Payments Scheme. However, it is difficult to assess its full impact.

2.86 The burning of agricultural straw was banned (with a few limited exceptions) in England in 1993 and restricted in Scotland by a code of practice (see paragraph 3.17). Evidence suggests that, as straw decomposes fairly rapidly, the soil carbon reservoir will not increase by more than between 1 and 3 MtC in the ten years following the burning restrictions.

2.87 The UK will stop the marine disposal of sewage sludge by the end of 1998. Disposal on land may increase the soil carbon reservoir by 2 - 3 MtC over 20 - 30 years.

Monitoring United Kingdom sinks

2.88 Since the first National Communication was published the Government has continued to sponsor research at the Institute of Terrestrial Ecology (ITE) to improve estimates of the carbon stored in UK soils and vegetation. Figures 2N and 2O show how carbon is distributed in these reservoirs across the UK. These new maps include Northern Ireland and are drawn on a 1 km by 1 km grid, enabling more accurate allowance to be made of the effect of associations between soil and vegetation types in estimating carbon stored. A more accurate assessment of carbon in peat soils has also been made, using density data from the Forestry Authority. Table 2.II gives the revised estimates of total carbon stored.

2.89 ITE has also revised estimates of uptake and loss of carbon associated with land use change, forestry and peat extraction and produced projected uptake and loss estimates in 2000 (Table 2.III)

2.90 The most significant difference from the first National Communication is in agricultural land use change, which has been revised upwards from about zero in 1990 to an annual loss of about 7.6 MtC. This takes full account of the historic loss of rough grazing and of urbanisation. The new estimates use the complete pattern of land use change by comparing the Countryside Surveys undertaken in 1984 and 1990.

2.91 The projections assume that the pattern of land use change recorded in the Countryside Surveys will continue, and take account of the current effects of past patterns of land use change as recorded by comparing surveys undertaken in 1947 and 1984. The projections assume that significant amounts of land will not enter the EU Set-aside scheme after 1996 and that peat extraction for fuel and horticultural use remains at about present levels. Areas of conifer and broadleaf tree planting are both assumed to expand by 10,000 ha/yr in Great Britain, and by 700 and 300 ha/yr respectively in Northern Ireland.

Projections and effects of measures

2.92 The latest UK energy projections, published in Energy Paper 65 (EP65), suggest that carbon dioxide emissions will be 6 - 13 MtC (4 - 8%) below 1990 levels by the year 2000. The projections given below and elsewhere in the report are based on the mid-point of the central scenarios in EP65. Projected emissions for land use changes were estimated by ITE.

2.93 Sustained economic growth in the UK is putting upward pressure on energy demand and hence emissions. However, there are some significant offsetting factors:

- The shift from coal to gas in electricity generation, following privatisation and liberalisation of the industry is expected to save around 17 MtC per year by 2000.
- The growth in renewables capacity will contribute a saving of 2 MtC per year by 2000.
- Significant improvements are anticipated in the productivity and efficiency of nuclear power. As a result, nuclear power is now expected to produce a much higher proportion of energy in 2000, saving 2.9 MtC per year by 2000.

- Growth in Combined Heat and Power capacity is expected to save 3.5 MtC per year by 2000.

2.94 A number of factors have changed within the original Programme:

- The introduction of VAT on domestic fuel and power at a rate of 8% is expected to save about 0.4 MtC a year, compared with the original estimate of 1.5 MtC at the originally proposed rate of 17.5%.
- The impact of the long term commitment to real annual increases in road fuel duties is now expected to have a greater impact, partly because duties have been raised by more than the 5% per annum originally envisaged. It is now expected to save 3 MtC a year rather than 2.5 MtC.
- The role and funding of the Energy Saving Trust have been revised, now expected to save 0.5 MtC a year rather than 2.5 MtC.

2.95 The significant reduction in the carbon intensity of fuels used for electricity generation means that energy efficiency measures which displace electricity supply have a smaller impact in terms of carbon savings.

2.96 The measures in the climate change programme are now estimated to save 7.7 MtC in total as shown in Table 2.IV.

Table 2.IV Expected changes in carbon dioxide emissions from 1990 to 2000^a

	MtC/yr
Total carbon dioxide emissions in 1990	167
Projected carbon dioxide emissions in 2000 without any offsetting changes	193
Less offsetting changes:	
projected savings from measures in the climate change programme	7.7
projected savings from measures pre-dating the climate change programme	7.6
projected effect of changes in the electricity supply industry and other changes	9.9
Projected total carbon dioxide emissions in 2000	158

^a The entries in this table are adjusted to take account of the revised estimates for emissions from UK carbon pools in Table 2.III

**Table 2.V Summary of expected CO₂ savings in the year 2000
(compared to projected emissions in 2000 without measures in place)**

Sector	Projected savings MtC/yr	Footnotes
Electricity Generation and Energy Supply		
Fuel switching in the electricity supply industry	17.0	
Improved productivity of nuclear power	2.9	
Renewable energy	2.0	(a)
Transport		
Increase in road fuel duties	3.0	(b)
Industry, Commerce and the Public Sector		
Energy Efficiency Best Practice Programme	3.0	(c)
Combined Heat and Power	3.5	(d)
Public Sector	0.8	(b)
Other measures	0.9	(b)
Residential		
Energy Saving Trust	0.5	(e)
VAT on domestic fuel and power	0.4	(b)
Energy Efficiency Best Practice Programme	0.5	
Other measures	0.7	(b)
Total	35.2	

(a) Corresponds to 1,000 MW of new renewable energy capacity adopted in 1990, increased to 1.500 MW (saving an additional 0.4 MtC) under the climate change programme and its 1995 progress report.

(b) Included in the climate change programme and its 1995 progress report.

(c) The Energy Efficiency Best Practice Programme also contributes 1.5 MtC towards the Combined Heat and Power target for 2000.

(d) Corresponds to the target of 5,000 MW of Combined Heat and Power capacity in 2000, which was increased under the climate change programme and progress report from the previous target of 4,000MW.

(e) Revised upwards from 0.3 MtC in the 1995 progress report.

CHAPTER 3

METHANE

KEY DEVELOPMENTS

- Annual emissions of methane are expected to fall from 4.4 Mt in 1990 to around 3.4 Mt in 2000 – a reduction of over 22% (equivalent to 5.6 MtC on a GWP-weighted basis).
- National Waste Strategy for England and Wales published in December 1995.
- Voluntary action by industry to reduce emissions from gas distribution network, coal mining and offshore oil and gas production.

METHANE EMISSION INVENTORY AND TRENDS

3.1 In 1990, anthropogenic emissions of methane (CH₄) from the UK were just over 4.4 Mt with the major sources being agriculture and landfill waste, (see Figure 3B). Annual

emissions fell by 12% between 1990 and 1994, (see Figure 3C), and are expected to continue to fall to 2000.

3.2 Since the first National Communication, the UK methane inventory has been developed to be consistent with the IPCC greenhouse gas inventory methodology and to include recently updated UK-specific emissions factors (see annex 4 and the NETCEN report). There are still large uncertainties in many of the source estimates but these have been reduced significantly in key sectors as a result of recent research commissioned by the Government. In particular, improved quantitative assessments of methane emissions from landfill sites, agriculture and sewage treatment and disposal have been obtained.

3.3 Based on the assessment of likely future emissions from each sector and the effect of policies and measures in the national programme, annual emissions of methane are expected to decrease by 0.98 Mt to around 3.4 Mt by 2000 – a reduction of 22% (see annex 2). As shown in Table 3.I, this decline is due primarily to an anticipated fall in emissions from coal mining and landfill waste. If no additional measures had been taken, emissions would have remained approximately constant at 1990 levels to 2000.

Table 3.I Projected changes in methane emissions from 1990 to 2000 by sector

Sector	Projected change in emissions (Mt CH₄)
Landfill	-0.35
Agriculture	-0.07
Coal Mining	-0.50
Gas distribution	-0.09
Oil and gas production	+0.04
Wastewater treatment	+0.01
Fuel combustion	-0.02
Total	-0.98

WASTE MANAGEMENT

Landfills

3.4 Landfills are estimated to have been responsible for 1.89 Mt CH₄ in 1990, around 43% of national emissions. Without measures, it is projected that emissions would rise to 2.4 Mt by the year 2000. However, as a result of the measures described below, annual emissions are expected to fall to 1.54 Mt in 2000 (see A Methodology of Emissions from Landfill Sites, ETSU). Landfills are the largest source of methane in the UK and a comprehensive measurement and analysis programme is being undertaken to help improve the emission estimates from this sector.

3.5 The White Paper on waste, Making Waste Work, published in December 1995, sets out the Government's strategy for achieving more sustainable waste management in England and Wales. Similar strategies are being drawn up for Scotland and Northern Ireland and will be published for consultation in 1997 and in 1998 respectively. The main objectives are to reduce the amount of waste produced, to make better use of that which is produced and to adopt practices which minimise risk to the environment and human health. In particular, the policies and measures set out in the White Paper will reduce methane emissions by helping to minimise the amount of waste disposed of in landfills and to maximise utilisation of landfill gas.

3.6 Key policies include:

- **New Waste Management System:** this was introduced in May 1994, and includes statutory guidance for imposing higher standards for landfill site operators to promote collection and utilisation (or destruction) of landfill gas. In 1994, around two thirds of waste being disposed of to landfill was sent to sites with gas collection systems and subsequent flaring or use of gas for energy. Around 162 kt of methane was burnt in landfill gas energy recovery schemes with an additional 425 kt oxidised by flaring. By 2000, it is estimated that nearly all waste will be sent to sites with gas collection systems resulting in a subsequent increase in the amount of gas collected and flared or used for energy.
- **Renewable Energy:** as at 30 September 1996, municipal and industrial waste plants and landfill gas installations with a capacity of 219 MW were generating electricity under the Renewables Orders (see paragraph 2.17). Energy Paper 62, New and Renewable Energy: Future Prospects in the UK, envisages that these technologies may contribute 650 MW by the year 2000.
- **Landfill Tax:** this was introduced on 1 October 1996 to ensure landfill costs reflect the environmental impact of landfilling. The tax will increase the amount of waste managed by options towards the top of the waste hierarchy. The tax is set at a standard rate of £7 per tonne and a reduced rate of £2 per tonne for inactive waste.

3.7 Key targets include:

- Reduce percentage of controlled waste going to landfills from 70% in 1996 to 60% by 2005.
- Recover value from 40% of municipal waste by 2005.

Sewage Treatment and Disposal

3.8 Very recently, a study commissioned by the Department of the Environment (DOE) provided a detailed, up to date assessment of methane emissions from sewage treatment and Control Measures to Limit Methane emissions from Sewage and Sludge Treatment and Disposal. Annual emissions in 1990 from this sector have been revised to 33 kt; approximately half the previous estimate of 71 kt, and less than 1% of total methane emissions in 1990. Without measures, emissions would increase slightly to 37 kt by 2000.

3.9 The water services industry is committed to reducing emissions wherever there are safe, practicable and cost effective options. The report of the recent study, published in January 1997, identified a number of options for taking cost effective action to reduce emissions. If the measures outlined are fully implemented, emissions would be around 34 kt in 2000.

3.10 The Water Services Association, has agreed to encourage its members to use the report as a basis for identifying the options for reducing emissions, and to continue working closely with the DOE to monitor progress.

3.11 The sewage treatment industry generates renewable energy from the anaerobic digestion of sewage sludge. As at 30 September 1996, 33 MW sewage gas capacity was generating electricity under the Renewables Orders. The Government would expect new large treatment works not to need to contract under the Renewables Orders since they will generally find it economic to use the electricity generated from sewage sludge digestion to power the sewage sludge plant.

Agriculture

3.12 Agriculture is estimated to have been responsible for around 26% of national methane emissions in 1990. The IPCC methodology used to calculate methane emissions has changed since the first National Communication was published. Total emissions are estimated to have been 1.14 Mt in 1990 and are expected to fall to 1.07 Mt by the year 2000. The majority of agricultural emissions, around 88% in 1990, arose from enteric fermentation in livestock (mainly cattle and sheep). Livestock wastes were responsible for about 11% of emissions and burning of crop residues for about 1%.

Livestock

3.13 The reason for the projected decrease in emissions between 1990 and 2000 is the expected decline in cattle numbers, particularly in the dairy herd which is the largest single source of agricultural methane emissions. The decline is caused partly by long term factors such as the 1992 reform of the Common Agricultural Policy (CAP) and gradual improvements in cattle productivity. Cattle numbers will also be affected by the impact of the measures introduced in 1996 to tackle bovine spongiform encephalopathy (BSE). The BSE measures are expected to lead to a short term increase in animal numbers in 1996 due to a backlog of animals waiting to be slaughtered under the over 30 month scheme, followed by a longer term decline. The predictions take no account of any accelerated cull policy which may be adopted and forecasts of animal numbers remain uncertain.

3.14 Improving the efficiency with which energy fed to animals is converted into milk or meat tends to reduce emissions from each animal. Beyond reduction in livestock numbers, improving the feed efficiency of animals offers the best possibility of reducing direct livestock methane emissions. UK livestock already emit less methane per unit of production than many countries because diets are well matched to requirements. In the short term there may be little room for improvement: the Ministry of Agriculture, Fisheries and Food (MAFF) is sponsoring research to assess whether further modifications to diets might provide a practicable means of further reducing emissions, although improvements seem unlikely to occur for some years.

Livestock Waste

3.15 In 1995, MAFF spent nearly £2.5 million on an extensive programme of Farm Wastes research. In future, more emphasis will be placed on the development of cost effective methods of waste treatment and production of advisory materials on safe and efficient utilisation of animal wastes. MAFF plans to revise the Code of Good Agricultural Practice for the Protection of Air. This will provide an opportunity to update advice on reducing greenhouse gas emissions from livestock wastes and other agricultural sources.

3.16 Efficient anaerobic digestion of farm wastes may help to reduce methane emissions and provide a renewable energy source as an alternative to fossil fuels. The Government has provided an opportunity to develop a market for anaerobic digestion (AD) through the Renewables Orders. The aim is to increase confidence in the technology; if this helps to stimulate interest and commercial activity, capital costs may be driven down. Large and small scale AD projects are eligible to bid for contracts to generate electricity under NFFO4.

Crop Residue Burning

3.17 The Government made crop residue burning illegal in England and Wales under the Crop Residues (Burning) Regulations in 1993, with limited exceptions. Emissions from this source will be negligible in the year 2000. In Scotland less than 5% of stubble is burnt, and guidance provided in a Code of Practice *Prevention of Environmental Pollution from Agricultural Activity* helps to restrict the extent of burning. In Northern Ireland straw burning is an uncommon practice due to a combination of a small area of arable cropping and the use of straw for livestock feed and bedding or in the mushroom compost industry. Guidance to farmers on straw and stubble burning (in the limited number of instances where this is the practice) is given in the Countryside Management Code *Preventing Air Pollution by Smoke and Greenhouse Gases*.

FUGITIVE FUEL EMISSIONS

Coal Mining

3.18 Activities related to coal mining were responsible for methane emissions of 0.76 Mt in 1990, 17% of national emissions, with the majority arising from deep mine operations. Emissions are expected to fall to 0.26 Mt in 2000 due to the combination of declining coal production and the anticipated increase in utilisation of methane extracted from the mines.

3.19 Coal production in the UK has been declining for many years and this process is expected to continue to some extent. Coal operators are committed to reducing emissions wherever this is safe, practicable and cost effective. RJB Mining (UK) Ltd is the largest UK operator and produces over 85% of national coal output from deep mines. Following discussions with the Government, RJB Mining has revised its Environmental Management System to establish a mechanism for regular monitoring of emissions, and on-going consideration of measures to limit emissions from deep coal mines. RJB Mining has already identified potential scope for taking cost effective action to limit emissions by increasing utilisation of methane. By the year 2000, these measures could reduce emissions by around 9,000 tonnes of methane a year and generate 14 MW of energy.

Natural Gas Distribution and Storage Network

3.20 Gas distribution and storage was responsible for 0.39 Mt in 1990, just under 9% of total emissions. Annual emissions are expected to fall to 0.30 Mt by 2000.

3.21 British Gas TransCo has a leakage control strategy and replacement of traditional steel and iron mains with polyethylene pipe, gas conditioning and pressure management. It aims to reduce emissions from the transmission network by 20% on 1992 levels by 2000 and reduce fugitive emissions from storage installations by 15% on 1992 levels by 2000. By 1995, TransCo was on course to meet its targets and is in the process of investing £12 million over three years on leakage control equipment above planned capital investment in mains replacement.

Oil and Gas Production

3.22 Methane emissions from oil and gas production accounted for 97 kt, 2% of national emissions in 1990. Without additional measures, annual emissions are expected to rise to 132 kt by 2000 as a result of increasing levels of production.

3.23 Following publication of a report commissioned by the Government to assess the scope for cost effective measures to reduce emissions, the United Kingdom Offshore Operators Association (UKOOA) published environmental guidelines in July 1995 on reducing all emissions to air; producing atmospheric emissions inventories; and on management systems, auditing and training. UKOOA expects a large part of the industry to take advantage of the measures in order to contribute to the minimisation of emissions from offshore oil and gas, and significant reductions from individual facilities have already been achieved.

Fuel Combustion

3.24 Methane emissions from fuel combustion accounted for 97 kt, 2% of national emissions in 1990. Fuel combustion includes emissions from energy and transformation industries, energy use in industry, transport and small combustion sources such as domestic gas appliances. Emissions from biomass burning for energy are also included. Reductions in emissions from vehicles and small combustion sources are likely to result in emissions from this source category falling by almost 20% from 1990 levels to 79 kt by 2000.

3.25 Exhaust emissions of methane from road transport are anticipated to fall by just over 40% as a result of the greater use of three-way catalytic converters on petrol-engine cars required under EC Directive 91/441/EEC.

3.26 Oil refining is a prescribed process under the Government's Integrated Pollution Control regime. The Environment Agencies regulate emissions and ensure they are minimised following Best Available Techniques Not Entailing Excessive Cost (BATNEEC) principles.

ers on straw and stubble burning (in the limited number of instances where this is the practice) is given in the Countryside Management Code Ð Preventing Air Pollution by Smoke and Greenhouse Gases.

CHAPTER 4

NITROUS OXIDE

Key Developments

- Annual emissions expected to fall from 112 kt in 1990 to 43 kt in 2000 – a reduction of 62% (equivalent to 5.8 MtC on a GWP-weighted basis).
- Emissions from nylon manufacture – the largest single source of emissions – are to be cut by 95%.
- Agricultural emissions likely to decline between 1990 and 2000.

Nitrous Oxide Emission Inventory and Trends

4.1 Anthropogenic emissions of nitrous oxide (N₂O) from the UK are estimated to have been 112 kt in 1990, with 85% being emitted from chemical manufacturing processes, (see Figure 4B). These industrial emissions vary annually as a function of demand causing much of the variation in annual emissions to 1994, seen in Figure 4C.

4.2 The UK emission inventory for nitrous oxide is updated routinely to maintain consistency with the IPCC inventory methodology and to incorporate new UK-specific emission factors (see annex 4 and NETCEN report). Work continues to reduce the uncertainties in many of the estimates and to identify and quantify emissions from other potential sources of nitrous oxide. Emission projections are based on information on likely future practices and the effect of emission reduction policies in each sector and are compatible with the inventory, (see annex 2).

4.3 Without any new measures, nitrous oxide emissions would be expected to fall slightly from 1990 to 2000. With the additional measures described below, emissions will fall by 69 kt to 43 kt in 2000, a reduction of 62%.

Industry

Adipic Acid Manufacture

4.4 Nitrous oxide is emitted during the manufacture of adipic acid, which is an intermediate chemical in the production of nylon. Emissions from this process accounted for 81 kt or 72% of national emissions in 1990.

4.5 Under the Environmental Protection Act 1990 (EPA 1990) nylon manufacturing operations (including adipic acid production) are prescribed processes which require an Authorisation to operate subject to regulation by the enforcing authority, the Environment Agency (EA). The legislation requires that emissions of prescribed substances, such as nitrous oxide, from Authorised processes are prevented or minimised subject to the use of Best Available Techniques Not Entailing Excessive Costs (BATNEEC). Adipic acid manufacturing operations are therefore required to minimise the release of nitrous oxide in line with the requirements of the EA.

4.6 DuPont (UK) Ltd operate the only adipic acid plant in the UK, and are authorised to do so under the EPA 1990. DuPont will shortly be applying for a variation to their current Authorisation to install a common off-gas abatement unit (COGA) by October 1998 that will reduce annual nitrous oxide emissions by at least 95%. The COGA unit will burn nitrous oxide in an initial reductive and then oxidative environment thus converting the nitrous oxide to nitrogen. DuPont had originally planned to install equipment that would catalytically decompose the nitrous oxide to nitrogen and oxygen but implementation of this technique was not deemed BATNEEC for the site or able to be implemented within EA timescales.

4.7 Conditions for operation and emission monitoring of the COGA unit will be an integral part of the Authorisation, as varied, and will be scrutinised to ensure satisfactory operation of the system.

Nitric Acid Manufacture

4.8 Manufacture of nitric acid was responsible for 13% of national emissions in 1990. Emissions are expected to remain approximately constant at around 14 kt per annum to 2000 although, as nitric acid is also a precursor for other chemical manufacturing processes, production is demand-led and emissions are likely to vary significantly between years.

4.9 The manufacture of nitric acid is a prescribed process under the Integrated Pollution Control (IPC) regime, and the EA (in England and Wales) and the Scottish Environment Protection Agency regulate emissions and ensure they are minimised through the use of BATNEEC. Production methods in the UK differ from plant to plant and authorised releases vary accordingly.

Agriculture

4.10 Agriculture was responsible for 9% of national emissions in 1990. Emissions from this sector are expected to fall from 10.4 kt in 1990 to around 9.7 kt by the year 2000.

Chemical Fertilizer Use

4.11 The application of chemical fertilisers to land is estimated to have resulted in 5.3 kt of nitrous oxide emissions in 1990. Emissions are expected to be around 5.0 kt in 2000. Significant factors which are likely to affect the use of chemical fertilisers are the prices of fertilisers and cereals, and removal of land from agricultural production under the Set-aside Scheme. EU production-based, financial support is declining for many agricultural commodities following the 1992 reform of the CAP and this should reduce the economic optimum fertiliser rate for those crops.

4.12 In addition, since 1990 the Government has greatly expanded its agri-environment schemes which encourage, amongst other things, reduced fertiliser use.

- In 1996 approximately 24,000 ha of agricultural land (out of a total of 35,000 ha of eligible land) was entered into the Government's Nitrate Sensitive Areas (NSA) Scheme. Practically all land managed under the NSA scheme must receive low rates of organic and inorganic fertiliser, and roughly 12% receives no fertiliser at all.
- The Environmentally Sensitive Areas (ESA) Scheme which covers more than 3 million hectares of UK land. A third of this land is managed according to ESA Scheme prescriptions, which include limitations on the application of inorganic and organic fertilisers. For example, it is estimated that over 75% of ESA agreement land in England is entered under scheme conditions which require low fertiliser inputs and half of this land will receive no inorganic fertiliser at all.

Therefore, the two schemes have helped to reduce fertiliser inputs over approximately 350,000 ha of land in England alone.

Livestock Waste

4.13 Livestock waste accounted for around 3.6 kt of emissions of nitrous oxide in 1990. Emissions are expected to be around 3.4 kt in 2000. This slight decrease reflects projected reduction in herd by the year 2000 (see paragraph 3.13).

Crop Residue Burning

4.14 The burning of crop residues was responsible for 0.2 kt of emissions in 1990. Emissions from this source will be negligible in the year 2000 (see paragraph 3.17).

Biological Nitrogen Fixation

4.15 The remainder of agricultural emissions of nitrous oxide is caused by biological nitrogen fixation which is the process by which some plants such as clover and beans are able to use nitrogen from the atmosphere for growth. The emissions from this source are uncertain but are thought to be relatively small – in the order of 1.3 kt in 1990 and 2000.

Transport

4.16 The transport sector was responsible for 3 kt, 3% of national emissions in 1990. Emissions are expected to rise to 14 kt in 2000. This reflects the increase in numbers of three-way catalysts (fitted to all new petrol-engine cars) and the projected growth in traffic by 2000. Catalytic converters reduce emissions of nitrogen oxides by more than 80% but produce nitrous oxide as a side effect. The attainment of air quality targets for several key pollutants is only likely in

the future if cars equipped with catalytic converters continue to increase their share of the passenger vehicle fleet. There is, therefore, an unavoidable trade-off between the attainment of local air policy objectives and global climate change objectives.

Energy and Transformation Industries

4.17 This sector was responsible for 3% of national emissions in 1990. Emissions are expected to fall from 3 kt in 1990 to under 2 kt in the year 2000, as a result of changes in the composition of the electricity generation mix. Nitrous oxide is a by-product of fossil fuel combustion, and there is little scope for cost effective measures to limit emissions.

CHAPTER 5

OTHER GREENHOUSE GASES AND PRECURSORS

Key Developments

- Total emissions of HFCs, PFCs and SF₆ are expected to fall by 58% from 1990 to 2000 on a GWP-weighted basis which is equivalent to 2.4 MtC.
- The Government concludes voluntary agreements with industry to minimise the use and emissions of HFCs.
- The UK greenhouse gas inventory has been extended to include emissions of HFCs, PFCs and SF₆.
- The draft National Air Quality Strategy published in August 1996 sets a target for reduced levels of tropospheric ozone.

Emission Inventory and Trends of Halocarbons and SF₆

5.1 Since the first National Communication, and in line with continuing developments to the IPCC inventory guidelines, the UK inventory has been extended to include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF₆), see annex 4 and the NETCEN report. Emissions of these gases are low at present but they are significant for climate change due to their very high global warming potentials and the likely growth in emissions from some sectors in the near future.

5.2 Information on usage and emissions of these gases has been obtained from a recent in-depth review commissioned by the DOE of producers, distributors and users of the chemicals in the UK, and subsequent discussions with various industries. UK Use and Emissions of Selected Halocarbons. Actual emissions are estimated using a time-resolved model disaggregated by use sector.

5.3 Overall, UK emissions of HFCs are anticipated to increase between 1990 and 2000 mainly as a result of their increased usage as replacements for ozone depleting gases controlled under the Montreal Protocol. Emissions of PFCs show a rapid reduction between 1990 and 2000 due to emission reduction policies in the aluminium industry, while emissions of SF₆ are anticipated to increase slightly reflecting an anticipated increase in use in magnesium foundries (see annex 2).

Perfluorocarbons

5.4 National emissions of perfluorocarbons (PFCs) are expected to fall from 310 tonnes in 1990 to between 80 and 90 tonnes by 2000 mainly as a result of reductions in emissions from the aluminium industry, (see Figure 5B). In 1990, emissions of carbon tetrafluoride (CF₄) represented over 90% of the total together with smaller losses of higher PFCs from aluminium smelting, the foam-blowing and electronics and electrical sectors and during fluid manufacturing processes. PFCs are also being considered for future uses in the fire-fighting and solvent sectors.

Aluminium Industry

5.5 Primary aluminium smelting is the largest source of PFC emissions. Emissions are expected to fall from 300 tonnes in 1990 to 30 tonnes in 2000 as a result of actions taken to minimise the occurrence of anode effects in the aluminium reduction cell.

5.6 Perfluorocarbons are prescribed substances under the Government's Integrated Pollution Control (IPC) regime, which was introduced to regulate industrial pollution under the Environmental Protection Act, 1990 and their emission from aluminium smelting is regulated by the Environment Agency (EA) in England and Wales and the Scottish

Environment Protection Agency (SEPA) in Scotland. When considering emission authorisations, the EA or SEPA will ensure that emissions from the process are as low as can be reasonably achieved through the use of BATNEEC.

5.7 The aluminium smelters have taken steps, in consultation with the EA or SEPA, to improve operation and process control systems to ensure 'anode effects' are minimised.

Other uses

5.8 PFCs are used in a number of specialised applications, for example in the electrical and electronics industry, as solvents and potentially in fire-fighting equipment. Emissions from these sources are expected to rise from 8 tonnes in 1990 up to 60 tonnes in 2000 assuming no additional measures to limit emissions are taken. The Department of the Environment is exploring with industry and users the scope for minimising emissions.

Hydrofluorocarbons

5.9 Emissions of hydrofluorocarbons (HFCs) in the UK come from the manufacture of the fluids, from use of HFCs in various appliances, and from fugitive losses during chemical production processes. In 1990, emissions of HFCs were predominately HFC-23 losses from the manufacture of HCFC-22. This source is likely to decline significantly in the near future as emission abatement technology is installed. Increasingly, HFCs are being used as replacements for gases controlled under the Montreal Protocol particularly in refrigeration units, foam-blowing and aerosols.

5.10 Total emissions of HFCs are expected to rise from 1,050 tonnes in 1990 to between 1,300 and 2,300 by 2000, the range indicating the uncertainty in the estimates, see Figure 5C. HFC-23 accounts for the majority of losses in 1990. By 2000, HFC-134a is likely to account for nearly one half of total HFC emissions from the UK.

5.11 A stated aim of the Climate Change Programme is that any actions taken to reduce HFC emissions should not damage current efforts to phase out ozone depleting substances. During 1996 the Government concluded voluntary agreements with 5 different sectors of industry – refrigeration, foams, fire, aerosols, mobile air conditioning – which set out strategies to minimise emissions of HFCs and to ensure that they are not used where emissions are unavoidable if safe, practical and more environmentally acceptable alternatives are available. The Government will be reviewing the effectiveness of these voluntary agreements on a regular basis.

5.12 HFC-23 is produced as a by-product during the manufacture of HCFC-22. Both ICI and Rhone-Poulenc manufacture HCFC-22 in the UK, although the majority of production is based at the ICI plant. In response to Integrated Pollution Control requirements, ICI have recently announced plans to install an incineration unit to treat all waste gases from their fluorocarbon works including flue gases from both the HCFC-22 plant and from the production of HFC-134a. The unit is due to be commissioned in 1999, and will reduce emissions of HFC-23 by more than 90% and will significantly limit losses of HFC-134a.

Sulphur Hexafluoride

5.13 In the UK, SF₆ is used mainly as a cover gas in the magnesium industry, for electrical insulation in power transmission equipment and in several specialised electronics applications. Emissions are expected to rise from 26 tonnes in 1990 to 42 tonnes by 2000 mainly due to an anticipated increase in use as a cover gas and assuming no additional measures are taken to limit emissions, see Figure 5B. The Government is currently exploring with industry and users the scope for minimising emissions.

5.14 Over 80% of SF₆ is used in high voltage electrical switching gear and circuit breakers. However, this equipment is built to high, internationally-agreed standards. Consequently emissions are very low.

5.15 The largest source of SF₆ emissions is from their use as a cover gas in magnesium foundries. The Government strengthened Local Air Pollution Control guidance in 1996 (PG2/6(96)) to ensure that consumption of SF₆ by magnesium foundries is minimised. This guidance also requires the industry to monitor levels of SF₆ consumption from which emissions of SF₆ can be inferred.

5.16 Other uses and emissions of SF₆ are thought to be very small but nonetheless the Government will continue work to establish the extent of emissions and consider appropriate policy responses.

Tropospheric Ozone

5.17 Tropospheric ozone, another powerful greenhouse gas, is not emitted directly into the atmosphere but is formed primarily through complex reactions driven by sunlight and involving anthropogenic atmospheric pollutants such as nitrogen oxides (NO_x), volatile organic compounds (VOCs) and carbon monoxide (CO). To limit the formation of low-level ozone, control strategies and emission reduction policies are aimed at reducing emissions of the precursors to ozone formation.

5.18 As a result of the actions described below, UK emissions of NO_x are expected to fall from around 2,700 kt in 1990 to 1,530 kt by 2000, emissions of non-methane VOCs from around 2,450 kt in 1990 to less than 1,520 kt by 2000 and emissions of CO from approximately 6,400 kt to 4,030 kt over the same period. Emissions of these gases by sector are included in the UK greenhouse gas inventory (see NETCEN report). A summary is given in annex 4.

5.19 The draft National Air Quality Strategy, published in August 1996, includes a target that levels of tropospheric ozone should not exceed 50 parts per billion measured as an 8-hour running mean, on a 97th percentile basis, by the year 2005: this approximates to allowing levels to exceed the target on up to 10 days per year. The Government expects that emissions of VOCs and NO_x will fall by around 40% by the year 2005 measured against 1988 levels, through the application of the upgrading plans of the Integrated Pollution Control and Local Air Pollution Control regimes. New passenger car and fuel standards have been proposed by the European Commission for 2000 resulting from the AutoOil programme. However, considerable uncertainties remain, and the target will require transnational cooperation if it is to be achieved fully. In view of these uncertainties, these targets will be reviewed in 1999.

5.20 The draft Strategy also includes a target that by the year 2005, levels of nitrogen dioxide should not exceed 150 parts per billion measured as an hourly mean and 20 parts per billion as an annual mean.

5.21 Emissions of nitrogen oxides peaked towards the beginning of this decade, and are now beginning to fall. The UK committed itself under the first UNECE Nitrogen Oxides Protocol to return its emissions to 1987 levels by 1994, and has achieved this target. Further reduction of nitrogen oxides would help meet two air quality targets and the lowering of ambient levels of nitrogen dioxide, and the containment of tropospheric ozone formation.

5.22 The target for carbon monoxide is that by 2005, levels should not exceed 10 parts per million measures as an 8 hours running mean. Road transport is the dominant source of carbon monoxide in urban areas and the vehicle emissions legislation passed in 1993 and 1996 will ensure that the proposed air quality objective is attained.

Sulphur Dioxide Emissions

5.23 Sulphur dioxide (SO₂) acts as a precursor in the formation of sulphate aerosols which, unlike the greenhouse gases, have a net negative radiative forcing effect and tend to cool the earth's surface.

5.24 National emissions of SO₂ are estimated to have been 3,750 kt in 1990 with the largest sources being fossil fuel power stations and other industrial combustion processes. Although not yet included in the UK greenhouse gas inventory, estimated emissions of SO₂ disaggregated by source sector, end user category and by type of fuel are published annually in the Digest of Environmental Statistics.

Table 5.1 UK emissions of SO₂, 1990 and 1995 and projected for 2000

<u>Year</u>	<u>Emissions SO₂ (kt)</u>
1990	3752
1995	2630
2000	1510

5.25 The EC Large Combustion Plant Directive requires the UK to reduce emissions of SO₂ from large combustion plant by 60% by 2003 relative to a 1980 baseline. In addition, the UK has signed and recently ratified the UNECE Oslo Protocol and is committed to reducing SO₂ emissions by 80% by 2010 on the same 1980 baseline. As a result, SO₂ emissions are expected to be 1.5Mt in 2000, a fall of 60% relative to 1990, see Table 5.1.

CHAPTER 6

IMPACTS AND ADAPTATION

Key Developments

- Published Climate Change Impacts Review Group's second report on potential effects of climate change in the UK.
- Scoping study to develop research on the impacts of climate change on the UK.

Assessment of Impacts

6.1 The priority aim is to improve the understanding of the potential impacts of climate change on the UK. This will enable the assessment and development of appropriate adaptation strategies. This will, inter alia, enable a comparison to be made between the relative costs of adaptation and mitigation.

6.2 The UK Climate Change Impacts Review Group (CCIRG) published its report on the potential effects of climate change in July 1996 on the basis of a particular climate change scenario based on Hadley Centre modelling studies. This scenario was consistent with the science of climate change in the IPCC second assessment report.

6.3 The CCIRG report is the most comprehensive assessment of the potential impacts of climate change on the UK by the 2020s and the 2050s. The climate change scenario suggests that the north could become wetter and stormier and the south drier, with more frequent droughts; there might be some benefits for sectors such as forestry but these would probably be outweighed by adverse effects on soils, wildlife, water resources, arable agriculture, the insurance sector and human health. The report also identifies implications for how the UK might adapt to climate change.

6.4 The CCIRG report identified the potential impacts on a number of sectors and suggested what action might be necessary to adapt. These are summarised in annex 3.

Framework for Further Work

6.5 Following the CCIRG report, further work is needed:

- to improve knowledge of scale and timing of the potential impacts;
- to identify other impacts; and
- to explore interactions between sectors.

6.6 The UK, therefore, plans to develop further the estimation of climate impacts by taking a more coordinated and integrated approach. Potential users of climate impacts data have been consulted and a proposal for an integrated assessment of climate change impacts in the UK has been circulated for further comment with the aim of developing a stakeholder-driven research programme.

6.7 If the proposal is implemented, the Department of the Environment would establish a framework for integrated studies and sponsor a core office, which would coordinate sectoral studies led by private and public organisations. This would also provide the integration between different studies to take account of the impacts between sectors and regions.

6.8 Integrated impacts studies would improve the information and data available to decision-makers in all sectors so that they could take account of climate change in developing their plans and future policies.

6.9 The impacts of climate change are already being taken into consideration in a number of sectors, for example in the UKOs policy on coastal erosion and defence. The recent strategy document Water Resources and Supply: Agenda for Action identifies a requirement for continuing research into how water is used by households, how that could change with a changing climate and that further studies should be undertaken on the implications for water demand. Annex 3 summarises initial responses to the possible impacts of climate change.

CHAPTER 7

RESEARCH, SYSTEMATIC OBSERVATION AND SCIENTIFIC ASSESSMENTS

Key Developments

- Comprehensive UK programme on global environmental change research.
- Hadley Centre is the national focus for climate prediction.
- Support for IPCC Second Assessment Report including co-chairmanship of Working Group I.
- Climate Change Impacts Review Group work on impacts and adaptation.
- Study undertaken to assess research needed to provide objective information on the impacts of climate change in the UK, to provide a foundation for the development of adaptation policies and to inform the negotiation process under the Framework Convention on Climate Change.

Assessments

Intergovernmental Panel on Climate Change (IPCC)

7.1 The IPCC is the prime source of scientific and technical information to the Convention. Its Second Assessment Report is the most comprehensive and authoritative assessment of the science of climate change, its impacts and response options.

7.2 The UK is a strong supporter of the IPCC. Sir John Houghton is the co-chair of the IPCC Working Group I (WGI). The UK also funds WGI's Technical Support Unit at the Hadley Centre and supports expert scientists to act as lead authors.

Climate Change Impacts Review Group

7.3 In 1996, the UK Climate Change Impacts Review Group (CCIRG), published its report on the Review of Potential Effects of Climate Change in the UK. This used the climate change scenario based on results from the Hadley Centre and considered the impacts on sea level, the natural environment, agriculture, forests, water resources, energy, transport, health and many key industrial sectors for the 2020s and 2050s. It provides an initial basis for the UK to develop its adaptation strategy, see Chapter 6 for further details.

Research and Observation

7.4 The Global Atmosphere Division research programme of the Department of the Environment supports the development of policy responses to climate change. The programme provides up-to-date scientific and technical information to Ministers as a basis for formulating national policy, participating in national and international negotiations and fulfilling commitments under international agreements.

7.5 Research on global and regional climate change is undertaken within the context of the Convention and the IPCC. In 1995/96 Global Atmosphere Division commissioned 27 research projects at a cost of £13.91 million, see Table 7.I. The Annual Global Atmosphere Research Programme Report providing details on individual contracts is available from Global Atmosphere Division at the Department of the Environment, see Annex 7.

7.6 Research commissioned by the Department of the Environment advises policy needs. Such work is underpinned by basic and strategic research programmes supported by the Research Councils and is complemented by sectorally specific research on climate change funded by other government departments particularly with respect to the impacts of climate change and greenhouse gas emissions (eg Ministry of Agriculture, Fisheries and Food £1.16m). Where possible the UK participates in internationally coordinated research programmes.

Science of Climate Change

7.7 The focus of UK climate change science is the Hadley Centre for Climate Prediction and Research which was established at the Meteorological Office to provide decision makers in the UK and worldwide with authoritative, up-to-

date assessments of natural and human-induced climate change. It is one of the world's leading climate modelling centres and runs high-resolution climate models to assess potential climate change over the next century. It has made major advances in the assessment of anthropogenic influence on climate and in regional modelling.

7.8 A wide range of research is carried out in the UK into various aspects of the atmosphere, ocean and biosphere, all of which influence the climate system, and on the impacts of climate change.

7.9 A major research programme covering terrestrial processes and climate change, the Terrestrial Initiative of Global Environmental Research (TIGER) has recently been completed. TIGER has identified significant uptake of CO₂ in the Amazonian rain forest and has revised upwards the estimates of N₂O emissions from UK soils. The UK programme is strongly linked with international programmes such as the World Climate Research Programme and the International Geosphere Biosphere Programme.

Data Collection, Monitoring and Systematic Observation

7.10 The availability of data is crucial to effective research. The UK is, therefore, playing a strong role in a range of international projects to collect and disseminate data including:

- Climate monitoring at the Meteorological Office. Global average surface temperatures are published annually and a comprehensive, historic, sea-surface temperature data set has been published.
- Sea level is monitored and the global database for sea levels is located in the UK.
- Changes to flora, fauna, soil, water and air composition and land use are monitored by the Environmental Change Network and a major survey will be carried out in 2000.
- The concentrations of greenhouse gases are monitored as part of the Global Atmospheric Gases Experiment (GAGE).
- The UK participates in the Global Observatory Systems covering climate (GCOS), the oceans (GOOS) and terrestrial issues (GTOS).
- The UK is active in earth observation from space, mainly through the programme of the European Space Agency.

Climate Change Impacts

7.11 Research is needed to help preparation for adaptation to impacts in the UK. The aim is to reduce the uncertainty about impacts so that adaptation measures can be properly targeted.

7.12 The LINK programme at the University of East Anglia provides the impacts community with the appropriate climate change scenarios to encourage the development of research on impacts projections and to ensure that the most recent modelling predictions are available.

7.13 A range of other research is being carried out by individual sectors, eg Ministry of Agriculture, Fisheries and Food research on crop and weed responses, land use, crop and animal diseases, sea levels and coastal modelling techniques.

7.14 It is planned to develop further the estimation of climate impacts by taking a more coordinated and integrated approach. Potential users of climate impacts data have been consulted and a proposal for an integrated assessment of climate change impacts in the UK has been circulated for further comment with the aim of developing a stakeholder-driven research programme, see Chapter 6.

Response Options

7.15 Research is underway to develop emission projections under different policy scenarios, to indicate the scope for emissions reduction, to quantify emissions sources and sinks and to provide scientific underpinning of the UK's greenhouse gas emissions inventory. This research helps monitor and contributes to the credibility and robustness of the UK Programme.

7.16 The Ministry of Agriculture, Fisheries and Food is undertaking research to improve national emission inventories from agriculture and to determine the sensitivity of emissions to management practices.

Table 7. I Financial summary of research contracts let by Global Atmosphere Division

Research Area	Value £K, 1995/96
1.Prediction and Detection	10,305.90
2.Earth Observation	2,081.81
3.Trace Gases and Radiative Forcing	371.39
4.Impacts	45.48
5.Response Strategies	1,108.07
Total	13912.65

CHAPTER 8

FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

Key Developments

- £77 million was spent in 1995/96 on bilateral projects wholly or partly concerned with energy efficiency, both in developing countries and countries in transition.
- The UK is the fifth largest contributor to the Global Environment Facility with a commitment of £130 million to the pilot phase and first replenishment.
- The UK contributes US\$3.67 billion to the World Bank for projects such as the Energy Sector Management Assistance Programme. In 1996 the World Bank committed US\$ 2,918 million on environmental projects.

Institutions

8.1 The UK makes a major contribution to the aid programmes of the UN development agencies and other international financial institutions, funding projects in developing countries related to the implementation of the Convention.
World Bank

8.2 The World Bank (IBRD) is one of the three implementing agencies for the Global Environment Facility (GEF) and currently acts as the GEF's trustee of funds. The IBRD also funds a separate portfolio of environmentally relevant projects. In US fiscal 1996, the IBRD committed US\$1.63 billion and leveraged another US\$1.64 billion from other sources for 20 new environmental projects. These new commitments brought the IBRD's active environmental portfolio to 153 projects totalling US\$11.4 billion.

8.3 The Energy Sector Management Assistance Programme (ESMAP), a programme funded by a consortium of donors and the IBRD, aims to advance the introduction of contemporary solar technology to developing countries. Identification and preparation of solar renewable energy projects are underway in at least 14 countries including Bolivia, Cameroon, Indonesia, Kenya and Mali.

8.4 The IBRD has not had a general capital increase (GCI) since 1988 when a GCI of US\$7.84 billion, with 3% paid-in element was agreed. The UK subscribed to 30,450 shares with a value of US\$3.67 billion.

Global Environment Facility

8.5 The Global Environment Facility (GEF) finances the incremental costs to developing countries of protecting the global environment in four focal areas: climate change, biodiversity, depletion of the ozone layer and the pollution of international waters. It supplements the funds provided for sustainable national development from national resources and by aid donors and international development agencies. Projects are conducted by the three implementing agencies: the IBRD, the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). GEF funding is also available to countries in transition.

8.6 Commitments to the GEF by the UK so far have totalled £130 million, making it the fifth largest contributor.

8.7 The GEF has also been designated, on an interim basis, as the Financial Mechanism of the Climate Change Convention. UK policy is to ensure that the GEF will be agreed on a permanent basis in this role.

8.8 During the pilot phase 41 projects addressing climate change, mainly in Africa, Asia and Latin America were approved by the GEF at a total cost of US\$ 260 million. A further 55 projects addressing climate change have been approved up to November 1996 under the First Replenishment of the GEF at a total cost of US\$ 257 million.

8.9 GEF operational policy has concentrated on developing the institutional capacity of developing countries to implement the Convention, and on helping them to prepare the inventories and national strategies required by Article 12. The GEF is now focusing on supporting the measures taken by developing countries under the Convention to mitigate change.

8.10 The GEF was replenished at a level of over US\$ 2 billion for three years from July 1994. It has also been restructured to conform to the requirements of the Conventions and of Agenda 21. The Instrument for the restructuring of the GEF was agreed by the Organisation for Economic Cooperation and Development (OECD) and G77 governments in Geneva (March 1994). The UK played a leading role in negotiating this agreement and also intends to play a prominent role in forthcoming negotiations for the Second Replenishment of the GEF.
European Bank for Reconstruction and Development (EBRD)

8.11 The EBRD was established in 1991 to assist the countries of central and eastern Europe and central Asia to develop into market-oriented economies and to promote private and entrepreneurial initiatives. It has now approved investments totalling over ECU 9 billion in the region and committed a further ECU 350 million in investment-related technical cooperation (TC) activities. The UK contributes to EBRD's capital funds (8.5% share holding) and has provided over £10 million for its TC programmes. Under its charter the EBRD is required to promote, in all its activities, sustainable development. It therefore applies environmental due diligence to all its investment and TC operations; has developed municipal and environmental infrastructure and energy efficiency investment operations; and continues to promote a range of training, standards and other environment-related TC initiatives. One of EBRD's principal environmental contributions is investment operations that are more energy and resources efficient, less polluting and which generate less waste than the facilities they replace.

8.12 The UK believes that it is vital to have participation of developing countries in the IPCC and Convention process. Therefore the UK makes an annual contribution to IPCC and Convention Trust Funds which enable developing country participants to attend meetings.

Preparation of National Strategies

8.13 Assistance to developing countries and countries in transition, for country studies is made through the UK's contributions to the GEF.

8.14 The Overseas Development Administration (ODA) also funds studies of specific aspects and processes of climate change through the Environment Research programme (ERP). One recent example is a collaborative project between the International Rice Research Institute, National Resources Institute and Oxford University investigating methane generation and consumption in rice fields (cost £0.377 million).

Mitigation

Energy Efficiency

8.15 The UK funds a number of large energy efficiency projects through its overseas aid programme. In the light of the Framework Convention on Climate Change, the ODA agreed a dedicated Energy Efficiency Strategy which aims to conserve fuel resources; improve the economics of energy production and use; and alleviate environmental damage by minimising the production of harmful emissions. To this end, the strategy focuses support on:

- improving the efficiency of power generation and distribution;
- promoting appropriate renewable energy; and
- improving the energy efficiency of end users.

8.16 In line with this strategy, £77 million was spent in 1995-96 on bilateral aid projects either wholly or partly concerned with energy efficiency, see Table 8.IV. A few examples are highlighted below.

- A four year end use energy efficiency project in Indonesia will enable the Indonesian Government to significantly strengthen its energy efficiency programmes. Part of a soft loan agreement in Indonesia worth £64 million is being used to construct the Samarinda power station, a fuel efficient, combined cycle gas turbine plant.
- In Western Uganda, a feasibility study will develop a small scale hydropower project to supply tea estates that presently rely on diesel generators for essential electricity supplies.
- In China, a project will reduce harmful emissions by improving the coal related industrial energy efficiency in Guizhou and Shanxi Provinces.

Another project, to develop energy efficient practices in clay brick making will improve practices in Zimbabwe, Peru and Ecuador, reducing their dependence on fuel wood.

In Vietnam a further project will increase the availability of gas through assisting the Vietnamese Government with its Gas Master Plan Strategy.

Forestry

8.17 The UK participates in international efforts on forestry conservation. The Tropical Forestry Action Plan aims to protect tropical forests through financial support and development of integrated planning for forest development. Support is given to other international initiatives for example the International Centre for Research in Agroforestry, and participates in international efforts to improve forest management and helped establish the UN Intergovernmental Panel on Forests which will report to the Commission on Sustainable Development in April 1997.

8.18 The ODA Forestry Strategy aims to promote sustainable forest management in poorer countries, including support for research on forest issues. The ODA has about 200 forest projects underway, or in preparation, in 41 countries at a total cost of about £182 million.

Adaptation

8.19 The GEF Operational Strategy, which was approved by the GEF Council in October 1995, specifies a range of activities eligible for assistance from the GEF to facilitate adequate adaptation to climate change.

8.20 Agreed activities include assessments of vulnerability to climate change, the evaluation of policy options for monitoring systems and response strategies, the assessment of policy frameworks for implementing adaptation measures and response strategies in the context of coastal zone management, disaster preparedness, agriculture, fisheries and forests, and the building of national, regional and/or sub regional institutional capacity. The UK supports these agreed adaptation activities through its contributions to the GEF.

Technology and Training

8.21 The UK participates in the Climate Technology Initiative D launched by International Energy Authority (IEA) countries at the First Conference of the Parties in Berlin in 1995 D to speed up development and dissemination of cost effective, environmentally-friendly technologies by reducing barriers to the use of existing technology and encouraging development of medium to long term technologies.

8.22 The UK has supported the development of the IEA Greenhouse Gas Technology Information Exchange (GREENTIE) and will continue to participate in the practical implementation of this project. The database, which is available on CD Rom and on the Internet, is intended to help developing countries to locate information on new technologies and identify equipment suppliers and centres of excellence.

8.23 The UK Technology Partnership Initiative (TPI) was launched in 1993 and extended and relaunched in 1996. Through its information network, it aims to encourage the transfer of environmental technology and know how to developing countries on commercial terms. It includes a guide to UK sources of environmental technology and services, as well as regular information in the form of a quarterly newsletter, case studies and a helpline to network members. TPI also co-sponsors initiatives both in the UK and overseas which bring together UK business people and those from developing countries and which focus on technology transfer.

8.24 The UK's Know How Fund , set up to help develop market economies in Central and Eastern Europe includes a special tranche focusing on environmental issues D the Environmental Know How Fund (EKHF). Its main objective is to support the transfer of UK skills to the countries of Central and Eastern Europe. Over 200 projects have been funded (at a cost of £9 million) since 1992, including projects to improve the energy efficiency of Russian industry through better energy management and to introduce energy efficient technology to the Russian coal-fired power industry.

8.25 The UK also participates in a wide range of European environmental programmes, which have relevance to climate change.

Scientific

8.26 Developing country scientists work at the Hadley Centre from time to time and a number of UK research programmes involve collaboration with developing countries. For example, the carbon balance of the Amazonian rain forest was studied in a bilateral cooperation programme with Brazilian scientists under NERC's TIGER programme.

Table 8.I Financial contributions to the operating entity (or entities) of the financial mechanism, regional and other multilateral institutions and programmes

	Contributions (millions of £ sterling)		
	1994/1995	1995/1996	1996/1997
Global Environment Facility	7.38	6.630	11.88
Multilateral institutions:			
World Bank	205.0	220.6	200.0
International Finance Corporation	10.8	11.0	10.7
African Development Bank	2.8	10.1	20.6
Asian Development Bank	20.4	17.2	36.3
European Bank for Reconstruction and Development	39.6	42.0	13.6
Inter-American Development Bank	7.2	7.0	7.6
United Nations Development Programme	28.2	29.0	25.5
United Nations Environment Programme	4.5	4.5	4.5
World Meteorological Organisation	1.9	2.0	2.5

**Table 8.II Bilateral financial contributions related to the implementation of the Convention,
1993/1994 (£ m)(a)**

Recipient country(a)	Mitigation						Adaptation(b)	Other(b,c)
	Energy	Transport(b)	Forestry	Agriculture	Waste(b) management	Industry(b)		
1. Bangladesh	19.41		0.205	2.877				
2. Belize			1.067	1.271				
3. Brazil			1.41	1.11				
4. Bolivia				1.016				
5. Chad			0.137					
6. Chile	0.161							
7. China	7.214		0.218					
8. Ecuador			0.124	0.4				
9. Egypt			0.105					
10. Ethiopia	0.112		0.217	1.12				
11. Ghana			0.952	1.351				
12. Honduras	0.103		0.41	0.41				
13. India	18.312		3.048	1.217				
14. Indonesia	0.052		2.944	3.243				
15. Kazakhstan	0.26							
16. Kenya	0.031		3.601	0.586				
17. Malawi			0.428	0.622				
18. Mexico	0.128							
19. Nepal	0.19		3.471	3.636				
20. Nigeria	2.013		0.702	1.447				
21. Pakistan	1.153		0.774	1.376				
22. Peru	0.033							
23. Poland	0.29							
24. Russian Fed.	2.242			0.369				
25. Sri Lanka	0.03		1.864	1.864				
26. South Africa				0.291				
27. St Helena	0.034		0.202					
28. St Kitts-Nevis	0.17							
29. Uganda	4.323			0.54				
30. Zimbabwe			0.258	0.436				

a Figures are included only for the top twenty recipients in each category.

b The UK does not identify contributions in these categories separately.

c for greenhouse gas inventories, as under Article 4.1(a).

Table 8.III Bilateral financial contributions related to the implementation of the Convention, 1994/1995 (£ m) (a)

Recipient country(a)	Mitigation						Adaptation (b)	Other (b,c)
	Energy	Transport(b)	Forestry	Agriculture	Waste(b) management	Industry(b)		
1. Bangladesh	10.674		2.188	4.649				
2. Belize			0.704	0.876				
3. Brazil			1.318	0.889				
4. Bolivia				1.084				
5. Cameroon			0.33					
6. Chile	0.821							
7. China	0.973							
8. Ecuador			0.543	0.792				
9. Egypt	0.225			0.394				
10. Ethiopia	0.14		0.221	0.947				
11. Ghana	0.16		1.274	1.542				
12. Honduras	0.1							
13. India	21.4		3.673	1.512				
14. Indonesia	1.081		3.271	3.491				
15. Kenya			2.063	1.407				
16. Malawi			0.67	0.842				
17. Mexico	0.87		0.332					
18. Mozambique				0.898				
19. Nepal	0.501		3.775	3.86				
20. Nigeria	0.555		0.763	1.492				
21. Pakistan	0.911		1.548	2.085				
22. Poland	0.415							
23. Romania				0.384				
24. Russian Fed.	1.205			2.88				
25. Sri Lanka	0.473		2.06	2.06				
26. St Kitts-Nevis	0.98							
27. Thailand	0.518							
28. Uganda	3.415							
29. Ukraine	0.273							
30. Zimbabwe			0.207					
All others			0.971	0.452				

a Figures are included only for the top twenty recipients in each category.

b The UK does not identify contributions in these categories separately.

c for greenhouse gas inventories, as under Article 4.1(a).

Table 8.IV Bilateral financial contributions related to the implementation of the Convention, 1995/1996 (£ m) (a)

Recipient country(a)	Mitigation						Adaptation(b)	Other(b,c)
	Energy	Transport(b)	Forestry	Agriculture	Waste(b) management	Industry(b)		
1. Bangladesh	5.121		7.706	8.814				
2. Belize				0.789				
3. Brazil			1.448	0.979				
4. Bolivia			1.3	2.18				
5. Bulgaria	0.12							
6. Chile	0.335		0.444	1.058				
7. China	1.294							
9. Egypt	0.747			0.748				
10. Estonia	0.169							
11. Ethiopia	0.132							
12. Georgia	0.146							
13. Ghana	0.105		1.285	1.464				
14. Guyana			0.296					
15. Honduras			0.425					
16. India	40.234		5.198	1.735				
17. Indonesia	17.63		3.634	4.128				
18. Kazakhstan	0.222							
19. Kenya				3.695				
20. Malawi			0.48	1.685				
21. Malaysia			0.832					
22. Mexico			0.858	0.69				
23. Mozambique				1.198				
24. Nepal	0.177		3.718	3.778				
25. Nigeria			0.545					
26. Pakistan	1.45		1.504	1.604				
27. Poland	0.443							
28. Russian Fed.				3.643				
29. Sri Lanka			1.62	1.62				
30. Thailand	0.218							
31. Uganda	3.345							
32. Ukraine				1.496				
33. Zimbabwe	0.104							
All others	1.135		1.086	1.731				

a Figures are included only for the top twenty recipients in each category.

b The UK does not identify contributions in these categories separately.

c for greenhouse gas inventories, as under Article 4.1(a).

CHAPTER 9

EDUCATION, TRAINING AND PUBLIC AWARENESS

Key Developments

- National public information campaigns on energy efficiency
- Publication of National Indicators of Sustainable Development
- Annual White Papers on Sustainable Development

Raising Awareness

9.1 Improving energy efficiency and cutting out energy waste are among the quickest and most cost-effective ways of reducing CO₂ emissions. The Government has sought to raise awareness and change behaviour in the domestic sector in the first two stages of a national campaign on energy efficiency. The third stage will link in with the Energy Saving Trust's new marketing campaign Energy Efficiency, launched in January 1997, which is intended to provide a highly visible and consistent brand image for energy efficient goods and services.

9.2 The Energy Saving Trust is working closely with the Department of Economic Development in Northern Ireland to promote the efficient use of energy and has appointed a Northern Ireland Programme Coordinator.

9.3 Regular editions of the Department of the Environment's Climate Change Newsletter, which provides information on national and international developments, and reports on progress made under the Climate Change Programme, complement the Trust's programmes. The DOE also provides information on climate change through a wide range of environmental information booklets and fact sheets.

9.4 The Department of the Environment, Environment Protection Statistics and Information Management Division, has a home page (<http://www.open.gov.uk/doe/epsim>) on the Internet which is accessible to audiences in Britain and world-wide. The page holds, inter alia, information on climate change including CO₂ monitoring information.

9.5 It is expected that the Global Atmosphere Division of the Department of the Environment will have its own home page by the summer of 1997. This will include information on the work of the Division, copies of recent ministerial speeches and press releases, plus the annual report on research commissioned and undertaken by the Division.

Encouraging Action

National

9.6 Building partnerships and encouraging active participation in all sectors are important elements of the Climate Change Programme. In 1994 the Government published its Strategy for Sustainable Development and one of the commitments was to develop a set of indicators to inform people, including those in government, industry, non-governmental organisations and the public about the issues involved in sustainable development. An Interdepartmental Working Group was established and a preliminary set of indicators was developed and published in March 1996 for discussion.

9.7 Active participation at all levels in the country is essential to bring about the changes which are necessary to achieve sustainable development. In order to encourage this involvement the Government publishes This Common Inheritance - UK Annual Report. This White Paper reports on the progress which has been made in the preceding 12 months and highlights priorities for the coming year. The document presents tables auditing Government action and sets new commitments.

Agriculture

9.8 The Ministry of Agriculture, Fisheries and Food (MAFF) intends to publish a booklet in 1997 summarising, for farmers and others, results of research and development on the impacts of climate change on agriculture. MAFF is also

planning the relaunch of Codes of Good Agricultural Practice for the Protection of Air, Water and Soil to encourage the adoption of best practice by farmers. The Codes include guidance on minimising emissions of greenhouse gases from agriculture, including management of soil and nutrients and more efficient use of energy.

Industry, Commerce and Public Sector

9.9 The Energy Efficiency Best Practice Programme is the Government's main information transfer programme for cost-effective energy efficiency measures. Under the Best Practice Programme a range of publications providing independent, authoritative guidance is produced, with the aim of advancing and spreading information about energy efficiency throughout all sectors of industry and commerce, except agriculture and transport, in the UK. Material is made available via published case studies, guides, workshops and seminars, some in collaboration with professional bodies, energy suppliers and trade associations.

9.10 The Best Practice Programme for buildings, including housing, is managed and promoted for the Department of the Environment by the Building Research Energy Conservation Support Unit (BRECSU) at the Building Research Establishment. The industry sector is managed and promoted by ETSU at Harwell.

9.11 Also produced as part of the Best Practice Scheme is information for school head teachers, governors and caretakers to improve energy efficiency in school buildings. The Department for Education and Employment has also issued advice to schools on energy saving measures.

9.12 The Government announced the results of the first stage of its campaign to reduce energy consumption on its own estate in December 1996. Over the five years to 1 April 1996 the reduction amounted to just over 14.5%. A further target of a 20% reduction from the same baseline by the year 2000 has been announced.

9.13 The Government offices in the regions continue to work to raise awareness of the benefits of positive environmental and energy management, and stimulate action by industry, commerce and the public sector. They aim to build partnerships with key players in the region; employ specialist energy advisors to offer specific advice to major energy users; and particularly focus on encouraging improved energy performance among smaller firms.

9.14 Good progress is being made in Northern Ireland to promote energy efficiency in industry and commerce. This includes advisory visits to firms, the organisation of technical seminars, distribution of Best Practice Programme material and the provision of grants to small businesses to finance energy efficient capital investment.

9.15 The Government is also running a Business and Environment Campaign in Wales. This is an umbrella campaign designed to raise awareness of environmental issues and the commercial advantages of good environmental management; promote increased take up of environmental services for businesses; and to encourage Welsh businesses to adopt best practice in environmental management.

Transport

9.16 The Government has taken an active role in promoting local awareness campaigns. Many local authorities are operating schemes to raise public awareness, particularly through the TravelWise campaign. Working with local media, schools and community groups, these campaigns encourage people to consider alternatives to using the car. The Government has also supported nationwide campaigns such as Green Transport Week and "Don't Choke Britain" which provides an umbrella for local events to promote travel awareness. Particular areas that the Government has targeted include journeys to school and commuting journeys. The Government is encouraging firms to adopt Green Commuting Plans which promote alternatives to the car, including car parking constraints, liaising with bus operators, providing cycling facilities, car sharing, support for public transport tickets and remuneration packages that provide alternatives to company cars. As noted in paragraph 2.42 above, a range of guidance on best practice and travel awareness has been published, aimed at changing the behaviour of individuals and businesses.

9.17 The Greener Motoring Forum has resulted in a number of advertising and design measures to encourage environmentally responsible motoring. Two key initiatives are the "Tune Your Car campaign", which has been run in five cities, offering free testing and tuning for petrol cars, which will be extended across the country in coming years, and a guide on "Environmental Information for New Cars", which will replace the existing fuel consumption guide and

also provide information on emissions of pollutants, recycling schemes, and life time fuel costs to strengthen people's awareness of the link between fuel consumption and overall motoring costs.

Local Initiatives/Education

9.18 Chapter 28 of Agenda 21 - the action plan for the 21st century agreed at the Earth Summit in Rio in 1992 - encourages local authorities to adopt a Local Agenda 21 for their community by 1996. Good progress is being made by local authorities in partnership with all sectors of their communities to develop strategies for sustainable development. The Local Agenda 21 Initiative has provided the framework for work such as energy efficiency measures in buildings, street lighting, transport fleets and local authority owned housing; traffic calming, pedestrianisation, cycle lanes and other urban traffic management schemes.

9.19 The UK Sustainable Development Strategy (published in 1994) provided the context for the Agenda 21 Initiative. Central and local government have worked together to produce guidance on eco-management and audit (EMA) and development of an EMA Scheme for local government launched in April 1995. The Department of the Environment has provided financial support to help with a series of round table discussions, and to help carry forward work already done on eco-management and audit through the provision of a help desk.

9.20 The Government has also contributed funding to the Atmospheric Research Information Centre (ARIC)'s Global Climate Change Information Programme (GCCIP) based at Manchester Metropolitan University. The GCCIP was established in October 1991 to provide a public information service on climate change issues. It also aims to provide information to teachers and pupils and to foster awareness of the importance of climate change from an early age. The programme has responded to over 3,500 requests for information every year. The Global Climate Information Programme may be accessed through e-mail, internet, paper copy, fax or telephone, see Annex 7.

9.21 GCCIP also produces a series of fact sheets and during 1995/96 produced ones on the Framework Convention on Climate Change and Climate Change and Forestry. GCCIP also produces a quarterly newsletter which aims to provide information on new developments and publications in the field of climate change. Production of educational resources was also begun in 1994 and they include a secondary education teaching pack on ozone depletion and climate change; a climate change resource guide for teachers; and an activity pack for primary school pupils.

9.22 The Government launched its strategy for taking environmental education into the next century, in 1996. The strategy will bring together the activities of all interested bodies and provide mechanisms for liaison and coordination of activities within Government and among Non-Government Organisations and other bodies.

International

9.23 The UK remains committed to cooperation and promotion of climate change material at the international level. Chapter 8 gives more information of the education and training programmes which assist developing countries.

9.24 The UK continues to lead Working Group I, Science Assessment of the Intergovernmental Panel on Climate Change to promote wider understanding of the science of climate change. Under the chairmanship of Sir John Houghton, supported by a Government-funded technical secretariat at the Hadley Centre, the Working Group's Second Assessment Report of 1996 has been prepared and published by Cambridge University Press and is widely regarded as the most comprehensive and authoritative document on the science of climate change currently available. The Government intends that this pattern of open publication will continue.

SUMMARY OF POLICIES AND MEASURES

Table A1.I Summary of Policies and Measures: Carbon Dioxide

Policy/measure	Type of instrument	Objective	Sector	Status	Estimate of Mitigation Impact (MtC)				indicators of progress
					2000	2005 (b)	2010 (b)	2020 (b)	
Fuel switching	Market liberalisation	Efficiency in energy markets	Electricity generation	Implemented	17	18	25	24	Electricity supply industry fuel mix recorded in UK energy statistics
Nuclear productivity	Market liberalisation	Efficiency in energy markets	Electricity generation	Implemented	2.9	1	0	-4	Nuclear output recorded in UK energy statistics
Renewable energy	Market stimulation	Diversity and sustainability of electricity supply	Electricity generation	Implemented	2	2	3	3	Renewable energy output recorded in UK energy statistics
Road fuel duty	Fiscal	Emissions abatement	Transport	Implemented	3	5	6	7	Econometric analysis of impact of duty imposed
Domestic fuel prices	Fiscal	Emissions abatement	Residential	Implemented	0.4	1	1	1	Econometric analysis of impact of tax imposed
Combined heat and power	UK strategy	Emissions abatement	Electricity generation	Implemented	3.5	4	5	7	Survey data on installed capacity of CHP in the UK
Public sector	Savings target	Emissions abatement	Public	Implemented	0.8	1	2	2	Government estate monitored
Energy Saving Trust	Information and incentives	Emissions abatement	Mainly residential	Implemented	0.5	1	1	1	Individual project monitoring
Energy Efficiency Best Practice Programme (a)	Information	Energy efficiency	Industrial, commercial, institutional, residential, transport	Implemented	3.5	4	4	4	Annual market surveys and direct monitoring leading to annual estimate of savings achieved
Others	Regulations, advice, grants, labelling	Energy efficiency, equity	Residential, commercial, institutional	Implemented	1.6	3	3	4	Rates of new building and grants monitored
Total					35.2				

Notes

- Energy Efficiency Best Practice Programme also contributes about 1.5 MtC to CHP target in 2000.
- Figures are consistent with the central assumptions in UK national energy projections but subject to increasing uncertainty into the future.

Table A1.II Summary of Policies and Measures: Methane

Policy/measure	Type of instrument	Objective	Sector	Status	2000	2005 (b)	2010 (b)	2020 (b)	indicators of progress (a)
Waste management strategy	Statutory guidance, fiscal	Sustainable waste management, emission abatement	Landfill	Implemented	840	1160	1460	1800	Renewable energy output recorded in UK energy statistics
Utilising waste gas from coal mines for energy	Voluntary action	Emission abatement	Fugitive fuels	To be implemented by 2000	9	9	9	9	Not yet implemented
Leakage control strategy for gas distribution	Industry initiative	Safety, economics, emission abatement	Fugitive fuels	Implemented	85	100	110	140	Progress on all aspects of strategy programme monitored by British Gas TransCo.
Improving wastewater treatment works	Voluntary action	Upgrading installations, emission abatement	Sewage treatment and disposal	Under consideration	3	5	7	7	Not yet implemented
Limiting emissions from offshore oil and gas installations	Industry guidelines	Emission abatement	Fugitive fuels	Implemented		Not quantified			emissions reductions to UK00A on a regular basis

Notes

- a. Inventory estimates updated annually for all sectors.
b. Figures subject to increasing uncertainty into the future.

Table A1.III Summary of Policies and Measures: Nitrous Oxide

Policy/measure	Type of instrument	Objective	Sector	Status	2000	2005 (b)	2010 (b)	2020 (b)	indicators of progress (a)
Limiting emissions from adipic acid manufacture	Regulation under EPA, 1990	Emission abatement	Industrial	To be implemented in 1998	56	57	57	57	Not yet implemented
Fuel switching	Market liberalisation	Efficiency in energy market	Energy and transformation	Implemented	1 (c)	1 (c)	1 (c)	1 (c)	ESI fuel mix recorded in UK energy statistics

Notes

- a. Inventory estimates updated annually for all sectors.
- b. Figures subject to increasing uncertainty into the future.
- c. Relative to a baseline assumed to be 1990 emission levels.

Table A1.IV Summary of Policies and Measures: HFCs, PFCs and SF6

Policy/measure	Type of instrument	Objective	Sector	Status	2000	2005 (b)	2010 (b)	2020 (b)	Indicators of progress (a)
Limiting PFC (CF4 and C2F6) emissions from primaryaluminium smelting	Industry initiative, regulation under EPA, 1990	Emission abatement	Industrial	Implemented	270 (c)	270 (c)	270 (c)	270 (c)	Anode effects monitored by industry
Reduction in HFC-23 by-product emissions from chemical manufacture	Regulation under EPA, 1990	Emission abatement	Industrial	To be implemented by 1999	970 (c)	980 (c)	990 (c)	990 (c)	Not yet implemented
Minimising HFC emissions from use sectors	Voluntary agreements with Government	Emission abatement	Industrial	Implemented		Not quantified			Annual emission from each sector to be reported to DOE
Minimising emissions of SF6 from magnesium foundries	Government local air pollution control guidance foundries	Emission abatement	Industrial	Implemented		Not quantified			Foundries required to monitor use of SF6

Notes

- a. Inventory estimates updated annually for all sectors.
- b. Figures subject to increasing uncertainty into the future.
- c. Relative to a baseline assumed to be 1990 emission levels.

PROJECTION SUMMARY TABLES AND METHODOLOGIES

Table A2.I Summary of projections of anthropogenic emissions of carbon dioxide (gigagrams*, thousands)

	1990	1995	2000	2005	2010	2020
Fuel combustion: energy and transformation industries (a)	217	171	155	185	177	232
Fuel combustion: industry (a, b)	132	131	136	140	140	143
Fuel combustion: transport (a)	121	130	137	145	154	180
Fuel combustion: other (a)	110	121	122	123	124	127
Other (c)	31	29	28	26	25	24
Total	611	581	578	619	620	706

Notes

- a. The categories used for projections differ to some extent from the IPCC categories but the total emissions agree in the base year.
- b. Includes agriculture and industrial process emissions.
- c. Emissions from land-use change.

Table A2.II Summary of projections of removals of carbon dioxide by sinks and reservoirs (gigagrams, thousands)

	1990	1995	2000	2005	2010	2020
Agriculture (d)	1.5	7.7	7.0	6.2	5.5	4.2
Land-use change and forestry (e)	8.9	9.8	9.9	10.9	10.8	7.0
Other (c)	-	-	-	-	-	-
Total removals	10.4	17.5	16.9	17.1	16.3	11.2

Notes

d. Estimated removals from agricultural set-aside.

e. Includes forestry products.

* One gigagram is equal to one thousand tonnes (kt)

Table A2.III Summary of projections of anthropogenic emissions of methane (gigagrams*)

	1990	1995	2000	2005	2010	2020
Fuel combustion	97.6	79.1	79.5	72.7	68.9	73.8
Fugitive emissions from fuels	1,238.8	859.7	689.5	722.9	538.8	623.9
Industrial processes						
Enteric fermentation	1,005.0	980.7	954.7	939.9	925.4	896.6
Animal wastes	137.5 (f)	123.5	120.2	118.4	116.6	113.2
Rice cultivation	-	-	-	-	-	-
Waste	1,923.0	1,784.0	1,574.0	1,373.0	1,202.0	962.0
Other	-	-	-	-	-	-
Total	4,401.9	3,827.0	3,417.9	3,226.9	2,851.7	2,669.5

Note

f. Includes emissions from stubble burning.

Table A2.IV Summary of projections of anthropogenic emissions of nitrous oxide (gigagrams)

	1990	1995	2000	2005	2010	2020
Transport	3.1	7.9	14.5	18.7	21.4	25.0
Other energy sources	3.0	2.3	1.7	2.0	1.9	2.0
Industrial processes	95.2	62.5	17.0	18.0	18.0	17.0
Agriculture	10.4	9.7	9.7	9.6	9.5	9.3
Waste	-	-	-	-	-	-
Other	-	-	-	-	-	-
Total	111.7	82.4	42.9	48.3	50.8	53.3

Table A2.V Summary of projections of anthropogenic emissions of other greenhouse gases (gigagrams)

	1990	1995	2000	2005	2010	2020
SF6	0.024	0.030	0.043	0.043	0.044	n/a
HFCs	1.051	1.958	1.289-2.284	2.036-3.609	2.158-4.374	n/a
PFCs	0.308	0.084	0.085	0.110	0.132	n/a

* One gigagram is equal to one thousand tonnes (kt)

Table A2.VI Summary of key variables and assumptions in the carbon dioxide projections analysis

	1990	1995	2000	2005	2010	2020
World coal prices (US\$/ton)	48.15	42.50	47.50	48.38	50.58	55.00
World oil prices (US\$bbbl)	23.30	17.50	20.00	21.25	22.50	25.00
Domestic energy prices by fuel type, electricity and sector						
GDP (UK £ billion)	478.90	498.39	576.40	549.68	729.70	920.49
Population (millions)	57.561	58.590	59.597	60.448	61.128	62.057
New vehicle Efficiency (litres/100km) Average vehicle km Travelled						
Primary energy demand (petajoules)	9,248	9,338	9,808	10,356	10,589	11,665
Index of industrial and manufacturing production, excluding energy sector (1990 = 100)	100.0	114.9	124.7	135.1	151.3	193.1

Table A2.VII Representative delivered price assumptions for the domestic, industry, service and transport sectors (g)

	1990	1995	2000	2005	2010	2020
Domestic sector (p/kWh) (h)						
~ solid fuels	1.5	1.65	1.71	1.73	1.95	1.97
~ oil	1.67	1.58	1.81	1.92	2.03	2.26
~ gas	1.67	1.4	1.28	1.24	1.29	1.36
~ electricity	7.41	7.67	6.89	7.05	7.54	7.2
Industry (p/kWh) (h)						
~ coal	0.58	0.58	0.62	0.65	0.9	0.92
~ oil	0.64	0.61	0.68	0.73	1.01	1.08
~ gas	0.77	0.62	0.65	0.68	0.74	0.83
~ electricity	3.92	3.69	3.35	3.4	3.75	3.5
Service sector (p/kWh) (h)						
~ solid fuels	0.78	0.8	0.85	0.87	1.13	1.15
~ oil	1.15	1.05	1.18	1.25	1.39	1.52
~ gas	1.23	1.09	1.05	1.06	1.13	1.23
~ electricity	5.58	5.33	4.77	4.82	5.19	4.9
Transport (p/kWh) (h)						
~ 4-star petrol	4.61	5.25	6.35	6.45	6.55	6.74
~ unleaded petrol	4.3	4.79	5.75	5.87	5.97	6.18
~ diesel	3.75	4.28	5.14	5.22	5.34	5.51
~ aviation turbine	1.08	0.88	1.01	1.07	1.13	1.26

Notes

g. Average of high and low price assumptions used in projecting UK carbon dioxide emissions.

h. Gross calorific values have been used to calculate kWh equivalents.

Table A2.VIII Overview of methane inventory and projection assumptions

Source category	Inventory methodology (i)	Basis for projections
Fuel combustion	Emission factors based on carbon content of fuels, national energy statistics	Projected national energy use (j)
Oil and gas production	Emission factors by installation type, reporting of gas flared, census of installations, national oil and gas production data	Changing number of installations, projected energy use (k)
Coal mining	Emission factors from measurements at UK mines, annual coal production data	Projected national energy statistics (j)
Natural gas distribution	Comprehensive leakage measurements on national distribution network	Changing network characteristics and leakage abatement (l)
Agriculture: livestock wastes Landfills	Emission factors and waste arisings by animal type; national animal census First order decay model calibrated to UK measured data, national data on waste characteristics and energy recovery from landfill	Estimated animal populations (m) UK waste strategy targets, population, trends in landfill site design and energy recovery schemes (n)
Sewage treatment and disposal	Emission factors for specific treatment and disposal routes, national data on sludge production	Population, estimated likely changes in disposal routes (o)

Notes

- i. Details of the methodologies used to estimate current emissions by sector and references to the relevant source documents are given in the NETCEN inventory report.
- j. Energy Paper 65, Energy Projections for the UK, 1995, DTI.
- k. Towards 2020: Future Oil and Gas Production in UK Waters, 1996, UK Offshore Operators' Association.
- l. Data from British Gas TransCo.
- m. Data from MAFF.
- n. A Methodology for Updating Routinely the Annual Estimate of Methane Emissions from Landfill Sites in the UK, 1996, ETSU.
- o. Control Measures to Limit Methane Emissions from Sewage and Sludge Treatment and Disposal, 1996, WRC.

Table A2.IX Overview of nitrous oxide inventory and projection assumptions

Source category	Inventory methodology (i)	Basis for projections
Industry	Emission factor calculated from an assessment of chemistry involved, annual production statistics	Estimated production data, EPA/IPC regulations (p)
Agriculture: livestock wastes	Emission factors and waste arisings by animal type; national animal census	Estimated animal populations (m)
Agriculture: biological nitrogen fixation	Basic Horticultural Statistics, emission factors for representative UK crops	Estimated crop areas (m)
Transport	Emission factors for general types of vehicles, national transport statistics	Estimated vehicle fleet composition (q) Projected national energy statistics (j)
Energy and transformation industries	National energy statistics	Projected energy use statistics (j)

Notes

- p. Information from DuPont (UK) Ltd.
q. Data from DoT.

Table A2.X Overview of HFC, PFC and SF6 inventory and projection assumptions

Source category	Inventory methodology (i)	Basis for projections
PFCs: Aluminium industry	Emission factors relevant to UK industry, number and duration of "anode effects"	Projected number and duration of "anode effects" (r, s)
PFCs: other uses	Consumption statistics by sector, time resolved emission model	Use predictions by sector, likely future emission rates (s, t)
HFCs: manufacture of HCFC-22	Emission factor calculated from an assessment of chemistry involved, annual production statistics	Estimated production data, EPA/IPC regulations (s)
HFCs: other uses	Consumption statistics by sector, time resolved emission model	Use predictions by sector, likely future emission rates (s)
SF6: magnesium foundries	Emission factor based on technology used, production data	Estimated production levels (s)

Notes

- r. Data from Aluminium Federation.
- s. UK Use and Emissions of Selected Halocarbons, 1996, DOE.
- t. Information from ICI.

SUMMARY OF POTENTIAL CLIMATE CHANGE IMPACTS AND RESPONSES

Sector	Likely impacts	Policy implications	Response
Soils	<p>Erosion from soils</p> <p>Effects on: future land use</p> <p>biodiversity ecosystems</p> <p>Loss of: southern wetlands peat soils</p>	<p>Promotion of appropriate soil management techniques</p> <p>Increase in carbon and other emissions</p> <p>Review of land use planning</p> <p>Review of current conservation strategy</p> <p>Increase in carbon and other emissions</p>	<p>Ministry of Agriculture, Fisheries and Food (MAFF) to revise its Soil Code in 1997 with the aim of management practices by farmers.</p> <p>MAFF R&D looking at sustainable soil management, the causes of upland erosion and effects of changes in soil organic matter.</p> <p>Future revisions to MAFF's Agricultural Land Classification Guidelines will consider impacts of climate change.</p> <p>Environment Agency funding research into land use changes under climate change scenarios.</p>
Flora, Fauna & Landscape	<p>Changes in species distribution</p> <p>Nature Reserves lose their value</p> <p>Increased fire hazard</p> <p>Loss of mudflats and salt marshes & bird habitats</p>	<p>Development of conservation strategy that is less site based (ie SSSIs and reserves)</p> <p>Provision of habitat corridors to assist migration</p> <p>Fire control</p> <p>Eutrophication control</p>	<p>Department of the Environment (DOE) considering further research to look at the impacts of climate change on wildlife and habitats; to consider range of policy response available and to recommend systems for early detection of climate change impacts.</p> <p>Welsh Office (WO) funds project to assess impacts of climate change on upland areas including (with NERC) the impact of drought on greenhouse gas emissions and water quality.</p> <p>NERC Terrestrial Initiative of Global Environmental Research (TIGER) Programme (£20m over 6 years) ends 1997.</p>
Agriculture, Horticulture & Aquaculture	<p>Increased need for irrigation</p> <p>Longer growing season</p> <p>Increased range and distribution of crops</p> <p>Production shifts to to the north and west</p> <p>Productivity of some sectors may increase</p> <p>Greater heat stress for housed livestock</p> <p>Increased invasion of pests and weeds</p> <p>Salmonoids (eg trout & other cold water fish) vulnerable as a result of increased temperatures and reduced river flows</p>	<p>Provide advice to farmers on best irrigation practice</p> <p>Appropriate selection of plant species to promote more effective catchment-area water management</p> <p>Introduction of new crops and varieties; new planting techniques and change planting and harvesting</p> <p>Promote flexibility in the Common Agriculture Policy (CAP)</p> <p>Advice on stocking densities and ventilation in hot weather</p> <p>Promote the development of wildlife corridors</p>	<p>MAFF policy to encourage farmers and growers to take steps to secure adequate supplies of water for irrigation eg by means of winter storage reservoirs, and conserving and using water efficiently. Supported by free advisory material, R&D programmes and ad hoc surveys of irrigation practice and needs</p> <p>MAFF spent around £0.6m in 1996 on a wide range of research looking at impacts of climate change on agriculture. MAFF intends to publish a summary of the results of this and previous research during 1997 to raise awareness throughout the industry.</p> <p>MAFF funds research on conservation of plant genetic resources including seeds from arid climates, thus increasing the availability of germplasm of significance for the future.</p> <p>Government policy to pursue continuing CAP reform</p> <p>MAFF funds publicity on need to reduce stocking densities in hot weather in livestock housing and transport vehicles to avoid suffering or death.</p> <p>MAFF has incentives to create wildlife corridors in place eg Countryside Stewardship Scheme; ESA schemes and the Habitats Scheme.</p>

Sector	Likely impacts	Policy implications	Response
Forestry	<p>Increase in productivity by up to 25% possible</p> <p>Possible decrease in productivity in the south-west and north-east</p> <p>Change in species distribution</p> <p>Increased fire hazard</p>	<p>50 year time lag for forestry policy: current decisions need to reflect likely climate in 2050</p> <p>Decisions on adapted tree species</p> <p>Research into the likely impact of climate change on UK's various forest types</p> <p>Expansion of forestry could provide habitats for migrating flora and fauna; additional rural recreation and employment opportunities</p> <p>Fire control</p> <p>Key role in sequestering carbon; reducing reliance on fossil fuels and offsetting imports of wood products</p>	<p>Promoting research into the likely impact of climate change on UK's various forest types (3.20 Sustainable Forestry) part of HMG response to Helsinki Guidelines Resolution 1.8)</p> <p>Wide-ranging £6m research programme relevant to impacts of climate change</p> <p>Encouraging afforestation</p> <p>DOE research on carbon sequestration in vegetation relevant to impacts of climate change</p>
Water Resources	<p>Reduced water availability in the south and east</p> <p>Increased river flow in winter</p> <p>Reduced river flow in summer</p> <p>Increase in winter riverine flooding</p> <p>Reduction in ground water recharge</p> <p>Reduction of water supply yields</p> <p>Change in seasonal demand for water</p> <p>Water quality</p>	<p>Planning and investment</p> <p>New water management schemes (in the short and medium term to consider impacts of climate change)</p> <p>Planting of appropriate tree and plant species to promote more effective catchment areas</p> <p>To consider further research into techniques for evaluating possible changes in river flood regimes</p> <p>Revision of practices for the design, inspection and monitoring structures associated with the water industry eg reservoirs</p> <p>Possible options for demand management:</p> <ul style="list-style-type: none"> ~ water saving technologies ~ metering 	<p>DOE/WO commissioned review of water resources and supply arrangements September 1995</p> <p>Water industry taking forward major research programme taking account of climate change models and impacts</p> <p>DOE/WO published paper in October 1996 setting out policy and strategy framework which aims to provide for the effective, efficient and environmentally sustainable supply of water in the longer term. The paper identifies a number of actions which are particularly concerned with adaptation to climate change.</p>

Sector	Likely impacts	Policy implications	Response
Energy	<p>Diverse – no major impacts on sector as a whole</p> <p>Decrease in demand for space heating: down 3% by 2020 and down 5% by 2050</p> <p>Increased use of air conditioning</p> <p>Increased storminess and sea level rise could affect offshore oil and gas production</p> <p>UK oil refineries are located on coast and estuaries</p> <p>Availability of renewables ~ hydroelectric and biomass</p>	<p>Technological potential for adaptation is high and the lifetime of most assets is shorter than climate change</p> <p>Protection requirements site specific</p>	
Minerals Extraction	<p>Increased storminess and sea level rise could lead to inland and coastal flooding and erosion, leading to increased costs of extraction</p>	<p>History of adaptation to different locations and environmental protection pressures. Expected to be able to cope with potential impacts of climate change</p>	
Manufacturing, Retailing and Service Industries	<p>Fewer severe winters could reduce disruption to manufacturers</p> <p>Types of goods in demand would shift</p> <p>Change in shopping habits and buying patterns</p>	<p>Changes to design of shopping malls and opening hours</p> <p>Increase in electronic shopping</p>	
Construction	<p>Shrinkage of soils undermining building foundations: change in pattern of risk of subsidence</p> <p>Increased and changed risk of storm damage</p> <p>Changes in construction seasons</p>	<p>Revision of design codes and standards for performance of buildings</p> <p>Planning horizons for infrastructure lengthy</p> <p>Productivity at construction sites</p> <p>Availability of construction materials</p> <p>Quality and sustainability of materials used in housing</p> <p>Insurance industry to advise and cooperate with stakeholders in the property market to reduce society's vulnerability to extreme events</p>	<p>DOE will review construction research programme to address industry needs for more reliable information on climate change impacts</p> <p>DOE will encourage industry to examine potential changes to its costs and operating methods</p> <p>DOE will fund research into climate-effect triggers for significant changes in client/occupier demands</p> <p>MAFF and WO will keep under review the Guidelines for construction of flood defences in response to climate change</p>

Sector	Likely impacts	Policy implications	Response
Transport	<p>Greater disruption to road, rail and air transport</p> <p>Flooding and increased incidence of storms will increase disruption</p> <p>Highly dependent on impacts and changes in other sectors</p>	<p>Effects of increased wind speeds on rail electrification</p> <p>Few other areas where transport is especially sensitive to impacts</p>	<p>Department of Transport (DOT) revised standards for road surfaces following the hot summer of 1995. New requirements include a test for rut resistance with the test temperature raised to 60C for high stress sites reflecting the higher temperatures that surfaces have been subjected to. This is expected to be sufficient for the foreseeable future.</p> <p>British Waterways have conducted review of operations and proposed a number of measures to conserve water in the waterways network following serious water loss in the hot summer of 1995.</p> <p>DOT identified further research important to understand better secondary effects on transport sector eg increased tourism. The Standing Advisory Committee on Trunk Road Assessment will be looking at the links between transport and economic growth, which might help inform the linkages between transport and other sectors of the economy.</p>
Insurance Sector	<p>Increased frequency of extreme events and change in pattern and increased risk of subsidence</p>	<p>Insurers need to co-operate with property market to reduce society's vulnerability to extreme events</p> <p>Adoption of relevant disaster plans</p>	<p>Association of British Insurers (ABI) commissioned several research projects to help assess the impacts of climate change on its business.</p> <p>ABI interested in further research on effects of climate change on increased risk of subsidence</p>
Health	<p>Health effect of air pollution exacerbated</p> <p>Increased risks to health including: food and water borne infections heat related deaths possible increase in the incidence of vector-borne disease (eg malaria and lyme disease)</p>	<p>Weather warnings</p> <p>Air pollution abatement</p> <p>Assurance of drinking water quality and food hygiene</p> <p>Appropriate vaccination and disease surveillance</p> <p>Appropriate health care facilities</p>	<p>Draft National Air Quality Strategy sets air quality objectives</p> <p>Consultative document The Environment and Health issued November 1996 considered consequences and opportunities for health alliances</p> <p>Existing controls and monitoring of water will continue</p> <p>Department of Health (DH) will respond to any changes in incidence of disease and provide vaccination as appropriate</p> <p>DH through the National Health Service will continue to plan and provide facilities best suited to the health needs of the population</p> <p>Results of DH's existing research, in the linked areas of air pollution and UV radiation, will enable it to judge the health consequences of possible climate changes and to respond</p>

Sector	Likely impacts	Policy implications	Response
Recreation, Tourism & Heritage	<p>Possible increase in tourism activity. If so, increased pressure on infrastructure, especially in rural areas</p> <p>Impact of climate change on the built heritage and possible increase in rate of decay</p> <p>Increased demand for traditional materials for building repair and maintenance</p>	<p>Policy makers need to accommodate greater pressures, including in future planning policy guidance</p>	<p>Department of National Heritage (DNH), Tourist Boards and others doing ongoing work to build awareness of the need for good environmental practice in the tourism industry. Sustainable Rural Tourism - Opportunities for Local Action containing good practice guidance for those running sustainable rural tourism projects, published in November 1995. English Tourist Board issued guidance in March 1996 on how individual tourism businesses can run environmentally friendly operations.</p> <p>Continued careful monitoring of environmental impact of tourism. Important to maximise potential economic benefits without destroying environment on which tourism depends.</p> <p>Joint British Tourist Authority/English Heritage working party has considered impact of increased tourism on sites. English Heritage and Cathedrals Fabric Commission issuing advice on care and management of historic floors</p> <p>English Heritage and Historic Scotland are sponsoring a wide range of research projects including traditional building construction methods and sourcing of materials.</p> <p>English Heritage and Historic Scotland are carrying out audits of coastal archaeological sites and buildings to assess the impact of sea level change.</p> <p>English Heritage research into potential invasion from termites. Proposal put to EC for pan-European study in 1997 research programme</p>
Coastal Zones and Sea Levels	<p>Impacts of climate change should be considered alongside other human activities in coastal zones (natural changes interrelated with socio-economic changes)</p> <p>50% of grade 1 agricultural land is below 5m contour</p> <p>Impacts on coastal aquifers and freshwater intakes close to tidal limit</p> <p>Impacts of flooding on coastal settlements</p> <p>Effects of sea temperature changes, increased precipitation and increased wind speeds on distribution of fish stocks</p> <p>Effects of changes in coastal morphology on nursery and aquaculture sites and on fishing harbours and associated infrastructure</p> <p>For salmon and other migratory species the effect changes in freshwater temperature and flows as well as changes in marine conditions</p>	<p>Strategic planning and guidance need to be kept under review</p> <p>Improve integration of coastal management (coastal zone planning should be informed by shoreline management plans and vice versa)</p> <p>Continued research into the development of appropriate responses to climate change needs</p>	<p>MAFF/Welsh Office circular on Development and Flood Risk (December 1992) and Scottish Office National Planning Policy Guideline D Planning and Flooding (September 1995) explain the importance of possible impacts of climate change and the need for planning decisions to take account of any risk of flooding</p> <p>MAFF funding research project on the climatic status of UK coastal waters to provide a better assessment of the effect that natural changes have on the marine ecosystem</p>

NATIONAL GREENHOUSE GAS INVENTORIES:

SUMMARY TABLES 1990 TO 1994

Table A4.I

			CO2 emissions	CO2 removals	CH4	N2O	NOx	CO	NMVOC	HFC	PFC	SF6
1990 SUMMARY (Gg)												
	Total national emissions and removals		610854	10377	4402	112.5	2710	6419	2419	1.051	0.308	0.024
1	All energy (fuel combustion and fugitive)		569813	0	1336	7.1	2692	6112	1393	NO	NO	NO
A.	Fuel combustion		562522	~	97.7	7.1	2610	6079	1069	NO	NO	NO
1	Energy and transformation industries	a b	231926	~	7.7	2.96	832	38.9	7.8	NO	NO	NO
2	Industry	a c d e	96092	~	7.04	0.52	173	65.5	11.4	NO	NO	NO
3	Transport	f	119255	~	30.4	3.11	1454	5638	996	NO	NO	NO
4	Small combustion	d g	111377	~	49.1	0.4	112	279	49.2	NO	NO	NO
5	Other	g	3872	~	0.09	0.02	37.4	5.4	0.7	NO	NO	NO
6	Traditional biomass burnt for energy	h	1136	~	3.34	0.05	1.4	52.5	4.3	NO	NO	NO
B.	Fugitive emissions from fuels		7291	~	1238	NE	82	33.5	324	NO	NO	NO
1	Solid fuels		NO	~	756	NO	NO	NO	NO	NO	NO	NO
2	Oil and natural gas	b f	7291	~	482	NE	82	33.5	324	NO	NO	NO
2	Industrial processes	c e	9911	~	NE	95.2	8.2	NE	311	1.04	0.3	0.02
3	Solvent and other product use		NO	~	NO	NO	NO	NO	658	0.01	0.008	0.004
4	Agriculture		0	~	1143	10.4	5.7	257.9	35.3	NO	NO	NO
A.	Enteric fermentation	i	NO	~	1005	NO	NO	NO	NO	NO	NO	NO
B.	Manure management	i	0	~	125	3.5	NO	NO	NO	NO	NO	NO
C.	Rice cultivation		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
D.	Agricultural soils	j	0	~	NE	6.6	NO	NO	NO	NO	NO	NO
E.	Prescribed burning of savannas		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
F.	Field burning of agricultural residues		0	~	12.3	0.24	5.66	257.9	35.3	NO	NO	NO
G.	Other		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
5	Land use change and forestry		30617	10377	NE	NE	NO	NO	NO	NO	NO	NO
A.	Changes in forest and other woody biomass stocks		~	10377	NE	NE	NO	NO	NO	NO	NO	NO
B.	Forest and grassland conversion	k	~	0	NE	NO	NO	NO	NO	NO	NO	NO
C.	Abandonment of managed lands	k	~	IE	NE	NO	NO	NO	NO	NO	NO	NO
D.	Other	l	30617	~	NE	NO	NO	NO	NO	NO	NO	NO
6	Waste		513	~	1923	NE	4.2	48.3	21.6	NO	NO	NO
A.	Solid waste disposal on land	m	0	~	1890	NO	NO	NO	18.9	NO	NO	NO
B.	Wastewater treatment	m	0	~	33	NO	NO	NO	NO	NO	NO	NO
C.	Waste incineration		513	~	0.033	NE	4.2	48.3	2.7	NO	NO	NO
D.	Other waste		0	~	NO	NO	NO	NO	NO	NO	NO	NO
7	Other		NE	~	NE	NE	NE	NE	NE	NO	NO	NO
	International bunkers	n	20729	~	0.44	0.18	250	26.9	3.4	NO	NO	NO

Table A4.II NATIONAL GREENHOUSE GAS INVENTORIES
1990 SUMMARY (Gg)

				CO2 emissions	CO2 removals	CH4	N2O	NOx	CO	NMVOC	HFC	PFC	SF6
		Total national emissions and removals		616225	11183	4358	107	2607	6304	2399	1.066	0.237	0.025
	1	All energy (fuel combustion and fugitive)		577049	~	1343	7.2	2591	5037	1373	NO	NO	NO
A.		Fuel combustion		570441	~	102.5	7.2	2506	6002	1047	NO	NO	NO
	1	Energy and transformation industries	a b	229165	~	8.3	2.94	731	37.8	7.7	NO	NO	NO
	2	Industry	a c d e	96123	~	6.97	0.53	174	64.9	11.3	NO	NO	NO
	3	Transport	f	118509	~	30	3.28	1442	5539	971	NO	NO	NO
	4	Small combustion	d g	122772	~	53.7	0.42	120	302	51.5	NO	NO	NO
	5	Other	g	3872	~	0.09	0.02	37.4	5.4	0.7	NO	NO	NO
	6	Traditional biomass burnt for energy	h	1136	~	3.34	0.05	1.4	52.5	4.3	NO	NO	NO
B.		Fugitive emissions from fuels		6608	~	1240	NE	85	35.2	326	NO	NO	NO
	1	Solid fuels		NO	~	760	NO	NO	NO	NO	NO	NO	NO
	2	Oil and natural gas	b f	6608	~	480	NE	85	35.2	326	NO	NO	NO
	2	Industrial processes	c e	8303	~	NE	89.7	7.4	NE	311	1.041	0.23	0.02
	3	Solvent and other product use		NO	~	NO	NO	NO	NO	658	0.024	0.007	0.005
	4	Agriculture		0	~	1124	10.4	4.8	218.5	35.3	NO	NO	NO
A.		Enteric fermentation	i	NO	~	989	NO	NO	NO	NO	NO	NO	NO
B.		Manure management	i	0	~	124	3.5	NO	NO	NO	NO	NO	NO
C.		Rice cultivation		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
D.		Agricultural soils	j	0	~	NE	6.7	NO	NO	NO	NO	NO	NO
E.		Prescribed burning of savannas		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
F.		Field burning of agricultural residues		0	~	10.5	0.2	4.82	218.5	35.3	NO	NO	NO
G.		Other		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
	5	Land use change and forestry		30360	11183	NE	NE	NO	NO	NO	NO	NO	NO
A.		Changes in forest and other woody biomass stocks		~	11183	NE	NE	NO	NO	NO	NO	NO	NO
B.		Forest and grassland conversion	k	~	0	NE	NO	NO	NO	NO	NO	NO	NO
C.		Abandonment of managed lands	k	~	IE	NE	NO	NO	NO	NO	NO	NO	NO
D.		Other	l	30360	~	NE	NO	NO	NO	NO	NO	NO	NO
	6	Waste		513	~	1891	NE	4.2	48.3	21.3	NO	NO	NO
A.		Solid waste disposal on land	m	0	~	1860	NO	NO	NO	18.6	NO	NO	NO
B.		Wastewater treatment	m	0	~	31	NO	NO	NO	NO	NO	NO	NO
C.		Waste incineration		513	~	0.033	NE	4.2	48.3	2.7	NO	NO	NO
D.		Other waste		0	~	NO	NO	NO	NO	NO	NO	NO	NO
	7	Other		NE	~	NE	NE	NE	NE	NE	NO	NO	NO
		International bunkers	n	19523	~	0.4	0.18	241	25.1	3.14	NO	NO	NO

Table A4.III

			CO2 emissions	CO2 removals	CH4	N2O	NOx	CO	NM VOC	HFC	PFC	SF6
1991 SUMMARY (Gg)												
		Total national emissions and removals	599283	11660	4248	91	2513	5852	2323	1.162	0.118	0.025
1		All energy (fuel combustion and fugitive)	561223	~	1255	7.7	2498	5645	1298	NO	NO	NO
	A.	Fuel combustion	554779	~	96.2	7.7	2410	5608	970	NO	NO	NO
	1	Energy and transformation industries	a b	~	9.8	2.78	720	35.7	7.6	NO	NO	NO
	2	Industry	a c d e	~	6.78	0.53	169	64.4	11.1	NO	NO	NO
	3	Transport	f	~	28.4	3.89	1365	5184	899	NO	NO	NO
	4	Small combustion	d g	~	47.8	0.4	117	266	47.3	NO	NO	NO
	5	Other	g	~	0.09	0.02	37.4	5.4	0.7	NO	NO	NO
	6	Traditional biomass burnt for energy	h	~	3.34	0.05	1.4	52.5	4.3	NO	NO	NO
	B.	Fugitive emissions from fuels		~	1159	NE	88	36.3	328	NO	NO	NO
	1	Solid fuels		~	681	NO	NO	NO	NO	NO	NO	NO
	2	Oil and natural gas	b f	~	478	NE	88	36.3	328	NO	NO	NO
2		Industrial processes	c e	~	NE	73.1	6.7	NE	311	1.121	0.11	0.02
3		Solvent and other product use		~	NO	NO	NO	NO	658	0.039	0.007	0.005
4		Agriculture		~	1117	10.1	3.5	158.8	35.3	NO	NO	NO
	A.	Enteric fermentation	i	~	986	NO	NO	NO	NO	NO	NO	NO
	B.	Manure management	i	~	124	3.5	NO	NO	NO	NO	NO	NO
	C.	Rice cultivation		~	NO	NO	NO	NO	NO	NO	NO	NO
	D.	Agricultural soils	j	~	NE	6.4	NO	NO	NO	NO	NO	NO
	E.	Prescribed burning of savannas		~	NO	NO	NO	NO	NO	NO	NO	NO
	F.	Field burning of agricultural residues		~	7.6	0.1	3.5	158.8	35.3	NO	NO	NO
	G.	Other		~	NO	NO	NO	NO	NO	NO	NO	NO
5		Land use change and forestry		11660	NE	NE	NO	NO	NO	NO	NO	NO
	A.	Changes in forest and other woody biomass stocks		~	NE	NE	NO	NO	NO	NO	NO	NO
	B.	Forest and grassland conversion	k	0	NE	NO	NO	NO	NO	NO	NO	NO
	C.	Abandonment of managed lands	k	~	NE	NO	NO	NO	NO	NO	NO	NO
	D.	Other	l	30067	NE	NO	NO	NO	NO	NO	NO	NO
6		Waste		~	1875	NE	4.2	48.3	21.1	NO	NO	NO
	A.	Solid waste disposal on land	m	~	1840	NO	NO	NO	18.4	NO	NO	NO
	B.	Wastewater treatment	m	~	35	NO	NO	NO	NO	NO	NO	NO
	C.	Waste incineration		~	0.033	NE	4.2	48.3	2.7	NO	NO	NO
	D.	Other waste		~	NO	NO	NO	NO	NO	NO	NO	NO
7		Other		~	NE	NE	NE	NE	NE	NO	NO	NO
		International bunkers	n	~	0.44	0.18	251	27.3	3.45	NO	NO	NO

Table A4.IV

1993 SUMMARY (Gg)			CO2 emissions	CO2 removals	CH4	N2O	NOx	CO	NM VOC	HFC	PFC	SF6	
		Total national emissions and removals		584819	12687	4066	81.4	2347	5285	2215	1.242	0.078	0.025
1		All energy (fuel combustion and fugitive)		546843	~	1106	8.7	2336	5237	1225	NO	NO	NO
	A.	Fuel combustion		540417	~	98.7	8.7	2234	5193	883	NO	NO	NO
	1	Energy and transformation industries	a b	201014	~	11.7	2.48	631	31.5	8.1	NO	NO	NO
	2	Industry	a c d e	91710	~	6.58	0.51	166	61.1	10.6	NO	NO	NO
	3	Transport	f	121552	~	26.3	5.24	1280	4756	813	NO	NO	NO
	4	Small combustion	d g	122269	~	50.6	0.39	118	286	46.1	NO	NO	NO
	5	Other	g	3872	~	0.09	0.02	37.4	5.4	0.7	NO	NO	NO
	6	Traditional biomass burnt for energy	h	1136	~	3.34	0.05	1.4	52.5	4.3	NO	NO	NO
	B.	Fugitive emissions from fuels		6426	~	1007	NE	103	44.2	342	NO	NO	NO
	1	Solid fuels		NO	~	521	NO	NO	NO	NO	NO	NO	NO
	2	Oil and natural gas	b f	6426	~	482	NE	103	44.2	342	NO	NO	NO
2		Industrial processes	c e	7691	~	NE	63.1	5.9	NE	311	1.164	0.07	0.02
3		Solvent and other product use		NO	~	NO	NO	NO	NO	658	0.076	0.007	0.005
4		Agriculture		0	~	1107	9.6	NO	NO	NO	NO	NO	NO
	A.	Enteric fermentation	i	NO	~	983	NO	NO	NO	NO	NO	NO	NO
	B.	Manure management	i	0	~	124	3.5	NO	NO	NO	NO	NO	NO
	C.	Rice cultivation		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
	D.	Agricultural soils	j	0	~	NE	6.2	NO	NO	NO	NO	NO	NO
	E.	Prescribed burning of savannas		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
	F.	Field burning of agricultural residues		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
	G.	Other		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
5		Land use change and forestry		29773	12687	NE	NE	NO	NO	NO	NO	NO	NO
	A.	Changes in forest and other woody biomass stocks		~	12687	NE	NE	NO	NO	NO	NO	NO	NO
	B.	Forest and grassland conversion	k	~	0	NE	NO	NO	NO	NO	NO	NO	NO
	C.	Abandonment of managed lands	k	~	IE	NE	NO	NO	NO	NO	NO	NO	NO
	D.	Other		129773	~	NE	NO	NO	NO	NO	NO	NO	NO
6		Waste		513	~	1854	NE	4.2	48.3	20.9	NO	NO	NO
	A.	Solid waste disposal on land	m	0	~	1820	NO	NO	NO	18.2	NO	NO	NO
	B.	Wastewater treatment	m	0	~	34	NO	NO	NO	NO	NO	NO	NO
	C.	Waste incineration		513	~	0.033	NE	4.2	48.3	2.7	NO	NO	NO
	D.	Other waste		0	~	NO	NO	NO	NO	NO	NO	NO	NO
7		Other		NE	~	NE	NE	NE	NE	NE	NO	NO	NO
		International bunkers	n	21851	~	0.48	0.17	250	29	3.72	NO	NO	NO

Table A4.V

1994 SUMMARY (Gg)

				CO2 emissions	CO2 removals	CH4	N2O	NOx	CO	NMVOC	HFC	PFC	SF6
		Total national emissions and removals		581017	16903	3843	93.7	2224	4859	2135	1.578	0.07	0.026
1		All energy (fuel combustion and fugitive)		542688	~	899	10.1	2215	4810	1145	NO	NO	NO
	A.	Fuel combustion		534123	~	90.6	10.1	2106	4763	802	NO	NO	NO
	1	Energy and transformation industries	a b	197980	~	12.7	2.41	578	29.2	8.3	NO	NO	NO
	2	Industry	a c d e	93937	~	6.71	0.48	169	59	10.6	NO	NO	NO
	3	Transport	f	121961	~	24.6	6.84	1207	4380	742	NO	NO	NO
	4	Small combustion	d g	116373	~	43.1	0.35	113	237	35.9	NO	NO	NO
	5	Other	g	3872	~	0.09	0.02	37.4	5.4	0.7	NO	NO	NO
	6	Traditional biomass burnt for energy	h	1136	~	3.34	0.05	1.4	52.5	4.3	NO	NO	NO
	B.	Fugitive emissions from fuels		8566	~	808	NE	109	47.3	343	NO	NO	NO
	1	Solid fuels		NO	~	321	NO	NO	NO	NO	NO	NO	NO
	2	Oil and natural gas	b f	8566	~	489	NE	109	47.3	343	NO	NO	NO
2		Industrial processes	c e	8373	~	NE	73.6	5.2	NE	311	1.206	0.06	0.02
3		Solvent and other product use		NO	~	NO	NO	NO	NO	658	0.373	0.007	0.006
4		Agriculture		0	~	1116	9.9	NO	NO	NO	NO	NO	NO
	A.	Enteric fermentation	i	NO	~	991	NO	NO	NO	NO	NO	NO	NO
	B.	Manure management	i	0	~	125	3.5	NO	NO	NO	NO	NO	NO
	C.	Rice cultivation		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
	D.	Agricultural soils	j	0	~	NE	6.4	NO	NO	NO	NO	NO	NO
	E.	Prescribed burning of savannas		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
	F.	Field burning of agricultural residues		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
	G.	Other		NO	~	NO	NO	NO	NO	NO	NO	NO	NO
5		Land use change and forestry		29443	16903	NE	NE	NO	NO	NO	NO	NO	NO
	A.	Changes in forest and other woody biomass stocks		~	16903	NE	NE	NO	NO	NO	NO	NO	NO
	B.	Forest and grassland conversion	k	~	0	NE	NO	NO	NO	NO	NO	NO	NO
	C.	Abandonment of managed lands	k	~	IE	NE	NO	NO	NO	NO	NO	NO	NO
	D.	Other	l	29443	~	NE	NO	NO	NO	NO	NO	NO	NO
6		Waste		513	~	1826	NE	4.2	48.3	20.6	NO	NO	NO
	A.	Solid waste disposal on land	m	0	~	1790	NO	NO	NO	17.9	NO	NO	NO
	B.	Wastewater treatment	m	0	~	36	NO	NO	NO	NO	NO	NO	NO
	C.	Waste incineration		513	~	0.033	NE	4.2	48.3	2.7	NO	NO	NO
	D.	Other waste		0	~	NO	NO	NO	NO	NO	NO	NO	NO
7		Other		NE	~	NE	NE	NE	NE	NE	NO	NO	NO
		International bunkers	n	21794	~	0.49	0.16	237	29.4	3.83	NO	NO	NO

Notes

Numbers in columns may not add up to the total due to rounding.

- a. Emissions and activity data for coke ovens, blast furnaces and patent fuel production are allocated according to a carbon balance on the coal consumed and the coke, patent fuel, blast furnace gas and coke oven gas produced.
- b. Emissions of methane, NO_x, CO, NMVOC, (but not CO₂) from own energy use on offshore installations are included under 1B2.
- c. Emissions of CO₂ from iron and steel are included under 1A2.
- d. Emissions from off-road vehicles are reported under 1A2 and 1A4.
- e. The feedstock use of natural gas for the manufacture of ammonia, methane and acetic acid is accounted for. Emissions of CO₂ from ammonia manufacture are reported under 2.
- f. Includes emissions of NO_x, CO and NMVOC from fuel use on offshore installations which are also included under 1B2. This contribution is expected to be no more than 5Gg NO_x, 0.8Gg CO and 3Gg NMVOC in 1991.
- g. Emissions from stationary combustion at military installations are reported under 1A4.
- h. CO₂ emissions are given for information only and are not totalled.
- i. Emissions from cattle, pigs, sheep, goats, horses, fowls, turkeys, ducks and geese.
- j. Agricultural soils could be a net sink of methane.
- k. Categories 5B and 5C have been combined.
- l. Emissions of CO₂ is from wetland drainage and peat extraction.
- m. Sewage sludge disposed of by landfill is included under 6A.
- n. Emissions are given for information only and are not totalled.

NE Not estimated.

NO Not occurring.

IE Included elsewhere

Source: NETCEN Report, updated to incorporate the most recent emissions estimates.

ANNEX 5 RELEVANT PUBLICATIONS

The information in this report draws on a number of sources including the following publications:

A Methodology for Updating Routinely the Annual Estimate of Methane Emissions from Landfill Sites in the UK, report by ETSU to the Department of the Environment, 1996

A UK Strategy for Combined Heat and Power, Department of the Environment, 1996

Annual Global Atmosphere Research Programme Report, Department of the Environment, Global Atmosphere Division

Climate Change 1995 - The Science of Climate Change - Contribution of Working Group 1 to the Second Assessment Report of the IPCC, Cambridge University Press, 1996 ISBN 0-521-56436-0

Climate Change Newsletter, Department of the Environment, Global Atmosphere Division

Climate Change - The UK Programme, HMSO, London, 1994 ISBN 0-10-124272-7

Code of Good Agricultural Practice for the Protection of Air, Ministry for Agriculture, Fisheries and Food, 1992

Code of Good Agricultural Practice for the Protection of Soil, Ministry for Agriculture, Fisheries and Food, 1993

Code of Good Agricultural Practice for the Protection of Water, Ministry for Agriculture, Fisheries and Food, 1991

Control Measures to Limit Methane Emissions from Sewage and Sludge Treatment and Disposal; report by WRc plc to the Department of the Environment, 1996

Crop Burning (Residues) Regulations 1993, HMSO, London, 1993

Digest of Environmental Statistics, No.18, Department of the Environment, HMSO, London, 1996 ISBN 0-11-753297-5

Emissions and Uptake by UK Terrestrial Carbon Reservoirs, 1990-2020, Institute of Ecology, 1997 (in preparation)

Energy Paper 65, Energy Projections for the UK, Department of Trade and Industry, HMSO, London, 1995 ISBN 0-11-515365-9

Energy Paper 62, New and Renewable Energy: Future Prospects in the UK, Department of Trade and Industry, HMSO, London, 1994 ISBN 0-11-515384-5

Energy Services for the Public Sector - A Working Guide, Department of the Environment, 1996

Environmental Protection Act 1990, HMSO, London, 1990 ISBN 0-10-544390-5

Guidelines on Reducing Atmospheric Emissions from Oil and Gas Facilities, UK Offshore Operators, Association Ltd, London, 1995

Handbook for the International Treaties for the Protection of the Ozone Layer, Ozone Secretariat UNEP, 1996 ISBN 92-807-1581-X

Household Growth: Where Shall We Live? (CM3471), TSO, London, 1996

Home Energy Conservation Act 1995, HMSO, London, 1995 ISBN 0-10-541095-0

Indicators of Sustainable Development for the United Kingdom, Department of the Environment, HMSO, 1996 ISBN 0-11-753174-X

Making Waste Work, Department of the Environment and the Welsh Office, HMSO, London, 1995 ISBN 0-10130402-1

NETCEN Report - see below reference UK Greenhouse Gas Inventory

New Car Fuel Consumption Figures, Department of Transport, 1996

Planning Policy Guidance 13: Transport, Department of the Environment and Department of Transport, HMSO, London, 1994 ISBN 0-11-752941-9

Planning Policy Guidance 22: Renewable Energy, Department of the Environment and Department of Trade and Industry, HMSO, London, 1993 ISBN 0-11-752756-4

Planning Policy Guidance 22 Annexes, Department of the Environment and Department of Trade and Industry, HMSO, London, 1994 ISBN 0-11-753023-9

Preventing Air Pollution by Smoke and Greenhouse Gases, Department of the Environment for Northern Ireland, 1995 ISBN 1-85527-1613

Prevention of Environmental Pollution from Agricultural Activity, Scottish Office, HMSO, 1993

Progress Report on Carbon Dioxide Emissions, Department of the Environment, 1995

Review of the Potential Effects of Climate Change in the United Kingdom, Second Report of the CCIRG, Department of the Environment, HMSO, London, 1996 ISBN 0-11-753290-8

Rural England, HMSO, London, 1995 ISBN 0-10-130162-6

Sustainable Development - The UK Strategy, HMSO, London, 1994 ISBN 0-10-124262-X

The National Cycling Strategy, Department of Transport, 1996

The Prospects for Nuclear Power in the UK, Department of Trade and Industry and the Scottish Office, HMSO, London, 1995 ISBN 0-10-128602-3

This Common Inheritance - UK Annual Report 1995, HMSO, London, 1995 ISBN 0-10-128222-2

Towards 2020: Future Oil and Gas Production in UK Waters, UK Offshore Operators' Association Ltd, London, 1996

Transport: The Way Forward, HMSO, 1996 ISBN 0-10-132342-5

United Nations Framework Convention on Climate Change, UNEP/WMO Information Unit on Climate Change, 1992

UK Greenhouse Gas Inventory, 1990 to 1994. Annual Report for Submission under the FCCC, National Environment Technology Centre, 1996 ISBN 0-7058-1728-8

UK National Air Quality Strategy Ð Consultation Draft, Department of the Environment, 1996

UK Use and Emissions of Selected Halocarbons, Department of the Environment, HMSO, 1996 ISBN 0-11-753309-2

Water Resources and Supply: Agenda for Action, Department of the Environment, 1996

Note

HMSO is now The Stationery Office

ANNEX 6

GLOSSARY

ABI	Association of British Insurers
AD	Anaerobic Digestion
AGR	Advanced Gas-Cooled Reactor
ARIC	Atmospheric Research Information Centre
BATNEEC	Best Available Technology Not Entailing Excessive Cost
BRECSU	Building Research Energy Conservation Support Unit
BSE	Bovine Spongiform Encephalopathy
CAP	Common Agricultural Policy
CCGEF	Central and Local Government Environment Forum
CCGT	Combined Cycle Gas Turbine
CCIRG	Climate Change Impacts Review Group
CFC	Chlorofluorocarbon
CF ₄	Carbon Tetrafluoride
CH ₄	Methane
CHP	Combined Heat and Power
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
COGA	Common Off-Gas Abatement Unit
Convention	Framework Convention on Climate Change
COP	Conference of the Parties of the Framework Convention on Climate Change
DH	Department of Health
DNH	Department of National Heritage
DOE	Department of the Environment
DOT	Department of Transport
DSM	Demand Side Management
DTI	Department of Trade and Industry
EA	Environment Agency
EBRD	European Bank of Reconstruction and Development
EC	European Community
EEBPP	Energy Efficiency Best Practice Programme
EKHF	Environmental Know How Fund
EMA	Eco Management and Audit Scheme
EPA1990	Environment Protection Act 1990
EP62	Energy Paper 62, New and Renewable Energy: Future Prospects for the UK
EP65	Energy Paper 65, Energy Projections for the UK
ERP	Environment Research Programme
ESA	Environmentally Sensitive Area
ESCO	Energy Services Company
ESMAP	Energy Sector Management Assistance Programme
EST	Energy Saving Trust
EU	European Union
FCCC	Framework Convention on Climate Change
GA	Global Atmosphere Division of the Department of the Environment
GAGE	Global Atmospheric Gases Experiment
GCCIP	Global Climate Change Information Programme
GCOS	Global Climate Observatory Systems
GDP	Gross Domestic Product

GEF	Global Environment Facility
GHG	Greenhouse Gas
GMF	Greener Motoring Forum
GOOS	Global Ocean Observatory System
GREENTIE	IEA Greenhouse Gas Technology Information Exchange
GTOS	Global Terrestrial Observatory System
GWP	Global Warming Potential
HCFC	Hydrochlorofluorocarbon
HEES	Home Energy Efficiency Scheme
HFC	Hydrofluorocarbon
HMG	Her Majesty's Government
HMT	Her Majesty's Treasury
IBRD	International Bank for Reconstruction and Development (World Bank)
ICAO	International Civil Aviation Organisation
IEA	International Energy Agency
IPC	Integrated Pollution Control
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
ITE	Institute of Terrestrial Ecology
kt	Kilotonne
kWh	Kilowatt-hour
MACC	Making a Corporate Commitment Campaign
MAFF	Ministry of Agriculture, Fisheries and Food
MOD	Ministry of Defence
MtC	Million tonne of carbon
MtCH ₄	Million tonne of methane
MtCO ₂	Million tonne of carbon dioxide
MW	Megawatt
N ₂ O	Nitrous oxide
NAQS	National Air Quality Strategy
NERC	Natural Environmental Research Council
NETCEN	National Environmental Technology Centre
NFFO	Non-Fossil Fuel Obligation
NGC	National Grid Company
NHS	National Health Service
NI-NFFO	Northern Ireland Non-Fossil Fuel Obligation
NMVOC	Non Methane Volatile Organic Substance
NO _x	Nitrogen Oxides
NSA	Nitrate Sensitive Area
ODA	Overseas Development Administration
OECD	Organisation for Economic Cooperation and Development
OFFER	Office of Electricity Regulation
OFGAS	Office of Gas Supply
PES	Public Electricity Supplier
PFC	Perfluorocarbon
Programme	UK Climate Change Programme
PWR	Pressurised Water Reactor
R&D	Research and Development
SAP	Standard Assessment Procedure
SACTRA	Standing Advisory Committee on Trunk Road Assessment

SCEEMAS	Small Company Environmental and Energy Management Assistance Scheme
SEPA	Scottish Environmental Protection Agency
SF6	Sulphur Hexafluoride
SO	Scottish Office
SO2	Sulphur Dioxide
SOP	Standard of Performance
SOx	Sulphur Oxides
SRO	Scottish Renewables Obligation
SSSI	Site of Special Scientific Interest
TC	Technical Cooperation
TIGER	Terrestrial Initiative of Global Environmental Research
TPI	Technology Partnership Initiative
UK	United Kingdom
UKOOA	United Kingdom Offshore Operators' Association
UN	United Nations
UNDP	United Nations Development Programme
UNECE	United Nations Environmental Commission for Europe
UNEP	United Nations Environment Programme
UV	Ultra-violet
VAT	Value Added Tax
VOC	Volatile Organic Compound
WGI	Working Group I of the IPCC
WMO	World Meteorological Organisation
WO	Welsh Office
WSA	Water Services Association

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