

Climate Change
The UK Programme 2006

TOMORROW'S CLIMATE
Today's Challenge



Climate Change The UK Programme 2006

Presented to Parliament by the
Secretary of State for the Environment,
Food and Rural Affairs
by Command of Her Majesty

Presented to the Scottish Parliament by the Scottish Ministers:

Presented to the Northern Ireland Assembly:

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March 2006

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Prime Minister's Foreword

Climate change is probably the greatest long-term challenge facing the human race. That is why I have made it a top priority for this government, at home and internationally.

The scientific evidence is now overwhelming. Since 1990, global temperatures have risen by 0.2C and atmospheric carbon dioxide concentrations have increased from 354 parts per million to over 380 parts per million and are still rising. If the anticipated growth in emissions is left unchecked, global average temperatures could be as much as 5.8C higher by the end of this century, with a devastating impact on our economy and natural world, in the UK and, above all, in the most vulnerable developing countries.

We have to accept that some climate change is now inevitable. We must adapt to this and provide greater support for the poorest nations. We can, however, avert the worst global scenarios if the world acts decisively, but there can be no delay. The longer we put off action, the more dramatic and costlier the changes we will have to make.

Our 2000 Climate Change Programme has already helped put us on track to meet our Kyoto greenhouse gas reduction commitment. Indeed, we are projected to go significantly beyond our Kyoto commitment and reduce our greenhouse gas emissions by 23-25 per cent by 2010, one of the best records of any Kyoto signatory. Without the measures introduced since 1997 and the package of new measures being announced today, we estimate that carbon dioxide emissions in 2010 might only be about 1 per cent lower than in 1990, rather than 15 to 18 per cent lower. But we are not complacent. This programme contains further commitments to help achieve our national goal of reducing carbon dioxide by 20 per cent below 1990 levels by 2010 and, in the long-term, reduce emissions by 60 per cent by 2050.

Domestic action is essential, not least to underline the fact that emissions reductions and prosperity can go hand-in-hand. But national action can only be part of a much bigger strategy. The UK is responsible for 2 per cent of global emissions, and this figure is falling. Climate change is a global problem that requires a global solution. That is why our new programme sets out our strategy for both international and national action.



The UK has already taken a strong lead internationally on climate change. We played a major role in negotiating the Kyoto Treaty. In the Hadley Centre, we have one of the world's leading climate change research centres. We have also taken a policy lead, through the climate change levy and UK emissions trading scheme.

In 2005 we took this to a new level, through our Presidencies of the G8 and EU. We made important progress. Crucially, the G8 countries agreed to a new Dialogue with the Leaders of China, India, Brazil and other emerging economies that will hold meetings annually and culminate in 2008 when it reports to the Japanese G8 Presidency. The progress made at the G8 and in our EU Presidency helped to secure a positive outcome to the UN Climate Change Conference in Montreal.

But the progress made last year has, in truth, simply got the world to the starting blocks for the real race – to secure agreement to the long-term goal of global action on climate change and on the action needed to deliver that goal.

This document sets out our plans for working, with other countries, to secure agreement on the scale needed. They include a strong focus on a stabilisation goal to frame future international action, progress through the UN Framework on Climate Change and the G8 Dialogue, and a much greater role for the European Union.

We will work with our EU partners to take further action both internally and internationally. The UK will push hard for greater certainty on European plans for implementation of the EU Emissions Trading Scheme beyond 2012. The scheme remains the most important mechanism for stimulating international investment in low-carbon technology. We will also seek agreement for much more ambitious collaboration with emerging economies. Our EU Summits with China and India in 2005 were a useful step forward. But again we need to go much further, to scale up these actions to make a real difference.

We will also work with the G8 and developing countries through the Dialogue to accelerate the deployment of clean technologies and provide incentives for investment in low carbon technologies. We will co-operate closely with the World Bank and other multilateral development banks to deliver an effective framework for investment in clean energy, and with the International Energy Agency.

Targets matter, at home and abroad. But recent events have shown that no government can control emissions in any one year, due to factors such as changes in international fuel and energy prices that are outside our control. Our approach seeks to secure steady emissions reductions over time, through a framework that recognises the importance of maintaining our economic competitiveness and our responsibilities to all members of society – particularly those experiencing fuel poverty.

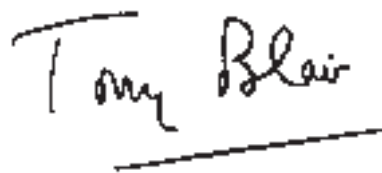
This programme will take us close to our domestic target. But it is by no means the last word. We are launching the consultation today on the UK's approach to the next phase of the EU emissions trading scheme, which will provide a vital signal to business of the parameters from 2008–12. I am a strong supporter of the scheme. We look forward to hearing people's views prior to our final

decision this summer. We will also be considering other future policy options through the Energy Review and the annual Budget process. We will report to Parliament annually on emissions, future projections, the impact of these measures and forward plans.

Government will play its part and give the necessary lead. But we won't succeed without the support and active participation of all sectors of society.

If every household and business took measures to reduce its carbon dioxide emissions, by reducing energy used in the home, in buildings, and by changing how journeys are made, we could achieve our 20 per cent target. We can and will help make this happen. We are putting more funding into a new initiative to raise consumer demand for energy efficiency. The Carbon Trust and the Energy Saving Trust will this year run awareness campaigns on what companies and individuals can do to help. Our Climate Change Communications Initiative will do more to inform the public of the threat and how we can together overcome it.

Our emissions goals require leadership and action, by government and by us all. This programme will move us closer, and we will go further. But the solution is in the hands of us all – as businesses, citizens and consumers. Let's achieve this together.

A handwritten signature in black ink that reads "Tony Blair". The signature is written in a cursive, flowing style. Below the signature is a single horizontal line.

Tony Blair
Prime Minister
March 2006

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Executive Summary

This Government believes that climate change is the greatest long-term challenge facing the world today. There is strong and indisputable evidence that climate change is happening and that man-made emissions are its main cause. The ten warmest years globally since formal records began in 1861 have all occurred since 1994. If left unchecked, climate change will have profound impacts on our societies and way of life, affecting agriculture and food security, leading to water shortages, triggering population movements and impacting on our economies, and our security. So action is needed now.

The UK has already taken significant steps to meet this challenge. The Government has led the way with innovative policies, such as the Climate Change Levy and agreements, Renewables Obligation and Energy Efficiency Commitment. Equally, we have built on our experience of domestic policy to foster greater action at the international level – most notably with the successful introduction of the EU Emissions Trading Scheme which draws many elements from our domestic emissions trading scheme. The combination of these measures has had a substantial impact on greenhouse gas reduction in the UK. It is for this reason that the UK is one of very few countries on track to meet our commitment under the Kyoto Protocol to reduce emissions of greenhouse gases by 12.5 per cent below 1990 levels by 2008-12. And we have made progress beyond this commitment, with our greenhouse gas emissions projected to be almost 20 per cent below 1990 levels in 2010 even without the new measures in this programme.

We want to go further. This Climate Change Programme sets out our policies and priorities for action in the UK and internationally. Climate change is a global problem, so we will strive to secure global action on the scale needed to tackle it. But we will also take further action at home, to meet our commitments and demonstrate that climate change can be tackled without damaging our economy.

The UK is already at the forefront of the fight against climate change. Our Presidencies of the G8 and the EU in 2005 and this made a powerful impact. At the Gleneagles Summit in July 2005, the G8 leaders agreed that climate change was a serious and long-term challenge caused by human activity, and that urgent action was needed. The Gleneagles Action Plan and the

commitment by G8 leaders and leaders of other countries to launch a Dialogue on “climate change, clean energy and sustainable development” were a major signal of renewed political will. The Montreal UN Conference in December 2005 was an important step forward for the whole international community.

But there is a long way to go. So we will continue to play a leadership role in 2006 and beyond through the European Union, G8 and UN Framework Convention processes, and find ways to reach global agreement to action on the scale needed to avert dangerous climate change.

We have also set ourselves a more challenging domestic target to reduce carbon dioxide emissions by 20 per cent below 1990 levels by 2010. Although we have made significant progress, higher than anticipated levels of economic growth and the recent rise in global energy prices, which has altered the relative prices of coal and gas, have led to increases in our carbon dioxide emissions in recent years. As a result, achieving our domestic target has become more challenging since our last Climate Change Programme in 2000. We have therefore used this Review to assess both the impact of existing policies and the potential contribution of new policy options.

This new Climate Change Programme will take us close to our domestic target, and ensure that the UK can make the real progress by 2020 towards the long-term goal to reduce carbon dioxide emissions by some 60 per cent by about 2050 that we committed to in the 2003 Energy White Paper. The package of existing and new policy measures in the Programme are projected to reduce carbon dioxide emissions to 15-18 per cent below 1990 levels – the new measures saving 12 million tonnes of carbon by 2010. This is very good progress. Our overall emissions of greenhouse gas emissions are now projected to be 23-25 per cent below 1990 levels in 2010 – around double our Kyoto target.

This Programme is not the final word. The projections and policies set out in this Programme will change over time. There is more that government will do both to influence emissions directly and to encourage action by others. The 2010 carbon target is still within reach. Further contributions could be made by the Energy Review, the ODPM review of buildings and other government policy processes over the coming years.

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Recent experience has proven the need to assess progress towards our medium and long-term goals on a more frequent and regular basis. We will therefore in future report annually to Parliament on our progress at reducing the UK's greenhouse gas emissions. Building on this, the Review of the Economics of Climate Change, led by Sir Nick Stern, will consider other aspects of recent proposals for the introduction of "carbon budgeting". This analysis will inform the Energy Review.

So this Climate Change Programme sets out the Government's commitments both at international and domestic levels to meet the challenge of climate change. It also sets out our approach to strengthening the role that individuals can play. We will encourage individuals as citizens, consumers, motorists and business people to take the action needed to help meet our goals. There is no choice to be made between action at international, national and personal levels. We regard all as essential.

The primary elements of our programme at all levels are summarised below.

Internationally we will:

- work to build consensus on the scale of action needed to stabilise the climate and avoid dangerous climate change, and build on the progress made at the G8 Summit in Gleneagles and the Montreal climate change conference to strengthen the international regime;
- work with EU partners to secure agreement to further action in the EU, in particular by extending and strengthening the Emissions Trading Scheme and the Clean Development Mechanism to make them key regional and global tools for emissions reductions beyond 2012;
- in partnership with the EU, enhance our efforts to help India, China, Brazil and other large emerging countries evolve as low-carbon economies;
- work with the World Bank and the multilateral development banks to ensure that the proposed Clean Energy Investment Framework delivers significant new investment in low carbon energy sources, energy efficiency and adaptation to climate change in developing countries;

- support international collaboration and coordination to ensure the successful expansion of new technologies, through action in key areas such as product standards and research and development; and
- help poorer developing countries to adapt to changes in climate already occurring and to make their economies more resilient to future changes.

Domestically we will:

- report annually to Parliament on emissions, our future plans and progress on domestic climate change; and
- set out our adaptation plan for the UK, informed by additional research on the impacts of climate change.

In the energy supply sector we will:

- consult now on a National Allocation Plan for the second phase of the EU Emissions Trading Scheme to achieve carbon savings of between 3 and 8 MtC;
- spend £80m in the next three years to support microgeneration technologies, with the aim of encouraging manufacture at higher scale leading to lower costs;
- provide £35m over four years for the development of carbon abatement technologies, and consult on the barriers to wide-scale commercial development of carbon capture and storage (CCS) in the UK and the potential role of economic incentives in addressing those barriers;
- continue to support electricity from renewables under the Renewables Obligation and address barriers to take-up; and
- fully consider the treatment of CHP in the UK's National Allocation Plan for the second phase of the EU Emissions Trading Scheme.

In the business sector we will:

- continue to use the climate change levy and associated climate change agreements to encourage businesses to improve the efficiency with which they use energy;

Executive Summary

- maintain a strong package of support, advice and information measures to help businesses improve their energy efficiency;
- continue to make the EU Emissions Trading Scheme a central element of the business sector's contribution to our national goal; and
- keep the current policy mix under review to ensure that it continues to represent the most effective use of policy instruments to deliver emissions reductions.

In the transport sector we will:

- introduce the Renewable Transport Fuel Obligation from 2008 to increase the uptake of biofuels and ensure a long term framework which promotes additional investment;
- continue to use fiscal instruments such as Vehicle Excise Duty and Company Car Tax to give incentives to purchase less polluting vehicles;
- maintain momentum in the EU to secure agreement to the inclusion of aviation in the EU Emissions Trading Scheme from 2008 or as soon as possible thereafter;
- work strongly to achieve further commitments from vehicle manufacturers to improve fuel efficiency; and
- continue to promote carbon offsetting and lead by example to offset emissions arising from central Government air travel.

In the domestic sector we will:

- continue to take forward significant improvements already made and update the Building Regulations in April 2006 to raise energy standards of new build and refurbished buildings;
- introduce the Code for Sustainable Homes which will have minimum standards for energy and water efficiency at every level of the Code, with the lowest levels raised above the level of mandatory building regulations;
- building on substantial progress to date, seek to achieve substantially higher carbon savings from the Energy Efficiency Commitment in 2008-11, working with stakeholders to examine the scope to provide greater flexibility and incentive in the design of the

scheme and to enable it to encourage consumers to reduce their energy demand;

- achieve 250,000 additional subsidised installations of home insulation over the next two years over and above existing commitments;
- launch a major new initiative designed to strengthen consumer demand for energy efficiency, working closely with energy suppliers and through local authorities, with funding of £20m over the next two years;
- provide more reliable consumer product information and set effective standards for energy-using products via voluntary agreements, in particular a new initiative with major retailers on consumer electronics, the Eco-design of Energy Using Products Directive and other national, EU and international policy measures and initiatives, including public procurement;
- consider how to enable consumption feedback to households via improved billing and metering, including the Budget 2006 announcement of £5m to help co-finance with energy companies a pilot study in the use of "smart" meters and associated feedback devices;
- maintain the Energy Efficiency Commitment, Warm Front and Decent Homes schemes to deliver energy efficiency measures in low income households to help meet our fuel poverty targets; and
- continue to support the activities of the Energy Saving Trust and the Climate Change Communications Initiative to raise awareness about climate change and the action individuals can take to help tackle it.

In the public sector and local government we will:

- introduce a package of measures to drive additional action for local authorities to include an appropriate focus on action on climate change;
- set up a new revolving loan fund of £20m for the whole of the public sector, to finance investment in energy efficiency; and
- introduce new strategic targets for the central government estate in summer 2006.

In the agriculture, forestry and land management sector we will:

- promote resource efficient farm management in order to reduce agriculture's contribution to greenhouse gas emissions; and
- examine the scope and feasibility of an emissions trading scheme for the agriculture and forestry sector.

And to encourage personal action we will:

- introduce further measures and initiatives to encourage and enable individuals to understand their role and responsibility in tackling climate change;
- continue to support the essential work of the Energy Saving Trust and Carbon Trust and other organisations that provide information and advice to individuals, businesses and local authorities;
- set out a plan for action on sustainable consumption by the end of 2006, in response to the Sustainable Consumption Round Table report due in Spring 2006;
- establish a new online information service (working title: Environment Direct) to provide information on the environmental impact of a range of everyday products and services, and practical advice on sustainable lifestyle choices;
- provide up to £4m over three years to roll out a new package of measures to help thousands of community groups across England to take action on sustainable development, including climate change; and
- enhance our new Climate Change Communications Initiative, to change public attitudes toward climate change, above all at local, grass roots and regional level.

SECTION

1

The International Challenge

What is climate change and why does it matter?

The overwhelming majority of scientific opinion supports the view that human activities are changing the earth's climate and that likely future changes present a serious threat to human society and the natural environment.

The ten warmest years globally since instrumental records began in 1861 have all occurred since 1994. 1998 was the warmest year and 2005 was almost as warm.

Without action to reduce greenhouse gas emissions global temperatures are expected to rise by between 1.4 and 5.8°C by 2100 and sea level could also rise by between 0.09 and 0.88 metres compared to 1990 levels.

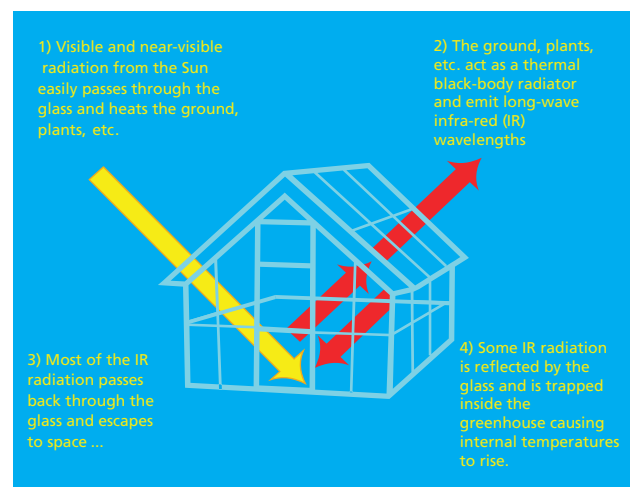
Such changes will have significant impacts on human society and on the natural environment, with increases in drought and extreme rainfall and greater risks of abrupt changes in climate.

Introduction

1. The earth's climate has changed frequently over the long periods of geological time in responses to changes in the strength of the sun, the shape and tilt of the earth's orbit around the sun, the position and shape of the continents and the composition of the atmosphere. There is strong evidence that greenhouse gas emissions from human activities are now raising the earth's temperature and causing other changes in climate. Emissions are projected to rise significantly over the next few decades, and quite likely beyond this, leading to significant increases in global temperatures with profound risks for the natural environment and human society worldwide. This Chapter provides background material on the nature of human induced climate change and its likely impacts.

The greenhouse effect and other influences on climate

2. The temperature of the earth is determined by the balance between energy from the sun in the form of visible radiation (sunlight), and energy constantly re-radiated from the earth to space in the form of infra-red radiation. Sunlight passes through the atmosphere with little direct warming effect but it warms the earth's surface which in turn warms the atmosphere by convection and the emission of infra-red radiation, which is absorbed by certain trace gases – the greenhouse gases. These return some infra-red radiation back to the surface thereby warming the surface further. An analogy is often made with the effect of a greenhouse which allows sunshine in through clear glass or plastic that in turn stops the heat inside from escaping, hence the term 'greenhouse effect'.



3. The greenhouse effect occurs naturally. Without it the earth would be over 30°C cooler than it is and largely uninhabitable. The main naturally occurring greenhouse gases are water-vapour (H_2O), carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Although water vapour makes the greatest contribution to the greenhouse effect, it has a short lifetime in the atmosphere and its concentration is largely determined by the temperature of the atmosphere and not simply by emission or loss rates. By contrast, the other three gases have relatively long atmospheric lifetimes – about a

What is climate change and why does it matter?

century for CO₂ – and so their concentrations are determined by emission and removal rates. Since the industrial revolution, man's use of fossil fuels and increase in agriculture has increased the emissions of all the long-lived greenhouse gases.

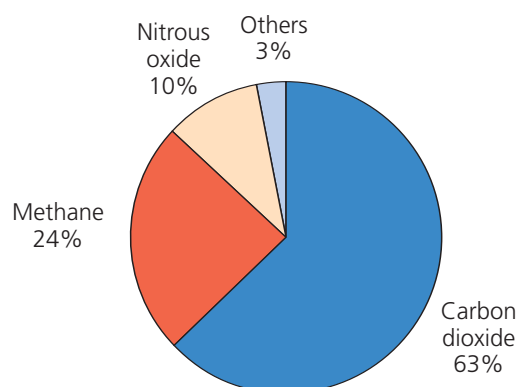
4. Human activities also affect the climate in other ways. Airborne aerosol particles emitted by sources such as industry, power stations and transport scatter sunlight, which would otherwise reach the earth's surface, and have a cooling effect on the climate system. Their influence can be important in heavily polluted regions but, unlike greenhouse gases, they do not accumulate in the atmosphere because they are washed out by rain within a few weeks. Aerosols have partially masked the full effect of increasing greenhouse gases and have slowed the rate of temperature increase. Human activities, such as agriculture and deforestation, have also changed the nature of the earth's surface in ways which affect climate. For example, changing land use from forests to pasture increases the amount of sunlight reflected and the availability of moisture at the surface. Such changes affect the climate on a regional scale. Deforestation also leads to significant emissions of CO₂ to the atmosphere and currently accounts for some 20 per cent of global emissions.

Greenhouse gases

5. In addition to the human induced emissions of carbon dioxide, methane and nitrous oxide, industrial activities have generated other greenhouse gases, namely hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride¹. Each greenhouse gas has a different capacity to cause global warming, depending on its radiative properties, its molecular weight and its residence time in the atmosphere. Global warming potential (GWP)² is a convenient index that can be used to assess the relative global warming effect of the emissions of different gases over a set time period – usually taken to be one hundred years – relative to the emission of an equal mass of CO₂. The following table summarises the GWPs for the main greenhouse

gases. The overall effect of emissions on the climate system can be found by multiplying the emissions by the relevant GWP.

The relative contribution to global warming over the next 100 years of current emissions of greenhouse gases.



Global Warming Potentials for selected gases from the IPCC Third Assessment Report

GAS	GWP
CO ₂	1
CH ₄	23
N ₂ O	296
HFC-23	12000
HFC-134a	1300
CF ₄	5700
SF ₆	22200

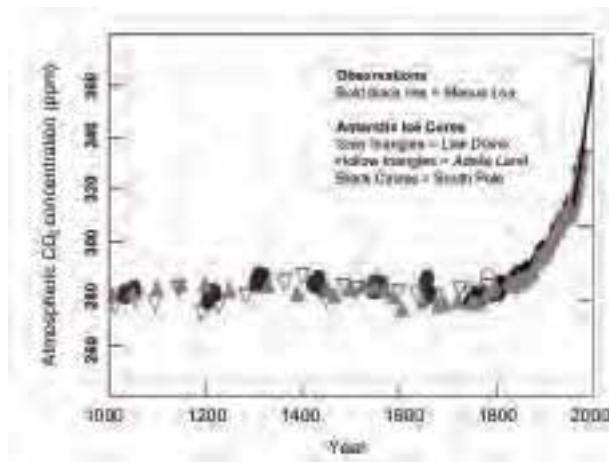
6. Atmospheric concentrations of carbon dioxide, methane and nitrous oxide have been rising for 200 years. Concentrations of most other greenhouse gases have also been rising in the past five decades. Evidence from bubbles in ice cores shows that the pre-industrial level of carbon dioxide in the atmosphere was about 270ppm (parts per million) which has risen to 377ppm by the end of 2004 and provisional data for 2005 show a concentration of over 380ppm. The atmospheric CO₂ concentration is already at a level not seen on earth for at least 740,000 years, and probably for over 20 million years. Both ice core and instrumental measurements have also shown well over a doubling of pre-industrial methane concentrations in the atmosphere.

¹ The UNFCCC and the Kyoto Protocol are concerned with greenhouse gases not covered by the Montreal Protocol. Chlorofluorocarbons (CFCs) and hydro-chlorofluorocarbons (HCFCs) are also greenhouse gases but are being phased out under the Montréal Protocol.

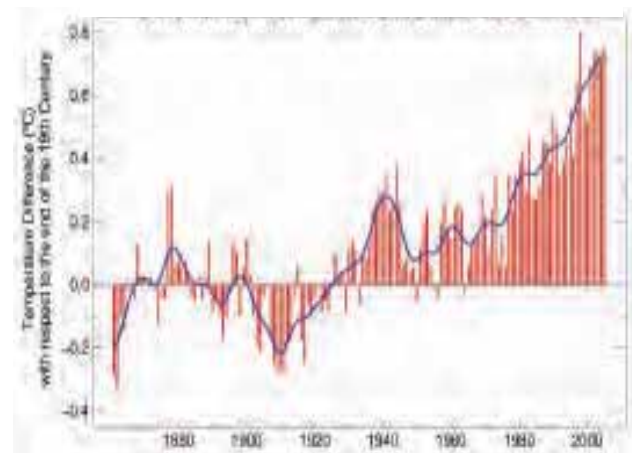
² GWP is defined as the warming influence of a gas over a set time period relative to that of carbon dioxide. The GWP values used for calculating national greenhouse gas emissions totals are from IPCC's Second Assessment Report and differ slightly from the values shown in Table 1 – see Annex H.

What is climate change and why does it matter?

Historical CO₂ concentrations



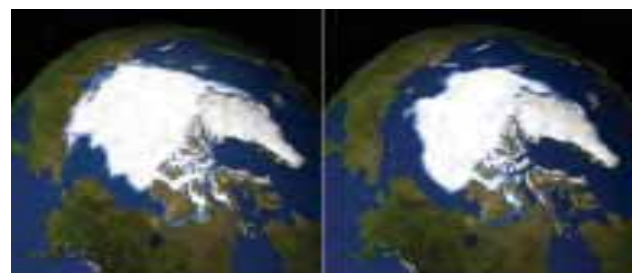
Global average near surface temperatures (1861-2005)



Historic trends and observed changes

7. The global temperature record indicates that the earth has warmed by about 0.7°C since the beginning of the last century. All of the ten warmest years on record since 1861 have occurred since the beginning of the 1990s and the last ten years have seen nine of the ten warmest years on record with only 1996 not making the top ten. 1998 was the warmest year on record and 2005 was almost as warm.
8. How much of this change in temperature can be attributed to human activities is studied using complex climate models which show a characteristic fingerprint (spatial and temporal response) of the pattern of change due to increasing greenhouse gas concentrations. This suggests that at least half of the increase since 1900 has been caused by human activities, with the remainder likely due to natural variations, including changes in the sun's output and volcanic eruptions. Most of the warming over the past 50 years is likely to have been caused by human activities.

9. The area of snow cover in the Northern Hemisphere has decreased by 10 per cent since the 1960s and there has been a significant retreat of glaciers in most regions of the world. Large areas of ice shelves in the Antarctic Peninsula have broken off in recent years. Arctic sea-ice has thinned by up to 40 per cent in recent decades in late-summer and has decreased in extent in late-summer by 15 per cent since the 1950s. Latest estimates indicate a decline in Arctic sea ice area of about 8 per cent in the last decade alone. The melting of sea-ice does not affect sea levels (as it already displaces its own weight of water) but the loss of ice shelves may hasten the flow of land ice to the ocean and consequently add to sea level rise.



What is climate change and why does it matter?

10. Sea level has risen by 1 to 2 mm per year during the 20th century, mainly as a result of thermal expansion of the oceans and melting of glaciers. Sea levels will continue to rise for several centuries after greenhouse gas concentrations in the atmosphere are stabilised because of the very large thermal inertia of the oceans.
11. The ranges of many plant and animal species have shifted pole-ward and to higher altitudes in recent decades. Plant flowering, the arrival of migrating birds, the onset of some bird breeding seasons and the emergence of insects have all been observed to occur earlier across much of the middle and high latitudes of the Northern Hemisphere. In several regions insect and pest species are now over-wintering more easily.
12. Coral reef bleaching has increased globally. This is caused by unusually high sea surface temperatures. We are also beginning to see an increase in ocean acidity as more CO₂ is absorbed by the ocean. This could have serious impacts on marine organisms and reduce the oceans' ability to absorb carbon dioxide from the atmosphere.
13. There is strong evidence of increases in storm and heat-wave frequency in many parts of the world and, most importantly, a significant decrease in cold weather snaps in high and mid-latitudes, including in Britain.

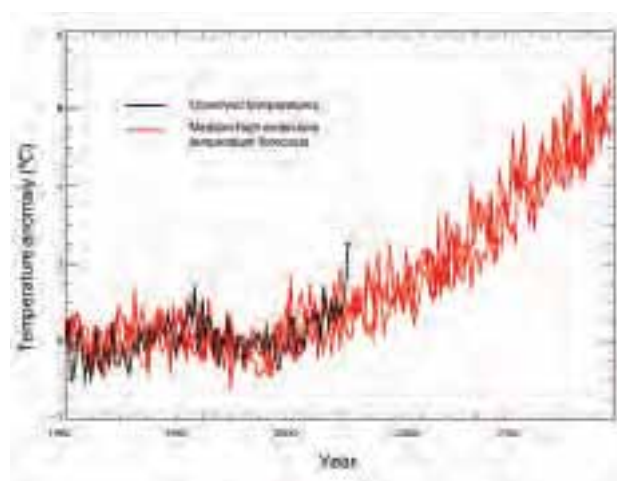
For example:

- in the Arctic, temperatures have risen by up to twice the global average since the mid-1970s;
- Alaska has warmed especially quickly in the last two decades, with dramatic impacts on the environment, plants and animals and human societies; and
- across Europe, several dramatic floods have hit the headlines during the last decade. Possibly the hottest summer in a thousand years in Europe killed more than 35,000 people in 2003 and set a new UK record high temperature (38.5°C near Faversham in Kent on 10 August). A study shows that a summer of such exceptional warmth was twice as

likely to occur due to the presence of increased levels of greenhouse gases and that by the middle of this century such a summer may occur every two or three years.

14. Some exceptional tropical storm activity has been observed in recent years. In 2005 in the Atlantic sector there were an unprecedented number of hurricanes stretching over a very long season, leading to speculation that global warming is responsible. Recent studies provide some evidence that tropical storms are becoming more intense and that this is related to rising sea surface temperature. But many factors influence tropical storm formation and the scientific community is still analysing the possible linkage with climate change.

Projected European summer temperatures through this century

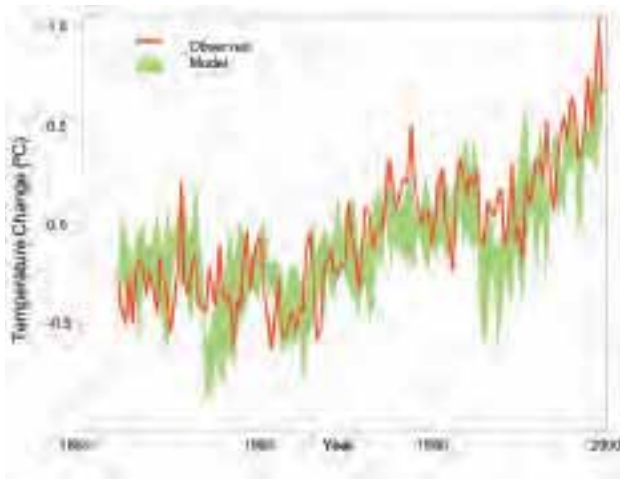


What is climate change and why does it matter?

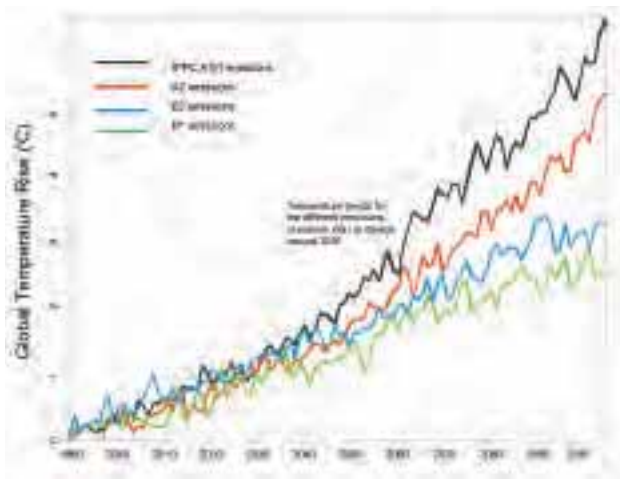
How the climate may change in the future

15. Complex computer models are used to simulate global and regional climates of the past, present and future. The first graph below shows observed global temperature change between 1861 and 2000 (black curve) as well as a simulation of global temperature change back into the 19th century from the latest climate change model developed by the Met Office's Hadley Centre (red curve). The second graph shows four simulations into the future using the same model and based on four emissions scenarios of the Intergovernmental Panel on Climate Change (IPCC). Each shows a continuing global temperature rise until the end of this century.

Recent warming can be simulated when man-made factors are included



Predicted warming due to range of IPCC emissions



Intergovernmental Panel on Climate Change (IPCC)

Recognising the need for a scientific assessment, the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change in 1988.

The role of the IPCC is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation.

The IPCC does not carry out research. It bases its assessments on peer reviewed and published scientific/technical literature. Since its establishment the IPCC has produced a series of publications which have become standard works of reference.

The main products are Assessment Reports, Special Reports, Methodology Reports and Technical Papers. Each assessment includes a Summary for Policymakers published in all official UN languages. IPCC's next major assessment, the Fourth Assessment Report on climate change, is currently under preparation and will be published during 2007.

The UK considers that the assessments of the IPCC provide the most authoritative and comprehensive picture of all aspects of climate change. UK scientist Professor Martin Parry co-chairs Working Group II on impacts, adaptation and vulnerability. The Government funds a technical unit, which supports him in this role.

Abrupt and dangerous climate change

16. As global temperatures continue to increase, the risks of abrupt and possibly irreversible changes that would have serious consequences are

What is climate change and why does it matter?

increasing. These include substantial melting of polar ice sheets like those of Greenland and West Antarctica, which would cause an additional sea level rise of up to 12 metres, reduction in the strength of the North Atlantic ocean currents, which could cause significant cooling in the North Atlantic and Europe region, and increased methane emissions following melting of permafrost or destabilisation of the large quantities of methane hydrates deposited in the oceans depths along continental margins.

17. Important questions are how the current upward trend in greenhouse gas emissions can be halted and how their atmospheric concentrations can ultimately be stabilised at a level which avoids these and other potentially dangerous changes; in the mid-1990s the EU proposed that the aim should be to limit global temperature rise to no more than 2°C to avoid dangerous climate change.
18. At that time, it was thought that this equated to atmospheric carbon dioxide levels below approximately 550 ppm. The more recent work of the IPCC suggests that a limit closer to 450 ppm or even lower, might be more appropriate to meet a 2°C stabilisation limit. Since pre-industrial times we have already seen a rise from 270 to about 380 ppm adding urgency to need for action to reduce emissions sufficiently to avoid "dangerous levels" of climate change.
19. In order to encourage scientific debate on this issue, the UK Government hosted an International Symposium on Stabilisation of Greenhouse Gases, *"Avoiding Dangerous Climate Change"*³ in February 2005 at the Met Office, Exeter. The conference brought together over 200 experts from some 30 countries. Issues including the long-term implications of different levels of climate change for different sectors and the world as a whole were considered. Major themes included:
 - key vulnerabilities of the climate system and critical thresholds;
 - socio-economic effects, both globally and regionally; and

- emission pathways to climate stabilisation and technological options available to achieve them.

20. The conference findings were published by Cambridge University Press in January 2006⁴. The conference concluded that climate change looks to be worse than expected, that we need to act urgently to avoid considerable risks and that the long term costs of mitigation are small and less than previously stated.

How the world might be affected

21. As a result of past and present emissions, some degree of climate change is now inevitable. Global temperature is now increasing at 0.17°C per decade, and is projected by the IPCC to be between 1.4 and 5.8°C above 1990 levels in 2100. Sea levels could be between 9 and 88 centimetres above 1990 levels by 2100. As temperature continues to increase the frequency of droughts and extreme rainfalls are also expected to increase with a wide range of impacts on both the natural environment and human society. The table below summarises some of the key impacts that are predicted to become significant at different levels of temperature change.

Temperature increase above pre-industrial	Impacts
1-2°C	Major impacts on ecosystems and species; wide ranging impacts on society
2-3°C	Greenland ice cap starts to melt, major loss of coral reef ecosystem; considerable species loss; large impacts on agriculture; water resources; health; and economies. Terrestrial carbon sink could become a source
1-4°C	North Atlantic circulation at increasing risk of collapse
2-4.5°C	West Antarctic ice sheet at increasing risk of collapse

³ Further information can be found at: www.stabilisation2005.com

⁴ "Avoiding Dangerous Climate Change", Cambridge University Press, January 2006.

What is climate change and why does it matter?

22. As the table shows, even seemingly small increases in temperature can have significant impacts on ecosystems and species, lead to increasing drought and extreme rainfalls and imply severe consequences for our society. The extent to which future climate change will affect human society and ecosystems across the world will vary greatly from place to place. The most vulnerable communities in developing countries are likely to be affected more severely and will be least able to cope. Changes in rainfall and drought patterns and storm intensities are likely to lead to further millions at risk from drought, famine and disease. Increases in sea level of almost a metre over the next 100 years bear potentially devastating consequences for many coastal areas and low-lying small island states. Disruption of key components of the climate system, such as the ice sheets and ocean currents could have far reaching consequences but it is very difficult to predict what level of climate change might trigger such changes.

The economic costs of climate change damage

23. Increasing attention is being placed on assessing the economic costs of climate change as it is clear that extreme weather can have considerable economic effects. For example, the damage costs from Hurricane Katrina alone are estimated at about \$135 billion⁵. A measure for assessing the potential economic damage costs of climate change is the social cost of carbon (SCC). The social cost of carbon is the global marginal damage costs of carbon emissions – in common language the damage done to the world economy by every new tonne of emissions (carbon dioxide or equivalent) added to the atmosphere. Although estimates differ considerably, the SCC can provide illustrative monetary benchmarks for valuing changes in emissions in cost-benefit analyses.

Social Cost of Carbon

The analytical work in support of the UK Climate Change Programme included an element of cost-benefit analysis that valued reductions in emissions using estimates from the Government Economic Service (GES) Working paper *Estimating the Social Cost of Carbon Emissions*, which was published in 2002.

The paper suggested a central value of £70/tC (within a range of £35 to £140/tC) as an illustrative estimate for the global damage cost of carbon emissions. It also suggested that these estimates should increase by £1/tC per year in real terms, to reflect the increasing damage costs of carbon emissions over time. Finally the GES paper recommended periodic reviews of the illustrative figures as new evidence became available.

In 2004, the Inter-departmental Group on the social cost of carbon (IGSCC) commissioned further research on the issue. Two research reports, *Social cost of carbon: a closer look at uncertainty*⁶ by the Stockholm Environment Institute, and *Methodological Approaches for Using Social Cost of Carbon Estimates in Policy Assessment*⁷ by AEA Technology Environment have been published by Defra.

Both reports will provide relevant input into the **Review of the Economics of Climate Change, led by Sir Nick Stern**, which as part of its terms of reference is considering evidence on the economic, social and environmental consequences of climate change, including extreme events. Overall, the evidence gathered by the research reports indicates a comparable range of estimates to those currently recommended in the GES paper including the risk of higher values at the top end of the range. The Government will consider whether any revision of the current advice is necessary once the review has reported in the autumn 2006.

⁵ Swiss Re Sigma Report No 2/2006 – Natural catastrophes and man-made disasters 2005: high earthquake casualties, new dimension in windstorm losses, available from: www.swissre.com

⁶ www.defra.gov.uk/environment/climatechange/carboncost/sei-scc.htm

⁷ www.defra.gov.uk/environment/climatechange/carboncost/aeat-scc.htm

The UK Government will:

- **build on the progress made at the G8 Summit in Gleneagles and the Montréal Climate Change Conference to strengthen the international regime to tackle climate change;**
- **in partnership with the EU enhance our efforts to help India, China and other developing countries evolve as low-carbon economies;**
- **work to build international consensus on the scale of global action needed to stabilise the climate and avoid dangerous climate change;**
- **work with EU partners to secure agreement to further action in the EU, in particular strengthening the Emissions Trading Scheme beyond 2012 and making it the heart of a global carbon market; and**
- **support international collaboration and coordination to ensure the successful expansion of new technologies, through action in key areas such as product standards and research development.**

1. Climate change is a global problem, with global causes and effects. Preventing dangerous man-made climate change and dealing with the impacts that cannot now be avoided requires efforts by all countries, consistent with their responsibility for greenhouse gas emissions, their capacity to take action, and the effects they will experience. In 2003, the UK contributed about 2 per cent of world greenhouse gas emissions. Our contribution will fall as we move towards a low-carbon economy, and as the increasing demand for energy in developing countries continues to be met. By 2020 our net contribution to world emissions from fossil fuels will be 1.5 per cent or lower. For that reason the Government considers it essential that the UK and our EU partners give high priority to reaching and implementing international agreements to tackle climate change.

The UNFCCC

2. In recognition of the global nature of the problem, the United Nations Framework Convention on Climate Change (UNFCCC) was agreed at the Earth Summit in Rio de Janeiro in 1992. To date 189 countries, including all major developed and developing countries, have ratified the Convention. The UNFCCC sets the overarching objective for multilateral action: to stabilise greenhouse gas concentrations in the atmosphere at a level that avoids dangerous anthropogenic climate change. It also establishes key principles to guide the international response, in particular that countries should act consistently with their responsibility for climate change as well as their capacity to do so, and that developed countries should take the lead, given their historical contribution to greenhouse gas emissions and the economic development they have enjoyed as a result. The Convention places a commitment to act on all countries but whereas for developing countries this is unquantified and linked to assistance from developed countries, the developed countries agreed specifically to aim to return greenhouse gas emissions to 1990 levels by 2000. The UK was one of relatively few countries that achieved this, with emissions in 2000 about 13.6 per cent below the 1990 level⁸.

The Kyoto Protocol

3. The Parties quickly acknowledged that the Convention commitments could form only a first step in the international community's response to climate change. The Kyoto Protocol, agreed in December 1997, sought to address this. Developed countries agreed to reduce their overall emissions of a basket of six greenhouse gases by 5.2 per cent below 1990 levels over the period 2008-2012, with differentiated, legally binding targets. The then 15 EU Member States adopted a collective target to reduce EU emissions by 8 per cent. Under this 'bubble' arrangement the EU's target is distributed between Member States to reflect their national circumstances, requirements for economic

⁸ 13.6 per cent is the fall in all emissions minus all removals between 1990 and 2000. Emissions of Kyoto basket fell by an estimated 13.8 per cent between the base year and 2000.

International framework for action

growth, and scope for further emissions reductions. Each Member State has a legally binding target, with the UK undertaking to reduce its emissions by 12.5 per cent.

4. The Protocol also established the innovative flexible mechanisms to assist in meeting Kyoto targets in the most efficient and cost-effective manner. This recognises that as greenhouse gases are emitted into the atmosphere they will contribute to global increases in temperature, regardless of the source, and that equally it does not matter where reductions are made provided that they are real reductions. The Kyoto mechanisms are international emissions trading and two mechanisms, Joint Implementation (JI) and the Clean Development Mechanism (CDM), by which credits from emission reducing projects in one country can be used to meet the Kyoto target of another country. Under JI, projects can be hosted in developed countries, and under CDM, in developing countries.
5. The Kyoto Protocol entered into force in February 2005 and to date has been ratified by 162 countries. Uncertainty about entry into force of the Kyoto Protocol led to a loss of momentum in international action and a slow start to the international carbon market. Crucially, it also undermined international political will to address the increasingly urgent question of what further action would be taken by countries beyond the first set of Kyoto targets that expire at the end of 2012.

Progress in 2005

6. It was against this background that the Prime Minister put climate change on the international political agenda in 2005 by making it a priority for the UK's Presidencies of the G8 and EU. The effect was to put a strong public and political spotlight on climate change and encourage unprecedented international debate by government ministers, scientists, parliamentarians, businesses, non-governmental organisations and other areas of civil society.

7. At their Summit at Gleneagles in July 2005 the G8 leaders agreed that climate change was a serious and long-term challenge, that it was caused by human activity and that urgent action should be taken to make significant reductions in greenhouse gas emissions – a significant statement from countries that had not previously committed themselves to the case for urgency so publicly. They also agreed on a package of actions to combat climate change⁹.

The G8 Gleneagles Plan of Action aims to increase the speed with which we reduce greenhouse gas emissions. It includes improvements to energy efficiency in both appliances and buildings, cleaner vehicles, aviation, work on developing cleaner fuels, renewable energy and promoting research & development and the financing of future projects. The World Bank and the International Energy Agency (IEA) are playing an important role in supporting the Action Plan. The World Bank is working to create a framework for investment in cleaner energy technologies and in measures necessary for adaptation, involving the private sector and the regional development banks. The IEA is analysing alternative energy strategies and supporting work on best practice in energy efficiency and cleaner coal technologies.

8. In addition, G8 leaders agreed, with the leaders of the other countries invited to attend the Summit (China, India, Brazil, South Africa and Mexico), to launch a new *Dialogue* on "climate change, clean energy and sustainable development".

⁹ www.fco.gov.uk/Files/kfile/PostG8_Gleneagles_Communique,0.pdf

International framework for action

The Gleneagles Dialogue on Climate Change, Clean Energy and Sustainable Development aims to provide a forum for continuing discussions amongst the G8, China, India, Brazil, South Africa, Mexico, and other countries with significant energy needs. It enables participating countries to work together on the shared challenges of addressing climate change, energy security and access to energy.

The Dialogue complements the work of the UNFCCC and existing organisations, partnerships and initiatives by providing an informal space to explore these issues away from the negotiating room. The Dialogue will also oversee implementation of the G8 Action Plan. The Dialogue will report back to G8 leaders under the Japanese G8 Presidency in 2008.

The first Ministerial meeting of the Dialogue was held on 1 November 2005 in London. The Dialogue Partners agreed to work together on: the deployment of clean technologies; incentives for investment in low carbon technologies; co-operation between developed and developing countries; and action on adapting to the impacts of climate change. The next Ministerial meeting will be hosted by the Government of Mexico in 2006.

9. Twelve months of intense focus and political discussion on climate change culminated in December 2005 at the Montreal UN Climate Change Conference in a significant set of important decisions to strengthen international action. The Parties to the Kyoto Protocol, at their historic first meeting, adopted the operating rules and the compliance provisions needed to ensure that the Protocol and its mechanisms could function effectively. They also agreed to launch negotiations on further emissions reductions by developed country Parties for the period beyond 2012 and to begin preparation for a broader review of the Protocol at the end of 2006. The Convention Parties, including the USA and Australia, agreed to launch a dialogue on long term cooperative action to enhance implementation of the Convention, focusing on

promoting sustainable development, adaptation, and realising the potential of technology and of markets, as well as a five-year work programme on adaptation to the effects of climate change. The first discussions following up these decisions will take place in May 2006.

Next steps

10. The intensive discussions on climate change in 2005 have focused attention on the scale and urgency of the challenge, based on the compelling scientific evidence, and the actions needed to tackle it successfully and meet the objective of the UN Convention which all countries are committed to work towards. There is no longer any real debate over the fact that climate change is happening and that man-made emissions are the main cause. The debate has shifted to how much we need to do to stabilise the climate, and the economic implications.
11. The IEA projects that \$17 trillion of investment is needed globally by 2030 in energy infrastructure and that carbon dioxide emissions could increase by more than 60 per cent over current levels by 2030. It is therefore clear that international efforts must be urgently directed towards more effective ways to drive uptake of existing lower carbon technologies as well as the research, development and deployment of new ones. The huge investment in energy systems in the emerging economies like China and India, and the long lifetime of such investments, makes it essential to ensure that these countries have access to the most efficient, lowest carbon technologies and that international financial institutions take full account of climate change in their investment decisions to enable them to continue to grow sustainably. The significant role of the private sector alongside governments creates a need to incentivise both private and public choices of lower carbon technologies. And the fact that a certain degree of climate change is now inevitable and its consequences are already being felt means that more urgent and effective support to poor and vulnerable countries is needed to cope with the impacts,

harnessing the efforts of the many bodies engaged in development.

12. The Government will therefore continue to show leadership in 2006 and beyond in maintaining the high international political profile of climate change as countries consider the further action needed. We will be working for speedy progress in multilateral discussions in the UNFCCC and also in associated fora such as the Commission on Sustainable Development (CSD), which is currently working on climate change and associated topics¹⁰. The UNFCCC is the only forum in which binding international agreements on emissions reductions can be made, and binding agreements will be needed to underpin political and market confidence. But other organisations, informal discussions and partnerships will also have an essential complementary role in exploring how countries can work together, sharing experience and building political will and confidence. We will work with G8 partners, particularly the Russian G8 Presidency in 2006 and the subsequent German and Japanese Presidencies, to deliver on the commitments in the G8 Action Plan and build on the agreement reached at Gleneagles. The Government believes that the Gleneagles Dialogue will be able to make an important contribution to accelerating international progress in tackling climate change.

13. The Government also believes that a high priority for driving action on the scale and with the urgency needed to deliver a long term shift towards a global low-carbon economy is for governments to give an early signal about the long term direction of policy that is sufficiently clear to drive investment decisions. Without that there will be insufficient confidence among business and in the fledgling carbon market. The Government therefore believes that the political debate in 2006 should focus in particular on building consensus on the scale of action needed to stabilise the climate and avoid dangerous climate change, the costs and benefits of taking such action and the long term signals that are needed to drive it.

14. A key element of the international debate will be how countries can develop sound, effective and timely responses to climate change whilst maintaining the health of their economies and their competitiveness. It will be important to engage economic policymakers and institutions in this. The Review of the Economics of Climate Change, within the context of existing national and international climate change policy, will help the Government to understand more comprehensively the nature of the economic challenges and how they can be met, in the UK and globally.

UK bilateral co-operation on climate change

15. The UK works bilaterally in partnership with a number of countries on both mitigation and adaptation measures in order to build understanding of the urgency of tackling climate change and possible solutions. In 2004, the UK and China agreed to establish a bilateral working group on climate change. Defra has been working with the Chinese Ministry of Science and Technology since 2001 on the impacts on agriculture in China. The first phase was a research project on the impacts of climate change on four key agricultural crops – cotton, rice, wheat and maize. The second phase, launched in September 2005, consists of national and regional components taking forward the earlier work and will explore the effect of climate change on water availability and the impact of this on projected crop yields. The UK also supports activities to accelerate the deployment of renewable energy and improve energy efficiency in China, primarily through the Renewable Energy and Energy Efficiency Partnership (REEEP).

¹⁰CSD's second implementation cycle focuses on climate change, energy for sustainable development, industrial development, and air pollution/atmosphere.

International framework for action

REEEP is a public-private partnership that was launched by the United Kingdom along with other partners at the Johannesburg World Summit on Sustainable Development in August 2002. It has been developed via an intensive consultation process in 2003 covering a wide range of stakeholders at the national and regional levels.

In June 2004, REEEP was formally established as a legal entity in Austria with the status of an International NGO. The partnership actively structures policy initiatives for clean energy markets and facilitates financing mechanisms for sustainable energy projects.

16. In 2005 the UK and India announced the intention for a structured dialogue on climate change. A number of activities have since been taken forward. In November 2005, the UK and India announced the launch of a joint study on how to reinforce co-operation on energy technology between developed and developing countries. The study will look to address concerns over barriers to technology transfer and in particular the issue of Intellectual Property Rights (IPR). Defra also funded a collaborative project with the Indian Ministry of Environment and Forests involving eight Indian research institutions that looked into the effects of climate change in India. The results were reported in September 2005, and a second phase of the project is under development. India hosts the South Asia Regional Secretariat for REEEP, and through REEEP the UK is funding initiatives to promote the acceleration of renewable energy and improvement of energy efficiency in India.
17. March 2006 saw the launch of the UK-Brazil working group on climate change, which focuses on the promotion of low-carbon technology globally, improved scientific collaboration on assessing the impacts of climate change and the further development of Brazil's leading role in the emerging Latin American carbon market. The working group will also examine the links between climate change, poverty eradication and social development.

18. At the G8 Environment and Development Ministers' meeting in March 2005, the UK announced funding of £100k towards regional predictions of climate change for Africa and £400k over the next three years towards a new multi-country initiative on advancing knowledge, capacity and networks in support of climate change in Africa.

European Union

19. Both the European Community and the individual Member States are Parties to the UN Convention and the Kyoto Protocol. The European Union has always taken a strong lead in pushing for global action to tackle climate change: the EU negotiates as a bloc, which gives it a powerful voice in the UN discussions, and the Commission and Member States work together to promote effective international action. In recent years the EU, as a major signatory of the Kyoto Protocol, has played a key role in keeping the UN climate change process on track through its determination to put in place measures to meet Kyoto targets, and in particular its pioneering activity on emissions trading. This commitment underpins the EU's influential position in formal and informal international discussions – including at the recent Montreal Conference, where the European Union, under the UK Presidency, played a leading role in securing agreement from all parties to discuss further international action.

European Climate Change Programme

20. Member States have agreed that European-level policies and measures are essential to help them deliver their Kyoto targets. Some measures can be delivered most effectively at Community level. In some sectors, for example, there is a strong, single market case for European action. Other measures could have little impact if taken at a national level or could harm the competitiveness of the industry in the Member State concerned. European-level co-ordination also gives Member States a valuable opportunity to share experience and expertise on action to reduce greenhouse gas emissions.

21. In 2000 the European Climate Change Programme (ECCP) was launched, to identify and develop the necessary elements of an EU strategy to implement the Kyoto Protocol. Between 2001 and 2003, a package of priority actions to tackle climate change was put in place, including the Directive setting up the EU emissions trading scheme¹¹, as well as Directives on the promotion of electricity from renewable energy sources¹², on the energy performance of buildings¹³, and on the promotion of biofuels¹⁴.
22. The EU's latest estimate of progress towards meeting its Kyoto target is that, as a result of measures in place or planned purchases of emissions credits, the EU is on track to lower projected emissions in 2010 by 9.3 per cent below base year levels¹⁵.

EU medium- and long-term strategy

23. Since 2004 the EU has been working to develop its strategy for the period beyond 2012, addressing both international and EU action for the medium and long term. The process is driven by EU leaders in the European Council, reflecting the fact that climate change is a major strategic challenge for the EU with implications for all sectors of the economy and requiring co-ordinated action to tackle both the causes and effects. The extent of the challenge and the possible responses were reflected in the European Commission's February 2005 Communication, *Winning the Battle Against Climate Change*.
24. In March 2005 the European Council moved the process forward significantly by identifying ambitious greenhouse gas emissions reductions pathways to be considered by developed countries, consistent with the EU's objective of limiting average global temperature increase to no more than 2°C above pre-industrial levels. EU leaders agreed that developed countries should consider emissions reductions in the order of 15-30 per cent by 2020 compared to 1990 levels. They also stressed that longer-term cuts were essential, consistent with EU Environment

Ministers' conclusion that reductions of the order of 60-80 per cent by 2050 should be considered. EU Heads of Government underlined the importance of the EU engaging with other countries both on strategies for achieving further emissions reductions and on options for further action within the UN framework.

25. Work is continuing to develop the medium and long term strategy. In October 2005 the Commission launched a new phase of the ECCP to consider further measures to contribute towards the EU's Kyoto Protocol target and beyond. This will include geological carbon capture and storage, passenger road transport, aviation, and non-carbon dioxide emissions. For the first time, the ECCP will also consider adaptation to the impacts of climate change. During the UK Presidency the Government put particular emphasis on the involvement in climate change policy development of Ministers covering all relevant policy areas, including energy, competitiveness and agriculture.
26. Under the UK's Presidency, climate change featured prominently in the EU's bilateral discussions with China and India at Head of Government level, with the successful agreement of the EU-China Partnership on climate change and the EU-India Initiative on clean development and climate change.

¹¹Directive 2003/87/EC.

¹²Directive 2001/77/EC.

¹³Directive 2002/91/EC.

¹⁴Directive 2003/30/EC.

¹⁵"Report on Demonstrable Progress under the Kyoto Protocol", December 2005 – www.europa.eu.int/comm/environment/climat/pdf/demonstrable_progress_kyoto_2005.pdf

International framework for action

In September 2005, EU summits with China and India resulted in an **EU-China Partnership on Climate Change** and an **EU-India Initiative on Clean Development and Climate Change**.

Through these initiatives the EU aims to scale up efforts for development, deployment and transfer of low carbon energy technologies as well as to increase co-operation on adaptation to climate change.

A centre-piece of the EU-China Partnership on Climate Change was a new initiative on Near-Zero Emissions Coal with carbon capture and storage. The UK is leading the first phase of the project, supporting it with £3.5m of funding. The three-year feasibility study will examine the viability of different technology options for the capture of carbon emissions from power generation and the potential for geological storage in China.

The EU-India Initiative on Clean Development and Climate Change aims to encourage and promote sustainable patterns of consumption and production to lessen the causes and the adverse impacts of climate change. India and the EU will also co-operate on improving adaptation to current climate variability and future climate change, and on one integration of adaptation concerns into sustainable development strategies.

strategy as an important signal of the EU's continuing determination to show leadership in shaping the international response to climate change, both through its own actions and by developing and sharing proposals for strengthening international action. To be effective, it will be essential for the EU's work on climate change and energy strategy development to be closely linked. The UK believes that a key priority for the EU is to give a firm signal about the medium and long term direction of EU policy to reduce greenhouse gas emissions and the continuing role of the EU emissions trading scheme in delivering emissions cuts beyond 2012. Without confidence in the EU's determination to move decisively towards a low-carbon economy, business investment in the technologies needed to deliver deep cuts in emissions will simply not take place. The UK also believes that the EU should expand its outreach to other countries, supported by Community resources such as the Country Strategy Programmes and Research Framework Programme, and building in particular on the EU-China and India partnerships. The EU should direct significant future resources towards supporting its internal and external climate change objectives, in particular on co-operation with developing countries on research and development, technology and capacity building.

The international carbon market

27. The EU-Russia Summit reaffirmed both parties' commitment to tackling climate change, and to the Kyoto Protocol and its effective implementation, and bolstered co-operation on energy and energy efficiency.
28. EU leaders in the European Council are expected to return to the issue of considering a medium and long-term strategy under the Finnish Presidency in the second half of 2006, when they will be able to reflect on further cost-benefit analysis by the Commission of action to reduce emissions, and on the outcome of the review of the ECCP.
29. The Government strongly supports the development of the EU's medium- and long-term
30. The Government believes that, by providing for emissions savings to be made at the point of least cost, emissions trading is the most promising mechanism for stimulating international investment in low-carbon technology. The Government has been a strong advocate of the EU emissions trading scheme since its inception. The UK Government has made it a priority to work with the European Commission on its review of the EU emissions trading scheme post-2012. Our policy for the second phase of the scheme is set out in the "Business" chapter in Section 2.
31. The EU Environment Council acknowledged in October 2005 that the scheme will remain an

essential instrument in the EU's medium and long term strategy to tackle climate change. The UK believes that the true potential for emissions trading to achieve global emissions reductions will only be delivered through the continued international extension of the carbon market outside Europe. Our international work on developing the Kyoto Protocol project mechanisms and promoting the use of emissions trading outside the EU recognises this as a priority.

32. Since the Kyoto Protocol was adopted, the UK has been active in developing the detailed rules and implementation of the project mechanisms of the Clean Development Mechanism (CDM) and Joint Implementation (JI). At the Montreal UN Climate Change Conference, the UK, holding the EU Presidency, played a key role in strengthening CDM institutions and procedures at UN level, establishing the framework for JI and the timetable for the deployment and linking of UN registry systems. Over \$8m in additional funding was agreed to fund CDM administrative activities this year.
33. Through the EU Linking Directive, companies with obligations under the EU emissions trading scheme can now make use of credits from these mechanisms, leading to increased investment in overseas projects aimed at reducing emissions of the basket of six greenhouse gases. The UK is a leading investor country in the CDM. By the end of February 2006, the UK was ranked second investor country in terms of number of registered projects with UK approval of participation. The UK designated national authority for CDM had issued 48 letters of approval of participation by 17 UK companies in 38 CDM projects in 11 countries. These are estimated to deliver annual reductions of up to almost 30 million tonnes carbon dioxide equivalent.
34. At the same time, the Government has also been active in promoting the development of domestic emissions trading schemes in countries outside Europe and the potential for establishing links between those schemes and the EU emissions trading scheme. Not only is the linking of trading

schemes consistent with a multilateral approach to dealing with climate change but successful linking will also lead to greater economic efficiency, as cost-effectiveness and liquidity increase with market size, and as clearer signals for investment emerge through the establishment of a single price of carbon across all linked schemes. During 2005, we have continued to exchange information with those developing emissions trading schemes outside the EU, including a successful event at the Montreal UN Climate Change Conference which reviewed the prospects for linking trading schemes and areas such as monitoring and reporting where the use of common standards might play a role. The Government considers that the international carbon market has a vital role to play in the future of climate change policy and will continue to prioritise further work in this area, which in time could lead to the emergence of a global network of linked trading schemes.

SECTION 2

Delivering emissions reductions

1. The Climate Change Programme is designed to deliver the UK's Kyoto Protocol target of reducing emissions of the basket of six greenhouse gases by 12.5 per cent below base year levels over the commitment period 2008-2012, and move the UK close to the domestic goal to reduce carbon dioxide emissions by 20 per cent below 1990 levels by 2010. It also aims to put the UK on a path to cutting carbon dioxide emissions by some 60 per cent by about 2050, with real progress by 2020.
2. This chapter includes information on historical trends of the UK's greenhouse gas emissions since 1990 and sets out projections to 2020. These projections are defined as baseline with measures. They include the ongoing impact of existing policies and the effect of measures that the Government has introduced since the Kyoto Protocol was agreed. The projections do not reflect the impact of the additional policies and measures set out in the remainder of this Section. The *Bringing it all together* chapter summarises the baseline with measures projections and the impact of additional policies and measures in order to estimate the total level of emissions reductions that the Programme is expected to deliver.

Base year

3. The base year for the purposes of assessing progress towards the Kyoto Protocol target is a combination of 1990 and 1995 data. 1990 is the base year for emissions of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). The UK has chosen to use 1995 as the base year for emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) in accordance with the Kyoto Protocol which allows Parties the flexibility to choose either 1990 or 1995 as the base year for the industrial gases. Using a 1995 base year is in line with the approach other EU Member States are adopting.

Convention and Kyoto accounting

4. The UK will report land use, and use change and forestry (LULUCF) emissions and removals in accordance with separate rules for reporting on this sector under the UNFCCC and the Kyoto Protocol. The Convention reporting basis includes all human-induced changes to land-based carbon stocks i.e. total emissions minus total removals from the LULUCF sector. This is consistent with the Intergovernmental Panel on Climate Change (IPCC) 1996 guidelines. It is on this basis that the Government assesses and reports progress towards the domestic carbon dioxide goal¹⁵.
5. The Kyoto reporting basis includes only LULUCF emissions and removals associated with mandatory activities under Article 3.3 of the Kyoto Protocol, which are afforestation, reforestation and deforestation occurring since 1990, and forest management as an elective activity under Article 3.4 of the Kyoto Protocol. The UK has decided not to account for cropland or grazing land management or revegetation which are other options under Article 3.4 because of the additional uncertainties associated with the detailed monitoring of these activities required under the Protocol. In addition, a small allowance related to deforestation emissions in 1990 is included in our base year estimate, as required by Article 3.7 of the Kyoto Protocol and subsequent decisions of the COP.

Greenhouse gas emissions inventory and trends

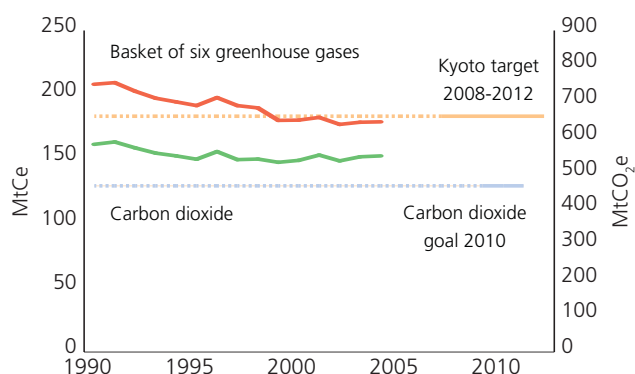
6. In 1990, the UK's emissions of the six greenhouse gases covered by the Kyoto Protocol were about 209 million tonnes of carbon (MtC)¹⁶. Action in the UK is already driving a significant reduction in emissions, with annual emissions falling by about 14.6 per cent between 1990 and 2004. Carbon dioxide emissions were 161.5 MtC in 1990 and fell by about 5.6 per cent between 1990 and 2004. Figure 1 shows emissions of carbon dioxide and the basket of all six greenhouse gases included in the Kyoto Protocol target, over the period 1990 to 2004.

¹⁵ The Government will also use any credits generated through the Kyoto mechanisms in its assessment of progress towards the domestic target.

¹⁶ Greenhouse gas emissions are expressed throughout this document as million tonnes of carbon equivalent (MtC). One tonne of carbon is contained in 3.67 tonnes of carbon dioxide which is the ratio of the molecular weight of carbon dioxide to the atomic weight of carbon (i.e. 44/12). Other gases are expressed in terms of carbon equivalent by multiplying their emissions by their global warming potential (GWP) and dividing by 3.67.

UK emissions inventory and projections

UK emissions of greenhouse gases 1990-2004



Source: UK greenhouse gas inventory 1990-2004

7. The reduction in greenhouse gas emissions since 1990 has mainly been driven by restructuring, especially in the energy supply industry; energy efficiency; pollution control measures in the industrial sector and other policies that reduced emissions of non-CO₂ greenhouse gases. Compared with what would have happened otherwise, it is estimated that greenhouse gas emissions in 2004 could have been some 15 per cent higher, rather than almost 15 per cent lower, than in the base year.
8. The total annual reduction of all greenhouse gases since the base year is therefore estimated at about 30 per cent of base year emissions or some 65 MtC in 2004. Of this it is estimated that:
 - improved energy efficiency represents about 35 per cent of the total reduction;
 - fall in non-CO₂ greenhouse gas emissions contributed about 30 per cent;
 - restructuring of the energy supply sector in the mid-1990s, with fuel switching from coal to gas, which led to an increase in the proportion of gas in the energy mix, contributed around 25 per cent; and
 - greater use of other lower carbon fuels, higher nuclear output, more renewable energy and other fuel switching, contributed around 10 per cent.

Carbon dioxide

9. Carbon dioxide is the main greenhouse gas in the UK. It contributed around 77 per cent of the UK's total emissions of greenhouse gases in 1990 or 161.5 MtC. The main driver behind the reduction in emissions between 1990 and 2004 comes from the power generation sector. While carbon dioxide emissions from power stations fell by 16 per cent¹⁷ between 1990 and 2004, electricity consumption increased by 17 per cent. The reason that emissions did not increase in line with electricity consumption was largely due to a switch from coal to gas in electricity generation, together with improved reliability and performance from nuclear generation. There have also been increases in the use of renewable energy and combined heat and power.
10. Carbon dioxide emissions presented here take into account carbon emission factor revisions that have been implemented since the consultation document for the review of the UK Climate Change Programme was published in December 2004¹⁸. Emission factor revisions affect the whole historical time series and the projections.

Methane

11. Methane is the second most important greenhouse gas in the UK after carbon dioxide. It contributed 12 per cent of the UK's total emissions of greenhouse gases in 1990 or 25.1 MtC. The major sources were landfill waste, agriculture, natural gas distribution and coal mining. Annual emissions fell by about 50 per cent below 1990 levels to 12.5 MtC in 2004. Emissions from all the main sources of methane in the UK have fallen since 1990.
12. Methane emissions from landfill sites have recently been revised upwards due to the revision of gas collection and oxidation efficiencies¹⁹. These revisions affect the whole historical time series and the projections.

¹⁷ This percentage excludes emissions of carbon from Flue Gas Desulphurisation (FGD) units fitted to UK power stations. In 2004 these emissions were 0.08 MtC.

¹⁸ www.defra.gov.uk/corporate/consult/ukccp-review/ccpreview-consult.pdf

¹⁹ UK Landfill Methane Emissions: Evaluation and Appraisal of Waste Policies and Projections to 2050, Golder Associates, November 2005.

Nitrous oxide

13. Emissions of nitrous oxide from the UK in 1990 were 18.6 MtC or 9 per cent of the UK's total greenhouse gas emissions. The major sources were agricultural soils and industrial processes, particularly fugitive emissions from adipic acid manufacture. Emissions from this source have now been reduced significantly due to the introduction of abatement technology in 1998. Nitrous oxide emissions from road transport have increased due to the rise in the number of petrol-fuelled motor vehicles fitted with three-way catalytic converters to reduce emissions of hydrocarbons, carbon monoxide and other nitrogen oxides (NO and NO₂). Annual emissions of nitrous oxide fell by 40.4 per cent below 1990 levels to 11.1 MtC in 2004.
14. Estimates of nitrous oxide emissions from agricultural soils are currently under review and may be revised in future. This is unlikely to have a significant effect on the overall trend in nitrous oxide emissions.

Fluorinated gases

15. Although emissions of the fluorinated or industrial gases are small in absolute terms, these gases generally have high global warming potentials (GWP)²⁰. Emissions of all fluorinated gases from the UK in 1995 (as indicated above, 1995 is the UK's base year for the fluorinated gases) were 4.7 MtC or 2.4 per cent of UK total greenhouse gas emissions in that year. Use of HFCs rose in the early to mid-1990s in response to the phase out of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) under the Montréal Protocol²¹ and accounted for 90 per cent of the total fluorinated basket in 1995. The major source in 1995 was fugitive emissions of

HFC-23 from the manufacture of the refrigerant and chemical feedstock, HCFC-22.

16. Emissions of HFCs have fallen by 42.8 per cent between 1995 and 2004, mainly due to the introduction of thermal oxidiser pollution abatement equipment at the two UK plants where HCFC-22 is manufactured. Emissions of PFCs have reduced by 25.2 per cent between 1995 and 2004. This is mainly due to the introduction of improved technology in the aluminium production sector that has led to lower process emissions. SF₆ is used in four main markets: electrical insulation, magnesium smelting, electronics and training shoes. Total use of SF₆ has decreased from these end use markets by 9 per cent between 1995 and 2004.

Projections of UK greenhouse gas emissions

17. Even without the additional measures included in the Programme, the UK's emissions of the basket of six greenhouse gases are expected to be about 19.4 per cent²² below base year levels in 2010. The UK is therefore on track to meet its Kyoto Protocol target. Emissions by sources minus removals by sinks of carbon dioxide are projected without additional measures to be about 10.6 per cent below 1990 levels in 2010. This means further effort is required to move the UK closer to its domestic goal to reduce carbon dioxide emissions by 20 per cent below 1990 levels by 2010.
18. Tables in this Section show historical greenhouse gas emissions data and baseline with measures projections classified in three different ways – by gas, by sector and by end user. The first table includes historical greenhouse gas emissions for the UK's base year, 1990, 1995, 2000 and 2004 and baseline with measures projections for 2010, 2015 and 2020, disaggregated by gas²³. The

²⁰ Global warming potentials are used by Parties to the UNFCCC to compare the relative climate effects of greenhouse gases by assessing their contribution to changes in the net downward infrared radiation flux at the tropopause (the top of the lower atmosphere) over a period of time. GWP provides the contribution of a unit emission of a greenhouse gas relative to the effect of a unit emission of carbon dioxide integrated over a fixed time period. A 100-year time horizon has been chosen by the Convention in view of the relatively long time scale for addressing climate change.

²¹ www.ozone.unep.org/Treaties_and_Ratification/2B_montreal_protocol.asp

²² This figure includes the effect of the mandatory Art 3.3 ARD activities and the Forest Management 'cap' in the LULUCF sector in accordance with the choices that the UK has made under Art 3.4.

²³ CO₂ energy projections are based on the greenhouse gas inventory published in 2005 which agrees with the inventory published in January 2006 to about 0.01 per cent for total CO₂ emissions on average over the period 1990 to 2003, with individual years differing by up to about 0.4 per cent. The energy projections will be updated to be based on the 2006. Other projections have already been updated for consistency with this inventory.

UK emissions inventory and projections

historical time series of emissions set out in this Programme is based on the UK greenhouse gas inventory published in 2006 covering the period 1990 to 2004²⁴. The methodologies used to generate the projections are described in Annex A and the uncertainties associated with the projections are set out by gas in Annexes B-E.

19. The calculation of the UK's base year for reporting under the Kyoto Protocol includes a small allowance representing emissions from Deforestation in 1990. This allowance (0.1 MtC/year in 1990) is calculated in accordance with rules associated with Article 3.7 of the Kyoto Protocol and forms part of a Party's assessment of progress towards meeting its Kyoto target.
20. The same historical data and baseline with measures projections from Table 1 are set out in Table 2, grouped by sectors consistent with the UNFCCC's reporting guidelines²⁵. Table 2 shows how historical and projected greenhouse gas

emissions are distributed across the UK economy. In this classification, the emissions from the energy supply sector which includes emissions from power stations, refineries and other energy supply industries are shown separately.

21. Table 3 shows another way of looking at how historical and projected greenhouse gas emissions are distributed across the UK economy. In this classification, the emissions from power stations, refineries and other energy supply industries are re-allocated to the end users of the electricity, petroleum products and other fuels. There is therefore no separate line for the energy supply industry. This classification gives the most complete account of the relationship between emissions and the production of goods and services. It is called the end user classification.
22. Tables 4 and 5 show emissions of carbon dioxide by source and by end user respectively, grouped by sector

Table 1: UK greenhouse gas emissions, MtC

Gas	Base Year	1990	1995	2000	2004	2010	2015	2020
Total carbon dioxide ²⁶	161.5	161.5	149.9	149.0	152.5	144.3	149.0	146.6
Methane	25.1	25.1	21.8	16.3	12.5	10.8	10.0	9.5
Nitrous oxide	18.6	18.6	15.5	12.1	11.1	11.0	11.0	11.0
Hydrofluorocarbons	4.2	3.1	4.2	2.5	2.4	2.7	2.6	2.5
Perfluorocarbons	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.1
Sulphur hexafluoride	0.3	0.3	0.3	0.5	0.3	0.4	0.3	0.3
Total greenhouse gas emissions ²⁷	209.9	209.0	191.9	180.5	178.9	169.2	173.0	170.0
Total greenhouse gas emissions including only mandatory Art 3.3 LULUCF activities ²⁸	209.5	208.2	191.6	180.3	179.0	168.9	172.1	168.5
Change from base year levels (for row above)		-0.6%	-8.5%	-13.9%	-14.6%	-19.4%	-17.9%	-19.6%

Note: the percentage changes and emission estimates may differ slightly due to rounding

²⁴ UK Greenhouse Gas Inventory, 1990 to 2004, only data tables available at present. Full report will be available later in 2006 at www.naei.co.uk/reports.php.

²⁵ Guidelines for the preparation of national communications by Parties included in Annex I to the Convention FCCC/CP/1999/7 (UNFCCC, 2000).

²⁶ Total emissions by sources minus total removals by sinks.

²⁷ Does not include emissions from Overseas Territories or Crown Dependencies

²⁸ Totals for assessing progress with Kyoto Protocol commitments include the forest management cap of 0.37 MtC agreed for the UK under Art 3.4 of the Kyoto Protocol and emissions from UK overseas territories to whom the UK's instruments of ratification of the Kyoto Protocol are being extended.

UK emissions inventory and projections

Table 2: Greenhouse gas emissions by source, MtC

Sector	Base year	1990	1995	2000	2004	2010	2015	2020
Energy supply	74.4	74.4	63.1	58.2	61.4	56.2	56.0	51.1
Business	58.4	57.5	52.5	43.8	38.7	38.0	39.8	40.4
Transport	34.1	34.1	34.3	36.0	37.4	38.6	40.1	40.7
Domestic	22.3	22.2	22.5	24.6	25.3	21.8	22.0	22.2
Agriculture, forestry and land management	17.0	17.0	15.9	14.7	13.2	11.5	12.1	12.6
Public	3.7	3.7	3.6	3.2	2.9	3.0	3.1	3.2
Total emissions by sources minus total removals by sinks	209.9	209.0	191.9	180.5	178.9	169.2	173.0	170.0

Note: the percentage changes and emission estimates may differ slightly due to rounding

Table 3: Greenhouse gas emissions by end user, MtC

Sector	Base year	1990	1995	2000	2004	2010	2015	2020
Business	97.2	96.4	84.7	74.1	70.3	65.2	66.3	66.0
Transport	40.2	40.2	41.2	42.6	45.0	46.5	47.5	47.2
Domestic	45.9	45.8	41.7	42.1	43.7	38.6	39.9	37.7
Agriculture, forestry and land management	18.0	18.0	16.8	15.4	14.0	12.3	12.8	13.1
Public	8.5	8.5	7.7	6.3	5.9	6.5	6.6	6.0
Total emissions by sources minus total removals by sinks	209.9	209.0	191.9	180.5	178.9	169.2	173.0	170.0

Note: the percentage changes and emission estimates may differ slightly due to rounding

Table 4: Carbon dioxide emissions by source, MtC

Sector	1990	1995	2000	2004	2010	2015	2020
Energy supply	66.1	56.6	53.7	58.0	53.4	53.7	49.1
Business	34.3	32.5	32.4	30.6	30.1	32.3	33.2
Transport	33.5	33.4	34.7	35.8	37.0	38.3	38.8
Domestic	21.7	22.1	23.8	24.4	20.8	21.0	21.2
Agriculture, forestry and land management	2.2	1.7	1.2	0.7	0.0	0.6	1.1
Public	3.7	3.6	3.2	2.9	3.0	3.1	3.1
Total emissions by sources minus total removals by sinks	161.5	149.9	149.0	152.5	144.3	149.0	146.6

Note: the percentage changes and emission estimates may differ slightly due to rounding

Table 5: Carbon dioxide emissions by end user, MtC

Sector	1990	1995	2000	2004	2010	2015	2020
Business ²⁹	68.8	61.2	60.3	60.5	56.4	58.0	58.1
Transport	39.2	39.8	40.9	43.1	44.8	45.7	45.3
Domestic	42.4	39.1	39.8	41.7	36.5	38.0	36.0
Agriculture, forestry and land management	3.2	2.5	1.9	1.5	0.7	1.3	1.7
Public	7.9	7.2	6.1	5.7	5.9	6.0	5.5
Total emissions by sources minus total removals by sinks	161.5	149.9	149.0	152.5	144.3	149.0	146.6

Note: the percentage changes and emission estimates may differ slightly due to rounding

²⁹ Includes the category 'exports' which includes emissions occurring within the UK from producing fuels (for example from a refinery or coal mine) which are subsequently exported or sent to bunkers for use outside the UK. These emissions are properly part of the UK inventory even if the use of the fuel occurs outside the UK.

UK emissions inventory and projections

23. The baseline with measures projections in the tables include the emission reductions expected from existing measures such as the climate change levy. They also include the effect of policies introduced since the Climate Change Programme was published in 2000, such as the climate change agreements, the UK emissions trading scheme and the Energy Efficiency Commitment.
24. The impact of these policies on greenhouse gas emissions in 2010 and 2015 has been re-evaluated and quantified wherever possible. The analytical work was undertaken by the Interdepartmental Analysts Group (IAG) following the consultation on the review of the 2000 Climate Change Programme initiated in December 2004. The analytical work is summarised in the documents setting out respectively the basis for the analysis, the re-evaluation of existing policies, and the appraisal of new policies³⁰. The review of the 2000 Programme focused mainly on policies to reduce carbon dioxide emissions because of the significance for the UK's domestic goal and because non-CO₂ policies are generally described in the separate work commissioned by Defra on non-CO₂ projections³¹. The *Bringing it all together* chapter sets out the estimated carbon savings that existing measures are now expected to deliver.

³⁰ Will be available at www.defra.gov.uk

³¹ Non-CO₂ projections report by Entec will be available at www.defra.gov.uk

Strategy to reduce UK emissions

1. The Government's priority is to deliver the UK's legally binding target under the Kyoto Protocol but it believes that greater reductions in emissions are feasible, and that there will be real advantages to the UK in aiming to achieve them. That is why the Government and the devolved administrations agreed a separate domestic goal of reducing carbon dioxide emissions to 20 per cent below 1990 levels by 2010. This is to ensure that the UK continues to lead by example on climate change and starts to make the transition to a lower carbon economy.
2. Recent rises in global energy prices and in particular their impact on the relative prices of coal and gas have led to increases in UK carbon dioxide emissions in recent years. Some policies designed to tackle climate change will involve upfront costs, but in the long-run they can lead to substantial savings in energy costs. The Government has therefore to combine a number of objectives and strike the right balance when making decisions.
3. The Climate Change Programme is based on a number of principles:
 - the need to take a balanced approach with all sectors and all parts of the UK playing their part;
 - the need to safeguard, and where possible enhance, the UK's competitiveness, encourage technological innovation, promote social inclusion and reduce harm to health;
 - the need to focus on flexible and cost effective policy options which will work together to form an integrated package;
 - the need to take a long term view, looking to targets beyond the first Kyoto commitment period and considering the need for the UK to adapt to the impacts of climate change; and
 - the need for the Programme to be kept under review.
6. Our existing policies will ensure that we will meet our international commitment under the Kyoto Protocol. But more needs to be done to achieve our national carbon dioxide goal. The new measures in the Programme are expected to lead to further reduction of some 7-12 MtC by 2010, achieving an overall reduction of between 15-18 per cent by 2010. The range is accounted for by the EU emissions trading scheme on which we will be launching consultation today. We will decide the final cap for the National Allocation Plan in the Summer, when we will need to submit our plan to the European Commission.
7. By this time too, the Energy review will have reported to the Prime Minister. Its findings will inform decisions about how we can achieve our longer-term targets set out in the Energy White Paper, to reduce carbon dioxide emissions by some 60 per cent by about 2050 with real progress by 2020. Several processes that are currently underway such as the review of existing buildings, will be important parts of this process. The Programme also identifies some ideas for additional carbon savings. Work in these areas will continue to see if they should be taken forward.
8. The next six chapters of the Programme set out the measures to reduce greenhouse gas emissions in six broad sectors: energy supply, business, transport, domestic, agriculture, forestry and land management and public and local government.
9. The *"Bringing it all together"* chapter summarises all of the measures included in the Climate Change Programme and gives an indication of the progress which the Government expects to be have made by 2010 against its commitments under the Kyoto Protocol and the domestic carbon dioxide target.
10. This Programme is not the Government's last word. We will keep our policy under review. The Government will introduce a new annual report to Parliament on the level of greenhouse gas emissions in the UK and the steps it has been

Strategy to reduce UK emissions

taking to reduce these. It will also set out an indicative work plan for the following year. The Review of the Economics of Climate Change – led by Sir Nick Stern, will also consider recent proposals for the introduction of “carbon budgeting”. This analysis will inform the Energy Review.

11. In developing the measures in the Climate Change Programme we have taken account of the principles of better regulation. This will mean that the programme will look to achieve its objectives with the minimum additional regulatory burden and taking on board the work of the Better Regulation Commission (previously the Better Regulation Task Force). Evaluations of individual policies will also consider options for simplifying the regulatory landscape as well as ideas for reducing administrative burdens.
12. The ongoing review of the Air Quality Strategy to reduce air pollution, has also been considering the impact of policies and measures on greenhouse gases. The review of the Climate Change Programme adopted a similar approach, identifying measures that will have some air quality benefits. In the long term the two policies will work together synergistically.
13. Involving all parts of society in the fight against climate change is a key part of the national strategy. Each one of us, whether citizens, consumers, businesses or motorists, we all have something to offer. The Government is committed to raising awareness and understanding of climate change, working with organisations such as the Energy Saving Trust and the Carbon Trust to encourage and stimulate individuals and businesses to take action to reduce their greenhouse gas emissions.

The energy supply sector has contributed a large reduction in the UK's greenhouse gas emissions over the past decade. This has been largely through the switch away from more carbon intensive fuels such as coal and oil towards low or zero carbon emissions fuels such as gas, nuclear and renewables.

In 2004, the energy supply sector was responsible for carbon dioxide emissions of 53.7 MtC or about 36 per cent of the UK total. Emissions fell to about 19 per cent below 1990 levels by 2004 and we estimate that they will fall further through to 2010 as a result of the impact on electricity demand of existing measures and a further increase in the share of gas-fired electricity generation. Greenhouse gas emissions fell by 17 per cent below base year levels by 2004.

Measures introduced in the Climate Change Programme 2000 are estimated to save 2.5 MtC in 2010. The main contributions are the Renewables Obligation and support for Combined Heat and Power.

The second phase of the EU emissions trading scheme will save an additional 3.0 – 8.0 MtC in 2010.

The Government will also be introducing a support scheme for biomass heat in the industrial, commercial and community sectors.

Budget 2006 announced a further £50m for DTI's Low Carbon Buildings Programme with the aim of encouraging manufacture at higher scale leading to lower costs. This will help fund the installation of microgeneration technologies in a range of buildings including schools, social and local authority housing, businesses and public buildings. Further details will be announced by the DTI in due course.

The Energy Review is assessing further options for longer-term carbon savings from both the supply and demand side for energy. This will include consideration of what more can be done to improve the conditions for low carbon technologies, such as carbon capture and storage, to come forward.

Introduction

1. A principal reason for the fall in the UK's greenhouse gas emissions over the past decade has been the restructuring of the energy supply industry in the mid-1990s. Fuel switching from coal and oil to gas led to a significant increase in the proportion of gas in the energy mix. The volatile and high gas price – and the corresponding switching from gas to coal and oil generation that have resulted from this – will inevitably have had a detrimental effect on carbon dioxide emissions this winter.



2. The direction of the energy supply sector over the coming decade will be critical to our ability to make the much deeper emission cuts to which the Government is committed. This is one of the key questions being considered by the current Energy Review.

Greenhouse gas emissions inventory and trends

3. The energy supply sector, which is the biggest single contributor to the UK's carbon dioxide emissions, was responsible for about 58 MtC or 38 per cent of net CO₂ emissions in 2004.
4. Emissions from the energy supply sector include those from the production of fuel for final consumption by other sectors. This includes electricity generation, oil production and refining,

Energy supply

Greenhouse gas emissions from energy supply industry, MtC

Gas	1990	1995	2000	2004	2010	2015	2020
Carbon dioxide	66.1	56.6	53.7	58.0	53.4	53.7	49.1
Methane	7.8	6.1	4.1	3.0	2.4	2.0	1.7
Nitrous oxide	0.5	0.4	0.3	0.4	0.4	0.3	0.3
Total	74.4	63.1	58.2	61.4	56.2	56.0	51.2
Change from 1990 levels		-15.2	-21.8	-17.6	-24.5	-24.8	-31.4

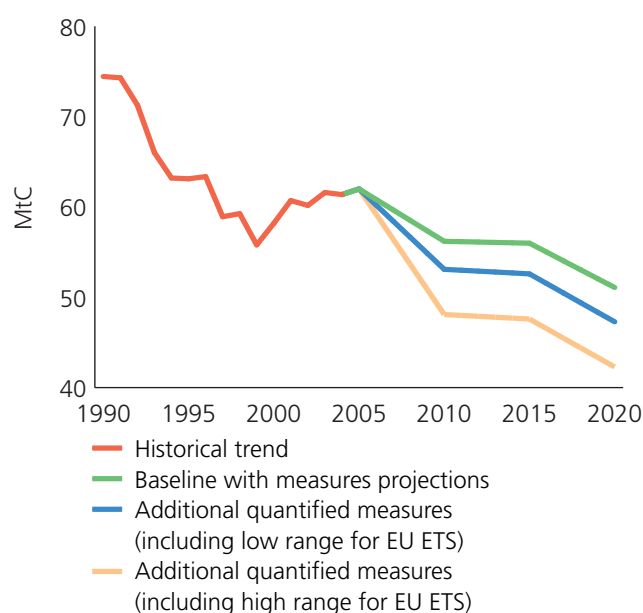
Note: the percentage changes and emission estimates may differ slightly due to rounding.

Existing measures	Carbon savings in 2010 (MtC)
Renewables Obligation	2.5
TOTAL	2.5

gas production and transmission, and the production of coal and other solid fuels. (Carbon dioxide emissions from the energy supply industry are shown separately in the table below, but are incorporated into emissions from individual sectors that use the final products from energy supply in the 'end user' tables.)

- Carbon dioxide contributed around 94 per cent of the greenhouse gas emissions from the energy supply sector in 2004. The other emissions are of methane from natural gas transmission and distribution, coal mining and offshore oil and gas production. In 2004, greenhouse gas emissions from the UK energy supply sector were about 61.4 MtC. Annual emissions have fallen since 1990 and are projected to be about 56.2 MtC in 2010, 24.5 per cent lower than 1990 emissions.

Projections of greenhouse gas emissions from the energy supply sector and the estimated effect of additional quantified measures, MtC



Potential carbon savings

Additional measures	Carbon savings in 2010 (MtC)
Subsidy for biomass heat	0.1
Second phase of EU emissions trading scheme	3.0 – 8.0
TOTAL	3.1 – 8.1

Energy policy

6. The Government set out a long-term framework for energy policy in the 2003 White Paper *"Our Energy Future – Creating a Low Carbon Economy"*. The White Paper brings climate change to the heart of energy policy, as one of four key goals:
 - to put the UK on a path to cut its carbon dioxide emissions by some 60 per cent by about 2050, with real progress by 2020;
 - to maintain the reliability of energy supplies;
 - to promote competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve our productivity; and
 - to ensure that every home is adequately and affordably heated.
7. The White Paper made clear that, in reducing carbon dioxide emissions, the priority is to strengthen the contribution of energy efficiency and renewable energy sources, and to put the EU emissions trading scheme at the centre of the future market and policy framework. It also noted that energy efficiency is likely to be the cheapest and safest way of addressing all four goals.
8. Liberalised and competitive markets continue to be a cornerstone of UK energy policy, improving efficiency and helping keep prices down for domestic consumers and industrial users. Indications are that in January 2006, prices in the UK were below the EU median for both domestic electricity and gas prices. For industry, indications are that prices will be above the EU median for all size bands. However, historically prices to industrial users have been below the EU median, and right up to October 2005 prices were no higher than the EU median. Annual prices for 2005 will be significantly higher than 2004, the latest available published annual figures. However, they are not as high as in previous years. Indications are that domestic gas prices in real terms¹ are likely to be around 1994 levels, and domestic electricity prices in real terms are likely to be around 1999 levels. Industrial gas prices in real terms including the climate change levy (CCL) are likely to be around 1988 levels, and industrial electricity prices in real terms including CCL are likely to be around 1997 levels. Provisional 2005 estimates will be published in March 2006.
9. On 1 April 2005, a single GB-wide wholesale electricity market was introduced by BETTA (the British Electricity Trading and Transmission Arrangements). This extended the market arrangements previously operational in England and Wales to Scotland, enabling competitive markets in the generation and supply of electricity to develop further.
10. The Government believes that the market framework, reinforced by long-term policy measures, is the best way of delivering energy security and encouraging investment, including through the provision, maintenance and replacement of electricity generating capacity to meet demand. Nevertheless the Government recognises, as set out in the Energy White Paper, that to encourage the innovation that will help us meet our goals, some technologies, including renewable energy, require additional support.
11. In January 2006, the Government launched a public consultation on the **Energy Review**. This is taking place against a background of more evidence on the nature and extent of climate change and increasing concerns about the future security of UK energy supplies. The Review is looking at whether the Government needs to take further steps to meet our goals and is due to report to the Prime Minister and the Secretary of State for Trade and Industry in early summer 2006. The consultation document – *"Our Energy Challenge: securing clean, affordable energy for the long-term"* – makes clear that the UK's liberalised energy markets have delivered well against the four goals for energy policy of the 2003 White Paper, and the current review is not re-examining the goals themselves. Rather, it recognises that there are risks that the Government may make only limited further progress against these goals in the medium- and long-term without further measures. The Review is

¹ Adjusted to take account of inflation.

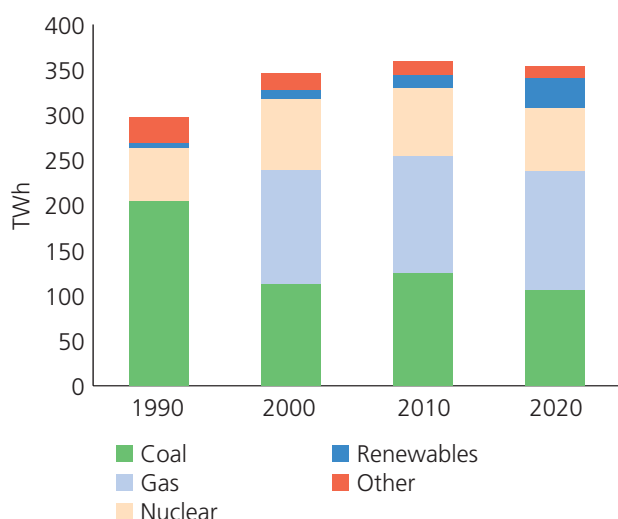
Energy supply

therefore assessing options on both the supply and demand side for energy. It does not mean pulling back from the priorities set out in the White Paper, notably on encouraging renewable energy and energy efficiency, but it does include looking again at nuclear power. The Review is also considering whether the UK should do more to improve the conditions for other low carbon technologies to come forward. The Review will also examine what role carbon capture and storage might play in ensuring we can continue to use fossil fuels, particularly coal, while also reducing emissions.

Electricity generation

12. There has been a significant change in the way that electricity is generated in the UK since 1990, and this has been an important contributor to reductions in the UK's greenhouse gas emissions. There has been a shift away from more carbon intensive fuels such as coal and oil towards lower or zero carbon emission fuels such as gas, nuclear and renewables.

UK electricity generation 1990-2010



13. Emissions from power stations have steadily decreased over the recent past – by around 26 per cent between 1990 and 2004. This is against a general rise in the demand for electricity, of some 24 per cent over the same period. Emissions are

expected to decline further, falling to around 41 MtC by 2010, a reduction of 26 per cent below 1990 levels, as older coal plant is retired and the proportion of electricity supplied from renewables increases. Although high gas prices have made coal stations more competitive in the past few years, pushing emissions back up, new gas-fired power stations are expected to replace some of the existing coal capacity as it reaches the end of its economic life or its closure is accelerated by other environmental legislation, such as the EU Large Combustion Plants Directive.

EU emissions trading scheme

14. The inclusion of the electricity industry in the EU emissions trading scheme (covered in detail in the next chapter) has also begun to provide generators and suppliers with direct incentives to reduce emissions. The scheme covers all emissions from the generation of electricity which is supplied to the grid and therefore, by association, the use of electricity by homes and businesses. Over time, it should provide incentives for investment in lower carbon forms of generating capacity.
15. The Government will explore how it can provide the generators with more certainty about the contribution it expects the scheme to make to longer-term emissions reductions and how it could allocate allowances in ways that encourage the investment that is needed.
16. **The Government has decided that the overall cap for the second phase of the EU emissions trading scheme should be set within a range which would achieve average annual emission reductions of between 3.0 and 8.0 MtC.** In the draft National Allocation Plan, the Government proposes that the reductions in allowances against business as usual would be borne entirely by the electricity supply industry, which is relatively insulated from international competition and is able to pass on the costs of carbon to customers.

Electricity from renewables

17. In January 2000, the Government set a target to increase the proportion of electricity provided by renewable sources to 10 per cent of electricity supplied by 2010, subject to the cost to the consumer being acceptable. The Energy White Paper signalled the Government's aspiration to double the proportion of electricity supplied by renewables by 2020.
18. The main policy mechanism through which the Government supports the development of new renewables capacity is the **Renewables Obligation** on licensed electricity suppliers in England and Wales and its equivalents in Scotland and Northern Ireland. The Renewables Obligation requires suppliers to source a specific and annually increasing percentage of electricity they supply from renewable sources. The level of the Obligation in England, Wales and Scotland is 5.5 per cent for 2005-06 rising to 15.4 per cent by 2015-16. In order to provide a stable and long-term market for renewable electricity, the Obligation will remain in place until 2027. At the end of 2004, generation from renewable sources eligible under the Renewables Obligation stood at 3.1 per cent² of electricity supplied.
19. For each megawatt hour of renewable electricity generated, a tradable certificate called a Renewables Obligation Certificate (ROC) is issued by Ofgem who administers the scheme. Suppliers can meet their obligation either by acquiring ROCs or by paying a buy-out price, set at £32.33/megawatt hour in 2004/05 and indexed to inflation, or by a combination of both. Money paid into the buy-out fund is recycled to ROC holders at the end of the 12-month Obligation period.
20. It is expected that the Obligation, together with exemption from the climate change levy for electricity from renewables, will provide financial support worth up to £1 billion per year by 2010.
21. The Obligation is working well. Since its introduction in April 2002, there has been a step change in the number of renewables projects that have been built in the UK; almost 450MW of wind capacity was installed in 2005, double that installed in 2004. And following the opening of the Cefn Cross wind farm in Wales in June 2005, the UK became only the eighth country to pass 1 GW of installed wind capacity. We expect 2006 to be another record year for growth in onshore wind, with over 500 MW planned for construction in Scotland alone.
22. In April 2001, The Crown Estate announced that 18 companies had pre-qualified for offshore wind site development options under the first round of site awards in UK territorial waters. Three of the 18 offshore windfarms have been built and are now generating electricity: North Hoyle off the north Wales coast, Scroby Sands off Great Yarmouth, Norfolk and Kentish flats in the Thames Estuary. A number of others are either under construction or planned for the near future. The first round was intended to act as a demonstration round, enabling prospective developers to gain technological, economic and environmental expertise and building on the experience of the Blyth offshore windfarm, which was commissioned in 2000. The second round took a more strategic approach to offshore windfarm development by restricting development to three areas: the Greater Wash, the Thames Estuary, and the North West (Liverpool Bay). In December 2003, The Crown Estate announced that 15 projects had been successful. Five applications for consent have been received from those projects granted leases in the second round.



² 3.6 per cent including all non-eligible renewable sources.

Energy supply

23. Unlike some other renewable technologies, biomass has the advantage that it can be used to generate electricity when required, once a fuel supply chain is in place. A strong biomass supply chain can also offer diversification opportunities for farmers and foresters as well as job opportunities, and building and operating the generating plant. Installed biomass and waste capacity had reached 1,333 MWe by the end of 2004, with biomass providing 2.6 mtoe of electricity and 0.64 mtoe of heat in 2004³ £66m of capital grant funding allocated under the DTI/Big Lottery Fund is bringing forward additional capacity, such as the plants at Teesside (30 MW) and Lockerbie (43MW) which are under construction, and the biomass CHP plant at Enniskillen in Northern Ireland, which was commissioned in 2005.
24. Co-firing of biomass with fossil fuels is eligible for ROCs under the Renewables Obligation with certain restrictions and a requirement for a minimum use of purpose-grown energy crops from 2009. The Government has recently announced its intention to review the co-firing rules within the Renewables Obligation as part of the Energy Review, focusing on the potential contribution to our energy and environmental policy goals and the level of support it will require going forward.
25. Although the Government is making progress towards the 10 per cent target, recent projections indicate that this level of generation may not be achieved until some time after 2010. The Government is continuing with a range of work to address barriers to progress towards the 10 per cent target. The Government has recently laid a new Renewables Obligation Order before Parliament, which includes a number of small modifications that are aimed at improving its effectiveness over time.
26. As well as the Renewables Obligation, the Government is providing support through R&D funding and capital grants worth around £500m between 2002 and 2008, including grants for offshore wind, biomass, solar PV and R&D. The Government will continue to explore other

options, such as geopressure, to see whether they can play a role in producing low carbon energy in the UK.

Wave and tidal stream

27. Wave and tidal stream technologies will only make a small contribution towards the 2010 renewables target but, if they can be successfully developed on a commercial scale, they could make a significant contribution towards achieving the 2020 aspiration and beyond. A report by the Carbon Trust, published in January 2006, indicates that wave and tidal stream energy could provide 15 – 20 per cent of UK electricity.
28. Since 1999, the Government has committed around £25m to the research and development of wave and tidal stream technologies through the DTI's Technology Programme. This has led to a number of full-scale prototype demonstrations with several more planned. Developers of some of these devices have indicated that R&D is nearly complete and that they are, or soon will be, ready to begin pre-commercial operation to gain more experience through accelerated trials of small numbers of arrays of devices to discover whether feasible cost-effective solutions can be developed. In August 2004, the Secretary of State for Trade and Industry announced the setting up of a Marine Renewables Deployment Fund (MRDF) that aims to support innovative and visionary businesses to take R&D on wave and tidal stream technologies to market. The centrepiece of the MRDF is a Wave and Tidal Stream Energy Demonstration Scheme, which will provide up to £42m to support the deployment of a small number of multi-device wave or tidal stream electricity generating facilities connected to the UK electricity grid. It will do this through a combination of capital grants and revenue support.

³ Digest of UK Energy Statistics 2005.



29. Support for technology deployment is also being backed up by support for infrastructure, such as support for the European Marine Energy Centre and the development of a consents framework for wave and tidal stream demonstration projects.

Network infrastructure for renewables

30. The development of renewable energy will require the upgrade or reinforcement of parts of the transmission or distribution system. In particular, there is a need for upgrades to allow a surplus of power from proposed wind farms in Scotland to flow to centres of demand in other parts of the UK.
31. The Government is working with Ofgem to ensure that these upgrades happen in a timely manner and to ensure that there is sufficient network capacity for new renewable generators to connect to and thus contribute to meeting the Renewables Obligation target. In December 2004, Ofgem approved additional investment of £560m to strengthen electricity transmission networks in Scotland and the North of England so that they can accommodate the growth in renewable generation.
32. The Government published a public consultation document in July 2005 outlining proposals for giving renewable developers on the Scottish Islands of Shetland, Orkney and the Western Isles a discount on the transmission charges they will have to pay to use the high voltage transmission

grid. While these islands are not connected to the transmission network yet, these proposals will help to support the industry and unlock the vast potential of the Scottish islands for renewables development.

33. Ofgem and DTI consulted in 2005 on the high level regulatory options for offshore transmission. The Energy Minister, Malcolm Wicks intends to announce his decision as soon as possible.

Biomass heat

34. Around 30 per cent of non-transport energy consumed in the UK is in the form of heat for space and process heating. The Government is committed to putting in place a framework for reducing emissions from heat production by supporting the use of combined heat and power and by looking to support the use of renewables.
35. Developing a strong biomass heat sector supplied from indigenous sources will also help secure future energy supplies. The recent rise in fossil fuel prices has also helped shift the economic arguments, although in most cases biomass heat generation still remains more expensive than conventional heat generation.
36. Currently only about one per cent of UK heat demand is supplied from renewable sources. A report commissioned by the Government⁴ concluded that this could rise to 1.8 per cent by 2010 and 5.7 per cent by 2020, but that numerous barriers need to be addressed to achieve this outcome.
37. One key barrier is the greater cost of renewable heating infrastructure compared to conventional systems. **The Government will introduce a support scheme for biomass heat in the industrial, commercial and community sectors.** The scheme will run for five years and will be worth at least £10-15m in England over the next two years. This builds on the support for renewable heat provided through the Bioenergy capital Grants Scheme and the Clear Skies initiative. In developing the scheme, account will be taken of the recommendations of the Biomass

⁴ 'Renewable Heat and Heat from Combined Heat and Power Plants – Study and Analysis' Future Energy Solutions: www.dti.gov.uk/renewables/policy_pdfs/heatreportfinal.pdf

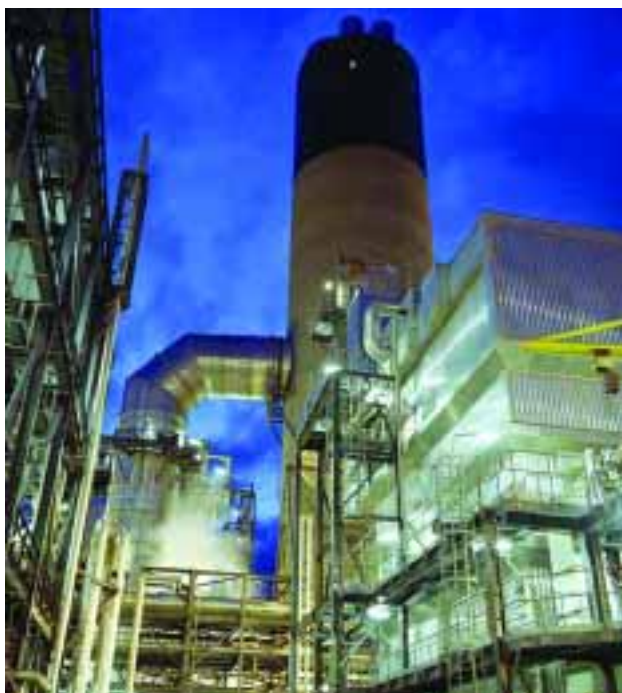
Energy supply

Taskforce on how the support can best be delivered. By May 2006, the Government will have published its full response to the Taskforce's recommendations on optimising the contribution of biomass to renewable energy targets. Other measures on biomass are described in the Agriculture, Forestry and Land Management chapter.

38. Additional analysis of the issues affecting renewable heat development is provided in reports from the Royal Commission on Environmental Pollution⁵ and the Carbon Trust⁶. The latter noted that biomass can be drawn from a very large number of sources, and highlighted particularly forestry, agricultural residues, waste wood and energy crops. Energy from waste is considered further below.

Combined heat and power (CHP)

39. CHP is an efficient way of providing heat and electricity at the same time. Overall fuel efficiency is around 70-90 per cent of the input fuel – much better than conventional power stations which are only up to around 50 per cent efficient. It enables a very wide range of energy users, from heavy industry down to individual homes, to save money and to reduce overall carbon emissions.



40. The Government has introduced a range of measures to support CHP, including:
- climate change levy exemption on fuel inputs to Good Quality CHP and on all Good Quality CHP electricity outputs;
 - Enhanced Capital Allowances eligibility to stimulate investment;
 - reducing the VAT rate to all domestic micro-CHP appliances; and
 - a target for Government departments to source 15 per cent of their electricity from CHP by 2010.
41. In recognition of CHP's environmental benefits, in 2000 the Government set a target to achieve at least 10 gigawatts (GW) of Good Quality CHP capacity by 2010. Installed capacity in the UK stood at 5.6 GW at the end of 2004, which is estimated to save around 4.5 MtC per year.
42. In recent years the CHP industry has faced adverse economic conditions, due largely to the spark spread – the difference between the price received for the electricity and the cost of generation – which has not been large enough to provide an adequate return on investment. The disparity between gas and electricity prices in recent years has acted against CHP, which means that there is still room for support for CHP in the current market conditions. Modelling by Cambridge Econometrics estimates a 2010 capacity figure of 7.5-7.7 GW excluding the impact of the EU ETS. With the EU ETS, Cambridge Econometrics estimate an increased capacity of 9.3-9.6 GW with a medium allowance price. However this modeling is subject to uncertainty and depends significantly on carbon price assumptions.
43. The Government has assessed several new support measures for CHP and will introduce two:
- **The treatment of CHP will be fully considered in the UK's National Allocation Plan for the second phase of the EU emissions trading scheme**, to address some of the concerns about the impact of the first

⁵ 'Biomass as a Renewable Energy Source' 2004, Royal Commission on Environmental Pollution.

⁶ 'Biomass sector review for the Carbon Trust' 2005. www.thecarbontrust.co.uk/carbontrust/about/publications/Biomass%20Sector_FINAL.pdf

phase allocations on CHP. Government will be consulting on proposals to create a separate sector for incumbent (existing) Good Quality CHP plant and a ring-fenced New Entrant Reserve for new plant generating Good Quality CHP electricity. Government will also consult on proposals for incumbent CHP to receive an equitable allocation based on historic emissions within the Good Quality CHP sector. Government will additionally consult on new entrant CHP to receive favourable allocation arrangements relative to non-CHP through the New Entrant Reserve.

- **eligibility for Renewable Obligation Certificates will be extended to include mixed waste plants which use Good Quality CHP.** This would add CHP to the list of eligible advanced conversion technologies.

44. **The Government will shortly undertake a study into the licensing and exemption arrangements governing small-scale CHP and renewables operations and the cost and benefits of these operations.**

45. The Energy Review will consider the contribution that CHP can make to our energy policy goals.

46. The Government has considered a number of other measures to support CHP but has decided not to take them forward at this time:

- a CHP Obligation, along the lines of the Renewables Obligation would be the one measure that could enable us to meet the 2010 target. However, it would be hugely expensive and interfere with our policy of promoting competitive energy markets;
- the proposal to guarantee the level of spark spread for CHP, which would reduce the uncertainty that has inhibited growth in the CHP sector. However, the measure would have significant public expenditure implications and, at the same time, be a significant intervention in the electricity market;
- under the review of the Renewables Obligation, exempting CHP from the Renewables Obligation base has been

considered. However it would be an additional cost to customers at a time of rising fuel bills; and

- adding a heat element to the target for using CHP electricity on the Government estate would be disproportionately expensive, because purchasing heat requires significant capital expenditure to install heat mains.

47. The opportunity was also taken to review the proposed £10m Community Energy programme extension (discussed in the Domestic chapter) and CHP Quality Improvement Programme (QIP). The development of QIP was an undertaking in the CHP Strategy with an aim to increase Good Quality CHP capacity through targeting specific CHP schemes thought to have the potential for expansion. Detailed analysis, involving direct contact with schemes, indicates that the potential is around 35MW and it is not cost-effective to develop a programme for such a small return. We will be contacting the few schemes concerned with the offer of site-specific advice, but will not roll out the programme more widely.

Microgeneration

48. Micro generation is the production of heat or electricity on a small-scale from a low carbon source. Various technologies can be used for microgeneration – air source heat pumps, ground source heat pumps, fuel cells, micro-CHP, micro-hydro, micro-wind, bio-energy and solar.



Energy supply

49. The Government commissioned the Energy Saving Trust to undertake an analysis of the potential of microgeneration in the UK. This report, published in December 2005, suggests that microgeneration could reduce household emissions by approximately 15 per cent by 2050. The Government is currently developing a strategy to promote microgeneration, which will include measures to tackle the barriers currently preventing widespread take-up of microgeneration technologies. This strategy is due to be finalised by the beginning of April 2006.
50. The strategy will also include the Low Carbon Buildings Programme. The Government has committed £80m over three years that will enable the programme to run between 2006-09, including £1.5m that has been brought forward to facilitate a smooth transition between existing schemes (Clear Skies and the Major PV demonstration programmes) and the new programme.
51. Microgeneration technologies can also make a contribution to achieving our other energy goals. Widespread local generation from renewable sources would reduce the load on the national gas and electricity networks. A thriving microgeneration industry could improve the competitiveness of UK energy markets by providing consumers with a wider choice of products from which to gain their electricity and heat. It would also allow existing major energy suppliers to offer more innovative energy services packages including a microgeneration element.
52. In June 2005, the Government set out its strategy for supporting the technical development and commercial deployment of carbon abatement technologies (CAT).

Carbon abatement technologies

Low Carbon Buildings Programme

The Low Carbon Buildings Programme (LCBP), with a £80 million budget over three years, is due to start in April 2006 and will supersede the current Clear Skies and Photovoltaic Major Demonstration programmes. £1.5million was brought forward to smooth transition between existing capital grant schemes and the new programme. The new programme will mark a change to current grant programmes as it aims to take a more holistic approach to reducing carbon emissions by innovatively combining energy efficiency and microgeneration technologies. This change is in direct response to The Renewable Innovation Review, February 2004, which recommended this approach.

While there will be continued support for household and community installations, there will be a shift in emphasis to large-scale developments. The focus on larger developments is designed to engage the construction sector more widely and to increase the take up of microgeneration products in new build and refurbished developments. This change in focus will aim to deliver standard low carbon buildings that can be more easily replicated. The DTI will be working closely with the Carbon Trust to develop the advice element of the programme, which will be important to ensure projects deliver low carbon developments. DTI aims to promote these developments in ways, which clearly communicate the replicability, cost effectiveness and appeal of low carbon technologies.

In parallel, work to develop the Microgeneration strategy should help to create a sustainable microgeneration industry in the UK. The microgeneration strategy will seek to address some of those none-grant barriers preventing widespread take-up of microgeneration technologies.

Budget 2006 announced a further £50m for DTI's Low Carbon Buildings Programme with the aim of encouraging manufacture at higher scale leading to lower costs. This will help fund the installation of microgeneration technologies in a range of buildings including schools, social and local authority housing, businesses and public buildings. Further details will be announced by the DTI in due course.

53. Carbon abatement technologies cover a range of generic options for reducing the carbon dioxide emissions from fossil fuel combustion, including higher efficiency conversion processes (also referred to as cleaner coal technologies), co-firing with biomass, and, the most radical, carbon capture and storage (CCS), which could be combined with enhanced oil recovery. Most of the technologies needed to implement CCS are currently available through other applications and the first requirement is to combine and optimise their operation for carbon dioxide capture.
54. Over the longer term, carbon abatement technologies could make a significant contribution to reducing the UK's carbon dioxide emissions. But as they are not commercially viable under current market conditions, the strategy announced £25m, in the form of capital grants, to support demonstration of these technologies, including capture ready plant and storage. In the 2005 Pre-Budget report the Government committed an additional £10m to the demonstration programme.
55. At Budget 2006 the Government published a consultation document on the barriers to the commercial deployment of carbon capture and storage in the UK and the potential role of economic incentives in addressing those barriers. The responses will be fed into the Energy Review.
57. A consultation on the Government's Waste Strategy for England is currently in progress. This outlines the role and benefits of recovering energy from waste that cannot realistically be reused or recycled and would otherwise be disposed of to landfill, and invites views on the proposed approach.
58. Advanced conversion technologies for generating energy from waste (pyrolysis, gasification and anaerobic digestion) are supported by the Renewables Obligation. These technologies currently make a very small contribution to waste management and electricity generation in the UK, but may be expected to expand as pressure to reduce landfilling of waste increases. The Biomass Taskforce recommended that more efficient use should be made of the heat element of energy from waste. The inclusion in the Renewables Obligation of 'good quality' CHP fuelled by waste should help to encourage this approach.
59. Under the Renewables Obligation definition at least 98 per cent of the calorific value of the biomass must be derived from plant or animal matter. Following the review of the Obligation the Government has reduced the figure to 90 per cent to encourage the use for energy generation of some potential fuels (such as waste woods which are presently sent to landfill) that are very largely biomass in content but do not meet the requirements of the 98 per cent rule.

Energy from waste

56. With increasing pressure to divert biodegradable waste from landfill, there will be opportunities to increase the recovery of energy from residual, post-recycling waste. This approach provides a waste management solution, as well as a source of partially – renewable energy and an additional tool for reducing carbon emissions. The energy currently recovered from residual municipal waste accounts for 0.35 per cent of electricity generation in the UK or 1.4 TWh. This could rise to about 1.5 per cent or 6 TWh by 2020 on the basis of anticipated increases in this waste management route⁷.
60. Conventional energy from waste technology offers a considerable climate change benefit compared to landfill, principally by reducing methane emissions from landfill. Energy recovered also displaces fossil fuel use in conventional power generation. Recovering energy from one million tonnes of municipal waste could reduce greenhouse gas emissions by around 30 ktC compared to landfill⁸. However, the carbon benefit will decrease over time as increased recycling reduces the biodegradable component of the residual waste. Methane production, and the resulting energy generation, from the anaerobic digestion of animal and food wastes, are discussed in the Agriculture, Forestry and Land Management chapter.

⁷ Some commentators have produced considerably higher estimates, based on theoretical maximum assumptions about conversion efficiencies and waste available for energy recovery.

⁸ *Impact of Energy from Waste and Recycling Policy on UK Greenhouse Gas Emissions*, ERM report for Defra, 2006: www.defra.gov.uk/environment/waste/strategy/pdf/ermreport.pdf

Energy supply

Coal mine methane

61. The production of electricity from coal mine methane (CMM) was exempted from the climate change levy in November 2003. The Government is working with the Coal Authority to develop a competitive grant scheme to be administered by the Authority, to support projects aimed at controlling CMM emissions.

Hydrogen

62. Hydrogen offers good prospects for cost-competitive reductions in carbon dioxide from 2020 onwards, particularly for the transport sector. It may also have a role in energy storage for balancing intermittent renewables in grid-constrained situations.
63. Hydrogen can be made via a number of different routes, thereby contributing to energy security, but its potential to contribute to carbon reduction is dependent on the method used. Low or carbon neutral methods include electrolysis using renewable or nuclear energy, and hydrogen production from biomass. Production of hydrogen from fossil fuels could be used in conjunction with carbon capture and storage.
64. The Government announced in June 2005 a £15m demonstration programme for hydrogen and fuel cell technologies, part of a £50m programme also covering carbon abatement technologies. State Aids approval for the programme is currently being sought from the European Commission. The Government intends to establish a Hydrogen Coordination Unit to enable the development and deployment of low carbon, low cost and secure hydrogen energy chains for transport, and to ensure that the UK contributes to and benefits from international collaboration on hydrogen through global partners such as the International Energy Agency and the International Partnership for the Hydrogen Economy.

65. The Government has targets of, as far as practicable, ending fuel poverty in England in vulnerable households by 2010 and in all households by 2016, with other targets being set in the devolved administrations such that by 2018 no household in the UK should be in fuel poverty. A range of actions will be required to meet those targets, particularly in respect of hard-to-treat homes. Many of these households lack access to mains gas, the most efficient, cost-effective conventional fuel for heating, and many would not be removed from fuel poverty without such access.

Extending the gas network

66. The Design and Demonstration Unit (DDU), a team of private sector secondees based in DTI, has undertaken a number of demonstration projects designed to test a model for providing gas connections, together with associated heating and insulation measures to deprived communities. This model, which uses market mechanisms and draws on a range of public and private sector funding sources, has shown that the costs of providing connections can be significantly reduced. Whilst primarily designed to address fuel poverty, connecting a significant number of additional households to the gas network, and providing them with central heating and insulation at the same time, would also offer other social, health and environmental benefits. For example, connecting 120000 households could reduce carbon dioxide emissions by 0.1 MtC in 2010.
67. The DDU will shortly begin a combined gas network and community renewables programme in partnership with the Regional Development Agencies in the North East and Yorkshire and Humberside. The gas network element of the programme will use the proven DDU model. The renewables projects will draw on a range of proven technologies that can deliver heat at a price comparable with that of mains gas, to homes that could not economically be connected to the gas network because of the distance from the existing network or the local terrain.

In 2004, the business sector was responsible for carbon dioxide emissions of 60.5 MtC or around 40 per cent of the UK total. Emissions had fallen to about 12 per cent below 1990 levels by 2004 and we estimate that, including the expected impact of the new measures included in this programme, they could fall further, to almost 18 per cent below 1990 levels by 2010.

Greenhouse gas emissions had fallen by about 28 per cent between the base year and 2004. We estimate that with the additional measures introduced in this Programme, they could fall further to 33 per cent below base year levels by 2010.

The Government is committed to developing a clear policy framework that allows for long-term planning and investment in reducing emissions while ensuring a healthy and competitive business base is maintained. Business has already cut its greenhouse gas emissions significantly, but further reductions could be made cost-effectively.

Independent evaluation by Cambridge Econometrics forecast full carbon savings from the climate change levy to be 3.7 MtC in 2020. In addition, measures introduced in the Climate Change Programme 2000 are estimated to save around 4.9 MtC in 2010. The main contributions are from the climate change agreements, the UK emissions trading scheme, the activities of the Carbon Trust, and the Building Regulations 2002 and 2005.

Measures introduced through this programme will deliver additional carbon savings to 2010:

- additional funding to allow for a significant expansion in the Carbon Trust's Energy Efficiency Loans scheme for SMEs;
- further measures to encourage SMEs to take up energy saving opportunities.

Together it is estimated that these new measures will contribute an additional 0.2 MtC of carbon savings, bringing total savings to 5.1 MtC in 2010.

Introduction

1. Business is a key determinant of the strength and momentum of an economy. However, increasing economic activity is putting greater pressure on our environment and natural resources. The business sector contributes the most to overall UK emissions.
2. Climate change needs to be tackled if we are to achieve long-term growth and prosperity. If climate change is not tackled it means that economic growth is not sustainable, and so it is essential that business adapts to the new conditions it faces. The task is to maintain economic growth in the short, medium and long-term at the same time as meeting the challenge of climate change.
3. Business' commitment to tackling climate change is growing in the UK. Many firms recognise that action to reduce emissions can bring wide-ranging benefits including lower costs, improved competitiveness and new market opportunities. Energy-efficient alternatives can provide cost-effective options for businesses. However, short-term cost considerations and market failures can create barriers to investment. Where this is the case, the Government recognises the role of different policy instruments in overcoming these barriers. The decision to intervene needs to be evidence based and needs to take account of wider economic and social objectives. If a case for intervention is seen, the most cost-effective instrument – or range of instruments – should be used.
4. The Government is committed to developing a clear, flexible and stable policy framework that allows for long-term planning and investment in reducing emissions while ensuring that a healthy and competitive business base is maintained. The framework must also recognise the diversity of the business sector: emissions, energy intensity and the ability to respond to climate change vary sharply between commerce and industry, and between large and small firms.

Business

5. This section covers emissions from both the manufacturing and commercial sectors, and also from industrial processes and waste management. Business' share of the emissions associated with energy supply is taken into account when estimating the effects of policies. Business use of transport is covered in the transport chapter.

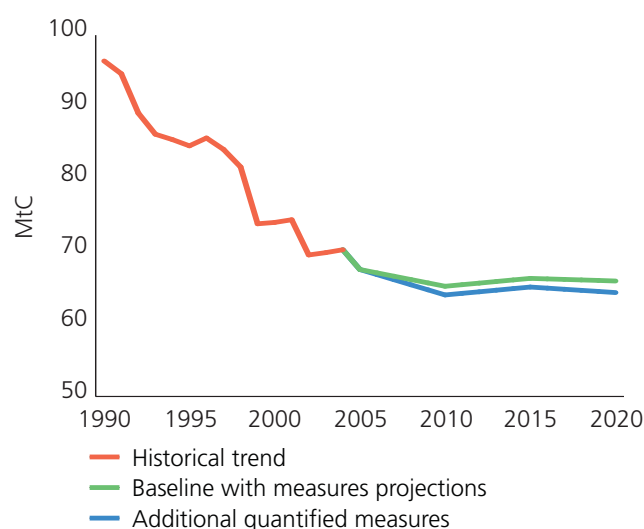


Greenhouse gas emissions inventory and trends

6. In the base year, greenhouse gas emissions from the business sector (including those from its use of energy) were 97.2 MtC. In 2004, emissions from this sector were about 28 per cent below 1990 levels and they are projected to be around 33 per cent below base year levels by 2010, mainly because of fuel switching in the electricity supply industry, other fuel switching and improved energy intensity. Emissions are

projected to be around 33 per cent below base year levels by 2010.

Projections of greenhouse gas emissions from the business sector and the estimated effect of additional quantified measures, MtC



7. Emissions of the other five greenhouse gases from the business sector have reduced significantly. More details are given below and in annexes C to E, but the key points to note are:

- the increased collection of landfill gas for energy recovery and environmental control; and
- a large reduction in N₂O from adipic acid manufacture and in HFCs from HCFC-23 manufacture due to introduction of abatement equipment.

Greenhouse gas emissions from business, MtC

Gas	Base year	1990	1995	2000	2004	2010	2015	2020
Carbon dioxide	68.8	68.8	61.2	60.3	60.5	56.4	58.0	58.1
Methane	14.8	14.8	12.8	8.6	5.7	4.6	4.1	3.8
Nitrous oxide	9.0	9.0	6.1	2.6	2.0	1.9	1.9	1.9
HFCs	4.1	3.1	4.1	1.9	1.7	1.9	1.9	1.7
PFCs	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.1
SF ₆	0.3	0.3	0.3	0.5	0.3	0.4	0.3	0.3
Total	97.2	96.4	84.7	74.1	70.3	65.2	66.3	66.0
Change from base year levels			-12.9	-23.8	-27.7	-32.9	-31.8	-32.1

Note: the percentage changes and emission estimates may differ slightly due to rounding

Existing measures	Carbon savings in 2010 (MtC)
Voluntary UK emissions trading scheme	0.3
Carbon Trust	1.1
Building Regulations 2002	0.4
Building Regulations 2005	0.2
Climate change agreements	2.9
TOTAL	4.9
<i>Climate Change Levy¹</i>	<i>3.7</i>

Potential carbon savings

Additional measures	Carbon savings in 2010 (MtC)
Carbon Trust support for investment in energy efficiency in SMEs	0.1
Measures to encourage or assist SMEs to take up energy saving opportunities	0.1
TOTAL	0.2

A framework for business action

8. Business has asked for a clear, flexible and stable policy framework that allows long-term planning and investment in reducing greenhouse gas emissions. The Government and devolved administrations are committed to delivering this.
9. The policy framework draws together in an integrated way a range of instruments and measures including:
 - **economic instruments** – the climate change levy and, for energy-intensive industries, the associated climate change agreements; emissions trading; enhanced capital allowances for energy-saving technologies and grant schemes;
 - **technology deployment** – the Carbon Trust delivers an integrated programme of support to accelerate the take up of low carbon technologies and other energy saving measures;
 - **regulation** – in England and Wales, implementation of the IPPC directive through the pollution prevention and control regulations, which require major industrial plants to take up best available techniques, and tightening the energy efficiency requirements of the Building Regulations in England and Wales and the Building Standards (Scotland) Regulations;
 - **measures to make the market work better** – helping business to respond to market pressures with advice and information; improving the energy efficiency of consumer products and other equipment; and supporting benchmarking; and
 - **improving public and company information** – making it easier for business to measure their emissions and set public targets for improvement by establishing clear guidelines for companies reporting on greenhouse gas emissions.
10. The introduction of the EU emissions trading scheme in January 2005 means that overlapping policy measures now cover some business sector emissions. As an input into the review of this programme, the Government asked the Carbon Trust, as part of the Energy Efficiency Innovation

¹ An independent evaluation by Cambridge Econometrics (CE) concluded that CCL would deliver annual carbon savings of 3.7MtC by 2010, from an announcement effect and price effect of the levy. This figure assumes CCL rates are increased in line with inflation from 2005 to 2010. The impact of CCL in the projections is incorporated through the price elasticity of demand for different fuels ('the price effect'), and there is no separately identified announcement effect within the UEP baseline.

Review, to consider the future of measures impacting on business, in particular the relationship between the EU trading scheme and climate change agreements, and to recommend improvements to the policy mix. A key consideration was that while the EU emissions trading scheme will be the most significant policy instrument, it is unlikely on its own to deliver the full potential of emissions reductions from business.

11. The Carbon Trust concluded that the current overlap between the EU trading scheme and climate change agreements is not an economic burden at this stage but can create additional administrative requirements. As the EU emissions trading scheme becomes more established, the implications of this for wider UK climate change policy will be considered. The Government will explore the medium-term regulatory framework in the light of developments in the EU emissions trading scheme.

Climate change levy

12. The climate change levy (CCL), introduced in 2001, seeks to encourage businesses to improve the efficiency with which they use energy. Improving energy efficiency is an effective way to lower emissions of carbon dioxide, and can also help businesses reduce their energy costs. To support competitiveness, the introduction of the levy was accompanied by a 0.3 percentage point cut in employers' national insurance contributions (NICs), which has led to a net reduction in tax liability for business.
13. The CCL has had a significant impact on business energy demand which, in turn, has helped improve energy efficiency and reduce emissions. An independent evaluation by Cambridge Econometrics, commissioned by HM Revenue and Customs and published alongside Budget 2005, has examined the effect of the levy since its announcement in Budget 1999 and introduction in April 2001. It concluded that the levy could deliver cumulative savings to 2005 of 16.5 million tonnes of carbon (MtC) and by 2010, annual

carbon savings of over 3.5 MtC a year – well above the 2 MtC estimated at the time of its introduction. According to this evaluation, the impact was largely due to an announcement effect, with a smaller reduction in demand due to the price effect of the levy feeding through into higher fuel prices. The impact of the levy is incorporated into the baseline with measures projections but only through the price effect and there is no separately identified announcement effect within the UEP baseline.

14. It is also estimated that by 2010, CCL will reduce energy demand in the economy as a whole by 2.9 per cent a year – and in the commercial and public sector by nearly 15 per cent a year – compared with the levy package not being in place. The reduction in energy demand, along with the 0.3 percentage point cut in employers' NICs, has reduced costs for business. Cambridge Econometrics estimated that the CCL/NICs package will reduce overall unit costs for business by 0.13 per cent by 2010 compared with the package not being in place.
15. The climate change levy is playing a crucial role in enabling the UK to meet its Kyoto Protocol target. Levy rates have not been raised since its introduction. Budget 2006 announced that, to ensure the UK continues to make progress in tackling climate change, CCL rates will increase in line with current inflation. The inflation increase will be introduced on 1 April 2007. The Government is committed to returning CCL revenue to business, discussing with business the most effective way of supporting investment in energy efficiency and the environment.
16. The levy is a tax on the use of energy in industry, commerce and the public sector. The levy does not apply to fuels used by the domestic or transport sectors, or fuels used for the production of other forms of energy (such as for electricity generation) or for non-energy purposes. It does not apply to oils, which are already subject to excise duty. Energy used by small firms is also excluded. There are also several exemptions from the levy, including:
 - electricity generated from new renewables;

- fuel used by good quality combined heat and power (CHP);
 - fuels used as a feedstock; and
 - electricity used for electrolysis processes, such as the chlor-alkali process or primary aluminium smelting.
17. The horticulture sector, which is relatively energy intensive, contains a large number of smaller companies and is exposed to significant international competition, was also given a temporary 50 per cent discount on the levy for a five-year period, which expires on 31 March 2006. This sector has now qualified for a full climate change agreement under the new eligibility criteria (see below) and growers who have enjoyed the discount are eligible to join the new agreement.
 18. The current rates of levy are 0.15p/kWh for gas, 1.17p/kg (equivalent to 0.15p/kWh) for coal, 0.96p/kg (equivalent to 0.07p/kWh) for liquefied petroleum gas (LPG), and 0.43p/kWh for electricity.
 19. The levy is structured to incentivise business to improve their energy efficiency levels. Improving energy efficiency can help to deliver a double dividend of both reducing emissions but also maintaining and enhancing business competitiveness. To further ensure that the levy was introduced in a way that supported business competitiveness, it was accompanied by a 0.3 percentage point cut in employers' National Insurance contributions, worth approximately £1.2 billion in 2004-05, compared with the £772 million raised by the levy in the same year, helping shift the burden of taxation from 'goods' to 'bads'.
 20. Enhanced capital allowances (ECAs) were also introduced to encourage the use of environmentally friendly technologies. ECAs are now available for 15 different categories of technology and 13,000 different products. In addition, the Carbon Trust was established to provide support and advice to business. Combined

with the incentive to improve energy efficiency provided by the levy, these other measures have provided support to help business adapt.

Climate change agreements

21. Recognising the need to maintain the competitiveness of energy-intensive sectors subject to international competition, climate change agreements (CCAs) were introduced alongside the climate change levy. CCAs provide an 80 per cent discount from the levy for those sectors that agree to meet challenging targets for improving energy efficiency or reducing greenhouse gas emissions.
22. The twelve-year climate change agreements are negotiated between relevant trade associations and Defra. The agreements operate at two levels with targets for both sectors and individual operators. Sector level umbrella agreements detail the facilities covered by the agreement and the relevant process. They also list sector targets, and the conditions which apply to participating companies. Participants in the agreements can determine how best to achieve energy savings. They are able to meet their targets by trading emission allowances either with other companies in an agreement or companies in the voluntary UK emissions trading scheme.
23. Eligibility to enter CCAs was dependent initially on criteria based on the Pollution and Prevention Control Regulations 2000, which implement the Directive (EC/96/61) on integrated pollution prevention and control. There are currently 42 sectors with around 10000 facilities covered by agreements under this eligibility criterion. The Pre-Budget Report in 2003 announced that the eligibility criteria would be extended to cover other energy-intensive sectors of industry that qualify if they exceed energy intensity thresholds and, in some cases, a test of international competition. A further ten sectors with over 300 facilities have completed negotiations and five of these have been granted state aid approval by the European Commission. The remainder are

expected to obtain approval in the near future. The Government is also in discussion with other potentially eligible sectors.

24. In order to continue to receive the discount, facilities must achieve the energy efficiency or emissions reduction targets set out in the agreements. Performance is tested every two years up to 2010.
25. At the second target period in 2004, sectors again performed well against their targets, with a total of the absolute savings from each sector compared to its base year of 3.9 MtC (14.4Mt CO₂) per annum. Although in the first target period in 2002, a large proportion of the savings were a result of reduced output in the steel sector, in 2004, output had risen by 28 per cent over the 2002 level, and is forecast to rise further up to 2010. Nevertheless, energy use in the steel sector rose by only 10 per cent, indicating that the steel sector is continuing to improve its energy efficiency.
26. Targets for 2006 to 2010 were reviewed during 2004 and 2005 to ensure that they continued to represent the potential for cost-effective energy savings taking into account any changes in technical and market circumstances. The review took into account the better than expected performance for the majority of sectors in the first target period. For the largest sectors that are also affected by the EU Emissions Trading Scheme (EU ETS), the revised targets were taken into account in setting the allocations under the UK National Allocation Plan.
27. The target reviews have, overall, resulted in forecast additional savings by 2010 (over business as usual) of 0.2 MtC above the 2.5 MtC predicted in 2001. The additional savings from sectors excluding steel is 0.4 MtC. The forecast increase in production from the steel sector up to 2010 which is reflected in the targets allows a net increase in emissions of 0.2 MtC for this sector.
28. On the whole the ten sectors entering agreements under the new energy intensity criteria are smaller sectors in terms of number of companies and energy use, even though they are energy intensive. Estimated carbon savings from these ten sectors could amount to 0.03 MtC in 2010.
29. It is estimated that the climate change agreements will, in aggregate, save 2.9 MtC per annum by 2010. These savings are included in the baseline with measures projections.
30. Around 500 installations in the first phase of the EU emissions trading scheme are also at least partially covered by CCAs. The UK has obtained temporary exclusion for 331 of these, with the remainder opting to go into the scheme. To apply equivalent reporting arrangements with the EU ETS, which is a requirement of the Directive, the target units containing a temporarily excluded installation will report their CCA performance annually for the duration of the exclusion.
31. For those installations opting to enter the EU ETS, there are overlaps in coverage with the CCAs. It was necessary to avoid the situation where companies would be able to sell a surplus arising from the same emission reduction in both schemes, or alternatively have to buy in both schemes to cover the same shortfall. Industry preferred a mechanism to net off the EU ETS surplus from the CCA performance to the alternative of taking out the EU ETS emissions from the CCA target. This procedure is in place for the first phase of the EU trading scheme, but the Government is consulting the sectors through the UK Emissions Trading Group on arrangements for the second phase.

Carbon Trust



Making business sense
of climate change

32. The Carbon Trust is an independent company funded by the Government. It was established in April 2001, at the same time as the climate change levy was introduced, to help the UK move towards a low carbon economy by helping business and the public sector save energy, reduce carbon dioxide emissions and capture the commercial opportunities of low carbon technologies. It provides independent information and impartial advice on energy saving and carbon management, through site visits, events, and case studies.
33. Carbon management is a systematic approach to support core business strategy looking at every aspect of an organisation's performance in relation to climate change. The Carbon Management Programme has worked with more than 200 large companies, 63 local authorities and five major Government departments.
34. The Carbon Trust also promotes the Enhanced Capital Allowances Scheme to encourage investment by business in qualifying energy saving technologies and products, and manages the list of qualifying equipment. Companies can claim 100 per cent first year allowances against investment in qualifying technologies.

EU Emissions Trading Scheme

35. The European Emissions Trading Scheme (EU ETS), which was established in 2003 by Directive 2003/87/EC, is the largest emissions trading scheme in the world, regulating emissions of carbon dioxide from over 11,500 installations across Europe. In the UK, the scheme covers over

1,000 installations, responsible for approximately 50 per cent of our carbon dioxide emissions, including electricity generators, oil refineries, offshore platforms and industrial plants in the iron and steel, cement and chemicals sectors.



36. The Government believes that, by providing for emissions savings to be made at the point of least cost, emissions trading is a cost-effective mechanism for reducing greenhouse gas emissions. The 2003 Energy White Paper therefore made clear that the Government wanted the EU emissions trading scheme to play a central role in our future emissions reduction policies.
37. Since the Directive was adopted, the European Commission, the UK and other Member States have successfully established the institutional framework necessary for the scheme's operation. National Allocation Plans for the first phase of the scheme which runs from 2005 to 2007 have been submitted by all Member States and been approved by the European Commission³. These plans state the total quantity of allowances to be issued – the 'cap' – and how many allowances each installation will receive. Since 1 January 2005, operators of installations have been required to monitor their emissions and to ensure that they surrender allowances equivalent to their emissions in any calendar year. The Government has played an active role in the development of emissions trading registries which track the ownership and transfer of allowances and the UK has licensed its GRETA software to 16 other States. The 'carbon market', which trades in EU

³ For further details of the National Allocation Plans of other Member States see: www.europa.eu.int/comm/environment/climat/emission_plans.htm

ETS allowances has developed rapidly across Europe with the City of London emerging as one of the main centres of trade.

38. The second phase of the scheme runs from 2008 to 2012, coinciding with the first Kyoto Protocol commitment period. In developing their National Allocation Plans for the next phase, Member States will have to demonstrate how they intend to use the scheme and other policies and measures to achieve their targets under the burden sharing agreement. Over the last year, the Government has been working with the European Commission and other Member States to ensure that the lessons learned from the implementation of the scheme are applied for the second phase.
39. For the purpose of assessing the contribution of the EU emissions trading scheme to the Government's 2010 domestic carbon dioxide goal, the key issue is the total quantity of allowances to be allocated to UK installations. Installations in the EU emissions trading scheme can meet their obligations by purchasing allowances, which might come from installations in other EU countries, and credits from the Kyoto Protocol project mechanisms, which will come from outside the UK and might come from reducing emissions of greenhouse gases other than carbon dioxide. This means that the emissions reductions expected from the second phase of the scheme and included in this Programme (see below), will not necessarily take place in the UK, nor will they necessarily be of carbon dioxide. Nevertheless, as the chapter "UK Emissions Inventory and Projections" explains⁴, the Government will include allowances or project credits surrendered by installations in its assessment of the UK's progress towards the 2010 domestic carbon dioxide goal.
40. The Government has decided that the overall cap for the second phase of the EU emissions trading scheme should be set within a range which would achieve average annual emission reductions of between 3.0 and 8.0 MtC. In the draft National Allocation Plan, the Government proposes that the reductions in allowances against business as usual would be borne entirely

by the electricity supply industry, which is relatively less subject to international competition and able to pass on costs.

Key priorities for the second phase of the EU emissions trading scheme

- 1 **Contribution to UK emissions reduction targets:** The Government has said that the total quantity of allowances allocated for the second phase should be consistent with ensuring that the trading sector makes an appropriate contribution to the domestic goal to reduce carbon dioxide emissions by 20 per cent below 1990 levels by 2010 and ensure it contributes to making progress towards the long-term targets set out in the Energy White Paper.
- 2 **Maintain the competitive position of UK industry:** The Government has been working with other Member States and the European Commission to improve consistency of implementation of the Directive and welcomes the further clarification provided by the Commission's guidance for the second phase. Application of the guidance will minimise distortions that have arisen through different interpretations in the first phase and the Government will work to encourage robust and transparent assessment of National Allocation Plans for the second phase.
- 3 **Facilitate development of an economically efficient EU-wide trading market** that incentivises emissions reductions and provides appropriate signals for long term investment. A key consideration has been to look for ways in which to improve the scheme for the second phase by providing appropriate messages to industry and signalling the long term direction of the Government's policy.

41. The EU emissions trading scheme will continue after 2012 and, as noted by the European Environment Council in October 2005, will remain an essential instrument in the EU's medium and

⁴ paragraph 4.

long-term strategy to tackle climate change. The Government recognises the need for more certainty about the future shape of the trading scheme post 2012 to encourage investment in the technologies needed to deliver deeper cuts in emissions. There is a strong case for strengthening the scheme beyond 2012 and for developing a robust scheme that maintains the competitiveness of European firms, supports investment in developing countries through the continuation of the Clean Development Mechanism, and provides early certainty for industry. The European Commission's review of the trading scheme will provide the best opportunity to address these issues, by considering the level of emissions reductions required in future phases and by moving towards a harmonised approach to allocation, such as auctioning, which motivates rather than discourages early investment.

42. The review also provides an opportunity to consider the expansion of the scheme to other greenhouse gases and activities. This should build upon the work on expansion to other industrial sectors and gases undertaken by the UK and other Member States as part of their preparation for the second phase. It should also consider the prospects for applying emissions trading to other sectors. The Commission is due to report on the review by 30 June 2006.

UK Emissions Trading Scheme

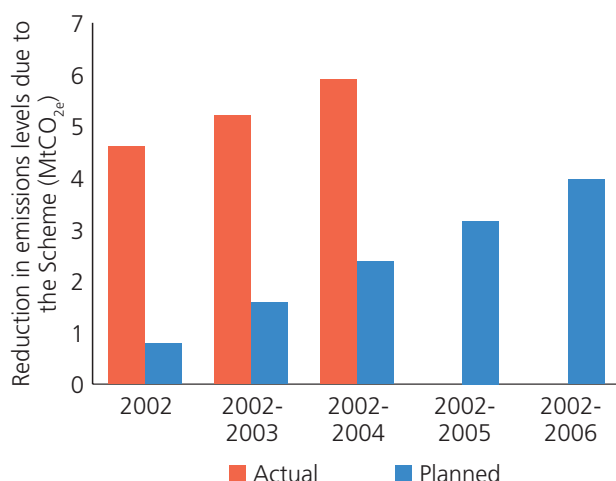
43. In April 2002, the Government established the first economy-wide greenhouse gas emissions trading scheme. To enter the UK Emissions Trading Scheme (UK ETS), the 33 Direct Participants bid annual, cumulative greenhouse gas emissions reductions targets set against a 1998-2000 baseline, in return for a share of the incentive money of £215 million. Direct Participants committed to reduce their emissions by 3.96m tonnes CO₂ equivalent (MtCO₂e) (1.08 MtC) by 2006. The voluntary UK ETS was established as a 5 year pilot scheme, and is set to end for Direct Participants in December 2006. Installations temporarily excluded from the EU ETS due to UK ETS participation will then move into the EU ETS.



44. The three main aims of the scheme were to achieve cost-effective emissions reductions; to enable 'learning by doing' ahead of international emissions trading; and, to establish the City of London as a centre for emissions trading.
45. In 2004, an independent National Audit Office report described the scheme as a "pioneering initiative" that had achieved "significant emissions reductions". Whilst the scheme has mostly delivered its key aims, there are also important lessons to be learned, which the Government will apply in future policy development.
46. To date, the scheme has delivered emissions reductions of over 1.6 MtC – significantly in excess of planned reductions. While the Government recognises that the voluntary nature of the scheme meant that it was more attractive to businesses with greater potential for low cost emissions reductions, which led to an oversupply of allowances and reduced liquidity in the market, it has nonetheless still delivered substantial emissions reductions. In particular, the inclusion of non-CO₂ emissions meant that certain participants were able to install relatively low cost abatement equipment and then have large quantities of allowances to sell. Overall, as results from the first two years show, some companies were able to meet their targets easily, resulting in a surplus of allowances in the market, and a significant fall in the price of allowances.

47. In November 2004, six leading companies restated their commitment to the UK ETS by offering an additional 2.4 MtC emissions reductions relative to their baselines by 2006. This helped to reduce the overall surplus of allowances in the market and to keep the scheme on track. In considering the future policy mix (see paragraphs 11 and 53) the Government will take full account of the experience gained from the voluntary UK scheme.
48. Site closures and other changes of operation are factored into annually amended baselines. Figure 1 shows planned and actual emissions reductions due to the scheme.

Direct Participants' planned and delivered reductions in emissions levels



49. Participants have gained valuable experience in developing emissions reduction strategies as well as learning about the mechanics of trading and how to monitor, report and verify their emissions. The Government has also learnt valuable lessons from the development of the scheme, notably the importance of incorporating emissions projections into baseline setting, to ensure "real and additional" emissions reductions, and the fact that trading has delivered more emissions reductions than expected.
50. The UK ETS has given UK business a 'first-mover advantage' on the global carbon trading market. Companies providing emissions trading services, such as brokerage and verification, have gained experience that places them in a strong position as EU and international emissions trading develop. In addition, the UK Emissions Trading

Registry (ETR) has been adapted for use in the EU scheme and the UK's EU/UN registry has now been licensed to 16 other countries.

51. In the Pre-Budget Report 2004, the Chancellor announced that Defra and HM Treasury would jointly sponsor a review into innovation in energy efficiency. The purpose of the review was to examine how a step-change in energy efficiency in the domestic, business and public sectors in the UK could be delivered cost-effectively and how energy efficiency improvement could be embedded into decision making across the economy. A summary of the principal conclusions of the review was published alongside the Pre-Budget report in December 2005. The Carbon Trust and the Energy Saving Trust published detailed, independent reports to Government at the same time.
52. The Carbon Trust concluded that there is significant scope for cost-effective energy efficiency and emissions reductions in large non-energy intensive businesses and public sector organisations. It put forward a proposal for a new, mandatory auction based UK emissions trading scheme, which would not be linked to the existing voluntary market, that would target energy use by large non-energy intensive businesses and public sector organisations not covered by the EU emissions trading scheme or climate change agreements.
53. The Government is considering the proposal, which raises some important issues, and will decide in due course whether to take it forward. As well as exploring the potential environmental benefits of such a scheme, we will also examine the impact of such a scheme on different sectors, including implications for regulatory burden and competitiveness. We will also consider whether it would be consistent with the Government's Better Regulation principles.

Small and medium-sized businesses

54. The Carbon Trust launched a pilot Energy Efficiency Loan scheme for SMEs in 2002. It

provides interest free loans of between £5,000 and £100,000 for up to four years for qualifying energy efficiency projects. The purpose of the scheme is to overcome a common barrier to investment – where the project is financially viable but the capital budget is constrained by short-term cash flow requirements. The Scottish Executive funds an equivalent scheme in Scotland called Loan Action Scotland.

55. **In the 2005 Pre-Budget Report, the Chancellor announced extra funding of £15m for the Carbon Trust to support the roll-out of the Energy Efficiency Loans scheme for SMEs, building on the current pilot. Defra will provide additional funding to allow the Carbon Trust to expand the scheme further.**

The Government estimates that the scheme could save 0.1 MtC by 2010.

56. **The Government will introduce further measures to encourage and assist SMEs to take up energy saving opportunities. Defra has commissioned work to examine some different possible policy options.** Initial analysis suggests that these measures could save 0.1 MtC by 2010.

Improving company reporting on climate change

57. There is an increasing recognition that good environmental performance makes good business sense. Climate change risks and uncertainties impact to some extent on many companies, and affect investment decisions, consumer behaviour and Government policy. Management of energy, natural resources or waste will affect current performance; failure to plan for a future in which environmental factors, such as climate change, are likely to be increasingly significant may risk the long-term future of a business.
58. Some good progress has been made – the Carbon Disclosure Project's third information request in 2005 received a record high 71 per cent disclosure rate from Financial Times Global 500 companies, with 54 per cent disclosing

emissions data. In the UK, 140 companies in the FTSE250 now report on their environmental performance. However, the number of FTSE All Share companies linking climate change and financial performance is markedly lower. For example, only 17 per cent of companies refer to climate change risks in their Annual Report and Accounts, and only 6 per cent provide quantitative information.

59. From April 2005, the EU Accounts Modernisation Directive introduced requirements for quoted and large private companies to produce an Enhanced Business Review. Companies will need to report on environmental matters to the extent necessary for an understanding of the company's development, performance or position.
60. In January 2006, the Government published 'Environmental Key Performance Indicators: reporting guidelines for UK business'⁵. The use of Key Performance Indicators (KPIs) will help companies both manage and communicate the links between environmental and financial performance, and meet their reporting obligations under the EU Accounts Modernisation Directive, which requires, where appropriate, analysis using KPIs relating to environmental matters. For most sectors, greenhouse gas emissions is the *most* significant KPI, which means that KPIs provide a mechanism for Government to challenge the FTSE All Share and large private companies to report on their climate change performance in a transparent and meaningful way.

Investors and climate change

61. Investors' primary interest in climate change is financial, and based upon the need to protect the value of the investments under their care. Climate change brings with it compliance, reputational, strategic and physical risks for many sectors. Investors are beginning to check that companies have carbon management systems in place (including through the Carbon Disclosure Project). There are also many opportunities for companies to create shareholder value, for example through

⁵ www.defra.gov.uk/corporate/consult/envrep-kpi/envrep-kpi.pdf

⁶ The full statement can be found at www.defra.gov.uk/environment/business/scp/ems.htm

energy efficiency, clean energy and new markets for low carbon products and services.

62. The longer-term nature of climate change (versus investors' typically shorter-term investment horizon) means that among most 'mainstream' investors, interest is still at a fairly early stage. The Government is seeking to enable investors to engage more effectively in driving business change and is working with institutional investors, lenders and insurers. It is also currently examining policy options on long-term responsible investment. As part of this, the Government will look at what can be done to empower individuals to make sustainable choices in how their money is invested.
63. The UK already has some landmark legislation in this area. The amendment to the Pensions Act 1995 requiring pension schemes to state the extent to which they consider social, environmental or ethical issues in their investment strategy will continue to raise the profile of responsible investment. In August 2005, a guide for pension trustees on climate change, prepared by Mercer Investment Consulting for the Carbon Trust and the Institutional Investor Group on Climate Change, confirmed that considering climate risk was consistent with fiduciary duty. The guide offered innovative and practical guidance to pension trustees for understanding and addressing climate risk⁷.
64. In the Charity Sector, the new Statement of Recommended Practice highlights the need for charities to communicate with their stakeholders and the public how ethical considerations, which include sustainability considerations, influence their investment decisions.
65. The Carbon Trust is also actively engaging with the financial and investment community to encourage the emergence of a low carbon technology sector in the UK, primarily by supporting direct investment in low carbon technologies through direct venture capital investment in companies alongside commercial investors. In November 2004 one of the Carbon Trust's investments, Ceres Power, floated on the Alternative Investment Market (AIM).
66. The Trust also helps technology companies get ready for the investment market under its low carbon technology incubator programme. The Carbon Trust's investor engagement programme plays a key independent role in the quantification of shareholder value at risk from climate change, and in engaging grassroots mainstream institutional investor interest.
67. The Carbon Trust is building on the G8 Action Plan by bringing together leading international investors and policymakers to develop a better understanding of how policy can accelerate low carbon technology investment. This group, known as the Transatlantic Investment Forum, will feed in to the G8 Dialogue process.
68. Many UK institutional investors are engaged in the United Nations Environment Programme's Finance Initiative (UNEP-FI). UNEP-FI has facilitated the drafting of a set of Principles for Responsible Investment, expected to be launched in March 2006. These are primarily designed to be applied by asset-owners (such as pension funds, endowments and insurance companies).
69. In a similar vein, in 2002, the Corporation of London initiated the London Principles Project on the role of the UK's financial services sector in promoting sustainable development. This proposed seven principles by which financial market mechanisms can best promote the financing of sustainable development, and is an example of the City of London's leadership in this area.
70. In March 2006, the Carbon Trust published its report on Climate Change and Shareholder Value. This introduced a clear new methodology to analyse potential profit risk from climate change across a range of sectors. Its findings concluded that what can initially appear a high exposure, can reduce significantly if properly managed. Under its base case scenario, only two of the sector case studies analysed were exposed to value risk in excess of 10 per cent of Earnings before Interest and Tax (EBIT) by 2013. The report clearly illustrates that 'value at risk' is not as simple as mere emissions exposure, and that for many companies understanding their risk exposure

⁷ It can be accessed through <http://www.thecarbontrust.co.uk/trustees>

could be complex. The report provides a list of seven key questions that senior corporate management should ask themselves, and investors should ask companies, in order to ensure that climate risks are being properly addressed.

Industrial processes

71. Industrial processes produce significant emissions of nitrous oxide and fluorinated gases from large IPPC regulated sites. There has been understandable uncertainty about HFCs ever since the agreement of the Kyoto Protocol, and the Government believes it needs to give a clear signal to industry and users so that they can make investment decisions with more certainty.



72. Nitrous oxide is emitted during the manufacture of adipic acid, an intermediate chemical in the production of nylon. Emissions from this process accounted for 6.8 MtC in 1990. DuPont (UK) Ltd operates the only adipic acid plant in the UK. Emissions from this source have been reduced greatly since 1990 due to the introduction of Common Off-gas Abatement (COGA) equipment in 1998, and are projected to be about 90 per cent lower in 2010.
73. Manufacture of nitric acid was responsible for emissions of 1.1 MtC in 1990. Emissions are projected to decrease to 0.7 MtC by 2010 due mainly to the closure of one plant. All nine nitric acid manufacturing facilities in the UK are currently

regulated. IPPC has applied to existing nitric acid production processes since the end of 2004.

74. Total hydrofluorocarbon (HFC) emissions have fallen significantly between 1990 and 2004 because of action to control emissions as a by-product of one industrial process. However, this masks an underlying upward trend in emissions as HFCs are used as a replacement for ozone-depleting substances. The Government is concerned that emissions from these sources are forecast to grow strongly in the near future. It believes that this trend is unsustainable in the longer term and that action should be taken to limit the projected growth.
75. The Government recognises that the successful phase out of ozone-depleting substances under the Montreal Protocol is being achieved with a range of technologies, and accepts that HFCs are necessary to replace ozone-depleting substances in some applications. In view of this, the key elements of the Government's position on HFCs are set out below:
- HFCs should only be used where other safe, technically feasible, cost effective and more environmentally acceptable alternatives do not exist;
 - HFCs are not sustainable in the long term – the Government believes that continued technological developments will mean that HFCs may eventually be able to be replaced in the applications where they are used;
 - HFC emission reduction strategies should not undermine commitments to phase out ozone depleting substances under the Montreal Protocol; and
 - HFC emissions will not be allowed to rise unchecked.
76. This policy takes account of the fact that HFCs are used in a wide range of applications and that they will continue to have a role in these applications where there are no acceptable alternatives. At the same time, industry and users are being given a clear signal to look closely at all

the alternatives and to select those that are more acceptable where they do exist.

77. The policy also takes account of energy efficiency. The Government recognises that, over recent years, industry has made significant improvements in the energy efficiency of equipment but it believes there are opportunities for further gains. The scope for improving energy efficiency mainly depends upon the size, design, and the maintenance and operation of equipment. The choice of refrigerant can have an impact but is less significant. It is noted that the use of HFCs in insulation foams can in certain applications provide higher energy savings than other types of insulation.

EU Regulation and Directive on f-gases

78. Final agreement on a Regulation on certain fluorinated greenhouse gases and a Directive relating to emissions from Mobile Air Conditioning systems in cars was reached in January 2006.
79. The principal objective of these proposals is to contain, prevent and thereby reduce emissions of f-gases covered by the Kyoto Protocol. They will make a significant contribution towards the European Community's Kyoto Protocol target by introducing cost effective mitigation measures.
80. The main provisions in the Regulation cover:
- containment through responsible handling during use;
 - recycling and end-of-life recovery;
 - training and certification for personnel involved in the containment and recovery f-gases;
 - reporting on quantities produced, supplied, used and emitted;
 - labelling of products and equipment;
 - certain application specific controls on use; and

- certain placing on the market prohibitions.

81. The Directive will modify the European Whole Vehicle Type Approval Directive (70/156/EEC), which lays down the procedure Member States use to ensure vehicles comply with technical requirements before they are placed on the market. The Directive will therefore place restrictions on the types of Mobile Air Conditioning (MAC) systems fitted to vehicles before vehicles are approved for sale. Specifically, the Directive will introduce:
- a two-step phase out of MACs that use f-gases with a GWP greater than 150: 1 January 2011 for new types of vehicle, and 1 January 2007 the sunset date for all new vehicles;
 - maximum annual leakage limits to cover the interim period before the phase out; and
 - controls on refilling the retrofitting for these systems.
82. These measures will minimise emissions of f-gas from MAC by ensuring only environmentally responsible technology may be fitted to any vehicle.
83. The Regulation will enter into force in mid 2006 with the main body of the provisions in the Regulation set to apply from one or two years after that date. The Government will work with key stakeholders to ensure that the key information is targeted to those who need it in timely way. We expect that the Directive will enter into force in mid 2006 and it will be transposed by the Vehicle Certification Agency.

Waste management

84. Methane is the dominant greenhouse gas emission from the waste sector, and of this, landfills contributed 98 per cent of national methane emissions from that sector in 1990. Landfill methane emissions are falling mainly because of increased collection of landfill gas for energy recovery and environmental control. Future reductions will be dominated by growth in alternative waste management routes.

85. The EU Landfill Directive will have a significant effect on emissions; partly because it imposes strict engineering requirements on landfills, partly because it requires landfill gas (methane) to be captured and used, and partly as it imposes limits on the amount of biodegradable municipal waste that can be landfilled. The targets (based on the amount of waste produced in 1995) and timescales that apply to the UK are:

- a reduction to 75 per cent of the total amount by 2010;
- to 50 per cent of the total amount by 2013; and
- to 35 per cent of the total amount by 2020.

86. The Government has introduced a number of policy measures to divert biodegradable waste from landfill, including landfill allowance schemes to specifically meet these targets for biodegradable municipal waste, as well as more generally through increasing landfill tax. These are described in chapter 1 Diverting biodegradable municipal waste from landfill to meet these targets will result in additional carbon savings, through avoided methane emissions, of 2.7 MtC by 2010 and 3.3 MtC by 2020 (compared to 2000 levels)⁸. The total reduction in methane emission from UK landfills relative to the level in 1990 is between 6 and 7 million tonnes of carbon equivalent. Additionally the increase in energy recovery from biomass waste at incineration plant is projected to save a further 0.2 MtC in 2010. This is built in to the baseline with measures projections.

87. Other waste management routes produce significantly less GHG emissions per tonne of waste managed than does landfill. The principal reason for this is that methane emissions from landfill are avoided by managing the waste some other way. In addition, however, recycling generates significant CO₂ savings as a result of the reduced need to extract and process raw materials (although much of this benefit accrues overseas), whilst recovering energy from the biogenic fraction of waste yields other, relatively modest, savings. All waste management options, including

landfill, result in CO₂ emissions from the transport, treatment and recovery or disposal of waste.

88. There may be additional CO₂ savings not in the baseline arising from savings in fossil fuel CO₂ emissions due to an increase in energy from waste beyond the level allowed for in the DTI model; as a result of landfill allowance schemes (for municipal waste) and increases in landfill tax that will also impact on commercial and industrial waste streams. To the extent that the resulting changes in waste management practices (including increases in recycling) divert greater amounts of waste from landfill than is assumed in the DTI model, and displace additional fossil fuel generation, there will be further greenhouse gas emissions savings. These have not been quantified.

Working with others to deliver change

89. Businesses play a crucial role in supporting Government to move become innovative and develop low carbon emission technologies needs to stretch beyond 2010. Alongside companies that are already taking action to cut their emissions, there are already those that are developing innovative low-carbon products and services. To ensure this effort is maintained and enhanced, the Government is committed to carry on working to support the deployment of new technologies and products and to help develop vibrant markets to provide businesses with the confidence for long-term investments.



⁸ UK Landfill Methane Emissions: Evaluation and Appraisal of Waste Policy and Projections to 2050, Golder Associates report for Defra, 2005.

BT

BT's targets for sustainable environmental improvement include capping their CO₂ emissions at no more than 25 per cent below 1996 levels by 2010. BT are currently running at a 53 per cent reduction below 1996 levels and expect this figure to change significantly due to increases in electricity consumption as a result of increased broadband usage and the need to run two networks in parallel during installation of our new 21st Century Network.

The annual CO₂ savings arising from their energy and fleet efficiency initiatives alone, which began in 1991, equate to almost 1.4 million tonnes of CO₂.

In 2005 BT signed the world's largest green energy contract which means that almost all of its UK electricity needs will be met from environmentally-friendly, sustainable sources, including wind generation, solar, wave and hydroelectric schemes or low carbon fuel-efficient energy from CHP (combined heat and power) sources. In terms of CO₂ emissions savings, this equates to an additional 325,000 tonnes each year (equivalent to the amount of CO₂ produced by more than 100,000 cars) on top of the considerable savings we have already made in the last 10 years.

90. In the 2005 Pre-Budget report⁹, the Government announced support for alternative sources of energy and committed to consult on carbon capture and storage (CCS) and work with Norway to develop its understanding of this technology further. In addition, Budget 2005¹⁰ announced a new UK Energy Research Partnership (UKERP) bringing together private and public sectors to develop a common vision for energy research and innovation. The Government will work closely with the UKERP and will consider further the scope for supporting innovation and technological development as part of the Comprehensive Spending Review 2007.
91. In October 2005, Defra, DTI and the Climate Group co-hosted "*Climate Change: The Business Forecast*", a major international conference. The event was attended by over 300 delegates, and produced a set of "business insights" on climate change. The consistent message from the discussions was that climate policy should be long (long-term), loud (to compete with other CSR issues) and legal (underpinned by regulation).
92. Looking ahead, Defra is funding work by the UK Business Council for Sustainable Energy and the Climate Group to examine business issues and concerns around the 'post-2012' debate, the date when the first commitment period ends under the Kyoto Protocol.

The **G8 Davos Climate Change Roundtable** is a collaborative project between the UK Government and the World Economic Forum in the year of the UK's G8 Presidency. It was conceived as a way of providing global business leaders with an opportunity to present the Prime Minister with their perspectives on climate change ahead of the G8 Summit.

The **Corporate Leaders Group (CLG)** was convened by the University of Cambridge Programme for Industry, under the auspices of HRH The Prince of Wales' Business & the Environment Programme. In a letter to the Prime Minister, the CLG offered advice and help in taking forward action on climate change, including proposing a partnership between business and the UK Government. Secretaries of State for Defra and DTI met the CLG on 20 July 2005 to discuss how to take forward this offer.

Representatives of both the Davos Roundtable and the Corporate Leaders Group presented their messages to the Prime Minister at a meeting on 9 June 2005, ahead of the G8 Summit.

¹⁰ www.hm-treasury.gov.uk/media/FA6/45/pbr05_chapter7_173.pdf

¹¹ www.hm-treasury.gov.uk/media/AA7/59/bud05_chap07_171.pdf

Environment Agency

93. The Environment Agency for England and Wales plays a major role in managing climate change. With the exception of offshore installations that are regulated by DTI, the Agency is the main Competent Authority to implement the EU emissions trading scheme in England and Wales, and it handles the registry for the UK.
94. The Environment Agency promotes the implementation of waste minimisation action plans at industrial and commercial sites action plans and seeks to ensure the use of Best Available Technology (BAT). In the future, the Environment Agency will seek to assess the scope for reducing non-carbon dioxide greenhouse gases using IPPC measures and by promoting waste and land/soil management practices that reduce methane emissions and nitrous oxide emissions. It will also promote renewable energy technologies onshore and offshore and will prepare to handle the regulatory impact of emerging technologies (such as hydrogen, carbon capture and storage).
95. The Environment Agency also has an important role on work adapting to climate change. It has core responsibilities on coastal and river flood risk management and water resource planning and ensures that general environmental protection responsibilities are incorporated in its operations.

Representative groups and trade unions

96. There is great potential for the trade unions to work in partnership with Government and businesses to tackle climate change in the workplace. The Trade Union Sustainable Development Advisory Committee (TUSDAC) can mobilise the trade union movement to engage companies on these issues and provide pertinent advice to Government. In June 2005, the trade unions launched Greening the Workplace , a forward-looking strategy to tackle climate change and other environmental issues. The strategy

places a strong emphasis on a sustainable energy and transport policies for the UK and on the actions that trade unions can take in the workplace, in their own operations and in the management of their pension funds to deliver this.

In 2004, the transport sector was responsible for around 27 per cent of total UK carbon dioxide emissions. Emissions had risen to about 10 per cent above 1990 levels by 2004. We estimate that including the expected impact of the new measures in this Programme, emissions are expected to be at the same levels in 2010.

Similarly greenhouse gases had increased by around 12 per cent between the base year and 2004 and we estimate that they will be at about the same level in 2010 with the new measures described in this chapter.

The Government is committed to reducing the impact of travel on the environment and with the devolved administrations is promoting policies to reduce the fossil carbon content of transport fuels, increase the fuel efficiency of vehicles and encourage a move towards more environmentally friendly forms of transport.

Measures included as part of the 2000 Climate Change Programme are projected to save around 5.1 MtC by 2010. The voluntary agreement package (including reform of company car taxation and graduated vehicle excise duty – 2.3 MtC), wider transport policies (0.8 MtC), sustainable distribution (in Scotland – 0.1MtC) and the fuel duty escalator (1.9 MtC) are the main contributors.

New measures delivering savings to 2010 include:

- the Renewable Transport Fuel Obligation which will require 5 per cent of all UK fuel sales to come from renewable sources by 2010-11; and
- further improving the fuel efficiency of new vehicles, for example through use of fiscal incentives and by working to develop options on how to move forward beyond the first phase of the EU voluntary agreements with automotive manufacturers after 2008.

Together it is estimated that these new measures will contribute an additional 1.7 MtC savings in 2010, bringing total savings in 2010 to 6.8 MtC. Further unquantified carbon savings will be delivered through measures to help people make smarter travel choices, including using more fuel efficient vehicles. Also, looking beyond this programme, we will continue to work towards the inclusion of aviation in the EU emissions trading scheme.

Introduction

1. It is important to be clear why transport emissions are rising, especially at a time when emissions from most other sectors are falling. As the economy grows, people travel much further than they used to and buy more goods from all over the world.



2. As they get more prosperous, they also tend to choose to travel in a way that uses more carbon. Instead of walking, they are more likely to take the bus and instead of taking the bus they go by car or by train. They also heat their homes more and their businesses use more fuel. But the impact on travel is larger because in a growing economy the demand for transport fuel grows faster than the demand for other kinds of fuel and so transport's share of total emissions is likely to increase.
3. This is why road transport CO₂ emissions grew by 8 per cent between 1990 and 2000 even though average new car fuel efficiency has improved by 10 per cent since 1997. And this is why forecasts indicate that road transport emissions will grow by another 8 per cent between 2000 and 2010, although the link between traffic growth and economic growth has weakened in recent years.
4. This is the difficult backdrop against which the Government's decisions are made. What we need to do is on the one hand reduce the environmental impact of the journeys people

make and on the other hand help people make more informed travel choices, which will benefit both them and the environment.

- 5. And in making a significant contribution to meeting the Government’s long-term emissions reduction goals there will also be opportunities for the transport sector and for UK industry, with the potential to benefit from domestic and global demand for innovative products and services geared towards greener transport.

Greenhouse gas emissions inventory and projections

- 6. Transport accounted for about 21 per cent of UK greenhouse gas emissions in 2004. Carbon dioxide is the most significant greenhouse gas emitted from this sector, accounting for over 95 per cent of emissions in 2004. Nitrous oxide is emitted during the catalytic conversion of vehicle exhaust, and hydrofluorocarbons are emitted from vehicle air conditioning systems and refrigerated transport. Methane is emitted in small amounts by natural gas powered vehicles.
- 7. Greenhouse gas emissions from road transport grew by some 12 per cent between 1990 and

2004, and would be expected to be 15.6 per cent above 1990 emissions by 2010 in the absence of the further measures described in this chapter. The table below shows the baseline ‘with measures’ projections for transport to 2020. These projections include the effect of policies introduced since Kyoto but not the additional policies and measures in this programme.¹

Potential carbon savings

- 8. The Government appraises all its road schemes for their environmental impacts, including carbon dioxide emissions. Beyond this the Government has a range of policies in place to reduce the environmental impact of transport and these are already delivering significant carbon savings.
- 9. But we want and need to do more, and so this programme adds a set of carbon-saving policies including:
 - the Renewable Transport Fuels Obligation;
 - measures to help people make smarter travel choices; and

Greenhouse gas emissions from transport, MtC

Gas	1990	1995	2000	2004	2010	2015	2020
Carbon dioxide	39.2	39.8	40.9	43.1	44.8	45.7	45.3
Methane	0.6	0.6	0.4	0.3	0.1	0.1	0.1
Nitrous oxide	0.4	0.8	1.3	1.6	1.7	1.8	1.9
Total	40.2	41.2	42.6	45.0	46.5	47.5	47.2
Change from 1990 levels		2.3	5.8	11.8	15.6	18.0	17.4

Note: the percentage changes and emission estimates may differ slightly due to rounding

Existing measures	Carbon savings in 2010 (MtC)
Voluntary Agreement package, including reform of company car taxation and graduated VED	2.3
Wider transport measures ²	0.8
Sustainable distribution (in Scotland)	0.1
Fuel duty escalator ³	1.9
TOTAL	5.1

¹ Transport’s use of energy including refineries is included in the carbon dioxide estimates given in the table. The estimates also include emissions from domestic aviation, but not emissions from international aviation which are currently excluded from international target assessments.

² As set out in ‘Transport 2010: The 10 Year Plan for Transport’ and built upon in ‘The Future of Transport: A network for 2030’.

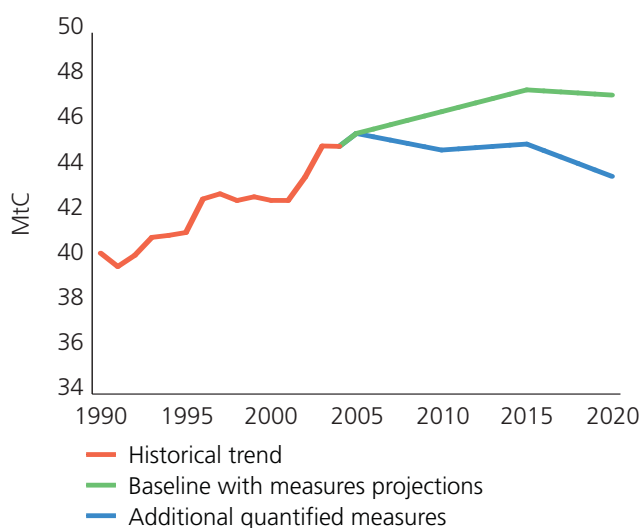
³ The fuel duty escalator was in place from 1993 to 1999. Carbon savings have been estimated by comparing the level of emissions with the fuel duty escalator in place with what would have happened had fuel duty been increased annually in line with inflation.

Transport

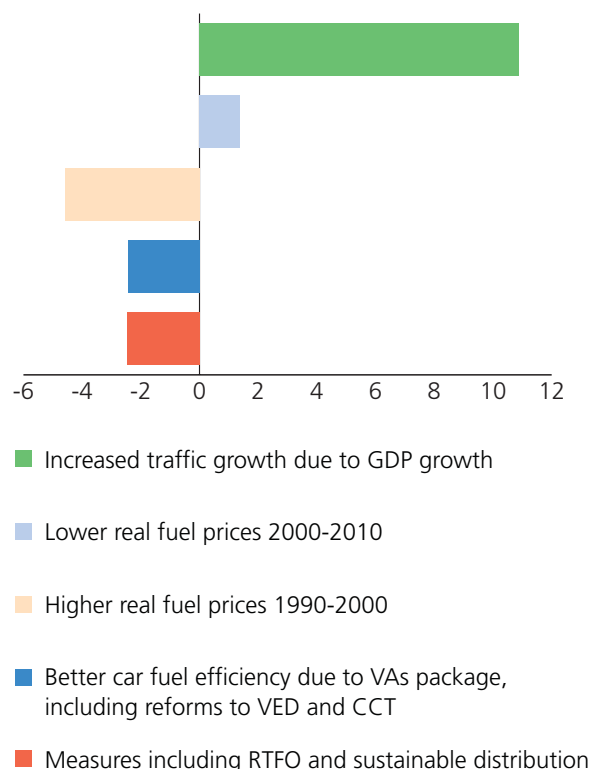
- further improving the fuel efficiency of new vehicles, for example by enhancing fiscal incentives to choose less polluting vehicles and working to develop options on how to move forward beyond the first phase of the EU voluntary agreements with automotive manufacturers after 2008.

10. Overall, these additional policies are designed to reduce carbon dioxide emissions by 1.7 million tonnes per annum in 2010. This is over and above the carbon savings from the measures that have been previously agreed and does not include the potential benefits from including surface transport in emissions trading schemes.

Projections of greenhouse gas emissions from the transport sector and the estimated effect of additional quantified measures, MtC



Impact of transport on carbon emissions from 1990-2010, MtC



Notes: VAs = Voluntary agreements, VED = Vehicle Excise Duty, CCT = Company Car Tax, RTFO = Renewable Transport Fuel Obligation

11. The Government estimates that, as a result of the additional measures we are taking, transport carbon dioxide emissions in 2010 will be 5 per cent lower than they would have been from the original programme (the with measures projections), and 13 per cent lower than they would have been if we had not acted at all (if we had not taken the measures set out in the original climate change programme). This does not mean that we expect total transport emissions to fall.

Additional measures	Carbon savings in 2010 (MtC)
Renewable Transport Fuel Obligation (RTFO)	1.6
Future EU level agreement with car manufacturers to reduce CO ₂ emissions from new cars	0.1
TOTAL	1.7

Policies and measures

12. The Government is committed to promoting sustainable transport and cutting transport emissions in the medium to longer term. The task of tackling emissions growth in this sector from strong sustained economic growth is challenging and a range of approaches will be required, including regulation, taxation, public spending and voluntary measures.



13. Carbon dioxide emissions from transport depend on three key variables:
- I) the fossil carbon content of fuel consumed;
 - II) the fuel efficiency of vehicles; and
 - III) the distance travelled and the means of transport chosen.
14. It is essential that we address all three of these in the most cost-effective and practical way possible. To achieve this we need to take action on a range of levels and that is exactly what we are doing by developing policies for:
- reducing the fossil carbon content of road transport fuels;
 - improving the fuel efficiency of vehicles;
 - encouraging a move towards more environmentally friendly means of transport; and

- promoting the inclusion of aviation in emissions trading schemes and developing the evidence base around the possibility of including surface transport in emissions trading schemes in the future.

Reducing the fossil carbon content of road transport fuels

15. The 2003 Energy White Paper made clear that for transport to play its part in putting the UK on the path to a 60 per cent reduction in CO₂ emissions by 2050, with real progress by 2020, there has to be a move towards low carbon and renewably produced fuels.
16. The Government published the Alternative Fuels Framework as part of Pre-Budget Report 2003. This set out the Government's commitment to promoting the development of sustainable alternatives to fossil fuel, and affirmed the need for fiscal incentives to reflect environmental benefits. The framework committed the Government to a three-year rolling guarantee for biofuels and road fuel gas duty rates, offering certainty to support investment. Budget 2006 announced that the 20 pence per litre duty incentive for bioethanol and biodiesel will be maintained to 2008-09.
17. In November 2005 the Government announced it would introduce a **Renewable Transport Fuel Obligation** (RTFO). The RTFO requires transport fuel suppliers to ensure a set percentage of their sales are from a renewable source. It will be introduced in 2008-09, with the obligation level set at 5% in 2010-11. We estimate that this will lead to a 1.6MtC reduction in emissions. This figure follows the internationally agreed methodology for allocating emissions to individual states, which prevents global double counting of emissions. As such it does not take into account the carbon emitted during the production of biofuels which are produced abroad and used in the UK. When this is taken into consideration the net global reduction in carbon dioxide emissions is around 1MtC, equivalent to taking one million cars off the road, without stopping people from travelling.

Transport

18. Budget 2006 announced that the level of obligation will be 2.5% in 2008-09 and 3.75% in 2009-10. This will ensure significant growth of biofuels prior to reaching the 5% level in 2010-11. RTFO levels beyond 2010-11 will be set in due course, but the Government intends that in principle the target should rise beyond 5% after 2010-11, so long as infrastructural requirements and fuel and vehicle technical standards allow, and subject to the costs being acceptable to the consumer. This will deliver additional carbon savings from road transport.



19. In the short term, the fuels that will be used to meet the Obligation are almost certain to be biofuels, which are available today and can easily be blended into today's petrol and diesel and used in any vehicle. Drivers filling up at petrol stations will not notice any difference, as biofuels used in low percentage blends do not change the performance of cars.
20. Today most biofuels come from crops including oilseed rape and wheat. Biofuels can be blended with fossil fuels and used in ordinary cars. In the future we could see more advanced biofuels made from waste and possibly even renewable hydrogen. **The Government is considering how best to use the Obligation to encourage innovation in this area, including the development of advanced biofuel production techniques to promote greater carbon savings.**

21. The Government has also announced, subject to State aids agreement, an Enhanced Capital Allowance (ECA) scheme for the cleanest biofuels production plant, to support innovation and help develop the lowest-carbon biofuels production methods. This will provide a 100% first-year allowance for biofuels plant that meet certain qualifying criteria and which make a good carbon balance inherent in the design. The Government has now applied for State aids approval and envisages the scheme starting early in 2007.

22. To ensure that biofuels are sourced sustainably, the Government is developing a robust carbon and sustainability assurance scheme as part of the Obligation. Obligated companies will be required from day one to report on the level of carbon savings achieved and on the sustainability of their biofuel supplies.

23. **The Government is consulting on the details of how the Obligation will work, and aims to publish draft Regulations by early 2007.**

24. We are also working to support the use of clean, low carbon fuels:

- the Hydrogen and Fuel Cells Demonstration Programme (referred to in the Energy Chapter) will provide £15m support over the next four years to demonstrate hydrogen and fuel cells, including the use of hydrogen as a transport fuel; and
- The Government has announced a new grant programme to support an **alternative re-fuelling infrastructure**. This could, for example, include funding for hydrogen, electric, bio-ethanol and natural gas/biogas refuelling points⁴.

Improving the fuel efficiency of vehicles

25. We are taking action on a range of levels, from voluntary agreements to fiscal measures to information campaigns, to create incentives to encourage consumers to make more environmentally friendly choices and to make sure

⁴ Details of the grant programme are at www.est.org.uk/fleet/funding/infrastructurep.

that they can make informed decisions. And the Energy Review will also be considering the medium to long-term potential of technologies to reduce carbon dioxide emissions in the transport sector.

25. We have seen steady progress in improving **the average fuel efficiency** of new cars sold in the UK. New cars sold in the UK in 2004 were on average some 10 per cent more fuel-efficient than in 1997. The rate of progress has slowed in recent years, however, and new cars sold in 2005 were only 0.9 per cent more fuel efficient on average than new cars sold in 2004. There is also an increasing split between the company car market, where average emissions of new vehicles continue to fall, and that for private cars, where progress has stagnated.

26. **The Government will also continue to support the development, introduction and take-up of new vehicle technologies to help cut carbon dioxide emissions.** The 2002 Powering Future Vehicles Strategy, which will be reviewed during 2006, sets out the main policies and targets in this area and a grant programme supports research and development into low carbon vehicle technologies⁵. The Government will continue to fund the **Low Carbon Vehicle Partnership** (LowCVP), a stakeholder organisation set up in 2003 to help the shift towards low carbon vehicles and fuels.

The Low Carbon Vehicle Partnership is an action and advisory group, established in January 2003 to take the lead in accelerating the shift to clean low carbon vehicles and fuels in the UK.

LowCVP is a partnership of organisations from the automotive and fuel industries, Government, academia, environmental NGOs and other stakeholders who are working together on shared goals to make the shift happen.

27. The Government is committed to the **Voluntary Agreements on new car fuel efficiency** between the European Commission and the automotive industry, which aim to improve the average fuel efficiency of new cars sold in the EU by 25 per cent by 2008-9 against a 1995 baseline. These have already led to improvements in average new car fuel efficiency across the EU, but, as indicated in the figure below, indications are that the target is unlikely to be reached in full. The target has been set at EU level, and, as such, not all countries need to individually meet the target in order for it to be reached on average. However, by 2003 average new car carbon dioxide emissions had been reduced by only 12 per cent across the EU. The Government is pressing for new targets beyond 140g/km after 2008 to be finalised as soon as possible. This might deliver carbon savings of 0.1 MtC in 2010, potentially increasing to 0.7MtC by 2015, depending on the form it took.

European Community Strategy to reduce CO₂ emissions from cars

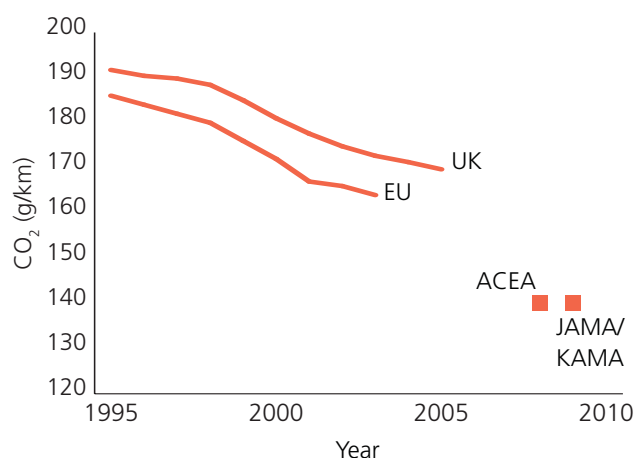
The voluntary agreements on new car fuel efficiency represent one of the three pillars of the European Community's Strategy to reduce CO₂ emissions from cars, launched in 1995. The aim of the strategy is to reach – by 2010 at the latest – an average CO₂ emission figure of 120 g/km from new passenger cars sold in the European Union. The objective of the voluntary agreements is to reduce average new car CO₂ emissions to 140g/km by 2008-9, mainly through technological developments. The other two pillars of the Strategy are to improve consumer information on the fuel-economy of cars and market-based measures to influence motorists' choice towards more fuel-efficient cars.

More information on the strategy can be found at http://europa.eu.int/comm/environment/co2/co2_home.htm The strategy is currently being reviewed as part of the wider review of the European Climate Change Programme.

⁵ Details of the grant programme are at www.est.org.uk/fleet/funding/lowcarbonresearch/.

Transport

Average new car CO₂ emissions in grams per km for the UK and EU since 1995 (the base year of the voluntary agreement).



Note: ACEA = European Automobile Manufacturers Association
JAMA = Japanese Automobile Manufacturers Association
KAMA = Korean Automobile Manufacturers Association

28. **The Government is committed to using vehicle taxation frameworks alongside other policy instruments to support the move to lower carbon transport.** The Government reformed Vehicle Excise Duty in 2001 to move to a carbon dioxide-based graduated system, and reformed company car tax in 2002 to move the benefit in kind charge similarly to make it carbon-based. It is estimated that this saved 200,000 to 300,000 tonnes of carbon in 2005 – and it is expected to save up to 0.65MtC in 2010.

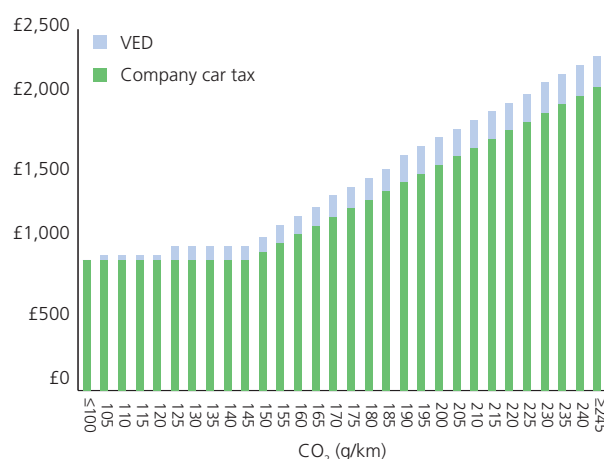
29. The company car tax fuel benefit charge was also reformed in 2003, and the Government published, alongside Budget 2006, a consultation on capital allowances for new business cars, including options to introduce a range of first year allowances for cars depending on carbon emissions.

30. Budget 2006 also announced further reforms to Vehicle Excise Duty (VED) for cars, to sharpen incentives to choose fuel-efficient cars. A new higher band of VED (Band G) has been set at £210 for the most polluting new cars, while VED for the very lowest-emission vehicles has been reduced to £0, to assist the development of the low carbon vehicles market.

31. To further promote environmentally friendly vehicles, Budget 2006 announced that the threshold for the minimum percentage charge rate for calculating the company car tax benefit in kind will be reduced from 140g CO₂/km to 135g CO₂/km in 2008-09. A new rate of 10% for cars of 120g CO₂ and below will also be introduced from 2008-09.

32. The chart below demonstrates the significant annual savings that can be made on VED and company car tax through opting for less polluting vehicles. The figures are illustrative (as the company car list price is held constant), however they demonstrate the level of savings available to motorists for a given company car list price.

Annual VED and company car tax paid on a typical petrol company car



33. It is important that consumers have the best possible information available to them when they buy a car, so that they can make informed choices, reflecting the benefits that lower emissions vehicles bring. With this in mind, most UK car showrooms now display **colour-coded fuel efficiency labels**, developed and delivered in close co-operation with the vehicle industry and LowCVP, which are directly linked to the Vehicle Excise Duty (VED) bands and which will be familiar to consumers used to similar labels for their household white goods.

An example of the fuel economy label, reflecting the recent changes to VED (note official VCA version not available at time of print)



34. We are also awaiting a legislative proposal from the European Commission which is likely to propose a mandatory system of colour coded fuel-efficiency labelling across the EU. The UK strongly supports this approach, provided that flexibility is built into the system so that Member States can ensure compatibility with other national policy measures.

Logistics

35. In 2006 we will also look at how and whether to expand the sustainable distribution programmes to encourage efficient operating practices in the haulage/logistics industry through which we have been able to give practical advice on how to cut down on lorry mileage, on fuel

consumed and on accidents. This work should deliver increasing carbon savings over time and help reduce congestion as transport operators integrate this best practice fully into their everyday activities. In the meantime, we have decided to allocate a one off budget increase of £1.5m to the Safe and Fuel Efficient Driving scheme (SAFED) which aims both to provide relevant training and to identify best practice for truck and van drivers.

36. Using rail instead of road to transport **freight** can also cut carbon emissions. The amount of freight moved by rail in terms of tonne kilometres has increased by over 55 per cent since 1995/96. The Government is currently spending around £20m each year on grants for rail freight, which take about 800,000 lorry movements off the road each year.

The Food Industry Sustainability Strategy, published by Defra in April 2006, challenges the food and drink industry (manufacturers, wholesalers, retailers and the food service sector) to make significant reductions in the external costs associated with the domestic transportation of food, including road congestion and carbon dioxide emissions, by building upon current best practice and the logistical improvements of the last decade. Emissions from food transportation by the food industry in the UK were about 2.6MtC in 2002.

Hydrogen and hybrid buses

The number 25 bus route runs the gamut of London traffic conditions in its journey between Oxford Circus and Ilford, which makes it a perfect choice for the first hydrogen fuel cell trial bus route. These buses emit only steam from their tailpipes, because they work by generating electricity from a fuel cell on the vehicle, in which hydrogen reacts with oxygen from the air to form an electrical charge which powers the vehicle. If the hydrogen can be produced from carbon-free sources such as renewable electricity, these vehicles could lead to totally carbon-free transport.

In February 2006, the Mayor of London announced the addition by Transport for London (TfL) of six new, environmentally friendly hybrid vehicles - the first ever such vehicles in London - to the London Buses fleet. The hybrids operate on route 360, run by London Central. A leafy motif on the buses will help passengers recognise their environmentally-friendly status. They use less fuel than a standard diesel bus, leading to a substantial reduction in carbon dioxide emissions.

Encouraging a move towards more environmentally friendly means of transport

37. We are putting record investment into public transport to improve reliability and to give people a real alternative to travelling by car.
38. The UK now has the fastest growing **railway** in Europe and we expect it to continue to grow. Encouraging more people to use rail rather than road helps because the average person travelling by rail produces around half the carbon dioxide emissions of the average person travelling by car⁶. **The Government will consider how new technologies can improve energy efficiency and reduce fuel consumption to get even more environmental benefits from rail.**
39. A good **bus** network plays a similar role in cutting congestion and carbon dioxide emissions. In the July 2004 *Future of Transport White Paper* we announced further measures to develop the potential of Quality Contracts, which give local authorities greater powers to determine the bus network.
40. The Government has also greatly increased funding for local authority expenditure on infrastructure schemes such as bus lanes, and has funded many new services through the rural bus grants and urban bus challenge.
41. Alongside this investment in public transport, we support a range of measures, called '**smarter choices**' which are aimed at helping people choose sustainable travel options.
42. The Government has also been encouraging local authorities to make smarter choices an integral part of their transport plans and have three headline projects:
 - with the Department for Education and Skills we are working on a **Travelling to School** initiative which aims to have active travel plans in every school in England by the end of the decade. We have already achieved our interim target for 25% of schools to have an active travel plan by March 2005;

- the **Sustainable Travel Towns** initiative aims to create three showcase sustainable travel towns to act as models for other local authorities and show what can be achieved. Over five years, the Department for Transport is providing revenue funding for Darlington, Peterborough and Worcester to help them achieve this; and
- we have set up an expert advisory body, Cycling England, with an annual budget of £5m a year for the next three years. Its work programme includes £2.8m a year for the next three years for six **cycle demonstration towns** to test the hypothesis that by providing investment at the level sustained by certain European towns which have seen cycling increase, cycling in English towns can be similarly increased. The towns are Aylesbury, Brighton, Darlington, Derby, Exeter and Lancaster (with Morecambe).

Woodfield Infant and St George's Junior Schools, Shrewsbury

The share of children at these schools who walk, cycle or take the bus to school has risen steadily from 46 per cent in 2000 to 56 percent in 2004 – an impressive result as car use continues to rise nationwide. Of particular note is an almost doubling of the level of cycling at both schools, to 7 per cent.

This success is down to a mix of imagination and commitment. In 2001 many parents told the schools that they were worried about the traffic around the school entrances and about the dangers of crossing local roads on their route to school. By 2002, the schools had produced their first joint travel plan offering: cycle training, walking buses, Walk to School Weeks and an innovative trailer bike loan scheme for parents. This travel plan was publicised at social and community events such as a summer fete and with a 'walk and cycle to school' winning entry in the 2003 Shrewsbury Carnival. In 2004, the children themselves were asked how they preferred to travel. Some 73 per cent chose walking and cycling – only 10 percent chose travelling by car.

⁶ Average emission factors are calculated using 2002 National Atmospheric Emissions Inventory CO₂ emissions estimates by mode/vehicle type and data on passenger kilometres and load factors from DfT Transport Statistics

43. Other aspects of transport policy can help support and reinforce the measures described above. These include using technology to enable the **improved management of transport networks** and to help manage demand. For instance in some local authority areas sophisticated real time information and traffic management systems are being used to provide bus priority at traffic signals and information for real-time passenger information displays. Transport information services, such as Transport Direct, can also help to encourage a move to more environmentally friendly means of transport by offering information on different forms of transport, and helping travellers to make better-informed travel decisions.
44. **Demand management** on the road network can include anything from relatively simple parking measures to sophisticated road pricing schemes. The Government is examining how pricing could be used to address congestion in areas where it is a problem today or soon will be. It is also committed to using pricing in these areas in ways that allow piloting of technology for a national scheme in the longer term. Complementary public transport and travel information, together with pricing, can form an overall transport solution to make a town or city a better place to live and work. The Government is prepared to invest up to £200m per annum between 2008/09 and 2014/15 from the Transport Innovation Fund to support schemes involving road pricing, if suitable packages are developed by local authorities.

Emissions trading schemes

45. The Government has been examining the scope for including **surface transport** in CO₂ emissions trading mechanisms. Whilst the results of our work suggest this could be a means of delivering carbon reductions at relatively low cost, there are many issues to be addressed before a definitive view can be taken about the desirability of including surface transport in emissions trading. These issues include the route for implementation, the regulatory burden on current and future participants, whether carbon savings

achieved occur within the surface transport sector itself, the impact on carbon prices and the impact on UK competitiveness.

46. **Drawing on the work we have already carried out, we will engage with key stakeholders, the European Commission and other EU member states to help develop a robust evidence base on the costs and benefits of including surface transport in CO₂ emissions trading at an EU level. We will also continue to investigate the desirability of introducing surface transport CO₂ emissions trading at a UK level, either as preparation for EU-wide adoption or as a self-standing measure.**

Aviation

47. At present, the emissions from international **aviation** are not included either in the Kyoto Protocol target, or the domestic carbon dioxide goal, as there is no international agreement yet on allocating these emissions to national greenhouse gas inventories. We are continuing to pursue such agreement with a view to their inclusion within any future international climate change regime. The Air Transport White Paper, published in December 2003, acknowledged the growing contribution that aviation emissions are making towards climate change and recognised the need for the aviation sector to take its share of responsibility for tackling the problem of climate change.



Transport

48. UK forecasts suggest that by 2030 carbon dioxide emissions from UK aviation could amount to some 16 to 18 MtC⁷, of which over 90 per cent would be from international flights. It has been estimated that the climate change impact of aircraft emissions are 2-4 times greater than that of CO₂ alone. Further research is required to clarify the exact figure, but it is clear that the impact of aviation on climate change is greater than that due to direct CO₂ emissions alone, due to some of the other emissions released and their specific effects at altitude (including increased tropospheric ozone, contrail formation and a small amount of methane destruction). Hence, as set out in the Air Transport White Paper, aviation could amount to about a quarter of the UK's total contribution to global warming by 2030⁸.
49. We believe that the best way of ensuring that aviation contributes towards climate stabilisation is through a well-designed emissions trading regime, because it allows a specific emissions limit to be set and achieves that limit in the most cost effective way.
50. In light of this the Government made the inclusion of aviation in the EU emissions trading scheme by 2008 or as soon as possible thereafter, a priority of the recent UK Presidency of the European Union. Therefore we welcome the fact that in December 2005 under our chairmanship the EU Environment Council recognised that emissions trading seems to be the best way forward. The European Commission is taking forward work through an Aviation Working Group (within the European Climate Change Programme) and will aim to bring forward draft legislation by the end of 2006. We are taking an active role in this Working Group and will consult on this legislative proposal in due course, taking account of the full range of impacts, including on the existing trading scheme.
51. In line with our approach to Better Regulation, a rigorous impact assessment will be central to policy decisions. Some of the key issues to consider are:
- how the non-CO₂ impacts of aviation should be covered;
 - the geographical coverage of aviation emissions under the scheme;
 - the trading entity – who should be made responsible for surrendering allowances and be allowed to trade;
 - allocation methodology – how many allowances should be available, who should allocate them and how they would be allocated;
 - how to integrate aviation into the EU scheme, given that emissions from international aviation are not covered by assigned amount units (AAUs) under the Kyoto Protocol;
 - monitoring, reporting and verification – the emission measurement or calculation method to be used and the agent responsible for monitoring and reporting emissions; and
 - the impact on the allowance price of the current scheme – forecasting allowance prices is complicated and uncertain but an understanding of the impact on the allowance price should form part of the impact assessment of any legislative proposal.
52. The Government is also continuing to press for the development and implementation, through the International Civil Aviation Organization, of emissions trading at the international level. It is also pressing for other ways of tackling aviation emissions, including:
- the adoption by airports, airlines and air traffic controllers – including the European Organisation for the Safety of Air Navigation (EUROCONTROL) – of working practices that minimise the impact of their activities on climate change;

⁷ The Future of Air Transport, DfT 2003

⁸ As an analytical device, UK aviation is defined here as all domestic services plus all international departures from the UK, there being no international agreement yet on how to divide international emissions into national contributions.

- research and development by aerospace manufacturers of new technologies to reduce the climate change impact of future aircraft; and
- voluntary action by airlines, airports and aerospace companies to control greenhouse gas emissions and develop sustainability strategies (such as the Sustainable Aviation strategy). Such action should include emissions reporting and targets at a company level.

53. All these measures provide a solid foundation for action in tackling aviation's global impacts, but we realise that they may not provide a total solution. In view of this, the Government will continue to explore and discuss options for the use of economic instruments for tackling aviation's greenhouse gas emissions. The Government has made it clear that it reserves the right to act alone or bilaterally if progress at an international level proves too slow.

Carbon offsetting

54. We recognise the potential of carbon offsetting to help raise awareness of the environmental impact of travel and other activities. Investment in high quality offset projects (for example through the Clean Development Mechanism) can deliver certified emission reductions to offset unavoidable emissions and often provide additional sustainable development benefits.
55. Carbon offsetting of air travel emissions played a large part in minimising the environmental impact of the UK's G8 Presidency. As a result, the Kuyasa low-income housing energy upgrade project (the first Clean Development Mechanism project to be accredited in Africa) was selected to offset the G8 Presidency. Emissions arising from the UK's Presidency of the EU are to be offset in a similar way.
56. We are developing this approach to offset emissions arising from central Government air travel through a Government Carbon Offsetting

Fund from April 2006. We are also encouraging other sectors to consider the value of offsetting and we welcome recent airline initiatives, allowing customers to voluntarily calculate and offset emissions from their flights.

Shipping

57. The UK is also playing an active role in reducing emissions from **Shipping**.
58. In the medium to long term, technological improvements may deliver carbon savings. For example, developments in marine engine manufacturing, the use of propulsion systems other than diesel engines and alternative fuels could all offer ways to cut carbon dioxide emissions.
59. Working within the International Maritime Organization (IMO), the UK made a significant contribution at the latest Maritime Environment Protection Committee (MEPC) negotiations on the adoption of Interim Guidelines for Voluntary Ship CO₂ Emission Indexing for Use in Trials. Ships under the United Kingdom flag are being encouraged to participate in these trials, which will help identify a ship's greenhouse gas index.

Other Measures

60. The **Highways Agency** is working hard to improve its environmental performance and has made substantial progress. The energy it uses to light the network and provide communications systems is now sourced in a greener way: 15 per cent will come from clean energy and the rest through good-quality Combined Heat and Power. The Agency has also adopted innovative construction techniques and materials, cutting both the embodied energy needs of roads and the energy used in transporting materials. On recent projects such techniques have saved tens of thousands of lorry trips. Beyond that, it is investigating the wider use of solar panels and inter-seasonal heat transfer systems.

Transport

61. On the issue of the extra carbon dioxide emissions that road improvements generate, we estimate that the road improvements this decade will only have a small impact – offsetting just 10 per cent of the net carbon savings expected from the Renewable Transport Fuel Obligation in 2010.
62. We will also conduct a feasibility study into the potential carbon emission reductions, and other environmental benefits, of an **accreditation scheme** for UK companies that implement best practice and show improvements in the environmental performance of their transport operations. Such a scheme could cover a wide range of issues, from the efficiency of HGVs and/or company cars to the travel modes used by employees when commuting and travelling for work.



In 2004, the domestic sector was responsible for around 27 per cent of total UK carbon dioxide emissions on an end user basis. Emissions had fallen to about 2 per cent below 1990 levels by 2004 and we estimate that, including the expected impact of the new measures included in this Programme, they will fall further, to almost 16 per cent below 1990 levels by 2010.

Greenhouse gas emissions had fallen by about 5 per cent between the base year and 2004. We estimate that with the additional measures introduced in this Programme, they could fall further to almost 16 per cent below base year levels by 2010.

The Government is committed to taking action to cut carbon dioxide emissions from the domestic sector. Tackling household energy usage is an effective way not only to reduce emissions but also to support progress towards wider economic and social objectives. Although most energy efficiency measures are very cost-effective, generating net benefits to consumers, significant barriers remain, especially the lack of consumer demand for energy efficiency measures.

Measures introduced in the Climate Change Programme 2000 are estimated to save around 3.6 MtC in 2010. The Energy Efficiency Commitment (1.6 MtC), Building Regulations (1.5 MtC), and fuel poverty programmes (0.4 MtC) are the main contributors in carbon terms, with product policy and information, advice and support also playing a key role.

New measures that will deliver additional carbon savings to 2010 are:

- seeking to achieve substantially higher carbon savings from the Energy Efficiency Commitment in 2008-11. We will consider with stakeholders how to provide as much flexibility as possible in the range of measures that can be employed;
- the Code for Sustainable Homes which has minimum standards for energy and water efficiency at every level of the Code, with the lowest levels raised above the level of mandatory building regulations;
- the update to the Building Regulations in April 2006 to raise energy standards of new build and refurbished buildings. The cumulative effect of these and the 2002 and 2005 changes to the Building Regulations is substantial, giving a 40 per cent improvement in the energy efficiency of new buildings. We are also conducting a review of measures to improve the sustainability of existing buildings, which will be completed by summer 2006;
- more reliable consumer product information and setting effective standards for energy-using products via voluntary agreements, in particular a new initiative with major retailers, the Eco-design of Energy Using Products (EUP) framework Directive and other national, EU and international policy measures and initiatives, including public procurement;
- enabling consumption feedback to households via improved billing and metering;
- continuing to tackle fuel poverty through the Warm Front and Decent Homes programmes; and
- continuing to support the activities of the Energy Saving Trust and the Climate Change Communications Initiative to raise awareness about climate change and the action individuals can take to help tackle it. We are launching a major new initiative designed to strengthen consumer demand for energy efficiency, working closely with local authorities, energy suppliers, and others, with funding of £20m over the next two years.

Together, it is estimated that these new measures will contribute an additional 1.2 MtC of carbon savings in 2010, bringing total savings in 2010 to 4.8 MtC.

Introduction

1. In 2004 the domestic sector was responsible for about 30 per cent of total UK energy use and about 27 per cent of carbon dioxide emissions on an end user basis. That energy is used by a wide range of different appliances in the home – with around 60 per cent used for heating, 20 per cent for hot water and the remainder for lighting and appliances.



2. A range of different approaches are required to tackle domestic energy efficiency effectively. These include the provision of information and advice to consumers, such as energy labels on new appliances, incentives, such as reduced VAT on energy saving materials, voluntary agreements with retailers and manufacturers, regulations, such as minimum standards for buildings and appliances, or supplier obligations such as the Energy Efficiency Commitment.
3. There are many potential barriers to the take-up of energy efficiency measures in the home. People can be reluctant to introduce energy efficiency measures, even when they are demonstrably cost effective, for a variety of reasons – lack of awareness and information, lack of capital for the up-front investment required or other spending priorities, inertia, or an unwillingness to become involved in even limited building improvements, because of the 'hassle factor' for example. To correct these market failures, the Government recognises that different

policy interventions are sometimes necessary. The case for government intervention needs to be built on a firm evidence base, with decisions taking account of wider economic and social objectives. Where the case for intervention is seen, the most cost-effective and well-targeted package of measures need to be used. But the Government cannot deliver this alone – it will need changes in consumer attitudes and behaviour if we are to successfully make a step-change in energy efficiency and tackle the trend towards rising energy demand that has been predominant for recent decades.

Greenhouse gas emissions inventory and projections

4. In 1990 greenhouse gas emissions from this sector were 45.8 MtC¹, they had fallen to 43.7 MtC in 2004 and they are projected to be 38.7 MtC in 2010. Carbon dioxide emissions in 1990 were 42.4MtC, and fell by 2.6MtC over the decade to reach 39.8MtC in 2000. This small net change was the result of the interaction between several much larger individual contributions over the decade. Three factors had a major influence on carbon dioxide emissions:
 - growth in demand for the underlying energy services (such as warmer homes, hot water, and home entertainment) – up nearly 30 per cent, i.e. 11.5 MtC;
 - background improvement in energy efficiency – over 1 per cent per annum or a 12 per cent reduction, i.e. 4.5 MtC; and
 - reduction in the carbon intensity of grid electricity resulting from the switch from coal to gas generation – worth over 20 per cent of household emissions, i.e. 8 MtC.

Together with other smaller factors (such as fuel switching by householders and changes in external temperatures), which reduced emissions by around 1 MtC, these resulted in an overall net reduction of 6 per cent, or around 2.5 MtC.

¹ Emissions from the generation of electricity used by this sector are included in the total figures

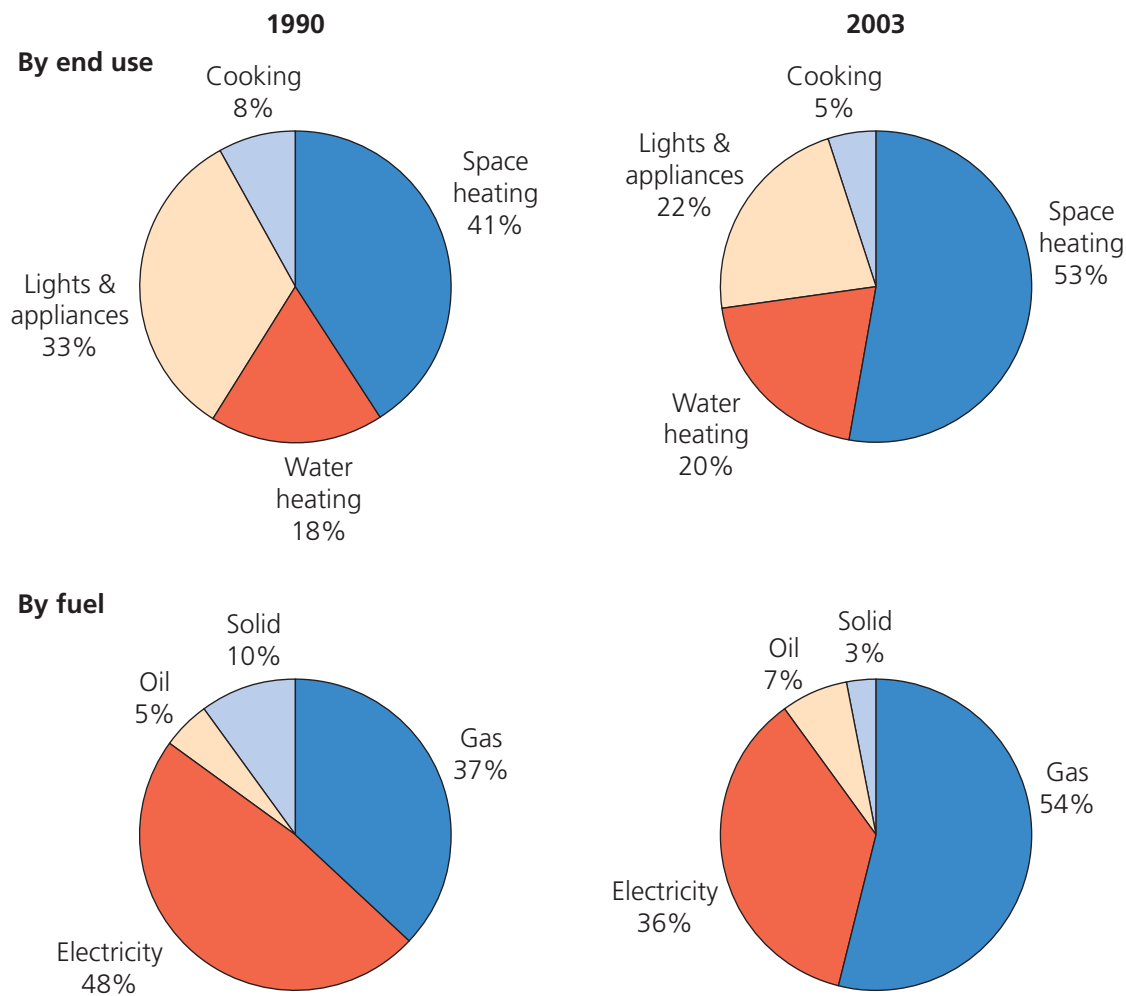
5. Over 2000-10, before the effects of policies in this programme are taken into account, emissions under Business as Usual (BAU) would now be expected to remain almost constant, increasing by only 0.3 MtC, from 39.8 MtC in 2000 to 40.1 MtC in 2010. However, policy savings, which are calculated net of BAU savings, are expected to reduce annual emissions by 4.8 MtC below the BAU emissions figure for 2010, so that emissions in 2010 are projected to be 35.3 MtC. These policy savings consist of 3.6 MtC from policies in the 2000 programme and a further 1.2 MtC from the new measures introduced in this programme. These savings will keep us on track to meet our 2010 targets for household energy efficiency².

6. As with the previous decade, the very small net change in estimated BAU emissions for 2000-2010 is the result of several larger effects: this time, they more or less cancel out.

These are:

- upward pressure from service demand increases (slightly less than in the 1990s as gas central heating installations saturate) at nearly 25 per cent, i.e. around 8.5 MtC;
- decreases from the background level of energy efficiency improvement (ie before the additional effects of policies are counted), very similar to that over 1990-2000, at 12 per cent, i.e. around 4.5 MtC;

Domestic carbon emissions



Source: Defra

² Our targets are: savings of 3.5 MtC from households in England by 2010 (as set out in the Energy Efficiency Action Plan 2004, in fulfilment of the Sustainable Energy Act 2003); and to improve household energy efficiency in England by 20 per cent by 2010, from a 2000 baseline (Housing Act 2004).

Domestic

Greenhouse gas emissions from the domestic sector, MtC

Gas	Base year	1990	1995	2000	2004	2010	2015	2020
Carbon dioxide	42.4	42.4	39.1	39.8	41.7	36.5	38.0	36.0
Methane	3.2	3.2	2.3	1.6	1.2	1.2	1.0	0.8
Nitrous oxide	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.1
HFCs	0.1	0.0	0.1	0.6	0.7	0.8	0.8	0.8
Total	45.9	45.8	41.7	42.1	43.7	38.7	39.9	37.7
Change from base year			-9.2	-8.3	-4.7	-15.8	-13.0	-17.9

Note: the percentage changes and emission estimates may differ slightly due to rounding

Existing measures	Carbon savings in 2010 (MtC)
EEC (2002-05)	0.4
EEC (2005-08)	0.6
EEC (2008-11)	0.6*
Building Regulations 2006 including 2005 condensing boilers update	0.8
Building Regulations 2002	0.7
Warm Front and fuel poverty programmes	0.4
Other measures	0.2
TOTAL	3.6³

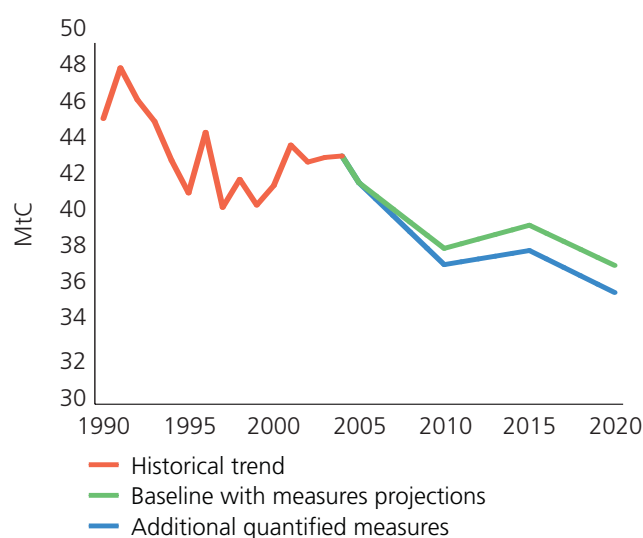
*Note: This does not include the proposed increase to EEC savings – see below.

- smaller reduction than in the 1990s from changes in the generators' fuel mix, probably around 3 MtC; and
- a net reduction from smaller factors, i.e. around 1 MtC.

The overall Business as Usual (BAU) effect is projected to be a small increase of 0.3 MtC over the decade.

7. The main sources of other greenhouse gases from the domestic sector are methane from domestic waste disposed in landfill and hydrofluorocarbons from domestic refrigeration. Landfill methane emissions are expected to be around 70 per cent lower in 2010 than 1990, as a result of measures to collect and burn landfill gas and reduced waste disposal in landfill. Hydrofluorocarbon emissions are expected to increase from 0.1 to 0.8 MtC from 1990 to 2010, due to their use as replacements for ozone-depleting refrigerants.

Projections of greenhouse gas emissions from the domestic sector and the estimated effect of additional quantified measures, MtC



³ Figures may not add up due to rounding

Additional measures	Carbon savings in 2010 (MtC)
Increased activity in EEC (2008-11)	0.5*
Provision of advice to stimulate early replacement of inefficient boilers and implementation of the Energy Performance of Buildings Directive	0.2
Package of measures to improve energy efficiency in buildings	0.1
Better billing and metering	0.2
Products Policy: consumer information and standards for lights and other energy-using products (EUPs)	0.2
TOTAL	1.2

* This is the median figure from the range of proposed EEC (2008-11) levels

Energy Efficiency Commitment (EEC)

8. The Energy Efficiency Commitment (EEC) is the principal policy mechanism driving increases in the efficiency of existing homes. Under EEC, electricity and gas suppliers are required to achieve targets for the promotion of energy efficiency improvements in the domestic sector. These targets do not prescribe how suppliers should attain these improvements. Suppliers can fulfil their obligations by carrying out any combination of approved measures including installing insulation or supplying and promoting low-energy light bulbs, high efficiency appliances or boilers. The only constraint on the suppliers' activity is that they must achieve at least half of their energy savings in households on income-related benefits and tax credits.



9. The first phase of EEC ran from April 2002 to March 2005. Energy suppliers successfully met their targets and were able to bank additional activity into the next phase of the scheme. EEC 2002-05 is expected to save 0.37 MtC annually by 2010. The current phase of EEC running from April 2005 to March 2008 will deliver roughly double the level of activity of EEC 2002-05 and is expected to achieve carbon savings of around 0.62 MtC annually by 2010.
10. Since April 2002 EEC has delivered energy saving measures to consumers, with overall cost-effectiveness of about £300 per tonne of carbon saved (i.e. net benefits) and costs to suppliers of around £3.20 per customer per fuel year⁴. The assumed average cost of the current phase of EEC to energy suppliers is estimated at less than £9 per fuel per customer per year. To put this indicative figure in context, energy bills in Great Britain currently average around £340 and £530 per year for electricity and gas respectively⁵, so this contribution equates to around 2 per cent of household bills. On average, these costs will be more than outweighed, by the end of EEC2, by the benefits householders enjoy in the form of reduced fuel bills or increased comfort from installing the subsidised energy efficiency measures on offer. These benefits continue for the lifetime of the measure⁶.
11. The Energy Efficiency Innovation Review⁷ looked in detail at the scope to further expand EEC, and has concluded that it would be feasible and cost-

⁴ Assessment of EEC 2002-05 Carbon, Energy and Cost Savings, (Defra 2006), www.defra.gov.uk/environment/energy/eec/pdf/eec-assessment.pdf

⁵ Source: Energywatch, March 2006.

⁶ Assuming around 12 years for appliances and 40 years for cavity wall insulation, for example

⁷ www.defra.gov.uk/environment/energy/eeir/index.htm

Domestic

effective to do so. However, an increasing share of EEC activity is likely to come from the installation of insulation in privately owned homes, compared to the earlier years when activity in social housing predominated.

Awareness needs to be raised to increase demand. **To encourage consumers to take up energy efficiency measures, the Government is launching a major new initiative, working closely with local authorities, energy suppliers and others to help overcome consumers' reluctance to invest in measures, with funding of £20m over the next two years.**

12. With the current phase of EEC underway for less than a year, it is too early to set a firm target for the next phase. **The Government believes that in its third phase, which runs from 2008-11, the Energy Efficiency Commitment could offer more options for delivery of carbon savings, with a larger range of eligible measures and more scope for innovation and competition among companies to encourage consumers to reduce their energy demand.**

The scheme must, however, remain cost-effective and practical and the overall policy framework needs to continue to take account of wider social considerations. The design and scale of the scheme will be set following the review (which has already started) and public consultation in 2007. **The Government believes that it could deliver about 0.9 to 1.2 MtC per year by 2010.**

13. The Government intends to **consider with all stakeholders how to provide as much flexibility as possible in the range of measures that can be employed to meet EEC targets, for example microgeneration, renewables, smart metering and behavioural measures.** Legislative amendments currently being considered as part of the Climate Change and Sustainable Energy Bill would allow the Government more flexibility in extending the range of measures suppliers could use to meet obligations in the domestic sector. The provisions would only be implemented following full analysis and consultation on the practical

implications, potential benefits and disbenefits of such an approach, and would be included in our consultation process for the next phase of the EEC.

14. The Government recognises the important role that market mechanisms can play in delivering environmental benefits at least cost and in a way that gives flexibility and stimulates innovation by business and has therefore commissioned a study to critically evaluate existing mechanisms and the potential to introduce new market-based mechanisms to deliver energy efficiency, with a particular focus on households. The Government has recently published this work and will use its conclusions to inform the EEC review, particularly the question of whether and if so, how enhanced trading should be incorporated into the EEC framework from 2008.
15. The Government also recognises that appropriate transitional arrangements between one phase of the EEC and the next are essential to ensure effective delivery of higher targets. **The Government intends to allow unlimited carry-over of activity from the current phase of EEC to the next and will establish effective transitional arrangements following appropriate consultation and analysis providing clarity as soon as possible on practical arrangements.** Budget 2006 announced that suppliers will be able to count extra work carried out in this EEC period towards their targets in the next period. As a result, British Gas, EDF, npower, PowerGen, and Scottish and Southern Energy have already announced that they will carry out between them an extra 250,000 subsidised installations of home insulation over the next two years. This will bring forward annual carbon savings of 35,000 tonnes and reduce annual household bills by around £20 million.

Building Regulations

16. Building Regulations⁸ are steadily driving up the energy standards of new and refurbished buildings. Since 1990, the energy efficiency of new buildings has increased by 70 per cent. For example, a house built to the 2002 standards uses about half the energy consumed in the average existing house. The 2002 Building Regulations are expected to deliver reductions in carbon dioxide emissions in 2010 of 0.7 MtC in the domestic sector.
17. In September 2005, the Government announced further changes to the Building Regulations to make buildings more energy efficient. From April 2006 these new measures will deliver increased energy efficiency standards for new buildings of up to 27 per cent in non-domestic buildings, 22 per cent in houses and 18 per cent in flats. On average the energy efficiency improvement in dwellings will be 20 per cent, which reflects the growing proportion of flats being built with more people now living alone.
18. The new measures, taken together with the 2002 revisions, will improve new build standards of energy efficiency by 40 per cent and cut fuel bills by up to 40 per cent for new homes built from 2006 compared to pre-April 2002 new build. The latest changes to new building standards and requirements for condensing boilers are expected to deliver carbon savings of around 0.75MtC per year by 2010⁹. One provision of the revised Building Regulations came into force in April 2005, requiring all new and replacement boilers to be at least B-rated condensing boilers, subject to some exemptions. This has been a major success and has had the effect of rapidly increasing the market share of the most efficient condensing boilers.
19. The Building Regulations do not currently address the fabric of a significant proportion of the existing building stock, which dominates the overall impact of buildings. There is significant potential to reduce carbon emissions further through an improvement



in the energy efficiency performance of existing buildings. **The Government is currently undertaking a wide-ranging review to identify measures to improve the sustainability of the existing building stock, including energy efficiency and will put recommendations to ministers by the summer of 2006.**

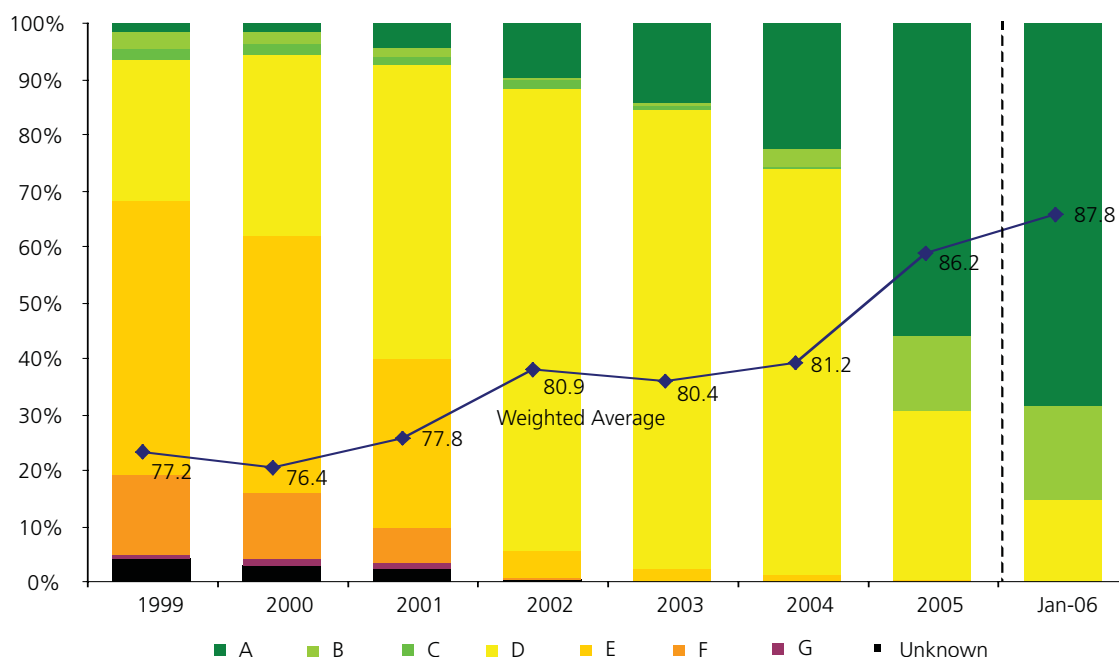
20. The Government is aware of the need for greater compliance with the Building Regulations. Therefore, as part of the 2006 revisions to the Building Regulations, the Government has engaged in an unprecedented dissemination programme aimed at ensuring that all stakeholders can acquaint themselves with the changes and what they mean in practice. This programme includes "train-the-trainer" workshops for over 200 industry trainers, seminars and regional road-shows for Building Control Bodies. An e-learning pack that walks through the new Part L as applied in an example building situation will be issued to every Building Control Surveyor. We have also introduced a requirement for random sample air leakage testing of buildings. This will help secure better compliance by showing where there is unacceptable air leakage, which can reduce the energy efficiency of the building.

⁸ The same Building Regulations do not apply UK-wide: those in England and Wales are shared, while Northern Ireland and Scotland have separate Regulations.

⁹ Note that the carbon savings quoted here are larger than those recently published by the Office of the Deputy Prime Minister (ODPM), for a number of reasons: the figure here applies to the UK (ODPM to England and Wales only), include savings for an additional year, allow for increased demand for comfort and hot water by 2010, and assume a slightly larger number of boiler replacements each year.

Domestic

Transformation of the market for domestic boilers 1999-2005: boiler deliveries by efficiency (coloured bands) with increasing average efficiency (black line) (Source: Society of British Gas Industries)



Code for Sustainable Homes

21. The Code for Sustainable Homes will set out voluntary standards beyond those required by Building Regulations and further contribute to decreasing the environmental impact of housing growth. The lowest level will be above Building Regulations. It will cover a range of environmental impacts including energy, water and waste, with minimum standards of energy and water efficiency at every level of the Code. This will ensure that builders cannot trade energy and water efficiency for other kinds of improvements. To encourage on site energy generation, new homes that use micro-renewable technology such as wind turbines will gain extra Code points.

22. Importantly, the Code will form the basis for the next set of improvements to building regulations to ensure that industry can have certainty in the longer term regarding the minimum levels they will be expected to build to. The Code will apply to all new buildings, with the initial focus on new housing.

23. Once the Code is launched, all new homes funded by the Government or its agencies, including through relevant public-private partnerships, will have to meet Code level 3. As an interim measure, these homes will have to meet the new EcoHomes Very Good 2006 standard from 1 April, which is broadly equivalent to Code level 3. The Government is now looking at how to encourage new homes to be built to the highest levels of the Code.

Setting an example

The Government, working with partners, including English Partnerships, is showing leadership in creating exemplar sustainable new settlements in the growth areas, of which Northstowe, Cambridgeshire will be one of the first.

Energy Performance of Buildings Directive

24. The Government will also be implementing elements of the EU Energy Performance of Buildings Directive (EUPD) from April 2006¹⁰. The Directive lays down requirements on the application of minimum standards for the energy performance of new buildings and on the performance of large existing buildings undergoing major renovation. It also requires the provision of energy performance certificates when buildings are constructed, sold or rented out, and the display of these certificates in public buildings over 1000m².
25. One of the key provisions of the Directive is the regular inspection of boilers, or an equivalent national advice system, and the inspection of air conditioning systems in buildings¹¹. We estimate that the effect of this, including the early replacement of boilers brought about by advice could deliver additional savings of up to 0.2 MtC in 2010.
26. Other key provisions of the Directive are:
 - minimum energy performance requirements for all new buildings;
 - minimum energy performance requirements for large existing buildings subject to major renovation; and
 - requirement to consider renewable energy and CHP in new buildings over 1000sqm.
27. The energy used in buildings represents around 45 per cent of carbon dioxide emissions in the UK. There is significant potential for cost-effective energy savings in the stock of existing buildings – only some 2 per cent of the building stock at any given time is under construction or undergoing refurbishment that is subject to current Building Regulations.
28. Given this potential, we have commenced a review of the existing building stock as mentioned earlier in the chapter. It will not only examine what more can be done to improve energy efficiency but go further and consider how existing buildings can make more efficient use of other resources – especially water. The review will be wide ranging and cover the whole spectrum of tools available to us from regulatory and non-regulatory measures to demonstration through leadership and market pull. It will identify cost effective measures that can be readily employed to improve the sustainability of the existing building stock.
29. The Government is exploring what more can be done to implement the EPBD in ways that encourage greater carbon savings.
30. In the Energy Efficiency Action Plan we committed to procuring buildings in the upper quartile of energy performance. The technical basis for this commitment will be developed as part of ODPM's work to develop the non-domestic energy rating methodologies necessary under the Energy Performance of Buildings Directive.
31. Better communication and advice is highlighted as one way of tackling the failure to recognise the economic case for energy-saving measures. One means through which the Government will be delivering this is the requirement of the Energy Performance of Buildings Directive for an energy performance certificate to be made available to the prospective owner or tenant when buildings are constructed, sold or rented out. Home Information Packs, being introduced in June 2007 under the Housing Act 2004, will deliver this for residential properties on marketed sale. The Packs will include a 'Home Condition Report', part of which will be an energy survey for prospective buyers that will specify the energy efficiency of the property. The survey will also provide information on energy efficiency measures together with a potential SAP rating¹² that the property could achieve if those measures were carried out.
32. **The Government estimates that the Sustainable Buildings Code, the Energy Performance in Buildings Directive, the commitment on procuring public buildings,**

¹⁰ www.europa.eu.int/eur-lex/pri/en/oj/dat/2003/L_001/L_00120030104en00650071.pdf

¹¹ In accordance with article 8(b) of the Energy Performance Buildings Directive.

¹² The Standard Assessment Procedure is the Government's recommended system for energy rating of dwellings.

and further measures coming out of the review of the existing building stock, together could deliver additional carbon savings of 0.1 MtC in 2010. ODPM and Defra will work together to establish how this level of carbon savings could be delivered. In addition to this, the provision of advice to stimulate the early replacement of inefficient boilers and the effective use of heating and hot water controls could deliver additional carbon savings of up to 0.2 MtC in 2010.

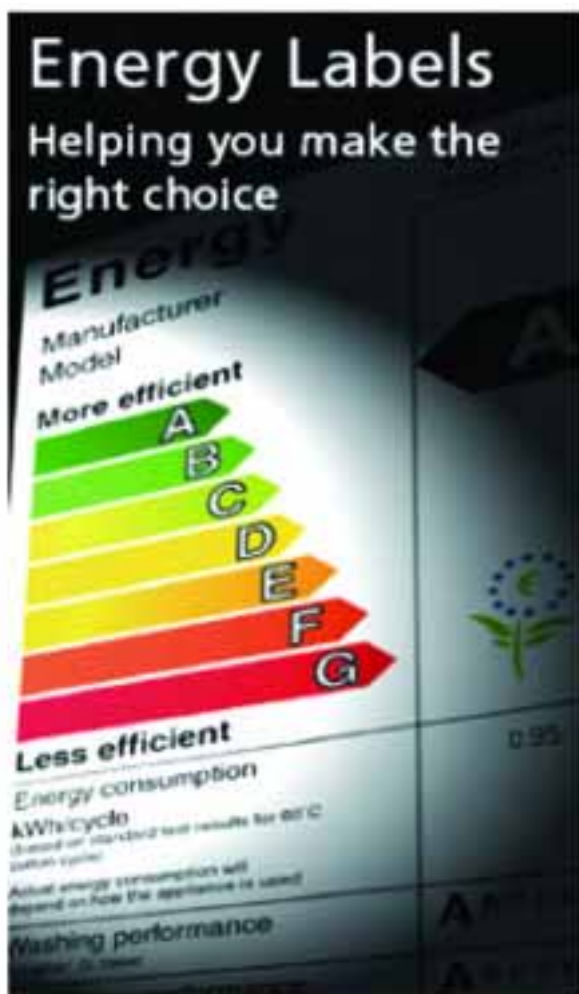
Encouraging consumer choice and raising standards

33. Most household energy is used by gas heating equipment. Nevertheless almost a quarter of all the electricity used in the UK is used by domestic appliances and lighting systems. As products such as washing machines and TVs achieve near universal take-up, new services, such as digital TV and broadband communications, pose new challenges. Not only are these appliances energy-hungry, but also, as users, most of us are also energy-lazy. For example, we leave appliances to consume around £650m worth of electricity annually (£25 per household) while on standby and power supplies and chargers permanently plugged in.
34. Our targets for saving energy in households depend on a policy package which, over time, removes the inefficient products from use, and builds markets for the most resource efficient goods and services. Consumer education is important, encouraging better behaviours and raising expectations that goods and services should be designed to be energy efficient and not waste energy. But there is also the need for Government to work with industry to set and to drive up product performance standards that can meet those expectations.
35. The Government's Market Transformation Programme (MTP)¹³ works with industry and other stakeholders to drive and underpin sustainable improvements in the energy efficiency and other environmental characteristics of products. It does this via policy measures which assess and rank the performance of energy-using products, establish performance information, including labels, to encourage innovation and competition, and identify appropriate levels for rising minimum, average, or best practice standards which show how product performance would need to develop over time if the sustainability commitments are to be met.
36. The Government committed last July in Gleneagles to promote an international 1-Watt Initiative to reduce these emissions, and is concerned that progress in reducing them is too slow. The Government believes that voluntary agreements can be an effective way to raise standards and reduce carbon emissions. **Budget 2006 announced a new initiative, in partnership with major retailers and the Energy Saving Trust, to introduce voluntary schemes in the retail sector that encourage the purchase of more energy efficient alternatives in consumer electronics.**
37. The Eco-design of Energy Using Products (EUP) framework Directive now provides a formal mechanism for establishing product standards. EUP permits Member States and the EU to signal to industry their product innovation priorities, to negotiate and, if necessary, to set mandatory energy and other eco-design requirements for energy-using products which are placed on the EU market. The Commission estimates that this measure alone could reduce EU energy consumption by around 10 per cent¹⁴. Clearly, if successful, this could avoid the costs that can arise from overlapping national programmes which aim to achieve the same result. EUP will integrate with a wide range of existing EU measures dealing with the energy performance of domestic appliances including mandatory energy labelling of domestic appliances, minimum standards directives which remove the worst performing appliances from the market place and a number of existing industry self commitments. Although the focus of the directive is on setting mandatory standards, a clear intention is to encourage voluntary action by manufacturers to improve their products, which would make

¹³ www.defra.gov.uk/environment/consumerprod/mtp/ and www.mtprog.com/

¹⁴ By way of comparison, a recent IEA study on energy savings in California attributes 30 per cent of all energy saved to product standards of the type envisaged in EUP.

regulatory action unnecessary. **The Government would prefer voluntary agreements where they are effective and has already committed to proactively follow this policy approach and, supported by the Market Transformation Programme, is actively determining UK priorities to negotiate with the Commission and other Member States. The Commission has identified 14 priority product sectors including consumer electronics, lighting, heating, white goods and electric motors.**



- **industry voluntary agreements** – such as the new initiative mentioned above and the Code of Conduct on Digital TV Services. As a result of this code over half the set-top boxes in UK homes now consume significantly less than they would have done and the UK has been able to avoid carbon emissions of an estimated 0.4 MtC per annum at virtually no cost;
- **embedding product standards into Building Regulations** – such as raising the standards of new and replacement boilers through the Building Regulations;
- **product endorsement** via schemes such as the Energy Saving Trust's 'Energy Saving Recommended' logo;
- **procurement policy** – the Government and the wider public sector can use their market leverage to promote energy efficient products and buildings. The UK Procurement Task Force is due to publish an action plan in April 2006; and
- **the International Task Force on Sustainable Products** – a UK initiative, responding to G8 and wider international commitments to promote more co-operation on labelling and standards policy, encouraging international benchmarking, looking ahead at least 10-20 years.

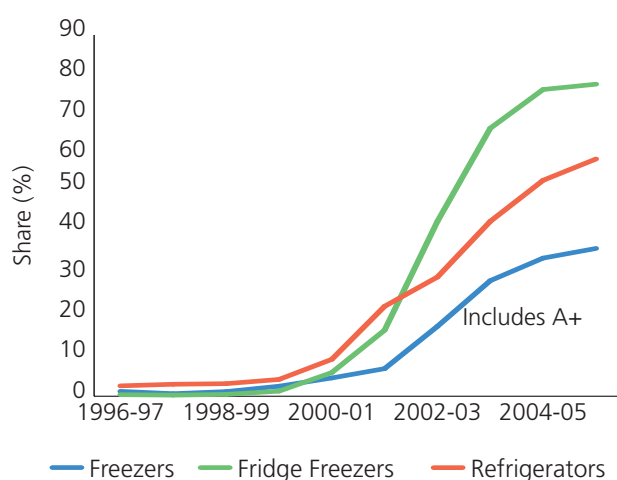


38. The first implementation measures under EUP will be introduced at the earliest in 2008 and therefore the Government is actively pursuing other measures, both in the UK and internationally, to raise product standards. These include:

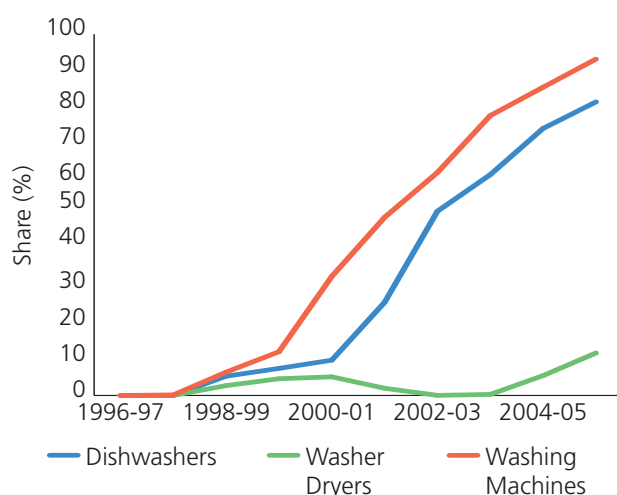
Domestic

39. Statutory labels¹⁵ providing relative performance information for traded goods need to be established at the EU level but are often supported by additional national schemes promoting the best appliances, for example the Energy Saving Trust's Energy Saving Recommended logo¹⁶. In conjunction with the Energy Efficiency Commitment, regulations and other policy instruments, labelling has transformed the market for key domestic appliances as shown below.

Market Share of A Rated Cold Appliances (Source: GfK Retail Audit)



Market Share of A Rated Wet Appliances (Source: GfK Retail Audit)



Consumer engagement

40. The Energy Saving Trust's (EST) activities are designed to underpin and complement the work of other actors in energy efficiency markets. In particular it seeks to work with key Government

policy drivers for domestic energy efficiency – EEC, Warm Front, Decent Homes and Building Regulations. Its principal activities are aimed at increasing demand for energy efficiency by raising awareness, providing advice and support for action. It also supports the supply of energy efficiency products and services to meet this demand by developing partnerships, stimulating innovation, supporting training and providing accreditation.



41. The EST's energy efficiency activity is grant funded by Defra. The Trust also receives funding from Scottish Executive, from the Department of Transport to run transport programmes and from the Department of Trade and Industry to run renewable energy programmes.
42. The EST is piloting the development of a Sustainable Energy Network (SEN), a network of regional delivery agencies that aims to support national awareness raising of sustainable energy and translate householder awareness into practical action. EST has set up three Sustainable Energy Centres which build on the approach of existing Energy Efficiency Advice Centres by providing increased resources, more support for action and covering small-scale renewable energy and transport as well as energy efficiency. Defra has provided additional funding of £10m over three years for the SEN Pilot.
43. An increasing share of energy efficiency activity under EEC is likely to come from the installation of insulation in privately owned homes, compared to the earlier years when activity in social housing predominated. The Energy Efficiency Innovation Review identified barriers to the uptake of energy efficiency measures that will need to be overcome:

- the widespread misapprehension about installing insulation with regard to its costs, benefits, and the disruption it causes; and

¹⁵ The mandatory EU Energy label currently covers domestic refrigeration appliances, washing machines, electric tumble dryers, washer dryers, dishwashers, lamps, electric ovens and air conditioners (see www.defra.gov.uk/environment/consumerprod/energylabels/index.htm)

¹⁶ www.est.org.uk/myhome/efficientproducts/recommended/

- consumers' lack of confidence in offers made by energy suppliers and the installation industry, and lack of awareness of the independent 25-year guarantees for cavity wall insulation fitted by registered installers.

44. The EEIR also recognised that acting alone, the EEC suppliers are unlikely to be able to tackle these barriers. As part of the Government's ongoing work to help overcome these barriers, we will continue to highlight the benefits of energy efficiency measures and the links between what EEC offers and our wider climate change targets. As set out above, the Government will launch a £20m programme, working closely with local authorities and energy suppliers, to help raise levels of consumer demand for energy efficiency measures.

Energy Services

45. In January 2006, HM Treasury hosted a high-level summit to explore the potential for energy services – energy services is a shift away from providing units of energy towards a focus on the services delivered from the use of energy. Energy services appear to have the potential to overcome a number of the barriers to delivery of efficiency in the domestic sector. Participants agreed that growing public awareness of climate change and high energy prices provide new opportunities for alternative ways to deliver energy. Following the summit, an independent industry group has undertaken to explore options for energy services, and to contribute to the Energy Review process.

Billing and metering

46. Providing customers with better information about their energy use and its costs may encourage energy-saving behaviour among households, such as switching off unnecessary lights and appliances, or purchasing more efficient products. 'Smart' electricity and gas meters and associated feedback devices can provide real-time information on energy costs to users in a more visible way than a regular bill.

47. **The Government is committed to seeking measures to achieve savings of 0.2 MtC by 2010 through better billing and metering in the UK** and believes one way this could be achieved is if all new and replacement meters are 'smart' meters, also providing consumption feedback. More informative billing and feedback devices attached to existing meters can also play a role. However, there is considerable uncertainty about the scale and duration of these carbon savings. **The Government announced at Budget 2006 a £5m fund to co-finance with energy suppliers a pilot study of feedback devices such as 'smart' energy meters that could potentially reduce energy demand and facilitate other market efficiencies.**

48. Smart meters have not only the potential to reduce consumption but they could also be a useful tool for reducing peak loads e.g. via time-of-day tariffs. Smart meters can therefore contribute to improving energy security, as some network re-enforcement and new generation capacity could be avoided. Smart metering could also be beneficial for addressing fuel poverty, by helping consumers to better manage their energy use and avoid waste. In addition, meters with an "import-export" facility are required for any consumers installing micro-generation such as small scale wind, solar (PV) panels or micro-CHP.

49. Despite their potential benefits very few smart meters have been installed in the UK. Ofgem's recent review of metering looked at international experience of smart metering and, in the light of this evidence, examined the potential costs and benefits of innovative metering in the UK context. Ofgem conducted a public consultation, which closed in March. The results are due in May 2006 and will inform the nature of the pilot study and future decisions on what measures need to be taken to secure carbon savings and other benefits from improved metering and billing.

50. The recently agreed Energy End-Use Efficiency and Energy Services Directive will require installation of 'actual time of use' metering for all new connections and for replacement meters

where “technically possible, financially reasonable and proportionate to the potential savings”.

Economic instruments

51. In line with its 1997 Statement of Intent on Environmental Taxation, the Government has used the tax system to support progress towards environmental goals. Fiscal measures – as part of a range of measures – can help to address market failures. In 1998, the Government introduced a reduced VAT rate of 5 per cent VAT for the grant-funded installation of certain energy-saving materials (ESMs) in the homes of elderly, less well off and vulnerable households. This reduced VAT rate applied to all insulation, draught stripping, hot water and central heating controls. In Budget 2000, the Government extended this scheme to all households, even if the service is not grant funded. Budget 2000 and 2002 also introduced further reduced VAT rates for ESMs when they are part of grant-funded installations into vulnerable households – including central heating systems, heating appliances, and factory-insulated hot water tanks.
52. The Government has also introduced reduced VAT rates for microgeneration in order to support the development of micro technologies that use renewable energy sources and can help to improve energy efficiency. Since Budget 2000, reduced VAT rates have been introduced for solar panels; micro wind and water turbines; ground source and air source heat pumps; micro-combined heat and power (micro-CHP); and wood fuelled boilers.
53. The Government consulted in 2002 and 2003 on the possible use of economic instruments for domestic energy efficiency. Responses indicated that there was little incentive for private landlords to improve the energy efficiency of the residential properties that they let, as the benefit of investment often flows to the tenant rather than to the landlord. In response to this, the Government introduced the Landlord's Energy Saving Allowance (LESA) in 2004. This offers up-front relief (up to £1500) for capital expenditure on investment in cavity wall and loft insulation. This was extended in 2005 to include solid wall insulation, and again in 2006 to include draught proofing and hot water system insulation. The Government will also seek to improve awareness of LESA among landlords, and examine the possible extension of LESA to corporate landlords.
54. In the 2005 Pre-Budget Report, the Government also announced that it intended to implement a Green Landlord Scheme by reforming the existing Wear and Tear Allowance and making it conditional on the energy efficiency level of the property. The Government continues to explore how the Allowance should be reformed to make it incentivise landlords to invest in the energy efficiency of their properties, with a view to introducing the new allowance structure alongside the forthcoming Energy Performance Certificates.

Tackling fuel poverty

55. Fuel poverty¹⁷ is caused by a combination of poorly insulated, energy inefficient housing and low incomes. The latest available figures¹⁸, indicate that the number of fuel poor households had fallen between 1996 and 2003. The published figures show that there were approximately two million households in fuel poverty in the UK in 2003, down from six and a half million in 1996. Of this figure, around one and a half million vulnerable households were in fuel poverty in the UK in 2003, down from five million in 1996. However, it is expected that recent increases in energy prices will have begun to reverse the process that has been made to date. Analysis of the overall effects of changes in fuel prices and incomes, excluding consideration of energy efficiency improvements, suggested that the total number of vulnerable households in fuel poverty is likely to rise by around one million households in England between 2003 and 2006, with proportional rises in the Devolved Administrations.
56. In *Fuel Poverty In England: The Government's Plan for Action*, published in November 2004, the Government set out how the 2010 target in

¹⁷ A household is in fuel poverty if in order to maintain a satisfactory heating regime it would be required to spend more than 10 per cent of its income (including Housing Benefit or Income Support for Mortgage Interest) on all household fuel use

¹⁸ Taken from *The UK Fuel Poverty Strategy: Third Annual Progress Report*, published in July 2005.

England¹⁹ will be met and announced extra funding of £140m between 2005-08 to tackle fuel poverty. This has since been boosted by the announcement in the 2005 Pre-Budget Report of an additional £300m over the same period to tackle fuel poverty across the UK. £250m of this funding will help tackle fuel poverty in England, taking total fuel poverty funding over the 2005-08 period to over £800m. Carbon dioxide savings from Warm Front and other fuel poverty programmes are expected to be 0.4 MtC by 2010.

57. The document also set out a number of changes to the Warm Front Scheme, the Government's key tool for tackling fuel poverty in the private sector in England, which seeks to target vulnerable households to provide a range of heating and insulation measures that can be tailored to suit each individual property. These changes have now been implemented. Warm Front now offers central heating to all eligible households and gives them the option to receive the full range of appropriate measures over a period of time, subject to the maximum amount of grant that can be paid. Since the launch of the Scheme in June 2000, over one million households have been assisted.
58. A range of challenges lie ahead in tackling fuel poverty. The Energy Review will consider whether there are any further steps that the Government, working with a wide cross-section of key stakeholders, can take to ensure we meet our UK goal of eradicating fuel poverty by 2016-18.

Decent Homes Standard

59. Since 2001 there has been a 31 per cent reduction in the number of social sector homes failing the Decent Home standard on the thermal comfort criterion (from 1.3 to 0.9 million homes), which is a key criterion of the standard. Also since 2001, over 470,000 dwellings have received work to improve their energy efficiency under the decent homes programme or as part of wider local authority work to update the stock. This work is continuing. Local authorities typically work very closely with EEC suppliers when

tackling their housing stock, so most of the carbon savings from the Decent Homes programme are attributed to EEC, and to a lesser extent to Building Regulations. But some additional activity does take place that is not accounted for elsewhere, and savings from this are conservatively estimated at 0.02 MtC per year.

60. The average SAP rating²⁰ of the social sector stock rose to 58 by 2004 from 48 in 1996 and is likely to rise further over the coming years. The Decent Homes standard is a 'trigger point' for action to improve energy efficiency. As social landlords undertake works beyond the standard, energy efficiency improvements are continuing, in turn reducing carbon emissions.

Community Energy

61. In January 2002, the Government launched Community Energy, a £50m UK-wide capital programme for installing and refurbishing community heating. Schemes are mainly based on CHP with innovative approaches also encouraged. The funding was provided by Treasury's Capital Modernisation Fund.
62. In December 2004, Defra announced an extra £10m to extend the programme. The decision to do this was based on initial strong demand and a number of larger schemes with significant outputs. However, experience has shown that many larger schemes under the initial programme could not complete within the 31 March 2007 spend deadline and did not go ahead. The smaller schemes that can complete tend to be expensive in relation to their outputs. The following table summarises how the programme has delivered against its targets and shows that the programme has fallen well short of delivering its objectives on all fronts.
63. The high drop out rate for larger schemes is the main reason for the limited estimate of spend. The situation would not improve appreciably if we extended the spend deadline, as these larger schemes cannot complete within a timescale

¹⁹ "To eradicate fuel poverty in vulnerable households in line with the Government's fuel poverty strategic objective".

²⁰ SAP (2001) rating is on a scale from 1 to 120. This will be replaced on the 6 April 2006 with the SAP (2005) rating scale which comes into effect with the Building Regulations.

suitable for government funding, in some cases after 2010.

64. The review of the 2000 Climate Change Programme has given us the opportunity to conduct a wide ranging appraisal of the effectiveness of existing climate change policies. In the light of the considerations above we have decided to neither extend the time span for the £50m programme nor continue with the £10m extension. In considering the relative cost-effectiveness of programmes, we have decided that there are other programmes that more cost-effectively deliver carbon savings. These include taking forward support for biomass community heating through the new heat support scheme, which will include CHP.

Comparison of outputs against targets for the Community Energy programme

	Programme targets	Estimated programme outputs
Funding	£50m	£22.3m (45%)
Carbon Savings (tC/yr)	150,000	19,481 (13%)
Leverage of other funding	£200m	£50m (25%)
CHP capacity (MWe)	130	28.9 (22%)
People on low incomes helped	100,000	18,453 (18%)

The agriculture and forestry sector contributes 7 per cent of UK greenhouse gas emissions. The major focus is on non-CO₂ gases, with, in 2004, this sector accounting for 46 per cent of methane and 66 per cent of nitrous oxide emissions, but only 1 per cent of carbon dioxide. Annual total emissions fell by 22 per cent between 1990 and 2004, with methane emissions reducing by 13 per cent, and nitrous oxide emissions by 17 per cent.

The major issue for this sector is in tackling direct emissions of nitrous oxide and methane emissions, rather than carbon dioxide emissions. The agriculture and forestry sector has a contribution to make to creating a low carbon economy through the production of bioenergy. Agriculture and forestry is the first sector to feel the direct effects of a changing climate. The challenge is to adapt to new threats and opportunities, whilst still maintaining a sustainable agriculture and forestry sector. As with many other sectors climate change has not, until recently, been a priority. This programme seeks to raise awareness of the issues across the sector and develop measures for the sector to allow it to play a full part in tackling climate change.

Since 2000 we have introduced the Energy Crops Scheme, the Bioenergy Infrastructure Scheme and an overarching Non-Food Crops Strategy, saving 0.1MtC by 2010.

In addition the Government is committed to:

- Promoting **resource efficient farm management**, including making the best use of the latest research findings and technology, in order to reduce nitrogen and other inputs which contribute to greenhouse gas emissions.
- Examining the scope and feasibility of a **market based mechanism** to facilitate trading of greenhouse gas reductions from agriculture, forestry and other land management sectors.
- Developing a **communications strategy** to raise awareness and communicate climate change issues to land managers.
- Exploring how **Environmental Stewardship** can make a greater contribution to achieving the Government's climate change objectives.
- Considering the case under the new **EU Rural Development Regulation** for providing support for land managers to establish energy crops and develop biomass and woodfuel supply chains.
- **Launching a further round of the Bioenergy Infrastructure Scheme** in 2006-07 to help further the development of biomass supply chains.
- Taking forward the **Non-Food Crops Strategy** to substitute renewable products for those based on fossil fuels.
- Ensuring that the development of measures under the **Catchment Sensitive Farming Programme and Nitrate Action Plan** also support our climate change goals.
- Engaging the **Rural Climate Change Forum** fully in delivering this programme.

Introduction

1. Agriculture, forestry and land management¹ have a key role to play in addressing climate change, by providing alternative energy sources and low energy materials, by helping to mitigate adverse
2. Action to address climate change issues in the land management sector forms a key part of the Strategy for Sustainable Farming and Food. The

climate change events, and by direct mitigation of greenhouse gas emissions from agriculture, forestry and land management activities.

¹ Agriculture and forestry are devolved issues and therefore while the discussion of land management's role applies to the UK, the specific policy measures discussed apply only to England except where otherwise noted.

Agriculture, forestry and land management

Government's priority is to facilitate a farming and food industry in this country which makes a major contribution to sustainable development. This means a partnership to:

- help UK farming and food industries compete successfully both at home and abroad;
- produce quality food and non-food products that the market will buy;
- ensure an appropriate reward structure for the positive contribution our farmed landscape makes to the countryside and the natural environment; and
- play an increasing part in tackling the biggest threat, climate change.

3. To date, most UK and EU agricultural, forestry and land management policies have not included greenhouse gas mitigation or climate change adaptation as specific goals. This means that identifying their precise contribution to addressing climate change can be difficult. In future, more explicit recognition of their contribution will be needed. This will also need to be consistent with the Government's intention to prepare and consult on a new PPS setting out how it expects participants in the planning process to work towards the reduction of carbon in the location, siting and design of new development.

4. Equally, the agricultural and forestry industries need to do more to ensure that climate change is regarded as a high priority. Agriculture and forestry are among the first activities to be directly affected by changes in climate, and are already beginning to adapt to climate change through, for example, new crops, changed planting and harvesting regimes, and dealing with new pest threats.

5. The Government believes that it is vital that land managers change their behaviour in order to help to deliver emission reductions, to allow them to take advantage of the opportunities to their businesses of adopting a resource efficiency approach, contribute to the shift to a low carbon

economy, and to incentivise innovation of all kinds. This chapter of the Climate Change Programme is intended to establish the context and set out the broad policy framework in which such change can take place.

6. A second element of the Programme is to ensure that future policies affecting land managers are 'climate change proofed' so that they deliver, directly or as an ancillary benefit, positive climate change outcomes.

Greenhouse gas emissions inventory and projections

7. Land management activities both absorb and release greenhouse gases. Although agriculture and forestry contributes to carbon dioxide emissions (primarily through the use of fossil fuels and electricity, as in other sectors), the major focus is on non-CO₂ gases, with agriculture accounting for 46 per cent of methane and nearly 66 per cent of nitrous oxide emissions in the UK in 2004². Emissions of these gases arise mainly from the digestive processes of animals, animal wastes, and fertiliser use.

8. Land management can help to remove carbon from the atmosphere through increases in forest coverage and organic matter in the soil, and avoidance of degradation of those stores and so avoid carbon loss. Woody and other non-food crops also have an important potential to provide renewable sources of energy and alternatives to fossil fuel based materials and products.

9. The Government funds a continuing programme of research looking at the contribution of different land management practices to greenhouse gas emissions. However, comparisons between different farming methods and land use change are complex and the research findings are dependent on the scale considered. Limited evidence comparing different farming systems is available, and reduced emissions in one greenhouse gas may be offset by increased emissions of another, so whole life cycle analyses are needed. The Government will continue to support research, at a cost of £1m over three

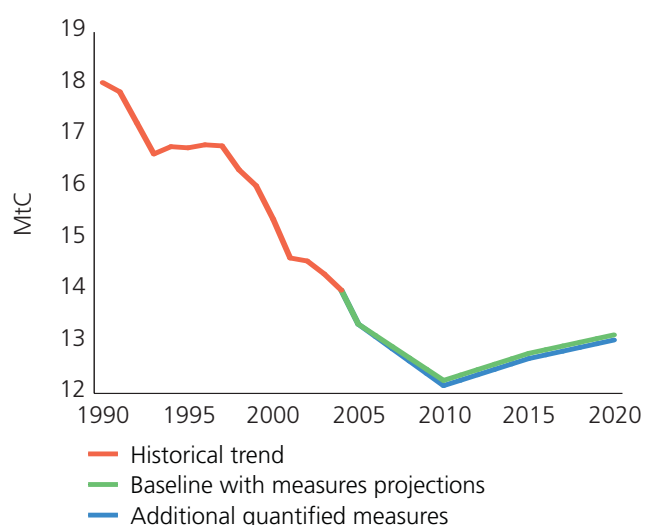
² <http://www.defra.gov.uk/environment/statistics/globalatmos/gagccukem.htm>

Agriculture, forestry and land management

years, to improve the inventory of emissions from agriculture and will continue to invest in research to improve the overall environmental performance of different farming systems, including organic, to improve our understanding of, and their ability to optimise their contribution to climate change objectives.

10. In 1990, greenhouse gas emissions from agriculture, forestry and land management were 18 MtC or about 9 per cent of the UK's total greenhouse gas emissions. This includes net emissions and removals from the land use, land use change and forestry (LULUCF) sector estimated to be 0.8 MtC in 1990 (see Annex F for the breakdown by gas). Annual emissions from agriculture, forestry and land management are estimated to have fallen by 22 per cent between 1990 and 2004, and are projected to continue to fall to 32 per cent below 1990 levels by 2010³.

Projections of greenhouse gas emissions from the agriculture, forestry and land management sector and the estimated effect of additional quantified measures, MtC



11. As is clear from the figures, the UK land management sector's potential contribution to addressing climate change arises at least as much from tackling methane and nitrous oxide as CO₂. Opportunities to reduce methane and nitrous oxide must therefore take a more important place than previously if this sector is to play its full part in addressing climate change.
12. Raising awareness of the issues and working with stakeholders to develop practical and sustainable options is vital to help land managers play their part in addressing climate change. There are a wide range of mitigation and adaptation options that offer benefits for land managers, the environment, and wider society.
13. The Government sees it as vital to highlight the challenges of climate change for land managers and to provide leadership in developing a policy framework that will encourage practical action. The Government set up the *Rural Climate Change Forum*⁴ (see box) as a high level forum for discussion, input into policy development, and communication with land managers on climate change mitigation and adaptation. The Forum has discussed practical actions for mitigation, how best to communicate key messages on climate change to this sector, and has advised the Government on the development of this Programme. It will also have a role in advising on the most effective ways to deliver this Programme.
14. To raise awareness in the land management sector of the risks, responsibilities and opportunities of climate change, the Government will put in place a sector specific communications strategy, as part of its wider Climate Change Communications Initiative. The Rural Climate

Greenhouse gas emissions from agriculture, forestry and land management, MtC

Gas	1990	1995	2000	2004	2010	2015	2020
Carbon dioxide	3.2	2.5	1.9	1.5	0.7	1.3	1.7
Methane	5.9	5.8	5.5	5.2	4.4	4.4	4.4
Nitrous oxide	8.9	8.5	8.0	7.4	7.1	7.1	7.0
Total	18.0	16.8	15.4	14.0	12.3	12.8	13.1
Change from 1990 levels		-7.0	-14.7	-22.3	-32.0	-29.1	-27.1

Note: the percentage changes and emission estimates may differ slightly due to rounding.

³ Largely due to reducing livestock numbers and more targeted input use.

⁴ For more information on the work of the Forum see <http://www.defra.gov.uk/web/environment/climatechange/uk/agriculture/rocf>

Rural Climate Change Forum

The Rural Climate Change Forum was launched in March 2005 to provide a high level forum for dialogue with Government, and authoritative advice and leadership for rural stakeholders, on climate change and rural land management.

The Forum's objectives are to:

- raise awareness among stakeholders at all levels about the impacts of climate change in rural areas through existing and/or new knowledge networks, to help develop and promote appropriate responses to climate change;
- identify, propose and promote practical actions and policy options, including the uptake of research findings:
 - to reduce and offset greenhouse emissions from rural land uses;
 - on adaptation measures for rural land uses (including for conservation purposes and new agricultural uses); and
 - on the potential for managing the impacts of climate change, e.g. Flooding, through changed land management practices.
- identify relevant research needs and priorities; and
- contribute to relevant policy review and development.

The Forum is co-chaired by Elliot Morley MP, Minister of State (Climate Change and Environment), Defra, and John Gilliland, Member of the Sustainable Development Commission.

Change Forum will be invited to advise on the delivery of this communications strategy.

15. A number of the Carbon Trust's programmes (see Chapter 4) are available to businesses in the agriculture, forestry and land management sector. The Government will work with the Carbon Trust to identify new opportunities for action by them which could support the agriculture, forestry and land management sector.
16. Climate change and agriculture is a matter of importance not only for the UK but also for our European partners. In September 2005, the UK under its Presidency of the EU, hosted the first ever *Joint Informal Meeting of EU Agriculture and Environment Councils*, where international experts presented a range of issues on climate change and agriculture. They underlined that sustainable agriculture and land-use can play a significant role in addressing climate change and still provide the economic and social benefits rural areas

need. We have encouraged the Commission and future Presidencies of the EU to consider how to take forward work on the issues highlighted at the Ministerial meeting, and the UK will continue to encourage our European partners to give this issue the importance it deserves, including in the revised European Climate Change Programme.

17. Scenarios presented at the Informal and elsewhere suggest that climate change impacts do not appear to threaten the viability of UK agriculture industry as a whole, due to the adaptability of UK systems⁵. But particular regions and individual farmers need to be aware of changes so they are able to deal with the risks and opportunities in good time. This is discussed in more detail in the adaptation section of this Programme and will be developed in the Adaptation Policy Framework. **The Government will continue to fund research on impacts and adaptation responses for land managers.**

⁵ For example, the review of the Defra's research on climate impacts on agriculture concluded that "the negative impacts of climate change on UK agriculture's productivity will be small and that in all likelihood the effects will be positive, with the exception of low lying areas susceptible to flooding".

18. Understanding of these issues is supported within Defra by an ongoing research programme of £4m into both the impacts of climate change on agriculture, and means through which agriculture can contribute to reducing emissions. This work is complemented by knowledge transfer programmes, including through partners such as UKCIP (See Section 3), to ensure that policy makers and land managers receive relevant and timely information. The Government's approach to addressing climate change in this Climate Change Programme is informed by these principles, and we will continue to promote action to address climate change across the full range of issues covered by the Strategy for Sustainable Farming and Food.

Impact of reforms of the Common Agricultural Policy

19. Over the past thirty years the European Common Agricultural Policy (CAP) has had a dominant influence on UK agriculture. Since the launch of the Climate Change Programme in 2000, there have been two significant reforms of the CAP. Firstly, Agenda 2000 led to some moderation in production subsidies and greater emphasis on rural development measures. Independent economic evaluation and the Government's own economists suggest that the impact of Agenda 2000 on greenhouse gas emissions was limited.
20. The CAP reform agreement reached in June 2003 was more fundamental in nature, particularly in breaking the link between production and direct payments through the introduction of the Single Payment Scheme. Although not designed for the purpose of climate change mitigation, and though it is still too early to know exactly how farmers will respond to the 2003 CAP reforms, the associated changes in agricultural practice and market responses are likely to have an impact on greenhouse gas emissions. Decoupling of direct payments from production is likely to lead to a reduction in livestock numbers and an associated decrease in methane emissions estimated at some 0.68 MtC per annum in 2010. Similarly, it is expected that trends towards lower input agriculture and better soil nutrient management will be reinforced with a consequent reduction in nitrous oxide emissions.
21. The 2003 model of reform has subsequently been applied to the sugar sector. There is expected to be a reduction in sugar beet growing in Europe, although in England it is noted that beet growing currently occupies only 2 per cent of crop and grassland areas. Direct climate change implications are uncertain, but the sugar reform is encouraging processors to look at diversification into bioethanol. Demand will depend on competitiveness of beet compared to other feedstocks and wider renewable energy policy drivers.
22. The 2003 CAP reforms also introduced mandatory cross-compliance measures linked to all CAP direct payments to farmers, including those under the Single Payment Scheme. This will result in an increasing focus on some aspects of environmental management that, together with changes driven by decoupling, are likely to have positive effects on greenhouse gas mitigation. Notably our aim is that cross compliance will generally improve soil management through the implementation of Soil Protection Reviews, and so reduce soil carbon loss. **The Government will consider whether monitoring of cross-compliance can help to identify ancillary benefits in addressing climate change.** This monitoring is due to be undertaken in 2008.
23. These are significant changes that will affect the agricultural sector. We are committed, through the Agriculture and Environmental Change Observatory to monitoring the changes in order to improve our understanding of the implications for the industry and the environment, including climate change. **The Government will ensure that the Agricultural Change and Environment Observatory contributes data to assess current and predicted greenhouse gas emissions from agriculture, and the factors underlying the change.**

Reducing nitrous oxide emissions

24. The use of inorganic nitrogen as fertiliser is a major source of nitrous oxide. Nitrous oxide emissions also arise from manures during storage. There are a number of effective practical actions and technologies that can be taken up by farmers to optimise the efficiency of the use of fertilisers, reduce inorganic nitrogen use and maximise the benefit of organic nitrogen, thereby reducing nitrous oxide emissions. These would contribute to greater resource efficiency and more sustainable farming overall, and include:

- regular fertiliser spreader testing to ensure accuracy of application;
- operator registration and training;
- crop nutrient management planning;
- soil nutrient status testing – to better match application of fertiliser to need;
- maximising the use of technology to target nutrient use and reduce machinery operations;
- integration of manures into fertiliser regimes and reduction in inorganic fertiliser use (particularly grassland fertiliser applications); and
- improved slurry handling.



25. For example, we estimate that a 5 per cent reduction in overall fertiliser use could be achieved through improving spreader efficiency and related measures. This would save the equivalent of 0.15 MtC per year by 2010.

26. The practices needed to reduce nitrous oxide emissions are, in many cases, similar to those required to address other negative impacts of the use of nutrients. As part of a resource efficient approach to farm management, these actions would also reduce farmers' fertiliser costs as a proportion of overall production costs and also contribute to a reduction in the overall negative environmental impact of agriculture.

The Government's aim is to encourage action which will maximise the multiple benefits that can be achieved from changes in farm practice, and to simplify the messages to land managers about the change in behaviour required.

27. Farm practice changes can be incentivised by an appropriate policy framework, which may range from voluntary initiatives and supportive measures (including incorporation of some changes in revisions of agri-environment schemes), through market mechanisms to well-designed and targeted regulation. This range of policy measures is being examined by the Government as part of the Catchment Sensitive Farming (CSF) Programme aimed at tackling diffuse water pollution from agriculture (DWPA) to help meet objectives of the Water Framework Directive. For water quality outcomes, the CSF programme focuses on all pollutants and takes account of delivery of commitments under the Nitrates Directive through the Nitrate Vulnerable Zones (NVZ) Action programme. CSF and NVZ Action Programmes are discussed in detail below.

28. The Water Framework Directive requires all inland and coastal waters to reach 'good status' by 2015. Diffuse pollution from agriculture is a significant problem; 60 per cent of nitrates and 44 per cent phosphorus loads in UK surface waters comes from agriculture. Defra's Catchment Sensitive Farming (CSF) Programme seeks to tackle this issue and help land managers meet their obligations under the Directive. The

Nitrates Directive will be a basic measure under the Water Framework Directive and will be a key mechanism for helping to meet the Directive's nitrates targets.



29. The CSF Programme and measures under NVZ Action Programmes are not however designed to tackle climate change directly. The final package of measures for tackling diffuse water pollution from agriculture will not be finalised until 2008-09. Work on predicting the ancillary benefits of future and current policy options (including impacts of the England CSF Delivery Initiative and Nitrates Directive), such as greenhouse gas reduction, is under way, as is monitoring of the effectiveness of the current CSF Delivery Initiative. The monitoring activity is unlikely, however, to provide clear results until 2009. The Nitrates Directive is aimed at reducing water pollution by nitrate from agricultural sources.
30. The final package of CSF policy measures, which will most likely go further than the England CSF Delivery Initiative and the Nitrates Directive, will be based on the most cost-beneficial options for meeting the Water Framework Directive, which will include consideration of impacts on climate change. At this stage, and before final decisions are made, it is difficult to predict the precise greenhouse gas reductions resulting from these measures. However, information available on the impacts of the Nitrates Directive suggests that the changes in organic and inorganic nitrogen use that NVZ Action Programmes may bring about, are expected to lead to some reduction in greenhouse

gas emissions. **The Government will encourage agricultural practice changes which both deliver water quality outcomes and at the same time reduce greenhouse gas emissions and will ensure that the developing measures under the Catchment Sensitive Farming Programme and NVZ Action Programme are also designed, where possible, to maximise benefits for climate change goals.**

31. There may also be a need in future for further action on greenhouse gas emissions if other policies, such as the Catchment Sensitive Farming Programme, are assessed as not delivering sufficient change, or where there is continued uncertainty as to their effect on greenhouse gases. **The Government will explore this further in the context of a broader approach to resource efficiency in agriculture, as part of future work on delivering the Sustainable Farming and Food Strategy.**

Reducing methane emissions

32. Methane is an important greenhouse gas, with 46 per cent of UK emissions arising from agriculture. 80 per cent of this methane comes from enteric fermentation in the digestive systems of animals, and 20 per cent from animal waste⁶. Methane levels have been decreasing over the recent years. The likely decline in animal numbers as a result of decoupling following the latest CAP reform, and ongoing increases in productivity and fertility in the livestock industry, suggest that overall emissions of methane are likely to decrease further in the period to 2020.



⁶ www.defra.gov.uk/environment/statistics/globalatmos/gagccukem.htm

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33. Emissions of methane result from diffuse sources and through variable biological processes, making them difficult to quantify. Actions to directly reduce methane emissions from livestock may include changes to feed regimes: recent research suggests that substantial methane reductions could be achieved by this approach. Improving the longevity of dairy cows will also result in decreased methane production as a result of a reduction in the total number of animals needed to produce the same quantity of milk. In the longer-term it may be technically feasible to directly reduce emissions by manipulating enteric fermentation processes, for example through genetic improvement. Defra's research portfolio is examining all these options in a programme costing some £5.5m in 2005-06.
34. Some of the potential options may however be inappropriate: they may not always be compatible with the Government's wider goals for sustainable agriculture, may not be cost effective, have unacceptable animal welfare implications, or may risk additional environmental impacts involved in growing a high resource input alternative, for example maize instead of grass based feed.

Research into use of feed additives to reduce methane emissions

Researchers at the Rowett Institute in Aberdeen have been conducting research into developing a feed additive for ruminants that inhibits methane formation and improves feed efficiency. By adding a form of fumaric acid to the diet, lamb growth trials have shown that up to 70 per cent inhibition of methane formation can be achieved. This inhibition also gives rise to an improved feed efficiency of 10 per cent, i.e. the lambs gain weight 10 per cent faster for the same consumption of feed⁷. Further economic and environmental evaluations are now being conducted.

Anaerobic digestion

35. Anaerobic digestion is a widely-used technology for the purification of industrial and municipal waste waters, which reduces their environmental impact and also produces a useful by-product in the form of biogas, mainly methane. The technology can be applied to the treatment of animal manures. The resulting biogas can be used for heat and power, thereby providing an additional income source for farmers and further reducing greenhouse gas emissions through fossil-fuel substitution, especially in areas where animal slurries are available year-round, for example in intensive livestock units. Compared to the original manures, the remaining solid digestate can have improved properties for use as an organic fertiliser.
36. Manures can also be co-digested with other waste streams, such as from the food chain. The latter already provides a composting and disposal opportunity for some farm businesses. Co-digestion also enhances the nutrient content of the digestate, further improving its value as a fertiliser source. Industry has called for a standard for the digestate produced by anaerobic digestion plants, and the Government is currently scoping what further work might be required on this issue.
37. The understanding of the technologies, practical management options, issues such as biosecurity, and the market potentials for dealing with methane from the agriculture sector is still evolving. The Government views this as an important area for further work, and the Biomass Taskforce recently recommended that options to pursue anaerobic digestion technology and biogas production were explored. The UK is also committed to identifying solutions as part of the G8 inspired international Methane to Markets Partnership and co-chairs a new Agriculture Subcommittee of the Partnership. **The Government will convene a high level international seminar of experts before the end of 2006 to identify opportunities, barriers and technologies for addressing methane**

⁷ www.rowett.ac.uk/Reducing_Methane_JWallace.htm

emissions from agriculture under the auspices of the Methane to Markets Partnership Agriculture Sub-committee.

Market-based mechanisms

38. The measures described above for reducing emissions of nitrous oxide and methane are intended to deliver gains in the short to medium term. To allow the agriculture forestry and land management sector to play its full part in meeting the challenge of climate change, and to ensure real engagement by individuals and businesses, the Government believes that a long term policy signal is required. This needs to offer the prospect of bringing financial gain in return for behavioural change, and of promoting innovation. **The Government will examine the scope and feasibility of a market based mechanism, compatible with the Government's aspirations for the EU Emissions Trading Scheme and UK Emissions Trading Scheme, to facilitate trading of greenhouse gas reductions from agriculture and other land management sectors.**

Rural Development Regulation and Environmental Stewardship

39. The impact on greenhouse gas mitigation of existing agri-environment agreements is not easy to evaluate, as the schemes were not designed to achieve this goal. However, they have encouraged low-input agriculture and are likely to have contributed to decreased emissions, for example through decreased fertiliser use, buffered waterways against fertiliser run off, and reduced grazing intensity. The Government sees it as essential to improve our knowledge base on this issue, and will support further relevant research.
40. The Government is currently preparing a strategy for England for expenditure under the new EU Rural Development Regulation for 2007-2013, of which Environmental Stewardship will be a key part. The EU Strategic Guidelines for Rural Development require that resources devoted to

environmental issues should contribute to three EU level priority areas: biodiversity, water, and climate change.

41. The Regulation contains many relevant measures, for example support for agri-environment schemes, forestry and energy crops. The strategy for England is currently the subject of consultation, which provides an opportunity for consideration on how the England Rural Development Programme might best assist in future in addressing climate change.
42. The main vehicle in England for environmental land management is Environmental Stewardship, introduced in 2005 under the England Rural Development Programme. It builds on the success of the previous schemes, but has wider objectives, and it comprises Entry Level, Organic Entry Level, and Higher Level strands. The requirements of Entry Level Stewardship go beyond those of cross-compliance regulations and it is hoped that the majority of agricultural land will be covered by ELS after the first few years of operation.
43. **Building on the first phase of Environmental Stewardship, the Government will review progress in 2007-8 to ensure that expenditure is effectively directed to policy priorities, including the potential for Environmental Stewardship to contribute to climate change objectives. Through its research programme the Government will improve its understanding of the contribution which improved land management practices (including Environmental Stewardship measures) can make to climate change mitigation.**

Integrated Pollution, Prevention and Control (IPPC)

44. The UK Pollution Prevention and Control Regulations will apply to large intensive pig and poultry producers in the agricultural sector. Measures being considered under IPPC are focused primarily on ammonia reductions, but are likely also to contribute to nitrous oxide emission reductions.

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Reducing carbon dioxide emissions

45. Although the majority of greenhouse gas emissions from land-based sectors are non-CO₂ gases, there are ways in which land-based sectors can reduce their own carbon dioxide emissions. Additionally, agricultural practices can help to mitigate carbon dioxide emissions from other sectors, through carbon sequestration in soil and timber, and by substituting for fossil fuels and fossil fuel-based products.

Energy efficiency

46. The intensive pig and poultry farming sectors have been involved in climate change agreements since 2001 and have targets to reduce their CO₂ emissions by some 100k tonnes over their baselines.
47. Members of the horticulture sector of the National Farmers' Union also receive a 50 per cent discount from the climate change levy until the end of March 2006. In the 2003 Pre-Budget Report the Chancellor announced an extension to include some other energy intensive businesses in the climate change agreements. The horticulture sector is now eligible for a full climate change agreement under the new criteria and has agreed challenging energy reduction targets.
48. Government research to identify methods to improve energy efficiency in the glasshouse horticulture sector is ongoing. Early results indicate it is possible to achieve significant reductions in energy use in commercial situations, often combined with the use of combined heat and power.

Carbon Aware Land Management

The Country Land and Business Association (CLA) is pioneering the use of a farm-level tool for land managers to audit their net greenhouse gas emissions and sinks. The CLA has developed CALM as a way of raising awareness of climate change amongst rural land based businesses. Doing a greenhouse gas audit will give individual farmers an idea of the magnitude of their emissions and will enable them to look at ways to reduce those emissions while working with the grain of their business. For example, this could include more efficient use of fuel, budgeting nutrient inputs and sequestering carbon in soil and timber, where these are practical and in some cases supported.

Non-food crops

49. Crops grown for alternative uses to food can be used as energy crops or as a source of renewable raw materials to replace other fossil fuel based products. **The Government is committed to supporting the development of non-food crops and in November 2004 launched the Strategy for Non-Food Crops and Uses⁸.** The Biomass Taskforce, headed by Sir Ben Gill, was established to help Government and industry optimise the development of biomass energy in support of renewable energy targets and sustainable farming, forestry and rural objectives. The Taskforce published its final report⁹ on 25 October 2005 and the Government will respond at the end of April 2006.

⁸ Strategy for Non-Food Crops and Uses, November 2004: www.defra.gov.uk/farm/acu/pdf/nfc-strategy.pdf

⁹ Biomass Task Force Report 25 October 2005: www.defra.gov.uk/farm/acu/energy/biomass-taskforce/btf-finalreport.pdf



50. The Biomass Taskforce has made recommendations directly relevant to land managers on energy crops research and support for supply chains. We are considering these proposals as part of the Government's response to the Taskforce report. Subject to State Aids approval, **the Government intends to launch a further round of the Bio-energy Infrastructure Scheme during 2006-07.** The Taskforce recommendations are considered

further in the energy supply chapter, as part of the discussion on renewable energy, and in the public sector chapter.

51. In 2000 we introduced the Energy Crops Scheme to support farmers growing energy crops. This runs to 2006, and the Government is consulting on further measures to apply from 2007 under the new EU Rural Development Regulation. Defra also supports an extensive energy crop breeding programme to develop varieties which offer increasing yields but require little in the way of fertilisers and pesticides.
52. Plantings to 2006 under the *existing* Energy Crops Scheme are expected to lead to carbon savings of 11 ktC in 2010. Additional savings from a new scheme with plantings from 2007 onwards, including interim arrangements already made by Defra, would be expected to be around 13ktC in 2010, rising to 43 ktC by 2020. In addition to the contribution to emissions reduction through fossil fuel substitution, the expansion of energy crops also enhances on-site carbon stocks. It is estimated that in 2010, the projected uptake associated with standing biomass stocks (stumps and roots) from planting under a new scheme from 2007, would be 47 ktC, with ongoing new savings of 27 ktC and 12 ktC by 2015 and 2020 respectively.

Energy Crops Scheme

Renewable Energy Growers Ltd in South Yorkshire, and Thames Valley Bioenergy Coppice in Berkshire, are two producer groups established with funding from Defra's Energy Crops Scheme. Grants have been provided to help with the administrative set-up costs for the producer groups and the purchase of equipment such as harvesters and trailers. The groups aim to recruit 30 and 50 short rotation coppice growers respectively during the five year funding period. Members will work together to harvest their crop and supply it to a variety of end-users including small-scale local heat boilers, Slough Heat and Power (a large CHP plant) and Drax Power Ltd (a large power station which is trialling the co-firing of energy crops with coal).



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53. Non-food crops can also provide renewable raw materials to replace fossil fuel based products such as plastics and chemicals. In principle, crop derived products can usually be considered to be carbon neutral, or offer further carbon savings when assessed over their whole lifecycle, subject to efficient production and proper recovery. The Government-supported National Non-Food Crops Centre is driving forward innovation in the non-food crops sector and is working with farmers, universities and research institutes, and industry, to help bring new sustainable products and technologies to market. **The Government will continue its research on non-food crops with funding of around £2m a year, and the monitoring of the Non-Food Crops Strategy for its contribution to climate change policy outcomes.**

54. The Strategy encompasses a range of concerted actions to incentivise and support development of markets for non-food crops, including provision of advice and information and funding scientific research into their use. This policy could save 0.1MtC by replacing crude oil, used as a feedstock in various industrial processes, with renewable raw materials (RRM). It is estimated that up to 10 per cent of crude oil consumed in the EU is used for these purposes especially in the production of polymers but also in the production of lubricants, solvents, surfactants and fibres. At end of life disposal of such materials a transfer of carbon from fossil deposits to the atmosphere occurs though incineration, or over a significantly longer timescale through material decay. Using plant-derived RRM ensures that at least some of this carbon cycle is closed by substituting atmospheric carbon for fossil carbon in products.

Sustainable forestry policy

55. The practical framework for the delivery of sustainable forestry in the UK is the UK Forestry Standard, which has been endorsed by the administrations of England, Scotland, Wales and Northern Ireland and built into their separate forestry policies.

56. Growing trees provide an important 'carbon sink' by capturing carbon dioxide from the atmosphere and storing it as wood and in associated forest soils. The proportion of land under woodland in the UK has increased from 5 per cent in 1924 to nearly 12 per cent in 2003. These woodlands contain 150 MtC in tree biomass and are currently removing about 4 MtC annually. Increasing and protecting such sinks through afforestation, reducing deforestation and good management, are therefore important aspects of climate change mitigation and adaptation. Forest soils in the UK contain significantly more carbon than the trees and it is essential that these carbon reserves be maintained through good management practice. Updated guidance will be available following the ongoing revision of the Forests and Soil Conservation Guidelines¹⁰.



57. Forestry policies which support planting or the sustainable management of woodland are a useful tool in delivering carbon benefits. For example, woodland established since 1990 under the English Woodland Grant Scheme will remove 3.5MtC between 2006 and 2020, assuming planting continues at current levels¹¹. The dynamics of tree growth mean that any increase in woodland creation would have limited initial impact, with maximum carbon savings achieved beyond 2020. As an illustration, increasing the area planted threefold between 2006 and 2020 would only realise relatively modest additional emissions reductions of 0.025 and 0.3 MtC in 2010 and 2020, rising to 0.4MtC in 2035.

58. Forestry can contribute to mitigating climate change through providing wood as a renewable

¹⁰ FC (1998). Forests and soil conservation guidelines. Forestry Commission, Edinburgh.

¹¹ Modelling carried out by CEH using methodology employed in UK GHG inventory projections (www.nbu.ac.uk/ukcarbon).

fuel source, as identified by the Biomass Taskforce and the existing Forestry Strategies. In England, 0.7Mt of woodfuel (equivalent to carbon savings of 0.25MtC) could be provided annually without serious disruption to existing wood-using industries¹². The majority would be sourced from the use of arboricultural arisings, harvesting residues and small dimension or poor quality stemwood from ongoing management activity.

59. Increases in the growing stock have outstripped removals through harvesting over a number of decades, particularly for broadleaf species in privately owned woodlands. Many woodlands are currently overstocked and not being actively managed. If barriers to active management were removed, up to an additional one million dry tonnes per annum of woodfuel could be sourced from existing English woodland between now and 2020, corresponding to savings of 0.12MtC in 2010 and 0.4MtC in 2020. Utilisation of this existing woodfuel resource could satisfy much of the immediate need for woody biomass, enabling the strategic development of capacity in bioenergy. **The Government will continue to develop the woodfuel supply chain, increasing the operationally available resources and focusing on local capabilities through the Regional Forestry Frameworks.**

60. As with other non-food crops, wood can make a substantial contribution to emissions reductions by substituting for materials that have a higher fossil fuel input required for their production, such as concrete or steel. Development of wood technology and an increased usage of wood in the construction industry will maximise these benefits. **The Government will continue to promote the role of wood as a renewable material in sustainable development through schemes such as 'wood for good' which transfers knowledge of timber systems to the construction industry.**

61. **The Government will continue to develop adaptation strategies to make woodlands more resilient against the impacts of climate change,** both to prevent stored carbon being released into the atmosphere and to protect the

environmental, social and landscape functions of woodland. We will ensure that adaptation policy operates at a landscape scale and is an integral part of other rural and urban policies. We also recognise that woodlands can assist society in coping with some of the challenges of a changing environment such as protecting threatened habitats and species, reducing pollution impacts on water resources and achieving sustainable flood management.

The Government will ensure that the current and future reviews of the England Forestry Strategy take full account of the opportunities and risks for forestry from climate change. These include forestry's role in mitigation and its contribution to adaptation strategies to minimise the effects of climate change.

Soil management

62. Soil is a major reservoir of carbon: UK soil carbon stocks are in the order of 10,000 billion tonnes, and soils of the English uplands contain more carbon than all the trees in the UK and France added together. Evidence suggests that over the last 25 years there has been a general decline in soil organic matter in agriculturally managed soils, more so in some soils than others. The mechanism for this, and that of carbon sequestration in soils, is complex and still not fully understood.



63. The Government has a programme of work in place to increase our understanding of which soils are vulnerable to carbon loss (among other

¹² McKay H. (2003). Woodfuel resource in Britain. Final contract report to DTI, Scottish Enterprise, Welsh Assembly Government and the Forestry Commission (www.dti.gov.uk/renewables/publications/pdfs/bw300787main.pdf).

key threats), and identify and encourage land management practices that will conserve soil resources, for example through erosion control and cultivation practices. The Strategy for Sustainable Farming and Food includes targets to encourage practices to halt the decline of soil organic matter caused by agricultural practices in vulnerable soils by 2025. These measures are currently being implemented through a number of policies; more may be needed in the future. Specifically, sequestration of carbon in soil is not a simple process and requires a long-term commitment to consistent land management in order to be viable.

64. Under Action 30 of the First Soil Action Plan for England, Defra and UKCIP have also funded initial work on the impacts of climate change on soil functions. This work is reviewing research to date to provide us with a comprehensive, current view of potential climate change impacts on soils and the ecosystem services they provide; and to identify high risk land management practises and potential mitigation/climate-proofing options. This research also aims to identify suitable soil reference sites for use in assessing climate change effects in the years ahead. **The Government will commission further work on the cause of soil carbon decline and will host a conference to address the state of our knowledge of the issue and what could be done to address it.**

In 2004, the public sector estate, including the devolved administrations, was responsible for carbon dioxide emissions of 5.7 MtC on an end user basis or about 5 per cent of the UK total. Central government departments were responsible for about one-tenth of this that share.

Emissions had fallen to about 28 per cent below 1990 levels by 2004 and we estimate that, including the expected impact of the new measures included in this programme, they will remain at about this level through to 2010, as electricity consumption has been increasing per unit of floor area with the introduction of open plan working, increased IT equipment and air conditioning, and flexible and extended working hours.

The Government recognises that demonstrating leadership by reducing carbon dioxide emissions from its own estate is important and can be achieved by reducing energy demand, improving energy efficiency and continuing to source more electricity from renewables. Local authorities can have a significant influence over emissions in their local areas, particularly through how they exercise their functions and discharge their statutory duties. The Government is also currently responsible for around 30 per cent of total new build spending and will only procure buildings in the Central Government estate that are in the top-quartile in terms of energy performance.

Measures introduced in the Climate Change Programme 2000 are estimated to save around 0.2 MtC in 2010. Activity undertaken to meet targets in the central Government estate and NHS, public sector engagement with the Carbon Trust, and improvements in the standard of buildings as a result of the Building Regulations are the main contributors, with product policy also playing an important role.

Some of the new measures that will deliver additional carbon savings to 2010 are:

- provision of £4 million in new funding to create a local authority best practice support and improvement programme to be launched in 2006-7 and consideration of how to ensure that the local government performance framework will include an appropriate focus on action on climate change, sufficient to incentivise more authorities to reach the levels of the best.
- a new revolving loan fund of £20m to finance investment by the public sector in energy efficiency. This will provide support to at least 20 local authorities in 2006-07 and 20 other public sector organisations by the end of 2008; and
- delivering the DfES Building Schools for the Future and other capital programmes to make a substantial improvement in energy efficiency and carbon emissions standards of new and refurbished schools in England.

Together it is estimated that these new measures will contribute an additional 0.3 MtC of carbon savings in 2010, bringing total savings in 2010 to 0.5 MtC.

Introduction

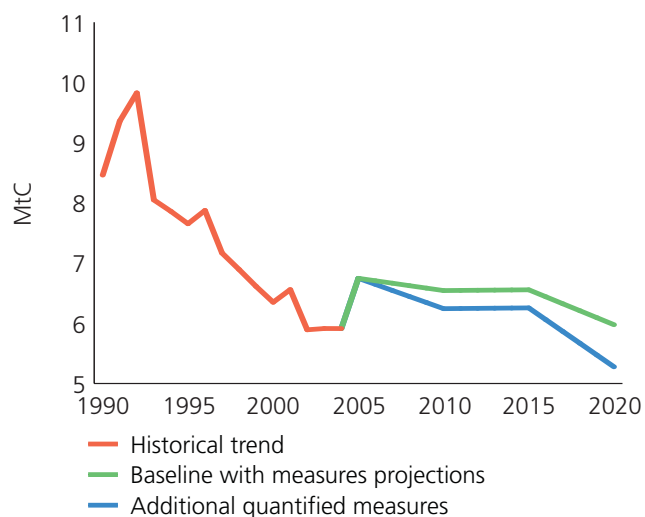
1. The public sector is in a key position to lead on carbon emissions reduction by setting a behavioural and strategic example to the private sector. By setting high standards of energy efficiency and reducing carbon emissions, the public sector can not only reduce its own emissions but also influence the supply chain for buildings and energy-using appliances.
2. However, like the private sector, public sector organisations, face barriers in identifying and driving through carbon saving opportunities. A key consideration is finding the up-front investment that could lead to savings in future years. Equally important is the need to engage senior management and to attract staff resources dedicated to tackling energy waste. By overcoming these barriers in its own organisation, the Government can set an example for the wider public and the private sector to follow.

Public sector

Greenhouse gas emissions inventory and projections

3. In 2004, public sector greenhouse gas emissions were around 6 MtC on an end user basis, around 3.3 percent of total UK emissions and had reduced by some 30 percent since 1990. Annual emissions by 2010 are expected to be 23 per cent below 1990 levels. These emissions include those from the central government estate, the NHS estate, local authorities, and the education sector¹.

Projections of greenhouse gas emissions from the public sector and estimated effect of additional quantified measures, MtC



Greenhouse gas emissions from the public sector, MtC

Gas	1990	1995	2000	2004	2010	2015	2020
Carbon dioxide	7.9	7.2	6.1	5.7	5.9	6.0	5.5
Methane	0.5	0.4	0.2	0.2	0.5	0.4	0.4
Nitrous oxide	0.1	0.0	0.0	0.0	0.1	0.1	0.1
Total	8.5	7.7	6.3	5.9	6.5	6.6	6.0
Change from 1990 levels		-9.5	-25.0	-30.1	-22.7	-22.5	-29.4

Note: the percentage changes and emission estimates may differ slightly due to rounding

Existing measures	Carbon savings in 2010 (MtC)
Central Government estate energy efficiency target, NHS Estates targets, UK universities and English schools	0.2
TOTAL	0.2

Additional measures	Carbon savings in 2010 (MtC)
Additional effort by local authorities	0.2
Revolving loan fund for the public sector	0.1
TOTAL	0.3

¹ Local authority housing is covered by the domestic sector.

² 'Local and Regional Action to Cut Carbon', Centre for Sustainable Energy, July 2005.

³ Under the 1995 Home Energy Conservation Act, local authorities with housing responsibilities are required to report on energy efficiency improvements for all residential accommodation within their boundaries. They must also prepare a strategy for improving energy efficiency within residential accommodation, produce annual progress reports and set targets for themselves.

The role of local government

4. Action by local authorities is likely to be critical to the achievement of Government's climate change objectives. Local authorities are uniquely placed to provide vision and leadership to local communities, raise awareness and help change behaviours. In addition, through their powers and responsibilities (housing, planning, local transport, powers to promote well-being and through activities such as their own local procurement and operations) they can have significant influence over emissions in their local areas.
5. During the review of the Climate Change Programme the Government commissioned a study to assess the scope for carbon savings from local and regional activity². This showed that some local authorities are already taking exemplary action on climate change. For example, in response to their responsibilities under the Home Energy Conservation Act (HECA)³. Examples of such action have been showcased in the Round 6 Sustainable Energy Beacon Councils Theme and through initiatives such as the Nottingham Declaration on Climate Change.

Sustainable Energy Beacon Councils

In 2005, the Government launched a Sustainable Energy Beacon Councils scheme. Seven councils were selected as Beacons:

Cornwall with Caradon, Carrick, Isles of Scilly, Kerrier, North Cornwall, Penwith, and Restormel has an ambitious and far-reaching strategy for sustainable energy development, published by the Cornwall Sustainable Energy Partnership.

Within its Environmental Management Audit Scheme (EMAS) partnership framework, **High Peak** takes responsibility for delivering its climate change, fuel poverty, energy efficiency, energy costs and air quality objectives.

Leicester has set itself a very ambitious 50 per cent reduction target for CO₂ emissions by 2025. Innovative projects include innovative use of metering and monitoring; and recycling of sustainable electricity export receipts from households.

Lewisham's work includes large-scale domestic energy efficiency and fuel poverty programmes; providing sustainable energy advice; energy auditing surveys and use of remote energy management controllers.

Nottinghamshire has reduced CO₂ emissions from council buildings by 25% in the past 4 years. The council has delivered projects covering energy management, CHP, wood-fuelled boilers, transport and fleet management.

Shropshire engages in partnership working with various communities including Women's Institute groups, church congregations and focused action in specific market towns. Action and targets are formulated with the communities.

Woking operates a private wire distributed generation system, using technologies including fuel cell CHP, solar PV and ground source heat pumps. A save-to-spend approach maintains momentum.

6. The Government welcomes and supports the work by these exemplary local authorities, and recognises the value they have added. However, the study raised concerns about the extent that local action depends critically on interested, committed individuals within local government to succeed.
7. The Government recognises that the local government performance framework does not currently include the outcome-focused content on climate change which would reflect the importance of tackling climate change and the potentially critical role local government will need to play in this in the short, medium and long term. But the Government also has a commitment to avoid placing unfunded new burdens on local government, and to move existing responsibilities to a more flexible, outcome-focussed basis, with greater flexibility to deliver on national priorities in the most effective way for that locality.
8. Local Area Agreements (LAAs) offer great potential for delivering shared central local priorities, including sustainable development outcomes. Climate change and energy outcomes are included in the current LAA Guidance and associated Outcomes Framework.
9. The Government wants to see a significant increase in the level of engagement by local government in climate change issues. The current local government performance framework, including the Comprehensive Performance Assessment, is currently under review. It is intended a new framework will be introduced post 2008, following the Comprehensive Spending Review, which is considering the overall performance framework for public services. **In this context, the Government will consider how to ensure that the local government performance framework will include an appropriate focus on action on climate change, sufficient to incentivise more authorities to reach the levels of the best.**

The Nottingham Declaration on climate change

The Nottingham Declaration was launched in October 2000. The Declaration is a voluntary pledge to address the issues of climate change, signed by the Leader and Chief Executive of a council. In signing it, councils are committing to ensure that tackling climate change is a cornerstone of the council's strategy.

So far, over 100 local authorities have signed the Declaration, each pledging to actively tackle climate change within their area.

The Declaration was recently re-launched and will soon be accompanied by a much improved support package that shows councils how to develop a sustainable energy strategy.

10. **The Government will also publish a report on ways in which local authorities can reduce greenhouse gas emissions and alleviate fuel poverty, within 18 months of the Climate Change and Sustainable Energy Bill's commencement. Local authorities will have to have regard to this report in carrying out their functions.** The Bill, currently before Parliament, is sponsored by Mark Lazarowicz and supported by the Government.
 - will bring together central and local government to encourage the further dissemination of best practice and innovation;
 - **provide further resources to local authorities to invest in energy saving on their own estate through the Carbon Trust's Local Authority Energy Financing Scheme**, which will be developed into a public sector revolving loan fund following the announcement of an additional investment of £20m in the 2005 Pre-Budget Report. This is discussed in more detail elsewhere in this chapter;
 - as set out in the Domestic Sector chapter, the Government has announced £20 million over the next two years, to help local authorities and others work in partnership with energy companies to promote and incentivise energy efficiency measures to households; and
 - **work with the Local Government Association (LGA) and others, to review thoroughly existing requirements on, and guidance to, local authorities on sustainable energy and climate change.** Within this, the Government is committed to a realignment of existing resources away from process (for example the preparation of reports) and towards outcomes (for example carbon savings, delivered in a way most appropriate for the local area) – so that, combined with funding available to local authorities, consideration of the inclusion of a focus on climate change in the new performance framework does not represent a
11. The Government will ensure that there are no unfunded new burdens created. In keeping with this commitment the Government and its agencies will:
 - **fund a new £4m local government best practice support programme, to be launched in 2006-7.** This programme will be delivered through the new local authority led Improvement Partnerships being set up in every region in conjunction with the 7 Sustainable Energy Beacons. The programme will aim to proactively benchmark the performance of local authorities on climate change and sustainable energy and target those who need the most help to raise their performance. It will help local authorities to access existing sources of expertise, support and funding, on sustainable energy and climate change by the EST and the Carbon Trust, as well as external sources of support, such as the Nottingham Declaration and UK Home Energy Conservation Association;
 - to assist this HM Treasury announced in Budget 2006 that it will host a seminar that

new unfunded burden and provides greater flexibility to deliver on national priorities in the most effective way for that locality.

12. We believe that together these measures can deliver additional savings of 0.2MtC in 2010.
Given the critical role of local government in achieving our climate change objectives, the longer term benefits may be much more significant.
13. Datasets will be important if local authorities are to begin to effectively monitor their performance on climate change issues. In October 2005, the Government published experimental statistics on carbon dioxide emissions at local authority and Regional Government Office level. These estimates will be updated in 2006 and there will be further engagement with local and regional government and other stakeholders to establish what other monitoring approaches may be useful.
14. The Government recognises the important role Sustainable Community Strategies, Local Strategic Partnerships (LSPs) and Local Area Agreements have to play in helping to tackle climate change. In order to strengthen the delivery of sustainable development at local level, **the Government has committed to reshaping Community Strategies into Sustainable Community Strategies. As previously mentioned, under the Climate Change and Sustainable Energy Bill, the Government will publish a report which local authorities will have to have regard to in exercising their functions. The Sustainable Community Strategy framework may be a suitable route to show how they will take this forward with partners on LSPs.**

Planning

15. The location, design, construction and siting of built development and economic and social activity can significantly affect the level of greenhouse gas emissions. Statements of planning policy, issued by the Government and the devolved administrations, set out a national policy framework for plan making at regional and

local levels and may be relevant to individual planning decisions. These statements take account of the impacts of climate change. The Government is examining ways to enhance the role of the planning system in tackling climate change.

16. The Government has already set out in Planning Policy Statement 22 its policies for the promotion of renewable energy in England. It is committed to a review of the permitted development rights enjoyed by householders, to see if the rules could be made easier and clearer, especially as regards the installation of renewable energy technology on the exterior of houses and in domestic gardens. It is currently in the process of strengthening guidance on managing flood risk in development. **The Government now intends to prepare and consult on a new PPS setting out how it expects participants in the planning process to work towards the reduction of carbon emissions in the location, siting and design of new development.**

The role of communities

17. Local communities have a major role to play in tackling climate change, for example, by raising awareness locally or through local projects on cleaner transport or the use of renewable energy in community buildings. All types of community groups can make a difference including neighbourhood groups, residents' groups, sports or social groups, faith groups and tenants' groups.
18. Many communities are already making a big difference through programmes such as the Energy Saving Trust's *Community Action for Energy* initiative, which is designed to promote and facilitate local community-based energy projects. It provides advice, case studies and support to groups who are interested in getting involved in local action⁵.
19. The Prime Minister made a commitment to re-invigorate community action on sustainable

⁴ The LAA Guidance outlined how LAAs can help deliver SD. A section of the LAA Toolkit deals with the ways in which LAAs can deliver on cross-cutting outcomes such as climate change. This can be found at: www.idea-knowledge.gov.uk/idk/core/page.do?pagelId=910763

⁵ For further information call the helpline on 08701 261 444, or visit the website at www.est.org.uk/cafe/

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development and, at the launch of the Sustainable Development Strategy in March 2005, he announced *Community Action 2020*. This is a programme of action to improve support for wider community action on the sustainable development priorities⁶. Community Action 2020 is part of the Government's overall commitment to work together with local people to secure a more sustainable future⁷.

The role of English Regions

20. The Energy White Paper (EWP) highlighted the key role played in England by regional bodies, such as Regional Development Agencies (RDAs), Regional Assemblies and Government Offices and local authorities in delivering UK objectives on climate change and sustainable energy.

21. Regional bodies have powers and responsibilities that will impact on the long-term shift to low carbon such as the responsibility RDAs have for regional economic development. Regional bodies are uniquely placed to help coordinate local, sub-regional and regional activity with national policy, and reduce overlaps to optimise outcomes.
23. In response to the Energy White Paper's call for the English regions to develop strategic approaches to energy, energy partnerships, part-funded by central Government, now exist in all regions. These partnerships have been taking forward a variety of practical regional projects aimed at reducing emissions, linking closely with the regional sustainable development agenda. Through work to integrate climate change into the new performance framework for local authorities, the Government proposes to look over the next year at what might be done to further enhance the role.

The Greater London Assembly (GLA)

London's directly elected Mayor and Assembly, came to power in July 2000.

The Mayor has stated that energy and climate change are key issues for London and in 2004, through his own initiative, set out how the capital could contribute to reducing UK emissions in the London Energy Strategy. One of the aims of the strategy was to set up the London Energy Partnership to ensure that London's energy sector attracted both investment and intellectual capital.

In 2005, the **London Climate Change Agency** was established with a remit to support climate change projects in the capital utilising public and private funds.

The GLA has also published a draft Supplementary Planning Guidance document on Sustainable Design and Construction to complement the Spatial Development Strategy (London Plan). The Guidance includes new policies on energy efficiency and renewable energy.

The Government welcomes these steps. The consultation on the review of GLA powers in 2004-5, asked specifically whether the GLA should be given statutory responsibility to produce an energy strategy to enhance the impact of a wider range of regional strategies, and act as a focus for cooperation between regional partners.

The Government will be reviewing responses to this consultation and will consider how the Assembly's role in promoting sustainable energy and climate change may be enhanced.

London's programme of activities may generate additional carbon savings, which may impact on progress towards our domestic goal. GLA are developing a roadmap for emissions reductions, which they intend to publish in summer 2006. **The Government will work closely with GLA over the coming months to determine how any savings that emerge should be factored into the UK Programme.**

⁶ More information, ideas and useful links can be found at the community action webpage: www.sustainable-development.gov.uk/delivery/global-local/community.htm

⁷ Further information about the Government's *Together we can initiative* can be found at the following website: www.communities.homeoffice.gov.uk/civil/together-we-can/

24. The Government is working with representatives of the Regional Development Agencies to respond to Recommendation 13 of Ben Gill's biomass taskforce report, which recommends that all RDAs should set themselves targets for carbon reduction. **Initial discussions have been positive, and the Government and RDAs expect to bring forward proposals jointly over the coming year.**

Funding schemes for public sector organisations

25. In the 2005 Pre-Budget Report the Chancellor announced an increase in funding for the Carbon Trust by £20m over the next two years to **establish a revolving fund for energy efficiency work in the public sector, building on the pilot Local Authority Energy Financing (LAEF) Scheme.** In such a scheme loan funding for organisations is conditional on maintaining a ring-fenced energy management fund, with initial funding supplied by the scheme and sometimes all or part matched by the participating organisation.



26. Most energy efficiency measures in public sector buildings have a payback period of within five years or less. A scheme which creates revolving funds would be a net benefit to public expenditure after around four years, and continuing for the lifetime of the measures installed, in many cases, at least another ten years. Financial mechanisms of this type drive change by encouraging procurement managers and decision makers to look again at the way

they plan, invest and save within their portfolio giving them real reasons to 'invest to save' for the long term. Not only does this improve environmental and efficiency standards within estates, but it can also stimulate more widespread adoption of energy saving and carbon reduction measures.

27. With the additional funding of £20m, Salix Finance, which was set up by the Carbon Trust to administer the new revolving fund, will initiate a major escalation in funding support for public sector organisations in 2006-07. The scheme is expected to deliver additional carbon savings of 0.1MtC by 2010. **Salix will seek proposals from local authorities with the aim of increasing the size of its existing LAEF programme by around 60 authorities and will begin work on new funding vehicles to support central Government departments, higher education and the NHS, with the aim of supporting at least 20 new public sector organisations in 2007-08.**
28. The experience that Carbon Trust and Salix Finance have gained through the development of the Local Authority Energy Finance Scheme has shown that successful delivery of the fund will depend on client organisations developing innovative approaches to overcoming financial barriers to providing up-front investment in energy management. **Therefore the Government, with the Carbon Trust, will establish a high level steering group to oversee the early development of the fund and to tackle barriers as they are encountered.**
29. Overcoming financial barriers is important but they do not exist in isolation. Alongside the development of a revolving fund mechanism, the role of advice and support is central to the public sector achieving its goals. The **Carbon Trust's Carbon Management programme** is tailored to large public sector organisations such as Government Departments, local authorities and higher education organisations. The programme helps organisations assess how to combat the risks and take advantage of the opportunities

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associated with climate change. It goes beyond energy management, enabling organisations to consider their strategy and operations in the context of climate change. As well as reducing carbon emissions, the benefits include cost savings, clarity around responses to legislation and operational improvements.

Public sector procurement

30. The Government is ideally placed to lead by example, through its procurement of goods, services and buildings. With a budget of over £125bn, the wider public sector can build markets for new and improved products and services, such as systems for the generation of renewable electricity and renewable heat and through pursuing higher standards of energy performance. Sustainable procurement is a key lever to achieve this, from developers to architects, engineers, construction companies and facilities managers, the skills and mentality to deliver and operate low-carbon buildings could develop quickly across both public and private sectors if the public sector takes the lead.
31. In 2003 the Government implemented a range of measures to encourage central government departments to apply minimum environmental standards across a wide range of commonly purchased products. To help Government departments meet these standards the Sustainable Procurement Group identified 19 energy consumption-focused '**Quick Wins**' which are off-the-shelf procurement specifications. These were published in the OGC Buying Solutions (OGCbs) website⁹, along with corresponding procurement frameworks. The Government has since committed to extending and updating the list of Quick Wins. Proposals to extend them to 31 energy consumption focused products have been published in the Government's Market Transformation Programme and OGC's websites.
32. The future direction and scope of this initiative will take into account the views of the Sustainable Procurement Task Force. Established in May 2005 under the chairmanship of Sir

Neville Simms, the Sustainable Procurement Task Force is set up to draw up an action plan by spring 2006, to bring a step-change in sustainable public procurement so that the UK is among the leaders in the EU by 2009.

33. Energy is also set to play its part in meeting the wider target, set by the Gershon report, to generate £22bn public sector savings by March 2008. The **Public Sector Efficiency Review for Energy** is a project, managed by OGCbs, to generate £200m energy savings, through developing innovation in energy procurement, improving the management of energy through better metering and clearer billing and increasing conservation activity. A Pan-Government Energy Forum, which includes key stakeholders from the public and private sectors, will ensure that the project leverages good work, and avoids duplication of activity in different departments.

Central Government

34. Targets for the Government Estate are being reviewed as part of the UK Sustainable Development Strategy commitment to improve the Government's performance and ensure it leads by example. Targets on energy and climate change are two key areas for the review.
35. The Government launched the Sustainable Development Framework for the Government Estate¹⁰ in 2002 which included a range of environmental targets. The six energy targets focus on reducing the amount of energy used, and hence carbon dioxide emitted, increasing energy efficiency and sourcing energy from more sustainable sources. There are also transport targets for reducing emissions from road transport.
36. Progress is being made in many areas. For example most departments have continued to reduce their fossil fuel use per unit floor area since 2000. Overall, the combined average total of the amount of electricity sourced from renewable sources for the departments and their agencies is 19 per cent, suggesting that the central

⁹ www.ogcbs.gov.uk/environmental/newsroom/articles/downloads/Min_Env_Standards.DOC

¹⁰ www.sustainable-development.gov.uk/delivery/integrating/estate/energy-intro.htm

Government Estate has already met its renewable electricity target of 10 per cent by 2008. All nine of the departments that have initiated new estate management contracts since August 2004 have included clauses to ensure opportunities are identified, and measures are taken to reduce carbon dioxide emissions, leading to greater improvements in the management of the Estate in the future. Departments have already met, or are close to meeting, their transport carbon dioxide emissions reduction target.

37. Key targets on reducing absolute carbon emissions and electricity use per unit floor area are not currently being met. **The Government is therefore reviewing the existing targets in the Framework to deliver strengthened strategic targets by summer 2006, to ensure a step change in the way that Government departments manage their own energy and emissions is achieved.** Making sure that the correct set of targets is in place and issues with the collection and quality of data are tackled is necessary to guarantee a high level of confidence in the progress of this sector. Equally important is securing commitment to changing behaviour. To tackle the issue of engaging top management attention, new annual reporting procedures are being developed, and larger public sector organisations are being encouraged to sign up for the Carbon Trust's Carbon Management programme¹¹. Defra was the first department to do so. The Sustainable Development Commission already provides an independent report and commentary on the performance of central Government departments. **In the future, each Secretary of State will be required to sign-off their department's annual progress report.**

38. However there are significant challenges ahead. For example the Civil departments, excluding the Ministry of Defence, have experienced a 7 per cent increase in total floor area since 1999-2000; their electricity consumption per unit floor area has also been increasing with the introduction of open plan working, increased IT and air conditioning, flexible and extended working hours. Sustainable Development Ministers¹² have

agreed that **all central Government Departments will sign up for a Carbon Trust energy audit to identify cost effective savings and develop the action plans needed to deliver them.**

The wider public sector

39. The whole public sector estate, including the devolved administrations, is responsible for about 5 per cent of the total UK carbon dioxide emissions. Since central Government is responsible for only about 15 per cent of this total, it is necessary to extend focus on the wider public sector.
40. In December 2005 Sustainable Development Ministers committed to establishing reporting mechanisms on activity to improve energy efficiency for all parts of the public sector. To deliver this the Government will carry out an examination of energy management information in the wider public sector with a view to making recommendations for improvements in the completeness and quality of energy data before the end of 2006. This will help Government achieve its own public sector target of achieving a 0.5MtC reduction in emissions from its own operations, by 2010 which was set in 2000.
41. All sectors of the Government Estate will review their carbon emissions reduction strategies. While a raft of energy efficiency measures are currently being deployed to good effect across the Estate, further opportunities exist to reduce emissions from fossil fuels. A key approach is by using renewable fuels in place of gas and oil. This approach goes further than buying renewable electricity from the grid, it looks to the Government to produce its own renewable electricity and heat. Regarding heating for example: if 20 per cent of the heating boilers, which annually are replaced or refurbished on the Government Estate, were replaced by boilers equipped to run on biomass, the annual carbon savings from the replacements by 2020 would be between 0.12 – 0.15MtC by 2020.¹³

¹¹ Carbon Management is a tool developed by the Carbon Trust to help large public and private sector organisations develop effective management procedures for the efficient use of energy.

¹² www.sustainable-development.gov.uk/government/ministers.htm

¹³ Assumes 20-year replacement/refurbishment cycle; total Government Estate heat demand of 17.7TWh/a (of Public Estate total heat demand of 59.1TWh/a); 2.65TWh/a replaced; and carbon saving of 0.05 – 0.06 MtC per TWh.

Public sector

Schools

42. The education sector accounts for approximately 10 per cent of carbon emissions for all commercial and public buildings. Annual energy returns from schools, collected by the Government for the period 1999-00 to 2002-03 show that, due to increased use of information and communications technologies and extended opening hours, there has been a substantial increase in electricity consumption. Greater use of renewable energy technologies in schools has the potential to help address increased consumption and reduce carbon emissions from the schools estate.



43. **Building on the Sustainable Development Action Plan for Education and Skills launched in 2003, the Government will emphasise the sustainability and energy efficiency requirements for school buildings through a Sustainable Schools launch and consultation in 2006.** The intention is to provide a framework for sustainable development for existing schools which is designed to assist them

in producing and delivering a sustainability plan tailored to their needs.

44. To meet the challenge set by the Prime Minister, that all new schools and City Academies should be models for sustainable development the requirement is for all schools procured through the **Building Schools for the Future (BSF)** and other major capital programmes to achieve rating of 'very good'¹⁵ or better. Funding levels provide for this. A number of quality indicators¹⁶ must be used in all BSF school projects and in post-occupancy evaluations, such as transport (including cyclists), reducing energy and waste in the building process and using natural day-light and ventilation wherever possible. **To support this work, this year the Government will collect energy and consumption data from 2003-04 to 2005-06 to benchmark school energy consumption and set targets for the sector and will publish new guidance on the design of sustainable schools, emphasising the role of energy performance in sustainable design.**
45. The Government is committed to promoting renewable energy technologies in all schools in England from a range of options including biomass boilers, wind turbines, solar PV, solar thermal and ground source heat pumps. Government programmes to support the development of micro-generation have played an important part in providing funding for the development of technologies within the schools estate. To date the Government has committed nearly £3m for projects in 186 schools. The Budget 2006 announcement to provide a further £50m for the installation of microgeneration technology will benefit schools further. There are approximately 25,000 schools in England, uniquely distributed within its communities and connecting tangibly with millions of children, young people and families. Renewable energy technologies have a key role to play in reducing carbon emissions and engaging future generations with climate change issues. The use of renewable technologies can also provide a rich learning resource for teaching of science, geography, design and technology, citizenship and mathematics.

¹⁴ Though in secondary schools this has been partially offset by improved energy efficiency.

¹⁵ This is based on the Building Research Establishment Environmental Assessment Method (BREEAM13).

¹⁶ www.dqi.org.uk/Schools/default.htm



46. **To aid this process, the Government is developing a strategy on renewable energy generation and carbon reduction for schools.** This will include a whole life costs toolkit to help decision makers prioritise expenditure on energy efficiency measures and low and zero carbon energy systems. **The Government will work with the private sector and NDPBs to develop an approach to support schools in developing, as part of the primary capital programme, renewable energy generation to make the process easy, low (or zero) cost, and genuinely attractive to schools.** This approach will promote excellent sustainable design, offer high efficiency potential, develop best practice partnering with the private sector and set out how to develop the skill necessary in schools, local authorities and the private sector.

Higher and further education

47. Higher education institutions have a significant impact on the environment. Each year they are responsible for consuming 5.2 billion kWh of energy at a cost of over £200m and spend £3bn on goods and services. They educate two million students and employ almost 300,000 staff, and have an opportunity to support a sustainable society by equipping students with the values, skills and knowledge to contribute to sustainable development. They also have the opportunity to generate and transfer knowledge through research and leadership of, and influence on, local, national and international networks.

48. The Higher Education Funding Council for England¹⁷ (HEFCE) provides grants to institutions through their Leadership, Governance and Management Fund to support the development and promotion of good practice. In July 2005 HEFCE published a strategy and action plan¹⁸, setting out how, within the next ten years, the Higher education sector in England will achieve sustainability and tackle climate change. This will be a key cross-cutting theme of HEFCE's strategic plan for 2006-11, which will be published in April 2006.
49. The Carbon Trust has developed a version of **Carbon Management** tailored to the needs of the Higher education sector. This provides technical and change management support to help the sector realise carbon emissions savings from areas such as academic, accommodation and leisure buildings and vehicle fleets. This is supported by a Higher Education Carbon Management Toolkit which provides process guidance, technical advice, case studies and a suite of specifically tailored tools. The pilot programme was launched in April 2005 to 20 universities and runs until March 2006. The second phase is due to commence in May 2006 and will extend support to a further 25 universities.

The Learning and Skills Council (LSC) estate is approximately 7.13 million square metres (excluding agricultural buildings and residences) and is responsible for consuming approximately 1.7 billion kWh of energy at a cost of over £43m per year.

The Government expects providers, working with the Learning Skills Council, to demonstrate good governance in sustainable buildings and estate management which will see them undertake a review of the social, economic and environmental aspects of their organisations and identify areas for action, relating to energy, building and design, procurement and travel through for example, encouraging the use of video and telephone conferencing across the LSC to reduce business travel and 'recycling' redundant IT equipment for schools and charities.

¹⁷ www.hefce.ac.uk/

¹⁸ This is available at: www.hefce.ac.uk/pubs/hefce/2005/05_28/.

The NHS Estate

50. The NHS has the largest property portfolio in Europe and the biggest capital spend programme with an annual budget over £76bn. The NHS employs over one million people and spends £11bn per year on goods and services. Tasked with building new hospitals, and GP premises, it expects to spend £12bn on new facilities by 2010. Energy use costs the NHS over £312m per year and is responsible for emissions of nearly 1 MtC each year.

The NHS has two targets in England:

- to reduce the level of primary energy consumption by 15 per cent or 0.15 MtC from a base year of March 2000 by March 2010; and
- to achieve a target of 35-55 GJ/100m³ energy efficiency performance for the healthcare estate for all new capital developments and major redevelopments or refurbishments; and that all existing facilities should achieve a target of 55-65 GJ/100m³.

51. Data up to 2004-05 demonstrates that the energy efficiency of the NHS estate in England continues to improve. If this trend continues, predictions show that total energy consumption is likely to reduce by 15 per cent from 2000 figures by 2010. Predictions indicate that this performance is likely to continue with higher building standards and greater elements of the future estate comprising more local low-tech facilities and fewer, but more efficient, high-tech acute facilities. Carbon dioxide emissions are not reducing to the same extent but it is anticipated this will improve with the impact of the forthcoming revised Building Regulations and the Energy Performance of Buildings Directive and the further development of renewable energy sources.

52. The Hartlepool Hospital energy centre is a clear example of a partnership between the NHS and the private sector and is an exemplar of Best Value Procurement for the NHS. Not only does it deliver lower energy costs and reduce carbon emissions, but it also provides the Trust with a secure energy source and the ability to generate revenue when it exports electricity.

CHP and the Hartlepool Energy Centre

Dalkia Utilities Services developed a new energy centre at the Hartlepool Hospital as part of a PFI contract with North Tees and Hartlepool NHS Trust.

This development includes the installation, operation and the management of a 1.4 MWe reciprocating engine based CHP scheme with waste heat recovery boiler. The boiler extracts heat from the engine's exhaust gases to generate steam which will then be fed into the hospital's steam system. The low-grade heat from the engine water jacket will also be utilised to provide hot water.

The scheme is designed to provide most of the Hospital's steam and electricity requirements. Any surplus electricity is to be exported to other Trust properties so they can benefit from the climate change levy exemption. The scheme is to generate about 11,000 MWh of electricity per year for on site use and export to the Trust's other properties.



THE ENCODE

The Department of Health in partnership with the Carbon Trust and collaboration with the devolved administrations is working to produce a Health Technical Memorandum entitled "EnCO2de – making energy work in healthcare". The document is to be published in 2006 and is intended as a comprehensive guide to all issues relating to the procurement and management of energy in the NHS in the UK. The aim of Encode is to ensure that everyone involved in managing, procuring and using buildings and equipment thinks about the implications of energy use; today and in the future.

Cross-cutting measures to improve energy efficiency

53. The majority of emissions from the public sector come from buildings. In 2004 the sector accounted for 34 per cent of new non-domestic building construction and 37 per cent of non-domestic refurbishment and maintenance work (totalling almost 1.5 per cent of UK GDP)¹⁹.
54. The 2006 revision to **Part L of Building Regulations** in England and Wales is set to reduce emissions by up to 27 per cent for non-domestic buildings. Continued tightening of the standard with successive revisions to Part L will enable the sector to make progress towards the 2050 target of reducing UK emissions by 60 per cent. This will be necessary as the public sector is increasing the intensity of its activities, with the total floor area of public sector buildings growing at nearly 2 per cent per year (mostly in the health and education sectors). However, most of the emissions between now and 2050 will come from buildings that are already part of the public estate therefore the elements of the Building Regulations which apply to refurbishment and should generate a 5 per cent improvement in energy performance in the existing stock.
55. Another key measure which targets existing building stock is the **Energy Performance of Buildings Directive** (EPBD). A key requirement

of the Directive is that when a building is constructed, sold or rented out an energy performance certificate must be made available to the prospective buyer or tenant. In buildings over 1000m² that are used to provide a public service there is a requirement to display the certificate in a public place. Displaying an energy performance certificate is intended to encourage public pressure on building occupiers to modify their behaviour in order to make energy performance transparent. Through this measure the Government will deliver the commitment announced in the 2004 Energy Efficiency Action Plan to **only procure buildings in the Central Government estate which are in the top-quartile in terms of energy performance**. This has the potential to open up price differentials which could help to transform the property market in the similar way to white goods labelling.

56. The conclusion of negotiations of the **Energy End-Use Efficiency and Energy Services Directive** was a key achievement as part of the Government's efforts to give energy efficiency a high priority during UK's Presidency of the EU. The Directive was agreed in December 2005 and will be formally adopted in Spring 2006. Its objective is to enhance the cost-effective improvement of energy end-use efficiency in the Member States. This is to be achieved among other ways through the public sector communicating its efforts to the public and ensuring the exchange of best practice. As part of implementing the Directive, the Government must apply at least two measures from the following list: the use of financial instruments; guidance; requirements to purchase energy efficient equipment and vehicles; requirements to replace or retrofit existing equipment and vehicles; requirements to use energy audits; and the requirement to purchase or rent energy-efficient buildings. Through implementation of the Directive, the public sector will play a key part in contributing to the overall savings target of 9 per cent of the average amount of energy consumed during the previous five years, over 9 years.

¹⁹ BSRIA Statistics Bulletin, June 2005.

Stimulating action by individuals

Individuals, households and communities have a crucial role in tackling climate change. The UK's emissions are the cumulative result of the choices made by government, businesses, organisations in other sectors and individuals. But government can play a critical role, by establishing a framework that encourages and enables changes in behaviour that reduce the footprint of individuals. Many of the policies set out elsewhere in this programme will contribute to this. But we will do more, and enable individuals to make choices that reduce the impact of our individual and collective actions on the environment and help to meet our emissions reduction goals.

- The Government will review and find more innovative ways to encourage individuals to make sustainable choices and help them to understand their own role and responsibility in tackling climate change. Earlier chapters set out a number of commitments which will contribute to this.
- The Government will continue to build relationships with organisations such as the Energy Saving Trust to ensure that partnerships between key players are developed and links are made between raising awareness and taking action at all levels – individual, business and the public sector.
- The Government will set out a plan for further action on sustainable consumption by the end of 2006, responding to the report of the Round Table on Sustainable Consumption due in Spring 2006.
- The Government is planning a new online information service (working title: Environment Direct) to provide information on the environmental impact of a range of everyday products and services, and practical advice on how people can make the most sustainable lifestyle choices.
- In December 2005 Defra launched the first elements of a new Climate Change Communications Initiative. The Initiative aims to change public attitudes toward climate change, with a central focus on local, grass roots and regional engagement.
- Defra is providing up to £4m over three years to roll out a new package of measures to help thousands of community groups across England to take action on sustainable development, including climate change. This initiative will be launched later in 2006.

Understanding the barriers

1. Encouraging changes in the way we live, often habits engrained over many years, is not simple. What Government has done in the past has led to some significant changes but failed to make the fundamental shift needed to move to a low carbon economy. This chapter summarises the aspects of the Climate Change Programme through which the Government aims to encourage a change in individual and collective behaviour, and sets out further plans.
2. The Government's Sustainable Development Strategy, *Securing the Future – delivering UK sustainable development strategy*¹, introduced a new approach to delivering long-term behaviour
3. Further work has been undertaken by the Round Table on Sustainable Consumption, jointly led by the Sustainable Development Commission and the National Consumer Council, which has examined the potential for a significant shift towards more sustainable lifestyles and is about to come forward with recommendations aimed at those areas of our lives which have greatest environmental impact, including food, homes and travel.
4. One important issue that the Round Table has raised is the need to understand the respective

change based on the latest available research and evidence, and gave greater recognition to some of the social and practical factors that influence and limit how we choose to behave.

¹ HM Government (2005) *Securing the future – delivering UK sustainable development strategy*: www.sustainable-development.gov.uk

roles of Government, business and consumers in promoting behaviour change and reducing the negative environmental impacts of products. In certain circumstances Government and business will need to play a leadership role in “choice editing”, taking responsibility for ensuring appropriate minimum standards as well as advising consumers about better lifestyle choices. Consumers should expect that environmental responsibility will be as fundamental to the products they buy as health and safety is now.

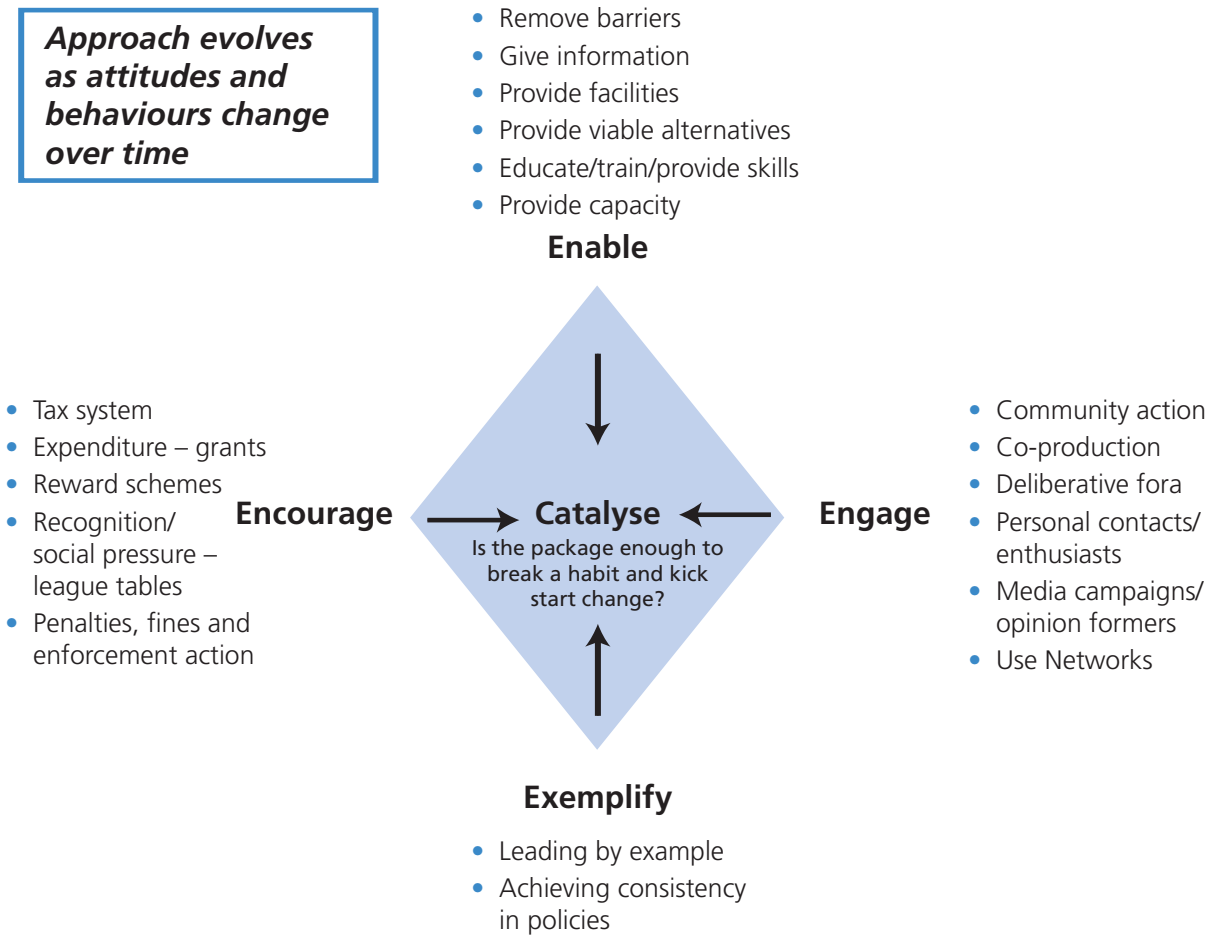
Making the Change

5. The new model in *Securing our Future* set out an integrated approach to **catalysing** behaviour change through the four “Es”. The Climate Change Programme includes measures that seek to **exemplify, enable, engage, and encourage** the right attitude.

Exemplify – Government taking the lead

6. Government can play a critical role by establishing a framework that encourages and enables changes in behaviour that reduces the footprint of individuals. Many of the policies set out in this programme already will contribute to this. But we will do more, and enable individuals to make choices that reduce the impact of our individual and collective actions on the environment and help to meet our emissions reduction goals.
7. By increasing the purchase and use of energy efficient goods and services we create a powerful demand that markets will seek to meet, stimulating innovation and new business opportunities. The Government is committed to leading by example by making sustainable choices in the management of its own estates.

Approach evolves as attitudes and behaviours change over time



Stimulating action by individuals

As set out in the Public Sector chapter:

- The Government will use its own purchasing power to lead by example and has set itself a challenge of being an EU leader in sustainable public procurement by 2009.
- In Summer 2006, the Government will introduce new strategic targets for the central government estate.

Enable – make it easy to behave differently

8. This is the starting point. We know that providing individuals and communities with information is not sufficient to enable behaviour change. We need to help people make responsible choices by providing them with accessible alternatives and suitable infrastructure, and supporting them with the necessary skills and information.

- As part of its Market Transformation Programme, the Government will identify potential eco-design standards for important products in households and non-households sectors.
- The Government will explore the role of industry voluntary agreements such as the Code of Conduct on Digital TV services, procurement policy and UK-Led International Task Force on Sustainable Products which will encourage international benchmarking.
- Budget 2006 announced a new initiative, in partnership with major retailers and the Energy Saving Trust, to introduce voluntary schemes in the retail sector which encourage the purchase of more energy efficient alternatives in consumer electronics.
- The Government will continue to support colour-coded efficiency labels for products to help consumers make sustainable choices.
- Providing better information and feedback on energy consumption through better billing and metering will also help individuals become more responsible in the way they use energy. The Government will work with Ofgem to explore these benefits and the potential for introducing smart metering in the UK.
- Making sustainable choices when travelling is equally important. The Government will therefore explore the role of “smarter choices” to help curb emissions.
- Defra is providing up to £4m over three years to roll out a new package of measures to help thousands of community groups across England to take action on sustainable development, including climate change. ‘Every action counts’ will provide new tools, information and support to community groups in taking small simple actions on energy, waste and water which add up to make a big difference nationwide. This initiative will also support over 20 national voluntary and community sector organisations to develop and implement their own sustainable development action plan, which will include the contribution these bodies can make to tackling climate change and energy efficiency. This initiative will be launched later in 2006.

Stimulating action by individuals

Engage – get people involved

9. Research² shows that information in isolation is rarely enough to change people's behaviour, but it has a very important role in underpinning and increasing the effectiveness of other Government actions. Information provision usually works best if some of the people the Government is seeking to influence are involved at a local level in developing the communication materials and selecting the media used. Such an approach also helps identify and encourage community champions and leaders and their networks to be involved.
10. As set out in the Public Sector chapter the Government will:
 - **provide local authorities with additional guidance on how to stimulate action on climate change at local level; and**
 - **introduce a revolving fund of £20m over the next two years to support public sector organisations in implementing energy efficiency measures.**
11. Businesses in the agriculture and land management sector face particular challenges from a changing climate, and awareness of the impacts of climate change in this sector needs improving. The Rural Climate Change Forum has made a strong contribution to getting key messages to farmers, but further effort is required.
 - **The Government will put in place an agriculture sector communications strategy as part of the wider Climate Change Communications Initiative.**

Encourage – give the right signals

12. The Government must use the most efficient and effective techniques to reward, encourage and where necessary, enforce, the desired behaviour change. The Government already supports consumers through the work of the Energy Saving Trust (EST)³ and other organisations such as the Low Carbon Vehicle Partnership.
 - **As set out in the Domestic chapter, the Government has announced £20m over the next two years for a programme to strengthen consumer demand for energy efficiency, working closely with energy suppliers, local authorities and others.**
13. EST's activities are designed to underpin and complement the work of other actors in energy efficiency markets. In particular it seeks to work with key Government policy drivers for household energy efficiency – EEC, Warm Front, Decent Homes and Building Regulations. Its principal activities are aimed at increasing demand for energy efficiency by raising awareness, providing advice and support for action to consumers, local authorities, schools, communities, vehicle manufacturers and technology developers. It also supports the supply of energy efficiency products and services to meet this demand by developing partnerships, stimulating innovation, supporting training and providing accreditation. The Energy Saving Trust also runs the Energy Efficiency Advice Centres in England, Scotland, Wales and Ireland.
14. More generally, the Government is supporting behaviour change, and our understanding of what drives change, through the Environmental Action Fund. This Fund, worth £6.75m in its current three year round, is supporting 35 projects in England that are designed to promote more sustainable consumption and production, covering lifestyle areas such as homes, food and transport.

² Motivating Sustainable Consumption - a review of evidence on consumer behaviour and behavioural change: www.sd-research.org.uk/documents/MotivatingSCfinal.pdf, Tim Jackson, 2005 .

The impact of sustainable development on public behaviour Andrew Darnton, for Defra, March 2004:

www.sustainable-development.gov.uk/taking-it-on/pdf/desk-research1.pdf

Driving public behaviours for sustainable lifestyles, Andrew Darnton, for Defra, May 2004:

www.sustainable-development.gov.uk/taking-it-on/pdf/desk-research2.pdf

Personal Responsibility and Changing Behaviour: the state of knowledge and its implications for public policy, Prime Minister Strategy Unit, February 2004:

www.number10.gov.uk/files/pdf/pr.pdf

Carrots, sticks and sermons: influencing public behaviour for environmental goals Demos and the Green Alliance, for Defra, December 2004:

www.green-alliance.org.uk/publications/PubCarrotsSticksSermons

³ Further information can be found on the Trust's website.

Stimulating action by individuals

Experience from these projects will be fed back into the Government's climate change and sustainable consumption and production programmes.

Catalyse – breaking habits

15. The *ultimate* test for the Climate Change Programme is how all of our individual policy initiatives on climate change come together as a package to collectively deliver the changes in behaviour needed – across business, voluntary organisations, Government at all levels, communities, families and individual consumers.
- **As part of the monitoring process of the Programme, we will set up a Stakeholder group to oversee the practical delivery of the new measures.**
 - **The Government will set out a plan for further action on sustainable consumption by the end of 2006, responding to the report of the Round Table on Sustainable Consumption due in Spring 2006.**

Educating the public

16. The public need clear and reliable advice about the environmental impact of different products and services and how they can make the most sustainable consumption choices. The Government believes the best way of making this available is through the internet, and is planning a new online information service (working title: Environment Direct). This will aim to enhance consumers' image of sustainable living so that it is perceived as attractive and desirable rather than about compromising quality of life. The Government aims to launch the new service by the end of 2006.

Climate Change Communications Initiative

17. Engaging with the public on climate change is a vital part of the UK climate change programme,

both to encourage specific behaviours to reduce carbon dioxide emissions directly and to gain acceptance for more ambitious Government policy. In December 2005 Defra launched the first elements of a new *Climate Change Communications Initiative*, with funding of £12m announced earlier in the year.

18. The Climate Change Communications Initiative⁴ aims to change attitudes toward climate change within the general public, with a central focus on local and regional level engagement. The initiative will address different themes as it unfolds. Its initial focus is on making climate change a 'here and now' and 'front of mind' issue, with the emphasis moving over time towards collective action and the social status of the attitudes and behaviours associated with climate change.
19. The research supporting the communications strategy shows that changing attitudes is an essential first step to voluntary behaviour change, so the communications strategy is intended to shift attitudes such that individual behaviour change as well as further government-led action to tackle climate change can be achieved at a later stage.
20. The Climate Change Communication Initiative includes:
 - a linking device or slogan ***"Tomorrow's climate, today's challenge"*** to give a visual identity to the whole initiative and, where used on other climate change-related material, to show central government, its partners and others working together;
 - a medium-long term aspirational goal ***"Together this generation will tackle climate change"*** to provide a clear, publicly accessible focus for all of our climate-related communications;
 - a **£6m fund** for local communication initiatives in England, which was opened in January 2006;
 - an interactive and user-friendly climate change website: www.climatechallenge.gov.uk;

⁴ Further details on the initiative and all of the resources are available from the website: www.climatechallenge.gov.uk/

Stimulating action by individuals

- **guidance for communicators** with ideas on how to communicate about climate change, together with free-to-use resources such as a short film and radio advertisements; and
- in January 2006, the Government launched an England-wide **“climate change champions” competition** to find young ambassadors for climate change in the 10-18 year age range. The aim of the competition is to raise the profile of climate change among a critical and hard-to-reach audience.

How individuals can help

21. The UK's overall carbon emissions could be reduced substantially by everyone making a few small changes. An action which seems insignificant on its own can combine with other actions to create a significant overall impact. These small changes can also save money. Some simple ideas are set out below.

At home

Households are responsible for around 30 per cent of total UK energy use, equivalent to around 40MtC. A combination of individual actions in the home can make a real contribution to reducing the UK's emissions. They can make substantial cuts to utility bills, too.

Some ideas (main source – Energy Saving Trust):

Turn your thermostat down by 1°C. This could cut heating bills by up to 10 per cent. If every household did this, the savings would be equivalent to the energy consumed by all the schools, colleges and universities in the UK.

Close your curtains at dusk to stop heat escaping through the windows and reduce draughts.

Don't leave appliances on standby. Every year, video recorders and televisions in the UK consume around £150m worth of electricity while on standby.

Only boil as much water as you need (but remember to cover the elements if you're using an electric kettle). If everyone did this, we could save enough electricity to run more than three quarters of the street lighting in the country.

Eliminate draughts and wasted heat. Install a cheap, easy-to-fix brush or PVC seal on your exterior doors, and cover letterboxes and keyholes. Fill gaps in floorboards and skirting boards with newspaper, beading or sealant.

Install energy saving light bulbs. They last up to 15 times longer than conventional bulbs and for each bulb you fit, you could save up to £7 on your annual electricity bill.

Look for the logo. When replacing appliances, look for ones displaying the energy saving recommended logo. Energy saving appliances use less energy and could save you up to £35 a year.

Stimulating action by individuals

Transport

A lot of individual journeys could be eliminated or made in a different way to reduce carbon emissions. Changing travel habits can also have health and financial benefits.

For instance:

Go by train. The average person travelling by rail produces around half the carbon dioxide emissions of the average person travelling by car.⁵

Teleconference. DfT research on smarter choices shows that the use of tele- and audio-conferencing and teleworking can be a powerful tool to help cut staff travel and therefore carbon emissions.

Think sustainably. Where travel is necessary, the impact on carbon emissions can be reduced by taking certain choices, for example car sharing. Government is encouraging businesses and schools to work with employees and pupils to develop travel plans which enable individuals to make sustainable travel choices.

Improve your technique. It is estimated that eco-driving techniques can help deliver significant reductions in carbon emissions from cars – and bring down fuel bills. Such techniques include maintaining appropriate tyre pressure, minimising weight, removing roof racks when not in use (minimising weight and drag), avoiding sharp braking and accelerating, using the correct gear and only using air conditioning when really necessary. Some of these measures, such as looking ahead to avoid sudden braking, can also have positive road safety benefits.

Look for the logo. When purchasing a new car, look for the new fuel efficiency label that shows how much money you could save a year by choosing lower carbon models.

⁵ Average emission factors are calculated using 2002 National Atmospheric Emissions Inventory CO₂ emissions estimates by mode/vehicle type and data on passenger kilometres and load factors from DfT Transport Statistics

Summary of proposed action

1. Chapter 1 of this Section summarises the Government's latest projections for emissions of carbon dioxide and other greenhouse gases in 2010, 2015 and 2020. These projections reflect the ongoing impact of policies introduced since the Climate Change Programme 2000.
2. The baseline with measures emissions projections show that in 2010:
 - emissions of the six greenhouse gas basket would be reduced to around 19.4 per cent below base year levels. This means that the UK is on track to exceed its Kyoto Protocol target; and
3. Section 2 of this programme sets out the action Government is taking to reduce emissions from all sectors. This includes policies the Government is introducing which will be additional to those reflected in the emission projections. The table below sets out the carbon savings that we are expecting existing measures to deliver by 2010. The table overleaf sets out the carbon savings that we are expecting from the new measures contained in this programme, which the Government estimates could lead to additional carbon savings of some 7.0 – 12.0 MtC in 2010.

Existing measures	Carbon savings in 2010 (MtC)
Energy supply	
Renewables Obligation	2.5
Business	
<i>Climate change levy¹</i>	3.7
UK emissions trading scheme	0.3
Carbon Trust	1.1
Building Regulations 2002	0.4
Building Regulations 2005	0.2
Climate change agreements	2.9
Transport	
Voluntary Agreements package, including reform of company car taxation and graduated VED	2.3
Wider transport measures ²	0.8
Sustainable distribution in Scotland and Wales	0.1
Fuel duty escalator	1.9
Domestic	
Energy Efficiency Commitment (EEC) (2002-05)	0.4
Energy Efficiency Commitment (EEC) (2005-08)	0.6
Energy Efficiency Commitment (EEC) (2008-11)	0.6
Building Regulations 2002	0.7
Building Regulations 2006 including 2005 condensing boilers update	0.8
Warm Front and fuel poverty programmes	0.4
Market Transformation including appliance standards and labelling	0.2
Agriculture	
Woodlands Grants Scheme (England)	0.2
Woodland planting since 1990 (Scotland)	0.5
Public Sector	
Central Government, NHS, UK universities and English schools including Carbon Trust activities	0.2
TOTAL	17.1³

¹ An independent evaluation by Cambridge Econometrics (CE) concluded that CCL would deliver annual carbon savings of 3.7MtC by 2010, from an announcement effect and price effect of the levy. This figure assumes CCL rates are increased in line with inflation from 2005 to 2010. The impact of CCL in the projections is incorporated through the price elasticity of demand for different fuels ('the price effect'), and there is no separately identified announcement effect within the UEP baseline.

² As set out in 'Transport 2010: The 10 Year Plan for Transport' and built upon in 'The Future of Transport: A network for 2030'.

³ Total does not include carbon savings from climate change levy, and may differ slightly from figures for total carbon savings shown in Chapters 3 to 8 due to rounding.

Bringing it all together

Additional measures	Carbon savings in 2010 (MtC)
Energy supply	
Subsidy for biomass heat	0.1
Second phase of EU emissions trading scheme	3.0-8.0
Business	
Carbon Trust support for investment in energy efficiency in SMEs	0.1
Measures to encourage or assist SMEs to take up energy saving opportunities	0.1
Transport	
Renewable Transport Fuel Obligation (RTFO)	1.6
Future voluntary agreement with car manufacturers to reduce CO ₂ emissions from new cars	0.1
Domestic	
Increased activity in Energy Efficiency Commitment (EEC) (2008-11)	0.5
Provision of advice to stimulate early replacement of inefficient boilers and implementation of the Energy Performance of Buildings Directive	0.2
Package of measures to improve energy efficiency in buildings	0.1
Better billing and metering	0.2
Products Policy: consumer information and standards for lights and other energy-using products (EUPs)	0.2
Agriculture	
Strategy for non-food crops	0.1
Public Sector	
Additional effort by local authorities	0.2
Revolving loan fund for the public sector	0.1
Actions by devolved administrations	0.3
Other measures ¹	0.1
TOTAL	7.0 – 12.0

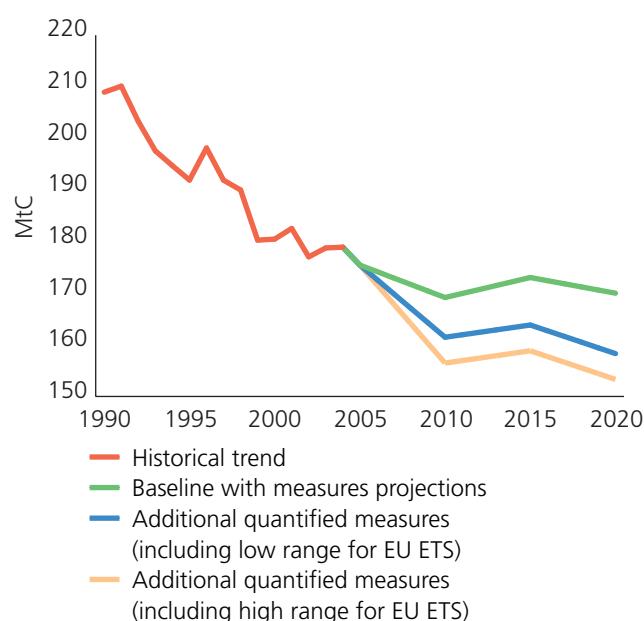
¹ These include the Green Landlord Scheme, increased funding for Warm Front, an Energy Report in the Home Condition Report, improved enforcement of Building Regulations, enhanced capital allowances for cleanest biofuels processing plants, reduced VAT for wood fuelled plants, funding for demonstration of Carbon Abatement Technologies and for the Low Carbon Building Programme. These policies together could deliver carbon savings of about 0.1MtC in 2010.

4. This Programme of action will take the UK well beyond its international target and move us close to the 2010 domestic carbon dioxide goal. The Government estimates that by 2010 the Programme could:

- reduce the UK's emissions of the basket of greenhouse gases on which the Kyoto target is based to 23 – 25 per cent below base year levels; and
- reduce the UK's carbon dioxide emissions to 15 – 18 per cent below 1990 levels.

5. The graph below shows the predicted effect in 2010 of the Programme on the UK's greenhouse gas emissions. The effects have been estimated for 2010, 2015 and 2020 only and emissions are assumed to fall linearly between 2005 and 2010 between 2010 and 2015, and between 2015 and 2020.

Projections of greenhouse gas emissions and estimated effect of quantified additional measures, MtC



Tracking progress

1. The UK reports on its greenhouse gas and specifically carbon dioxide emissions through a number of mechanisms at international, EU and domestic level.

International

2. Progress towards achieving UK and international climate change objectives is monitored through the UK's **greenhouse gas inventory**. The Government submits the inventory annually to the UNFCCC and to the EU Monitoring Mechanism. In addition, the UK is required to submit to the UNFCCC at regular intervals **national communications** that report on action being taken to tackle climate change. The UK will submit its 4th National Communication (4NC) in April 2006.

EU

3. Information on Member States' **projections** must be reported to the European Commission on a biannual basis, by 15 June, with the next report due in 2007. The previous year's results on the **EU emissions trading scheme** will be published in the first half of each year, and will set out what this means for progress towards our Kyoto target and domestic carbon dioxide goal.

Domestic

4. Updates on **PSA delivery plans** (including departmental PSAs relating to climate change) are submitted biannually to HM Treasury, and monitoring notes to departmental management boards quarterly.
5. There are a number of different sets of **indicators** which already record progress on greenhouse gas emissions and in other relevant areas. These include sustainable development indicators, reported on annually by Defra, and energy sector indicators, reported on by DTI. DTI also publishes **provisional estimates of carbon dioxide emissions** every March.

6. Progress on emission reductions is monitored through the **Sustainable Energy Policy Network** (SEPN), which operates through a Ministerial Committee, an Advisory Board, Strategy Group, working-level group and Interdepartmental Analysts' Group (IAG). The IAG provides cross-cutting analytical support to SEPN including: reviewing analytical requirements feeding into the workstreams; advising on potential gaps; identifying cross-cutting requirements and drawing links between analytical work conducted in support of workstreams; and providing a measure of peer review.
7. Two Cabinet Committees have climate change as part of their business:
 - the Cabinet Committee on **Energy and the Environment** (EE) has a remit to "develop the Government's energy and environmental policies, to monitor the impact on sustainable development of the Government's policies, and to consider issues of climate change, security of supply and affordability of energy"; and
 - the Cabinet Committee on **Sustainable Development in Government** (EE(SD)) has a remit to "improve the Government's contribution to sustainable development through the conduct of its business, including through consideration of departmental sustainable development action plans; and to report as necessary to the Committee on Energy and the Environment."
8. In addition to these existing processes, the Government will introduce a new **annual report to Parliament** on the level of greenhouse gas emissions in the UK and the steps the Government has been taking to reduce these. The report will include data from the existing sets described above, as well as any additional information needed for it to provide comprehensive coverage. It will also set out an indicative work plan for the following year, the basis for which will be announced in due course.

Carbon budget

9. One of the proposals made in response to the 2004 consultation was for the introduction of an annual carbon budget to manage progress towards our domestic goal. This would mean that within a national carbon account, carbon would be given a market value and our position relative to our targets calculated in monetary terms. The Government will consider this proposal. However, at present the primary mechanism for monitoring progress towards our targets will be through the annual report and the other reporting requirements as listed above. The carbon budget proposal merits serious study and will therefore be considered by the Stern Review, with analysis informing the Energy Review.

SECTION 3

Adapting to the impacts of climate change

The Government will take action to:

- develop a comprehensive and robust approach to adaptation in the UK through the Adaptation Policy Framework (APF);
- publish revised and expanded climate change scenarios for the UK in 2008; and
- monitor and develop the knowledge base on climate change impacts and adaptation through the UKCIP.

Introduction

1. Some degree of climate change resulting from past and present emissions of greenhouse gases is already inevitable. In order to cope with the impacts of climate change we need to adapt – this action is complementary to our efforts to reduce emissions to avoid dangerous levels of climate change.
2. Adaptation can mean any action, either intentional or accidental, taken to minimise the adverse effects of climate change or to take advantage of any beneficial effects. Adaptation strategies vary considerably between different types of organisation, and will be undertaken at a range of scales, from central government policy to modest individual projects. There are two main approaches to adaptation:
 - *building adaptive capacity.* This involves creating the information and conditions (regulatory, institutional, managerial) that enable adaptation actions to be undertaken; and
 - *delivering adaptation actions.* This involves taking actions that will help to reduce vulnerability to climate risks, or exploit opportunities.
3. Anticipatory adaptation (as opposed to reactive adaptation) is important for the protection or maintenance of existing and future capital assets with long life spans.

4. A great deal has happened in the field of climate impacts and adaptation since 2000, both internationally with the publication in 2001 of the IPCC's Third Assessment Report and work by the UNFCCC to support adaptation in both developed and developing countries, and domestically, with the publication of climate change scenarios for the UK in 2002 and the development of widely adopted tools, methodologies and research by the UK Climate Impacts Programme and other centres. The Government has played a key role in each of these arenas and will continue to do so.

Impacts of climate change in the UK

5. Chapter 1 set out the way in which the UK's climate has changed in the past, and is predicted to change further in the future. These changes in climate are likely to have far-reaching effects on our environment, economy and society in all regions and in some cases these are already being felt. Without effective action to tackle the causes of climate change, climate-related risks and damages will increase. Adaptation needs to be planned accordingly, and this section sets out the framework through which this will occur.
6. In the UK, although climate change may bring opportunities and benefits as well as threats, we note that the larger the changes and rate of change in climate, the more the adverse effects will predominate.
7. Some of the most widely-expected adverse impacts in the UK include:
 - an increased risk of flooding and coastal erosion;
 - increased pressure on drainage systems;
 - possible increased winter storm damage;
 - habitat and species loss;
 - summer water shortages and low stream flows;

Adaptation

- increased subsidence risk in subsidence-prone areas;
- increasing thermal discomfort in buildings; and
- health issues in summer.

8. The greater the change in climate the more serious the effects will be. However some opportunities and benefits have also been identified, for example:

- longer growing seasons;
- less winter transport disruption;
- reduced demand for winter heating; and
- less cold-related illness.

Some opportunities are anticipated, including:

- agricultural diversification;
- an increase in tourism and leisure pursuits; and
- a shift to more outdoor-oriented lifestyles.

9. The balance between these impacts will, to a large extent, depend on what approach is taken to adaptation. These impacts will also vary from region to region in the UK. However overall we expect that the adverse effects will outweigh the benefits particularly as climate change increases.

10. The economic consequences of some of these climate changes may also be beginning to be felt. For example, damage related to the heat-wave in 2003 left insurers with almost £400 million in subsidence claims in the UK. Claims for storm and flood damages in the UK totalled more than £6 billion over 1998-2003, which was twice the amount for the previous six-year period¹.

International commitments and programmes

11. Under the United Nations Framework Convention on Climate Change (UNFCCC), the UK not only has a commitment to mitigate emissions, but also to make progress in adaptation.
12. Article 4 (1(b)) states that all Parties to the Convention shall: "Formulate, implement, publish and regularly update national and where appropriate, regional programmes containing measures to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, *and measures to facilitate adequate adaptation to climate change.*"
13. Article 4 (1(f)) goes on to state that Parties shall: "Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example, impacts assessments, formulated and determined nationally, with a view to minimising adverse effects on the economy, on public health and on the quality of the environment, of projects undertaken by them to mitigate or adapt to climate change."
14. In December 2004, Parties to the UNFCCC agreed to develop a structured five-year programme of work on the scientific, technical and socio-economic aspects of impacts, vulnerability and adaptation to climate change. At Montreal in December 2005, agreement was reached on the framework and initial actions for this programme of work, and activities will begin during 2006.
15. The IPCC is currently working towards its Fourth Assessment Report and the Working Group 2 report on Impacts and Adaptation will give particular emphasis to regional impacts and adaptation.
16. In November 2005, the European Commission launched a consultation on the development

¹ A changing climate for insurance, June 2004, Association of British Insurers.

of the second European Climate Change Programme, which includes a work stream on adaptation. The Commission are working towards the production of a green paper on adaptation at the end of 2006, and the UK will contribute to this process.

Domestic commitments and programmes

Adapting to Climate Change in the United Kingdom – the Adaptation Policy Framework (APF)

17. Although the more excessive regional temperature increases and precipitation changes may only be felt in a few decades time, they need to be factored into decisions on investment and infrastructure taken now. There are already a range of adaptation activities taking place within different sectors, including planning guidance, health advice and water resource management, and across different agencies and regions. In order to develop a full picture of adaptation in the UK we need to review such activities and assess how far current efforts are contributing to successful adaptation to climate change and to identify what more needs to be done.
18. For this reason, the Government is developing a climate change Adaptation Policy Framework, which will set out the appropriate responsibilities and activities across a range of organisations in a sector by sector approach. A consultation exercise was completed in January 2006². This work contributes to the strategic outcome in Defra's Five Year Strategy, published in 2004³ under its climate change and energy strategic priority on the "UK successfully adapting to unavoidable climate change.
19. The 5-year strategy included development of an Adaptation Policy Framework which is described below. For Defra, an emphasis was placed on promoting research into climate change impacts on agriculture, maintaining its substantial flood and coastal erosion risk management programme, with greater targeting of spending to reduce the risks associated with climate change.
20. The Framework aims to provide a consistent approach to building adaptation into policies, and a coherent way to identify cross-cutting risks and opportunities and to assist in prioritisation of action across Government. Co-ordination of work within and across Government Departments and the devolved administrations will provide leadership to stakeholders.
21. The development of objectives, targets and measures of progress in each area of the framework is the responsibility of the relevant Government Departments and the devolved administrations, along with other key players. However, work on adaptation is the responsibility of a wider range of stakeholders. While the evidence base and the framework for a response can be provided by Government, adaptation is the responsibility of all and brings benefits to those organisations and individuals who adapt appropriately.
22. The Adaptation Policy Framework will provide the structure in which adaptation strategies can be integrated into policies developed by organisations at every level of decision making. Not only will the APF set out a rational structure for different roles and activities in adaptation (including at regional and local level), it will also be a primary information source for those involved in policy development and provide an indication of priorities for the private sector.
23. This first stage aims to capture the national picture of climate change adaptation as it currently stands across the UK. It will focus on priority sectors where climate change will have a significant impact, or where considerable co-ordination between Departments or with other bodies will be needed to make progress on adaptation. During stage 2, commencing in 2006, there will be an analysis of activities taking place and an assessment made of the reasons why some sectors are adapting more successfully than others. Stage 3 (2008) will identify those areas where adaptation is not occurring and what incentives and assistance may be required to ensure that it is considered appropriately in future planning and development.

² www.defra.gov.uk/environment/climatechange/uk/adapt/policyframe.htm

³ *Delivering the Essentials of Life: Defra's Five Year Strategy*, Defra, 2004. Available from www.defra.gov.uk

Adaptation

We will analyse stakeholder responses to the public consultation and will publish the first phase of the adaptation policy framework during 2006.

We will launch the second phase of consultation during 2007 and a third phase in 2008 to complete the APF work.

We will develop a process for reviewing and assessing existing and new policies for their vulnerability to climate change impacts and their contribution to adaptation.

We will initiate a study of the potential role of regulation and standards in accelerating action to adapt to inform future development of the APF.

UK Climate Impacts Programme

24. The UK Government set up the UK Climate Impacts Programme (UKCIP) in 1997 to provide essential information to help decision-makers plan their response to the impacts of climate change. Defra funds UKCIP on behalf of the UK government and the devolved administrations. From an initial focus on impacts research studies, there has been a progression towards developing stakeholder partnerships that share information, identify research needs and pursue work on climate impacts and adaptation in their regions and sectors.

UKCIP is modular in structure, with individual studies funded by stakeholder partnerships in two main categories:

- *regional studies* that consider multiple sectors within a given region and deliver information that is relevant to local decision-making; and
- *sectoral studies* that are typically undertaken at the national level, tend to be quantitative in nature, and inform decision-making on climate impacts and adaptation at the local, regional and national scale for given sectors. More recently, UKCIP has played an increasing

role in helping stakeholders to build adaptive capacity.

25. An integrated summary of findings from studies carried out for the UK Climate Impacts Programme was published in 2005⁴.
26. The UKCIP Office team helps others to commission and fund research and actively supports all studies and partnerships. The UKCIP has provided numerous tools to equip stakeholders to develop their own adaptation responses. All the tools and reports are available from the UKCIP website.

Risk, uncertainty and decision-making framework

27. The UKCIP report *Climate adaptation: Risk, uncertainty and decision-making* (Willows and Connell, 2003) was developed in co-operation with the Environment Agency. It provides an eight-stage decision-making framework with accompanying guidance to help assess climate risks and uncertainties and incorporate suitable adaptation measures into a decision. For each stage of the framework, there are questions to answer, and recommended tools to help.

The framework:

- directs decision-makers to undertake rapid risk characterisation and screening exercises, before moving on to more detailed assessments;
- helps refine the problem and objectives and modify adaptation options, before making a decision; and
- guides the decision-maker to review the decision, for instance to see if it delivered the expected benefits.

⁴ A comprehensive synthesis of the work achieved under the UK Climate Impacts Programme is provided in *Measuring Progress: Preparing for climate change through the UK Climate Impacts Programme*, UKCIP, 2005, available from www.ukcip.org.uk



- 28. The UKCIP has put stakeholders at the heart of the research process, in a pioneering approach for producing relevant information on climate change. The use of common tools and resources in climate impacts studies has achieved a degree of coherence within and between studies.
- 29. In 2004, an independent review⁵ of UKCIP indicated that the Programme had performed very effectively, establishing a valuable body of work on UK climate impacts and increasingly adaptation, through its stakeholder network. The review also noted that there is still much for the UKCIP to achieve, and that its work should be continued in a similar form.

In 2005, Defra established a new five-year contract for the UKCIP. The new programme of work retains *two main aims*:

- to improve knowledge and understanding of the impacts of climate change among stakeholders; and
- to help stakeholders to be better equipped to undertake adaptation to climate change.

And *five objectives*:

- to improve knowledge and understanding of the impacts of climate change at a regional and national level among stakeholders, through the co-ordination, integration and communication of research;
- to provide stakeholders with tools and methods, and supporting training and guidance;

- to promote a consistent programme of work on impacts and adaptation across the UK, working through partnerships with stakeholders and other researchers;
- to provide a focal point for information on climate change impacts in the UK, through the UKCIP Programme Office and strategic communications activities; and
- to learn from the research and experience of other countries, through appropriate links.

We will work with UKCIP to continue to raise awareness of climate change impacts and adaptation at strategic levels within private sector organisations and the business community.

We will publish revised and expanded climate change scenario datasets and information for the UK in 2008.

We will commission a programme of research to investigate cross-sectoral issues in adapting to the impacts of climate change in the UK.

We will review and update UK indicators of climate change, and provide guidance for the development of regional indicators of climate change.

We will commission a study of the business costs and benefits of adapting to climate change impacts.

We will assess the role and status of regional stakeholder climate change partnerships including future funding options.

Adaptation in the UK today

- 30. Most examples of adaptation today relate to adaptation to current hazards, stemming from natural climate variability or climate change.
- 31. The changing climate adds to the external risks that business already has to face. Alongside the physical risks from direct impacts in exposed sectors (like agriculture, property, life insurance, water, tourism), climate change may bring

⁵ Review of UKCIP, ESYS, 2004. Available from www.defra.gov.uk/

Adaptation

additional market risks (as demands change and competitors take advantage of new opportunities), operational risks (as logistics and premises are affected by climate events) and reputational risks (as customers, suppliers and shareholders gain awareness of the climate change issue). Businesses may be more vulnerable if they are currently affected by the weather; make long-term investment decisions; or have global markets and suppliers. In many cases, the climate change experienced in other parts of the world may have a more significant indirect impact on UK businesses than the direct impacts domestically, as global markets or supply chains are affected. The changing climate may also present opportunities and potential benefits such as new markets, products or services, reduced operational costs (say for building maintenance or transport), and enhanced corporate reputation through proactively addressing climate change.

32. The most secure way to manage increasing cross-cutting risks from climate change is likely to be through integrating climate change into corporate risk management strategies, particularly in order to attract forward-looking investors. The costs of adapting to climate change need not be large. Many adaptations may only require small changes to existing practices. “Win-win” solutions may also be identified, through other objectives, such as in corporate social responsibility or sustainable development plans. By contrast, the costs of impacts from damaging climate events can be very significant. In addition it may not be possible to adapt to all aspects or levels of climate change.

We will work with the UK Biodiversity Partnership to publish practical guidance for nature conservation managers and planners.

We will publish a revised guidance statement on the role of spatial planning in adapting to climate change.

We will produce revised guidance, with the Environment Agency, on implementing flood and coastal erosion risk management measures, to ensure that adaptability to climate change becomes an integral part of all flood and coastal erosion management decisions.

We will assess the role and status of regional stakeholder climate change partnerships including future funding options.

Case studies of how organisations have started to adapt

The New Construction Research and Innovation Strategy Panel (nCRISP)

The mission of nCRISP is to 'prioritise and promote research and innovation that will sustain a first class construction industry and enhance the value of its contribution to the quality of the built environment and the wealth and well being of society'. nCRISP has links with government, industry and the research community, and considers the impact of climate change on the built environment and vice versa. The organisation has a Climate Change Task Group, formed to prioritise future research on the significance and effects of climate change on the built environment (various publications available). The remit of the task group is to focus on the impacts of climate change rather than mitigation measures: “Research is needed for the UK construction industry to plan for future construction and to provide solutions of adaptation to current infrastructure features amidst future climatic extremes” (Wilson and Burtwell, 2002). Reports produced advocate responsiveness and adaptation to climate change in the construction sector (in an ‘effective and sustainable manner’).

South East Climate Change Adaptation and Mitigation Implementation Plan

The Implementation Plan is designed to support the *South East Plan*, and is part-funded by the ESPACE EU INTERREG project. The Plan seeks to provide both an overview of the existing actions and activities to mitigate and adapt to climate change in the South East as well as to propose new actions and activities to address gaps. The focus of the Implementation Plan is on actions that are relevant to spatial planning, but it also includes those that go beyond activity controlled by the town and country planning system.

The UKCIP Business Areas Climate Impacts Assessment Tool (BACLIAT) provides a simple checklist for organisations to assess the potential impacts of climate change on their business that can be used initially for any type of business organisation because it encourages consideration of the threats and opportunities across generic business areas. These include:

- *logistics*: vulnerability of supply chain, utilities and transport infrastructure;
- *finance*: implications for investment, insurance and stakeholder reputation;
- *markets*: changing demands for goods and services;
- *process*: impacts on production processes and service delivery;
- *people*: implications for workforce, customers and changing lifestyles;
- *premises*: impacts on building design, construction, maintenance and facilities management; and
- *management implications*: what are the strategic responses to the issues identified?

Costs of climate change on health in Hampshire

The summer 2003 heat wave event had particular significance in Hampshire because it was one of the two counties in the UK where a daily maximum of 100°F was reached. The heat wave is estimated to have caused 21 excess or premature deaths in the county, and 2142 additional hospital days.

Events such as the extreme temperatures experienced in summer 2003 are likely to become commonplace by 2050.

An initial assessment for mortality and hospital admissions in Hampshire under scenarios of future climate change shows that in net present value terms, the additional impact costs over the period 2010 to 2100 are estimated to be between £95-150m, depending on emissions scenario.

Adaptations to reduce some of this risk could include information provision and awareness-raising, and changes in spatial planning policy or building design. These kinds of measures might carry maximum annual costs of between £3-5m. These estimates were calculated using Costing the impacts of climate change in the UK costing method, available from the UK Climate Change Impacts Programme (UKCIP).

An increase in the frequency of heat waves is likely to entail an increase in mortality and morbidity principally in older people, due to cardiovascular and respiratory diseases. Specific individual impacts that can be costed in this respect are premature mortality and hospital admissions.

Climate change partnerships

The London Climate Change Partnership: Adaptation decision-making in London

The London scoping study was published in 2002 by the London Climate Change Partnership (LCCP). Information from the study was incorporated into London's key land use planning document, 'The London Plan' (Greater London Authority, 2004), which also refers to the role of the partnership in developing adaptation policies:

"The Mayor will and boroughs should assess and develop policies for the likely impacts of climate change on London identified in the work of the London Climate Change Partnership. Policies will be developed in conjunction with the Partnership and addressed in the first review of the London Plan."

"London is already feeling the effects of climate change. Sea-level rise relative to the land is now widely accepted as occurring at 6mm/year at high tide in the London area. A significant proportion of future development will be in east London, which could be increasingly at risk from tidal flooding. Preventative and adaptive measures will therefore be needed, including the construction of appropriate flood defences in new developments."

Following on from the scoping study, the LCCP's work has focused on transport and 'growth areas' such as developments in the Thames Gateway. LCCP has commissioned research to evaluate climatic risks and costs to London's transport systems, including the underground and overground railways systems and road network. This information will be used by London's transport decision-makers. In 2005, together with the South East and East of England climate change partnerships, the LCCP launched a consultation draft of 'Adapting to Climate Change: A Checklist for Development' (TRCCG, 2005). This provides developers and their design teams with information and a checklist so that a new development can be designed to be comfortable and secure in the face of climate change throughout its lifetime.

In early 2005, the GLA announced that it was developing the first climate adaptation strategy for a world city. This strategy will include policy directions on flooding, overheating, water resources management, emergency planning and other issues which will be affected by London's changing climate. Public consultation on the draft strategy is due to take place in summer 2006.

Research on climate change impacts across Government

33. Research on climate change impacts and adaptation is carried out across a number of Government departments and agencies. Defra leads on climate change policy, supports basic tools and frameworks for impacts research through UKCIP and other funded research of a more general exemplary nature. Remaining research falls to those responsible for different sectors as outlined below.
34. Defra and the Environment Agency fund a collaborative research programme on flood and

coastal erosion risk management. Climate change has featured in the work of a number of the themes and recently this has been based on analysis of the UKCIP02⁶ scenarios to provide guidance for design and appraisal. Effort is currently focussed on better understanding fluvial flows and in a recent project modelling was undertaken using three different methods of representing UKCIP02 scenarios:

- a "combined" scenario of percentage changes in average rainfall and the change in frequency of daily rainfall required for each month;
- statistical downscaling methods for rainfall; and

⁶ The UKCIP02 scenarios, which replace those produced for UKCIP in 1998, are based on four different IPCC greenhouse gas emissions scenarios, themselves based on four different descriptions of how the world may develop in the decades to come.

- data from the 25km Hadley Centre regional climate model.

35. This provided valuable information, but was limited to a small proportion of catchments under a limited range of scenarios and showed a very wide range of potential variation. A further study is now underway to:

- consider the evidence for refining current guidance to provide greater sensitivity to likely changes in both peak flood flows and total flood volumes between different regions and catchments with different characteristics and for different time periods;
- provide the scientific basis for analysing and communicating uncertainties associated with climate change in comparison with other uncertainties generally encountered in hydrological estimation of flood flows and volumes; and
- improve the scientific basis for regionalised policy guidance to the flood risk management community on changes in flood flows due to climate change or make recommendations for other developments necessary before such regionalisation can be achieved.

36. Future work is likely to consider the impacts of climate change on sea levels, surges and waves and how the next generation of UKCIP climate change scenarios can best be used in flood and coastal erosion risk management design and analysis activities.

We will produce revised guidance, with the Environment Agency, on implementing flood and coastal erosion risk management measures, to ensure that adaptability to climate change becomes an integral part of all flood and coastal erosion management decisions.

37. The changing climate brings particular challenges for the management of biodiversity and protected sites. Defra's research programme on biodiversity and climate change is undertaken in partnership with the devolved administrations, the statutory nature conservation agencies and other interested non-governmental organisations. The programme has three main objectives:

- to improve the understanding of climate change impacts on biodiversity in the terrestrial and marine environments, including through application of modelling techniques to assess vulnerability of priority species and habitats;
- to review and develop options for adaptation of policy and management, including improved knowledge transfer between researchers and practitioners; and
- to ensure that long-term monitoring systems are in place to detect changes in biodiversity and discriminate the effects of climate change from other factors.

38. Defra recently published a review of climate change impacts on migratory species⁷. As part of

EPSRC programme "Building Knowledge for a Changing Climate" (BKCC)

The Engineering and Physical Sciences Research Council (EPSRC) is working with UKCIP on a £3m portfolio of research projects addressing climate impacts and adaptation for the built environment.

The projects are exploring climate impacts and adaptation for urban planning and design, urban drainage, historic buildings, transport operations and infrastructure, and the electricity supply industry. All of the projects involve partnerships of researchers with decision-makers who plan to use the research outputs to inform their own organisations' adaptation strategies.

A bi-annually convening Stakeholder Forum was set up to oversee the whole programme and ensure that the research outputs are geared to meet decision-makers' information needs. The majority of the BKCC projects are due for completion in spring 2006.

Adaptation

the UK Presidency of the EU, the UK Government hosted a meeting of the European Platform for Biodiversity Research Strategy to review the status of knowledge on impacts of climate change and to identify knowledge gaps which are hindering implementation of adaptation strategies⁸.

We will publish the results of collaborative research on the effects of climate change on UK priority species and habitats (MONARCH3) and on the establishment of a long term monitoring network.

We will review the implications of climate change for biodiversity in England and

integrate adaptation within the England Biodiversity Strategy.

Adaptation to climate change as an impact will be built into the development of integrated policy for the Natural Environment.

39. Agriculture is inherently sensitive to climate. We have a long-standing programme of research of some £0.3m per year on climate change on agriculture and identifying adaptation options to help industry and policymakers plan for the uncertainties ahead. The programme has recently been reviewed and we will ensure climate change is factored into other key research on agriculture,

Foresight Project on Future Flooding

Rationale:

The Foresight Future Flooding study was commissioned by the Office of Science and Technology to provide an independent vision of flood and coastal erosion risk management in the UK between 2030 and 2100 so as to inform long-term policy. In undertaking the study there was a recognition that decisions taken today will have a profound impact on the flood and coastal erosion risks which future generations will need to manage. It was also recognised that the options available for managing risks in the long-term will be strongly influenced by short term actions.

Approach:

The study used four Foresight socio-economic futures paired with UKCIP climate change scenarios (for example the high-growth 'world markets' future was combined with high greenhouse gas emissions) to allow responses to be tested against different outcomes. In this way it was possible to identify policies and responses capable of coping with a range of possible futures, allowing flexible adaptation as the situation evolves.

Results:

Under the baseline assumption of current levels of expenditure and approaches to flood and coastal management remaining unchanged, it was found that all scenarios would result in a substantial increase in risk. The team demonstrated that an integrated approach combining a portfolio of responses would provide significant cost savings over conventional defences and also enable a much more sustainable approach to be realised.

Conclusions:

The Foresight Future Flooding study does not provide a definitive vision of the future or specify what our aims should be. It does, however, give a clear indication of how we should approach the management of flood risk and what issues are likely to be important. It has provided a vital input to the developing cross government strategy *Making Space for Water* and demonstrated that reducing climate change could make the task we face substantially easier.

Full details of the study are available from <http://www.foresight.gov.uk/>

⁷ www.defra.gov.uk/wildlife-countryside/resprog/findings/climatechange-migratory/index.htm

⁸ The recommendations of this meeting are available from www.epbrs.org/

and that climate change is linked more broadly to work on socio-economic change in the agriculture sector.

40. The impacts of climate change are less well-studied for the marine environment. Climate change could significantly affect the physical, biological and biogeochemical characteristics of the oceans and coasts, modifying their ecological structure and functions.
41. Changes in sea water temperature is changing the species composition of phytoplankton, the microscopic plants which respond to temperature, light and nutrients and form the lowest level in the food web. Such changes could also affect the life forms higher up the food web. More directly, sea temperature changes could affect the reproductive success of species at a given latitude and, thus, affect the abundance of animals and plants of any size. Since around 1987, changes in plankton have been considered so large-scale that they have been described as a regime shift. There has been increased primary productivity, merging of the spring and autumn blooms and a switch in the dominant species. This has been accompanied by the northward movement of plankton species by about 10 degrees of latitude.
42. More specific action is now being taken to investigate the possible impacts of climate change in the marine environment:
 - The Government and the UK Climate Impacts Programme (UKCIP) are establishing a Marine Climate Change Impact Partnership in order to develop a long-term, multidisciplinary approach to understanding the implications for the marine ecosystem.
 - Within the UK Marine Monitoring Strategy, relevant indicators will be identified to monitor and evaluate the effects of climate change on marine ecosystems.

We will conduct a review of current activities to assess the impacts of climate change in the marine environment.

We will commission an assessment of the changes in the distribution and abundance of marine species in relation to changes in hydrodynamics and sea temperature.

We will combine knowledge and expertise on the impacts of climate change in the marine environment through the Marine Climate Change Impacts Partnership.

43. Much of the research to date has been carried out to inform specific individual sectors about the implications of climate change. However, there may be more surprises in store as climate-related impacts on one sector bring with them indirect effects for another. Many of these cross-sectoral issues are much less studied, yet robust adaptation decisions in sectoral policy areas will need to take into account the implications of those decisions for facilitating or preventing effective adaptation in related sectors.

We will commission a programme of research to investigate cross-sectoral issues in adapting to the impacts of climate change in the UK.

44. Knowledge and understanding of the impacts of climate change is growing not only in the UK, but internationally too. The field of adaptation is still relatively young, and there is scope to learn much from initial efforts both in the UK and elsewhere to take effective adaptation. In order to be robust, policy-making needs to be flexible, build on the latest research, and allow the latest results to inform policy and planning.

We will commission an academic "Climate Change Impacts Review Group" to produce a review of the impacts of climate change and adaptation in the UK.

Conclusions

45. It is clear that there are many areas of policy where adaptation to the unavoidable impacts of climate change is beginning to occur. The UK has developed considerable expertise in this field, and in the period covered by this revised Programme will have the opportunity to share this internationally.
45. There is also much supporting research work that Government is taking forward to improve understanding of climate impacts and to enable the integration of this understanding into adaptation policy.
46. Action is required more widely than just Central Government. We are working to set in place the knowledge and frameworks to allow us to more successfully adapt to unavoidable climate change.

SECTION 4

Action by the Devolved Administrations

The Scottish Executive is committed to:

- Strengthening its climate change response through its own revised Scottish Climate Change Programme.
- Quantifying Scotland's equitable contribution to the UK's targets by developing the Scottish Share concept.
- Creating a framework to assist Scotland in responding to the unavoidable impacts of climate change.

Introduction

1. This chapter outlines some of the action being taken by the Scottish Executive to tackle climate change in Scotland. It is largely retrospective, providing an update on action the Executive has taken since the UK and Scottish programmes were published in November 2000. Detailed information about the outcome of the review process in Scotland and the new policies to be introduced will be provided in the revised Scottish Climate Change Programme, to be published soon after the UK Programme.



2. The original Scottish Programme contains a range of regulatory, voluntary and educational measures aimed at delivering emissions reductions in areas devolved to the Executive. It committed the Executive to make an equitable contribution to the UK Kyoto target and to work in partnership

with the UK Government in moving towards its ambitious domestic carbon dioxide goal for 2010.

3. To complement historic data, the Executive is developing updated greenhouse gas and carbon dioxide emissions projections for Scotland.

The Executive is committed to developing its strategic response to climate change as scientific understanding of the problem, and Scotland's contribution to it, develops. During the review of the Scottish Programme, described in greater detail below, the Executive developed a new approach to define what an equitable contribution to UK climate change commitments is in specific emissions saving terms (the "Scottish Share" – see below).

Greenhouse gas emissions inventory and projections

4. Greenhouse gas emissions data, disaggregated for the four countries of the UK, is available for 1990, 1995 and annually from 1998. Scotland's greenhouse gas emissions reductions demonstrate that Scotland is making a substantial contribution to the UK's Kyoto target. Greenhouse gas emissions fell by 2 MtC between 1990 and 2003 (10 per cent below 1990 levels and 14 per cent below if land use change removals are taken into account). Carbon dioxide emissions fell by almost 1.3 MtC over the same period (8 per cent below 1990 levels and 13 per cent if land use change removals are taken into account). These reductions were achieved at the same time as a 29 per cent growth in the Scottish economy over the period.
5. Scotland's carbon dioxide and total greenhouse gas emissions have fallen by more than the UK average in the period since the UK and Scottish Climate Change Programmes were published (2000-2003), by 5 and 6 per cent respectively. Scotland's greenhouse gas emissions reduction between 1990 and 2003, including land use change and forestry emissions and removals, was greater than that of 13 of the 15 EU Member States that make up the EU Kyoto burden-sharing agreement.

Scotland

Scottish and UK greenhouse gas emissions by sector in 2003

Sector	Greenhouse Gas Emissions (MtC) ¹		% Change 1990-2003	Scotland as % of UK ² (2003)
	1990	2003		
Business	3.2	2.0	-36	7
Waste Management	0.4	0.2	-51	6
Industrial Process	0.5	0.1	-72	3
Transport	2.8	3.0	6	9
Residential	1.9	2.0	2	8
Energy Supply	6.3	6.5	3	11
Agriculture	2.4	2.1	-15	16
Land Use Change Emission	1.5	1.4	-3	35
Public	0.5	0.3	-48	9
Total Emissions	19.6	17.6	-10	10
Land Use Change ³ : Removals**	-2.3	-2.7	20	62
Total Net Emissions	17.3	14.9	-14	9

Notes:

¹ Base year and 2003 emission figures taken from the Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland 1990-2003 (Baggott *et al.*, 2005). The emissions estimates for Scotland, Wales and Northern Ireland inventories are subject to greater uncertainty than the consolidated UK estimates.

² UK figures exclude unallocated emissions. This affects energy supply and transport (where emissions due to military transport, fishing and domestic aviation are unallocated).

³ Land use change removals is a sink and, therefore, removes carbon. Thus, the percentage change between 1990 and 2003 (in column 3) has therefore been shown as a positive to reflect the fact that the capacity of the sink has increased.

The impacts of climate change in Scotland

6. The UK Climate Impact Programme's climate change scenarios¹, published in 2002, predict that:

- by the 2080s Scotland will have warmer and wetter winters;
- there will be less snowfall and increased flooding;
- summer temperatures could rise by up to 3.5°C and winter ones by 2.5°C;
- rainfall in 24 hours from storms, which are expected to occur biennially, could rise by up to 25 per cent, especially in the east;
- the growing season could be extended by 30 to 80 days;
- sea levels could rise by up to 600 mm;
- summers could be up to 40 per cent drier; and

- snowfall could decrease by up to 90 per cent depending on location.

7. The Executive has worked closely with the UK Government on a £400,000 cross-regional research programme, which is funding six projects on impacts and adaptation. It is also working with: (1) the Scotland and Northern Ireland Forum for Environmental Research on the development of a regional partnership to assist organisations in Scotland to respond to the impacts of climate change; and (2) the UK Climate Impacts Programme to assist businesses and local authorities plan their adaptation response. In addition, the Executive is working closely with the UK Government and the other devolved administrations on the development of the UK climate change Adaptation Policy Framework. Further information on the Executive's adaptation response to flood risk and other climate change-related threats will be set out in the revised Scottish Climate Change Programme.

¹ www.ukcip.org.uk/scenarios/

The review of the Scottish Climate Change Programme

8. A formal review of the Scottish Programme was launched at the same time as the UK Government's review of the UK Programme in September 2004. The aim of the review was to consider the scope for strengthening existing measures and introducing new policies to reduce Scottish greenhouse gas emissions and adapt to the unavoidable impacts of climate change. The Executive received almost 400 responses, which are summarised in *Scottish Climate Change Programme Review: Analysis of Consultation Responses*². A Scottish stakeholder group was also established and met periodically during the review.

Scottish Share

9. One of the key aims of the review of the Scottish Programme was to assess to what extent Scotland makes an equitable contribution to UK commitments on climate change, in those areas of policy in which the Executive has direct responsibility.
10. The 'Scottish Share' concept was announced by the Minister for Environment and Rural Development at a Climate Leaders' Summit held in Montreal in parallel with the 11th Conference of the Parties on 5-6 December 2005. The Scottish Share quantifies the amount of carbon savings that Scotland has to deliver through its devolved policies to match savings from all devolved policies in the UK Climate Change Programme on a per capita basis. Details of the Scottish Share and further development of the overall approach will be included in the revised Scottish Climate Change Programme.

Scottish Sustainable Development Strategy

11. The Scottish Sustainable Development Strategy *Choosing Our Future*³ was published at the end of

2005. The Strategy is built around action to address the well-being of people in Scotland, supporting thriving communities, protecting Scotland's natural heritage and resources and making a global contribution. The Strategy provides a framework for a range of existing and planned policies, strategies and programmes, including the Scottish Climate Change Programme. It sets out cross-cutting proposals on education and learning, communication and governance and identifies actions that can be taken by public bodies, businesses, individuals and the community and voluntary sectors to address sustainable development concerns, including climate change.

Renewables

12. Promotion of renewable energy is devolved to the Executive. **Scottish Ministers are committed to promoting energy from a wide range of renewable sources**, and have a target that 40 per cent of electricity generated in Scotland as a proportion of demand should come from renewable sources by 2020. This equates to around 6GW of installed capacity, although Ministers have made clear that this is not regarded as a cap.
13. Much of the developer activity at present (driven by the Renewables Obligation Scotland/ROS) is focused on onshore wind. However, the Forum for Renewable Energy Development in Scotland has produced reports aimed at expanding the biomass and marine energy sectors. Scottish Ministers recently announced their intention to provide more support to wave and tidal power by amending the ROS, and further work and consultation on this option is currently under preparation. Plans to provide additional support to biomass heat and power projects are also being advanced, whilst the Executive continues to provide support to small and micro scale renewables through its Scottish Community and Household Renewables Initiative⁴.

² www.scotland.gov.uk/Topics/Environment/Climate-Change/16327/SCCPReview

³ www.scotland.gov.uk/Publications/2005/12/1493902/39032

⁴ www.est.org.uk/schri/

Scotland

European Marine Energy Centre

Among the first of its kind in Europe, the European Marine Energy Centre in Orkney provides testing facilities for commercial-scale wave devices and in the near future it will also provide tidal testing facilities. The £5m Centre, which has been operational since October 2003 and was opened officially in August 2004, hosts a four berth wave testing facility (2 kilometres offshore) and a data centre in Stromness. Work is underway on the creation of a five berth tidal testing facility.

It is hoped that the facility will become a world leader in the development, testing, accreditation and environmental monitoring of devices for the marine energy industry and will help to stimulate the creation of green jobs in Scotland. A Marine Energy Group report, published in 2004, suggested that up to 7000 jobs could be supported in both direct and indirectly related industries.



Energy efficiency

14. Overall energy policy is reserved to the UK Government while the Executive is responsible under the Scotland Act 1998 for *“the encouragement of energy efficiency other than by prohibition or regulation”*. **The Executive plans to publish an energy efficiency strategy for Scotland during 2006.** This will create a more

joined-up approach for energy efficiency interventions. The strategy will cover the domestic, business, transport, and public sectors.

CHP

15. Policy on Combined Heat and Power is reserved to the UK Government. CHP electrical capacity in Scotland in 2004 was 773 megawatts of energy, 13.8 per cent of the UK total.

IPPC

16. Implementation of the Integrated Pollution Prevention and Control Directive (96/61/EC) is devolved and has been implemented in Scotland through the Pollution Prevention and Control (Scotland) Regulations 2000 (PPC). IPPC includes energy efficiency requirements that are designed to minimise pollution arising from the consumption of energy in industrial processes. Each installation requires a PPC permit issued by the Scottish Environment Protection Agency (SEPA). These include conditions also encouraging energy to be used efficiently in the industrial process.

EU emissions trading scheme

17. The EU ETS is a devolved matter. The Executive worked closely with the UK Government to have the Scheme up and running uniformly across the UK by 1 January 2005. Over 1000 UK installations – accounting for over 46 per cent of UK carbon dioxide emissions – are involved in the first phase of the scheme (2005-2007). Over 100 of these are based in Scotland. The Executive continues to work closely with the UK Government on arrangements for the second phase.

Support for businesses

18. The Carbon Trust works with businesses and the public sector in the UK to support them in strategies to cut emissions of carbon dioxide, and to reduce climate change. In 2004-5, the Trust

carried out around 600 on-site energy audits in Scotland, identifying potential carbon savings of 0.07 MtC, representing financial savings of around £16m. Up to March 2005, it had also reached 34 partnership agreements with organisations in both the public and private sector producing an estimated 0.02 MtC of carbon savings and financial savings of around £8m.

19. *Loan Action Scotland* provides interest free loans from £5,000 to £50,000 to Scottish Small and Medium Sized enterprises (SMEs) for investments that reduce energy consumption. These loans are repayable over a maximum of five years. As well as reducing energy consumption and carbon emissions, the scheme directly increases the profitability of Scottish SMEs by reducing their energy bills.

Green jobs strategy

20. Resource efficiency is devolved and the Executive published *Going for green growth: a green jobs strategy for Scotland*⁵ in June 2005. The Strategy highlights the wealth of business and employment opportunities arising from the global shift towards a sustainable future, especially in sectors specialising in renewable energy and cleaner technologies, including carbon sequestration, waste management and recycling.

Waste management

21. Waste policy in Scotland is generally a devolved matter although taxation, including the landfill tax, is reserved. The National Waste Plan (NWP) and 11 constituent Area Waste Plans were published in February 2003 and established the direction of the Executive's policies for sustainable waste management to 2020. The aim of the plans is to minimise the impact of waste on the environment, both locally and globally, and improve resource efficiency in Scotland. Targets include recycling and composting 25 per cent of municipal waste by 2006, 30 per cent by 2008 and 55 per cent by 2020. A Strategic Waste Fund was established in 2001 to assist local authorities in meeting these

targets. Implementation of the NWP will lead to a significant reduction in landfill of municipal waste, from around 90 per cent to 30 per cent and subsequent reduction in methane gas emissions.

Transport

22. **The National Transport Strategy (NTS) will be launched in 2006.** Over the coming year the Strategy will provide the opportunity for the Executive to consider its transport policies and their alignment with its climate change and sustainable development goals. The NTS will be based on the Executive's aim for transport as set out in the 2004 White Paper, *Scotland's Transport Future*, for example to promote economic growth, social inclusion, health and protection of the environment through a safe, integrated and effective transport system. The Executive's environmental objective for transport is to "protect our environment and improve health by building and investing in public transport and other types of efficient and sustainable transport which minimise emissions and consumption of resources and energy".
23. The NTS will offer the opportunity to start a wider debate on environmental issues and provide an ideal forum to seek the views of stakeholders on targets and indicators. In the meantime the Executive is addressing the issue of transport impacts on the environment and transport emissions in a number of ways ranging from initiatives aimed at promoting modal shift such as the funding of StepChange⁶ location specific pilot projects, School Travel Co-ordinators and CyclingScotland⁷, to its Partnership Agreement⁸ commitment to introducing Green Travel Plans and directing 70 per cent of investment to public transport over the period of the Executive's long-term investment plan.

⁵ Going for green growth: A green jobs strategy for Scotland: <http://www.scotland.gov.uk/Publications/2005/06/1693437/34386>

⁶ www.stepchangescotland.org/

⁷ www.cyclingscotland.org/

⁸ www.scotland.gov.uk/library5/government/pfbs-00.asp

Scotland

Edinburgh CityCarClub

Edinburgh CityCarClub is the largest in Britain, operated by Smart Moves with the support of the City of Edinburgh Council. It offers an alternative to traditional car ownership through pay-as-you-drive car hire. Members have local access to a car when they need one and only pay for the time it is in use and the miles driven. Cars are parked in reserved parking spaces, close to homes or workplaces and can be booked on-line or by telephone. All vehicles are serviced and maintained by the club, which means members do not have the expense or bother of dealing with servicing, repairs, insurance, MOTs, road tax and cleaning.

City Car Club cites research showing that each car in a car club typically replaces five privately owned vehicles. Fewer cars = less carbon dioxide emissions, less congestion and also quieter, cleaner, safer streets.

Biofuels

24. The Executive recognises the environmental benefits of biofuels and has encouraged and supported the construction of Scotland's first large-scale biodiesel plant by the Argent Group near Motherwell through a Regional Selective Assistance grant of £1.2m. The plant became operational in early 2005 and reached full production levels at the end of the 2005. It also supports development work at UK level on the promotion and uptake of alternative and cleaner vehicle technology and fuels such as the *Powering Future Vehicles Strategy*⁹ and is involved in developments at the UK level related to the recently announced introduction of a Renewable Transport Fuel Obligation (RTFO).

Food transportation

25. The Executive understands the need to reduce unnecessary food miles and better understand issues around food transportation. The Processing

and Marketing Grant schemes support the use of Scottish produce and therefore local employment. This cuts down on imports that can have an impact on food miles and transportation.

Aviation

26. The impact of transport on the environment is not only a Scottish issue but also a UK and an international one. The Executive, therefore, strongly supports – subject to specific concerns being addressed regarding the unique nature of air services in the Highlands and Islands – the UK Government in seeking the inclusion of the aviation sector in the EU emissions trading scheme.

Energy efficiency in households

27. There has been significant growth in energy consumption in the residential sector. This issue will therefore be the focus for the energy efficiency strategy to be published in 2006. The Energy Saving Trust (EST) is one of the leading organisations working with the Executive to identify climate change interventions within the household sector. The Executive is providing direct funding of around £8m in the year 2005-6 for the EST's work in Scotland. In 2004-5 EST advised 90,000 clients in Scotland on energy efficiency matters. It is estimated that in 2005-6 EST programmes should produce lifetime savings of 194,000 tonnes of carbon equivalent.



⁹ www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_506885.hcsp

Fuel poverty

28. Policy to combat fuel poverty is devolved to the Executive. Fuel poverty in Scotland has more than halved between 1996 and 2002, from 738,000 to 286,000 households. Since 2001, over £140m has been made available to the *Central Heating programme* which has provided central heating systems to over 56,000 homes. Research on the first year of the programme showed that of the people who were fuel poor, nearly nine out of ten were lifted out of fuel poverty after receiving measures. The Executive has also so far devoted £64m to the *Warm Deal*, insulating over 218,000 homes – nearly one-tenth of all of Scotland's housing stock.

Agriculture

29. Agriculture policy is devolved to the Executive. The Common Agriculture Policy Reform introduced cross compliance¹⁰ and the requirement for farmers to maintain their land in Good Agricultural and Environmental Condition (GAEC). These became requirements for receipt of the new Single Farm Payment in 2005. Much of GAEC relates to soil protection issues and measures to preserve and enhance levels of organic matter in soils. About 70 per cent of Scottish land is managed according to GAEC.



30. Agri-environment schemes such as the Rural Stewardship Scheme (RSS) include a number of

measures which will contribute to a reduction in emissions by encouraging more extensive land use practices. Advice is provided to farmers through various means, including the Prevention of Environmental Pollution from Agricultural Activity (PEPFAA) Code and the Farm Soils Plan which include recommendations for techniques to reduce greenhouse gas emissions and encourage energy efficiency.

31. The Executive has funded a range of research projects to understand the role of agriculture and other rural land uses on greenhouse gas emissions, for example how fertiliser use in Scotland¹¹ contributes to climate change. A model to simulate carbon and nitrogen dynamics in organic soils and help predict the response to land use change will be published in 2007.

Scottish soils

32. Policy in this area is devolved to the Executive. A commitment has already been made by the Executive in the *Rural Implementation Plan of the Scottish Biodiversity Strategy*¹² to 'develop soil management strategies/policies which will promote conservation and enhancement of biodiversity interests' by 2007.



33. Recognising the importance of evidence when considering a more strategic approach towards soil protection, the Executive is currently involved in a number of research projects that will provide

¹⁰Cross compliance is a series of standards that farmers need to meet in order to receive their subsidy payment in full.

¹¹www.scotland.gov.uk/Resource/Doc/30701/0007033.pdf

¹²www.scotland.gov.uk/Publications/2004/05/19366/37239

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evidence on the state of and threats to Scottish soils. At the same time, the Executive is an active member of the UK Soil Indicators Consortium which aims to develop soil indicators and a soil monitoring scheme in order to broaden the knowledge base on the overall state of soils. Scottish soil policies are currently informing the UK's input to the negotiation of the EU Soil Thematic Strategy. The EU Strategy will in turn be an important factor in the development of the Scottish soil policy framework.

Forestry

34. Forestry policy is entirely devolved to the Executive. Forestry makes a net contribution to reducing atmospheric carbon dioxide by carbon uptake in growing biomass, and through forest vegetation and soils. A further contribution is made when wood fuel substitutes fossil fuels, and where timber and wood products substitute for energy-intensive materials such as concrete and steel.
35. Through Forestry Commission Scotland (FCS), the Executive promotes woodland creation in appropriate situations through the *Scottish Forestry Increase Grants Scheme*. This work aims to increase the accessibility of woodland creation grants via their incorporation into Land Management Contracts, which from 2007 will become the primary vehicle in Scotland for supporting land management. A review of the Scottish Forestry Strategy is underway; climate change mitigation will be recognised as a key issue for Scotland's 1.35m hectare forest estate.

Public sector

36. Scottish local authorities, the Health Boards, and Scottish Water spend over £100m a year on energy. The *Central Energy Efficiency Fund* (CEEF) is a revolving loan fund started in June 2004 to promote improved energy efficiency throughout the public sector by providing interest free loans to fund the installation of energy saving measures. The Executive has allocated £20m,

with £15m available to local authorities, £4m to the health sector, and £1m to Scottish Water. This scheme is directly financing projects that deliver energy, cost and carbon savings.

37. The Executive recognises that it must lead by example in tackling its own corporate contribution to climate change. The Greening Government policy sets out objectives and targets for improving the environmental performance of the Executive's own operations. These include, for example, the energy consumption of its estate, vehicle use, waste arising and recycling, and factoring in environmental considerations to the procurement of goods and services. The Executive's electricity contract enables the procurement of 100 per cent carbon-free energy attributed to hydro-electric and wind power generation, and an 80 per cent climate change levy exemption.
38. The Executive reports annually on progress against its environmental objectives and targets. This work also includes the development of environmental management systems across its estate and the continuing ISO14001 accreditation of its largest building.

Performance of the NHS Scotland estate

39. In line with Executive climate change commitments, NHSScotland had, between 1989-90 and 2004, reduced its carbon dioxide emissions by 37.6 per cent. Its target to reduce energy consumption by 22.5-30 per cent between 1985-86 and 2000-01 was surpassed, with a total reduction of 34 per cent achieved. In 2000, NHS Scotland committed to a national target to further reduce energy consumption by 2 per cent each year by 2010. If achieved, this target will be equivalent to a total saving of almost 50 per cent in energy consumption by 2010 against the 1990 Kyoto base year. An update on other key public bodies will be provided in the new Scottish Climate Change Programme.

Planning

36. The town and country planning system is a devolved matter. In Scotland, the integration of climate change considerations into land use planning is dealt with in a wide range of Executive planning publications. Firstly, it is recognised as a key issue and driver of change in the National Planning Framework. Secondly, *Scottish Planning Policy (SPP)1 – The Planning System*¹³ recognises the Executive's wider commitment to tackling climate change and acknowledges that burning fossil fuel is the biggest single contributor to global warming. Thirdly, more specific references are included in the policy and advice on individual planning issues, notably *SPP3 Housing*, *National Planning Policy Guideline (NPPG)6 Renewable Energy* (under review), *SPP7 Flooding*, *NPPG 10 Waste Management* and *NPPG 13 Coastal Planning*¹⁴.
37. Regarding emissions reductions, the *Scottish Planning Policy 17 Planning for Transport*¹⁵ and the associated planning advice note published in August 2005, incorporate a wide number of broader Executive policy objectives in the planning policy, including those related to climate change. In turn, planning authorities take the Executive's policy and advice into account in the preparation of their structure and local plans, and in the determination of planning applications. This is reinforced by requirements for Strategic Environmental Assessments (see below) for plans and Environmental Impact Assessments for projects, to consider any significant effects on climatic factors.

Building Regulations

38. The current energy standards for buildings were introduced in March 2002. These standards apply when new buildings are constructed and existing buildings are altered and/or extended. The improvements made represent a 25 per cent saving in energy terms over the previous set of standards. The revised Scottish Building Regulations, which came into force in May 2005, currently have the most demanding levels of thermal insulation for buildings (including conservatories) in the UK.

Strategic Environmental Assessment

39. Strategic Environmental Assessment (SEA) is a devolved matter. In Scotland and also UK wide, regulations implementing SEA came into force in July 2004. The Environmental Assessment (Scotland) Bill (SEA Bill) was passed in the Scottish Parliament on 9 November 2005 and extends the scope of Strategic Environmental Assessment beyond the requirements of the EU Directive, to cover all public sector strategies, plans and programmes.

Monitoring and reporting

40. Details of monitoring and reporting arrangements will be included in the revised Scottish Climate Change Programme.

¹³www.scotland.gov.uk/library5/planning/spp1-00.asp

¹⁴www.scotland.gov.uk/library5/planning/spp3-00.asp

¹⁵www.scotland.gov.uk/Publications/2005/08/16154406/44078

Northern Ireland is committed to:

- Implement a package of policies and programmes to mitigate climate change and contribute to the UK emission reduction targets.
- Focus effort on further reducing the emissions intensity of electricity generation and improving energy efficiency in homes, businesses and the public sector.
- Invest in research and development on renewable technologies, support and incentivise market uptake to reduce reliance on fossil fuels.
- Undertake research and engage with stakeholders to raise awareness and understanding of the potential impacts of predicted changes in climate and assist organisations in preparing for these changes.

Introduction

1. Northern Ireland is fully committed to implementing policies and programmes to reduce greenhouse gas emissions, to help contribute to the UK's Kyoto target and domestic goal. Climate Change and energy is a priority area for Northern Ireland. Work is also progressing on assessing the implications of climate change for Northern Ireland as the basis for developing adaptation policies. Northern Ireland's Sustainable Development Strategy, due to be published this year, will provide a cross-cutting strategic direction and framework for the Northern Ireland Administration to direct policy and decision-making and encourage a co-ordinated and co-operative approach to sustainable development.

Greenhouse gas emissions inventory and projections

2. Because of its small size and limited industrial base, Northern Ireland accounts for a relatively

small proportion of the UK's greenhouse gas emissions. In 2003, the latest year for which disaggregated data is available, greenhouse gas emissions accounted for three per cent of the UK total.

3. Total greenhouse gas emissions in 2003 were 3.5 per cent below the 1990 base year. While there has been improvement, the reduction is not as marked as in the UK as a whole. This partly reflects the different sector mix, the smaller industrial base in Northern Ireland, a larger agriculture sector, and historically low availability of natural gas. The largest reductions have taken place in the residential, and energy supply sectors, whereas emissions in the business and transport sectors continue to grow. The breakdown by sector for 2003 is shown below.

While there are no disaggregated emission reduction targets for the devolved administrations, specific energy efficiency targets apply in a number of sectors in Northern Ireland and progress on achieving these is monitored.

The impacts of climate change in Northern Ireland

4. The Department of the Environment (DOE) in Northern Ireland has taken forward a number of initiatives to promote understanding and awareness of climate change impacts. Much of this work has been developed in co-ordination with the UK Climate Impacts Programme (UKCIP). A comprehensive report on *Implications of Climate Change for Northern Ireland: Informing Strategy Development*¹⁶, published in 2002 by the Scotland and Northern Ireland Forum for Environmental Research (SNIFFER), examined the likely impacts of climate change across a wide range of sectors. The key impacts identified include potentially adverse effects on public health, the likelihood of more accidents and damage from extreme weather events and threats to vulnerable eco-systems.
5. The DOE has recently commissioned SNIFFER to provide an updated report on the implications of climate change for Northern Ireland. This study

¹⁶www.ukcip.org.uk/resources/publications/documents/Northern_Ireland.pdf

Northern Ireland and UK greenhouse gas emissions by sector in 2003

Sector	Greenhouse Gas Emissions (MtC) ¹		% Change 1990-2003	Northern Ireland as % of UK ² (2003)
	1990	2003		
Business	0.46	0.60	+30	2
Waste Management	0.10	0.06	-44	2
Industrial Process	0.20	0.05	-75	1
Transport	0.94	1.28	+36	4
Residential	1.14	0.90	-20	4
Energy Supply	1.51	1.39	-8	2
Agriculture	1.38	1.35	-3	11
Land Use Change Emission	0.32	0.27	-16	7
Public	0.08	0.04	-55	1
Total Emissions	6.14	5.94	-3.4	3
Land Use Change ³ : Removal**	-0.22	-0.22	2	5
Total Net Emissions	5.92	5.71	-3.5	3

Notes:

¹ Base year and 2003 emission figures taken from the Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland 1990-2003 (Baggott *et al.*, 2005). The emissions estimates for Scotland, Wales and Northern Ireland inventories are subject to greater uncertainty than the consolidated UK estimates.

² UK figures exclude unallocated emissions. This affects energy supply and transport (where emissions due to military transport, fishing and domestic aviation are unallocated).

³ Land use change removals is a sink and, therefore, removes carbon. Thus, the percentage change between 1990 and 2003 (in column 3) has therefore been shown as a positive to reflect the fact that the capacity of the sink has increased.

- will incorporate a risk assessment and will recommend adaptation strategies for the key impacts. This work is due to be completed by the end of 2006 and its results will help to inform Northern Ireland's input to the UK Adaptation Policy Framework.
6. The DOE's Environment and Heritage Service maintains a database on 13 indicators of climate change including rainfall, temperature, and the responsive behaviour of birds and insects. A report on *Climate Change Indicators for Northern Ireland*¹⁷ published in 2004, indicated that since 1840, nine of the fifteen warmest years recorded have occurred since 1990. It also pointed to evidence of:
 - average temperatures increasing;
 - an increase in the growing season;
 - number of snow days decreasing; and
 - swallows and butterflies being sighted progressively earlier.
7. The database will be updated annually and will form the basis of ongoing monitoring of climate change impacts in Northern Ireland.
8. To promote awareness of climate change, the Environment and Heritage Service issued a guidance booklet¹⁸ for public bodies on climate change impacts in Northern Ireland, with information on how climate change will impact across sectors and on the delivery of key public services. It includes checklists for public authorities in assessing their vulnerability to climate change.
9. DOE's Planning Service recently completed a public consultation on a draft Planning Policy Statement (PPS15) on Planning & Flood Risk. PPS15 seeks to reduce flood risks to people, property and the environment and adopts a precautionary approach to decision-making, taking account of climate change and acknowledging the wider sustainability objectives of the Northern Ireland Administration. Publication of the final PPS is anticipated by April 2006.

¹⁷ www.ehsni.gov.uk/pubs/publications/ccicover2.pdf

¹⁸ A summary of the possible impacts can be found at: <http://www.ehsni.gov.uk/pubs/publications/guidanceweb.pdf>

Northern Ireland

Northern Ireland Energy Study 2002

10. In order to establish a robust baseline for its work in Northern Ireland, the Carbon Trust, in partnership with Invest Northern Ireland, undertook a major scoping study into the use of energy in Northern Ireland during 2002. The purpose was to reconcile a variety of data sources across the main energy supply and energy demand sub-sectors. Published in October 2003, the *Northern Ireland Energy Study 2002*¹⁹ remains a valuable and authoritative cross sector view of the Northern Ireland energy landscape.
11. Building on the baseline established by the study, the *Northern Ireland Vision Study*²⁰ set out to determine how Northern Ireland could best achieve the deep carbon cuts required to deliver on the UK Government's national emission reduction targets. The Vision Study recognises that the Northern Ireland of 2050 is likely to be very different to today, and that high growth rates may be less realisable as climate change impacts become more evident. The study produced an Initial Action Plan²¹ to help initiate change, while still striving to develop a vibrant and prosperous economy. The ten-point Vision Study Action Plan sets out immediate actions, building options for the future, and cross cutting actions.
12. There have been a number of developments in the power generation sector in Northern Ireland in recent years that have contributed to a significant decline in emissions from electricity generation. The Belfast West coal fired power station closed in 2002 and a new combined cycle gas turbine (CCGT) was opened at Ballylumford in 2003. Another CCGT plant was commissioned in July 2005 at Coolkeeragh near Londonderry. This switch from coal and oil stations to more efficient gas-fired stations has had a positive impact on carbon dioxide emissions. In 2003, the Energy Supply sector contributed 31 per cent of carbon dioxide emissions in Northern Ireland. This is expected to decline further due to structural changes in the generation industry and due to a number of sectors participating in the EU emissions trading scheme.
13. Northern Ireland's electricity and gas markets are no longer isolated but are inter-connected into national and EU networks. In the next decade there will be an expansion of the gas network beyond the greater Belfast area. A multi-million pound project is currently underway involving the construction of a gas pipeline from Dublin to Antrim, the South-North pipeline, which will link with another new pipeline from near Carrickfergus to Londonderry, the North-West pipeline. This will result in the roll-out of gas to towns along the path of the new transmission network.

Energy supply



14. The introduction of natural gas into the Greater Belfast area since 1996 has brought significant environmental benefits as customers have switched from oil and coal to the more efficient fuel. By 2004, emissions of carbon dioxide had fallen by 0.30 MtC as a result of this change. The South-North and North-West pipelines are expected to reduce carbon dioxide emissions by some 0.11 MtC per annum.
15. The vision and challenges of the 2003 Energy White Paper are reflected in the Strategic Energy Framework for Northern Ireland published in June 2004 by the Department of Enterprise Trade and Investment (DETI). Key targets are:

¹⁹www.thecarbontrust.co.uk/carbontrust/about/publications/NI_2003_Energy_Study.pdf

²⁰www.thecarbontrust.co.uk/carbontrust/about/publications/CTC520.pdf

²¹www.thecarbontrust.co.uk/carbontrust/about/publications/CTC501.pdf

- by 2012 at least 12 per cent of electricity consumed in Northern Ireland must be from indigenous renewable energy sources, at least 15 per cent of which must be generated by a renewable source other than wind power; and
- to achieve a 1 per cent reduction in electricity consumption in Northern Ireland in each year from 2007 to 2012.

16. The latter target is challenging in the context of a 2 per cent per annum growth rate in consumption in recent years. DETI is leading a working group to co-ordinate actions to deliver this target and to develop an effective framework with agreed strategic objectives for energy efficiency.

Renewable energy

17. The main driver for increasing the use of renewable energy is the Northern Ireland Renewables Obligation (NIRO) which was introduced on 1 April 2005. The NIRO operates alongside the Renewables Obligation in the UK. Renewable generating capacity is now around 120 megawatts, a threefold increase over that delivered under the Non-Fossil Fuel Obligation schemes of the late 1990s.
18. On the demand side, the percentage of electricity consumed in Northern Ireland from renewable energy sources is currently around 6 per cent with indigenous renewables generation having doubled over the past 2 years, representing over 50 per cent of renewables consumption. There are currently 15,000 consumers using renewable energy electricity and every school, library and the majority of hospitals are supplied with renewable energy.
19. The main non-fossil resource available in Northern Ireland for electricity production is wind energy, mainly onshore but also with a significant offshore potential. This produces electricity at the lowest cost of all the renewable options. There are currently ten wind farms supplying the grid as well as commercial scale wind turbines installed to serve specific businesses. Large-scale wind

powered projects are expected to make the largest contribution to electricity generation from renewables over the next decade. The deployment of small-scale wind powered systems is also being promoted in disadvantaged rural areas through the Wind Energy for Rural Businesses Project. This is a EU funded programme which provides financial support to rural businesses to meet their energy costs through the installation of small scale (20kw) wind turbines.

20. There is already considerable interest in the growing and utilisation of Short Rotation Coppice willow biomass. Over the longer term, it is anticipated that biomass, solar power, wave and tidal power will provide an increasing contribution to renewable energy as technologies are developed and their potential is realised. Changes in the Common Agriculture Policy and implementation of the EC Nitrates Directive should provide an incentive for farm diversification into energy crops, and the development of renewable energy solutions for the disposal of livestock manure and residues. Research work in these areas is ongoing.
21. The Department of Agriculture and Rural Development in Northern Ireland has been leading an inter-departmental group to examine the potential for renewable energy production from the agri-food and forestry sectors to contribute to Northern Ireland's wider renewables obligations and to provide economic opportunities for rural communities in Northern Ireland. To inform this work, a wide ranging study was undertaken to investigate the potential market for, and economic and environmental sustainability of, small-scale imbedded heat and power and heat only systems in the rural economy. The potential of bio-fuel crops to provide energy for transportation was also addressed. Draft policy recommendations were issued for public consultation in September 2005; a policy position and action plan will follow.

Northern Ireland



Tidal power generation

In December 2005, Marine Current Turbines Ltd, one of the world's leading developers of tidal stream energy, announced that it had chosen Strangford Lough as a test bed for the development of clean, renewable electricity using tidal power generation. Strangford Lough has one of the strongest currents in the UK and provides an ideal location for the company to test a pre-commercial device. If successful, this could have considerable potential for harnessing the tidal resource off the North East Antrim Coast. The pilot project which is planned to commence in the autumn 2006 will be closely monitored, also in relation to assessing any potential environmental impacts of the technology on the Lough itself.

26. In February 2006 a £59m Environment and Renewable Energy funding package was launched to enhance and accelerate the development and deployment of renewables over the next two years. It will support actions in four broad programmes:
- research and demonstration – including flagship projects in energy from waste and biomass;
 - accelerated deployment of renewables and energy efficiency – mainly capital projects including a focus on public buildings and households;

- building market capacity through providing infrastructure and supply chain development – with a focus on bio-energy and energy crops; and
- underpinning knowledge and raising awareness.

27. Awareness of the benefits of renewable energy for both domestic and industrial users is being championed throughout Northern Ireland by Action Renewables²² – a joint initiative established in 2003 between the DETI and the Viridian Group. The key objectives are to increase awareness of renewable energy amongst the general public and to create a renewable energy installer academy, in partnership with Sustainable Energy Ireland, which will improve the quality of small-scale renewable energy installations and increase market competitiveness throughout Northern Ireland and the six border counties of the Republic of Ireland.

CHP

28. Policy for Combined Heat and Power is devolved to the Northern Ireland Administration. Northern Ireland has a CHP capacity of approximately 2 per cent of the installed electricity generating capacity compared with the UK figure of 7.6 per cent. There are two main factors contributing to this gap. Firstly, Northern Ireland has a relatively low industrial/manufacturing base and secondly, the limited availability of natural gas in Northern Ireland. Despite these drawbacks Northern Ireland has performed well in other ways with twice as many CHP plants, on a per capita basis, in the non-industrial sectors as the rest of the UK. In 2005 Northern Ireland had 68 CHP schemes with a total electricity generating capacity of 33.1 MW.
29. A small group of stakeholders is currently considering a revised CHP strategy for Northern Ireland in parallel with the transposition of the EU Cogeneration Directive. Consultations are also underway with the Republic of Ireland with a

²²www.actionrenewables.org/

view to ensuring that any CHP policy might, where possible, also align on an all island basis.

IPPC

30. Implementation of the Integrated Pollution Prevention and Control Directive (96/61/EC) is devolved and has been implemented in Northern Ireland through the Pollution Prevention and Control Regulations (Northern Ireland) 2003 (PPC). Each installation requires a PPC permit issued by the DOE's Environment and Heritage Service. Some 60 industrial installations have been permitted under PPC in Northern Ireland so far and around 250 installations in total will be subject to IPPC controls by the end of 2007.

EU emissions trading scheme

31. There are currently 28 industrial plants in Northern Ireland participating in the EU Emissions Trading Scheme, from a wide range of sectors including power generation, food and drink, and cement manufacturing.

Support for businesses

32. Over the past three years the Carbon Trust has been working successfully in partnership with Northern Ireland businesses and the public sector through energy surveys, interest free loans to fund energy saving projects, Enhanced Capital Allowances/Energy Technology List²³, design advice and training events. It has developed a comprehensive suite of design guidance documentation and has put in place an unparalleled range of skills transfer mechanisms to support local construction professionals. A key Northern Ireland-specific concept is the Low Carbon Design Initiative. This was launched in 2003 and seeks to ensure that the new generation of buildings are of a world class standard with respect to low energy/carbon design.

Compressed air systems

Over the past two years the Carbon Trust commissioned seventy specialist energy surveys looking solely at compressed air systems in Northern Ireland businesses. Between them the local businesses surveyed were spending around £7.6m annually on electricity to generate, treat, and distribute compressed air. As a result of the Carbon Trust intervention, annual savings of £2.3m (31 per cent) and 26,400 tCO₂ were identified for a one-off investment cost of £3m, and an overall simple payback of 16 months. Within 12 months of receipt of the survey reports, these businesses had implemented recommendations with annual savings of £1.5m and 17,000 tCO₂, and plans for further investment to realise additional savings.

Waste management

33. The Northern Ireland Landfill Allowances Scheme, introduced in April 2005, provides the mechanism for reducing biodegradable municipal waste (BMW) sent to landfill. The targets are to reduce landfilling of BMW to 75 per cent of 1995 levels by 2010, to 50 per cent of 1995 levels by 2013 and to 35 per cent of 1995 levels by 2020. Northern Ireland has a deficit of waste management infrastructure due to historical reliance on landfill as the cheapest option for waste disposal. Northern Ireland's revised Waste Management strategy, due for publication in Spring 2006, will focus on the provision and funding of the physical infrastructure necessary to deliver the EU Landfill Directive targets.

Transport

34. Road transport emissions in Northern Ireland continue to increase. This is now the second largest source of carbon dioxide emissions, comprising around 27 per cent of the Northern Ireland carbon dioxide emissions in 2003. This

²³www.eca.gov.uk/etl/

Northern Ireland

contribution is likely to increase as road traffic continues to grow.

35. An integral feature of Northern Ireland's Regional Development Strategy is the Regional Transportation Strategy 2002-2012 (RTS) which provides a framework for the future planning, funding and delivery of land-based transportation throughout Northern Ireland. A major aim of the RTS is to start a strategic move away from a transport system that is dominated by car use towards a more balanced and integrated system in which walking, cycling and public transport will be more viable and attractive options.
36. Walking and cycling are being encouraged by the provision of specifically designed physical measures, including the construction of additional footways, cycle lanes and cycle parking stands. Rail infrastructure and services have improved with the introduction of new trains. The first phase of the Belfast "Metro" high frequency network bus service, introduced in February 2005, has improved passenger access, comfort and convenience.
37. Land use planning is key to determining travel behaviour. Planning Policy Statement 13 on Transportation and Land Use was published in March 2005 to provide strategic policy guidance and advice on the integration of transportation and land use. Planning Policy Statement 3 on Access, Movement and Parking translates the strategic guidance on these issues into detailed operational policies. Both planning policy statements introduce an assessment of the potential transport impacts of the proposed development and seek for the first time to integrate transport policy and planning.
38. The Department for Regional Development's Travelwise scheme is being promoted within the Northern Ireland Civil Service to encourage staff to rely less on private cars and to make greater use of car sharing, cycling and public transport. Conversion of fleet vehicles to more environmentally friendly alternatives and or fuels is another goal.
39. In rural areas, where passenger numbers are low, alternatives to conventional bus services include community-based initiatives and the use of smaller vehicles. The *Rural Transport Fund* provides grant aid to support these initiatives.
40. The inventory of greenhouse gas emissions indicates that the household sector in Northern Ireland contributes around 20 per cent of Northern Ireland's carbon dioxide emissions. This amounts to 4 per cent of UK domestic emissions, which is slightly higher than what would be expected from the population size (3 per cent of the UK population). A contributory factor is the limited availability of natural gas for home heating resulting in higher consumption of oil and coal, although the latter is on the decline due to central heating conversions.
41. In partnership with public, private and voluntary sector organisations to improve energy efficiency in the housing stock and to tackle fuel poverty, a wide range of programmes and initiatives are being promoted by the Northern Ireland Administration. The Northern Ireland Housing Executive invests around £40m per annum on heating conversions, double-glazing and insulation works. The Housing Executive's policy is that natural gas should be the fuel of choice for domestic heating where supply is available. As a result of these measures and fuel switching in the private sector there have been significant changes in the domestic fuel mix in the eight years between 1996 and 2004, with solid fuel declining from 40 per cent to 8 per cent. Oil has risen from 36 per cent to 65 per cent and natural gas has risen from zero to 8 per cent. The 2004 interim House Condition Survey indicated a 17.2 per cent improvement in energy efficiency from 1996 to 2004. The associated carbon dioxide savings are of the order of 0.55 MtC per annum.
42. In partnership with other agencies, the Housing Executive is also piloting a range of renewable technologies on "hard to heat" homes which are defined as properties with solid walls, off the gas

Households

network. The installations include solar PV panels (photovoltaic), solar water heating, solar air heating, wind turbine, ground source heat pumps and a prototype high efficiency oil-condensing boiler. A partnership-funded micro CHP trial involving around 50 homes, across all tenures, is also underway with 17 installations to date. The trial will be used to assess the effectiveness of the technologies and will also be used to help stimulate the market.

Energy efficiency

43. During 2004-05, support for the domestic and non-commercial elements of the Energy Efficiency Programme came from DETI as part of a package of measures to reduce electricity costs. The much smaller commercial element of the programme continues to be funded through a levy on all electricity customers.
44. The Northern Ireland Authority for Energy Regulation set the framework for the programme with the Energy Saving Trust fulfilling the role of evaluating, assessing and auditing schemes. Seventeen individual energy efficiency schemes were implemented by Northern Ireland Electricity with an investment of £3.72m, providing whole house energy efficiency solutions for over 1,700 homes throughout Northern Ireland and delivering 340 GWh of energy. The schemes are estimated to deliver carbon savings of 100,332 tonnes.
45. Prior to April 2005, there were three Energy Efficiency Advice Centres (EEACs) funded by the Energy Saving Trust in Northern Ireland with offices in Belfast, Londonderry and Enniskillen. The Energy Saving Trust is currently piloting the concept of a Sustainable Energy Network with the creation of separate Sustainable Energy Centres (SECs) in three areas of the UK, one of which is in Northern Ireland.

Fuel poverty

46. Northern Ireland has the highest level of fuel poverty in the United Kingdom. In November 2004, the Department for Social Development launched the *Ending Fuel Poverty, A Strategy for Northern Ireland*²⁴ which aims to eliminate fuel poverty in vulnerable households and the social rented sector by 2010 and in non-vulnerable households by 2016. A Fuel Poverty Advisory Group was established in April 2005 to monitor and review the strategy and to promote a partnership approach to tackling fuel poverty. Since 2001 over 4,600 owner-occupiers have received central heating and over 16,000 have received cavity wall and/or loft insulation under the *Warm Homes Scheme*.

Agriculture

47. Northern Ireland's important agricultural sector currently contributes around 22 per cent of Northern Ireland's total greenhouse gas emissions. In 2003 agriculture contributed 91 per cent of Northern Ireland's methane emissions and 88 per cent of nitrous oxide emissions. Methane emissions have declined by 4 per cent from 1990, while nitrous oxide emissions have fallen by 10 per cent.
48. The current Northern Ireland Rural Development Programme comprises a range of agri-environment schemes including the Countryside Management Scheme (CMS), the Environmentally Sensitive Area (ESA) Scheme and the Organic Farming Scheme. Some 30 per cent of Northern Ireland's 28,000 farm businesses currently participate in this agri-environment programme. This is expected to rise to 50 per cent by mid-2006. CMS and ESA participants are required to adopt environmentally friendly farming practices such as ungrazed grass margins or the introduction of tree-planted margins.

²⁴www.dsdni.gov.uk/ending_fuel_poverty_-_a_strategy_for_ni.pdf

Northern Ireland

Forestry

49. Forest policy is currently under review in Northern Ireland with an emphasis on forest expansion and a commitment to encourage afforestation. Grant aid incentives are provided to complement the reform of the Common Agricultural Policy and to maximise the potential for the forestry sector to contribute to sustainable development. The Department of Agriculture and Rural Development's consultation paper, *Options for Forestry* (DARD, 2004²⁷), recognised the value of trees in removing carbon dioxide from the atmosphere and indicated that the Forest Service would work with others to pursue opportunities for carbon sequestration.
50. The Forest Service has operated a Challenge Fund for Short Rotation Coppice Energy Crops since August 2004 to encourage the establishment of short rotation willow coppice for renewable energy generation. To date, 200 hectares have been planted with an additional 350 hectares already agreed or in the planning stage. The Fund operates under the umbrella of the current Rural Development Regulation running from 2000 to 2006. Support is expected to be extended into the successor programme from 2007 to 2013.

Public sector

51. The Department of Finance and Personnel (DFP) in Northern Ireland has overall responsibility for the promotion of energy efficiency in public sector bodies. While this is a devolved matter, Ministers have agreed to work towards the national targets in the Sustainable Development Framework for the Government Estate. The DFP has developed a customised software programme for recording and analysing the energy performance of all buildings occupied by Northern Ireland public bodies. The system enables energy performance to be compared with nationally accepted benchmarks.
52. The DFP manages a Central Energy Efficiency Fund to finance energy efficiency improvements in the public sector. Since natural gas became available in 1996, some 125 government buildings in Northern Ireland have been converted to natural gas as the fuel of choice. This conversion programme has secured a 20,000 tonne reduction of carbon dioxide emissions over the eight years to 2004. Similar action has been taken by many other public bodies including District Councils, Health Trusts, Education and Library Boards, and the Police Service of Northern Ireland. Since 2001, there has been a steady

Balcas combined heat and power plant and wood pellet production

Balcas Timber, one of the largest saw mills in the British Isles, based near Enniskillen in County Fermanagh, obtained grant aid from the UK Government's Department of Trade and Industry's Bio energy Capital Grant Scheme to support a £10m investment in the development of a wood fired combined heat and power (CHP) generator in tandem with a wood pellet production facility.

The plant uses 180,000 tonnes of surplus wood chip and sawdust, produced as a co-product of Balcas sawn timber production, to provide its own power requirements (saving the company up to £1,000,000 per year in electricity costs) as well as producing heat for timber drying kilns and the production of pellets. The company has succeeded in securing deals with two major power stations in England which will purchase the pellets for co-firing. The fuel also has great potential as a renewable energy alternative to wind for small-scale commercial and domestic use. With a target pellet production of 50,000 tonnes per year, this is one of the largest plants of this nature in Europe.



²⁵ www.forestserviceni.gov.uk/home.htm

increase in the amount of green electricity purchased. Central Government departments currently purchase around 11,000,000 kWh of green electricity annually, representing some 30 per cent of their electricity requirements.

53. The DFP and the Northern Ireland Strategic Investment Board are jointly undertaking a strategic review of accommodation needs for the Northern Ireland Government estate (Workplace 2010). This will ensure that only buildings in the top quartile of energy performance are procured. The review also seeks to reduce the number of buildings occupied by departments and to make better and more efficient use of space. This will achieve efficiencies in energy use and further reduce emissions. As a result of the improvements in energy efficiency, the normalised carbon dioxide performance of the Northern Ireland public sector has shown an improvement from 141 kgCO₂/m² in 1989-90 to 80 kgCO₂/m² in 1999-2000 to 72 kgCO₂/m² in 2003-04.

Energy efficiency in the public sector

The proposed new library at Queen’s University will recover and use waste heat generated by its computer centre to heat the rest of the building using ground water heating/cooling and heat pump technology.

Omagh College of Further and Higher Education has installed a biomass boiler which feeds into an under-floor heating system to heat the industrial wing of its new campus.

The Environment and Renewable Energy Fund will provide means for a biomass heat network to supply the heating needs for several of the buildings in the Stormont Estate. If this is based on a CHP system, it is estimated that this network will be capable of meeting around 40 per cent of the electrical demand for those buildings.

Public procurement

54. The Northern Ireland Government is committed to taking action towards sustainable procurement and using the power of procurement spend to transform markets and influence the supply chain, for example by increasing the amount of energy bought from renewable sources, by buying from suppliers who have established environmental credentials, and through “green” specifications. In addition, the DOE is currently piloting an Environmental Management Scheme for potential roll-out to the Northern Ireland Civil Service (NICS) as a whole.

Building Regulations

55. Part F of the Northern Ireland Building Regulations on minimum standards for conservation of fuel and power is being amended. The revision will have the effect of reducing carbon dioxide emissions from those buildings to which these regulations apply by up to 40 per cent. The amendment will also incorporate a number of the requirements under the EU Energy Performance of Buildings Directive.

Monitoring and reporting

56. Progress with these policies will be monitored as part of the roll-out of the Sustainable Development Implementation Plan. In an attempt to mainstream sustainable development across the Northern Ireland administration, the DOE is considering the development of a revised integrated impact assessment process. Efforts to change consumer behaviour and raise public awareness of climate change issues will be taken forward through the Sustainable Development Communication Strategy.

The Welsh Assembly Government is committed to working with the UK Government, the other devolved administrations, the statutory, voluntary sector and business partners in Wales, and the community at large to tackle the threat of climate change.

Introduction

1. The Welsh Assembly Government recognises that climate change is one of the most important issues facing the world at the beginning of the 21st Century. **The Environment Strategy for Wales and its accompanying action plan which are due to be published in early 2006 will provide details of further actions to be taken to address climate change.** Scoping work has been carried out in each ministerial portfolio on how climate change mitigation and adaptation relates to current policies and programmes and will inform future policy choices.

Greenhouse gas emissions inventory and projections

2. In 2003, the latest year for which disaggregated data is available, Wales accounted for just over 2 per cent of the UK total (disaggregated figures for 2004 will be available later in the year). This is 3.2 per cent below the level in Wales for the 1990 base year. Emissions of greenhouse gases in Wales in 2003 were 0.54 million tonnes lower than in 1990. A breakdown by sector follows:
3. Industrial greenhouse gas emissions still account for a third of Wales' total emissions. This is not unexpected as Wales has a much larger manufacturing sector than the UK average, with a strong heavy industry component. Nevertheless Wales has tremendous natural potential for renewable and alternative energy and has already set a target that by 2010; 4 TWh of its electricity demand will be generated from renewable energy sources. This is expected to make a contribution to the UK's long-term aspiration to reduce carbon dioxide emissions by some 60 per cent emissions by around 2050.

Wales and UK Greenhouse gas emissions by sector in 2003

Sector	Greenhouse Gas Emissions (MtC) ¹		% Change 1990-2003	Wales as % of UK ² (2003)
	1990	2003		
Business	3.21	2.85	-11.2	2.7
Waste Management	0.38	0.15	-61.9	1.3
Industrial Process	0.79	0.69	-12.2	3.5
Transport	1.70	1.81	6.4	1.4
Residential	1.12	1.30	16	1.5
Energy Supply	473.40	4.95	4.6	2.3
Agriculture	1.75	1.55	-11.4	3.3
Land Use Change Emission	0.37	0.33	-10.8	2.2
Public	0.23	0.13	-41.8	1.2
Total Emissions	142.80	1375.00	-3.6	2.1
Land Use Change ³ : Removal**	-0.46	-37.00	-20.7	2.3
Total Net Emissions	13.82	13.38	-3.2	2.1

Notes:

¹ Base year and 2003 emission figures taken from the Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland 1990-2003 (Baggott *et al.*, 2005). The emissions estimates for Scotland, Wales and Northern Ireland inventories are subject to greater uncertainty than the consolidated UK estimates.

² UK figures exclude unallocated emissions. This affects energy supply and transport (where emissions due to military transport, fishing and domestic aviation are unallocated).

³ Land use change removals is a sink and, therefore, removes carbon. Thus, the percentage change between 1990 and 2003 (in column 3) has therefore been shown as a positive to reflect the fact that the capacity of the sink has increased.

The impacts of climate change in Wales

4. 150,000 residential properties, many commercial and industrial developments and other key infrastructure like power generation, transport links and schools as well as important environmental sites are situated on land at risk from flooding. Around half a million people live and work on flood plains and over £8bn worth of assets are at risk. The Environment Strategy for Wales will set out the Welsh Assembly Government's strategic response to climate change, building on actions already underway in key sectors.



5. The UK Climate Change Impact Programme has produced scenarios for changes in Wales over the period up to 2080. The potential negative impacts in Wales of the changes suggested by these scenarios include increased risk of:
 - river and coastal flooding and erosion;
 - pressure on sewer systems;
 - winter storm damage and coastal erosion;
 - habitat and species loss, for example in uplands and wetlands;
 - changes to the landscape;
 - summer water shortages and low stream flows (coupled with higher demand);
 - subsidence in prone areas; and

- thermal discomfort in buildings and health problems in summer, including heat-related deaths linked to high air pollution.

Climate change is predicted to have some local advantages, but these depend on the scale and rate of change of climate:

- a longer growing season, and potential opportunities for agricultural diversification;
- less cold-weather transport disruption balanced by greater disruption from storms;
- reduced demand for winter heating; and
- less cold weather related illness.

The Environment Strategy for Wales

6. The Environment Strategy for Wales will set the vision for the Environment in Wales through to 2025. The consultation on the Strategy, *Our Environment – Our Future – Your Views*²⁶, contained climate change as a central theme and recognised that it has major implications for the Welsh Assembly Government's policy agenda. The consultation ended on 3 October 2005. Around 200 written responses were received, many of which commented on action to tackle climate change. **The Environment Strategy will be supported by an action plan to deliver the vision set out in the Strategy.**

Sustainable Development Action Plan

7. Wales has a legal obligation to have a Sustainable Development (SD) Scheme and build sustainable development into all policies and practices. The present SD Action Plan runs from 2004 to 2007. Addressing climate change is one of the key themes and is supported by commitments to mitigating the effects of climate change. As a result, various initiatives have been put in place since 2004, which are supported by national and area-specific commitments in the Welsh Assembly Government's Wales Spatial Plan, *People, Places, Futures*. These are:

²⁶ www.wlga.gov.uk/uploads/publications/978.pdf

- **the Energy Route Map to be published in 2006** will set out the objective for a clean energy agenda, including the development of renewable energy. Clear targets for producing 4 TWh (approximately 10 per cent) of energy from renewable sources by 2010 and 7 TWh by 2020 are already in place. A project has been commissioned to investigate the benefits and barriers to promoting the uptake of alternative fuels in Wales, such as biofuels, biogas, natural gas and hydrogen;
- community renewables and innovative energy projects have been developed through a number of community projects and funded through the Objective 1 programme²⁹. Additional funds have been secured to ensure that the work of the Carbon Trust in Wales can continue to support the uptake of energy efficiency practices;
- research is in progress to develop guidelines on land-use for conservation of carbon stocks in soils. The guidelines will then be considered for implementation under the CAP reform and agri-environment policy;
- a two-year contract from 2005 to 2007 is in place to supply all Assembly street lighting with 100 per cent green energy, as part of the Wales Street-lighting Energy Purchase consortium; and
- a study has been commissioned to explore the feasibility of offsetting the carbon generated by road scheme.

Energy supply

8. The Welsh energy policy faces the challenge of fuelling an internationally competitive economy while maintaining the highest environmental standards and mitigating climate change. Although Wales is a net exporter of electricity, there is a significant north-south divide in energy generation. Electricity is exported from the concentration of generating stations in north Wales while in south Wales a significant proportion of electricity is imported.

Consequently, because of transmission costs, consumers in south Wales pay some of the highest electricity prices in Great Britain. There is a relatively poor electricity transmission infrastructure in mid Wales.

9. The Welsh Assembly Government is keen to encourage the development of small-scale renewable energy generation in Wales. This includes:
 - **small hydro projects** – these are already substantially developed in Wales. In addition smaller schemes have become viable as a result of the Renewables Obligation;
 - **photovoltaic (PV) and micro wind** – it is expected that the uptake of these technologies will increase in the future as they continue to advance and economy of scale will be making them more economical;
 - **biomass and biofuels** – will continue to be important as the results of studies and demonstration projects are being evaluated; and
10. **On large scale renewables**, as well as looking to generate 800MW from new large windfarms being built in accordance with the TAN 8 planning guidance, the Welsh Assembly Government believes the time is now right to further investigate building proposals, including the major environmental impacts, for a major low-carbon energy-generating Severn Barrage.



²⁹ www.defra.gov.uk/rural/structure/obj1.htm

CHP

11. Health estates in Wales have increased self-generation of CHP electricity by 11.7 per cent over the 2004-05 period. This accounts for 8 per cent of their total electricity requirement.
Opportunities for micro CHP will feature in the Wales micro-generation strategy which is expected to be issued for consultation in Spring 2006.
12. The Welsh Assembly Government and Forestry Commission Wales administer the £7m Wood Energy Business Scheme which provides: (1) appropriate projects with capital grants to facilitate the installation and operation of woodfuel powered heating and power generation plants; and (2) equipment for initial processing of roundwood into chip and pellet form. In addition, clean energy technology development will be encouraged by collaboration between the Welsh Energy Research Centre (WERC) and the higher education sector in Wales.

Households

13. The Welsh Housing Quality Standard sets a minimum energy rating (SAP)²⁸ for social housing, requiring that the heating in the whole dwelling should be at comfortable level and reasonably economical in normal weather conditions. Social landlords must also take all cost-effective opportunities to upgrade the thermal and ventilation performance of dwellings. Development Quality Requirements (DQR) are the published design standards for all new housing built by Registered Social Landlords in Wales when using a Social Housing Grant. DQR requires that all housing must be built to an EcoHomes rating standard of 'good'.
14. Companies supplying gas or electricity have been actively promoting their Energy Efficiency Commitment (EEC) programmes to customers in Wales. The Welsh Assembly Government also works with the Energy Saving Trust and the Welsh Local Government Association to assist

local authorities to meet their targets under the Home Energy Conservation Act and Policy Agreements. The Energy Saving Trust leads activity on domestic sector energy efficiency in Wales. Advice is offered to individual households and social landlords through the Energy Efficiency Advice Centres in Wales and the Welsh Local Government Association. The Welsh Assembly Government's *Energy Saving Wales portal website*²⁹, which was launched as a portal website in December 2005 will provide links to organisations with information, advice and support on energy efficiency and small scale renewable energy projects.

Support to businesses

15. The Welsh Assembly Government encourages businesses to take up the opportunities that low carbon technology offers. The Welsh Development Agency's *Environmental Goods and Services* (EGS) scheme supports businesses engaged in environmental legislation market activities such as clean energy. The Welsh Assembly Government also sponsors the Carbon Trust in Wales. Their direct support services have helped Welsh organisations identify potential cost savings of around £11.5m, equating to 144,500 tonnes of carbon dioxide emissions.

EU emissions trading scheme

16. The Welsh Assembly Government supports the EU ETS scheme and will be working closely with the UK Government to ensure that the second phase of the scheme recognises and addresses the specific needs of businesses based in Wales while delivering emissions savings.

IPPC

17. From 1 January 2006, the Welsh Assembly Government became responsible for implementing the Integrated Pollution Prevention and Control Directive (96/61/EC) in Wales.

²⁸Standard Assessment Procedure

²⁹www.energysavingwales.org.uk/index.cfm?alias=about

Fuel poverty

18. The 2004 *Living in Wales* survey indicated that in 2004, the overall number of households living in fuel poverty in Wales was 130,000 or 11 per cent of all Welsh households. The Home Energy Efficiency Scheme (HEES), the main programme to tackle fuel poverty in Wales has assisted over 50,000 households since 2000.

Waste management

19. In June 2002, the Welsh Assembly Government published *Wise about Waste: the National Waste Strategy for Wales*, which sets down policies and targets for waste management across all waste streams. The Strategy seeks to ensure that Wales will meet its obligations under both UK and European legislation and its duty to promote sustainable development set in the Government of Wales Act 1998. Recycling and composting have increased from an historic base of 3 per cent to 5 per cent in 2004-05 to 19.4 per cent with targets of 25 per cent in 2006-07 and 40 per cent in 2009-10.



20. The Welsh Assembly Government has made substantial financial resources available to local authorities to support delivery of the waste strategy, £93m over the three years to 2007-08. The Welsh Assembly Government has also allocated £9.5m support for businesses over three years to 2007-08 under the *Materials Action*

Programme. This will assist them to become more resource efficient thus using fewer materials and less energy. Businesses are also being encouraged to use recycled materials through an industrial symbiosis programme to identify partners whose waste they can use as a raw material and are also being encouraged to reduce the amount of hazardous waste they produce and the hazardousness of that waste.

Transport

21. The Transport (Wales) Act 2006 sets the context for the development of a Wales Transport Strategy (WTS) and places a statutory requirement on the Welsh Assembly Government to develop a Transport Strategy. The WTS will replace the existing *Transport Framework for Wales*. **The new Strategy will cover the period up to 2030 and a draft for consultation will be published in early summer 2006.** One of the over-arching objectives will be to reduce the impact of transport on climatic change, air and noise quality, water pollution, biodiversity, landscape and townscape. The WTS will include a Sustainable Distribution Strategy, which is being developed in consultation with the Wales Freight Group.
22. A new Welsh Transport Appraisal Guidance (WELTAG) is also being developed and will be published later this year. WELTAG will be used to appraise the strategies developed by the WTS, including examination of the Strategic Environmental Assessment (SEA) requirements. On completion of the WTS, schemes and measures to support the strategies will be explored.

Farming

23. Making farming more sustainable is at the heart of "Farming for the Future", the Welsh strategy for the agricultural industry. One of the concerns of the Welsh Assembly Government is to ensure that the carbon contents of soils in Wales are

conserved and enhanced. Current estimates of the carbon store are 350-480MtC, however there is recent evidence that this has decreased significantly over the past 25 years. Research is ongoing to understand better the land management methods to conserve soil carbon.

24. **The Rural Development Plan for Wales, covering the 2007-2013 programming period, will be published at the end of the year** and will be a key tool to support the agri-environment agenda within the farming community.

Forestry

25. Forestry policy is entirely devolved to the Welsh Assembly Government. The Forestry Commission Wales acts as the Assembly's department of forestry. *Woodlands for Wales* sets the Welsh Assembly Government policy for trees and woodlands. Much work has been undertaken by Coed Cymru³⁰ to develop products from Welsh hardwoods and softwoods, which both enhance the life of the forest carbon store and are a useful substitute for more energy intensive materials.

Public sector

26. The Sustainable Development Action Plan committed the Welsh Assembly Government to putting in place an Environmental Management System to be accredited to Green Dragon Environmental Standard³¹ Level 5 by 2006. Good progress has been made towards this goal. Level 4 was achieved in 2005 and actions have been taken to achieve Level 5 in early 2006. **The Welsh Assembly Government is also committed to purchasing green electricity** and currently procures approximately 90 per cent of its supplies from renewable sources. It will be looking to procure 100 per cent of its electricity supplies from renewable sources by 2010. Under the current round of Policy Agreements, local authorities have committed to reducing carbon dioxide emissions from Council buildings. The Carbon Trust's Carbon Management service helps large organisations to assess how to combat the

risks and take advantage of the opportunities associated with climate change.

Education

27. The Eco-schools project in Wales, supported by The Welsh Assembly Government, the Countryside Council for Wales and Awareness Wales, currently involves 1,100 schools in Wales though the target is to increase this to 1,700 by 2007. The Eco-schools programme encourages pupils to engage with environmental and sustainable development issues and so reduce the environmental impact of the school. Schools can also work towards obtaining the Eco-schools European Green Flag award, which is the national standard for parks and green spaces in England and Wales. 128 schools have achieved this to date.

NHS Estate

28. The performance of health estates is improving, for example, absolute carbon dioxide emissions have been reduced by 7.5 per cent compared with the previous year's figures and 3 per cent compared with the base year figures. There is increasing use of green electricity by Trusts, with North West Wales, Pontypridd & Rhondda, North East Wales and Gwent all supplementing their electrical demand, in part, from green electricity. The amount of self-generated CHP electricity has increased by 11.7 per cent over this period and accounts for 8 per cent of the total electricity requirement.

Planning

29. *Planning Policy Wales*, published in March 2002, sets out the Welsh Assembly Government's planning policies and is supplemented by a series of technical advice notes (TANs), some of which are of particular relevance to climate change.

³⁰Coed Cymru is an all Wales initiative to promote the management of broadleaf woodlands and the use of locally grown hardwood timber.

³¹www.greendragonems.com/

SECTION

5

Annexes

Carbon dioxide

1. Projections of the UK's emissions of carbon dioxide are largely derived from the DTI Energy Model. This is a set of interlocking sub-models of the UK energy market including final user energy sectors and the electricity supply sector. It is a top down demand model, based on econometrically estimated relationships between energy demand, energy supply, economic activity and energy prices and a bottom-up supply side model. The demand side comprises over 150 equations linking historic fuel demand for residential, transport, industry, service and agriculture sectors. The supply side comprises data on every major power producer and other energy producing industries. The sector classification and the principal source of energy statistics is the Digest of UK Energy Statistics (DUKES)¹. The DTI model makes projections based on prospects for fossil fuel prices, economic growth and demographics.
2. Rather than producing a single forecast, the projections provide a view of possible future levels of emissions and composition of energy demand based on agreed assumptions of world energy prices. This results in different scenarios within the umbrella of overall projected UK economic growth. Even then, considerable uncertainties remain. These are discussed further in Annex B.
3. Energy and emissions projections which informed the Climate Change Programme 2000 were published in November 2000 in Energy Paper 68. The exercise to provide updated energy and emissions projections began in April 2003 and Updated Energy Projections (UEP) are now published periodically. The UEP exercise includes significant improvements to the DTI model in several sectors. Key assumptions have been updated and revised and have been incorporated in the baseline. It also now includes all current government environmental policy measures as most recently evaluated, as described below. Baseline with measures projections underpinning the Climate Change Programme review were published in UEP 21, in February 2006².
4. Government policies and measures introduced since the Kyoto Protocol was negotiated, and since the publication of the Climate Change Programme in 2000, are now incorporated within the baseline projections. Thus, for example, the demand response to the climate change levy is incorporated in the projections, as is the impact of the Renewables Obligation, which is assumed in the DTI energy projections to raise the share of renewables in electricity supply to around 8 per cent by 2010. The level of carbon saving from the policy measure incorporated in the baseline has been determined during the re-evaluation process undertaken during the Summer of 2005. A table setting out the carbon savings associated with each policy included in the baseline projections is included in Section 2.
5. The UEP projections provide two central scenarios based on HM Treasury projections of economic growth combined with two variations on assumptions of world fossil fuel price projections. The two central price variations provide relative price situations that would indicate either gas or

UK carbon dioxide emission projections by scenario, 1990 to 2020, MtC³

	1990	1995	2000	2004	2010	2015	2020
Central favouring coal	160.6	150.1	148.7	148.8	144.6	149.3	147.3
Central favouring gas	160.6	150.1	148.7	148.8	144.9	148.4	144.6
Average of central projections	160.6	150.1	148.7	148.8	144.8	148.8	145.9
LULUCF emissions and removals	0.8	0.3	-0.1	-0.6	-0.5	0.1	0.7
Total CO ₂ emissions and removals	161.4	150.4	148.6	148.3	144.3	149.0	146.6
Change from 1990 emissions for row above		-6.8%	-7.9%	-8.2%	-10.6%	-7.8%	-9.2%

Note: the percentage changes and emission estimates may differ slightly due to rounding.

¹ See www.dti.gov.uk/energy/inform/dukes/dukes2005/index.shtml

² www.dti.gov.uk/energy/sepn/UEP_Feb2006.pdf

³ Historical CO₂ emissions and CO₂ energy projections in the table are based on the greenhouse gas inventory published in 2005 which agrees with the inventory published in 2006 (used elsewhere in the programme) to about 0.01 per cent for total CO₂ emissions on average over the period 1990 to 2003, with individual years differing by up to about 0.4 per cent. The energy projections will be updated to be based on the inventory published in 2006. The LULUCF emissions are taken from the inventory published in 2006.

Emissions projections

coal as more economic within the electricity generating sector. Alternative scenarios providing a longer-term view of either high or low fossil fuel prices are also provided but not reported here. The table below shows how the average of the two central scenarios from the DTI model combines with the central land use, land use change and forestry (LULUCF) emission scenarios developed by the Centre for Ecology and Hydrology under contract to Defra. This provides the total UK carbon dioxide projections used within this Programme. The CEH projections are described further under Annex F.

Other greenhouse gases projections

6. The emissions projections of the other greenhouse gases covered by the Kyoto Protocol – methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride – were produced by ENTEC⁴ under contract to Defra and are broadly consistent with the assumptions underlying the projections of carbon dioxide emissions published by the DTI. The projections have been developed for thirteen different sectors and sub-sectors based on a range of different sources, including consultation with experts and stakeholders from Government departments, industry and other organisations; technical literature; and incorporating results of studies undertaken for Defra.
7. Projections are calculated using simple spreadsheet models that calculate emissions based on forecast activity statistics, emissions factors and various other sector specific assumptions for each of the main sources of emissions. Greenhouse gas emission projections are disaggregated by sector and are calculated for each year from 2005 to 2020. These are then aggregated to provide an estimate of total projected emissions. The spreadsheets have been constructed so as to provide transparency in the assumptions and approaches used and also for ease of updating.
8. Methodologies and assumptions used to generate the projections are documented in the spreadsheets and accompanying report. Probabilistic modelling of the range of uncertainty associated with the total emissions for each gas has also been undertaken to calculate the confidence range for the projections.
9. As with the projections for carbon dioxide, the non-CO₂ projections are based on a 'with measures' scenario, which takes into account currently adopted and implemented policies and measures. Central estimates for sector projections are aggregated to calculate the best estimate for the total emissions.
10. The table below summarises the methodologies used to estimate projections of non-carbon dioxide gases, broken down by sector. Annexes D to F provide more details of the emissions of each gas and the methodologies used to derive them including uncertainty ranges associated with the central estimates reported in the Programme.
11. Projections are checked by comparing trends in actual historic emissions against future emission estimates. If there is a significant deviation between the trend in historic data and future emission estimates, projection methodologies and assumptions are revised accordingly.
12. In certain sectors, projection methodologies are verified by using a combination of bottom up and top down information. For example, the methodology that derives estimates of future emissions of hydrofluorocarbons is based on detailed disaggregated projections on a sector by sector basis. This is a bottom up approach. The outputs from this model have been checked against historic sales information for hydrofluorocarbons, where available – a top down approach. Consequently, the model has been verified by comparing projected emissions to actual sales information for the fluids concerned.

⁴ This technical report will be available following publication of the Programme. The non-CO₂ projections have been updated for consistency with the greenhouse gas inventory published in 2006.

Emissions projections

Methodologies for non-carbon dioxide projections

Sector	Gas	Methodology
Agriculture	Methane	Projections are consistent with the approach adopted in the UK Greenhouse Gas Inventory, 1990 to 2004 ⁵ , incorporating forecasts of livestock numbers (from Defra) and expectations for changes in body mass per cow and milk production per head (Defra).
	Nitrous oxide	Projections are consistent with the approach adopted in the UK Greenhouse Gas Inventory, 1990 to 2004, incorporating forecast changes in inorganic nitrogen-based fertiliser use (Agricultural Industries Federation).
Fuel combustion	Methane & Nitrous oxide	The DTI updated energy projections (UEP 21) have been incorporated into a model consistent with that used to calculate CH ₄ and N ₂ O emissions for the UK Greenhouse Gas Inventory, 1990 to 2004. DTI industrial growth forecasts are used to estimate emissions from the manufacturing and construction sectors and from metal production.
Gas distribution	Methane	Projections are based on reductions in leakage expected through an ongoing replacement programme for cast iron gas mains (low pressure pipes).
Coal mining	Methane	Projections are based on DTI estimates of future UK mined coal production, using the approach currently adopted in the UK Greenhouse Gas Inventory, 1990 to 2004.
Abandoned coal mines	Methane	Projections are based on an emission of 0.74 per cent of the estimated methane reserve of closed collieries per year ⁶ . Methane reserve estimates are based on detailed plans of abandoned mine workings and take into account the likely effects of rising water in the workings due to flooding. Calculations allow for a higher expected rate of emissions a few years after closure of individual collieries. Some mitigation of emissions has also been assumed for collieries closing in future. Projections are consistent with DTI estimates of future colliery closure.
Oil & Gas	Methane	Projections are based on estimates provided by United Kingdom Offshore Operators Association (UKOOA) and verified by comparison with forecast offshore oil and gas production.
Transport	Methane & Nitrous oxide	Road – Emission projections are based on projections of vehicle km traveled, provided by the Department for Transport and AEA Technology, and emissions factors for each of the 'Euro' standards comprising the vehicle fleet.
		Civil aviation – Emission projections are based on assumed growth in passenger demand (Aviation White Paper) ⁷ .
		Navigation – Emission projections are based on information from Department for Transport on expected growth (assuming emissions proportional to activity).
		Railways – Emission projections are based on the assumption that changes in rail activity influence emissions proportionately. The data was provided by the Department for Transport and the Strategic Rail Authority.
Landfill	Methane	Estimates developed by Golder Associates ⁸ based on municipal solid waste arisings generated from the Local Authority Waste Recycling Recovery and Disposal Model.
Wastewater handling	Methane	Based on expected change in sewage sludge production and projected changes in population developed by Government Actuary's Department.
Chemical industry	Nitrous oxide	Projected emissions from adipic and nitric acid manufacture are calculated based on knowledge of abatement techniques applied at relevant sites and projected future abatement achievable.

⁵ UK Greenhouse Gas Inventory, 1990 to 2004, to be published in April 2006, will be available at www.naei.co.uk/reports.php

⁶ Development of a Methodology for Estimating Methane Emissions from Abandoned Coal Mines in the UK, IMC White Young Green, 2005.

⁷ www.dft.gov.uk/stellent/groups/dft_aviation/documents/page/dft_aviation_031516.pdf

⁸ UK Landfill Methane Emissions: Evaluation and Appraisal of Waste Policies and Projections to 2050, Golder Associates, November 2005.

Emissions projections

Methodologies for non-carbon dioxide projections – continued

Sector	Gas	Methodology
Industrial, business, residential	HFCs, PFCs, SF ₆	Based on projections developed by AEA Technology in 2003 and updated in 2004 ⁹ . Mainly based on production trends and assumed trends in emission factors.
Mineral Products	Methane	Projections based on site-specific forecasts, developed in discussion with operators.

Overall uncertainty

13. Uncertainty ranges for each greenhouse gas, including carbon dioxide, were combined probabilistically to determine the overall uncertainty range for total greenhouse gas emissions and projections presented in the Programme. For this exercise, the probabilistic range of baseline emissions from energy use was consistent with the Average of central projections scenario.
14. This analysis suggests that in 2010, UK emissions of greenhouse gases will be between 16 per cent and 22 per cent below 1990 levels, with the central scenario about 19 per cent below. The range takes into account macroeconomic, sectoral and modeling uncertainties. Overall therefore, the Kyoto target would be delivered on the basis of the policies included in the projections. The additional policies set out in this Programme could further reduce UK emissions of greenhouse gases to between 20 per cent and 26 per cent below 1990 levels by 2010, with the central scenario about 23 per cent below.

⁹ Emissions and projections of HFCs, PFCs and SF₆ for the UK and Constituent Countries, AEA Technology plc, June 2004.

Key facts

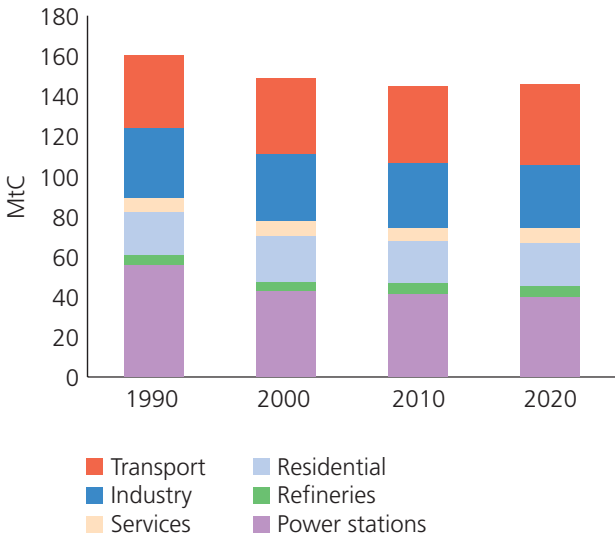
- Carbon dioxide is the most important greenhouse gas. It contributed 85 per cent to the UK’s total greenhouse gas emissions in 2004.
- CO₂ emissions are estimated to have fallen by 5.6 per cent between 1990 and 2004.
- Emissions are projected to continue falling to 10.6 per cent below 1990 levels by 2010, on the basis of existing measures only, with an uncertainty range of about ±6 per cent.

1. Section 2 of the Programme outlines the policies and measures that are being put in place to reduce carbon dioxide emissions. This Annex provides a more detailed breakdown of inventory trends and projections.

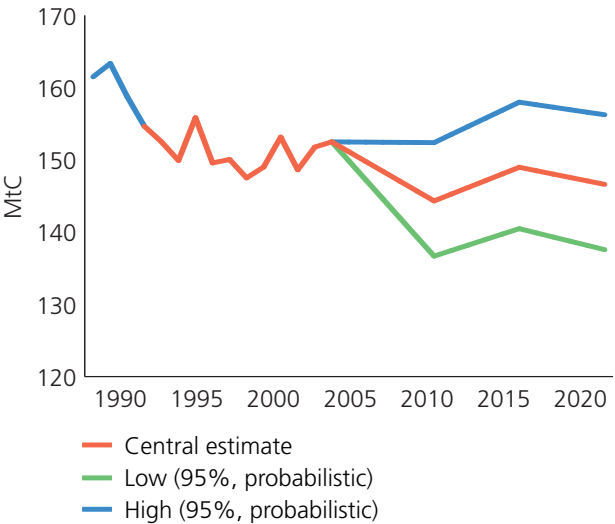
Emissions trends and projections

2. In 1990, anthropogenic emissions of the six greenhouse gases from the UK were about 209 MtC. Carbon dioxide made up around 77 per cent of this total. Annual emissions of carbon dioxide fell by about 5.6 per cent between 1990 and 2004. Emissions are projected to continue falling to 10.6 per cent below 1990 levels by 2010, on the basis of existing policies and measures only.
3. The table below provides a more detailed sectoral breakdown of carbon dioxide projections compared to the information provided in Section 2, chapter 1 of the Programme.

Carbon dioxide emissions by source, 1990 to 2020, MtC



UK carbon dioxide emissions 1990 to 2020, MtC



4. The uncertainty range indicated in the figure above will be about ±6 per cent in 2010, increasing to ±7 per cent by 2020. The range arises from an estimate of the uncertainty introduced by the energy modelling process, corresponding to the full range of emission scenarios produced by DTI¹⁰. A description of sensitivities in key assumptions can be found in chapter 8 of the DTI paper.

¹⁰www.dti.gov.uk/energy/sepn/UEP_Feb_2006.pdf

Carbon dioxide

Carbon dioxide emissions by source 1990 to 2020, MtC¹¹

Sector	1990	1995	2000	2004	2010	2015	2020
Power stations	55.6	44.6	42.4	46.5	41.2	42.8	39.6
Refineries	5.0	5.6	4.7	4.8	5.7	5.7	5.7
Residential	21.3	21.7	23.3	23.9	20.7	21.0	21.1
Services	7.1	7.5	7.2	6.4	6.4	6.7	7.7
Industry	34.8	33.5	33.4	32.2	32.4	33.1	31.6
Road Transport	29.9	30.3	31.7	32.6	34.6	35.8	36.2
Off-road	3.5	3.5	3.5	3.5	1.4	1.4	1.4
Other transport	3.4	2.9	2.8	3.1	2.3	2.4	2.5
LULUCF (net)	0.8	0.3	-0.1	-0.5	-0.5	0.1	0.7
Total CO ₂ emissions by sources minus total removals by sinks	161.5	149.9	149.0	152.5	144.3	149.0	146.6
Change from 1990 levels for row above		-7.2%	-7.7%	-5.6%	-10.6%	-7.8%	-9.2%

Note: the percentage changes and emission estimates may differ slightly due to rounding.

¹¹Actual historical data for 2004 are used in this table in place of 2005 projections.

Key facts

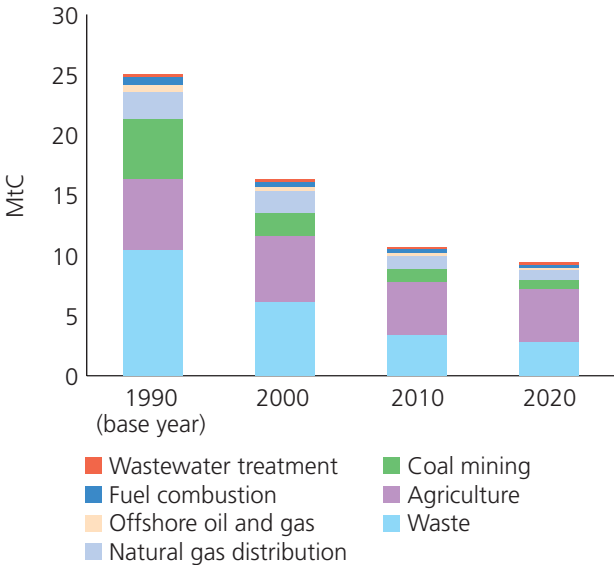
- Methane contributed about 7 per cent to total UK greenhouse gas emissions in 2004.
- Methane emissions are estimated to have fallen by about 50 per cent between 1990 and 2004 and are projected to continue falling to about 57 per cent below 1990 levels by 2010.
- Waste and coal mining contributed most to the overall reduction in methane emission levels.

1. Methane has a global warming potential (GWP) 21 times that of carbon dioxide over a 100-year time horizon¹². However, due to a relatively short turnover rate in the atmosphere of 12 years, reductions in total emissions result in rapid reduction in atmospheric concentration.

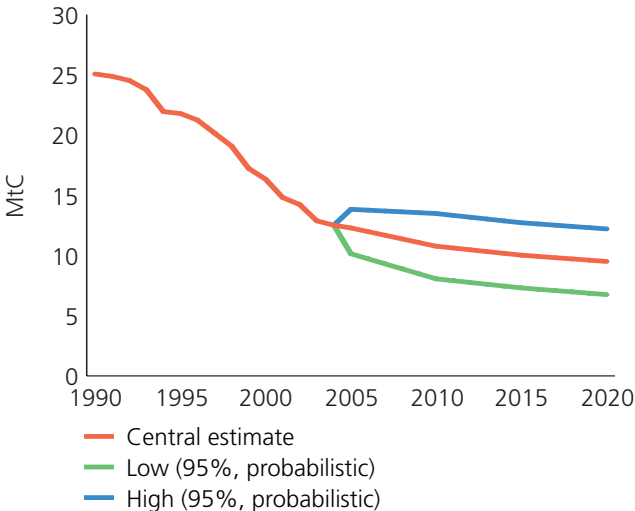
Emissions trends and projections

2. In 1990, emissions of methane from the UK were 25.1 MtC, contributing 12 per cent to total UK greenhouse gas emissions in that year. The major sources were landfill waste, agriculture, natural gas distribution and coal mining. Annual emissions fell by 50 per cent between 1990 and 2004 and are expected to continue to fall to about 57 per cent of 1990 emissions by 2010.

Methane emissions by source 1990 to 2020, MtC



Methane emissions, 1990 to 2020, MtC



3. The table below shows UK methane emissions by source. There are still large uncertainties in many of the source estimates but these have been reduced significantly in key sectors because of research commissioned by the Government. For each of the key sectors, high and low estimates of the projected emissions were derived. These were assumed to form the upper and lower bounds of a triangular distribution of the projected emissions. These high and low estimates were generally derived from expert judgement about the data inputs, the modelling approach and the historical variability in the data. Monte Carlo Analysis was used in order to derive a probability

¹²Please see Annex H for more information on GWP.

Methane

density function associated with the total projected emissions for methane. The range of projected emissions representing the 95th percentile is presented here.

4. Landfills are the dominant source of methane in the waste sector, contributing 98 per cent of national methane emissions from that sector in 1990. Methane emissions from landfill sites are estimated to have been 10.4 MtC in 1990 and are projected to fall to 3.4 MtC by 2010. The national methane assessment model estimate of methane emissions has been revised to take account of improvements to the gas collection efficiency and oxidation factors¹³.
5. Methane emissions from abandoned coal mines were 0.3 MtC in 1990 based on a new estimating method developed for Defra¹⁴. Annual emissions decreased to 0.25 MtC in 2004 but are expected to rise again by 2010 due to colliery closures. For the first time in 2005 the UK greenhouse gas inventory contained emissions estimates for abandoned mine methane.
6. Based on the latest assessment of likely future emissions from each sector and the effect of planned policies and measures, annual emissions of methane are expected to decrease by 57 per cent below 1990 levels to around 10.8 MtC in 2010.

Methane emissions by source 1990 to 2020, MtC¹⁵

Sector	1990	1995	2000	2004	2010	2015	2020
Waste	10.4	9.3	6.1	3.8	3.4	3.1	2.8
Agriculture	5.9	5.7	5.5	5.1	4.4	4.4	4.4
Coal mining	5.0	3.4	1.9	1.3	1.0	0.8	0.7
Natural gas distribution	2.2	2.0	1.8	1.3	1.1	1.0	0.9
Offshore oil and gas	0.6	0.6	0.4	0.3	0.3	0.1	0.1
Fuel combustion	0.7	0.5	0.4	0.4	0.3	0.3	0.3
Wastewater treatment	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Other	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Total	25.1	21.8	16.3	12.5	10.8	10.0	9.5
Change from 1990 levels		-13.1%	-34.9%	-50.1%	-57.0%	-60.0%	-62.1%

Note: the percentage changes and emission estimates may differ slightly due to rounding.

¹³UK Landfill Methane Emissions: Evaluation and Appraisal of Waste Policies and Projections to 2050, Golder Associates, November 2005

¹⁴Development of a Methodology for Estimating Methane Emissions from Abandoned Coal Mines in the UK, White Young Green 2005.

¹⁵Actual historical data for 2004 are used in this table in place of 2005 projections.

Key facts

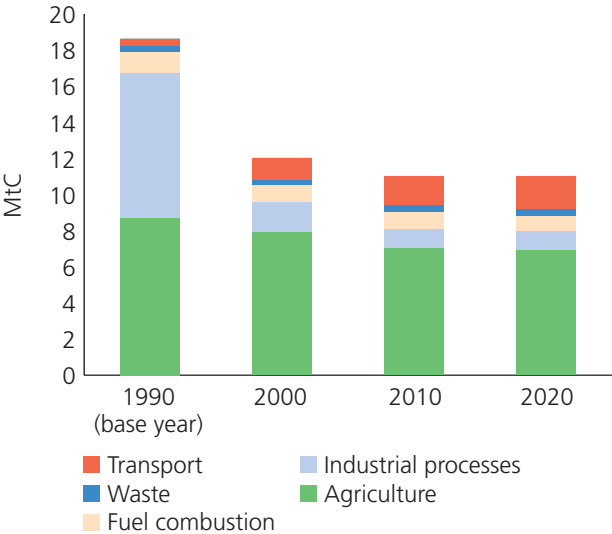
- Nitrous oxide contributed almost 6 per cent to total UK greenhouse gas emissions in 2004.
- N₂O emissions are estimated to have fallen by about 40 per cent between 1990 and 2004 and are projected to be about 41 per cent below 1990 levels by 2010.
- Large reductions in emissions from industrial processes contributed most to this fall.

1. Nitrous oxide has a global warming potential 310 times that of carbon dioxide over a 100-year time horizon. The main source of emissions in the UK is now agricultural soils because emissions from industrial processes, particularly fugitive nitrous oxide emissions from adipic acid manufacture, have been significantly reduced due to introduction of abatement equipment.

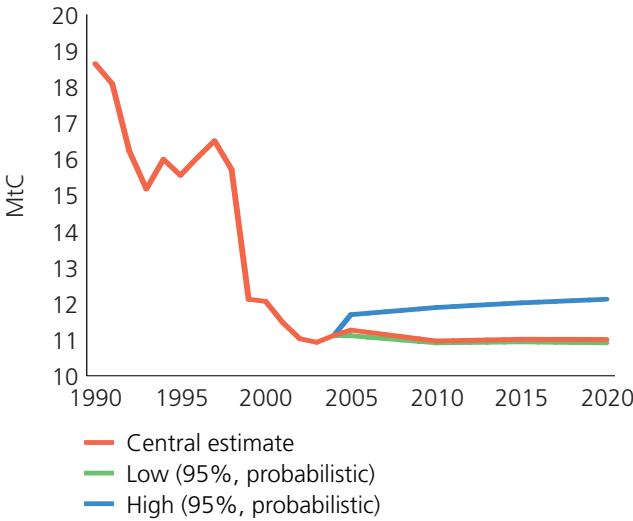
Emissions trends and projections

2. In 1990, anthropogenic emissions of nitrous oxide from the UK were 18.6 MtC. Annual emissions fell 40.4 per cent between 1990 and 2004. Projected nitrous oxide emissions in 2010 are 11.0 MtC, a decrease of 41.2 per cent on 1990 levels.

Nitrous oxide emissions by source 1990 to 2020, MtC



Nitrous oxide emissions, 1990 to 2020, MtC



3. The table below shows UK nitrous oxide emissions by source. There are large uncertainties in many of the source estimates but these have been reduced significantly in key sectors because of Government research. For each of the key sectors, high and low estimates of the projected emissions were derived. These were assumed to form the upper and lower bounds of a triangular distribution of the projected emissions. These high and low estimates were generally derived from expert judgement about data inputs, the modelling approach and the historical variability in the data. Monte Carlo Analysis was used in order to derive a probability density function associated with the total projected emissions for nitrous oxide. The range of projected emissions representing the 95th percentile is presented here. The central and low projections are close in this case because the uncertainty in the rates of application of nitrogenous fertiliser is skewed.

4. Estimates of nitrous oxide emissions from agricultural soils are currently under review, though this is unlikely to have a significant effect on the overall trend of nitrous oxide emissions.

Nitrous oxide

Nitrous oxide emissions by source 1990 to 2020, MtC¹⁶

Sector	1990	1995	2000	2004	2010	2015	2020
Agriculture	8.7	8.3	7.9	7.2	7.0	6.9	6.9
Industrial processes	8.0	5.2	1.7	1.1	1.1	1.1	1.1
Fuel combustion	1.2	1.0	0.9	0.9	0.9	0.9	0.8
Waste	0.3	0.3	0.3	0.3	0.4	0.4	0.4
Transport	0.4	0.7	1.2	1.5	1.6	1.7	1.8
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	18.6	15.5	12.1	11.1	11.0	11.0	11.0
Change from 1990 levels		-16.6%	-35.3%	-40.4%	-41.2%	-40.9%	-41.0%

Note: the percentage changes and emission estimates may differ slightly due to rounding.

¹⁶Actual historical data for 2004 are used in this table in place of 2005 projections.

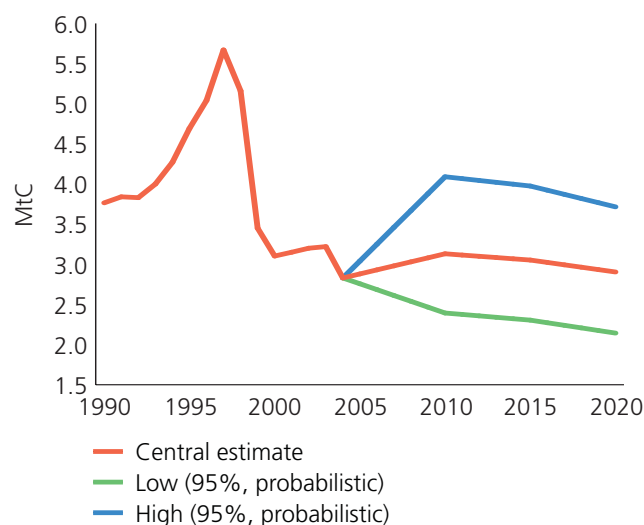
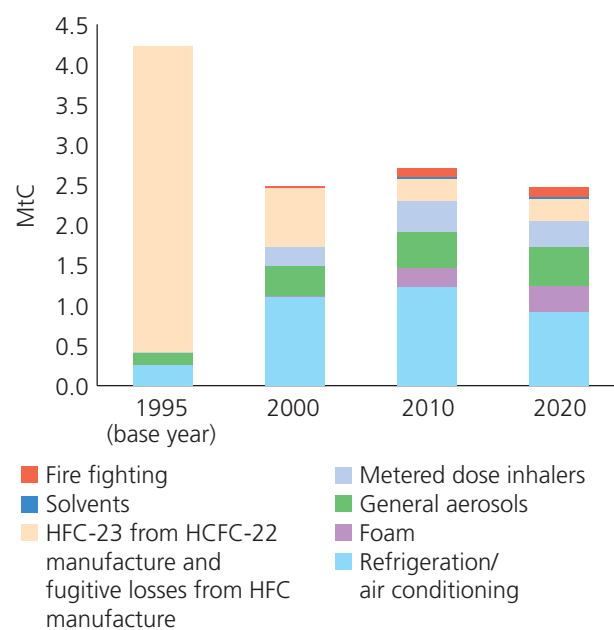
Key facts

- The fluorinated gases (F-gases) together contributed 1.6 per cent to total UK greenhouse gas emissions in 2004.
- F-gas emissions fell by 40 per cent between the 1995 base year and 2004 and are projected to be 33 per cent below 1995 levels by 2010.

1. Though relatively small as a proportion of total emissions, emissions of the fluorinated gases – hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) – are significant for climate change as they have high global warming potentials (see annex H) and usage particularly of HFCs is expected to grow in some sectors in the near future.

Emissions trends and projections

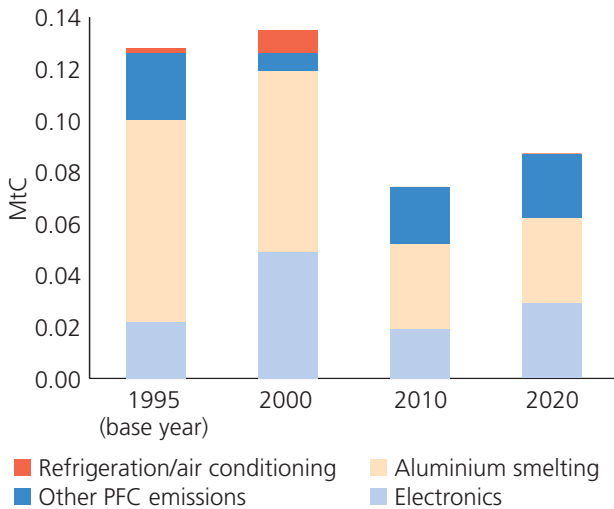
2. The Kyoto Protocol allows for either 1990 or 1995 to be used as the base year for measuring emissions of HFCs, PFCs and SF₆. The UK has chosen to use 1995 as the baseline.
3. Historical and projected emissions are shown graphically as low, central and high estimates. Uncertainties in the combined total UK f-gas emissions were derived from individual sector uncertainty estimates using an iterative Monte Carlo Analysis. Uncertainties were calculated as two standard deviations from the mean, corresponding to a 95 per cent confidence interval. Manufacturers and their representatives provided most of the data. Stakeholder workshops involving industry, NGOs and producers of alternative refrigerants and other interested parties helped to refine the emissions and projections, and reduce some of the uncertainties.

Emissions of HFCs, PFCs and SF₆, 1990 to 2020, MtC**UK emissions of HFCs, 1995 to 2020, MtC**

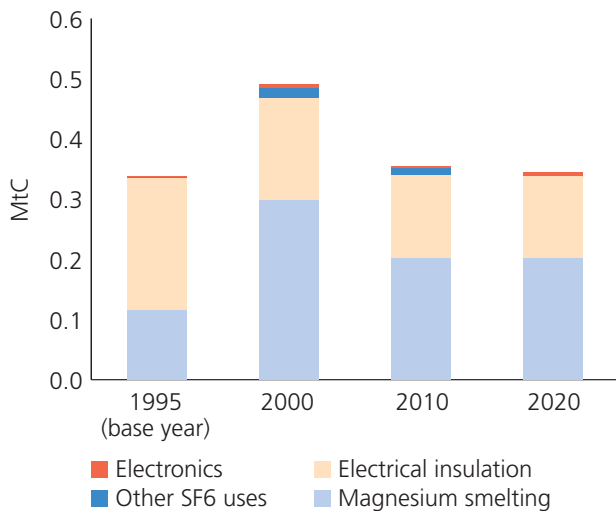
Notes: *from HCFC-22 manufacture and fugitive losses from HFC manufacture.

HFCs, PFCs and SF₆

UK emissions of PFCs, 1995 to 2020, MtC



UK emissions of SF₆, 1995 to 2020, MtC



4. In 1995, emissions of fluorinated gases from the UK were 4.7 MtC, contributing 2.4 per cent of total UK greenhouse gas emissions in that year. Annual emissions fell by about 40 per cent between 1995 and 2004 and are expected to be 33.4 per cent below 1995 levels by 2010. Details of major sources for each fluorinated gas are given below.

5. The projections are to be updated to take account of additional abatement action affecting HFC-23 emissions and use of SF₆ in the non-ferrous metal industry, which may together reduce emission by between 0.3 and 0.4 MtC/yr in 2010 below the level shown in the figures.

HFCs

6. In 1995, emissions of hydrochlorofluorocarbons (HFCs) from the UK were 4.2 MtC with the major source, representing about 90 per cent of HFC emissions, being fugitive emissions of HFC-23 from the manufacture of the refrigerant HCFC-22. Other sources of HFC emissions are refrigeration/air conditioning; foam blowing; general aerosols; metered dose inhalers; solvent cleaning; and firefighting.

7. HFCs were virtually unused in many of these sectors before 1990 but since then, consumption has risen in response to the phase out of chlorofluorocarbons (CFCs) and HCFCs under the Montreal Protocol.

8. HFC emissions are expected to fall by 36 per cent from 1995 to 2010, mainly due to a substantial fall in HFC-23 emissions from HCFC-22 manufacturing plants. Emissions from end use markets such as aerosols, refrigeration and foam blowing are projected to increase significantly compared to 1995. However, expected reduced levels of leakage and increased use of alternative fluids in these markets limit the magnitude of increases in HFC emissions.

PFCs

9. UK emissions of PFCs were 0.1 MtC in 1995. PFC emissions are expected to decrease by around 41.6 per cent of 1995 level by 2010 mainly due to improved control of aluminium smelters and improved fluid recovery in the electronics industry.

SF₆

10. SF₆ is used in four main markets: electrical insulation; magnesium smelting; electronics; and training shoes. SF₆ emissions from these end use markets are estimated to have been 0.34 MtC in 1995 and are expected to remain approximately the same in 2010.

HFCs, PFCs and SF₆HFC, PFC, SF₆ emissions by market sector 1990 to 2020, MtC¹⁷

Sector	1990	1995	2000	2004	2010	2015	2020
(Base year)							
HFCs							
Refrigeration/air conditioning	0.000	0.254	1.101	1.376	1.233	1.124	0.912
Foam (excluding OCF) ¹⁸	0.000	0.000	0.017	0.139	0.237	0.282	0.324
General aerosols (including OCF) ¹⁹	0.000	0.156	0.368	0.344	0.448	0.469	0.491
Metered dose inhalers	0.000	0.000	0.244	0.390	0.380	0.335	0.316
HFC-23 from HCFC-22 manufacture and fugitive losses from HFC manufacture	3.102	3.813	0.730	0.077	0.274	0.274	0.274
Solvents	0.000	0.000	0.001	0.009	0.029	0.029	0.029
Fire fighting	0.000	0.001	0.017	0.079	0.102	0.114	0.128
Total HFC emissions	3.102	4.225	2.478	2.415	2.703	2.627	2.474
PFCs							
Electronics	0.010	0.022	0.049	0.026	0.019	0.023	0.029
Aluminium smelting	0.363	0.078	0.070	0.042	0.033	0.033	0.033
Other PFC emissions	0.009	0.026	0.007	0.029	0.022	0.024	0.025
Refrigeration/air conditioning	0.000	0.002	0.009	0.000	0.000	0.000	0.000
Total PFC emissions	0.382	0.128	0.136	0.096	0.073	0.080	0.086
SF₆							
Magnesium smelting	0.116	0.116	0.298	0.106	0.202	0.202	0.202
Electrical insulation	0.163	0.219	0.170	0.142	0.138	0.138	0.135
Other SF ₆ uses	0.000	0.000	0.016	0.056	0.010	0.000	0.000
Electronics	0.002	0.003	0.006	0.003	0.004	0.005	0.007
Total SF₆ emissions	0.281	0.338	0.490	0.307	0.354	0.345	0.344
Total UK emissions of HFCs, PFCs and SF ₆	3.765	4.691	3.104	2.515	3.130	3.052	2.904
Change from base year for row above			-33.8%	-46.4%	-33.3%	-34.9%	-38.1%

Note: the percentage changes and emission estimates may differ slightly due to rounding.

¹⁷Actual historical data for 2004 are used in this table in place of 2005 projections.

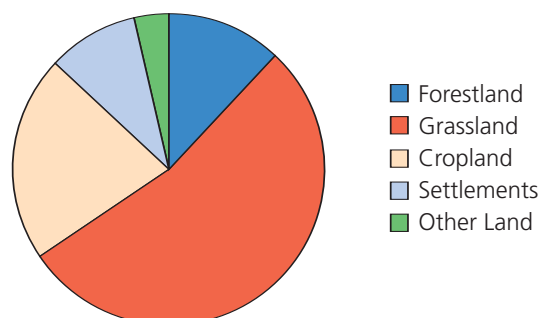
¹⁸OCF – One Component Foams.

¹⁹OCF – One Component Foams.

- The largest carbon pools in the UK are soils which store about 6 billion tonnes of carbon
- The UK was a net source of emissions from land use, land use change and forestry (LULUCF) in 1990
- Projections indicate the UK will become a small net sink of 0.5 MtC from LULUCF activities by 2010

1. Under the UNFCCC and the Kyoto Protocol, the UK is committed to protecting and enhancing sinks. The Kyoto Protocol also gives a limited allowance for forestry activities to be used to help meet emission reduction commitments. This Annex explains how the UK is approaching international negotiations on the use of sinks and about the current trends in emissions from land use change.
2. The latest information on land use in the United Kingdom comes from a Countryside Survey conducted in 1998²⁰. The use of land was estimated by classification of surveyed locations into one of 21 Broad Habitats or dense urban use. These classes can be combined into five of those recommended in the IPCC Good practice Guidance of Land Use, Land-Use Change and Forestry, namely Forest Land, Cropland, Grassland, Settlements and Other Land. The land that would be within the IPCC Wetland type is included in Grassland or Other Land. Using the IPCC classes the chart below shows how land in the United Kingdom is used. The main classes are grassland (54 per cent) and Cropland (22 per cent). About 12 per cent of Great Britain is wooded. Settlements occupy 9 per cent of land, including gardens and urban parks leaving 4 per cent of the UK in the IPCC Other Land class for example rock, open water and beaches.

Land use in the United Kingdom

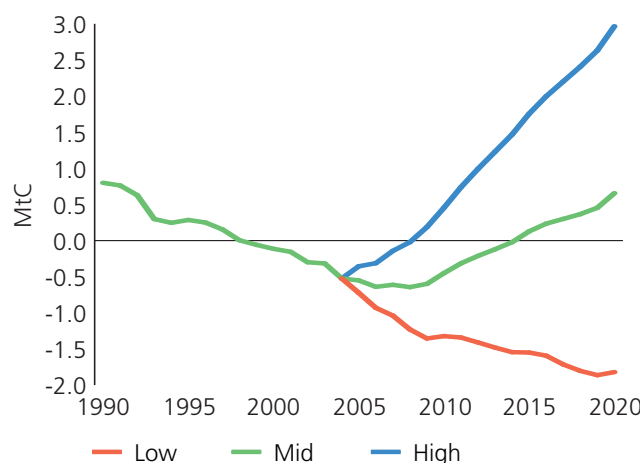


3. Soil is the largest carbon pool in the UK, which stores about 6 billion tonnes of carbon²¹. About 3 billion tonnes of this total are stored in peats and other organic soils which are found mainly in Scotland and which cover about 30 per cent of the UK's total land area. The biomass in woodlands contain some 90 million tonnes of carbon, 30 million tonnes of which are stored in conifers and some 60 million tonnes in broad leaves and mixed woodland.

Inventory and projections

4. The UK's annual greenhouse gas inventory includes categories covering LULUCF, in accordance with the IPCC's 2003 Good Practice Guidance for LULUCF. The methods used to estimate emissions from these categories have been reported in the scientific literature²² and are kept under review. The methodologies are described in the UK's National Inventory Reports (e.g. Baggott et al 2005).

Ranges in future land use change



²⁰Countryside Survey 1990, 1993, Barr et al: Main Report, DOE, London; Northern Ireland Countryside Survey, 1997, Cooper et al, EHS, Belfast.

²¹The figure included carbon stored in litter, which is dead plant matter lying on top of the soil.

²²Cannell et al, National Inventories of Terrestrial Carbon Sources and Sinks: The UK Experience, Climatic Change, vol 42, pp505-530, 1999.

Carbon sequestration

Greenhouse gas emissions and removals from land use, land use change and forestry, on a) UNFCCC basis and b) Kyoto Protocol (KP) basis, MtC²³

Convention Reporting bases

Gas	1990	1995	2000	2004	2010	2015	2020
Carbon dioxide	0.795	0.282	-0.120	-0.530	-0.455	0.124	0.653
Methane	0.004	0.003	0.005	0.005	0.004	0.003	0.003
Nitrous oxide	0.0004	0.0003	0.0005	0.0005	0.0004	0.0003	0.0003
Total greenhouse gas emissions by sources minus removals by sinks	0.799	0.285	-0.114	-0.524	-0.451	0.128	0.656

Kyoto Protocol Reporting bases

Gas	1990	1995	2000	2004	2010	2015	2020
Carbon dioxide							
<i>Afforestation & Reforestation</i>	0.008	-0.076	-0.388	-0.586	-0.843	-0.978	-1.179
<i>Deforestation</i>	0.046	0.061	0.100	0.102	0.104	0.106	0.104
Methane	0.004	0.003	0.005	0.005	0.004	0.003	0.003
Nitrous oxide	0.0004	0.0003	0.0005	0.0005	0.0004	0.0003	0.0003
Total greenhouse gas removals by Afforestation and Reforestation less emissions by Deforestation mandatory under Article 3.3 of the Kyoto Protocol. (-ve is net removal).	0.058	-0.011	-0.282	-0.479	-0.735	-0.869	-1.072
Removals associated with forest management under Article 3.4 of the Kyoto Protocol				0.37	0.37	0.37	0.37
Under Kyoto Protocol Article 3.7, Total Emissions in 1990 due to Deforestation (added to base year emissions for KP reporting)	0.1						

Carbon dioxide emissions and removals from LULUCF 1990 to 2020 MtC, on UNFCCC reporting basis²⁴

	1990	1995	2000	2004	2010	2015	2020
Removals (to forestland) (a)	-3.328	-3.804	-3.765	-4.446	-2.935	-2.140	-1.387
<i>Including removals due to land afforested since 1990 (b)</i>	<i>0.008</i>	<i>-0.076</i>	<i>-0.388</i>	<i>-0.586</i>	<i>-0.843</i>	<i>-0.978</i>	<i>-1.179</i>
Net Emissions from other land use change and management (c)	4.123	4.086	3.645	3.916	2.479	2.264	2.039
Total emissions minus total removals	0.795	0.282	-0.120	-0.530	-0.455	0.124	0.653

Notes:

(a) Includes carbon accumulated in forests by woody biomass, soils, litter and changes in the quantity of forest products from timber grown in the UK;

(b) Entries for woodlands planted from 1990 exclude increasing pool of carbon in timber products;

(c) Sum of source and sink terms due to transitions between land use categories and emissions due to specific land management, includes measures.

- The estimates for forest carbon sinks in the greenhouse gas inventory are based largely on data from the Forestry Commission, which has undertaken inventories of woodlands in Great Britain at 15-20 year intervals since 1924. The most recent inventory, was carried out between 1995 and 2000. Further woodland inventories will be carried out as part of a 10-year rolling programme, planned to start in 2006. Annual planting and felling data is used to update

information on the size and age structure of the national forest estate between the periodic inventories. This information, together with data derived from the growth characteristics of UK forests (so-called 'yield classes') is used in a dynamic carbon accounting model to estimate annual uptake and storage of atmospheric carbon by trees. Growth characteristics are kept under review through a national system of mensuration plots and associated yield models.

²³Actual historical data for 2004 are used in this table in place of 2005 projections.

²⁴Actual historical data for 2004 are used in this table in place of 2005 projections.

Carbon sequestration

This information will be used to keep the carbon accounting model up to date.

6. Estimates of land use change emissions rely on separate land use change matrices for Scotland, and for England and Wales. These matrices are derived from surveys on land use conducted in 1947, 1980, 1984, 1990 and 1998. The matrices show the pattern of land use change between different categories of land which have been grouped into the broad land types of Grassland, Cropland, Forest Land, Settlements and Other Land. Changes in carbon density for the types of land undergoing transition are estimated from soil survey data and used in a dynamic model to estimate annual gains and losses of carbon associated with the transitions in the matrix.
7. The tables above summarises the main trends in UK sources and sinks from land use change and forestry, with disaggregations by greenhouse gas. The data is consistent with the UK Greenhouse Gas emissions inventory published in 2006²⁵. The difference between UNFCCC and Kyoto Protocol reporting bases in table 1 lies in which components of the LULUCF sector are counted within the total carbon dioxide estimates. The Convention basis includes all human-induced changes to land-based carbon stocks, ie total emissions minus total removals from the LULUCF sector. The Kyoto reporting basis includes LULUCF emissions and removals associated with mandatory activities under Art 3.3 of the Kyoto Protocol – afforestation plus reforestation minus deforestation since 1990. In addition, since the UK has chosen to account for forest management under Art 3.4 of the Kyoto Protocol, the Kyoto table also indicates removals up to the level of the cap agreed for the UK as part of the Marrakesh Accords, since the actual uptake by forests is projected to exceed the cap in all years. A small base year allowance of 0.1 MtC related to deforestation emissions is added to the UK base year because land use change and forestry was a net source of emissions in the base year. This is in accordance with the provisions of the second sentence of Art 3.7 of the Kyoto Protocol, and subsequent COP decisions.
8. New forests and woodlands have been planted at rates between 12,000 and 21,000 hectares per year across the UK since 1990 as a result of government policy implemented by the Forestry Commission and the Northern Ireland Forest Service. The Government and the devolved administrations are committed to expanding the UK's woodland area. The projections for the forest sink shown in the above table assume that future policies will continue to produce new planting at rates of between 12,000 and 30,000 hectares per year, and that existing planting will be replaced after felling. Row (a) in the last table includes the continuing uptake by trees planted before 1990 and still growing, as well as more recent planting. Row (b) shows only the effect of expanding the forest area due to planting since 1990, to illustrate how taking account of forestry activities under Article 3.3 of the Kyoto Protocol might help the UK meet its commitments.
9. Estimated emissions from land use change in row (c) are mainly a result of agricultural intensification and urbanisation under the pattern of land use change before the mid-1980s. In the more recent land use change matrix, these trends are moderated or reversed, reflecting the effect of agri-environmental policies to protect and enhance the countryside and de-intensify conventional farming practices. These policies include Environmentally Sensitive Areas, Countryside Stewardship, Nitrate Vulnerable Zones, Woodland Grant and Farm Woodland Premium Schemes, the Organic Farming Scheme and the Tir Gofal agri-environment scheme for Wales. The ranges in the figure above show the uncertainty in knowledge of future land use change, either where the changes cause more change (higher emissions estimate) or less change (lower emissions line) compared to the continuation of recent land use changes.
10. The ranges in the figure are determined by the assumptions made about expansion of the forest area and the other land use changes reflected in the land use change matrix. They do not show the full range of uncertainties, which would also include methodological uncertainties linked to soil carbon densities in addition to the uncertainty in

²⁵UK Greenhouse Gas Inventory, 1990 to 2004, April 2006, NETCEN.

future rates of change in land use included here. Defra has supported recent work, reported in the scientific literature, suggesting that losses of carbon from the upper layers of UK soils may be greater than previously estimated²⁶. The causes of the estimated losses and the fate of the carbon are under investigation and these results are not reflected in the inventory or the projections.

²⁶Bellamy et al: Carbon losses from all soils across England and Wales 1978-2003, *Nature*, vol 437, 245, 8 Sept 2005.

Carbon capture and geological storage

- Carbon dioxide capture and storage (CCS) consists of separation of carbon dioxide from industrial and energy-related sources, transport to a storage location, and long-term isolation from the atmosphere.
- Storage in properly selected geological formations can store carbon dioxide with high probability over very long periods of time and is part of the portfolio of mitigation options that can contribute to stabilising concentrations of greenhouse gases in the atmosphere.
- Direct injection into the deep ocean would not isolate the CO₂ from the atmosphere indefinitely and would have unknown impacts on marine ecosystems. It cannot therefore be regarded as a mitigation option.

1. The potential of carbon dioxide capture and storage (CCS) as a mitigation option was highlighted in 2005 including in the UK's Carbon Abatement Technology strategy²⁷, the G8 Communiqué²⁸ and in the IPCC Special report on CCS²⁹.
2. Storage of carbon dioxide in deep geological formations, onshore or offshore, uses many of the same technologies that have been developed by the oil and gas industry. Three industrial-scale storage projects, which include direct injection of carbon dioxide into geological formations, are in operation in the world: the Sleipner project in the Norwegian sector of the North Sea, the Weyburn enhanced oil recovery project in Canada, and the In Salah project in a gas field in Algeria; more projects worldwide are at different stages of development. The UK's Carbon Abatement Technology Strategy identified CCS along with improved efficiency in existing power generation as the two key technologies for reducing carbon dioxide emissions from fossil fuel use.
3. Current evidence suggests that the cost of capture and storage of carbon dioxide from new power plants is around \$40-60 per tonne of carbon dioxide, which can be expected to fall as the technology matures. This is comparable with other major abatement options, and suggests that the technology could have a major role in mitigating emissions. The rate of deployment is constrained by uncertainties over economics (cost of capture technologies, and emissions trading eligibility) and legal status of subsea-bed storage under the London and OSPAR Conventions, which are designed to protect the marine environment. These issues are being addressed by the UK through active participation in the negotiations under the marine treaties and the UNFCCC, cooperation with the EU via the EU Climate Change Programme, membership of the Carbon Sequestration Leadership Forum and the North Sea Basin Task Force, assistance with development by IPCC of emissions inventory methodologies relevant to CCS, and considering possible requirements for domestic regulation. The IPCC Special Report provides confidence in the permanence of storage in appropriately selected and managed geological reservoirs.

²⁷www.dti.gov.uk/energy/coal/cfft/cct/pub/catreportlinked.pdf

²⁸www.fco.gov.uk/Files/kfile/PostG8_Gleneagles_Communique_0.pdf

²⁹www.ipcc.ch/activity/ccsppm.pdf

List of greenhouse gases

Greenhouse gas	Lifetime (years)	100 years global warming potential
Carbon dioxide	50-200	1
Methane	12.23	21
Nitrous oxide	120	310
HFC-23	264	11,700
HFC-32	5.6	650
HFC-41	3.7	150
HFC-43-10mee	17.1	1,300
HFC-125	32.6	2,800
HFC-134	10.6	1,000
HFC-134a	14.6	1,300
HFC-152a	1.5	140
HFC-143	3.8	300
HFC-143a	48.3	3,800
HFC-227ea	36.5	2,900
HFC-236fa	209	6,300
HFC-245ca	6.6	560
Chloroform	0.51	4
Methylene chloride	0.46	9
Sulphur hexafluoride	3,200	23,900
Perfluoromethane	50,000	6,500
Perfluoroethane	10,000	9,200
Perfluoropropane	2,600	7,000
Perfluorobutane	2,600	7,000
Perfluoropentane	4,100	7,500
Perfluorohexane	3,200	7,400
Perfluorocyclobutane	3,200	8,700
Trifluoroiodomethane	<0.005	<1

Source: IPCC, 1996

1. To compare the relative climate effects of greenhouse gases, it is necessary to assess their contribution to changes in the net downward infra-red radiation flux at the tropopause (the top of the lower atmosphere) over a period of time. Ultimately the best way to do this is by comparing different emission scenarios in climate models, but a simple working method has been derived for use by Parties to the UNFCCC which provides the relative contribution of a unit emission of each gas, relative to the effect of a unit emission of carbon dioxide integrated over a

fixed time period. A 100-year time horizon has been chosen by the Convention in view of the relatively long time scale for addressing climate change.

2. This factor is known as a global warming potential (GWP). It means, for example, that 1 tonne of HFC-134 emitted to the atmosphere has 1,000 times the warming impact over 100 years compared to 1 tonne of carbon dioxide³¹.

³¹The GWPs given in the table above were published in the IPCC's Second Assessment Report and are referred to as "1995 IPCC GWP values". Although some have since been updated, it was agreed that for reporting under the UNFCCC and the Kyoto Protocol, Parties should use these values.

List of greenhouse gases

3. To compute the carbon equivalent of the emission of any gas, multiply its emission by the GWP and by 12/44, the ratio of the atomic weights of carbon and carbon dioxide. Thus, for example, an emission of 1 tonne of HFC-134 is equivalent to $1 \times 1000 \times 12/44 = 273$ tonnes of carbon.
4. The GWPs given in the table were published in the IPCC's Second Assessment Report and are sometimes referred to as 1995 IPCC GWP values. These are the values agreed for use in reporting to the UNFCCC and the Kyoto Protocol. IPCC's Third Assessment Report published updated values that differ to some extent, these are shown in Section 1.

ANNEX I

Review of the 2000 Climate Change Programme

1. In the 2000 Climate Change Programme, the Government made a commitment to review both the Programme and its progress towards the Kyoto target and national goal in 2004. The review was launched on 15 September 2004 with the remit to look at how existing policies were performing and the range of measures that could be put in place in the future. In December 2004 the Government launched a public consultation which ran from 8 December 2004 to March 2005. Some of the questions asked were whether the existing measures were working, how they might be improved and whether any of them should be dropped. The Government also asked for ideas for new policies and measures that would ensure progress towards the 2010 national goal.
2. Around 300 responses were received. The majority of the responses were from business, including the energy supply industry and NGOs. A significant number of respondents stated that the evidence on climate change was stronger than ever and many also stated that the Climate Change Programme needed to be more strategic, more joined-up and or/higher priority. A significant number of respondents felt that existing measures were not effective in reducing emissions of greenhouse gases and that the Programme needed to be stronger on adaptation to climate change. The consultation received over 200 suggestions for additional policies.
3. The evaluation of existing policies in the 2000 Climate Change Programme was mainly carried out by external consultants, following Green Book guidance, while appraisals were a mixture of in-house and external analysis. All the evaluations and appraisals were presented to the IAG for discussion. In addition to Government departments, the IAG included representatives from Ofgem, the Carbon Trust, the Energy Saving Trust, the Environment Agency and the Sustainable Development Commission.
4. The evaluation of existing policies and appraisal of possible new policies that could be continued/adopted were carried out in accordance with the Treasury Green Book guidelines. Cost-benefit and cost-effectiveness analysis was carried out for both the evaluation of existing measures and the appraisal of possible new policies³². In addition an assessment of each policy's impact on innovation, competitiveness, security of supply, fuel poverty and air quality was also carried out. The evaluation synthesis report can be found at: www.defra.gov.uk/environment/climatechange/pubs/ukccp/index.htm. There will be an appraisal synthesis report to accompany the evaluation synthesis report, containing summary information about all of the policies appraised as part of the Climate Change Programme.

³² The cost effectiveness analysis presents each policy in terms of the cost per tonne of carbon saved whilst the cost-benefit analysis shows each policy in terms of its net present value (all the benefits minus all the costs).

Glossary of terms

ACEA	European Automobile Manufacturers Association
BIC	British Irish Council
BSF	Building Schools for the Future
CO ₂	Carbon dioxide
CAP	Common Agricultural Policy
CAT	Carbon Abatement Technology
CCA	Climate change agreements
CCP	Climate Change Programme
CCS	Carbon Capture and Sequestration
CDM	Clean Development Mechanism
CFC	Chlorofluorocarbon
CHP	Combined Heat and Power
CCL	Climate change levy
CMM	Coal mine methane
CPA	Comprehensive Performance Assessment
CSF	Catchment Sensitive Farming
CSS	Countryside Stewardship
CT	Carbon Trust
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DPs	Direct Participants
DTI	Department of Trade and Industry
DVLA	Driver and Vehicle Licensing Agency
DWPA	Diffuse Water Pollution from Agriculture
ECA	Enhanced Capital Allowance
ECS	Energy Crops Scheme
EEACs	Energy Efficiency Advice Centres
EEC	Energy Efficiency Commitment
EIA	Environmental Impact Assessment
ELS	Entry Level Stewardship
ESA	Environmentally Sensitive Area
EST	Energy Saving Trust
ESWG	Energy Services Working Group
ETS	Emissions Trading Scheme
EU	European Union
EU ETS	EU emissions trading scheme
FWPS	Farm Woodland Premium Scheme
GDP	Gross Domestic Product
GW	Gigawatts
G8	Group of 8
HA	Hectare

HCFC	Hydrochlorofluorocarbon
HECA	Home Energy Conservation Act
HFC	Hydrofluorocarbon
HLS	Higher Level Stewardship
HMT	Her Majesty's Treasury
ICAO	International Civil Aviation Organisation
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
JAMA	Japanese Automobile Manufacturers Association
JI	Joint Implementation
KAMA	Korean Automobile Manufacturers Association
KP	Kyoto Protocol
LA	Local authority
LCPD	Large Combustion Plant Directive
LNG	Liquefied Natural Gas
MCHP	Micro-CHP
MtC	Million tonnes of carbon equivalent
MW	Megawatt
N ₂ O	Nitrous oxide
NAO	National Audit Office
NAP	National Allocation Plan
NEAT	NHS Environmental Assessment Tool
NHSIS	NHS in Scotland
NO _x	Nitrogen oxides
NVZ	Nitrate Vulnerable Zone
ODPM	Office of the Deputy Prime Minister
Ofgem	Office of Gas and Electricity Regulation
PFC	Perfluorocarbon
PM	Particulate Matter
PPC	Pollution Prevention and Control
PPS22	Planning Policy Statement 22
RDA	Regional Development Agency
RDR	Rural Development Regulation
RO	Renewables Obligation
SCCP	Scottish Climate Change Programme
SD	Sustainable development
SEPA	Scottish Environment Protection Agency
SF ₆	Sulphur hexafluoride
SO ₂	Sulphur dioxide
STEP	School Turnkey Energy Programme

Glossary of Terms

TIWG	Transmission Issues Working Group
UKETS	UK Emissions Trading Scheme
UKCIP	UK Climate Impacts Programme
UNFCCC	United Nations Framework Convention on Climate Change
VED	Vehicle Excise Duty
WAG	Welsh Assembly Government



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