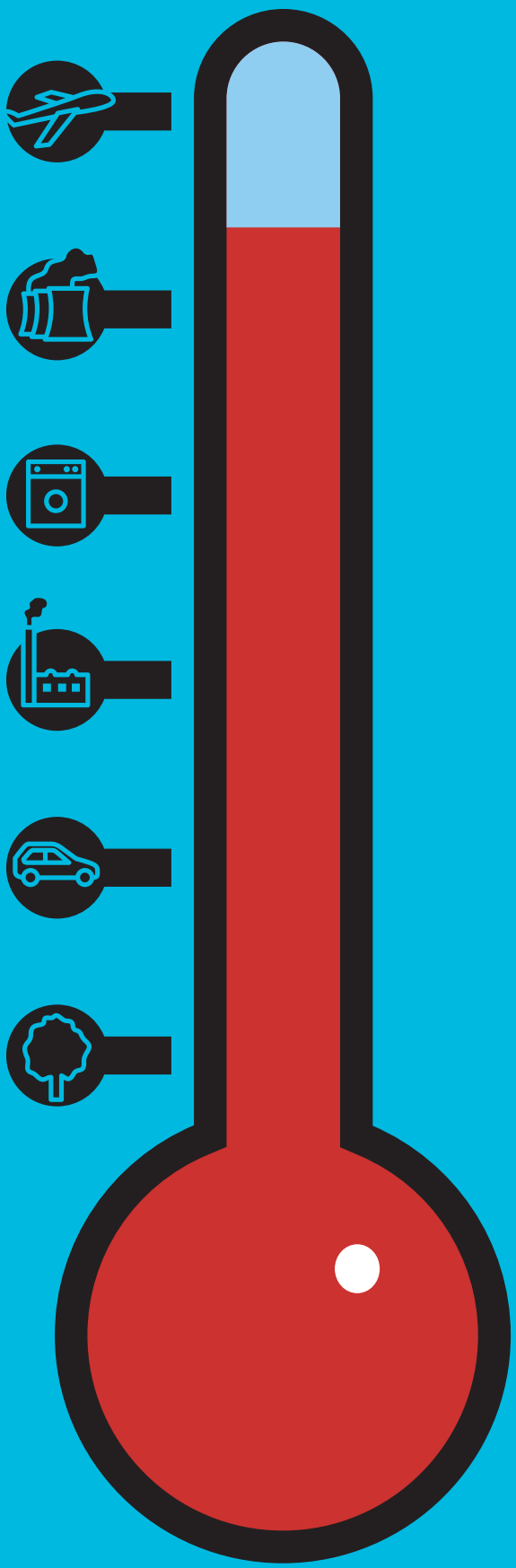

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The UK's Fifth National Communication under the United Nations Framework Convention On Climate Change

ACT ON CO2

DEPARTMENT OF ENERGY & CLIMATE CHANGE

The UK's Fifth National Communication under the United Nations Framework Convention On Climate Change

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Foreword

By the Secretary of State for Energy and Climate Change

I am pleased to present the UK's Fifth National Communication under the Framework Convention on Climate Change. The actions we have taken mean the UK's greenhouse gas emissions are already significantly below the level needed to achieve our Kyoto target. We estimate that the UK's greenhouse gas emissions should be 23 per cent below 1990 levels by 2010.

In 2008 the UK passed the ground-breaking Climate Change Act: for the first time anywhere in the world, there are legally-binding carbon budgets, putting the UK on the pathway to meeting an 80 per cent cut in greenhouse gases by 2050. By enshrining in law the UK's long-term commitment to tackling climate change, the Act will drive further our progress towards becoming a low-carbon economy and will support our efforts to secure a global deal on climate change. The levels of the first three carbon budgets, announced on 22 April, commit the country to reduce emissions by at least 34 per cent below 1990 levels by 2020. We will move to tighter budgets following a successful global deal.

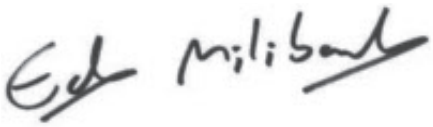
Meeting carbon budgets will be challenging. We are taking action for homes and businesses, power and transport to move to a low carbon economy, and this summer we will publish our energy and climate change strategy to build on existing success.

To move to low carbon in our homes, we have outlined plans to make sure every house in the country that is able to has cavity and loft insulation fitted by 2015, and seven million homes will be offered whole house heat and energy efficiency treatment by 2020.

To move to low carbon power, we have already tripled renewable power in five years, and have ambitious plans for more renewable, nuclear, and low-carbon fossil fuels. I proposed in April, a new path to low-carbon coal, including funding for up to four major demonstrations of carbon capture and storage, and a new condition that no new coal-fired power station will gain consent without using carbon capture and storage from day one.

And in transport, in the past year we have succeeded in negotiating new mandatory EU car emissions standards, entry for aviation into the EU emissions trading system and laid down strict conditions for the increase in capacity at Heathrow airport. We have introduced a renewable transport fuel obligation to increase the proportion of renewable sources in the UK transport fuel mix and moved to ensure that this should be sustainably produced. We continue to sponsor public transport, spending unprecedented amounts on the provision of public transport (in 2007-08 over £4 billion on the rail network and, together with local government, around £2.5 billion on supporting buses) as well as the encouragement of sustainable transport choices including cycling and driver behaviour changes.

2009 is a critical year for the global effort to avoid dangerous climate change. It is essential that we agree a post-2012 international framework if we are to have any chance of avoiding the worst social, economic and environmental costs of climate change. Failure to take adequate action internationally to tackle climate change will not only make its eventual impacts even greater and more dangerous, but it will cost considerably more than taking early action. The Conference of the Parties (COP 15) in Copenhagen later this year, offers the global community the opportunity to reach an ambitious international agreement on tackling climate change. This is a high priority for the UK Government. We have already taken significant steps to move the UK towards becoming a low carbon economy, and the action taken is detailed in this report. We will continue to work with other countries, and through the EU, to reach an effective international agreement later this year.



Ed Miliband
Secretary of State for Energy and Climate Change

June 2009

Executive Summary

UK greenhouse gas emissions counting towards our current Kyoto commitment were 18.4 per cent below base levels in 2007. The UK's Kyoto Protocol target is to reduce emissions of the basket of six greenhouse gases by 12.5 per cent compared to base-year levels. The UK is therefore well on track to exceed this commitment. Between 1990 and 2007, carbon dioxide emission (including Land Use and Land Use Change and Forestry (LULUCF)) fell by 8.3 per cent; methane emission fell by 53.1 per cent; and nitrous oxide emissions fell by 46.9 per cent. The latest interim projections show that UK emissions of greenhouse gases[1] are expected to fall to about 23 per cent below base year levels by 2010.

Background

The grave threats posed by climate change demand serious, concerted action by the whole world. Since no country can solve the problem on its own, all countries must show what they can achieve by their own actions, which should be consistent with their national circumstances. These actions can also help the international process to secure future agreements. These underlying fundamentals are the core of the UK's strategy for tackling climate change.

This communication sets out the progress that the UK has made in implementing its commitments under the UNFCCC and the Kyoto Protocol. Some of these commitments have been driven by national policy initiatives and some have been implemented following measures adopted at European Union (EU) level. The latter are described in more detail in the EU's report on demonstrable progress and the EU's fifth national communication – to be published later this year.

The UK's commitment under the Kyoto Protocol is to reduce its greenhouse gas emissions to 12.5 per cent below base-year levels over the first commitment period, 2008-2012[2].

The UK progress to date

The UK's emissions of the Kyoto basket of six greenhouse gases fell by 18.4 per cent between the base year and 2007. These reductions have been mainly 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-CO_2 greenhouse gases, most notably the increase in landfill methane capture and oxidation.

The action that the UK has taken to date, and the comprehensive policy framework now in place, means that greenhouse gas emissions are already significantly below the level needed to achieve its target for the first commitment period.

Since the Fourth National Communication[3] was published in May 2006, the UK Government and Devolved Administrations have implemented a range of policies and measures. Many of these were announced in the 2006 Climate Change Programme and 2007 Energy White Paper and others more recently.

Highlights of these policies and measures include:

- Phase II of the EU Emission trading system which started on 1 January 2008 and will run until 31 December 2012. The UK was the first EU member state to auction 7 per cent of allowances (approximately 86 million) and was the first Member State to do so on 19th November 2008, raising over £54m for the UK Exchequer.
- The UK passed legislation (the Climate Change Act 2008) in November 2008 which introduced the world's first long-term legally binding framework to reduce greenhouse gas emissions.
- The Environmental Transformation Fund (ETF) which is designed to bring forward the development of new low carbon energy and energy efficiency technologies in the UK. The fund began operation in April 2008, and is co-ordinated through the Department of Energy and Climate Change (DECC). The ETF also has an international element, jointly owned by DECC and the Department for International Development (DfID) and administered by the World Bank as part of the Climate Investment Funds.
- A new mandatory emissions trading scheme – the Carbon Reduction Commitment (CRC) – which will begin in 2010 and cover around 5000 large UK businesses and public sector organizations, responsible for about 10 per cent of the UK's total emissions. The scheme will deliver carbon savings of at least 4.4 $MtCO_2$ per year by 2020.
- In September 2008, the Government announced an additional £1 billion for the Home Energy Saving Programme (HESP), which will deliver a package of measures to help families on middle and modest incomes to permanently cut their energy bills.

1 The phrase UK emissions of greenhouse gases indicates UK emissions before emissions trading.

2 The Kyoto Protocol covers emissions of a basket of greenhouse gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. The base year for emissions of the first three gases is 1990 and 1995 for emissions of the fluorinated compounds.

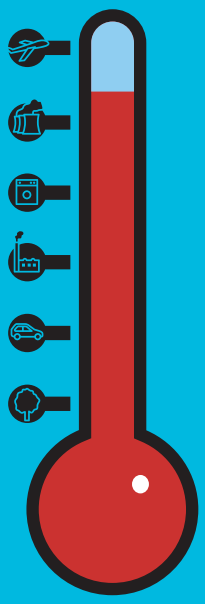
3 www.defra.gov.uk/environment/climatechange/uk/progress/pdf/4thnationalcommunication.pdf

- The Carbon Emissions Reduction Target (CERT), which is part of HESP, was introduced in 2008 and is the principal driver of energy efficiency improvements in existing homes in Great Britain. CERT is an obligation on energy suppliers to achieve targets for promoting carbon emissions reductions in the household sector. It replaced the earlier Energy Efficiency Commitments (EEC).
- An announcement by the Government in 2007 that all new homes in England were to be zero carbon by 2016. In 2008, it announced an ambition for all new non-domestic buildings to be zero carbon from 2019, and that all new public buildings should achieve zero carbon status from 2018. This announcement expanded on the ambition that all new schools and colleges should be zero carbon from 2016.
- In April 2009, the Government announced that all new coal-fired power stations would be required to demonstrate carbon capture and storage technology.
- Since the Renewables Obligation was introduced in 2002, renewable electricity generation has increased from less than 2 per cent in 2001 to 4.9 per cent in 2007. Banding for the RO, introduced in the Energy Act 2008, will target support to encourage a wider variety of renewable technologies.
- In July 2008, the Government's Adapting to Climate Change (ACC) Programme launched an adaptation website and published *Adapting to Climate Change in England: A Framework For Action*.
- The UK is working internationally on adaptation through the UNFCCC and bilateral agreements.
- The design of the multi-donor World Bank-administered Climate Investment Funds (CIFs) in which the UK played a pivotal role. The UK supported the World Bank and worked with other donors to design and establish the Funds.
- The UK considerably scaled up its International Development Association (IDA) contribution last year (£2.134 billion against a contribution of £1.430 billion in the previous replenishment round) partly in recognition of the need to respond to the challenges of climate change.
- *Living With Environmental Change* was launched in 2007 as major new £1billion 10-year interdisciplinary research and policy partnership programme
- The Energy Technologies Institute (ETI) was formally established in December 2007 as a novel partnership, involving government and industry, together contributing funding of up to £1 billion over ten years.
- The ACT ON CO_2 campaign, launched in 2007 (building on previous Government initiatives) to help encourage sustained behaviour change to reduce individual CO_2 emissions. Independent research shows that 73 per cent of people say they had taken action to reduce their CO_2 emissions or were planning to as a result of the campaign – an increase of 23 percentage points since the summer 2007. In 2009/2010, the campaign will build on the successes to date by building literacy around the reality of climate change and scientific consensus around the causes, and encouraging behavioural change.

On 22 April 2009, the Government announced the level of the UK's first three carbon budgets setting legally binding limits on UK greenhouse gas emissions covering the years 2008-12, 2013-17 and 2018-22 respectively. In summer 2009, the Government intends to publish an energy and climate change strategy that will outline a low-carbon future for the UK that is prosperous and energy-secure. It will also set out the policies and proposals for meeting these ambitious carbon budgets, on a pathway to achieving the UK's legally-binding target to reduced greenhouse gas emissions to at least 80 per cent below 1990 levels by 2050.

1

National Circumstances



National Circumstances

Key developments

- In 2007, UK total greenhouse gas emissions were more than 18 per cent below the base year level, compared with the 12.5 per cent reduction required to meet the UK's Kyoto commitment.
- Central England Temperature (CET) has risen by about a degree Celsius since 1980, with 2006 being the warmest year on record. The UK has experienced 8 of the 10 warmest years on records since 1990, and by 2040 UK temperatures are set to rise by up to one degree Celsius depending upon the region.
- The UK population in 2007 was 61 million with nearly 85 per cent of the population being resident in England. The UK population is predicted to rise to over 70 million by 2030.
- The UK covers over 24 million hectares. Around three-quarters of this is under agricultural use. The remaining quarter is made up of urban (14 per cent), forest and woodland (12 per cent) and inland water (1 per cent).
- The total area of woodland in the UK is currently 2.8 million hectares. Of this total, 47 per cent is in Scotland, 40 per cent in England, 10 per cent in Wales and 3 per cent in Northern Ireland.
- Following the succession of shocks that hit the world's economies in 2007 and 2008, the UK, like many advanced economies, has moved into recession. As macroeconomic policy stimulus builds and credit conditions ease, the economy is forecast to pick up progressively through 2010 and 2011.
- The growth in new gas fired electricity generation has slowed and falling nuclear generation is being replaced largely by coal leading to increased carbon emissions per unit of electricity.
- In 2007, most of the UK's energy supply was from natural gas (40 per cent). Renewable energy sources currently used in the UK are largely hydropower, wind, biomass and landfill gas and account for 1.8 per cent of energy supply. Under the new EU Renewable Energy Directive there is a target for 15 per cent of the UK's energy consumption to be from renewable sources by 2020.
- The UK's long term strategy to reduce transport emissions includes the Renewable Transport Fuels Obligation, which with current changes to legislation is expected to require 5 per cent of transport fuel sold in the UK to come from renewable sources by 2013-14.
- In 2008, the total livestock in the UK was around 215 million (this includes sheep, cattle, pigs, goats, farmed deer, poultry and horses on holdings)

Government profile

1.1 The United Kingdom (UK) consists of England, Scotland, Wales and Northern Ireland. The Devolved Administrations consisting of the Scottish Government, the Welsh Assembly Government and the Northern Ireland Executive were established in 1999. While the UK Government has overall responsibility for ensuring that a programme is put in place to deliver the UK's Kyoto target and its recently published domestic carbon budgets[4], all the administrations will play a part in meeting these targets. The approach taken by each administration will differ, drawing on the range of policies at their disposal.

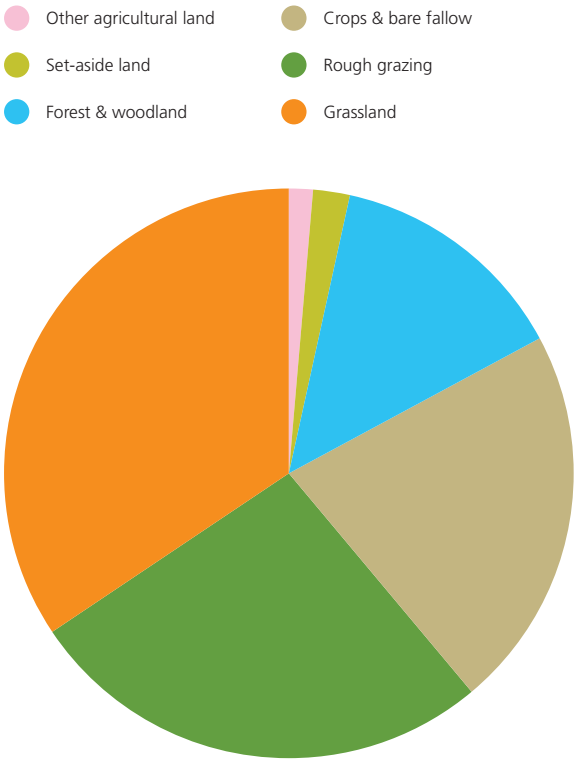
Within the UK Government, the Department of Energy and Climate Change (DECC) which was created in a machinery of Government change in October 2008 is now responsible for domestic and international mitigation and international adaptation policy. The Department for Environment, Food and Rural Affairs (Defra) has policy responsibility for domestic adaptation. Fiscal matters are the responsibility of Her Majesty's Treasury (HMT) and many of the policies are the responsibility of other government departments including Defra, the Department for Business, Enterprise and Regulatory Reform (BERR), the Department for Transport (DfT), the Department of Communities and Local Government (CLG) and the Department for International Development (DfID). The Scottish Government's Climate Change and Water Industry Directorate leads on mitigation and adaptation policy in Scotland. Local government implements policies through relevant responsibilities at the local level, e.g. as planning and waste authorities, and as housing and local transport providers.

4 www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/carbon_budgets/carbon_budgets.aspx

Geographic Profile

1.2 Figure 1.1 shows recent agricultural and forestry land-use data for the UK in 2007.

Figure 1.1 Agricultural and Forestry land use in the UK 2007[5]



Land use refers to the main activity taking place on an area of land. Around three-quarters of the total UK land area is used for agriculture.

Between 1996 and 2007 the area under crops and rough grazing land fell by 5 and 7 per cent respectively and the amount of set aside land decreased by 14 per cent. In the same period grassland and the area covered by forest and woodland increased by 6 and 4 per cent respectively.

Climate Profile

1.3 The UK's climate is maritime: moist and generally cool, with variable temperature and a moderate annual range. Average annual precipitation ranges from less than one metre to more than three metres. Space heating is required in buildings throughout the winter months and the use of air conditioning in the summer months is increasing.

1.3.1 UK Climate trends[6]

- Central England Temperature (CET) has risen by about a degree Celsius since 1980. Eight of the ten warmest years recorded have been since 1990 with 2006 being the warmest year on record. It is likely that there has been a significant influence from human activity on the recent warming of CET. Average annual temperature for all regions of the UK has risen by between 0.4 and 0.9°C since 1914.
- Severe windstorms around the UK have become more frequent in the past few decades, although not above the frequency in the 1920s.
- Sea level around the UK rose by about 1mm/yr in the 20th century, corrected for land movement. The rate for the 1990s and 2000s has been higher, up to 3mm/yr, which is closer to the global average for these years. Sea-surface temperatures around the UK coast have risen by about 0.7 °C over the past three decades.
- Annual mean precipitation over England and Wales has not changed significantly since records began in 1766. Scotland is on average 20 per cent wetter then it was in 1961. Seasonal rainfall is highly variable, but appears to have decreased in summer and increased in winter.
- All regions of the UK have experienced more winter rainfall from heavy precipitation events. In summer, all regions except North East England and Northern Scotland show decreases in rainfall.

1.3.2 UK Climate Projections[7]

1.3.2.1 *The UK will continue to get warmer.*

- By 2040, average annual temperature for the UK is expected to rise by between 0.5 and 1°C, depending on region. By 2100, average annual temperature for the UK could rise by between 1 and 5°C, depending on region and emissions scenario.
- Warming is expected to be greater in the south and east than in the north and west.

5 Land use, The Environment in your Pocket 2008. http://www.defra.gov.uk/environment/statistics/eiyp/pdf/eiyp2008.pdf

6 The climate of the United Kingdom and recent trends, UK Climate Impacts Programme (UKCIP), Jan 2009 http://www.ukcip.org.uk/images/stories/08_pdfs/Trends_section1%262.pdf

7 These are headline messages from the most current climate modelling scenarios courtesy of UKCIP02 (with revisions in 2009) http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=237&Itemid=331. UKCIP09 due imminently from http://www.ukcip.org.uk/

1.3.2.2 *Summers will continue to get hotter and drier*

- By 2040, average summer temperature for the UK is expected to rise by between 0.5 and 2°C, depending on region. By 2100, average summer temperature for the UK is expected to rise by between 1 and 6°C, depending on region and emissions scenario.
- The number of days when buildings require cooling is expected to increase.

1.3.2.3 *Winters will continue to get milder and wetter*

- The number of days when buildings require heating is expected to decrease.
- By 2040, average winter temperature for the UK is expected to rise by between 0.5 and 1°C, depending on region. By 2100, average winter temperature for the UK could rise by between 1 and 4°C depending on region and emissions scenario
- By 2100, there is expected to be up to 30 per cent more precipitation in the winter months, depending on region and emissions scenario.

1.3.2.4 *Some weather extremes will become more common, others less common*

- Heavier winter precipitation is expected to become more frequent.

1.3.2.5 *Sea level will continue to rise*

- The temperature of UK coastal waters is expected to increase, though not as rapidly as air temperatures over land.

Population Profile

1.4 Table 1.1 shows the estimated population and population density for the UK in 2007 and the projected population in 2031.

In mid-2007 the population of the UK was 61.0 million; 83.8 per cent of whom lived in England. The UK population is expected to reach 71.1million by 2031; an average annual rate of growth of 0.6 per cent from 2006. Longer-term projections suggest that this population growth will continue rising strongly beyond 2031, and still be rising at the end of the projection period (85.2 million in 2081)[9].

The population density is around three times higher in England than in Wales and Northern Ireland, and is nearly six times higher than in Scotland. This has implications for transport demand and the development of energy supply infrastructure.

Economic Profile and Industry

1.5 The UK is currently the world's sixth largest economy ($2.7 trillion in 2008), its eighth largest exporter of goods ($438 billion in 2007) and second largest exporter of services ($273 billion in 2007).

Among major advanced economies, the UK is an open economy, with export equivalent to around 29 per cent of GDP, the stock of inward foreign direct investment 47 per cent of GDP and the stock of outward foreign direct investment 73 per cent of GDP. The EU27 is destination for over 50 per cent of UK exports of goods and services. The next largest export markets are the US, at 17 per cent, and Asia at 15 per cent.

Table 1.1 Population in the UK in mid 2007 [8].

Country	Population (000's)	2007 population density (persons per km^2)	Predicted 2031 population (000's)
England	51,092	392	60,432
Wales	2,980	144	3,296
Scotland	5,144	66	5,374
Northern Ireland	1,759	130	1,999
UK total	60,975	251	71,100

Source: Office for National Statistics

8 Office for National Statistics, Mid Year Population Estimates, mid 2007, http://www.statistics.gov.uk/cci/nugget.asp?id=6 6

9 National Population Projections for the United Kingdom, Great Britain and Constituent Countries, Office for National Statistics, http://www.statistics.gov.uk/downloads/theme_population/pp2no26.pdf

The UK is a services oriented economy, with total services contributing 76 per cent of UK gross value added (GVA) in 2007, compared with manufacturing (12½ per cent), North Sea oil and gas (2½ per cent), utilities (1½ per cent) and construction (6½ per cent). Within the services sector, the sources of UK output are diverse, with financial services accounting for 7½ per cent of GVA, business services 24 per cent, and public administration, education, health and other social services each between 5 and 7 per cent.

The UK economy grew at an annual average rate of 3 per cent between 1997 and 2007, with GDP per capita rising 27 per cent over that period. Following the succession of shocks that hit the world's economies in 2007 and 2008, the UK, like many advanced economies, has moved into recession. GDP fell by 4.1 per cent on a year earlier in the first quarter of 2009. As the economy has declined, the labour market has weakened, with the working-age employment rate falling from around 75 per cent to around 74 per cent over the past year.

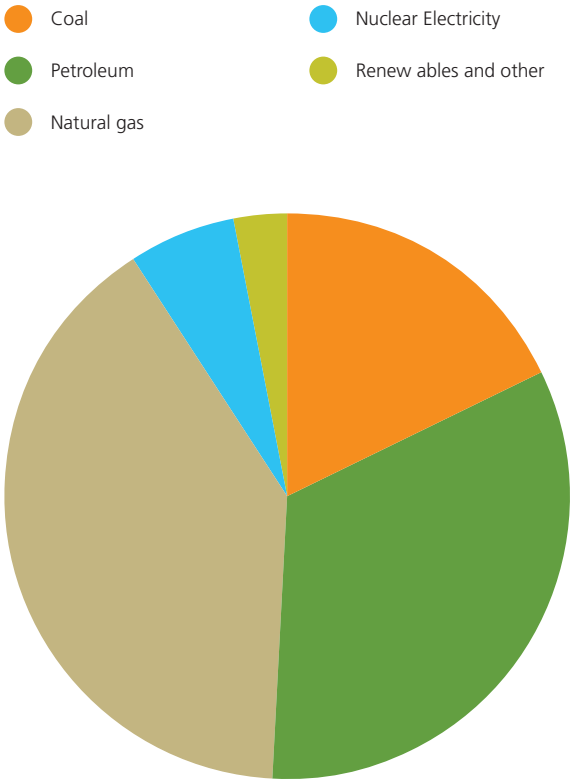
The Budget 2009 forecast is for the UK economy to contract by 3½ per cent in 2009. As macroeconomic policy stimulus builds and credit conditions ease, the economy is forecast to pick up progressively through 2010 and 2011.

Energy

1.6 The UK's energy supply incorporates coal, petroleum, natural gas, nuclear power and renewable energy. Over the next two decades much of the nuclear and coal powered electricity generation capacity of the UK is scheduled for closure. The majority of new build in the 1990s was in gas-fired generation. This slowed after 2000, with no further significant increase in capacity, but in the medium term new build is expected to be in gas.

The UK is currently one of the main global producers of oil and gas and is expected to remain an important producer for many years; however production of oil and gas is gradually declining and the UK became a net importer of gas on an annual basis in 2004 and became a net importer of oil in 2005. The UK remains a net exporter of petroleum products.

Figure 1.2 UK Energy Supply in 2007[10]



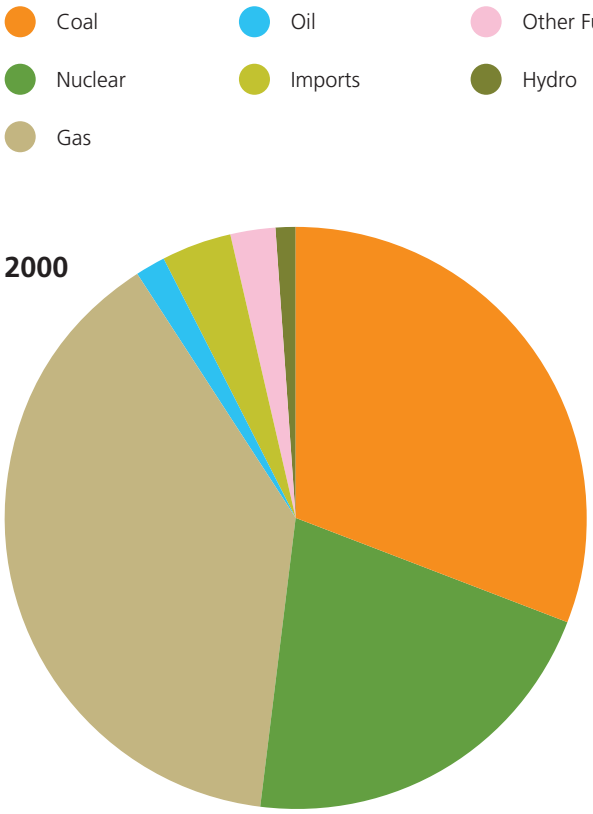
Source: DECC

In 2007, most of the UK's energy supply was from natural gas (40 per cent), followed by petroleum (33 per cent), coal (17 per cent), nuclear electricity (6 per cent), renewable energy sources (1.8 per cent) and others (1.2 per cent). The renewable energy sources currently used in the UK are largely hydropower, wind, biomass and landfill gas. The Government's current policy on renewable and other energy includes a target to generate 10 per cent of electricity from renewable sources by 2010. Under the new EU Renewable Energy Directive there is a target for 15 per cent of the UK's energy consumption to be from renewable sources by 2020. Promotion of renewable energy in Scotland is devolved to the Scottish Government, which has introduced a target to generate 50 per cent of Scotland's electricity demand and 20 per cent of its overall energy demand from renewable sources by 2020.

The shares of both gas and coal in electricity generation and supply were higher in 2007 than in 2000 mainly because of the declining share of nuclear. This has increased the carbon emissions per unit of generation, even though the share of renewables doubled over this period.

[10] DECC, Digest of UK Energy Statistics (DUKES), 2008

Figure 1.3 Share of fuels on electricity supplied basis[11]



Source: DECC

Consumers, businesses and households are all able to choose between competing suppliers of electricity and gas. This exerts a downward pressure on energy prices and the UK's gas and electricity prices for households have generally been lower than other major European countries. Electricity and gas networks are privately owned, but are regulated in Great Britain by the Independent Office for Gas and Electricity Markets (Ofgem) and in Northern Ireland by the Office for Regulation of Electricity and Gas (Ofreg).

Transport

1.7 Transport currently accounts for 21 per cent of the UK's greenhouse gas emissions[12]. This is an increase from 16 per cent in 1990. According to the recent energy projection scenarios carbon dioxide emissions from transport indicate a decrease in emissions of nearly one per cent from 2000 – 2010. These scenarios also predict an increase of less than a per cent in transport emissions by 2025[13]. Car use has increased as disposable income has risen, against a backdrop of little change in the real cost of motoring and rising real costs of public transport fares. Although the average number of trips people make has declined over the last ten years, the distance travelled and the time spent travelling has increased. (The average annual distance travelled by residents in Great Britain rose by 2 per cent between 1995/97 and 2006, but the number of walking trips fell by 15 per cent[14].)

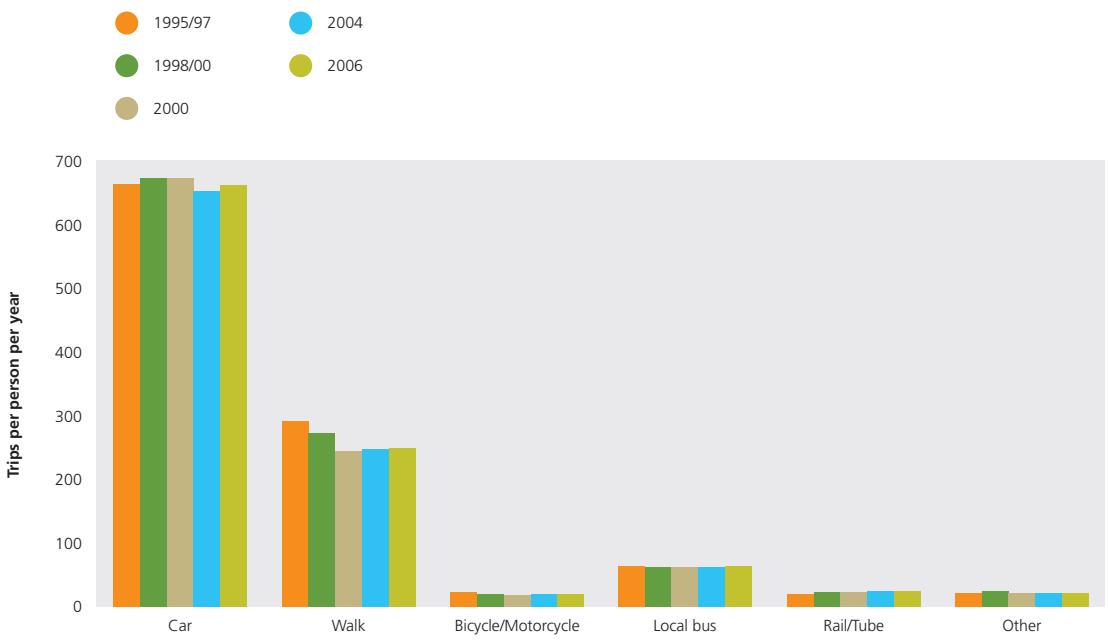
11 DECC, DUKES 2008

12 Emissions by source, and including those resulting from domestic aviation

13 CO_2 projections published in UEP 32

14 Department for Transport, National Travel Survey, 2006

Figure 1.4 Average annual trips made by mode: 1995/97 – 2006, Great Britain



Source: Transport Trends 2008 edition, Department for Transport

Note: 'Other' includes Other private, Non-local bus, Taxi/minicab and other public.

Both Vehicle Excise Duty (VED) and the Company Car Tax System[15] now reward motorists for selecting fuel-efficient cars by being linked to the vehicles' carbon emissions. Reforms to VED mean that for cars with the very lowest carbon emissions the rate is reduced to zero. Motorists can save thousands of pounds on their company car tax bill if they choose clean, low-carbon vehicles.

Due to the increased manufacture of more fuel efficient cars, new cars sold in the UK are on average some 10 per cent more fuel-efficient than they were a decade or so ago.

The UK's long term strategy to reduce transport emissions includes the Renewable Transport Fuels Obligation, which with current changes to legislation is expected to require 5 per cent of transport fuel sold in the UK to come from renewable sources by 2013-14[16].

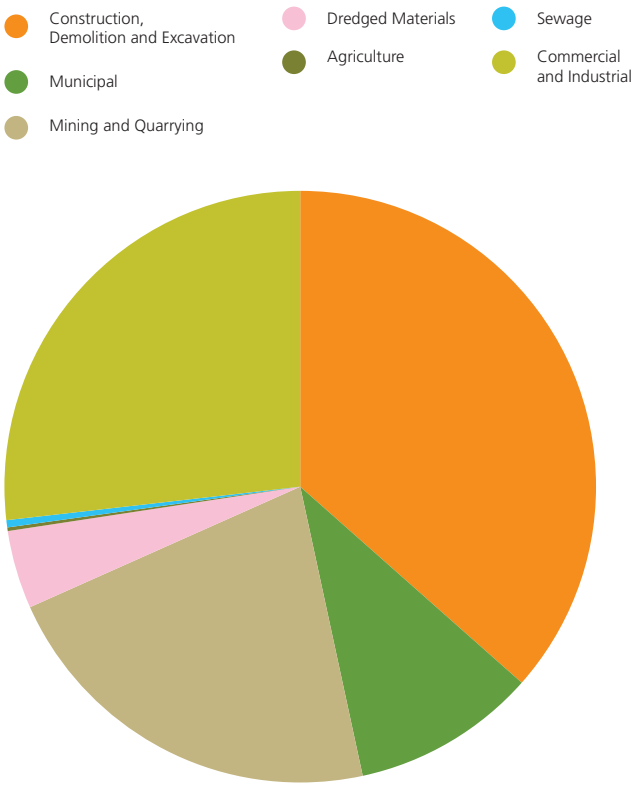
Waste

1.8 In 2006, 282 million tonnes of waste were produced in England, of which most (36 per cent) came from the Construction, Demolition and excavation industries. Approximately 10 per cent of the waste produced in 2006 came from municipal sources.

15 Vehicle Certification Agency (VCA) website – www.vca.gov.uk/fcb/index.asp

16 Dft: Renewable Transport Fuels Obligation http://www.dft.gov.uk/pgr/roads/environment/rtfo/

Figure 1.5 England Waste arisings 2006[17]



Source: Defra, Environment Agency, Department for Communities and Local Government, Office for National Statistics, Better Regulation Executive, Centre for Environment, Fisheries and Aquaculture Science, Water UK

Waste produced in England is currently disposed of at landfill sites, with the remainder treated by other means, including waste-to-energy, recycling and composting. In 2007/2008 households in England recycled nearly 34 per cent of their waste[18].

Consistent with the EU Landfill Directive, the Government and the devolved administrations have published waste strategies aiming to reduce the quantity of waste produced and to increasingly recover value from it. The strategies also set targets for reducing the amount of waste sent to landfill and to increase the amount of recycling or composting. These targets will further reduce the level of methane emissions from the waste sector in the UK.

Building Stock and Urban Structure

1.9 Despite the UK's long history of urbanisation, some areas are sparsely populated, including the Highlands of Scotland, and parts of Wales and northern England.

In 2007 there were around 27 million dwellings in the UK, of which 22 million were in England. Most common are semi-detached houses (32 per cent), followed by terraced houses (28 per cent), detached houses (23 per cent), and purpose built flats (12 per cent). The number of households in England is projected to increase by 23 per cent between 2004 and 2026. This reflects, amongst other things, the increasing number of people living on their own. This trend shows some large regional variations, with increases of about 29 per cent in the south west but only 12 per cent in the north east. In Scotland the number of households is projected to increase by around 19 per cent between 2006 and 2031.

Agriculture

1.10 The total area of agricultural land in the UK at June 2008 was around 18.7 million hectares. About 6.1 million hectares of this was arable (including uncropped land), of which around half was under cereal production. 10.4 million hectares is currently under grass, (permanent and sole right rough grazing). The remainder was other land (roads, paths, buildings, etc.) or farm woodland.

There are significant differences within the various countries of the UK. For example, some 84 per cent of the agricultural land area in Scotland has been designated as Less Favoured Area as compared with 70 per cent in Northern Ireland, 75 per cent in Wales, and 17 per cent in England.

In June 2008, the total livestock in the UK was around 215 million (this includes sheep, cattle, pigs, goats, farmed deer, poultry and horses on holdings) which is a decrease from 2000. Of this there were 10.1 million cattle, 33.1 million sheep, 4.7 million pigs and 154.2 million fowl in the UK[19].

During 2000, the Common Agricultural Policy was reformed. This involved the creation of an integrated EU Rural Development Policy, which provided the basis for a shift of emphasis from production support towards environmental and rural development.

17 Defra, Environment Agency, CLG, Office for National Statistics, Better Regulation Executive, Centre for Environment, Fisheries and Aquaculture Science, Water UK. Data are provisional estimates. Due to revisions in current data collection Defra are unable to produce total Waste Arisings statistics for the UK at present.

18 Defra: http://www.defra.gov.uk/environment/statistics/wastats/bulletin07.htm

19 June 2008 Survey of Agriculture and Horticulture.

Forestry

1.11 The total area of woodland in the UK is currently 2.8 million hectares. Of this total, 47 per cent is in Scotland, 40 per cent in England, 10 per cent in Wales and 3 per cent in Northern Ireland.

Around 1.6 million hectares of the total UK woodland is made up of conifers, the remainder being broadleaved species. There is a shift towards broadleaves which accounted for the majority (89 per cent) of new planting in 2007/08.

In 2007, around 9.5 million green tonnes[20] of timber was harvested from UK forests (9.1 million tonnes softwood, 0.4 million tonnes hardwood). Softwood availability is projected to increase to 12 million green tonnes by 2017-2021 as a number of large plantations from the 1960s and 1970s reach maturity[21]. Efforts are being made to increase hardwood production, to contribute to targets for wood fuel by bringing undermanaged woodlands back into management.

Table 1.2 Woodland activity 2007- 08[22]

Country	Area (kha) of woodland	Area (kha) of new planting	Area (kha) of restocking	Harvested timber (millions of green tonnes)
England	1127	2.6	3.5	2.1
Wales	285	0.2	2.3	1.0
Scotland	1342	4.2	12.6	5.9
Northern Ireland	87	0.6	0.5	0.4
UK total	2841	7.5	18.9	9.5

Source: Forestry Commission

The UK Forestry Standard (2004) provides criteria and standards for the sustainable management of UK forests and woodlands. This is used by the Forestry Commission for Great Britain and the Forestry Service for Northern Ireland, and its implementation is also required in those areas of private forestry receiving grants.

In the UK, 45 per cent of the total woodland area (all state forests and 22 per cent of other woodland) has now been certified under the UK Woodland Assurance Standard. This standard allows the certified forests to be recognised by consumers as a sustainable resource.

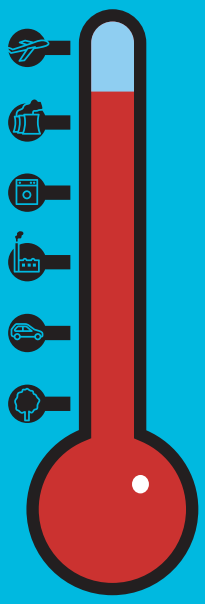
20 Green tonnes are used by the Forestry Commission to describe the weight measurement of timber fresh felled before any natural or artificial drying has occurred.

21 www.forestry.gov.uk/statistics

22 www.forestry.gov.uk/statistics

2

Greenhouse Gas Inventory



Greenhouse Gas Inventory

Key developments

- The UK's greenhouse gas emissions were 18.4 per cent below Kyoto Protocol base-year[23] levels in 2007. UK emissions are therefore lower than the Kyoto reduction commitment of -12.5 per cent agreed for the first commitment period.
- Between 1990 and 2007 carbon dioxide emissions including LULUCF fell by 8.3 per cent; methane emissions fell by 53.1 per cent; and nitrous oxide emissions fell by 46.9 per cent.
- Between 1995 and 2007, hydrofluorocarbon emissions fell by 38.3 per cent; perfluorocarbon emissions fell by 54.2 per cent; and sulphur hexafluoride emissions fell by 36.0 per cent.
- The reduction in the basket of six greenhouse gas emissions since 1990 has been mainly 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-CO_2 greenhouse gases, most notably the increase in landfill methane capture and oxidation.

Introduction

2.1 This chapter provides information on the national system for the UK greenhouse gas inventory, taken from the UK's greenhouse gas inventory submitted to the UNFCCC in April 2009[24]. It shows trends in UK greenhouse gas emissions between 1990 and 2007, disaggregating overall emissions by gas, and by source and end-use sector. The by-source basis reports emissions from the energy supply industry separately and the end-user basis reallocates these emissions to the sectors that make use of the energy supplied.

The UK's Kyoto Protocol target is to reduce emissions of the basket of six greenhouse gases by 12.5 per cent compared to base-year levels. This was agreed by the EU in 1998 and represents the UK's share of the agreement under the Kyoto Protocol by the fifteen States which were members of the EU in 1997 to reduce emissions collectively by 8 per cent relative to base year levels during the first commitment period. Under the Climate Change Act 2008, the UK now also has a carbon reduction target for 2050, and it is the duty of the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least 80 per cent lower than the 1990 baseline[25]. This more ambitious, longer-term goal shows the UK's commitment to making its contribution to the long term global emissions reduction needed to stabilise atmospheric concentrations of greenhouse gases.

The UK's base year for assessing emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) is 1990. In line with most other EU Member States, and in accordance with Article 3.8 of the Kyoto Protocol, the UK has chosen, for the purposes of accounting under the Kyoto Protocol, to use 1995 as the base year for emissions of the fluorinated gases: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

Land use, land-use change and forestry (LULUCF) emissions and removals are reported in the UK's greenhouse gas inventory in accordance with the rules for reporting this sector under the UNFCCC. The UNFCCC reporting basis includes an estimate of all anthropogenic sources minus sinks from the LULUCF sector. Common Reporting Format Tables used for reporting to the UNFCCC are included at Annex A. It is on this basis that progress against the carbon budgets and targets under the UK Climate Change Act 2008 will be assessed. A narrower definition of LULUCF emissions and removals is used to assess progress against the Kyoto target which includes only mandatory activities under Article 3.3 of the Kyoto Protocol, and forest management, which the UK has chosen as an activity under Article 3.4 of the Kyoto Protocol. The UK decided not to account for cropland or grazing land management or revegetation which are other choices under Article 3.4 because of the additional uncertainties associated with the detailed monitoring of these activities required under the Protocol. A small allowance related to deforestation emissions in 1990 is included in the base year estimate, as required by Article 3.7 of the Kyoto Protocol and subsequent decisions of the COP (Conference of the Parties).

23 The Fixed Base Year is taken from the UK's Assigned Amount report. This report was submitted in 2006, based on emissions reported in the 1990-2004 Greenhouse Gas Inventory, and was subject to official review in 2007. This base year is now fixed and is the value that the UK will be assessed against for its Kyoto Protocol target. The 18.4 per cent fall includes afforestation, reforestation and deforestation under Art 3.3 of the KP and forest management which the UK has elected under Art 3.4

24 UK Greenhouse Gas Inventory, 1990–2007, Annual report for submission under the UN Framework Convention on Climate Change, April 2009.

25 http://www.opsi.gov.uk/acts/acts2008/ukpga_20080027_en_2#pt1

The geographical coverage of the inventory for assessing progress against the UK's carbon budgets and targets under the UK Climate Change Act 2008 is the UK alone. The coverage for assessing progress on the 12.5 per cent reduction in emissions below base year levels for the first commitment period under the Kyoto Protocol also includes emissions from the Crown Dependencies of Jersey, Guernsey and the Isle of Man, and the Overseas Territories that have associated themselves with the UK's instrument of ratification, namely Bermuda, the Cayman Islands, the Falkland Islands and Montserrat. Annex C shows the relationship between these bases.

National system for preparing the UK greenhouse gas inventory

2.2 The UK's greenhouse gas inventory is compiled under contract to DECC by the environmental consultancy AEA Technology (AEA). AEA also compiles the UK's National Atmospheric Emissions Inventory, used for reporting emissions to other international agreements, including the Gothenburg Protocol and the UNECE Convention on Long Range Transboundary Air Pollution. Most of the underlying information is held on common databases and this helps ensure consistency between the inventories.

Emissions from the agricultural sector are provided by North Wyke Research under contract to Defra, and estimates for LULUCF are produced on behalf of DECC by the Centre for Ecology and Hydrology (CEH). Both DECC and Defra also fund research contracts to provide improved emissions estimates for certain sources such as fluorinated gases, landfill methane, and to provide estimates for previously unreported sub-sectors such as methane from abandoned coal mines, included for the first time in the UK's inventory submitted in 2005.

The greenhouse gas inventory is compiled annually according to Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance (IPCC, 2000 and 2003) and with regard to the 2006 Guidelines (IPCC, 2006). Methodological improvements take account of new data sources, updated guidance from IPCC, relevant work by organisations such as CORINAIR (the European inventory system for certain air pollutants) and specific research programmes sponsored by Government Departments including DECC, Defra and DfT together with the Devolved Administrations. All methodological improvements are applied back to 1990 to ensure a consistent time series.

The UK has established a national system for greenhouse gas emissions estimation, reporting and archiving and this system is fully compliant with the requirements of the Kyoto Protocol. DECC has been appointed as the Single National Entity with responsibility for the overall management and strategic development of the UK's greenhouse gas inventory. AEA is the delegated Inventory Agency with responsibility for compilation and reporting of the UK GHG inventory. DECC has established the National Inventory Steering Committee (NISC) which is an inter-departmental committee that ensures cross-Government co-ordination of inventory work. The NISC also performs several inventory management functions such as prioritising future inventory research and improvement, and the review and approval of the national inventory data prior to submission to the EU and the UNFCCC each year. The Committee on Climate Change (CCC), an independent body set up under the Climate Change Act, is represented on the NISC. The CCC provides advice to the UK Government and Devolved Administrations – including in relation to setting carbon budgets – and reports to the UK Parliament and devolved legislatures on the progress made in reducing greenhouse gas emissions.

A detailed description of the UK's national system was provided in the most recent annual inventory report submitted in April 2009 to the UNFCCC and the EU. The annual inventory report provides some of the additional reporting required under Article 7, paragraph 2 of the Kyoto Protocol. Other sources of information required under Article 7, paragraph 2 are summarised in Annex E.

Geographical Coverage

2.3.1 Geographical coverage used for National and International reporting

The UK inventory provides data to assess progress with the UK's commitments under the Kyoto Protocol, the UK's contribution to the EU's targets under the Kyoto Protocol and also progress towards domestic targets to reduce GHG emissions. Geographical coverage for these three purposes differs to some extent, because of the following:

1. The carbon budgets and targets under the UK Climate Change Act 2008 apply only to the UK itself.

2. The Kyoto commitment extends coverage also to emissions from the Crown Dependencies of Jersey, Guernsey and the Isle of Man, and the Overseas Territories that have ratified the FCCC

and Kyoto Protocol (the Cayman Islands, the Falkland Islands, Bermuda, Monserrat and Gibraltar). This is the coverage which is reported to the UNFCCC.

3. The UK's commitments under the EU's Kyoto Protocol target only include the parts of the UK which are also parts of the EU (the UK and Gibraltar, excluding all Crown Dependencies and other Overseas Territories).

Table 2.1 shows the total greenhouse gas emission estimates, presented as million tonnes of carbon dioxide equivalent (Mt CO_2eq)[26] associated with the geographical coverages of the United Kingdom, Crown Dependencies and Overseas Territories. Together these total the overall emissions estimates submitted to the UNFCCC. Combinations of these emission estimates also provide totals which correspond to those reported in UK National Statistics and to the European Union.

Table 2.1 UK Greenhouse gas emissions by geographical coverage, Mt CO_2eq

	1990	1995	2000	2005	2007
United Kingdom	773.9	713.3	673.0	650.6	634.7
Crown Dependencies	1.7	1.9	1.9	1.5	1.6
Overseas Territories (excluding Gibraltar)	1.4	1.5	1.7	1.9	2.0
Gibraltar	0.2	0.2	0.2	0.2	0.2
Total	**777.1**	**716.8**	**676.8**	**654.2**	**638.5**
Emission estimates may differ slightly due to rounding					

2.3.2 Geographical coverage used in this report

There are two geographical coverages used in this report. Figures 2.2-2.7 present emission estimates based on UNFCCC coverage. Tables 2.2a, 2.3a and 2.4 also present emission estimates consistent with this coverage. The second geographical coverage presented is UK only (excluding Crown Dependencies and Overseas Territories). This coverage is needed for the purposes of the Climate Change Act. Tables 2.2b, 2.3b present emission estimates based on this UK coverage. Figure 2.1 shows the trend in emissions reported under the Kyoto Protocol; the geographical coverage is on a UNFCCC basis but the total emissions differ due to different requirements for the reporting of LULUCF.

Greenhouse gas emissions trends

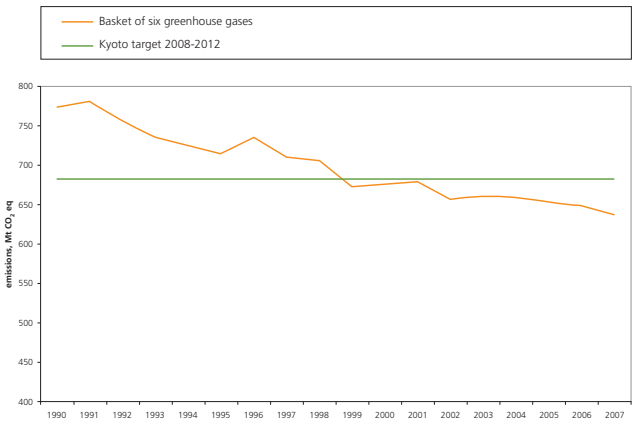
2.4 Figure 2.1 shows the trend in emissions of the basket of six greenhouse gases between 1990 and 2007 along with the emission reduction target relating to the first commitment period under the Kyoto Protocol. As a result of policy action and trends in the UK, annual greenhouse gas emission estimates for the basket of six greenhouse gases covered by the Kyoto Protocol fell by 18.4 per cent between the fixed base year[27] and 2007.

Information on individual gases is contained in sections below and Annex A contains tables summarising the UK's greenhouse gas emissions. More details can be found in the UK's annual greenhouse gas inventory, published in April 2009[24].

[26] Greenhouse gas emissions are expressed throughout this document as million tonnes of carbon dioxide equivalent ($MtCO_2$ eq). Other gases are expressed in terms of carbon dioxide equivalent by multiplying their emissions by their global warming potential (GWP).

[27] The Fixed Base Year is taken from the UK's Assigned Amount report. This report was submitted in 2006, based on emissions reported in the 1990-2004 Greenhouse Gas Inventory, and was subject to official review in 2007. This base year is now fixed and is the value that the UK will be assessed against for its Kyoto Protocol target.

Figure 2.1 UK emissions of greenhouse gases, 1990–2007.



Notes:

1. The geographical coverage for the basket of six greenhouse gases includes UK, Crown Dependencies and Overseas Territories
2. The total emission estimates differ from those reported to the UNFCCC as they include mandatory Article 3.3 LULUCF activities, forest management cap under Article 3.4 and deforestation emissions in the base year. Other LULUCF emissions are excluded, consistent with KP requirements and UK choices under Art 3.4.
3. The Kyoto Protocol target line is calculated from a fixed base-year figure

Greenhouse gas emissions inventory by gas

2.5 Table 2.2a and 2.2b show historical data for CO_2 and the other greenhouse gases. These tables have different geographical coverages for the reported emissions.

Table 2.2a includes the full UNFCCC coverage of the UK, its Crown Dependencies and Overseas Territories.

Table 2.2b shows emissions for the UK only.

The sections that follow summarise the main factors affecting the historical trend by gas and percentages and figures quoted in these sections refer to the full UNFCCC geographical coverage unless otherwise specified.

Table 2.2a UK Greenhouse gas emissions (UNFCCC coverage), Mt CO_2 eq

Gas	1990	1995	2000	2005	2007
Total carbon dioxide	594.2	554.6	552.8	555.1	544.6
Methane	104.5	91.2	69.8	51.1	49.0
Nitrous oxide	64.6	53.7	41.9	36.5	34.3
HFCs	11.4	15.6	10.0	10.2	9.6
PFCs	1.4	0.5	0.5	0.3	0.2
Sulphur hexafluoride	1.0	1.2	1.8	1.1	0.8
Total greenhouse gas emissions by sources minus removals by sinks	777.1	716.8	676.8	654.2	638.5
Total greenhouse gas emissions including only mandatory Article 3.3 LULUCF activities and forest management cap under Article 3.4 LULUCF [28]	773.0	714.1	674.7	652.8	636.6
Change from fixed base year levels (for row above)	-0.9%	-8.4%	-13.5%	-16.3%	-18.4%
Fixed Base Year[29]	779.9				

[28] As shown in the Kyoto basket line in fig 2.1. LULUCF component includes mandatory Article 3.3 LULUCF afforestation plus reforestation minus deforestation since 1990 and the forest management cap of 0.37MtC agreed for the UK under Article 3.4 LULUCF of the Kyoto Protocol. Totals also include emissions from UK Overseas Territories associated with the UK's ratifications of the UNFCCC and Kyoto Protocol.

[29] The Fixed Base Year is taken from the UK's Assigned Amount report. This report was submitted in 2006, based on emissions reported in the 1990-2004 Greenhouse Gas Inventory, and was subject to official review in 2007. This base year is now fixed and is the value that the UK will be assessed against for its Kyoto Protocol target.

Table 2.2b UK Greenhouse gas emissions (UK coverage), Mt CO_2 eq

Gas	1990	1995	2000	2005	2007
Total carbon dioxide [30]	591.5	551.5	549.5	551.8	541.2
Methane	104.0	90.8	69.5	50.9	48.7
Nitrous oxide	64.5	53.6	41.8	36.4	34.2
HFCs	11.4	15.6	9.9	10.1	9.6
PFCs	1.4	0.5	0.5	0.3	0.2
Sulphur hexafluoride	1.0	1.2	1.8	1.1	0.8
Total greenhouse gas emissions by sources minus removals by sinks	773.9	713.3	673.0	650.6	634.7

Percentage changes and emission estimates may differ slightly due to rounding

2.5.1 Carbon dioxide (CO_2)

Carbon dioxide is the main greenhouse gas in the UK. Net CO_2 emissions (all anthropogenic sources minus removals by sinks) in 1990 were estimated to be 594.2 Mt CO_2, or around 76 per cent of the UK's total emissions of greenhouse gases. By 2007 CO_2 emissions had been reduced by 8.3 per cent to 544.6 Mt CO_2, contributing around 85 per cent of UK greenhouse gas emissions in that year.

The main source of CO_2 is from combustion of fossil fuels. Energy efficiency and structural changes in power generation provided the main drivers behind the reduction in emissions between 1990 and 2007. Although electricity consumption increased by 22 per cent between 1990 and 2007, CO_2 emissions from power stations fell by 13 per cent. The reduced carbon intensity was mainly due to switching from coal to gas in electricity generation, but also because of improved performance from nuclear generation and an increased use of renewable energy and combined heat and power.

The CO_2 estimate takes account of changes in carbon stocks in forests and soils produced by CEH, based on land use and soil survey data, and on annual planting data from the Forestry Commission. CEH also uses the inventories of woodlands in Great Britain, which the Forestry Commission has undertaken at 15-20 year intervals since 1924.

2.5.2 Methane

Methane (CH_4) is the second largest share of the UK's greenhouse gas emissions. Emissions in 1990 were 104.5 Mt CO_2 eq, contributing around 13 per cent of the UK's total emissions of greenhouse gases. By 2007 CH_4 emissions had been reduced by 53 per cent to 49 Mt CO_2 eq, contributing around 8 per cent of UK greenhouse gas emissions in that year.

The major sources of CH_4 are from the anaerobic degradation of landfill waste, enteric fermentation and waste management sources in agriculture, leakage of natural gas from the distribution network and emissions due to coal mining. Emissions from all of these main sources of methane in the UK have fallen significantly since 1990. The most notable decrease has arisen from emissions of landfill waste. Changes in landfill gas capture and oxidation have led to an estimated 59 per cent reduction in emissions from this source. New waste policies were introduced in the 1990s to meet the requirements of the EU Landfill Directive as well as previous policy goals. Changes in energy production trends, replacement of the gas distribution infrastructure, utilisation of methane from working and abandoned coal mines and a reduction in livestock numbers have also reduced methane emissions.

2.5.3 Nitrous oxide

Nitrous oxide (N_2O) emissions contributed 64.6 Mt CO_2 eq or about 8 per cent of the UK's total greenhouse gas emissions in 1990. N_2O emissions had been reduced by around 47 per cent to 34.3 Mt CO_2 eq in 2007, contributing around 5 per cent of UK greenhouse gas emissions in that year.

The major sources were agricultural soils and industrial processes, particularly fugitive emissions from adipic acid manufacture. Emissions of N_2O from industrial processes fell from an estimated 24.7 Mt CO_2 eq in 1990 to 2.8 Mt CO_2 eq in 2007, largely from the introduction of abatement technology in adipic acid manufacture in 1998.

[30] As shown in the CO_2 line in fig 2.1. Includes total emissions by sources minus total removals by sinks.

N_2O emissions from road transport increased from 1.2 Mt CO_2 eq in 1990 to 1.3 Mt CO_2 eq in 2007, peaking at 2.4 Mt CO_2 eq in 1995. The initial rise in emissions was because of the rise in the number of petrol-fuelled motor vehicles fitted with three-way catalytic converters. However, improvements in catalyst formulation and engine management systems has resulted in more efficiently functioning catalysts in later years and hence emissions of N_2O from road transport are now in decline.

2.5.4 Fluorinated gases (HFCs, PFCs and SF_6)

Emissions of the fluorinated or industrial gases are small in absolute terms but their significance is increased by high Global Warming Potential (GWP) values. For the purpose of accounting under the Kyoto Protocol, the UK has chosen to use 1995 as the base year for emissions of HFCs, PFCs and SF_6. This is in line with the approach adopted by most other EU Member States. In 1995 emissions of all fluorinated gases from the UK amounted to about 17.3 Mt CO_2 eq or 2.4 per cent of UK total greenhouse gas emissions; by 2007 emissions had fallen by 38.6 per cent to 10.6 Mt CO_2 eq, contributing 1.7 per cent of UK greenhouse gas emissions in that year.

Emissions of HFCs fell by 38.3 per cent, from 15.6 Mt CO_2 eq in 1995 to 9.6 Mt CO_2 eq in 2007, mainly due to the introduction of thermal oxidiser pollution abatement equipment at the two UK plants where HCFC-22 is manufactured. Other sources of HFC emissions include refrigeration/air-conditioning, foam blowing, general aerosols, metered dose inhalers, solvent cleaning and fire-fighting. HFCs were virtually unknown in many of these sectors before 1990 but since then, consumption has risen in response to the phase out of chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs) under the Montreal Protocol.

Emissions of PFCs fell by 54.2 per cent between 1995 and 2007. This is mainly due to the introduction of improved technology in the aluminium production sector that has led to lower process emissions.

SF_6 is used in four main markets: electrical insulation, magnesium smelting, electronics and training shoes. Total use of SF_6 from these end use markets fell by 36 per cent between 1995 and 2007. Emissions from the magnesium sector have reduced due to the partial replacement of SF_6 with HFC134a at the main manufacturing site.

Sectoral emissions – by source

2.6 Tables 2.3a and 2.3b show the contribution to UK greenhouse gas emissions of different sectors by emissions source. Table 2.3a shows total emission estimates from the UK, Crown Dependencies and Overseas Territories, whilst Table 2.3b shows emission estimates from the UK only. By-source reporting shows emissions from the energy supply industry separately to the other sectors.

Table 2.3a Greenhouse gas emissions by source (UNFCCC coverage), Mt CO_2 eq

Sector	1990	1995	2000	2005	2007
Energy supply	274.7	236.3	220.3	229.0	226.1
Business	111.1	107.1	111.6	101.9	97.2
Industrial processes	54.3	44.7	24.4	17.7	17.7
Transport	125.2	125.8	129.4	134.3	137.1
Residential	81.7	82.8	90.3	88.5	81.4
Public	13.6	13.2	11.7	11.0	9.7
Agriculture	60.7	58.6	55.4	50.8	48.1
LULUCF (net)	3.0	1.3	-0.3	-1.9	-1.7
Waste management	52.9	47.0	34.1	22.9	22.9
Total GHG emissions by sources minus removals by sinks	777.1	716.8	676.8	654.2	638.5

Table 2.3b Greenhouse gas emissions by source (UK coverage), Mt CO_2 eq

Sector	1990	1995	2000	2005	2007
Energy supply	273.5	234.9	219.0	227.9	224.8
Business	110.8	106.7	111.0	101.3	96.5
Industrial processes	54.3	44.7	24.4	17.7	17.7
Transport	124.4	125.0	128.5	133.3	136.1
Residential	81.3	82.3	89.8	88.0	80.9
Public	13.6	13.2	11.7	11.0	9.7
Agriculture	60.4	58.3	55.1	50.6	47.8
LULUCF (net)	3.0	1.3	-0.3	-1.9	-1.8
Waste management	52.7	46.8	34.0	22.8	22.8
Total GHG emissions by sources minus removals by sinks	773.9	713.3	673.0	650.6	634.7
Note: the percentage changes and emission estimates may differ slightly due to rounding					

Figures 2.2 to 2.7 below show the contribution of each sector to the emissions of each in the basket of six greenhouse gases between 1990 and 2007. These are based on full UNFCCC coverage. The base year emissions estimates are generated from the 2007 GHG inventory.

Figure 2.2 Carbon Dioxide Emissions by Source, 1990-2007, Mt CO_2 eq

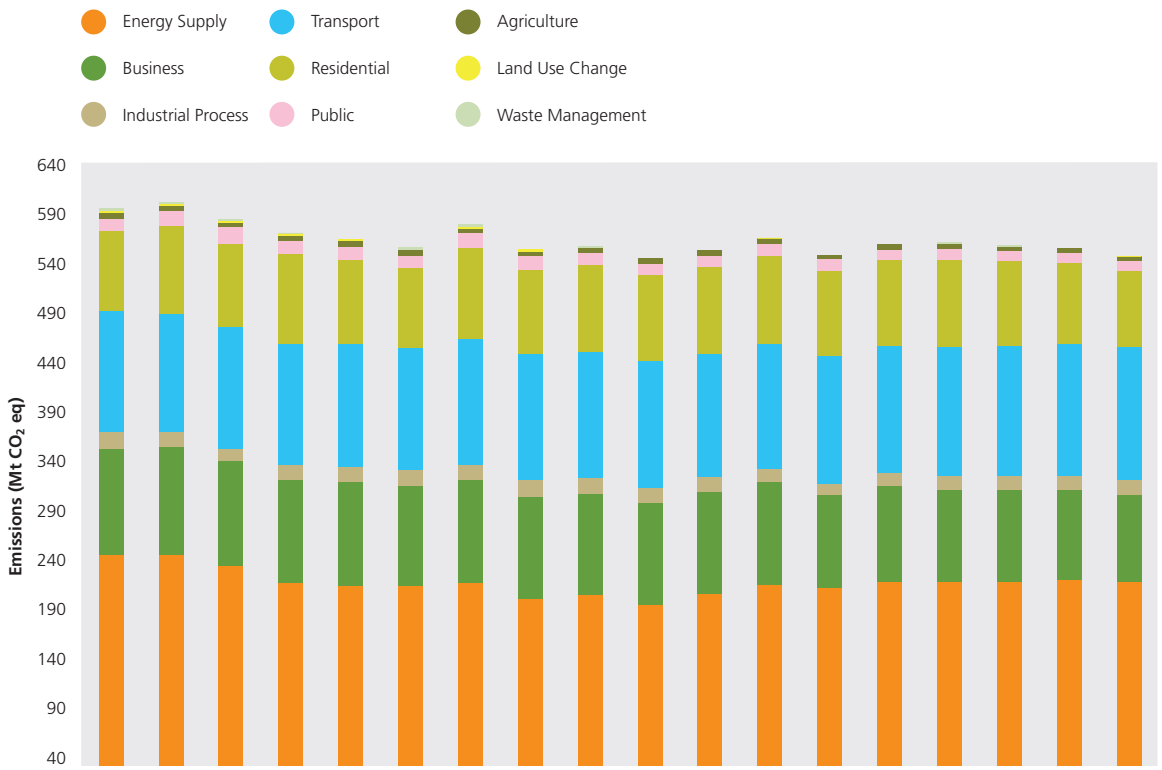


Figure 2.3 Methane Emissions by Source,1990-2007, Mt CO_2 eq

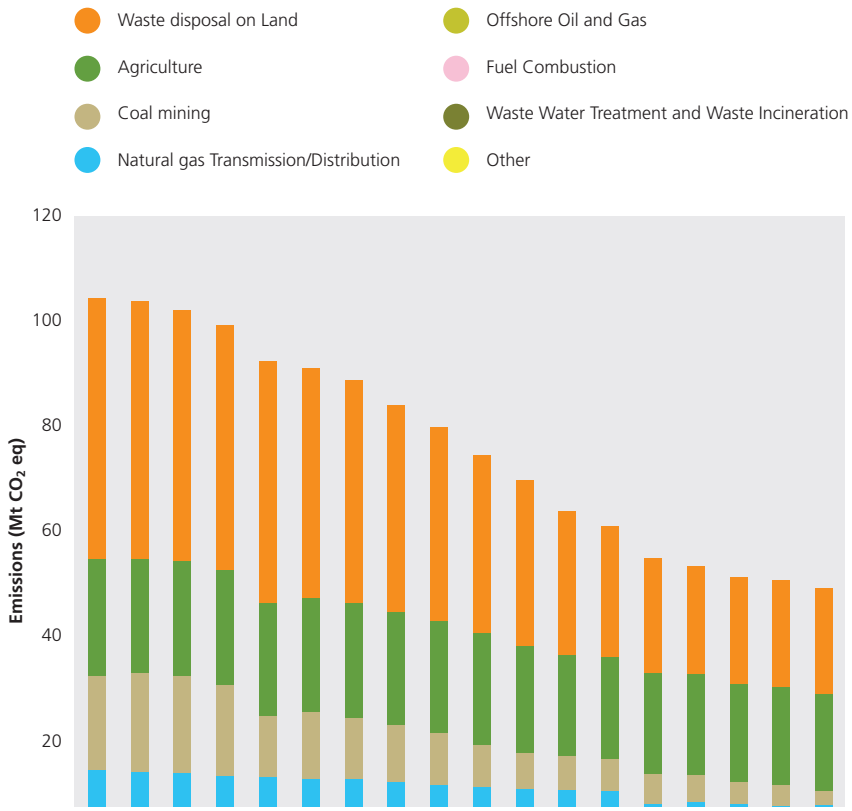


Figure 2.4 Nitrous Oxide Emissions by Source, 1990-2007, Mt CO_2 eq

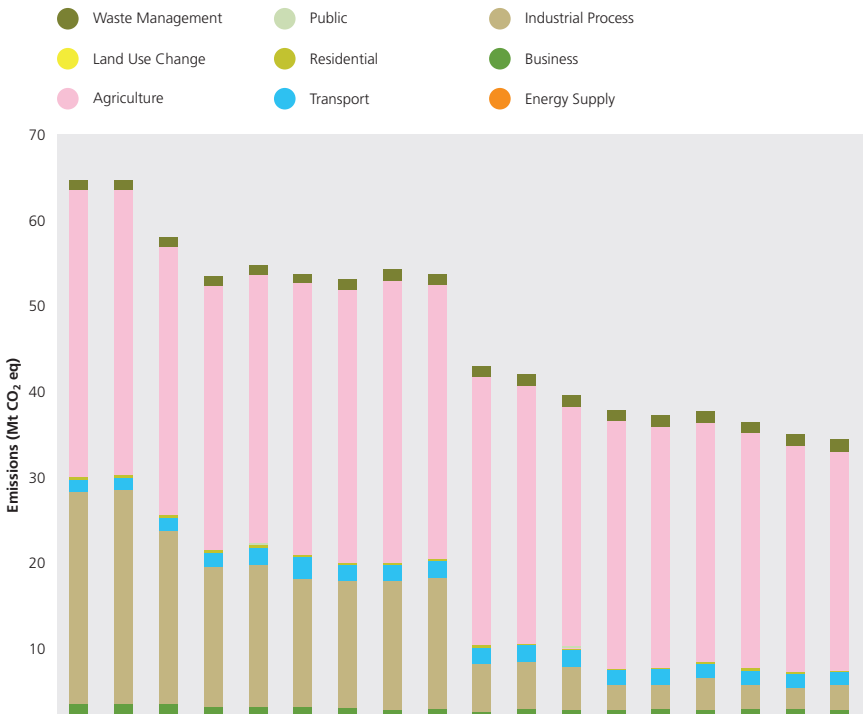


Figure 2.5 HFC Emissions by Source, 1990-2007, Mt CO_2 eq

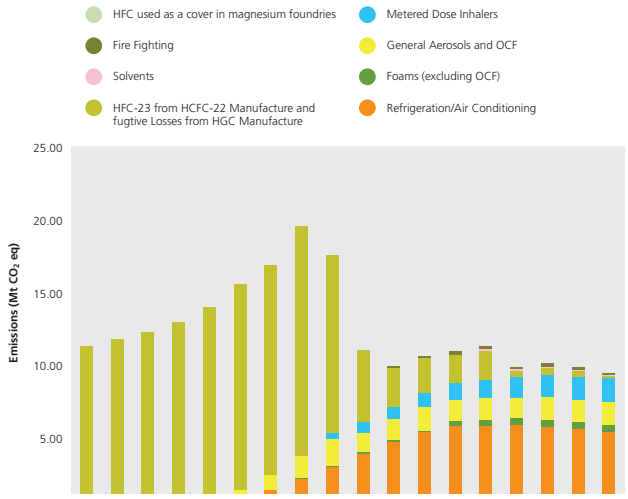


Figure 2.6 PFC Emissions by Source, 1990-2007, Mt CO_2 eq

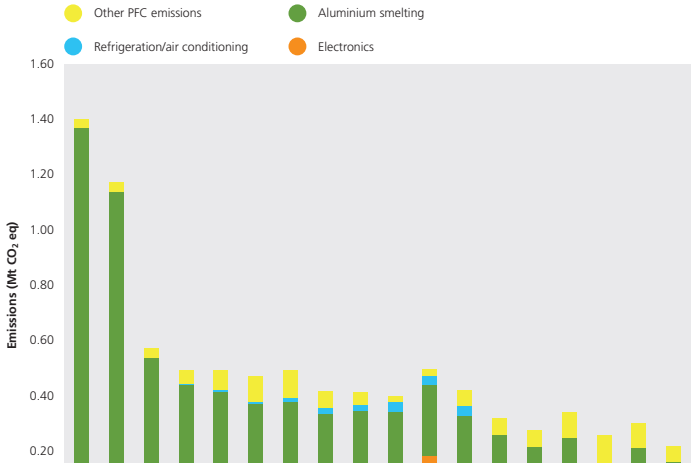


Figure 2.7 SF_6 Emissions by Source, 1990-2007, Mt CO_2 eq

2.6.1 Energy supply

Energy supply is the biggest single contributor to the UK's carbon dioxide emissions and was responsible for about 216 Mt CO_2 eq or 39.7 per cent of net CO_2 emissions in 2007. The restructuring of the energy supply industry in the mid-1990s led to a significant decrease in emissions to 1999. Between 1999 and 2006 emissions increased, due to the volatile and high gas price and the corresponding switching from gas to coal. However in 2007, emissions have again shown a decline and are down 2 per cent on 2006 figures.

Sectoral emissions – by end-user

2.7 Table 2.4 shows greenhouse gas emissions on an end-user basis. Emissions from the energy supply industry are reallocated to the sectors, which make use of the energy supplied. The geographical coverage presented includes UK and Crown Dependencies. Emissions from Overseas Territories are not included in the end user analysis, but are included in the table to ensure overall total emissions are consistent with UNFCCC coverage.

2.7.1 Energy use

A decreasing trend in emissions is evident since 1990 in the business sector. In 2007, emissions from this sector were about 17 per cent below 1990 levels and represented 32 per cent of total emissions. A number of factors contributed to this decrease; primarily fuel switching and a decline in energy intensity arising from structural changes and policy actions.

In 2007, residential sector emissions (including those derived from electricity use in the sector) are estimated as 149 Mt CO_2, compared to 1990 emissions of 169 Mt CO_2, a reduction of about 12 per cent. This small net change was the result of interactions between several much larger individual contributions over the decade. Three factors have had a major influence:

- growth in demand for underlying energy services (such as warmer homes, hot water and home entertainment)
- background improvement in energy efficiency, over 1 per cent per annum
- reduction in the carbon intensity of grid electricity

Transport accounted for around 24 per cent of UK greenhouse gas emissions in 2007, representing a growth of 8 per cent since 1990. This growth is driven by increasing demand, which more than offset improvements in new car fuel efficiency.

Public sector emissions fell from 31.2 Mt CO_2 eq in 1990 to 20.9 Mt CO_2 eq in 2007 and now represent 3 per cent of total emissions.

Table 2.4 Greenhouse gas emissions by end user, Mt CO_2 eq

Sector	1990	1995	2000	2005	2007
Business	243.8	211.8	211.1	206.5	203.2
Industrial processes	56.8	47.0	26.2	18.4	18.6
Transport	144.8	149.3	151.7	155.6	156.0
Residential	168.4	153.5	155.7	156.2	149.1
Public	31.2	28.2	23.3	22.1	20.9
Agriculture	64.5	61.7	58.0	53.6	50.6
LULUCF (net)	3.0	1.3	-0.3	-1.9	-1.8
Waste management	52.9	46.9	34.1	22.8	22.8
Exports	10.3	15.4	15.2	18.8	16.9
Overseas Territories	1.6	1.7	1.9	2.1	2.3
Total GHG emissions by sources minus removals by sinks	777.1	716.8	676.8	654.2	638.5

2.7.2 **Agriculture, forestry and land use**

In 1990, greenhouse gas emissions from agriculture, forestry and land use were 67.4 Mt CO_2 eq or about 8.7 per cent of the UK total. This includes net emissions and removals from LULUCF. Joint annual emissions from these sectors have fallen by 27.6 per cent between 1990 and 2007. The fall in emissions is the result of decreasing animal numbers and fertiliser use, plus expanded forest area and a tendency to less intensive agriculture.

2.7.3 **Waste**

Emissions from disposal of waste have decreased by 57 per cent since 1990, primarily due to the decline in methane emissions. This decrease has been realised mainly through fitting of methane recovery systems on landfills and increasing diversion of biodegradable waste from landfill, plus more diversion away from landfills in response to the UK landfill tax and policies to meet the requirements of the EU Landfill Directive.

2.7.4 **Industrial processes**

Industrial process emissions have decreased by 67 per cent since 1990. The largest reductions are from the chemical manufacturing industry, most notably the abatement of nitrous oxide emissions from nitric and adipic acid manufacture in response to Integrated Pollution Prevention Control (IPPC) and emissions trading schemes.

Uncertainties

2.8 The UK GHG inventory uses an error propagation and Monte Carlo simulation method to estimate uncertainties for GWP weighted emissions of all greenhouse gases. The uncertainties estimates from the Monte Carlo method are summarised in Table 2.5.

Carbon dioxide dominates GWP weighted emissions, and the estimated emissions have a low uncertainty of around 2 per cent. There are much larger uncertainties associated with emissions of N_2O and CH_4 and the source which makes the major contribution to the overall uncertainty of the UK GHG inventory is 4D Agricultural Soils. DECC has work programmes in place to reduce these uncertainties which include field based measurement programmes in the agricultural sector, literature review and assessment, and methodological development.

The trend in GHG emissions is clearly downwards over the reporting period, and the GWP weighted emissions in 2007 were between 16 per cent and 20 per cent below the level in 1990 with the best estimate being a decline of 18.4 per cent. Uncertainty in the trend is considerably less than the absolute uncertainty in any year.

For N_2O, HFCs and PFCs, the uncertainty in total emissions appears to have increased over time. This is because the relative contribution of sources of these gases associated with greater uncertainties are larger in the later years as other sources of emissions have fallen.

Table 2.5 Summary of Monte Carlo Uncertainty Estimates 1990-2007

Gas	1990 Emissions	2007 Emissions	Uncertainty in 1990 emissions as % of emissions in category		Uncertainty introduced on national total in 1990	Uncertainty in 2007 emissions as % of emissions in category		Uncertainty introduced on national total in 2007	% change in emissions between 2007 and 1990	Range of likely % change between 2007 and 1990	
			2.5 percentile	97.5 percentile		2.5 percentile	97.5 percentile			2.5 percentile	97.5 percentile
	Gg CO_2e	Gg CO_2e	Gg CO_2e	Gg CO_2e	%	Gg CO_2e	Gg CO_2e	%	%	%	%
CO_2 (net)	594,192	544,657	584,627	603,603	2	535,814	553,499	2	-8	-10.4	-6.2
CH_4	104,569	49,015	85,440	129,685	26	40,987	59,417	23	-53	-56.0	-50.0
N_2O	64,949	34,898	32,856	146,077	179	10,372	97,083	271	-53	-71.0	-32.0
HFC	11,390	9,614	9,992	12,790	15	7,897	11,317	22	-15	-33.0	4.0
PFC	1,402	216	1,346	1,457	5	174	257	24	-85	-88.0	-82.0
SF_6	1,030	794	887	1,173	17	692	894	15	-22	-36.0	-7.0
All	777,532	639,194	733,190	861,317	15	608,565	702,239	15	-18	-20.0	-15.0

Notes

Uncertainty calculated as 2s/E where s is the standard deviation and E is the mean, calculated in the simulation.

N_2O quoted but distribution is highly skewed and uncertainty quoted exceeds 100 per cent.

Emissions of CO_2 are net emissions (i.e. sum of emissions and removals).

Important – Emissions in this table are taken from the Monte Carlo model output. The central estimates, according to gas, for 1990 and the latest inventory year are very similar but not identical to the emission estimates in the inventory.

Comparison of 4NC and 5NC

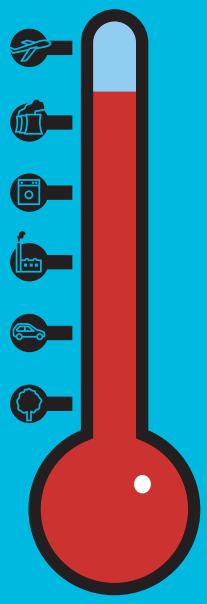
2.9 Since the publication of the 4NC, various updates and revisions to methodologies have been implemented in the UK GHG inventory that have impacted on the time-series of emissions. The most significant changes are highlighted in Table 2.6 below:

Table 2.6 Major revisions to the UK GHG inventory since publication of 4NC

Change	2007
Methodological improvements to the estimation of emissions from adipic and nitric acid	Decrease in the estimated emissions of nitrous oxide from industrial processes
Introduction of EUETS data in selected sectors from 2005 onwards	Revisions to emission estimates from the energy supply and industrial processes sectors
Revision to methodology used to estimate emissions from offshore oil and gas	Revision to estimated emissions for both methane and nitrous oxide from the energy supply sector
Correction to activity data used for landfill methane from 1998 onwards	Increase in methane emissions from the waste sector
Review of methods, activity data and emission factors for F-gas emissions in the UK	Revision and introduction of new sources affecting the industrial processes sector
Update to N_2O factors for road transport Agriculture	Decrease in the estimated emissions of nitrous oxide from transport

3

Policies and Measures



Policies and Measures

Key developments

Key targets and policies

- The UK is on track to meet its commitment under the Kyoto Protocol to reduce greenhouse gas emissions to 12.5 per cent below 1990 levels by 2008-12.
- The UK Government passed legislation in 2008 – the Climate Change Act – which introduces a legally binding long-term framework for reducing greenhouse gas emissions, through domestic and international action, to at least 80 per cent below 1990 levels by 2050 and to at least 34 per cent below 1990 levels by 2018-22
- The Climate Change Levy (CCL), a tax on energy use to encourage business and the public sector to improve their energy efficiency, has increased in line with inflation since 2007.
- Under Climate Change Agreements (CCAs) energy intensive industry may benefit from an 80 per cent reduction in the CCL for energy intensive industry if they meet challenging energy efficiency or carbon emissions targets. 2010 targets were reviewed in 2008, as a result of which, emissions savings in 2010 derived from targets will increase from 7 $MtCO_2$ to at least 10.6$MtCO_2$, when measured against Business As Usual Projections. The current CCA scheme ends in 2013. Subject to State aid approval, the scheme will continue to 2017.
- Carbon Reduction Commitment – a new mandatory emissions trading scheme, scheduled to begin in 2010, which will cover large UK business and public sector organisations. The scheme is expected to deliver carbon savings of at least 4 $MtCO_2$ per year by 2020.
- The EU Emissions Trading System (EU ETS) places an emissions cap on the large electricity producers and energy intensive industries, which creates a carbon price to drive abatement to meet the cap at least cost.
- A target for the UK to reduce greenhouse gas emissions from sectors not covered by the EU ETS to 16 per cent below 2005 levels by 2020.
- 20 per cent of the EU's energy consumption (electricity, heat and transport) to come from renewable sources by 2020. The UK's target is 15 per cent; for 10 per cent of road transport fuels to come from renewable sources, subject to them being produced in a sustainable way.

Introduction

3.1 The UK plays a leading role in the fight against climate change. Action taken since the 1990s has significantly reduced greenhouse gas emissions and the UK is on track to exceed its target under the Kyoto Protocol. Provisional figures show that emissions, including emissions reductions resulting from purchases through EU ETS, were 22½ per cent below base year emissions in 2008.

Between 1990 and 2007 carbon dioxide emissions (including LULUCF) fell by 8.3 per cent; methane emissions by 53.1 per cent; and nitrous oxide emissions by 46.9 per cent. The UK is therefore well on track to exceed its burden sharing commitment.

3.1.1 The UK's domestic targets

In November 2008, the UK introduced the world's first long-term legally binding framework to reduce greenhouse gas emissions (the Climate Change Act 2008).

On 22 April 2009, the UK Government announced the level of the UK's first three carbon budgets setting legally binding limits on UK greenhouse gas emissions covering the years 2008/12, 2013/2017 and 2018/2022 respectively. In summer 2009, the UK Government will publish an Energy and Climate Change Strategy that will describe the policies and proposals to meet these ambitious carbon budgets, outlining a low-carbon future that is prosperous and energy-secure and it will detail the policies that will help get there.

The Government already has a comprehensive set of policies in place to tackle greenhouse gas emissions, set out in the 2006 Climate Change Programme[31] and the 2007 Energy White Paper[32]. It is also taking action to strengthen policy in a number of areas, including through consulting on a Renewable Energy Strategy[33] and a Heat and Energy Saving Strategy[34] and work to accelerate the development and introduction of electric, and plug-in hybrid cars.

The Government will also respond in more detail to the advice received in December 2008 from the independent Committee on Climate Change, and meet the Climate Change Act requirement to set out our policies and proposals for meeting the first three carbon budgets which were announced in April 2009. The Strategy will draw on recent and

31 Climate Change Programme was published in March 2006 and available from: www.defra.gov.uk/environment/climatechange/uk/ukccp/pdf/ukccp06-all.pdf

32 Meeting the Energy Challenge – A White Paper on Energy was published in May 2007. Available from: www.berr.gov.uk/energy/whitepaper/page39534.html/whitepaper/page39534.html

33 www.renewableconsultation.berr.gov.uk/

34 http://hes.decc.gov.uk/

current public consultations, and will put the carbon reduction strategy in the context of the Government's overall programme for delivering secure low-carbon energy at competitive prices and to the benefit of the UK economy into the future.

Policy development process

3.2 The Department of Energy and Climate Change (DECC) coordinates UK policy on climate change at official level through inter-departmental committees chaired by DECC. A Cabinet Committee chaired by the Chancellor of the Exchequer makes decisions at Ministerial level.

Some policies are the responsibility of DECC directly, while others are the responsibility of Her Majesty's Treasury (HMT), the Department for Transport (DfT), the Department for Environment, Food and Rural Affairs (Defra), the Department of Communities and Local Government (CLG), the Department for Business, Enterprise and Regulatory Reform (BERR), the Foreign and Commonwealth Office (FCO) and the Department for International Development (DFID).

The UK Government's programme is supported by action taken by the Devolved Administrations in Scotland, Wales and Northern Ireland. While the UK Government has overall responsibility for ensuring that a programme is put in place to deliver the UK's Kyoto target and its recently published domestic carbon budgets[35], all the administrations will play a part in meeting these targets. The approach taken by each administration will differ, drawing on the range of policies at their disposal. Policies and programmes specific to each Devolved Administration are included throughout this chapter.

The *Stern Review on the economics of climate change*[36], published in October 2006, underpins climate change policy development in the UK. It confirmed that climate change is real and is a problem that can only be solved by collective international action. The Review demonstrated that urgent action is needed to mitigate the effects of climate change and that the costs of global action to mitigate the most dangerous effects are significant but manageable, as long as action is taken multilaterally. The damage costs of climate change through failure to take action would be greater than the costs of addressing the risks.

The Stern Review calculates that the dangers of unabated climate change would be equivalent to between 5 and 20 per cent of annual global GDP each year. In contrast, the costs of action to reduce greenhouse gas emissions to avoid the worst impacts of climate change can be limited to around 1 per cent of global GDP each year. People would pay a little more for carbon-intensive goods, but our economies could continue to grow strongly.

The UK's strategy to reduce emissions, in line with the framework set out in the Stern Review, is based on three essential elements: carbon pricing, technology policy, and removing the barriers to behavioural change.

In 2007 the UK Government published *Meeting the Energy Challenge – A White Paper on Energy* which built on the proposals contained in the Energy Review report, *The Energy Challenge*, published in July 2006.[37] The Energy White Paper set out the UK's domestic and international strategy to address the twin challenges of tackling climate change by reducing carbon dioxide emissions and ensuring secure, clean and affordable energy supplies. It focused on greater energy efficiency, the importance of carbon prices and strengthening the EU Emissions Trading System, the development of more low carbon sources of energy and security of energy supply delivered through liberalised energy markets. The Government projected at the time that the package of policies in the White Paper could save between 84 – 121 $MtCO_2$ by 2020.

The UK has undertaken research to determine the extent of impacts of response measures. The UK implements policies in a way that takes into account the impacts of response measures on all developing countries, including through the implementation of the world's first major international carbon trading scheme, the use of the flexible mechanisms and continued liberalisation of its energy markets. The policies are also aimed at reducing costs of mitigation as far as possible and where costs are unavoidable, the UK seeks to ensure that they are borne as far as possible within the UK and Europe.

The UK has also ensured that response measures are as diverse as possible, and include:

- measures to reduce emissions of greenhouse gases other than CO_2 from fossil fuels
- emissions trading

35 http://www.hm-treasury.gov.uk/d/Budget2009/bud09_carbon_budgets_736.pdf

36 Stern Review on the Economics of Climate Change: http://www.hm-treasury.gov.uk/sternreview_index.htm

37 Available from: www.berr.gov.uk/energy/whitepaper/review/page31995.html

- measures to enhance carbon sinks
- action to encourage carbon capture and storage

3.2.1 Scottish Government

Lead Cabinet responsibility for climate change policy in Scotland rests with the Cabinet Secretary for Finance and Sustainable Growth. A senior official level Greener Scotland Programme Board is responsible for embedding climate change across the Scottish Government, and a cross-Government Climate Change Delivery Group coordinates action within individual Directorates.

Through its *Government Economic Strategy*[38], the Scottish Government has committed to reduce Scottish emissions. In support of this, the Climate Change (Scotland) Bill was introduced to the Scottish Parliament at the end of 2008 and includes a mandatory target to achieve an 80 per cent reduction in 1990 levels of Scottish greenhouse gas emissions by 2050 and will create a statutory framework committing the Scottish Government to securing this reduction.[39]

Over 50 per cent of Scotland's emissions will be covered by the EU Emissions Trading System (which aims to deliver 21 per cent emissions reduction by 2020) or the UK Carbon Reduction Commitment. Strategic options for delivering future emissions cuts in Scotland will be published for discussion during 2009. The Scottish Government is also committed to assessing the impact on carbon emissions of its own spending and is developing a Climate Change Adaptation Framework to make sure Scotland can adapt to the impacts of climate change which are already being felt. The Scottish Government is also working with UK partners on delivering the requirements of the UK Climate Change Act.

The Scottish Climate Change Bill includes a mandatory provision for Scottish Ministers to develop and publish an Energy Efficiency Action Plan. This plan must be revised at least every three years and be reported on annually to the Scottish Parliament. The plan will set out the actions that the Scottish Government is taking to improve energy efficiency across all sectors in Scotland and the contribution that this will play in meeting the overall Climate Change Bill target. The plan will also cover activities driven by the UK Government and the European Union. An outline of the action plan was published in April 2009 and the Scottish Government intend to consult on the plan later in the year.

3.2.2 Welsh Assembly Government

In Wales, the Welsh Assembly Government's programme for government, *One Wales*, sets out the Assembly Government's commitment to achieve annual greenhouse gas emission reductions of 3 per cent per year by 2011 in areas of devolved competence and to set out specific sectoral targets in relation to residential, public and transport. In January 2009, the Assembly Government published its *Climate Change Strategy – High level policy statement consultation*. The second stage of the strategy, focused on actions, will be published in June 2009 and a final strategy, combining the outcome of the two consultations, will be published before the end of 2009. This will form the Assembly Government's contribution to meeting UK climate change targets. A Cabinet Committee on Climate Change, chaired by the Minister for Environment, Sustainability and Housing, coordinates work on the development of climate change policy and programmes.

The Climate Change Commission for Wales – which includes representatives of all four main political parties, business, local government, the third sector as well as representatives from expert organisations – has been established to build a consensus on the action needed in response to climate change, provide leadership in tackling both the causes and consequences of climate change in Wales, and make recommendations to the Assembly Government on what action is needed.

3.2.3 Northern Ireland Executive

The Northern Ireland Programme for Government (2008-2011) *Building a better future* commits the Northern Ireland Executive to reduce greenhouse gas emissions by 25 per cent on 1990 levels by 2025. This is expressed through a Public Service Agreement framework that identifies energy efficiency and renewable technologies as key to achieving emission reduction targets.

The Kyoto mechanisms

3.3 The baseline with measures projections set out in Chapter 4 indicate that the UK is on track to reduce its emissions to below the level required to meet its commitment under the Kyoto Protocol on the basis of domestic measures alone. The UK, in common with the EU as a whole, recognises that the Kyoto mechanisms will play an essential role in meeting commitments under the Protocol

[38] The Government Economic Strategy, Scottish Government, November 2007. Available from: http://www.scotland.gov.uk/Topics/Economy/Key-Publications/ges07.

[39] For further information please see: www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/ScottishBill

and has put in place the necessary institutions and accounting framework to facilitate their use, including development of a registry which has been licensed to date for use in a number of countries as well as the UK.[40]

Through the EU Linking Directive, companies with obligations under the EU Emissions Trading Scheme can make use of Kyoto's project-based mechanisms. The UK is a leading investor country in the Clean Development Mechanism (CDM). By mid-February 2009, the UK was ranked first investor country in terms of registered projects with UK approval of participation. The UK Designated National Authority for CDM had issued 1169 letters of approval of participation for 941 projects.

The UK Government will be purchasing CDM credits to offset emissions attributable to a variety of central government activities, chiefly official and ministerial air travel. These credits will then be unilaterally cancelled to offset emissions; they will not be counted towards our Kyoto commitment or carbon budget during the first budgetary period (2008-2012).

Looking beyond the current Kyoto commitment period, the UK is active among those countries promoting the introduction of new sectoral mechanisms for advanced developing countries and a shift away from a reliance on project-based approaches. At the same time, we are signalling to organisations active in the carbon market, both in the UK and elsewhere, that future investment opportunities are likely to be increasingly focused on sectoral mechanisms.

Cross cutting measures

3.4.1 EU Emissions Trading System

The European Emissions Trading System (EU ETS) was established in 2003 by Directive 2003/87/EC and is the largest emissions trading system in the world. In the UK, the system covers 1,000 installations, responsible for approximately 50 per cent of the UK's carbon dioxide emissions.

The Government believes that emissions trading is a cost effective mechanism for reducing greenhouse gas emissions because emissions are reduced at the point of least cost.

The National Allocation Plan (NAP) for the UK sets the total quantity of allowances to be issued and the number of 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.

Phase II of the system started on 1 January 2008 and will run until 31 December 2012. This coincides with the first Kyoto commitment period. The scope of the system has been broadened to cover additional carbon dioxide (CO_2) emissions from glass, mineral wool and gypsum production, flaring from offshore oil and gas production, petrochemicals, carbon black and integrated steelworks.

Installations in the EU ETS can meet their obligations by purchasing allowances, which might come from installations in other EU countries, and credits from the Kyoto Protocol project mechanisms. This means that the emissions reductions from the second phase of the system will not necessarily take place in the UK, nor will they necessarily be of carbon dioxide.

3.4.2 Auctioning

In Phase II of EU ETS, the UK is auctioning 7 per cent of allowances – approximately 86 million. The UK was the first Member State to hold an auction in Phase II on 19 November 2008, raising over £54m for the Exchequer.

Auctioning is the simplest and most transparent allocation methodology. Allowances are allocated according to the "polluter pays" principle. This ensures that allowances are allocated to those that value them most and that the price of carbon is incorporated into business decisions.

Auctioning eliminates such issues as windfall profits in sectors which can pass on costs to their customers without significant loss of market share to installations outside the EU. This will help to reduce the administrative burden on both industry and governments. Auctioning is therefore fundamental to achieving an efficient allocation and crucial to the environmental effectiveness of EU ETS.

[40] The UK Government has decided not to host the Joint Implementation (JI) mechanism during the first commitment period. However, the UK has established a Designated Focal Point for JI which has the capacity to issue letters of approval to JI projects based abroad.

3.4.3 Climate and Energy Package

In December 2008, EU leaders and the European Parliament agreed measures to a unilateral 20 per cent reduction in the EU's greenhouse gas emissions by 2020 from 1990 levels, and to scale this up to as much as 30 per cent under a new global climate change agreement when other developed countries make comparable efforts. As a result the EU ETS has been significantly revised and will result in many more emission reductions, more predictable market conditions and improved certainty for industry. The changes will take effect from 2013.

Specifically on the EU ETS, the following key elements were agreed, which will be implemented in Phase III of the scheme:

- The Directive provides for a fundamentally different and much more rigorous approach to setting the cap on emissions. A central EU cap will guarantee that the EU ETS will deliver its share of emission reductions in order to meet the EU's overall climate change targets.
- The central EU cap is set at a much more ambitious level. For the first time, there is an annually declining trajectory for the cap to 2020 and beyond which will reduce emissions to 21 per cent below 2005 levels by 2020.
- Access to international carbon credits is limited in the ETS to ensure that at least half of the required emission reductions take place within the EU, whilst providing finance to developing countries to invest in low carbon projects.
- There is a large increase in auctioning. At least 60 per cent of EU ETS allowances will be auctioned by 2020. In Phase II only around 3 per cent of allowances are being auctioned across the EU. This will provide a more economically efficient way of allocating allowances, and help to address the issue of windfall profits.
- Use of up to 300 million EU ETS allowances, worth billions of pounds, to part-fund up to 12 Carbon Capture and Storage (CCS) demonstration plants. This provides a credible financing mechanism for this technology that has huge potential to reduce emissions across the globe.
- These elements of a revised ETS demonstrate the EU's leadership in tackling global climate change. This represents a significant step forward towards a global, comprehensive international climate agreement in Copenhagen at the end of 2009.

3.4.4 UK Climate Change Act 2008

The UK passed the Climate Change Act in November 2008, introducing the world's first long-term legally binding framework to reduce greenhouse gas emissions.

The Climate Change Act has created a new approach to managing and responding to climate change in the UK, by setting ambitious, legally binding targets, taking powers to help meet those targets, strengthening the institutional framework, enhancing the UK's ability to adapt to the impact of climate change, and establishing clear and regular accountability to Parliament.

Central to the Act is a legally binding target to reduce the UK's greenhouse gas emissions to at least 80 per cent below 1990 levels by 2050,[41] to be achieved through action at home and abroad.

3.4.5 Carbon Budgets

To drive progress towards this target, the Act introduces five-year carbon budgets, which will define the emissions pathway to the 2050 target by limiting the total amount of greenhouse gas emissions allowed in the UK in each five year period, beginning in 2008.The first three carbon budgets – for 2008-12, 2013-17, and 2018-22 – were set in May 2009. In setting them, the Government has taken into account a range of matters set out in the Act, consulted the Devolved Administrations of Scotland, Wales and Northern Ireland, and obtained and taken into account the advice of the independent Committee on Climate Change (CCC), which has been established under the Act both to advise the Government on setting carbon budgets and to report to Parliament on the progress made in reducing greenhouse gas emissions.

The CCC published its first report, which set out its advice on the first three carbon budgets, on 1 December 2008[42]. The Committee recommended that the UK's carbon budgets should reflect the outcome of the UNFCCC conference in Copenhagen in December 2009, and any subsequent negotiations on a global treaty, and should be in line with the EU approach. It proposed two set of budgets, one to apply now before a global deal is reached (called *Interim* budgets), and a more challenging set to apply once a global deal on climate change has been agreed (called *Intended* budgets). The CCC recommended interim budgets that would require the UK to reduce its greenhouse gas emissions to

41 After taking account of carbon units that have been brought into the UK, for example by being bought from other countries (credits), or have left the UK, for example by being sold to other countries (debits).

42 The Committee on Climate Change's report Building a low-carbon economy – the UK's contribution to tackling climate change can be found at: www.theccc.org.uk/reports/

Sector	Budget 1 (2008-2012)	Budget 2 (2013-2017)	Budget 3 (2018-2022)
Proposed budget ($MtCO_2e$)	3018	2782	2544
Annual equivalent percentage reduction below 1990 levels	22	28	34
Traded sector ($MtCO_2e$)	1233	1078	958
Non-traded sector ($MtCO_2e$)	1785	1704	1559

at least 34 per cent below 1990 levels by 2018-22. Under the Intended scenario, it recommended that the UK increase this to 42 per cent below 1990 levels by 2020.

The Government published its high-level response to the CCC's advice on 22 April 2009. It agrees that the budgets set now should be based on the UK's share of the EU's target to reduce emissions by 20 per cent below 1990 levels by 2020. In meeting these interim budgets the Government will aim to ensure that all effort in the non-traded sector is achieved through domestic emission reductions without the purchase of offset credits, in line with the CCC's advice. The Government has set the first three carbon budgets covering the period 2008 to 2022, as table above.

The Government has also proposed the rules for carbon accounting to determine compliance with the budgets.

The Government plans to publish a report on proposals and policies for meeting the budgets, as part of a climate change and energy strategy in summer 2009.

3.4.6 The UK Environmental Transformation Fund

The Environmental Transformation Fund (ETF) is a new initiative to bring forward the development of low carbon energy and energy efficiency technologies in the UK. The fund began operation in April 2008, and is co-ordinated through the Department of Energy and Climate Change (DECC). The ETF also has an international element, jointly owned by DECC and the Department for International Development (DfID), and administered by the World Bank as part of the Climate Investment Fund.

The UK element of the Fund aims to accelerate the commercialisation of low carbon energy and energy efficiency technologies in the UK. It specifically focuses on the demonstration and deployment phases of bringing low carbon technologies to market. It provides funding to a range of bodies and projects in order to deliver its aims. It currently supports a range of technologies, including offshore wind, marine energy, carbon abatement technologies, hydrogen and fuel cell technology, biomass, anaerobic digestion and low carbon buildings.

The ETF works closely with other organisations funding earlier stage research and development including the Energy Technologies Institute, Technology Strategy Board, and the Research Councils' Energy Programme.

The Scottish Government provides annual funding of around £10 million to promote improvements in Energy Efficiency. This is supplemented by £13.5 million for Community and Microgeneration support. The majority of this funding is used for the activities of the Energy Saving Trust and the Carbon Trust in Scotland, and for grants for household and community investment in microgeneration.

3.4.7 Economic Instruments

Taxes and other economic instruments have a central role to play in delivering the UK's climate change objectives. They can provide incentives for behaviour that protects or improves the environment, and deter actions that are damaging to the environment. For individual consumers and business alike, economic instruments such as tax can enable environmental goals to be achieved at the lowest cost and in the most efficient way. By internalising environmental costs into prices, they help to signal the structural economic changes needed to move to a more sustainable economy. They can encourage innovation and the development of new technology. The revenue raised by environmental taxes can also be used to reduce the level of other taxes, which can help to reduce distortions in the economy, while raising the efficiency with which resources are used.

Over time, the Government aims to reform the tax system to increase incentives to reduce environmental damage. That will shift the burden of tax from "goods" to "bads"; encourage innovation in meeting higher environmental standards; and deliver a more dynamic economy and a cleaner environment, to the benefit of everyone. But environmental taxation must meet the general tests of good taxation. It must be well designed, to meet objectives without undesirable side-effects; it must keep deadweight compliance costs to a minimum; distributional impact must be acceptable; and care must be had to implications for international competitiveness. Where environmental taxes meet these tests, the Government will use them.

The Government has used a range of fiscal measures, such as the climate change levy, emissions trading and incentives for energy efficiency, to tackle climate change. These measures work in tandem with other economic instruments, for example the Renewables Obligation and climate change agreements and more traditional regulation and spending programmes. Transport taxes also have a role in reducing harmful emissions and signalling fuel efficient choices, while continuing to raise revenue to fund public services. For example, since 2001 reforms to Vehicle Excise Duty and Company Car Tax have incentivised the purchase of lower-carbon vehicles.

Energy Supply

3.5 Policy framework – the 2007 Energy White Paper

The measures in the 2007 Energy White Paper are helping to put the UK on track to meet greenhouse gas emissions reduction targets and are projected to cut UK emissions by about a quarter by 2020 relative to 1990 levels, notwithstanding economic growth over the period. Measures to achieve this include:

- Actions aimed at tripling the supplies of electricity we get from renewables by 2015.
- A package of measures to encourage local and microgeneration.
- Paving the way for commercial demonstration of carbon capture and storage – which has the potential to reduce carbon dioxide emissions from fossil fuel power stations by as much as 90 per cent.
- Doubling the current requirement for energy suppliers to deliver energy efficiency measures to households.
- Introducing a cap and trade carbon reduction scheme for business such as banks and supermarkets, as well as public sector organisations whose electricity use exceeds 6GWh per year. This will deliver an estimated saving of at least 4 million tonnes of carbon dioxide per year by 2020.
- Introduction over the next 10 years of smart meters so that domestic energy customers have visual displays to help manage better their energy use.

These measures should improve the energy efficiency of the UK's economy by around 10 per cent between now and 2020, this is over and above the 25 per cent improvement we already expect over that period. And developing cleaner sources of energy diversifies the domestic energy sources at the UKs disposal. Both of these factors are key to ensuring secure energy supplies.

3.5.1 Electricity from Renewables

The main policy mechanism through which the Government supports the development of new renewables capacity is the Renewables Obligation (RO) on licensed electricity suppliers in England and Wales and its equivalents in Scotland and Northern Ireland. The RO requires suppliers to source a specific and annually increasing percentage of the electricity they supply from renewable sources.

The RO was introduced in 2002 and is currently due to run until 2027. To enable the UK to meet its share of the EU target for 20 per cent of total energy consumption to come from renewables by 2020, the Government announced in November 2008 that it would extend the duration of the RO until at least 2037. This will provide a stable and long-term market for renewable electricity, so providing investors with the certainty they require.

Renewables Obligation

For each megawatt hour of renewable electricity generated, Ofgem who administers the scheme issues a tradable certificate called a Renewables Obligation Certificate (ROC). Suppliers can meet their obligation either by acquiring ROCs or by paying a buy-out price, set at £37.19/MWh in 2009/10 and indexed by 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.

The level of the Obligation in England, Wales and Scotland is 9.7 per cent for 2009/10 rising to 15.4 per cent by 2015/16.

Since the introduction of the RO there has been a step change in the number of renewables projects built in the UK. Almost 500 MWe of generating capacity was installed in 2006, and a further 665 MWe in 2007. This growth is mainly the result of the increase in wind capacity, with over 300 MWe installed in 2006 and over 500 MWe in 2007. This upward trend is set to continue, with over 2000 MWe currently under construction. The RO is expected to save 9 $MtCO_2$ per year by 2010, rising to 13 $MtCO_2$ per year by 2013.

Whilst the RO has been successful in bringing forward the most economic technologies such as onshore wind, it has not encouraged more emerging technologies as quickly as had been envisaged. Therefore the Government took powers in the Energy Act 2008 and has recently laid a new Order before Parliament to introduce some significant changes to the operation of the RO. The main change is to band the RO so that different technologies receive different levels of support depending on their costs. This should make it some 30 per cent more effective in delivering new generation over the next few years. The Order containing these changes took effect on 1st April 2009. The Government has also announced its intention to introduce, in April 2010, a Feed-In Tariff (FIT) for renewable electricity generation up to a maximum of 5MW. This should incentivise generation at the small- and micro-scales.

Unlike some other renewable technologies, biomass has the advantage that it can be used to generate electricity when required. A strong biomass supply chain can also offer diversification opportunities for farmers and foresters as well as job opportunities, building and operating the generating plant. As biomass production and use can have implications for the wider environment in terms of biodiversity, water, soils, land use and air quality, these issues are being factored into ongoing policy decisions, alongside considerations of overall lifecycle emissions. Co-firing of biomass or energy crops with fossil fuels is eligible for ROCs, subject to a restriction on the proportion of their obligation that suppliers can meet with ROCs awarded for co-firing with regular biomass.

As well as the RO, support is provided through R&D funding and capital grants. Since April 2008, many of these schemes are supported by the Environmental Transformation Fund – the UK element of which will total £400million – including the £10million Offshore Wind Capital Grants Scheme, the next tranche of which was launched in March 2009. The Bio-energy Capital Grants Scheme, launched in 2002, has brought forward additional capacity for the generation of electricity from biomass. These electricity-only projects are expected to save 0.3 million tonnes of carbon dioxide per year by 2010.

Scottish Ministers are committed to promoting energy from a wide range of renewable sources, and have a target that 50 per cent of electricity generated in Scotland as a proportion of demand should come from renewable sources by 2020, with an interim milestone of 31 per cent by 2011. Much of the developer activity to date, driven by the Renewables Obligation Scotland (ROS), has focused on onshore wind. In common with the rest of the UK, the introduction of banding is expected to bring on a wider range of technologies.

The Scottish Government continues to provide additional support to small- and micro-scale renewables through its Scottish Community and Household Renewables Initiative. The Scottish Government recognises the importance of developing renewable heat in order to make progress towards the 20 per cent target of final consumption of energy from renewable sources by 2020. The Scottish government is proposing an 11 per cent renewable heat target by 2020.

3.5.2 Wave and Tidal Stream

The UK is currently leading the world in the development of marine energy technologies with many of the leading technologies based in the UK. A combination of the excellent wave and tidal resources around our shores and our expertise in oil and gas exploration puts the UK in a unique position to benefit from renewable energy sourced from waves and tidal flow as well as develop wave and tidal services capabilities.

Wave and tidal technologies have the potential to make a significant long-term contribution to meeting the UK's energy needs and cutting our greenhouse gas emissions. The Carbon Trust and others have estimated that up to 15 per cent of the UK's current electricity consumption could be sourced from marine energy and that 2 GW of generation capacity could be installed by 2020 (with up to 30 GW by 2050).

The UK launched its Renewable Energy Strategy consultation on 26 June 2008. The consultation sought views on how to drive up the use of renewable energy (including Marine technologies) in the UK, as part of the UK's overall strategy for tackling climate change and to meet our share of the EU target to source 20 per cent of the EU's energy from renewable sources by 2020. Responses to this consultation will help shape the UK Renewable Energy Strategy which will be published in Summer 2009.

Meanwhile the Government is helping the sector to meet the challenge of developing and commercialising wave and tidal stream technology, the UK has already put in place the most comprehensive support regime in the world for marine energy. This provides support from the earliest stages of University research (many renowned Universities working in conjunction with technology developers) through to demonstration. The UK also has comprehensive test facilities at EMEC in Orkney and at NaREC in the North East of England. A further facility, Wave Hub, is planned to open off the coast of Cornwall in early 2011. Deployment receives enhanced support under the banded Renewables Obligation. As of April 2009, under the new banded Renewables Obligation, Wave and Tidal technologies will receive two Renewable Obligation Certificates (ROCs) for each MWh of eligible generation produced.

The Department of Energy and Climate Change has in place a £50m *Marine Renewables Deployment Fund* (MRDF) to allow leading technologies to continue to progress beyond the research and testing/prototype phase towards deployment of full-scale devices. A key feature of the MRDF Scheme is that it provides a grant towards capital costs, up to 25 per cent limited to £5m per project, plus grant support of £100 per MWh of electricity produced for up to 7 years (limited to an overall cap of £9m per project) for the commercial demonstration of devices. This is in addition to the revenue that projects will receive from the sale of electricity and ROCs.

In April 2009 the Government announced that it was beginning work towards a Strategic Environmental Assessment for English and Welsh waters. This will complement work being carried out in Scotland and Northern Ireland.

The Scottish Government is determined to support a world class wave and tidal energy sector, and to make Scotland a global leader in the development and deployment of these technologies. The Scottish Government is already supporting the sector through capital grants, and is due to introduce the highest level of support across UK under our Renewables Obligation – 5 ROCs for wave, 3 ROCs for tidal.

The Scottish Government is also developing a strategy and Road Map for technologies through separate stakeholder groups, the Marine Energy Group (MEG), who focus on financial support/ infrastructure and the Marine Energy Spatial Planning Group who deal with spatial planning and consents. MEG is intending to publish its Marine Road Map by end June 2009.

Scotland is host to the European Marine Energy Centre (EMEC) on Orkney – the world's only accredited testing facility for wave and tidal energy prototypes, built and supported by public sector consortium including Scottish Government, HIE, Scottish Enterprise, Carbon Trust and Orkney Island Council. EMEC played host last year to the UK's first grid connected tidal energy device, developed by Open Hydro. Open Hydro's tidal turbine was built and installed with support from Scottish Government's £13 million Wave and Tidal Energy Support Scheme (WATES).

3.5.3 Network Infrastructure for Renewables

Connection of large amounts of renewable generation as well as other essential low carbon generation will need significant onshore and offshore electricity network reinforcements and extensions from now up to 2020 and beyond. The cost of this has been estimated as up to £4.7bn[43], in addition to the current refurbishment and expansion plans of some £4-5bn which have already been approved by the electricity regulator Ofgem. The Government and Ofgem set out in the June 2008 Transmission Access Review, a package of measures which when taken together will remove or significantly reduce grid related access barriers. These include accelerating the connection of ready-to-go projects, developing new rules on long term grid access, revised financial incentive mechanisms for investment in grid infrastructure and developing a strategic vision for the grid to meet our 2020 renewable targets. These measures are now being implemented. At the same time the Government and Ofgem are leading a project to put in place a new regulatory regime for offshore electricity transmission so that significant amounts[44] of renewable offshore generation can be connected to the onshore grid. The aim is for this regime to be fully in place by 2010.

In order to improve the progression of planning applications for major infrastructure projects, including transmission infrastructure, the Planning Act 2008 which came in to force in November 2008 will improve the efficiency, transparency and accessibility of the planning system. This includes the setting up of an Infrastructure Planning Commission which will determine nationally significant projects.

43 Our Electricity Transmission Network: A Vision for 2020 A Report by the Electricity Networks Strategy Group March 2009 http://www.berr.gov.uk/files/file50333.pdf

44 The UK government expects that ultimately up to around 33GW of renewable generation will be developed within the entire UK offshore area.

3.5.4 Biomass Heat

Developing a strong biomass heat sector supplied from sustainable indigenous sources will contribute to security of supply, as well as reducing emissions. One of the barriers to the development of a biomass heat sector is the higher infrastructure cost compared to conventional systems. Accordingly capital support for the installation of biomass fuelled heat and Combined Heat and Power projects in the industrial, commercial and community sectors is provided through the Bio-energy Capital Grants Scheme. Once installed, the projects supported to date under the scheme are expected to save a total of 0.2 million tonnes of CO_2 per year.

On 12 February 2009, the Government issued an initial consultation on a proposed Heat and Energy Saving Strategy. This discusses plans for a new financial support mechanism aimed at promoting renewable heat generation in the form of a Renewable Heat Incentive (RHI) to come into effect by April 2011. This should help overcome some of the up-front costs of installations such as biomass heating systems. A further consultation on the operation of the RHI is expected later during 2009.

In Scotland biomass will be a key sector in developing measures to promote renewable heat. The 2007/08 Scottish Biomass Support Scheme worth £7.5 million supported 65 projects which resulted in about 20 MW thermal installed capacity. At the end of 2008, a further capital grant scheme was launched, targeting SMEs heat only projects. This is worth just over £3 million over 2 years. Decisions on first round projects will be made in spring 2009. In addition to that capital grant for biomass is also supported via other grant programme, including Scottish Rural Development Programme.

In Wales, the Assembly Government recently published a Bioenergy Action Plan for consultation. The aim of this Bioenergy Action Plan is to secure the annual generation in Wales of at least 5 terawatt-hours of electricity and 2.5 terawatt-hours of usable heat energy from renewable biomass by 2020, in ways that will result in a reduction of about 3 million tonnes of CO_2 emissions per year in comparison with generation based on fossil fuels. It would also contribute significantly to the achievement of the UK's target to produce 15 per cent of the total energy used from renewable sources by 2020, and to the associated detailed objectives on renewable heat and power proposed in the UK Renewable Energy Strategy.

3.5.5 Combined Heat and Power

The environmental benefits of combined heat and power (CHP) were recognised by setting, in 2000, of a target to achieve at least 10 GWe of Good Quality CHP capacity[45] by 2010. In recent years, the CHP industry has faced adverse economic conditions, largely due to the difference between the price received for electricity and the cost of generation. Recently market conditions for small scale CHP have improved, driven mainly by changes to planning guidance and building regulations. Measures to support CHP were reported in the UK's 3rd National Communication. Despite these measures, modelling estimates suggest that the installed capacity will not reach 10 GWe until sometime after 2010. Two new measures have been introduced:

- In the second phase of the EU ETS, there is a separate sector for existing Good Quality CHP in the UK's National Action Plan. In addition there is a special new entrants' reserve which receives favourable allocation arrangements.
- As set out above, renewable electricity is supported through the RO. From April 2009, in the banding of ROCs, renewable CHP will receive a higher rate of ROCs per MWh, to reflect the additional efficiency that CHP produces. Eligibility for ROCs has been extended to include mixed waste plants, which use Good Quality CHP.

In addition, the UK Government announced in the most recent budget that it will extend the climate change levy exemption for indirect sales of CHP electricity to 2023, subject to State aid approval and has committed to continuing other existing levy exemptions for CHP. It is considering support through feed-in tariffs for micro-CHP below 50kwe and support for the heat output from renewable CHP through a new Renewable Heat Incentive. Legal provision for these measures has been taken through the Energy Act 2008. The UK Government is currently working on a Heat and Energy Saving Strategy for publication in 2009.

3.5.6 Microgeneration

Following the Microgeneration Strategy[46] and the Review of Distributed Generation[47] there is a range of policies in place or under development to address identified constraints to more widespread take-up of distributed energy solutions including microgeneration:

45 Good Quality CHP ensures significant energy efficiency and environmental benefits compared to separate generation of heat and power. It meets the requirements high efficiency CHP set in Annex III of the EU Cogeneration Directive (2004/8)

46 http://www.berr.gov.uk/files/file27575.pdf

47 http://www.berr.gov.uk/files/file39025.pdf

- Through the Low Carbon Buildings Programme we have provided grant funding to reduce the capital costs for early adopters of microgeneration technologies.[48]

- Fiscal incentives – there is a reduced 5 per cent VAT rate for microgeneration technologies. Payments made for microgenerated electricity are exempted from income tax; Business Rates; Relief from Stamp Duty Land Tax for new zero carbon homes up to 2012.

- The Microgeneration Certification Scheme has been introduced to improve consumer confidence in microgeneration technologies through independent certification of microgeneration products and services.[49]

- From April 2008 Householders wishing to install most microgeneration technologies can do so more easily without the need to apply for planning permission thanks to changes in Permitted Development (PD) Rights for microgeneration. The intention is to continue the process and extend PD rights to Micro Wind Turbines and air source heat pumps and to non domestic renewables.

- National Occupational Standards for Environmental Technologies provide standard competences for microgeneration technologies, which can be integrated into existing skills qualifications.[50]

- Simplified market and licensing arrangements for distributed energy operators allow larger-scale distributed energy schemes to be accommodated within the competitive market on a cost-proportionate basis, so they can realise the value of their schemes whilst maintaining full consumer protection.[51]

- Easier connections for distributed energy – Householders producing microgeneration electricity no longer need to seek permission to connect to local network from a distribution network operator; they can now 'connect and inform'. Ofgem is proceeding with a range of activity, including introduction of cost-reflective distribution use of system charging.[52]

- Through the Energy Act 2008 the Government introduced powers to enable the implementation of feed-in tariffs for small scale low carbon electricity and a renewable heat incentive. Both these incentives include generation at the micro scale and will provide the simplicity, certainty and level of reward to enable higher take-up of microgeneration technologies

The Scottish Government has committed £13.5 million per year to support Community and Microgeneration until 2010/11. The main focus for this is through support programmes – the Energy Saving Scotland – home renewables and the Community and Renewable Energy Scheme. The grants offered through these programmes are generally the same as that offered through the Scottish Community and Householder Renewable Initiative – however this programme has been split to allow better targeting and focus on the distinctive needs of the different customer groups.

The Welsh Assembly Government will consult on a National Energy Efficiency and Savings Plan in March 2009. This is the Welsh Assembly Government's short term strategy to address energy efficiency and savings, and promote microgeneration, across the domestic, business and third sector.

A number of programmes are in place or being developed to support microgeneration in Wales. This includes supporting the installation of the mircogeneration technology as part of housing renewal projects, for example as part of the Heads of the Valleys programme, and in hard to treat, off-gas grid properties through the Home Energy Efficiency Scheme.

The Welsh Assembly Government announced a £12m Low Carbon Zone in the Heads of the Valleys as part of the December 2008 capital investment package. The Low Carbon Zone will seek to install microgeneration technologies and other energy efficiency measures in social housing in communities in the Heads of the Valleys. The project aims to regenerate the local economy by developing demand and a market for low carbon technologies that will be manufactured and/or installed by local businesses. The Welsh Assembly Government will explore how the benefits of the scheme can be widened to private sector households in the Heads of the Valleys.

3.5.7 Carbon Abatement Technologies

Carbon abatement technologies (CATs) cover a range of generic options for reducing the carbon dioxide emissions from fossil fuel combustion, including higher efficiency conversion processes and carbon capture and storage (CCS). The Government launched a CCS Competition to design and build a full-scale commercial demonstration project in November 2007.

48 http://www.lowcarbonbuildings.org.uk/home/

49 http://www.microgenerationcertification.org/

50 http://www.skills4business.org.uk/Renewable-and-Alternative-Energy/75

51 http://www.ofgem.gov.uk/Sustainability/Environment/Policy/SmallrGens/DistEng/Pages/DistEng.aspx

52 http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=480&refer=Networks/ElecDist/Policy/DistChrgs

The Chancellor announced in Budget 2009 his intention to proceed with the competition and £90m to fund Front End Engineering Design studies. The Chancellor also announced proposals for a financial mechanism to provide funding for up to four UK CCS demonstrations, including the current competition demonstration project.

In addition the Government has set out its proposals for a new regulatory framework for coal which includes any new coal power station would have to demonstrate CCS on at least 300MW net of its capacity; an independent process will establish when CCS has been technically and economically proven; coal power stations, consented under this new policy framework but before CCS is proven, would then have some five years to retrofit CCS to the full capacity of the power station and further new coal power stations would have to be fully CCS from day one. In addition we will prepare for the possibility that CCS will not be proven as quickly as we expect and look at other regulatory measures that would reinforce the carbon price signal that emissions from coal power stations need to be reduced substantially.

Government has now responded to the 2008 consultation with new guidelines that all new coal-fired power stations will require Carbon Capture Readiness (CCR). A consultation document, setting out further detail on these proposals will be published alongside an Environmental Report in summer 2009.

The Environmental Transformation Fund Carbon Abatement Demonstration programme is supporting CCS through a £15m joint call with the Technology Strategy Board and The Northern Way. The Energy Act 2008 provides the framework for regulating the storage of CO_2 and the detailed arrangements for licensing CO_2 storage facilities were consulted on in 2008.

3.5.8 Coal Mine Methane

In 2004, it was estimated that around 60 per cent of controllable methane from abandoned mines was captured and used, and that the uncaptured remainder represented only 0.07 per cent of the UK's total greenhouse gas emissions. There are no immediate plans to introduce measures to mitigate emissions further. For a five year period from November 2003 electricity produced from coal mine methane was exempt from the Climate Change Levy. Following changes to the qualifying criteria, this exemption expired in November 2008.

3.5.9 Hydrogen

The first call for hydrogen and fuel cell demonstration projects under the Hydrogen, Fuel Cells and Carbon Abatement Technologies Demonstration Programme resulted in support totalling some £5m being offered to five projects. Currently three projects are proceeding, two involving transport applications and one distributed stationary power. The UK contributes to and benefits from international collaboration on hydrogen with partners such as the International Energy Agency, the International Partnership for the Hydrogen Economy, and the European Fuel Cells and Hydrogen Joint Undertaking.

Business

3.6.1 Framework for action

The Government is committed to a clear, flexible and stable policy framework for business (comprising the industry and service sectors). This framework draws together a range of instruments and measures including:

- Economic instruments
- Technology deployment
- Regulation
- Measures to make the market work better
- Improving public and company information

The introduction of the EU ETS means that overlapping policy measures now cover some business sector emissions. The Government will explore the medium-term regulatory framework in the light of developments in the EU ETS.

3.6.2 Climate Change Levy (CCL) and Climate Change Agreements (CCAs)

The climate change levy and climate change agreements were described in detail in the 3rd National Communication. The levy is a tax on the use of energy in industry, commerce and the public sector and has been has been a central policy in encouraging energy efficiency. Levy rates were increased for the first time in April 2007, in line with inflation and again in 2008. In Budget 2006, it was announced that CCL rates would continue to increase in line with inflation. The levy also provides exemptions to incentivise investment

in renewable energy. By 2010, it is estimated to reduce energy demand by nearly 15 per cent a year, compared to a situation where the levy was not in place

Climate change agreements 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. At the three target periods so far completed, sectors performed well against their targets. The fourth target period is in the process of being assessed. Climate change agreements are an existing measure and expected to save 10.6 $MtC0_2$ per year by 2010. In 2007, Government announced that, subject to EU State aid approval, CCAs would be extended to 2017. Around 500 installations in the EU ETS are also at least partially covered by CCAs. The Government launched a public consultation process on the form and content of the new agreements in March 2009, the results of which are likely to be known by end 2009.

3.6.3 **The Carbon Reduction Commitment**

The Carbon Reduction Commitment (CRC) is a new mandatory emissions trading scheme to cover large UK business and public sector organisations. This sector is responsible for approximately 10 per cent of UK emissions. Around 5,000 organisations are expected to meet the qualification threshold for the scheme, which is based on half hourly metered electricity consumption.

The scheme is scheduled to begin in 2010 and will deliver carbon savings of at least 4.4 $MtCO_2$ per year by 2020. CRC has been designed to complement existing policy by covering emissions outside CCAs and direct emissions outside the EU ETS. Analysis indicates that, by driving energy efficiency, the CRC will deliver emissions reductions cost-effectively while saving participants money. It is estimated that CRC will yield a positive benefit to participants of £1billion by 2020.

3.6.4 **Carbon Trust**

The Carbon Trust is an independent company funded by the UK Government, the Scottish Government and Welsh Assembly Government, to help the UK accelerate the move towards a low carbon economy. It helps business and public sector organisations save energy, reduce carbon emissions and capture the commercial opportunities of low carbon technologies. It helps to reduce carbon emissions in the short-term by providing business and the public sector with expert advice, finance and accreditation, and by stimulating demand for low carbon products and services; and in the long-term by developing new low carbon technologies, and by identifying market failures and practical ways to overcome them. Carbon Trust also runs the government's Enhanced Capital Allowance Scheme, which provides businesses that invest in designated energy efficient equipment with enhanced tax relief. Carbon Trust activities are estimated to have saved its customers 17$MtCO_2$ cumulatively since 2001, and its work on development of low carbon technologies is expected to deliver savings of up to 23$MtCO_2$ a year in 2050.

3.6.5 **Small and Medium-sized Enterprises**

A range of measures is in place to help small and medium-sized enterprises (SMEs) reduce carbon emissions. These include:

Advice provision, including through the Government-funded Carbon Trust (see above)

Energy Efficiency Loan Scheme for SMEs, which provides interest free loans of between £5,000 and £200,000 for qualifying energy efficiency projects.

We will be establishing an Energy Services Development Network as a part of voluntary agreements with major energy suppliers to promote energy efficiency and energy services to SME's. This will bring together energy suppliers, energy services providers and other interested organisations to help identify and overcome the barriers to greater take up of energy efficiency by SME's. We will develop pilots, trials and improved communication across members to help develop the energy services market.

The Scottish Government funds dedicated support for SMEs through the Energy Saving Scotland – Small Business Support Scheme. Managed by the Energy Saving Trust in Scotland, this scheme offers SMEs on-site energy audits by dedicated business advisers. Interest free loans are then available to implement the recommendations through the Energy Saving Scotland – Small Business Loans, which are available from £5,000 to £100,000 for energy efficiency and microgeneration technologies.

The Welsh Assembly Government's Green Jobs Strategy sets out how the Assembly Government will support businesses to reduce their carbon footprint and to develop new low carbon business opportunities. The new FS4B business advice service provides advice on reducing their carbon footprint to all business contacting the Assembly Government for support.

3.6.6 Building Regulations

Building Regulations help deliver more efficient non-domestic buildings. Building Regulations[53] (described in more detail in the domestic section) are steadily driving up the energy standards of new and refurbished buildings. Since 1990, the energy efficiency standards for new buildings have been strengthened by over 80 per cent. The 2002 revision of the Building Regulations is expected to deliver reductions in emissions of 1.5 $MtCO_2$ per annum in the non-domestic sector in 2010.

The Building Regulations were amended in April 2006 to further raise energy efficiency standards. The average energy efficiency improvement for non-domestic buildings was between 24 per cent to 28 per cent against 2002 standards. This revision of the Building Regulations is expected to deliver a further reduction of 1.5 $MtCO_2$ per annum in 2010.

The 2008 Budget set out the Government's ambition for all new non-domestic buildings to be net zero carbon from 2019. The Definition of Zero Carbon Homes and Non-Domestic Buildings consultation, which closed in March 2009, sets out Government's current thinking in this area, and calls for further evidence, in anticipation of an in-depth consultation on new non-domestic buildings.

Scottish building regulations are devolved. The current energy standards for buildings in Scotland came into effect in May 2007 and deliver carbon savings in the region of 18-25 per cent for new domestic buildings and 23-28 per cent for new non-domestic buildings when compared with the previous 2005 standards. A further review of standards is in progress.

3.6.7 EC regulation 842/2006 on Certain Fluorinated Greenhouse Gases

Fluorinated greenhouse gases are covered by the Kyoto Protocol and have high global warming potential. They are widely used in commercial refrigeration and air-conditioning systems and other more specialised uses and emissions of these gases amounted to just under 2 per cent of UK emissions in 2007. A major consultation was completed in October 2008 on further proposed GB regulations and measures to implement controls and underpin EC legislation on fluorinated gases. The revised regulations came into force in early March.

Transport

3.7.1 Policy Framework

The UK Government is using a range of approaches to tackle the challenging task of tackling emissions growth in this sector:

- 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 international aviation in global emissions trading schemes and developing the evidence base for the possibility of including surface transport in emissions trading schemes in the future.

Scotland's National Transport Strategy (NTS), published in 2006, introduced three key strategic aims:

- improve journey times and connections;
- reduce emissions; and
- improve quality, accessibility and affordability.

The NTS includes a commitment to develop a Carbon Balance Sheet (now re-named The Carbon Account for Transport (CAT)). The CAT is to be used as a tool to monitor and review progress towards the NTS strategic goal of reduced emissions. The Transport (Wales) Act 2006 sets out the context for the development of a Wales Transport Strategy to cover the period up to 2030. The Wales Transport Strategy was published in 2008 and the National Transport Plan and the Transport Consortia's Regional Transport Plans are being developed and will set out how the Assembly Government will meet the objectives set out in the Strategy. It is anticipated that the final Regional Transport Plans will be in place by December 2009.

An integral feature of Northern Ireland's Regional Development Strategy is the Regional Transportation Strategy 2002-2012. A major aim of the RTS is to start a strategic move towards a balanced transport system.

[53] England and Wales share Building Regulations, Northern Ireland and Scotland have separate ones.

3.7.2 **Reducing the Fossil Carbon Content**

The Government published the Alternative Fuels Framework as part of the Pre-Budget Report[54] in 2003. This set out the Government's commitment to promoting sustainable alternatives for 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.

A Renewable Transport Fuel Obligation (RTFO) was announced in November 2005. The RTFO requires transport fuel suppliers to ensure a set percentage of their sales are from a renewable source. It was introduced in 2008, with the obligation set at 2.5 per cent in the first year (2008/09). Following the Gallagher review[55], which covered the indirect effects of biofuel production, the Government has proposed a more cautious rate of increase to reach a level of 5 per cent in 2013/14. It is estimated that the RTFO will lead to additional reductions of 5.2 $MtCO_2e$ by 2013/14. This figure uses the international agreed methodology to avoid global double counting of emissions and does not take into account emissions from the production of those biofuels that are produced abroad and used in the UK.

The UK Government will consult later in 2009 about the future implementation of the EU Renewable Energy Directive which will require 10 per cent of the energy used in transport to come from renewables by 2020. The Government is committed to achieving this target as long as it can de done sustainably. We are working with the European Commission to ensure that the mandatory sustainability criteria is as robust as possible and will seek ways of addressing the indirect effects of biofuel production within standards in the future. The target will require greater use of biofuels but there is also scope for electric and other low carbon vehicles to play a part in helping us meet this target, and the Directive will incentivise the use of second generation biofuels as there is provision that their contribution counts twice that of first generation biofuels.

3.7.3 **Improving the Fuel Efficiency of Vehicles**

Road transport accounted for 22.4 per cent of UK CO_2 emissions in 2007 and, of this, 63 per cent of emissions were from passenger cars. Improving the efficiency of vehicles is therefore a key element of the UK's strategy to reduce CO_2 emissions. Average new car CO_2 emissions improved by 15 per cent in the EU between 1995 and 2007 (the UK saw a similar 15 per cent improvement), however, this rate of improvement needed to accelerate. Therefore, in December 2008 the European Council and Parliament agreed mandatory CO_2 emissions targets for new cars registered in the EU. This set an EU-wide sales-weighted average target of $130gCO_2$/km by 2012 and, following lobbying by the UK Government, a longer-term target of $95gCO_2$/km by 2020. The 130g target represents a 18 per cent reduction on 2007 levels and the 95g target a 40 per cent reduction. It is anticipated that electric and plug-in hybrid cars, in addition to conventional hybrid cars will contribute towards these targets. In addition the Commission intends to deliver savings equivalent to another $10gCO_2$/km through other vehicle related legislative measures, such as addressing the rolling resistance of tyres and mandating gear-shift indicators in new cars. The Commission is also expected to bring forward a draft regulation on CO_2 emissions from vans in 2009.

This regulation builds on voluntary emissions targets implemented between the European Commission and car manufacturers (ACEA, JAMA and KAMA[56]) in 1998, as well as various fiscal measures undertaken by individual Member States. For example, in the UK the new car CO_2 regulation is supported by fiscal measures such as CO_2-linked Vehicle Excise Duty and Company Car Tax which provide incentives to purchase more efficient cars. Consumers are also provided with information on vehicle efficiency under the car labelling scheme and the Act on CO_2 campaign.

The potential environmental benefits, in terms of improving air quality and reducing greenhouse gas emissions, of all-electric vehicles (EV) and plug-in hybrid vehicles (PHEV), particularly as we move our electricity generating system to increasingly lower carbon sources, is well recognised. Indeed, the use of electricity generated from renewable sources will count towards the Renewable Energy Directive 10 per cent renewable energy in transport target.

To build the market for electric and plug-in hybrid cars, the Government will be making £250 million available from 2011 onwards for a system of incentives, supplementing the measures that are already in place.

As announced by the Secretary of State for Transport on 16 April, the bulk of the money will be used to create a scheme where pioneering

54 A summary of the UK Government's 2003 Pre-Budget Report is available from http://prebudget2003.treasury.gov.uk/ . The full report is available from http://www.hm-treasury.gov.uk

55 Gallagher Review can be found at: http://www.dft.gov.uk/rfa/_db/_documents/Report_of_the_Gallagher_review.pdf

56 ACEA: European Automobile Manufacturers Association, JAMA: Japan Automobile Manufacturers Association and KAMA: Korea Automobile Manufacturers Association

motorists will receive help worth in the region of £2,000 to £5,000 to buy electric and plug-in hybrid cars. We expect that a range of these cars will hit the showrooms, from 2011 onwards so the funds will be available between 2011 and 2014. To support this, up to £20 million will be available to develop an EV charging infrastructure framework to help consortia of cities, regions, private businesses and utility companies create a UK network of electric car cities. We will be setting out detailed eligibility criteria for both schemes later this year.

In addition to this, the Government is supporting research, development and demonstration of electric and other low carbon vehicles, investing over £120 million in the Technology Strategy Board's Low Carbon Vehicle Innovation Platform. Part of this platform includes a competition to demonstrate electric cars in the UK within the next 2 years. Around 200 electric and plug-in hybrid cars, from a number of global manufacturers will be on the UK's roads as a result of this programme – the winners will be announced shortly.

3.7.4 Encouraging a Move Towards Environmentally Friendly Means of Transport

The Government runs the promotional campaign *ACT ON CO_2*[57], part of which is focused on promoting smarter driving techniques and more fuel-efficient new car buying. The campaign highlights how individuals can save money and reduce their CO_2 emissions by using less fuel. The web portal has now been expanded to included a search tool allowing the comparison of CO_2 emissions and running costs of new cars and the potential savings compared to the 'Best in Class'. Alongside this, VCA is providing on its website[58] a new Fuel Consumption and Carbon Emission Database for all vehicles sold in the UK.

The Energy Saving Trust Scotland has launched a 3 year eco-driving campaign, which will also incorporate information about vehicle efficiency in Scotland. The Scottish Government has also started to benchmark the Scottish public sector fleet to identify potential criteria for vehicle renewal, scope for shared services and joint green procurement. This work will also feed into a conference planned for 2009 and a consultation on the development and uptake of low carbon transport as well as the development of an action plan for supporting the introduction of low carbon vehicles in Scotland.

To incentivise more fuel-efficient driving in the medium term, and provide an incentive for the development of more fuel-efficient, lower emitting cars, it makes sense to ensure that, where possible, the fiscal burden falls so that it helps to reduce harmful CO_2 emissions. The UK Government's 2008 Budget[59] therefore announced that the 20 pence per litre duty incentive for bioethanol and biodiesel will be maintained up to 2010 and its 2009 Budget[60] announced that fuel duty would increase by 2 pence per litre on 1 September 2009 and then by 1p per litre in real terms from 2010 to 2013. As well as helping to secure the public finances, this will also reduce CO_2 emissions by 2Mt per year by 2013-14.

In the 2008 Budget the Government announced the direction of future reform of Vehicle Excise Duty (VED) rates and bandings. From 1st May 2009, the increase in the number of VED bands to 13, to better incentivise a shift to 'best in class' cars and to reward drivers of lower emissions cars; and, higher first year rates (i.e. for new cars) in 2010-11 to better influence purchasing choices at the point of sale. The 2009 Budget confirmed commitment to environmental reform of VED for post 2001 cars. However, to reduce pressures on motorists during the current economic downturn, in 2009, no car will pay more than £5 extra, significant rate changes will be delayed until 2010, and no motorist will face a tax increase greater than £30 in 2010, many will see a £30 cut.

Provision of a company car, made available for an employee's personal use, is a Benefit in Kind that is subject to Income Tax (for the employee) and Employer NICs. Since being reformed in 2002, this tax is graduated according to the vehicle's CO_2 emissions – the less CO_2 the vehicle produces, the lower the benefit on which tax must be paid. By providing tax incentives to both employers and employees in favour of lower CO_2-emitting cars, graduated Company Car Tax will help the UK meet EU targets for average new-car CO_2 emissions.

As part of its strategy to improve public transport as an alternative to private road transport, the Government has spent heavily on the railways, over £4 billion in 2007-08. The UK now has one of the fastest growing railways in Europe and it is expected to continue to grow. The Government is considering how new technologies, such as regenerative braking, can improve energy efficiency and reduce fuel consumption to get even more environmental benefits from rail.

57 The Act on CO_2 web portal for transport can be accessed at: http://campaigns.direct.gov.uk/actonco2/home/on-the-move.html

58 Car Fuel Consumption and CO_2 Database can be accessed at the following link: www.vcacarfueldata.org.uk/information/cars-and-carbon-dioxide.asp

59 A summary of the UK Government's 2008 Budget is available from http://budget2008.treasury.gov.uk/. The full report is available from http://www.hm-treasury.gov.uk/bud_bud08_index.htm

60 A summary of the UK Government's 2009 Budget is available from http://www.hm-treasury.gov.uk/bud_bud09_index.htm

The Future of Transport White Paper[61] in 2004 gave local authorities greater power to determine the bus network. Greatly increased funding is also available for local authority expenditure on infrastructure schemes such as bus lanes and through rural bus grants and the urban bus challenge. In 2007-08 the Government and local authorities together spent around £2.5 billion on bus services.

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 Children, Schools and Families the Travelling to School initiative aims to have travel plans in every school in England by the end of the decade.
- The Sustainable Travel Towns initiative aims to create three showcase towns to act as models for other local authorities. Over five years, the Department for Transport is providing £10m funding for Darlington, Peterborough and Worcester between 2004 and 2009.
- Cycling England, with an annual budget of £140m for three years (2008-09 to 2010-11), has been set up as an expert advisory body. Its work programme includes £50m over 3 years for 18 cycle demonstration towns to provide investment for an increase in cycling.

The UK Government is examining how pricing could be used to manage congestion and reduce emissions. Together with complementary public transport and travel information, pricing could be an important part of demand management. It is prepared to invest up to £200m per annum between 2008/9 and 2014/15 from the Transport Innovation Fund to support schemes involving road pricing.

Launched on 17 March 2008, *Smarter Choices, Smarter Places* is a Scottish Government partnership project designed to increase active travel and public transport use and tackle transport emissions. Up to £15 million has been made available over the 3 years of the project. Seven successful proposals were announced in August 2008. Activities in these local authorities will include: better public transport services and residential improvements; upgrades in walking and cycling infrastructures; studies into travel patterns and access; intensive marketing and awareness campaigns; and workshops and information packs. Communities involved range from between approximately 10,000 in Kirkwall to 37,000 in Dumfries.

Other projects include:

- The Scottish Government is consulting on a *Cycling Action Plan for Scotland*, which aims to set a target for 10 per cent of all journeys to be by bike by 2020.
- To tackle the school run, the Scottish Government is promoting school travel plans and active travel projects through Sustrans' *Safe Routes to School* initiative. To date over 75 per cent of schools have or are delivering a travel plan.
- Funding to Regional Transport Partnerships to mainstream Smarter Choices and in particular travel plans in local authorities and health boards. All Local Authorities and Health boards have or are delivering a travel plan.

The Welsh Assembly Government has announced plans for developing Sustainable Travel Towns in Wales. These will target a series of focused, smarter choice, interventions that will encourage more people to walk and cycle and to use public transport. The Assembly Government also plans soon to introduce the Walking and Cycling Action plan that will encourage more people to use sustainable modes when making short journeys. The cross cutting nature of the Walking and Cycling Action Plan and the targets it contains should make a helpful contribution to meeting the Assembly Government's CO_2 targets, as well as engaging a wide range of organisations in their achievement.

3.7.5 Aviation

The UK Government contributes actively to international activity, in particular the International Civil Aviation Organisation (ICAO), to pursue efforts to develop measures to address emissions from international aviation.

The UK Government was instrumental in securing the inclusion of international aviation within the EU ETS. From 2012 all arriving and departing flights from EU airports will be covered by the EU ETS, with emissions initially capped at 97 per cent of average 2004-06 emissions, tightening to 95 per cent of average 2004-06 emissions from 2013. Any emissions above this cap will need to be accounted for by airlines securing reductions from other sectors within the EU ETS.

The UK Government considers the EU ETS an important first step towards the ultimate goal of a global mechanism to address international aviation emissions. The Government, with its EU colleagues, will continue to play an active role in negotiations towards the inclusion of international aviation in a global carbon market. In addition,

[61] The Future of Transport White Paper was published in July 2004, and is available from www.dft.gov.uk

the UK Government has introduced a number of domestic initiatives to address aviation emissions. In January 2009 the Government announced a new target to reduce total UK aviation CO_2 emissions in 2050 to below 2005 levels. It has asked the independent Committee on Climate Change (established by the Climate Change Act 2008) to advise on the basis for measurement of this target.

In Scotland, emissions from domestic and international aviation are included in the Scottish Government's Climate Change Bill.

The UK Government announced at the 2008 Pre Budget Report that it would reform Air Passenger Duty from two distance bands to four distance bands, to send a stronger environmental signal to passengers and the industry and to ensure that the sector contributes fairly to public services. The new banding system will come into effect from 1 November 2009 and means that passengers flying farther, and therefore contributing more to emissions from aviation, will pay more. This reform will result in savings of 0.6 $MtCO_2$ in 2011/12.

In addition to these high profile initiatives, the Government is also pressing for the tackling of aviation emissions through:

- the adoption of working practices by airports, airlines and air traffic controllers that minimise the impact of aviation;
- R&D by aerospace manufacturers to reduce the climate impact of future aircraft; and
- voluntary action by the aviation sector to control greenhouse gas emissions and develop sustainability strategies.

Carbon emissions from central Government air travel are also being offset, through the Government Carbon Offsetting Fund. Voluntary initiatives by airlines are also being welcomed.

Domestic sector

3.8.1 Policy Framework

A range of different approaches is required to improve domestic (residential) energy efficiency. Approaches include the provision of advice to consumers, financial incentives, building standards and voluntary agreements. The Government recognise that a step change in consumer attitudes and behaviour will be needed to tackle the trend towards rising energy demand.

3.8.2 Domestic Energy Efficiency Obligation

The Carbon Emissions Reduction Target (CERT) is the principal policy mechanism driving improvements in the energy efficiency of existing homes in Great Britain. It replaced the earlier Energy Efficiency Commitment (EEC) and its scope was broadened to allow obligated energy suppliers more flexibility in how they deliver their obligation. They meet their obligation by the installation of a range of approved measures including, insulation, boilers, low energy light bulbs and micro-generation. Suppliers must deliver at least 40 per cent of their obligation in the homes of low-income consumers in receipt of qualifying benefits and those aged 70 years and over.

The first phase of the EEC ran from April 2002 until March 2005 and is estimated to deliver savings of 1.1 $MtCO_2$ by 2010. The second phase of EEC ran from April 2005 until March 2008 and is estimated to deliver savings of 2.1 $MtCO_2$ by 2010. It has been very successful, with insulation delivered to over 4 million households and other energy saving measures to millions more.

Evidence suggests that the supplier obligation has delivered greater savings to consumers than the cost to consumers, suppliers and government collectively. An independent evaluation of the 2005-08 phase estimated that £0.92 billion energy supplier investment in energy efficiency delivered a net present value benefit to householders of £8.3 billion. These savings were delivered at a cost to the average UK consumer of 2.0p/kWh electricity and 0.6p/kWh gas; representing around 20 per cent of total electricity and 20 per cent gas costs (average 2006 consumer prices). These are significantly less than the consumer prices of these fuels.

The Prime Minister announced a Home Energy Saving Programme in September 2008 which included an increase to the current obligation – the CERT – by 20 per cent. The Government is now consulting on bringing forward legislation in order to implement this commitment. In practice the increase means a revised supplier carbon target of 185 Mt CO_2 savings over the lifetime of the measures (on average about 35 years), equivalent to annual net savings of 5.3 $MtCO_2$. It also means CERT is expected to drive supplier investment into energy efficiency of UK homes of some £3.2 billion by March 2011.

The Scottish Government in 2008 established the Scottish CERT Strategy Steering Group, chaired by the Minister for Housing and Communities, to work in partnership with the energy suppliers to ensure that Scotland receives its proportionate share of CERT activity under the current scheme

and to ensure closer alignment of CERT support and Scottish Government energy efficiency, housing and fuel poverty programmes.

The Scottish Government is implementing an area based Home Insulation Scheme (HIS) supported by £15 million of new investment in 2009/10, with an expectation that up to a further £15 million will be raised from other sources. The scheme aims to increase the take up of energy advice and insulation measures in selected areas to reduce emissions, tackle fuel poverty, reduce household bills and sustain jobs.

3.8.3 Building Regulations

Building Regulations[62] are steadily driving up the energy standards of new and refurbished homes. Since 1990, the energy efficiency of new homes has increased by over 80 per cent. The 2002 revision of the Building Regulations is expected to deliver reductions in emissions in 2010 of 3.7 $MtCO_2$ per annum.

In April 2006, further changes to the Building Regulations came into force to make buildings more energy efficient. The average energy efficiency improvement required in dwellings was 20 per cent in comparison to 2002 standards. One provision of the revised Building Regulations came into force in April 2005, requiring all new gas boilers to be at least B-rated condensing boilers, subject to some exemptions. For oil boilers the requirement came into force from April 2007. This measure and the 2006 Building Regulations are expected to provide 1.9 $MtCO_2$ savings per annum.

The Building Regulations do not address the fabric of a significant proportion of the existing building stock. The Government is currently undertaking work assessing how best to implement measures to improve the sustainability of the existing building stock, including energy efficiency and low carbon heat measures. A consultation on this will be released imminently.

As part of the 2006 Building Regulations revisions, the Government engaged in a substantial dissemination programme aimed at ensuring that all stakeholders could acquaint themselves with the changes. This programme aimed at achieving greater compliance with the Regulations. A requirement for sample air leakage testing of buildings has also been introduced to help secure better compliance.

The Government announced in 2007 that it intends to seek progressive improvements in the performance standards of Part L of the Building Regulations (the energy efficiency requirements) of 25 per cent in 2010 and 44 per cent in 2013, and for all new homes to be net zero carbon by 2016. In December 2008 the Government consulted on the detailed definition of zero carbon homes. A further policy statement is due to be issued this year reflecting the outcome of the consultation.

Scottish building regulations are devolved. In 2007, Scottish Ministers appointed an expert panel to advise on measures to improve energy performance and reduce carbon dioxide emissions in Scotland's buildings. The findings of the panel were published in December 2007 as the Sullivan Report[63] – 'A Low Carbon Building Standards Strategy for Scotland'. The Report includes recommendations for staged improvements to energy standards in building regulations in 2010 and 2013 with the goal of net zero carbon buildings by 2016/17. Work is presently underway on a review of energy standards for 2010, taking forward policy proposals to reduce CO_2 emissions by a further 30 per cent for new domestic and non-domestic buildings.

In Scotland, the building regulations and associated guidance were amended in 2007, with improved energy standards, requirements for accessibility that adopt Lifetime Homes principles. In 2008 the Scottish Government consulted on proposals for demanding requirements to reduce noise transmission, and various other sustainability measures including surface water drainage. A consultation on future energy standards is proposed in 2009.

3.8.4 Code for Sustainable Homes

The Code for Sustainable Homes[64] became operational in April 2007. It is the national standard for the design and construction of sustainable new homes. It covers a range of environmental impacts including, but not exclusively, energy, water and waste, and resistance to flooding. The Code has a number of mandatory standards, notably energy and water efficiency at every level of the Code. This ensures that builders cannot trade mandatory elements for other kinds of improvements. The Code is operational in England, Wales and Northern Ireland.

Like Building Regulations, the Code is outcome based and does not require any particular technology or techniques. This flexibility is allowing industry to innovate and find the best solutions for future regulations – such as the 2016 Zero Carbon target.

62 England and Wales share Building Regulations, Northern Ireland and Scotland have separate ones.

63 http://www.sbsa.gov.uk/sullivanreport.htm

64 http://www.planningportal.gov.uk/england/professionals/en/1115314116927.html

The Code is currently being reviewed in light of changes to Part L (Energy Efficiency) of the Building Regulations to ensure consistency of minimum requirements.

In England all new homes designed and built with Government funding or on Government land have to meet Code level 3. Planning policy also allows local authorities to require levels of the Code if there is specific reason on a particular development.

From April 2008 all new social housing in Northern Ireland will be built to Code Level 3 and the Welsh Assembly Government is also promoting the Code for Sustainable Homes as the assessment framework for new housing and requiring at least Code Level 3 for all new housing that is influenced through grant funding, investment and land disposals; moving to higher levels as quickly as possible.

3.8.5 Energy Performance of Buildings Directive

The UK completed implementation of the EU Energy Performance of Buildings Directive (EPBD) on 1st October 2008. The Directive requires: the application of minimum standards for the energy performance of new buildings and those large existing buildings undergoing major renovation, the provision of energy performance certificates and improvement recommendations when buildings are constructed, sold or rented out and the display of certificates in public buildings over 1000m^2.

The Directive also requires regular inspections of air conditioning systems installed in buildings. Member States must also ensure that there are either regular inspections of large boilers or that advice is available to users on replacements and modifications to the system. It is estimated that the effect of this, including the early replacement of boilers brought about by advice could deliver additional savings of up to 5.9 $MtCO_2$ in 2020.

The European Commission has published a proposed recast of EPBD. This would extend the scope of the original Directive, strengthen certain provisions, and clarify other aspects. It gives the public sector a lead role in improving the energy efficiency of its building stock. It is proposed that provisions that relate to public buildings are implemented by 31 December 2010 and other provisions are implemented by 31 January 2012. An Impact Assessment has been commissioned and is expected to be completed shortly.

In Scotland, Article 7 of the EPBD (Energy Performance Certificates) was implemented in May 2007 for new buildings. Implementation was completed in December 2008, for the sale of dwellings as part of the Home Report, and in January 2009 for the sale or rental of any building and for display of certificates in public buildings with an area greater than 1000m^2.

In line with other parts of the UK, advice has been developed in partnership with the Carbon Trust and Energy Saving Trust. A report on the 'equivalence' aspect of delivery in relation to Article 8 was submitted to the EC in January 2008. Legislation for the introduction of inspections for air-conditioning systems (Article 9 of the Directive) was introduced on 1 May 2007. Air-conditioning inspections cover the assessment of the efficiency and the sizing of the system compared to the cooling requirements of the building and promotes the improvement of the energy performance of buildings. For existing buildings, inspections will be phased in as follows:

- For all systems with an effective rated output of more than 250 kW, from 4 January 2009 with first inspections completed by 4 January 2011;
- For all other systems with an effective rated output of more than 12 kW, from 4 January 2011 with first inspections completed by 4 January 2013.

3.8.6 Raising Product Standards and Encouraging Consumer Engagement

Government targets for saving energy in households depend on a policy package which seeks to remove the least efficient products from use, and builds markets for the most resource efficient goods and services, for example, via the provision of information to consumers, both through the labelling of products and wider consumer education. It is also important that manufacturers and retailers are engaged in the process of setting this up and helping to drive up product performance standards.

The Government's Market Transformation Programme (MTP)[65] works with stakeholders to drive and underpin sustainable improvements in the energy efficiency and other environmental characteristics of products.

The 2007 Energy White Paper committed the Government to deliver between 3.7 $MtCO_2$ and 11 $MtCO_2$ savings from products by 2020. Good progress is being made to date. For example via measures developed in the EU Eco-design of Energy Using Products (EUP) framework Directive which has already established ambitious standards for 11 product groups with a further 2 expected by the end of June 2009. While the focus of the Directive is on setting mandatory standards, a clear intention is to encourage voluntary action by manufacturers.

65 http://www.mtprog.com/

The Government is also continuing to pursue other measures which include:

- industry voluntary agreements such as the Code of Conduct for data centres ;
- embedding product standards in Building Regulations;
- product endorsements via schemes such as the EST's *Energy Saving Recommended* logo; and
- public procurement policy.

Statutory labels[66] provide relative performance information for traded goods and are established at the EU level, but supported by national schemes.

The MTP and appliance standards and labelling are expected to contribute savings of 0.7 $MtCO_2$ annually by 2010 to the with-measures projections.

3.8.7 Consumer Engagement

ACT ON CO_2, launched in 2007, is a major Government-led multimedia campaign (including advertising, face-to-face events, partnerships and so on) which aims to engage citizens on climate change issues, address the confusion and powerlessness which can impede people from taking action, and encourage genuine and sustained behaviour change to help reduce CO_2 emissions and meet UK emissions targets. The ACT ON CO_2 brand is government-led and multi-partnered. It aims to help provide clarity and consistency across different communications.

The ACT ON CO_2 website aims to signpost, interact, coordinate and engage consumers on climate change, providing a clear, consistent, authoritative and credible voice. The website allows other government departments to build and add further climate change information as and when necessary.

The award-winning Act on CO_2 calculator has received over 1.5 million unique visitors since its launch in June 2007. Further enhancements are being added to allow users to calculate their CO_2 emissions from renewable technologies and public transport as well as providing an interactive results and action plan. This is an integral part of the Government's strategy to engage with and educate the public as part of the mobilisation of society to adopt low carbon lifestyles.

Independent research shows that 73 per cent of people say they have taken or are planning to take action to reduce their CO_2 emissions as a result of the campaign – an increase of 23 percentage points since summer 2007. There have been around 600,000 unique visitors to the campaign website between September 2008 and May 2009 and almost 400,000 calls to the ACT ON CO_2 advice line run by the Energy Saving Trust, from September 2008 to February 2009, which is double the number of calls over the same period in 2007/2008.

The ACT ON CO_2 campaign won two Green Awards in 2008 in best audio visual and best integrated campaign, adding to the two it won in 2007.

3.8.8 The Climate Change Initiative

The success of the ACT ON CO_2 campaign built on the achievements of the Climate Change Communications Initiative (CCCI) which was launched in 2005 to raise awareness of the issue and inspire collective action.

Defra developed an environmental segmentation model, predominantly used for advising policy and communications development. It is based on people's responses to a broad range of attitudinal questions which were included in Defra's 2007 Attitudes and Behaviours Towards the Environment Survey. The model divides the public into seven clusters each sharing a distinct set of attitudes and beliefs towards the environment, environmental issues and behaviours. There has been a recent increase in the number of research projects and government bodies using the model. In addition, a web based tool, designed for use by a range of stakeholders to inform the public of which segment they best fit into and how they can make environmental changes, is currently in development.

The work of the Initiative included the initial development of the web-based Act on CO_2 calculator, two short filler films, a DVD/booklet pack *Climate Change: Your guide to inspiring action*, which gives guidance to those wishing to encourage individuals to take action to tackle climate change (and is still available), and 83 local and community-level communications projects led by local government and the third sector.

Over 6,000 hard copies of our first booklet *A Guide to Communicating Climate Change* were distributed – including to a large number of

66 The mandatory EU Energy label currently covers domestic refrigeration, washing machines, electric tumble dryers, washer dryers, dishwashers, lamps, electric ovens, air conditioners and televisions

community and local organisations. The current version of the booklet, *Climate Change: A Guide to inspiring Action*, was launched on 5 June 2007 and over 2000 copies have been distributed to companies, schools, councils, public bodies, NGOs and individuals.

The Climate Challenge Fund sponsored 83 wide ranging projects with grants totalling £8.5M over two years. These projects generated over 700,000 promotional items, 140,000 visits to websites and direct contact with over 60,000 people at exhibitions, with overall direct engagement on almost 450,000 occasions. There were also over 24 million opportunities to communicate climate change through posters and billboard advertising.

3.8.9 **The Energy Saving Trust**

The Energy Saving Trust (EST) is grant-funded by the Department of Energy and Climate Change, the Department of Transport and the Devolved Administrations, as well as by the EU and the private sector. EST activities are designed to underpin and complement the work of other actors in carbon abatement markets: increasing demand for a low carbon lifestyle through raising awareness, providing advice and support for action. They also support the supply of carbon abatement products and services to meet this demand by developing partnerships, stimulating innovation, supporting training and providing accreditation.

A key part of the EST programme for 2008/09 is the Act On CO_2 advice line and nationwide network of regional advice centres which provides the consumer with comprehensive and tailored advice on how to reduce their carbon footprint. The one-stop-shop offers consumers a range of free and impartial advice on energy efficiency, microgeneration and renewable energy, low carbon transport, water efficiency and waste reduction and a range of independent services that will help them action that advice.

In a similar approach in Scotland, the Scottish Government funds the EST to manage the network of Energy Saving Scotland advice centres. In addition to energy efficiency, microgeneration and sustainable transport advice to the domestic and small business sectors in Scotland, the network of advice centres will now also deliver the new Scottish Government fuel poverty programmes through the new Energy Assistance Package.

The Welsh Assembly Government provided funding to the EST to bring forward the rollout of its enhanced energy advice service in Wales. The Welsh Assembly Government is also currently running a major climate change campaign, which informs people across Wales about the daily actions which contribute to climate change, encourages people to measure their carbon footprint and provides information on how to reduce it. The campaign uses a number of media, including television, radio, the internet, and street advertising, both stationary and on buses.

3.8.10 **Billing and Metering**

Smart meters perform the traditional meter function of measuring energy consumption, but they also store consumption data and transmit this to energy suppliers (or other third parties). The data collected can be used to provide consumers and their energy suppliers with detailed and accurate real-time feedback on their energy use.

The Government believes smart meters will play an important role in our transition to a low-carbon economy, and in helping to meet some of the long term challenges we face in ensuring affordable, secure and sustainable energy. Consumers will have more control over their own energy use and carbon emissions, and new opportunities will be opened up for energy retail services, infrastructure management and renewable energy generation.

The Government announced in October 2008 that it intends to mandate a roll-out of smart meters to all domestic customers, with an indicative timetable for completion of the roll-out by end 2020. It estimated that this will result in annual reductions in UK emissions of about 2.6 million tonnes of CO_2 by 2020. There are two elements to this reduction. The first will be annual savings of about 1.6 million tonnes of CO_2 (from reductions in residential combustion of natural gas); in addition, UK will be better off, annually, to the extent of about 1 million tonnes of EU Emissions Trading Scheme (ETS) CO_2 allowances which we would, otherwise, have needed to buy. This latter amount does not however represent a reduction in global CO_2; it is a redistribution of emissions within the pre-set EU ETS ceiling of CO_2.

For non-domestic customers, the Government has already announced (in the Budget 2008) a roll-out of advanced metering to larger consumers over a five year period starting in April 2009. We estimate that this will result in annual carbon savings by 2020 of about 0.5MtCO_2, made up of about 0.1MtCO_2 in the traded sector and 0.4MtCO_2 in the non-traded sector. For smaller non-domestic customers, the Government consulted on metering for the sector last year and the Government's response will follow.

3.8.11 **Tackling Fuel Poverty**

Fuel poverty is caused by a combination of energy inefficient housing, high energy prices and low incomes. Although the number of fuel poor households has fallen between 1996 and 2003 increases in energy price rises reversed this trend. To counter this £4.5b has been committed between 2008-11 to provide vulnerable households with energy efficiency and other measures. Warm Front[67] alone, which provides vulnerable households in England with efficient heating and insulation measures, will receive £970m of funding over this period. It is estimated that Warm Front delivers 1.8 $MtCO_2$ savings per year, and up to March 2008, about 7 $MtCO_2$ cumulative savings had been achieved.

The Welsh Assembly Government is reviewing its fuel poverty strategy and the role that the Home Energy Efficiency Scheme (HEES) plays in alleviating fuel poverty as part of the One Wales commitment to a National Energy Efficiency and Savings Plan, and the 3 per cent annual carbon reduction target in areas of devolved competence. To date, more than £100 million has been spent through HEES, helping more than 100,000 householders to save an average of £220 a year. The Welsh Assembly Government have recently appointed an independent Chair to lead the Fuel Poverty Advisory Group (FPAG). The group consists of external stakeholder representatives and will provide advice on the review of the Fuel Poverty Strategy.

The introduction of the Welsh Housing Quality Standard in May 2002 provides a common target standard for the physical condition of all existing social housing within Wales to be achieved by 2012. Welsh Housing Quality Standard provides for the annual energy consumption for space and water heating to be estimated using the SAP (Standard Assessment Procedure) method and specifies the minimum ratings to be achieved. Through the Development Quality Requirements, the Welsh Assembly Government requires that all new build social housing that it funds meets a minimum standard of at least Code for Sustainable Homes Level 3. Development Quality Requirements are the published design standards for all new housing built by Registered Social Landlords in Wales receiving Social Housing Grant.

Agriculture, forestry and land management

3.9.1 **Policy Framework**

The UK Government and Devolved Administrations are currently developing a policy framework to reduce all GHG emissions from the agriculture, forestry and land management sector to enable the sector to fulfil its potential in contributing to climate change mitigation.

The respective Governments are also working directly with the sector to raise awareness and encourage behaviour change. One of the ways in which it is doing this is through the high-level Rural Climate Change Forum (RCCF), which brings together the key organisations in England with an interest in the rural sector. The Forum helps to raise awareness of climate change among farmers land managers and the forestry sector, acts as a catalyst and coordinator of work on climate change in the rural sector, advises Government on rural climate change policies, helps ensure that policies are sufficiently ambitious and will lead to real results, and advises on research priorities to build a stronger evidence base on reducing greenhouse gas emissions from agriculture and managing the impacts of a changing climate. The work of the Forum is central to the UK Government's Agriculture and Climate Change work-stream, under the Farming for the Future Programme. The Government is also working with the sector to drive faster growth in the update of anaerobic digestion. All this work is supported by a strong Farming and Food Science Programme which includes a specific programme of research on agriculture and climate change.

The Scottish Government continues to fund an expanding range of research to understand the role of land use in greenhouse gas emissions and their mitigation, and on adaptation to the impacts of climate change, for example impacts upon biodiversity, water, soils, and the implications for ecosystem functioning, adaptation of farming systems (including crops, livestock and their diseases), changes in land capability under climate change, land use planning for delivering integrated responses across sectors, the costs and benefits of biomass energy crops, the role of forestry in relation to carbon sinks, changes in consumer demand in the move to a low carbon economy, visualisation of future landscapes and stakeholder perceptions of these changes, understanding policy instruments to reduce GHG emissions, evaluation of uncertainty related to climate scenarios and the scope for risk-based approaches.

67 The Warm Front Scheme is the Government's main grant-funded programme for tackling fuel poverty. It installs energy efficiency measures, including central heating and insulation, into vulnerable private sector households. The Scheme provides a grant of up to £3,500 for families and the disabled and a grant of up to £6,000 where the work approved is for the installation of an oil fired central heating system.

In May 2008, the Graham Report was published by the Scottish Government. This was the output of a Stakeholder Group, Chaired by Henry Graham, which looked at the main issues relating to agriculture and climate change in Scotland. Following on from this, advice to farmers is being formulated and communicated through an Agriculture and Climate Change Project within the Scottish Government. The focus of this Project is on practical measures that farmers and crofters in Scotland can take to reduce their greenhouse gas emissions.

In Wales, the report *Sustainable Farming and Environment – Action towards 2020* recommends that action is taken by the Welsh Assembly Government to achieve carbon neutral status for agriculture by 2020.

Through the Cambrian Mountains Initiative, Welsh Assembly Government is working with the Countryside Council for Wales, Environment Agency Wales and Forestry Commission to implement an ecosystems services approach that includes conserving soil carbon, reducing emissions, and ways to adapt to climate change.

Under the new Farming Connect Climate Change theme, Welsh Assembly Government will promote nutrient and resource management planning and best practice advice and ensure that adherence to the Code for Good Agricultural Practice (COGAP) occurs. The Welsh Assembly Government will use Farming Connect farm development programmes to deliver technical efficiency methods for the dairy, beef, sheep, arable and horticulture sectors to deliver emission reductions. It will also encourage farmers to take stock of farm emissions by use of an on-farm carbon-accounting tool which is part of the new agri-environment monitoring contract.

The current Northern Ireland Rural Development Programme comprises a range of agri-environment schemes including the Countryside Management Scheme, the Environmentally Sensitive Area Scheme and the Organic Farming Scheme.

3.9.2 Common Agricultural Policy

3.9.2.1 *Recapturing the Environmental Benefits of Set-aside*

The CAP Health Check agreement reached by the Agriculture Council in November 2008 includes, among other changes, action to abolish compulsory set-aside but also provides the basis of a legal framework to recapture the environmental benefits of set-aside for water protection and habitats. In England proposals to recapture these benefits are out for consultation and under all options a small proportion of land (approximately 5 per cent of the arable area) should be managed in ways that are beneficial to biodiversity or water quality. The proposals will reduce greenhouse gas emissions from land that has been brought back into production following the 0 per cent set-aside obligation set in 2007, mainly through reduced cultivation of, or nutrient input to, these areas.

3.9.3 Reducing Nitrous Oxide Emissions

The use of inorganic nitrogen as a fertiliser is a major source of nitrous oxide, which can also arise from manures during storage. The practices needed to reduce these emissions are, in many cases, similar to those required to address other negative impacts of the use of nutrients.

The Government is improving the advice it gives concerning nutrient management planning and the efficient use of fertiliser and manures.
In January 2009 under the revised Nitrates Action Programme it published *Protecting our Water, Soil and Air: A Code of Good Agricultural Practice for farmers, growers and land managers* (the CoGAP) which offers advice on minimising risk to pollution while protecting natural resources and allowing economic agriculture to continue.
The Government is also updating the Fertiliser Manual (RB209) which will act as a key point of reference in support of a range of policies aimed at improving nutrient management on farms.
The Government also offers the PLANET decision support software which is the industry standard software tool for helping farmers and advisers plan and record their nutrient applications. PLANET is a computerised version of the RB209 book.

3.9.4 Reducing Methane Emissions

Emissions of methane result from diffuse sources and through variable biological processes. Research funded by the UK Government is examining a range of options for decreasing emissions from dairy cows in a programme costing some £5m per year. Areas currently being researched include: ruminant nutrition regimes to reduce enteric methane and nitrogen emissions from livestock, research to improve the productivity of dairy cattle and a study to assess the level and type of farming activity in the livestock sector that UK resources can sustain in order to reach UK GHG and ammonia targets. This work is all part of our broader aim of achieving a thriving farming and food sector with an improving net environmental contribution.

3.9.5 Anaerobic Digestion

The Government is committed to making the most of the potential of anaerobic digestion to contribute to our climate change and wider environmental objectives. The UK Biomass Strategy, published in May 2007, includes details of how we propose to

work with stakeholders to drive a faster growth in the use of this technology. Complementary to this, the Waste Strategy for England, also published in May 2007, sets out the important contribution which anaerobic digestion can make to achieving our waste management goals, with this being a particularly beneficial technology for treating separately collected food waste. Our objective is to stimulate and develop the markets for anaerobic digestion and its products, and to address the administrative and technical challenges which may hamper its development.

In February 2009, the Government published "*Anaerobic Digestion: Shared Goals*". This document sets out the shared goals that businesses, regulators, Government and other stakeholders aim to achieve by the cost effective, innovative and beneficial use of anaerobic digestion in England. Government is now working with these actors to develop an Implementation Plan. This will set out the practical measures that each of us will take individually and collectively to achieve these goals.

The Budget of April 2009 announced an additional £10m funding for UK food waste infrastructure. For Defra this means new investment of £8.4m for grants for developing reprocessing facilities for food waste. This will be administered by WRAP (the Waste & Resources Action Programme) under their existing Organics Capital Programme, creating jobs and enabling new composting and anaerobic digestion facilities to be built.

The UK is taking a leading role in driving forward thinking about the role of anaerobic digestion internationally, in particular through the international Methane to Markets Partnership and in its bilateral programme of collaboration with China on sustainable agriculture. The UK is also looking to learn from and share experience with other countries through, for example, the International Energy Agency (IEA) Bioenergy Implementing Agreement on biogas (called *Task 37*).

In addition the Waste Strategy for England 2007 sets out the important contribution which anaerobic digestion can make to managing wet, organic wastes, especially separately collected food waste of which there is around 10 Mt per year.

The Welsh Assembly Government is actively promoting a role for anaerobic digestion as part of its new Waste Strategy which will be published for consultation later in 2009.

3.9.6 **Rural Development Regulation and Environmental Stewardship**

Rural Development Programmes for Scotland, Wales, Northern Ireland and England are being implemented using expenditure under the EU Rural Development Regulation for 2007-13, of which Environmental Stewardship is a key part. Addressing climate change is a key element of these Programmes

The Welsh Assembly Government is currently considering responses to its consultation on Axis II agri-environment programmes. The consultation provides three options with a strong focus on building carbon stores through reversion to semi-natural / wet habitats of more unproductive species-poor marginal grassland, as well as the re-wetting of some large scale areas of organic soils in the uplands.

3.9.7 **Energy Efficiency**

The intensive pig and poultry farming sectors have been involved in climate change agreements since 2001, and the horticulture sector has been in the scheme since 2006. Under the CCA scheme these sectors have agreed challenging energy efficiency targets in return for receiving an 80 per cent discount from the climate change levy.

3.9.8 **Non-Food Crops**

The UK Biomass Strategy, launched in May 2007[68], is intended to realise a major expansion in the supply and use of biomass in the UK and facilitate the development of a competitive and sustainable market and supply chain. It brings together Government policies on biomass for energy, transport and industry. It incorporates a refocused Non-Food Crops Strategy Action Plan[69] and builds on the Government's response to the 2005 Biomass Task Force Report.[70]

The Strategy highlights four priority areas: bioenergy (heat power and transport fuels), renewable chemicals, renewable construction materials and plant based pharmaceuticals. A number of measures are being taken forward by the UK Government to develop these sectors, including support for research, communications and dissemination of information and supply chain development. The production of biomass, including purpose-grown energy crops, is encouraged through support schemes. In England, the Energy Crops Scheme, provides planting grants to farmers. The Bio-energy Infrastructure

68 http://www.defra.gov.uk/ENVIRONMENT/climatechange/uk/energy/renewablefuel/pdf/ukbiomassstrategy-0507.pdf

69 http://www.defra.gov.uk/environment/climatechange/uk/energy/renewablefuel/pdf/nonfoodstrat-2yearreview.pdf

70 http://www.defra.gov.uk/farm/crops/industrial/energy/biomass-taskforce/pdf/btfreport-govresponse.pdf

Scheme gives grants to farmers, foresters and businesses to help develop the supply chain required to harvest, process, store and supply biomass fuel to heat and electricity end-users.

It is estimated that the use of non-food crops for the production of renewable materials and products for industrial applications led to annual carbon savings of 0.14 million tonnes of CO_2 in 2005. This figure is predicted to rise to 0.32 Mt CO_2 and to 0.87 by 2010 and 2020 respectively.

Scotland is well placed to develop the use of bio-energy as it has significant forest resource. There is a growing demand from the bioenergy sector for forestry material. In response to the growing demand Scottish Ministers set up the Woodfuel Taskforce which published it findings in January 2008. The Scottish Government has responded by identifying 25 actions to be implemented to ensure the biomass resource will be available to the renewable energy sector now and in the future.

In Scotland a range of financial support is available to help grow the sector including support for supply chain development and installation for biomass boilers.

3.9.9 **Sustainable Forestry Policy**

UK forestry policy is devolved to the four countries that comprise the United Kingdom. All four countries have established policies for woodland creation, co-financed through the EU Rural Development Programme. In Scotland, climate change mitigation is a specific objective of woodland creation and the Climate Change Action Plan associated with the Forestry Strategy aims to increase levels of woodland creation for this purpose. To complement afforestation, a framework to better control woodland removal has also been developed. England, Scotland and Wales also have established Woodfuel Strategies that aim to maximise the contribution of both existing and new woodlands to renewable energy production. For example, the supply of small to medium scale heat in off gas grid areas is the focus of Forestry Commission England's Woodfuel Strategy, which aims to bring an additional 2 million green tonnes from under-managed woodlands to market , annually, by 2020, saving 400,000 tonnes of carbon dioxide a year. Both England and Scotland are establishing short rotation forestry trials to evaluate the commercial viability and environmental/social sustainability of such plantations.

In addition to promoting woodland creation and associated carbon sequestration through public subsidy, the contribution of private finance is being encouraged through the development of a Code of Good Practice for UK-based forest carbon management schemes. This Code aims to increase confidence in forest based carbon projects and lead to enhanced rates of afforestation.

Public sector

3.10 The public sector is in a key position to lead on carbon emission reduction by setting a behavioural and strategic example to the private sector. The Government estate aims to set a leading example, for instance, by working to meet SOGE Targets (Sustainable Operations on the Government Estate) which include 'Climate Change & Energy' targets.

3.10.1 **The Government Estate**

The Government estate aims to set a leading example, for instance, by working to meet SOGE (Sustainable Operations on the Government Estate) targets. A number of the targets have already expired or are due to expire in 2010/2011. Government has therefore initiated a review of the SOGE framework to ensure that it continues to allow Government to demonstrate leadership on this agenda.

3.10.2 **The Role of Local Government**

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 (including housing, spatial planning and local transport) they can have significant influence over emissions in their local areas. To improve the contribution from local government to mitigating climate change, the Government introduced climate change mitigation indicators in the local government performance framework for the first time in 2008. Under National Indicator (NI) 185, local authorities in England will be required annually to report performance in reducing emissions of carbon dioxide from their operations (including buildings and vehicles). Under NI 186, performance in reducing per capita carbon dioxide emissions in local authority areas will also be reported.

Around two-thirds of Local Area Agreements (performance agreements for local authorities and their partners that are negotiated with Government in England) contain targets that are set against NI 186, while around one quarter include targets against NI 185. We believe that these targets will deliver substantial emissions savings, but even local authorities without targets against these indicators can be expected to

intensify the effort that they are expending on emissions reductions for reputational and cost saving reasons.

Tailored support is provided to local authorities across the UK for mitigating climate change by both the Carbon Trust and the Energy Saving Trust. Broadly speaking, the Carbon Trust focuses on support for reducing emissions from local authority operations, while the Energy Saving Trust offers support on reducing emissions from the wider community (NI 186), especially housing and transport. Local authorities can also benefit from the Salix Finance 'lend to save scheme' (see section on the public sector below).

The Scottish Government funded a similar scheme in Scotland through the Central Energy Efficiency Fund (CEEF) providing £20 million to Scottish Local Authorities, the NHSScotland and Scottish Water through a revolving interest free loan scheme for the capital investment in energy efficiency. In 2008 the Scottish Government awarded a further £4 million, managed through Salix Finance, for the Further and Higher Education sector in Scotland. From 2009 the public sector bodies involved in these funds can also use these loans for investment in renewable technologies.

In 2008 the Government launched a £4m climate change best practice programme to help local areas perform well against the climate change indicators in the local government performance framework for England and Wales. The programme is being delivered largely through the new Regional Improvement and Efficiency Partnerships (RIEPS), established with £185m of Government backing, which are voluntary regional partnerships of local authorities. RIEPS plan and manage their own improvement and efficiency needs, which can include support for tackling climate change beyond the best practice programme.

An additional incentive for local authorities across the UK to reduce their emissions will be provided by the Carbon Reduction Commitment (see section on the CRC).

It is anticipated that the local authority impact on climate change mitigation will make itself most felt in influencing national policies, such as CERT and CESP. The effect of purely local initiatives is likely to be less significant. It is estimated that by 2010 national policies will have reduced levels of carbon dioxide from 2005 levels by 4.7 per cent while purely local measures will result in 0.4 per cent reduction. By 2020, it is estimated that national policies with local influence will have reduced emissions by 12 per cent, with local measures being responsible for a 0.6 per cent fall.

In Scotland, all local authorities have signed Scotland's Climate Change Declaration and committed to taking action on climate change. A number of partners, including the Scottish Government, Sustainable Scotland Network, Convention of Scottish Local Authorities and Society of Local Authority Chief Executives (SOLACE) Scotland, are involved in developing a programme of support to assist local authorities take forward the Declaration commitments.

All of Scotland's local authorities are engaged with the Carbon Trust and have either completed or are going through their Carbon Management Programme. A number of other public sector bodies, including the Scottish Government's own estate, have either undertaken or are actively engaged in this programme.

3.10.3 **Regional Development Agencies and Regional Economic Strategies**

England's nine Regional Development Agencies (RDAs) provide a strategic direction for economic development in their region and work together to ensure that economic performance throughout England is evenly spread. They also support business development and competitiveness by encouraging public and private investment and have a role in improving education and skills levels. RDAs are aware of the increasing importance of addressing climate change and operate under a framework which specifies that they must adhere to achieve sustainable development.

RDAs are building into their activities a wide range of climate change mitigation measures that assist them to achieve sustainable development; from promoting business resource efficiencies and new environmental technologies to supporting low carbon physical regeneration and local food and agriculture sectors.

RDAs are also responsible for drawing up Regional Economic Strategies (RESs), in consultation with regional partners, which provide the overall strategic direction for the region's economic development. RESs contain a strong emphasis on sustainability and recognise the importance of addressing climate change. For example, the West Midlands RES has a strong focus on meeting the challenges and taking the opportunities of developing a low carbon economy.

As part of their role in delivering the priorities in the 2007 Energy White Paper at a regional level, RDAs have committed to:

- Set carbon budgets in their corporate plans; publish estimates of the carbon they expect to save from their policies and programmes by 2010 and 2020;

- Set out (by December 2007) which energy technologies they intend to prioritise and support over the next 10 years;
- Identify energy supply chain opportunities and set out priorities for promotion and support;
- Support small and medium-sized businesses on energy efficiency;
- Work with Sector Skills Councils and Regional Skills Partnerships to develop programmes to support the development of key energy skills;
- Ensure all regeneration projects and other developments for which RDAs provide funding for and meet carbon emissions standards significantly in advance of those required by Building Regulations (e.g. at least 10 BRE Environmental Assessment Method (BREEAM) carbon credits); and
- Play a key role in advocacy for the development of critical energy infrastructure and provide support through monitoring and advice on strategic proposals.

Multi Area Agreements

Multi Area Agreements (MAAs) were introduced in the 2006 Local Government White Paper and comprise of local authorities that share a common interest across a region. MAAs facilitate cross boundary collaboration in relation to economic development issues. By March 2009 there were eighteen MAAs either in force or awaiting sign off by Government.

The RDAs have emphasised the importance of early engagement with Government on MAA proposals and are keen to ensure that low carbon and natural environment issues are embedded within MAAs. These agreements also allow regional government the opportunities to build a strong skills base that will enable competitive environmental and low carbon industries as well as energy efficiency measures to flourish within the local business sector.

Regional Assemblies and Regional Spatial Strategies

Regional Assemblies currently have responsibility for producing Regional Spatial Strategies (RSSs) which provide a broad development strategy for the region for a fifteen to twenty year period. RSSs should take into account the identification of the scale and distribution of new housing, priorities for the environment and transport, infrastructure and economic development. The Government also requires RSSs to contain policies designed to promote and encourage, rather than restrict, the development of renewable energy resources. Regional planning bodies and local planning authorities should recognise the full range of renewable energy sources, their differing characteristics, locational requirements and the potential for exploiting them subject to appropriate environmental safeguards.

Sub National Review – Single Regional Strategies

The Local Democracy, Economic Development and Construction (LDEDC) Bill, currently before Parliament, will require a single Regional Strategy (RS) to be developed for each region in England, replacing the existing RESs and RSSs. The RS will set out the overarching strategic framework for the region, spanning both economic development and spatial planning. Government will expect Regional Strategies to secure enduring progress against the UK's greenhouse gas emissions targets and budgets, and make a full contribution to national energy policies. Government will expect the strategy to set out how opportunities for renewable energy will be maximised, and in doing so, demonstrate that the region is playing its full part in delivering the UK's EU target of 15 per cent renewable energy by 2020. RSs will be prepared jointly by RDAs and local authorities which will be represented through new local authority Leaders' Boards. The LDEDC Bill provides for the abolition of Regional Assemblies.

Economic development in Scotland

Scotland has its own devolved government. The equivalent to the English RDA's is administered by:

- Scottish Enterprise (SE) – Economic development remit, through three themes of enterprise, innovation and investment, covering Lowland Scotland.
- Highlands and Islands Enterprise (HIE) – equivalent to SE but covers Highland Scotland.
- SE, HIE and the Scottish Government jointly support Scottish companies to break into international markets and help attract overseas investors through the work of Scottish Development International.
- Skills Development Scotland – lead role on skills development and careers advice.
- Local Councils – lead on Community Planning (broadly the local equivalent to Regional Economic Strategies), local regeneration and advice to small and new start up companies through Business Gateway.

Given Scotland's geography (long coastline, wind and waves), marine renewables is seen as a growth industry that both SE and HIE are supporting. Opportunities will arise in tidal energy, wave energy and off-shore wind. The European Marine Energy Centre in Orkney is a facility

established to allow developers to test new marine renewables technology, supported by HIE and SE.

Scottish Enterprise

SE has the remit to contribute to the Government's purpose of increasing sustainable economic growth through the Government Economic Strategy. Specifically this includes targets to increase GVA and reduce carbon emissions over the period to 2011.

The key sustainable development priorities in SE's Business Plan are to promote the growth of a low carbon economy through support for resource efficiency, the development and use of cleaner technologies in our key sectors and an approach to business infrastructure investment that helps to mitigate climate change.

SE has adopted a Sustainable Development Policy framework that embeds sustainable development into all of its activities, for example, into its decision making processes prior to making investment decisions. This will ensure that the carbon impact is considered prior to any grants being released.

Highlands and Islands Enterprise

The Highlands and Islands of Scotland cover more than half the Scottish landmass, including over 90 inhabited islands. It is recognised as being one of the windiest places in Europe and has enormously powerful tidal flows operating around its coastline. Capitalising on these natural assets to generate renewable energy and create wealth are key areas of activity for HIE in its implementation of the Government Economic Strategy. This strategy has two high-level targets – one is to increase the rate of economic growth and the other is to reduce emissions. Fostering growth within the renewable energy sector offers significant impact in delivering both of these targets.

HIE has adopted a sustainable construction policy to ensure new property procured is of the very highest standard while also minimising the associated long-term running costs. As HIE's knowledge and understanding of greenhouse gas emissions grows it is moving from undertaking historical reviews of the carbon impact its investments made to monitoring and analysis which will allow it to ensure these issues inform the decision-making process and improve the quality of projects which receive financial support.

3.10.4 **Planning**

Planning policy statements issued by the Government and the devolved administrations set out a national planning policy framework. In England, a new Planning Policy Statement (PPS): *Planning and Climate Change* was published in December 2007 making clear that tackling climate change is at the centre of what Government expects from good planning. That is why the PPS was published as a supplement to PPS 1 which sets out Government's core objectives for the planning system.

The PPS builds on existing planning policies on climate change such as PPS 22: *Renewable Energy* and PPS 25: *Development and Flood Risk*, and confirms the central role of planning in helping to speed up the shift to renewable and low-carbon energy; helping shape places resilient to the impact of climate change; and supporting our ambitions on zero carbon development. The PPS is underpinned by new duties in the Planning Act 2008 on regional and local planning to take action on climate change.

In Scotland, the integration of climate change considerations into land use planning is dealt with in a wide range of planning publications. The proposed National Planning Framework 2 recognises the Scottish Government's wider commitment to tackling climate change. More specific references are included in Scottish Planning Policies (SPPs) including those on Housing (SPP3), Renewable Energy (SPP6) and Flooding (SPP7). The national planning policy series is currently being rationalised into a single document which will express policy in more concise terms. Statutory guidance on sustainable development in development planning will be published in Spring 2009.

Planning Policy Wales, published in March 2002, sets out the Welsh Assembly Government's planning policies and climate change is fully integrated into it. In 2006 the Assembly Government consulted on a range of proposed changes to Planning Policy Wales (PPW) through a Planning for Climate Change Ministerial Interim Planning Policy Statement (MIPPS). The MIPPS included a comprehensive set of changes to PPW to further increase the emphasis on tackling Climate Change in national planning policy. These policies have been further updated since the *One Wales 3 per cent* target was adopted in 2007.

To underpin the policy the Assembly Government is preparing a new (draft) Technical Advice Note, specifically on the proposals outlined in the consultation.

Technical Advice Note 12 Design is being updated to incorporate the current guidance on access statements and the finalised advice on design statements, which will increase the emphasis of Climate Change as a key design consideration.

The Welsh Assembly Government have funded the Royal Town Planning Institute Cymru to deliver a series of training seminars on planning for Climate Change and Good Design to help implement policies and technical advice and take forward the findings of research into local authority barriers to zero carbon developments. They will also be bringing a previous MIPPS into a consolidated PPW document after the Planning for Climate Change amendments have been agreed

3.10.5 **Funding Schemes for Public Sector Organisations**

In 2004 an independent, publicly funded company, Salix Finance, was established to accelerate public sector investment in energy efficiency technologies through invest to save schemes. It has established recycling energy efficiency loan funds with over 100 public sector bodies, including local authorities, universities, hospitals and central government, successfully instigating 1000s of projects and, providing annual financial savings of £6.5m and annual carbon savings of 45 $ktCO_2e$.

Salix currently provides ring fenced funding (interest free) matched by the public sector body to create a "local fund", which is used to pay for energy efficiency projects across the public sector body's estate. Energy savings are used to repay the project cost back to the local fund which can then finance further projects.

The Scottish Government funded a similar scheme in Scotland through the Central Energy Efficiency Fund (CEEF) providing £20 million to Scottish Local Authorities, the NHSScotland and Scottish Water through a revolving interest free loan scheme for the capital investment in energy efficiency. In 2008 the Scottish Government awarded a further £4 million, managed through Salix Finance, for the Further and Higher Education sector in Scotland. From 2009 the public sector bodies involved in these funds can also use these loans for investment in renewable technologies.

In April 2009, a further £65m was announced for energy efficiency loans for the public sector in 2009/10, with £54.5m for England. The additional funding is expected to save a further 100,000tCO_2 and create or safeguard a significant number of jobs in the short term. This fund will be 100 per cent interest free loans and will fund projects with a 5 year payback time.

3.10.6 **Public Sector Procurement**

Sustainable procurement is a key lever to build markets for new and improved products and services, where the public sector can play a large role. In 2003, the Government implemented a range of measures, defined as *Quick Wins*, to encourage central government departments to apply minimum environmental standards across a wide range of commonly purchased products. The products assessed were chosen for their environmental / financial impact, scope for environmental improvement, and political or example-setting function.

The UK Government's Sustainable Procurement Task Force reported its Action Plan in June 2006. The Action Plan presented the business case for sustainable procurement, recommended actions across six broad areas and provided two tools that can help organisations' progress. The Prioritisation Methodology, is a risk-based approach that helps organisations focus their efforts and resources appropriately, and the Flexible Framework, is a maturity matrix designed to help organisations make sustainable procurement happen. In March 2007, the Government published the *UK Government Sustainable Procurement Action Plan* (SPAP), in response to the Task Force, alongside a suite of revised targets on Sustainable Procurement and Operations (SOGE targets).

The SPAP stated that the public sector wants to move towards government supply chains and public services that are increasingly low carbon, low waste and water efficient, which respect biodiversity and deliver wider sustainable development goals. It also stressed that achievement of the SOGE targets will require Departmental effort to embed them, and mandatory product standards, into relevant contracts and decisions in key areas which include estates strategies, lease agreements, facilities management, buildings and grounds maintenance. For suppliers to government, the SPAP means that Government Departments will be seeking out innovative solutions and approaches to procurement, including early engagement with the marketplace and the use of outcome-based specifications; strategically engage with key sectors to help drive low carbon resource efficient supply chains and demonstrate how their activities and those in their supply chain are low-risk.

In 2008, the criteria were rebranded as 'Buy Sustainable – Quick Wins' and extended to include best practice specifications. These are intended for procurers that wish to purchase best in class products in certain areas in addition to the updated mandatory minimum standards set at the market average level.

Buy Sustainable – Quick Wins standards provide public sector procurers with a practical means of assisting Departments and their executive agencies to meet sustainable operations targets (such as SOGE targets, described below). Their widespread application will also help the UK Government to meet its commitment of being amongst the leaders in sustainable procurement across EU Member States by 2009.

In Scotland the Buy Sustainable – Quick Wins were issued as guidance across the public sector in October 2008.

The UK Government is also supporting an EU wide *Green Public Procurement (GPP)* initiative, which would operate on similar terms to *Buy Sustainable – Quick Wins,* but would apply across the wider public sector. GPP is a voluntary initiative with a proposed political target of 50 per cent of tendering procedures across the public sector complying with the Commission's core (minimum) criteria by 2010, a target which the UK would be well positioned to meet. It is hoped that, over time, the proposed GPP criteria will be harmonised with the UK's Buy Sustainable – Quick Wins standards to form a combined set of specifications which can guide procurers and decision makers towards products and services with reduced environmental impact and increased sustainability.

3.10.7 **Central Government**

In June 2006, new targets were set for the sustainable operation of the Government estate (SOGE). The targets replaced those in the Framework for Sustainable Development on the Government Estate (originally published between 2002 and 2004). The SOGE framework, includes targets on water, waste, recycling, carbon (from offices and administrative vehicles), renewable energy, Combined Heat and Power use, energy efficiency and biodiversity. There is also a commitment for the Government office estate to be carbon neutral by 2012.

In 2008, a Centre of Expertise in Sustainable Procurement (CESP) was established within the Office of Government Commerce, to drive government performance on SOGE. The Centre provides central coordination of performance management, as well as guidance and support to help departments develop the capability to deliver the Government's sustainability commitments.

The Sustainable Development Commission, the UK Government's independent advisor and watchdog for sustainable development reports on progress in its annual Sustainable Development in Government Report. Their 2008 report showed:

- A decrease of 6.3 per cent in carbon emissions from offices since the baseline year. However, government is still not on track to meet the 2010-11 target of a 12.5 per cent decrease.
- Good progress against the renewables target with 22 per cent of electricity derived from renewable sources.
- Some progress against the Combined Heat and Power target with a total of 8.7 per cent of electricity derived from CHP. However, government is still not on track to source at least 15 per cent of electricity from Combined Heat and Power (CHP) by 2010.
- Carbon emissions from road vehicles show a reduction of 10.3 per cent from the baseline.

Trajectories published by CESP in December 2008 forecast that government as a whole will meet the 2010-11 targets on Carbon Emissions from Offices and Road Transport.

The SOGE framework and targets are currently being reviewed to ensure that they are still focussed on the right target areas, and that they are sufficiently ambitious in both level and scope.

3.10.8 **Schools**

The Department for Children, Schools and Families' (DCSF) Sustainable Development Action Plan (SDAP) was revised in 2008. The revised SDAP – *Brighter Futures – Greener Lives*, gives an overview of the work planned and is underpinned by more detailed delivery plans covering sustainable operations, sustainable schools and children's wellbeing. The DCSF's aim is for all schools to be sustainable schools by 2020. The National Framework for Sustainable Schools was launched in 2006 which identifies 8 'doorways' for schools to embed sustainability within their operation and engaging their communities. Sustainable development is also taught within the national curriculum.

DCSF has scoped the total carbon footprint of all schools' activities and has committed to explore ways in which it can help schools to reduce their carbon emissions in England. DCSF will work with the Sustainable Development Commission to help establish priorities and scope actions within current programmes of work that enable the delivery of essential changes in behaviours within the school system without detracting from core business of delivering high quality education.

In terms of school buildings, the Children's Plan sets out the DCSF's long term ambition for all new school buildings to be zero carbon by 2016 and a Task Force has been appointed to advise on how this challenging goal can be met. The Children's

Plan, which was published in December 2007, also set an immediate requirement that new school buildings will meet a 60 per cent carbon emissions reduction.

In Scotland, sustainable development is an intrinsic part of the Curriculum for Excellence which aims to develop an ability to evaluate environmental, scientific and technological issues as well as informed, ethical views on complex issues, such as climate change. Education has an increasingly important role with its focus on green and environmental issues, the role of Eco-Schools and the learning opportunities of green school buildings and facilities.

The Eco-Schools Scotland Programme promotes pupil-led activity across a range of issues, including water and energy use, waste minimisation, bio-diversity, and sustainability. The programme has also worked alongside the Scottish Government supported Local Footprints project which aims to help local authorities and schools to play their part in reducing Scotland's global footprint.

In addition, Learning Teaching Scotland hosts a well-researched climate change resource for secondary schools as part of its sustainable development education website, to encourage young people to investigate, communicate and act to tackle climate change.

3.10.9 **Higher Education**

The Higher Education Funding Council for England published an updated strategy and action plan in February 2009 setting out how, within the next ten years, the higher education sector in England will be a major contributor to society's efforts to achieve sustainability and tackle climate change. HEFCE has commissioned work to measure the sector's carbon footprint and develop a sector level carbon reduction target and strategy. From 2011 capital funding will be linked to performance against carbon management plans.

In further and higher education, two thirds (42) of Scotland's universities and colleges have signed up to the Universities and Colleges Climate Commitment for Scotland (UCCCfS).

This is a public commitment from the further and higher education sectors to allocate time and resources to implementing measures that will reduce their greenhouse gas emissions and carbon footprints. It also welcomes the opportunity to expand Scotland's ability through its research capacity, knowledge transfer activity and the provision of skills, modules and courses to create solutions to the challenges posed by climate change.

Within 12 months, universities and colleges signed up will publish a 5-year climate change action plan that will include measurable targets and timescales to achieve a significant reduction in emissions from all business operations and activities.

3.10.10 **The NHS Estate**

The National Health Service (NHS) in England, Europe's largest employer and a leader in local communities across the country, launched a next step Carbon Reduction Strategy for England in January 2009. Entitled *Saving Carbon – Improving Health*, the strategy has been produced by the NHS and will aim to significantly reduce its carbon footprint by 80 per cent by 2050.

The strategy also identifies an interim aim to reduce its 2007 carbon footprint by 10 per cent by 2015. This will require the current level of growth in emissions to not only be curbed but the trend to be reversed and absolute emissions reduced.

Key recommendations call for NHS organisations in England to :

- Establish a Board approved Sustainable Development Management Plan
- Sign up to the Good Corporate Citizenship Assessment Model
- Monitor and report on carbon
- Actively promote carbon awareness at every level of the organisation.

In leading by example the NHS can help mitigate climate change and improve our health tomorrow as well as today.

In Scotland, a Sustainable Development Strategy for NHSScotland has been launched. The Strategy takes all the key legislative and policy requirements impacting on NHSScotland and creates a framework within which NHS Boards can prioritise, develop and manage their actions and performance in accordance with the Scottish Government's requirements for sustainable development.

The Strategy is consistent with and supports delivery of the sustainability principles and objectives of the Scottish Government's 'Better Health Better Care' agenda, the core strategic change programme which determines the operational and performance focus for NHSScotland.

The Sustainable Development Strategy for NHSScotland builds on the good work already undertaken by NHSScotland but broadens the focus of sustainability across the whole spectrum of NHSScotland activity to assist in the delivery of the Scottish Government's Greener strategic

objective. The strategy also provides a framework for a series of key actions associated with the identification and reduction of carbon emissions associated with NHSScotland Activity.

Waste

3.11 UK waste policy contributes to emission reductions via three routes: reductions in methane emissions from landfill; emission reductions from waste prevention, re-use and recycling; and, via energy recovery from waste, which offsets fossil energy generation elsewhere in the economy. To illustrate the importance of waste, methane emissions from biodegradable waste in landfill alone account for 40 per cent of all UK methane emissions and 3 per cent of all UK greenhouse gas emissions.

The Waste Strategy for England (WS 2007)[71] published in May 2007 aimed to reduce greenhouse gas emissions by diverting greater amounts of biodegradable waste away from landfill, by encouraging recycling and by increasing the recovery of energy from waste. A report on progress so far towards meeting the objectives of the Waste Strategy was released in 2008.[72] It should be noted that some of the policies described below apply in England only, however in general similar policies apply in the other constituent countries of the UK.

The single most important instrument working across different waste sectors is the landfill tax. This is currently set at £40/tonne landfilled (non-inert) waste, and will rise to £48/tonne in 2010/11. The landfill tax not only encourages diversion of biodegradable and recyclable wastes from landfill, but also encourages waste prevention through an increase in the cost of disposal. There have also been further initiatives on waste prevention, such as the Waste & Resources Action Programme's (WRAP[73]) *Love Food, Hate Waste* campaign. Although the drivers are not fully understood, and the series is relatively volatile, municipal waste growth has moderated substantially in the last 5 years, lending circumstantial evidence to the claim the waste prevention policies are having an effect.

There are additional drivers on the municipal sector – the EU Landfill Directive stipulates a reduction of biodegradable municipal waste landfilled to 35 per cent of 1995 levels by 2020 (with interim targets in 2010 and 2013). England has implemented the Landfill Allowance Trading Scheme (LATS) in order to meet this target.

Further incentives for recycling arise from the EU Packaging Directive targets for packaging recovery and recycling. The Packaging Recovery Note (PRN) scheme enables compliance with these targets, allowing obligated parties to buy and sell PRNs (generated through verified recycling/recovery of packaging) in order to demonstrate compliance. Further, in 2010 the revised EU Waste Framework Directive will come into force, stipulating a minimum household recycling target of 50 per cent of household waste, to be achieved by 2020. Alongside instruments to reduce landfilling of waste, regulations on the landfill sites themselves, and an incentive through the Renewables Obligation, have helped to increase the capture of landfill gas (methane) – up to 70 per cent of this gas is now captured and is either utilised for energy generation (which is supported by receiving 0.25 Renewable Obligation Certificates per MWh), or is flared. This ensures not only a reduction in methane emissions escaping to the atmosphere, but also produces electricity, offsetting the need for other electricity generation.

Defra policy also covers a broader resource efficiency agenda, such as on product design and has recently published a progress report on sustainable products and materials.[74]

3.11.1 Energy from Waste

Combustion, anaerobic digestion (AD) and burning of landfill gas, which contains methane, are the principal methods of obtaining energy from waste. The Waste Strategy identified combustion as the generally preferred option for waste wood over recycling and AD as the preferred option for food waste. WS 2007 sets out an expectation that the energy generated is utilised in the most climate change friendly way through the use of Combined Heat and Power (CHP) schemes. Several initiatives have been developed to encourage investment in renewable energy and waste infrastructure that meet energy efficiency and carbon reduction objectives include: the banding of the Renewables Obligation (RO) which now, for example, provides 1 Renewable Obligation Certificate per Megawatt hour (ROC/MWh) for waste combustion with CHP and 2 ROCs/MWh for anaerobic digestion and advanced thermal treatment technologies, extending enhanced capital allowances (ECAs),

71 http://www.defra.gov.uk/environment/waste/strategy/strategy07/pdf/waste07-strategy.pdf

72 http://www.defra.gov.uk/environment/waste/strategy/strategy07/pdf/waste-strategy-report-07-08.pdf

73 WRAP (Waste & Resources Action Programme) helps individuals, businesses and local authorities to reduce waste and recycle more, making better use of resources and helping to tackle climate change, further information available at: http://www.wrap.org.uk/wrap_corporate/about_wrap/

74 http://www.defra.gov.uk/environment/business/pdf/prod-materials-report0708.pdf

making the RO neutral to Solid Recovered Fuel (SRF) and the intention to introduce a Renewable Heat Incentive (RHI)[75]. Changes in respect of the RO took effect on 1st April 2009, while the introduction of an RHI is due to be announced in the Government's Renewable Energy Strategy in summer 2009.

The Government's Private Finance Initiative programme also offers a platform for new infrastructure, particularly plants capable of handling a range of waste materials including SRF (with biomass content) and waste wood.

The potential annual savings arising from substitution of grid electricity and heating oil by energy from the combustion (with CHP) of UK wood waste would be over 2 $MtCO_2$ eq, plus a further 0.45 $MtCO_2$ eq from avoided landfill emissions. Further significant carbon savings could be realised from the combustion and diversion from landfill of paper/card and green waste not deemed suitable for recycling or composting.

Methane emissions from biodegradable waste in landfill account for 40 per cent of all UK methane emissions and 3 per cent of all UK greenhouse gas emissions. Although technical constraints mean that 100 per cent utilisation is impossible, currently around 70 per cent of methane generated is either utilised for energy generation or flared. Use of landfill gas for energy generation is supported by the reformed RO, though to a lower extent than other forms of energy from waste technologies, at 0.25 ROCs/MWh. In Scotland the RO offers the same level of support for energy from waste generation.

Policies to promote sustainable development in developing countries

3.12.1 Sustainable Development Dialogues

Defra leads the cross-Governmental Sustainable Development Dialogues with China, India, Brazil, Mexico and South Africa, through which UK departments are collaborating with these fast emerging economies to exchange skills and knowledge and trial new SD methodologies. These dialogues pull a number of different themes together – from agriculture to international events; from sustainable consumption and production to environmental law enforcement.

Many of the projects implemented under the Dialogues or have been discussed at Ministerial meetings have contributed to climate change mitigation. Climate change adaptation is also a growing strand in our collaborations. During the recent Mexican state visit we agreed to collaborate to develop a toolkit for State-wide action plans on adaptation to climate change. Our work on Sustainable Agriculture with China also includes a strand on the impacts of climate change, and our cooperation with South Africa also includes two programmes supporting more efficient management of water resources, a key challenge for the future.

3.12.2 Trade and Investment Flow

The UK is strongly committed to ensuring that trade policies promote long term sustainable development and aims to support the long term benefits from reduction or elimination of tariffs on some products exported by developing countries. Ensuring that potential negative environmental impacts of trade liberalisation are addressed is essential for the long-term sustainability of benefits reaped by developing countries from improved market access. The UK continues to push for robust impact assessments of trade negotiations.

The UK is strongly committed to liberalising environmental goods and services under the Doha process, thus promoting a low carbon future in a pro-development dialogue. In addition, the UK is also strongly committed to provide Aid for Trade to developing countries, and especially the poorest among them, to help build their capacity to trade, integrate into global markets while also addressing any adjustment costs that might arise from more liberalisation, within the context of sustainable development. The UK has just adopted its first Aid for Trade strategy and has formally committed to spend at least £400 million per year by 2010 as Aid for Trade at national, regional and global levels.

3.12.3 Forestry

The UK government has a longstanding commitment to tackling illegal logging globally, which has serious social and environmental consequences, particularly in regions with tropical forests. The causes of illegal logging can be attributed broadly to the failure of international markets, which continue to accept illegal timber products, and failures of governance which allow commercial and political elites to benefit from forest exploitation by evading national forest laws in producer countries. Continued deforestation is a significant contributor to global carbon emissions, with deforestation accounting for approximately 18 per cent of global emissions. Timber consuming countries have a key role in tackling this problem by putting in place policies to limit the flow of illegal timber into their market.

[75] http://www.defra.gov.uk/environment/waste/wip/widp/documents/chp-information-note090127.pdf

The UK considers that measures to tackle illegal logging are best implemented at the EU level; without EU coverage, trade could simply be diverted to, or through, other Member States. We are therefore working to tackle illegal logging through the EU's flagship FLEGT Action Plan.

A significant element of the EU's 2003 Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan is the negotiation and implementation of Voluntary Partnership Agreements (VPAs) with timber producing countries where illegal logging is a recognised problem. These VPAs will establish a licensing system which declares that exports of timber products to the EU have been legally harvested. The VPAs promote sustainable forestry management and therefore maximise the ecosystem services which can be derived from them for poverty alleviation. In addition, the EU is currently negotiating the Due Diligence Regulation – which would set out the obligations on all operators first placing timber on the Community market, and therefore from all timber producing countries.

Policies no longer in place

3.13 **UK Emissions Trading Scheme**

The UK Emissions Trading Scheme ended in December 2006. Large energy intensive installations that were previously covered by the UK ETS are now covered by the EU ETS. In November 2006, a consultation was carried out on the Energy Performance Commitment. The consultation outlined a number of proposals to cut carbon emissions from the large non-energy intensive commercial and public sectors. Analysis of responses to this consultation showed strong support for a mandatory rather than voluntary measure such as the UK ETS. As part of the **Energy White Paper**, the UK government announced in May 2007, that it had decided to take forward the Carbon Reduction Commitment, as a policy measure to tackle emissions from these sectors from 2010.

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. In December 2004, Defra announced an extra £10m to extend the programme. This was based on the initial strong demand and a number of large schemes with significant outputs. However, many larger schemes under the initial programme did not complete within the 31st March 2007 spend deadline so given this experience the programme was not extended further. The programme is currently being closed and evaluated.

Monitoring and Evaluation

3.14 The UK's climate change objectives are set out in Public Service Agreement (PSA) 27: Lead the global effort to avoid dangerous climate change. PSA 27 sets out the key outcomes on mitigation and adaptation for the Comprehensive Spending Review (CSR) '07 period and the roles of Departments and other bodies in delivery. Progress reports – both self assessments and assessment by the Prime Minister's Delivery Unit (PMDU) – on delivery of objectives are completed every 6 months (October and April). These progress reports are discussed at Cabinet and reviewed by the Prime Minister and Chancellor of the Exchequer.

The Climate Change and Energy Programme is segmented by International, National Climate Change and Energy and UK Adaptation. Each Sub-Programme – International, National and Adaptation – has its own Director-level governance/Programme Board which monitors progress of work, makes policy trade-offs and resource decisions. Membership of the Boards is cross-departmental, reflecting the many departments that work on climate change issues. All three Sub-Programme Boards report into the high-level strategy board – the Delivery and Strategy High-Level (DASH) Board – which is responsible for overseeing delivery of the Climate Change and Energy Programme as a whole, including acting as delivery board for the climate change PSA (27). In turn, the DASH Board reports up to a Ministerial Cabinet Sub-Committee, Economic Development (Energy and Environment) (ED(EE)).

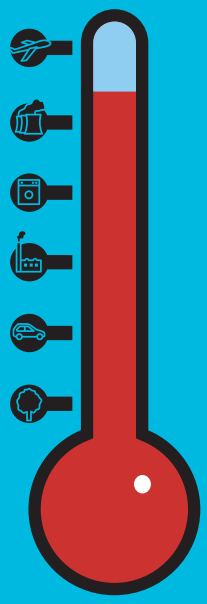
The Climate Change Act requires the Government to produce annual statements of UK emissions to Parliament, and end-of-budget statements following the end of each five-year carbon budget which show whether or not we have met the carbon budget.

In addition, the independent Committee on Climate Change must produce a progress report each year setting out their views on the Government's progress and performance towards meeting its carbon budgets and target in the Act. The Government must publish a response to each of these reports within a few months.

The Climate Change (Scotland) Act will require Scottish Ministers to report regularly to the Scottish Parliament on Scotland's emissions and on the progress being made towards the emissions reduction targets set in the Bill.

4

Projections of Emissions and Total Effects of Policies



Projections of Emissions and Total Effects of Policies

Key developments

- The latest interim projections show that UK greenhouse gas emissions are expected to fall to about 23 per cent below base year levels by 2010. The UK is therefore on track to meet its Kyoto Protocol target.
- Emissions of carbon dioxide, methane and nitrous oxide are projected to be about 14.9, 54.3 and 39.4 per cent below 1990 levels in 2010, respectively. Emissions of the fluorinated gases collectively are projected to be 54.5 per cent below the 1995 level in 2010.
- The UK is currently preparing further policies to help meet its EU effort sharing and renewable energy targets, and the carbon budgets[76] set under the 2008 Climate Change Act. New projections, including the impact of those further policies, will be published in summer 2009.

Projections of Greenhouse Gas Emissions

4.1 The UK updates its emissions projections for CO_2[77] and the other greenhouse gases[78] annually, to include the impacts of policies and measures that are firm and funded at the time the projections are produced. The current UK projections, which provide the basis for this communication, include the emission reductions expected from policies that were introduced in the UK Climate Change Programme 2000, UK Climate Change Programme 2006 and the Energy White Paper 2007. The current projections are based on projections published in November 2008, updated to reflect new economic growth forecasts announced in the Budget in April 2009 and revised estimates of emissions reductions from some policies. Further policies will be announced in summer 2009 as part of a package of measures to help the UK meet its EU effort sharing and renewable energy targets, and the carbon budgets set under the 2008 Climate Change Act. New projections will be published at the same time.

Table 4.1 sets out the UK's base year and historic emissions and baseline *with measures* projections, presented by greenhouse gas. The historic emissions set out in this chapter of the communication are based on the UK greenhouse gas inventory published in 2008[79]. The current emissions projections are consistent with this inventory. The revised energy projections to be published in the summer will be based on the latest UK greenhouse gas inventory published in February 2009[80]. The CO_2 inventory published in 2008 agrees with the inventory published in 2009 to about 0.3 per cent for total CO_2 on average over the period 1990 to 2006, with individual years differing by up to 0.7 per cent. These small differences are due to the sequencing in the work needed to produce projections relative to the inventory cycle, and the timing of the work needed for this Communication. They mean that the historic emissions in this chapter differ slightly from those presented in Chapter 2. The differences are small and should not be regarded as material to the conclusions in this Communication.

The UK's progress towards its Kyoto Protocol target is assessed against the fixed base year[81] – see Table 4.1a. In order to reflect the changes on a consistent time series basis, all the other percentage changes quoted in this chapter refer to emissions in 1990 or 1995 taken from the 2008 greenhouse gas inventory.

The tables of emissions in this chapter are reported, where appropriate, using two geographical coverages. The first is UNFCCC coverage[82] and the second is UK[83] only. The UK only coverage, provided in Table 4.1b, is included because it is the geographical coverage used by the 2008 Climate Change Act. All percentages quoted in this chapter refer to the UNFCCC coverage, unless otherwise stated.

The latest projections show that including the impact of firm and funded measures[84 85], UK greenhouse gas emissions are expected to fall to about 23 per cent below the fixed base year levels by 2010. The UK is therefore on track to meet its Kyoto Protocol target.

76 www.hm-treasury.gov.uk/d/Budget2009/bud09_carbon_budgets_736.pdf

77 CO_2 projections published in UEP32: www.berr.gov.uk/files/file48514.pdf

78 Technical report will be made available on Defra website at: www.defra.gov.uk

79 The UK Greenhouse Gas Inventory submissions to the EUMM and the UNFCCC are published at www.ghgi.org.uk/

80 www.defra.gov.uk/environment/statistics/globatmos/index.htm

81 Base year; For definition see Section 4.6.3 of this chapter.

82 This includes the Crown Dependencies of Guernsey, Jersey and the Isle of Man, and the Overseas Territories that have signed up to the UK's instrument of ratification to the UNFCCC and the Kyoto Protocol (Bermuda, Cayman Islands, Falkland Islands, Gibraltar and Montserrat).

83 The UK coverage is consistent with the coverage of the DECC energy model.

84 See annex B.

85 This includes the estimated impact of the carbon price on emissions from installations covered by the EU emissions trading system but excludes emissions reductions resulting from the purchase of allowances from operators of installations in other EU member states or of JI / CDM credits. The net effect of emissions reductions resulting from purchases through the EU ETS is presented in Table 4.17.

Table 4.1a UK greenhouse gas emissions, $MtCO_2$ eq (UNFCCC coverage)

Gas	Base Year	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide (net)		593.5	551.0	549.8	556.6	555.9	505.1	504.5	482.1
Methane		103.7	90.3	68.5	49.7	49.2	47.4	45.1	43.4
Nitrous oxide		63.9	53.1	43.6	39.8	38.3	38.7	39.1	38.7
HFCs		11.4	15.5	9.1	9.2	9.2	9.0	8.3	6.9
PFCs		1.4	0.5	0.5	0.3	0.3	0.2	0.2	0.2
Sulphur hexafluoride		1.0	1.2	1.8	1.1	0.9	0.7	0.7	0.7
Total net greenhouse gas emissions		774.9	711.6	673.4	656.7	653.8	601.1	597.8	572.0
Total greenhouse gas emissions including only mandatory Article 3.3 LULUCF activities and Forest Management cap under Article 3.4 LULUCF[86]		770.8	709.0	671.4	655.5	652.3	598.5	592.7	565.1
Fixed Base Year	779.9								
Change from fixed base year level				-13.9%	-16.0%	-16.4%	-23.3%	-24.0%	-27.5%

Percentage changes and emission estimates may differ slightly due to rounding

As noted above, this Table uses historical data from the inventory published in 2008, which differ slightly from the most recent inventory data tabulated in Chapter 2

Table 4.1b UK greenhouse gas emissions, $MtCO_2$ eq (UK only)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide (net)	592.4	549.8	548.6	555.2	554.5	503.8	503.2	480.7
Methane	103.5	90.2	68.4	49.6	49.1	47.3	44.9	43.3
Nitrous oxide	63.8	53.0	43.6	39.8	38.3	38.6	39.0	38.6
HFCs	11.4	15.5	9.1	9.2	9.2	9.0	8.3	6.9
PFCs	1.4	0.5	0.5	0.3	0.3	0.2	0.2	0.2
Sulphur hexafluoride	1.0	1.2	1.8	1.1	0.9	0.7	0.7	0.7
Total net greenhouse gas emissions	773.5	710.2	671.9	655.2	652.3	599.6	596.3	570.5

[86] Kyoto Protocol reporting basis: totals include only mandatory Article 3.3 LULUCF afforestation plus reforestation minus deforestation since 1990 and the forest management cap of -1.36$MtCO_2$ agreed for the UK under Article 3.4 LULUCF of the Kyoto Protocol. Totals also include emissions from UK Overseas Territories associated with the UK's ratifications of the UNFCCC and Kyoto Protocol.

Baseline 'With Measures' Projections by Sector

4.2 The following tables set out historic and projected with measures emissions by sector. Table 4.2a and b show how historical and projected greenhouse gas emissions are distributed across the UK economy. In this *by source* classification emissions from the energy supply sector, which includes emissions from power stations, refineries and other energy supply industries are shown separately.

Table 4.3 shows another way of considering the economic profile of UK emissions. In this classification, emissions from power stations, refineries and other energy supply industries are re-allocated to the end users of electricity, petroleum products and other fuels. There is therefore no separate line for the energy supply industry. This by *end-user* classification gives the most complete account of the relationship between emissions and the production of goods and services. Tables presenting emissions by end user broken down by gas can be found in Section 4.7.1.

Table 4.2a Greenhouse gas emissions by source, $MtCO_2$ eq (UNFCCC coverage)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
Energy supply	273.6	232.1	216.9	230.0	232.6	198.3	199.8	181.5
Business	111.5	107.6	111.1	102.1	100.4	92.0	92.1	91.6
Industrial processes	54.4	44.8	24.4	17.6	17.1	15.2	15.4	15.4
Transport	124.7	125.4	131.5	137.8	139.5	134.6	138.1	138.2
Residential	81.7	82.8	90.2	88.1	84.8	81.7	71.5	63.5
Public	13.6	13.2	11.7	11.0	10.5	10.4	10.3	10.3
Agriculture	59.6	57.6	54.5	50.1	48.9	48.8	49.2	49.0
LULUCF (net)	2.9	1.2	-0.4	-2.0	-2.0	-1.4	0.9	2.8
Waste management	52.9	47.0	33.5	22.0	22.0	21.5	20.5	19.7
Total net GHG emissions	774.9	711.6	673.4	656.7	653.8	601.1	597.8	572.0
Percentage changes and emission estimates may differ slightly due to rounding								

Table 4.2b Greenhouse gas emissions by source, $MtCO_2$ eq (UK only)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
Energy supply	273.0	231.4	216.2	229.2	231.8	197.5	199.0	180.7
Business	111.5	107.6	111.0	102.0	100.4	92.0	92.1	91.6
Industrial processes	54.4	44.8	24.4	17.6	17.1	15.2	15.4	15.4
Transport	124.4	125.1	131.3	137.5	139.3	134.4	137.8	138.0
Residential	81.5	82.6	90.0	87.9	84.5	81.5	71.3	63.3
Public	13.6	13.2	11.7	11.0	10.5	10.4	10.3	10.3
Agriculture	59.5	57.4	54.3	49.9	48.8	48.7	49.1	48.8
LULUCF (net)	2.9	1.2	-0.4	-2.1	-2.0	-1.4	0.8	2.7
Waste management	52.9	46.9	33.5	22.0	22.0	21.4	20.5	19.7
Total net GHG emissions	773.5	710.2	671.9	655.2	652.3	599.6	596.3	570.5
Percentage changes and emission estimates may differ slightly due to rounding								

Baseline with measures projections from the **energy supply** industry, in Table 4,4, show that emissions are expected to be 27.5 per cent lower than 1990 levels by 2010. Between 1990 and 2000, energy supply sector emissions fell sharply, due in large part to fuel switching to gas and higher output from nuclear plants. The short term projection path is influenced by the recent contraction in the economy. In the longer term there is a projected reduction in the electricity supplied from coal plants for three main reasons: firstly, due to the impact of the Large Combustion Plant Directive; secondly through natural ageing, and thirdly, due to the less favourable economic position of the remaining coal fired plants.

Generation from renewables is projected to grow significantly, more than offsetting the impact of the expected retirement of nuclear plant from the system. Emissions from the oil and gas extraction industry are projected to fall slightly between 2007 and 2020.

Emissions from the **residential** sector, in Table 4.5, are projected to return to 1990 levels by 2010. The CO_2 projection reflects the increasing impact of existing policies offsetting increases in the number of projected households.

Table 4.3 Greenhouse gas emissions by end user, $MtCO_2$ eq (UNFCCC coverage)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
Energy supply	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Business	243.8	211.7	210.4	208.1	210.5	182.7	185.4	176.4
Industrial processes	56.8	46.9	26.2	18.3	18.0	15.9	16.1	16.2
Transport	144.2	147.4	152.6	158.8	158.1	151.8	154.7	153.4
Residential	168.2	153.0	155.3	156.6	155.9	142.0	132.4	118.5
Public	31.1	28.1	23.3	22.2	22.1	21.0	20.5	18.9
Agriculture	63.4	60.6	57.0	52.8	51.6	51.0	51.3	50.8
LULUCF (net)	2.9	1.2	-0.4	-2.1	-2.0	-1.4	0.8	2.7
Waste management	52.9	46.9	33.5	22.0	22.0	21.4	20.5	19.7
Exports	10.2	14.3	14.2	18.4	16.0	15.2	14.5	13.9
Overseas Territories	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5
Total net GHG emissions	774.9	711.6	673.4	656.7	653.8	601.1	597.8	572.0
Percentage changes and emission estimates may differ slightly due to rounding								

Table 4.4 Greenhouse gas emissions from energy supply industry by source, $MtCO_2$ eq (UNFCCC coverage)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide	242.9	208.2	200.5	218.4	221.6	188.1	190.8	173.4
Methane	28.7	22.4	15.1	10.0	9.3	8.8	7.7	7.0
Nitrous oxide	1.9	1.5	1.3	1.6	1.7	1.4	1.3	1.1
Total GHG emissions	273.6	232.1	216.9	230.0	232.6	198.3	199.8	181.5
Change from 1990 levels for row above		-15.2%	-20.7%	-15.9%	-15.0%	-27.5%	-27.0%	-33.6%
Percentage changes and emission estimates may differ slightly due to rounding								

Transport emissions, in Table 4.6, in 2010 are projected to be 7.9 per cent above 1990 levels by 2010. The growth in road transport is projected to continue but emissions projections remain approximately level due to improving vehicle efficiency and other policy measures. Increasing N_2O emissions are due to the increased penetration of vehicles with three way catalysts in the vehicle fleet.

Emissions related to fuel combustion from ships and aircraft engaged in international transport are reported separately in the common reporting format (see Annex A), and in accordance with the UNFCCC's reporting guidelines are not included in the UK's historic or projected emissions. Emissions from aviation fuel loaded in the UK onto international flights have increased at an average rate of around 5 per cent per annum since 1990. The UK is working to establish an international method for allocating these emissions to national inventories and is working through the International Civil Aviation Organisation to encourage development and with the EU on implementation of emissions trading at the international level.

Emissions from **industrial processes**, which include process emissions from cement and lime production, glass manufacture, steel production, and chemicals manufacture, in Table 4.7, are projected to be 72.1 per cent below 1990 levels by 2010. In the short term, process emissions of CO_2 are projected to fall due to lower growth assumptions but emissions will remain approximately level in the longer term due to policy savings offsetting higher long-term growth assumptions. Large reductions in emissions of nitrous oxide and HFCs were achieved through introduction of abatement equipment to control fugitive emissions from adipic acid manufacture and HFC-23 emissions from HCFC-22 manufacture respectively.

Table 4.5 Greenhouse gas emissions from the residential sector by source, $MtCO_2$ eq (UNFCCC coverage)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide	79.9	81.3	87.2	84.9	81.5	78.8	68.7	60.7
Methane	1.4	0.8	0.7	0.4	0.4	0.3	0.2	0.2
Nitrous oxide	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1
HFCs	0.0	0.4	2.1	2.7	2.8	2.5	2.5	2.5
Total	81.7	82.8	90.2	88.1	84.8	81.7	71.5	63.5
% change from 1990		1.3%	10.4%	7.9%	3.8%	0.0%	-12.5%	-22.2%

Table 4.6 Greenhouse gas emissions from transport by source, $MtCO_2$ eq (UNFCCC coverage)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide	122.7	122.4	126.8	132.1	133.8	128.3	131.6	131.5
Methane	0.6	0.5	0.3	0.2	0.2	0.1	0.1	0.1
Nitrous oxide	1.3	2.5	4.4	5.5	5.6	6.2	6.4	6.6
Total	124.7	125.4	131.5	137.8	139.5	134.6	138.1	138.2
% change from 1990		0.5%	5.5%	10.5%	11.9%	7.9%	10.7%	10.8%

Projected emissions from **business and public administration** are presented in Tables 4.8 and 4.9, and emissions in each of these sectors are projected to fall by 17.5 and 23.1 per cent by 2010, respectively. The business category includes emissions from fuel combustion in industry The trends in industrial combustion within this sector are similar to those for CO_2 for industrial processes, and the emissions projection for services are fairly constant as the package of policy measures offset the growth in this sector.

The main trends in UK sources and sinks from the **land use, land use change and forestry**

(LULUCF) sector are presented in Table 4.10. The UNFCCC basis includes all human-induced changes to land-based carbon stocks i.e. all anthropogenic sources and sinks. (Emissions calculated in this way, but excluding estimated emissions from the Overseas Territories, will be used for assessing progress against targets under the Climate Change Act.) The Kyoto Protocol basis includes LULUCF emissions and removals associated with mandatory activities under Article 3.3 of the Kyoto Protocol – afforestation plus reforestation minus deforestation or ARD – since 1990. In addition, since the UK has chosen to account for forest management under Article 3.4 of the Kyoto Protocol, the Kyoto basis also indicates removals up to the level of the cap agreed for the UK as part of the Marrakech Accords, since the actual uptake by forests is projected to exceed the cap in most years. A small base year allowance of 0.3 $MtCO_2$ eq related to deforestation emissions in 1990 is added to the UK base year because LULUCF was a net source of emissions in 1990. This is in accordance with the provisions of the second sentence of Article 3.7 of the Kyoto Protocol, and subsequent COP decisions.

Table 4.7 Greenhouse gas emissions from industrial processes by source, $MtCO_2$ eq (UNFCCC coverage)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
Carbon Dioxide	16.3	14.9	14.7	13.9	13.9	12.5	13.2	13.5
Methane	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Nitrous Oxide	24.7	14.9	5.6	2.9	2.4	2.2	1.7	1.5
HFCs	11.4	14.0	2.7	0.3	0.3	0.2	0.2	0.2
PFCs	1.3	0.4	0.3	0.2	0.2	0.1	0.1	0.1
SF_6	0.4	0.4	1.1	0.2	0.2	0.1	0.1	0.1
Total	54.4	44.8	24.4	17.6	17.1	15.2	15.4	15.4
% change from 1990		-17.7%	-55.1%	-67.5%	-68.6%	-72.1%	-71.7%	-71.6%

Table 4.8 Greenhouse gas emissions from business by source, $MtCO_2$ eq (UNFCCC coverage)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
Carbon Dioxide	108.9	103.8	104.2	93.4	91.9	83.4	84.1	84.9
Methane	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Nitrous Oxide	1.6	1.5	1.3	1.3	1.3	1.4	1.5	1.6
HFCs	0.0	1.1	4.3	6.1	6.1	6.3	5.6	4.2
PFCs	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
SF_6	0.6	0.8	0.7	0.9	0.7	0.6	0.5	0.5
Total	111.5	107.6	111.1	102.1	100.4	92.0	92.1	91.6
% change from 1990		-3.5%	-0.4%	-8.5%	-9.9%	-17.5%	-17.4%	-17.8%

Table 4.9 Greenhouse gas emissions from public admin by source, MtCO2 eq (UNFCCC coverage)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon Dioxide	13.5	13.2	11.7	10.9	10.5	10.4	10.3	10.2
Methane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nitrous Oxide	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	13.6	13.2	11.7	11.0	10.5	10.4	10.3	10.3
% change from 1990		-2.5%	-13.7%	-19.1%	-22.7%	-23.1%	-23.7%	-24.3%

Annual emissions from **waste management**, in Table 4.11, are expected to fall to 59.5 per cent below 1990 levels by 2010. This can largely be attributed to a reduction in methane emissions from landfill sites due to increased collection of landfill gas for energy recovery and flaring for environmental control.

Emissions projections from the **agriculture** sector show that emissions are expected to fall to 18.1 per cent below 1990 levels by 2010. Reductions to 2006 amount to 18.0 per cent, which reflects declining livestock numbers and a reduction in the amount of synthetic fertiliser used. The projections show that emissions are unlikely to decrease further to 2020. A projected decrease in methane emissions is driven by further decreases in livestock numbers, but this is offset by an increase in N_2O emissions from agricultural soils due to an expected increase in the production of wheat and oilseed rape (Table 4.11)[87].

Projections by Gas

4.3 The following tables summarise projections organised by gas. Projections are broken down by source and end-user for carbon, by source for methane and nitrous oxide, and by market sector for the F-gases. The tables in this section are presented using the UNFCCC geographical coverage. For UK coverage tables, see Section 4.2.7.

Table 4.10 Greenhouse gas emissions and removals from land use, land use change and forestry, on a) Convention and b) Kyoto Protocol basis

a) UNFCCC basis	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide (net)	2.9	1.2	-0.4	-2.1	-2.0	-1.5	0.8	2.7
Methane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nitrous oxide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total net GHG emissions	2.9	1.2	-0.4	-2.0	-2.0	-1.4	0.8	2.7

b) Kyoto Protocol basis	Base Year	1990	1995	2000	2005	2006	2010	2015	2020
Article 3.3		0.20	-0.06	-1.02	-1.91	-2.09	-2.68	-2.94	-3.49
Article 3.4 (capped at -0.37 MtC)		-1.36	-1.36	-1.36	-1.36	-1.36	-1.36	-1.36	-0.69
Article 3.7	0.33								

Table 4.11 Greenhouse gas emissions from waste management by source, $MtCO_2$ eq (UNFCCC coverage)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide	1.2	0.9	0.5	0.5	0.4	0.4	0.4	0.4
Methane	50.7	45.0	31.8	20.3	20.3	19.7	18.7	17.8
Nitrous oxide	1.1	1.1	1.2	1.3	1.3	1.3	1.4	1.4
Total GHG emissions	52.9	47.0	33.5	22.0	22.0	21.5	20.5	19.7
Change from 1990 levels for row above		-11.3%	-36.8%	-58.4%	-58.4%	-59.5%	-61.3%	-62.8%
Percentage changes and emission estimates may differ slightly due to rounding								

87 Defra project SFF0601. Baseline projections for agriculture and implications for emissions to air and water.

Table 4.12 Greenhouse gas emissions from agriculture by source, $MtCO_2$ eq (UNFCCC coverage)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide	5.2	5.3	4.7	4.5	4.3	4.6	4.6	4.7
Methane	21.6	21.0	20.2	18.5	18.7	18.1	17.9	17.8
Nitrous oxide	32.9	31.3	29.6	27.1	25.9	26.1	26.7	26.5
Total	59.6	57.6	54.5	50.1	48.9	48.8	49.2	49.0
% change from 1990		-3.4%	-8.7%	-16.0%	-18.0%	-18.1%	-17.5%	-17.9%

4.3.1 Carbon dioxide

Table 4.13 Carbon dioxide emissions by source, $MtCO_2$ eq (UNFCCC coverage)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
Energy supply	242.9	208.2	200.5	218.4	221.6	188.1	190.8	173.4
Business	108.9	103.8	104.2	93.4	91.9	83.4	84.1	84.9
Industrial processes	16.3	14.9	14.7	13.9	13.9	12.5	13.2	13.5
Transport	122.7	122.4	126.8	132.1	133.8	128.3	131.6	131.5
Residential	79.9	81.3	87.2	84.9	81.5	78.8	68.7	60.7
Public	13.5	13.2	11.7	10.9	10.5	10.4	10.3	10.2
Agriculture	5.2	5.3	4.7	4.5	4.3	4.6	4.6	4.7
LULUCF (net)	2.9	1.2	-0.4	-2.1	-2	-1.4	0.8	2.7
Waste management	1.2	0.9	0.5	0.5	0.4	0.4	0.4	0.4
Total net CO_2 Emissions	593.5	551	549.8	556.6	555.9	505.1	504.5	482.1
Change from 1990 levels for row above		-7.2%	-7.4%	-6.2%	-6.3%	-14.9%	-15.0%	-18.8%
Percentage changes and emission estimates may differ slightly due to rounding								

Table 4.14 Carbon dioxide emissions by end user, $MtCO_2$ eq (UNFCCC coverage)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
Business	227.5	197.6	196.4	194.6	197.4	169.9	173.4	166.0
Industrial processes	17.3	15.8	15.6	14.2	14.4	12.9	13.5	13.8
Transport	140.6	142.7	146.7	152.2	151.5	144.8	147.6	146.2
Residential	155.7	143.5	146.8	149.5	149.0	135.7	126.7	113.2
Public	29.2	26.6	22.3	21.6	21.5	20.4	20.0	18.4
Agriculture	8.8	8.2	7.3	7.2	7.1	6.7	6.8	6.6
LULUCF (net)	2.9	1.2	-0.4	-2.1	-2.0	-1.4	0.8	2.7
Waste management	1.2	0.9	0.5	0.4	0.4	0.4	0.4	0.4
Exports	9.3	13.3	13.4	17.5	15.2	14.5	14.0	13.4
Overseas Territories	1.1	1.2	1.3	1.3	1.3	1.3	1.3	1.3
Total CO_2 emissions by sources minus removals by sinks	593.5	551.0	549.8	556.6	555.9	505.1	504.5	482.1
Percentage changes and emission estimates may differ slightly due to rounding								

4.3.2 Methane

Table 4.15 Methane emissions by source, $MtCO_2$ eq (UNFCCC coverage)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
Waste disposal on land	49.8	44.2	31	19.5	19.5	18.9	17.8	16.9
Agriculture	21.6	21	20.1	18.4	18.7	18.1	17.9	17.8
Coal mining	18.3	12.6	7	4.1	3.8	3.7	3.2	3.1
Natural gas distribution	8	7.4	6.6	4.7	4.5	4.1	3.7	3.3
Offshore oil and gas	2.3	2.3	1.4	0.9	0.8	0.8	0.5	0.4
Fuel combustion	2.6	1.8	1.6	1.2	1.1	1.0	0.9	0.9
Wastewater treatment	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9
Other	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.1
Total	103.7	90.3	68.5	49.7	49.2	47.4	45.1	43.4
Change from 1990 levels for row above		-12.9%	-33.9%	-52.0%	-52.5%	-54.3%	-56.5%	-58.1%
Percentage changes and emission estimates may differ slightly due to rounding								

4.3.3 Nitrous Oxide

Table 4.16 Nitrous oxide emissions by source, $MtCO_2$ eq (UNFCCC coverage)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
Energy Supply	1.9	1.5	1.3	1.6	1.7	1.4	1.3	1.1
Business	1.6	1.5	1.3	1.3	1.3	1.4	1.5	1.6
Industrial Process	24.7	14.9	5.6	2.9	2.4	2.2	1.7	1.5
Transport	1.3	2.5	4.4	5.5	5.6	6.2	6.4	6.6
Residential	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Public	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture	32.9	31.3	29.6	27.1	25.9	26.1	26.7	26.5
LULUCF (Net)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste Management	1.1	1.1	1.2	1.3	1.3	1.3	1.4	1.4
Total	63.9	53.1	43.6	39.8	38.3	38.7	39.1	38.7
Change from 1990 levels for row above		-16.9%	-31.7%	-37.7%	-40.0%	-39.4%	-38.8%	-39.4%
Percentage changes and emission estimates may differ slightly due to rounding								

4.3.4 Fluorinated Gases

Table 4.17 Fluorinated gas emissions by market sector, $MtCO_2$ eq (UNFCCC coverage)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
HFCs								
Refrigeration/air conditioning	0.000	0.945	4.076	5.118	5.035	5.434	4.638	3.135
Foams (excluding OCF)	0.000	0.000	0.061	0.563	0.619	0.535	0.664	0.779
General aerosols and OCF	0.000	0.572	1.350	1.278	1.293	0.936	0.936	0.936
Metered dose inhalers	0.002	0.002	0.894	1.579	1.585	1.583	1.586	1.586
HFC-23 from HCFC-22 manufacture and fugitive losses from HFC manufacture	11.374	13.981	2.677	0.341	0.303	0.174	0.174	0.174
Solvents	0.000	0.000	0.003	0.046	0.058	0.107	0.107	0.107
Fire fighting	0.000	0.003	0.061	0.298	0.305	0.204	0.214	0.225
HFC used as a cover gas in magnesium foundries	0.000	0.000	0.000	0.002	0.002	0.002	0.002	0.002
Total HFC emissions	**11.375**	**15.502**	**9.120**	**9.224**	**9.199**	**8.975**	**8.321**	**6.944**
PFCs								
Electronics	0.035	0.082	0.180	0.086	0.083	0.069	0.085	0.105
Aluminium smelting	1.333	0.286	0.244	0.055	0.123	0.056	0.056	0.056
Refrigeration/air conditioning	0.000	0.009	0.033	0.000	0.000	0.000	0.000	0.000
Other PFC emissions	0.034	0.094	0.027	0.110	0.090	0.055	0.055	0.055
Total PFC emissions	**1.402**	**0.471**	**0.485**	**0.251**	**0.296**	**0.179**	**0.196**	**0.215**
SF_6								
Magnesium smelting	0.426	0.426	1.093	0.240	0.184	0.139	0.142	0.145
Electrical insulation	0.598	0.802	0.623	0.522	0.509	0.507	0.504	0.496
Electronics	0.006	0.011	0.023	0.013	0.013	0.015	0.020	0.025
Other SF_6 uses	0.000	0.000	0.059	0.321	0.172	0.038	0.001	0.001
Total SF_6 emissions	**1.030**	**1.239**	**1.798**	**1.096**	**0.878**	**0.699**	**0.667**	**0.667**
Total UK emissions of HFCs, PFCs and SF_6	**13.807**	**17.213**	**11.404**	**10.571**	**10.374**	**9.853**	**9.183**	**7.826**
Change from 1995 levels for row above			-33.7%	-38.6%	-39.7%	-42.8%	-46.6%	-54.5%
Percentage changes and emission estimates may differ slightly due to rounding								

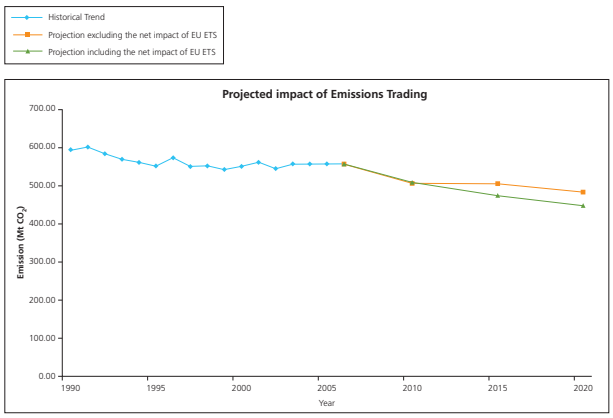
Assessment of Total Effect of Policies and Measures

4.4 The projections presented in this Communication include all firm and funded policies and measures that have been announced. These policies and measures and the projected CO_2 equivalent savings are detailed in Annex B.

The UK is currently preparing further policies and measures to help it meet its EU effort sharing and renewable energy targets, and the carbon budgets set under the 2008 Climate Change Act. Updated projections, including the impact of those policies, will be published in summer 2009.

Emissions reductions resulting from purchases through EU ETS are linked to the flexible mechanisms under the Kyoto Protocol. Any transfer of allowances under the EU ETS eventually also leads to a transfer of assigned amount units (AAUs) under the Kyoto Protocol between Member States. An allowance serves the purpose of providing compliance under the EU ETS whereas an AAU can be used by a Member State itself for compliance under the Kyoto Protocol. Figure 4.1 and Table 4.18 show historic and projected UK emissions, which include the impact of the carbon price on emissions from installations in the EU ETS, and the net effect on emissions of including reductions resulting from purchases of EU allowances and JI/CDM credits through the EU ETS.

Figure 4.1 Projected impact of emissions trading



Methodology

4.5.1 Carbon Dioxide

Projections of the UK's emissions of carbon dioxide have been largely derived from the DECC Energy Model. This is made up of 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 sector classification source, and the principal source of energy statistics, is the Digest of UK Energy Statistics (DUKES)[88]. DECC model makes projections based on prospects for fossil fuel prices, economic growth and demographics.

Energy and emissions projections were published in November 2008 and these use updated assumptions to the projections published alongside the Energy White Paper in May 2007. Updated Energy Projections (UEP) are now published annually. The projections include all firm and funded Government environmental policy measures most recently evaluated. These projections included scenarios for four fossil fuel price assumptions. The projections presented in this chapter are based on the central fossil fuel price scenario.

CO_2 projections from LULUCF are produced by the Centre for Ecology and Hydrology (CEH) using methods consistent with the inventory estimates. The projections[89] take account of the dynamics of carbon stocks in the relevant pools and assume that current trends in land use as summarised by the land use change matrix will continue.

Table 4.18 Projections of carbon dioxide emissions in the with measures and with additional measures scenarios $MtCO_2$ eq

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Total net carbon dioxide with measures	593.5	551.0	549.8	556.6	555.9	505.1	504.4	482.0
Total net carbon dioxide including the net effect of emissions trading	593.5	551.0	549.8	556.6	555.9	507.7	473.1	446.6

88 www.berr.gov.uk/whatwedo/energy/statistics/publications/dukes/page45537.html

89 The approach used is described in Inventory and projections of UK emissions by sources and removals by sinks due to land use, land use change and forestry. Annual Report July 2008. Available at http://nora.nerc.ac.uk/5956/

4.5.2 Other Greenhouse Gas Emissions

The emissions projections of the other greenhouse gases covered by the Kyoto Protocol, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride, were produced by AEA[90] and are broadly consistent with the assumptions underlying the projections of carbon dioxide emissions published by the DECC. The projections have been developed to the same level of sectoral detail included in the emissions inventory and have been based on a range of different sources of data. These include consultation with experts and stakeholders from UK Government departments, industry and other organisations; technical literature; and incorporating results of studies undertaken for DECC.

Projections have been calculated using a bespoke projections system which complements the national inventory system. The projections system includes spreadsheets to pre-process data, and to feed the projections database which is linked to the national greenhouse gas emissions database. This projections system calculates 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 2050. These are then aggregated to provide an estimate of total projected emissions. The projections system has been designed to be transparent, flexible and easily updateable.

The UK has a range of measures to reduce emissions of the non-CO_2 gases. For waste disposed to landfill, emissions of methane to air are controlled through the IPPC Directive[91], implemented via the Environmental Permitting Regulations 2008, and through the Landfill Directive[92]. The Landfill Directive states that landfill gas must be treated and used, and if the gas cannot be used to produce energy, it must be flared. The IPPC Directive also controls industrial emissions from all major industrial installations. Future emissions from the manufacture of adipic and nitric acid will be mitigated based under site specific decisions regulated via IPPC, following the principles of BAT (best available technology).

Emissions of nitrous oxide from agriculture are being limited both now and will be limited in the future through the Nitrate Directive[93]. This Directive requires a mandatory Action Programme of measures for the purposes of tackling nitrate loss from agriculture. Many commercial, industrial and public sector organisations in the UK have obligations under the EC regulation on certain fluorinated greenhouse gases[94] and this regulation will limit emissions of F-gases, especially from refrigeration and air conditioning equipment.

In accordance with the mechanism for producing the projections of carbon dioxide, the non-CO_2 projections are based on the 'with measures' scenario, which takes into account currently adopted and implemented policies and measures.

Projections are verified 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.

4.5.3 Base Year Definition

The base year chosen for the purposes of assessing progress towards the Kyoto Protocol target uses 1990 data for emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) and 1995 data for emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).
This National Communication uses the estimate of Base Year emissions used to fix the UK's Assigned Amount[95], which was based on the 1990-2004 greenhouse gas inventory, which was finalised following an in-country review of the inventory in 2007.

The calculation of the UK's base year for reporting under the Kyoto Protocol includes a small allowance (0.33 $MtCO_2$) representing emissions from deforestation in 1990. This allowance is calculated in accordance with rules associated with Article 3.7 of the Kyoto Protocol. Annex C provides a table comparing the UNFCCC and Kyoto Protocol coverage.

90 This technical report will be available following publication of the National Communication. The non-CO_2 projections have been updated for consistency with the greenhouse gas inventory published in 2008, and with UEP37.

91 Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control

92 Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste

93 Council Directive 91/676/EEC of 19 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources

94 Regulation (EC) No 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases

95 www.defra.gov.uk/environment/climatechange/uk/progress/pdf/uk-kyoto-1206.pdf

4.5.4 Key Assumptions

The projections presented in this National Communication are based on the UK energy projections detailed in the November 2008 publication of carbon emissions[96], updated to reflect improved policy appraisals and revised assumptions for economic growth announced in the Budget[97]. Key assumptions for the projections are given in this section.

Updated economic growth assumptions are shown in Table 4.19.

Table 4.19 Growth assumptions

	2005	2010	2015	2020
Growth assumption	2.1%	1.25%	2.4%	2.3%

Fossil fuel price assumptions are set out below.

Table 4.20 Central fuel prices

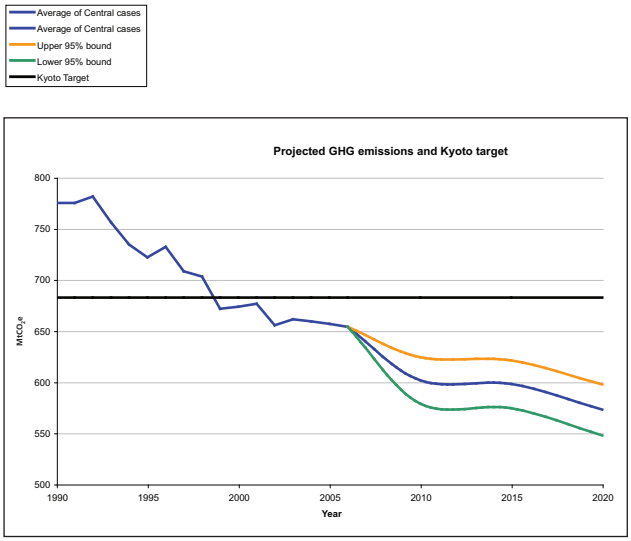
(2007 prices)	Oil ($/bbl)	Gas (p/therm)	Coal (£/tonne)
2005	58	28	34
2010	65	43	36
2015	68	44	31
2020	70	46	32

4.5.5 Overall Uncertainty

The figures presented are all based on central assumptions which are subject to uncertainty. Fossil fuel prices, policy impact, economic and demographic growth are all subject to uncertainty and natural variation driven by factors such as temperature.

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 here. Figure 0.2 shows the results of the probabilistic analysis, which is based on the analysis described in the report on the appraisal of policy options[98]

Figure 4.2 Results of the probabilistic analysis



This analysis suggests that in 2010, UK emissions of greenhouse gases will be between 19 per cent and 25 per cent below 1990 levels, with the central estimate about 22 per cent below (equivalent to 23 per cent below the base year level). The range takes into account macroeconomic, sectoral and modelling uncertainties. Overall therefore, the Kyoto target would be delivered on the basis of the policies included in the projections.

4.5.6 Differences from the 4th National Communication

The table below summarises the differences between the projections in the fourth and fifth National Communications. The main differences between the two projections include additional policy announced in Energy White Paper 2007, higher fossil fuel price assumptions and lower economic growth. The projections have also been updated to take into account improvements to the historic inventory, such as updates to the landfill methane model and other improvements to methods, emission factors and activity data. These changes are summarised in Chapter 2.9 (see page 27).

96 www.berr.gov.uk/files/file48514.pdf

97 www.hm-treasury.gov.uk/d/Budget2009/bud09_completereport_2520.pdf

98 Published in Synthesis of Climate Change Policy Appraisals, which will be available at www.defra.gov.uk

Additional Tables

4.6 The tables in these sections present emissions on an end user basis, according to sector, and emissions from the UK alone.

Table 4.21 Differences in baseline with measures projections between the fourth and fifth national communications, $MtCO_2$ eq

Gas	Fourth National Communication			Fifth National Communication		
	Baseline	2010	Projected Change	Baseline	2010	Projected Change
Carbon Dioxide	592.1	529.1	-10.6%	593.5	505.1	-14.9%
Methane	91.9	39.5	-57.0%	103.7	47.4	-54.3%
Nitrous Oxide	68.3	40.2	-41.2%	63.9	38.7	-39.4%
HFCs	15.5	9.9	-36.0%	15.5	9.0	-42.1%
PFCs	0.5	0.3	-43.2%	0.5	0.2	-62.0%
SF_6	1.2	1.3	4.9%	1.2	0.7	-43.6%

4.6.1 Emissions on an end user basis

Table 4.22 Greenhouse gas emissions from business by end user, $MtCO_2$ eq (UNFCCC coverage)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide	227.5	197.6	196.4	194.6	197.4	169.9	173.4	166.0
Methane	13.0	9.9	6.9	4.5	4.2	4.0	3.7	3.5
Nitrous oxide	2.5	2.1	1.9	1.9	2.0	2.0	2.1	2.0
HFCs	0.0	1.1	4.3	6.1	6.1	6.3	5.6	4.2
PFCs	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
SF_6	0.6	0.8	0.7	0.9	0.7	0.6	0.5	0.5
Total GHG emissions	243.8	211.7	210.4	208.1	210.5	182.7	185.4	176.4
Change from 1990 levels for row above		-13.2%	-13.7%	-14.6%	-13.6%	-25.1%	-24.0%	-27.6%
Percentage changes and emission estimates may differ slightly due to rounding								

Table 4.23 Greenhouse gas emissions from industrial processes by end user, $MtCO_2$ eq (UNFCCC coverage)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide	17.3	15.8	15.6	14.2	14.4	12.9	13.5	13.8
Methane	1.7	1.4	0.9	0.5	0.4	0.5	0.4	0.5
Nitrous oxide	24.7	14.9	5.6	2.9	2.4	2.2	1.7	1.5
HFCs	11.4	14.0	2.7	0.3	0.3	0.2	0.2	0.2
PFCs	1.3	0.4	0.3	0.2	0.2	0.1	0.1	0.1
SF_6	0.4	0.4	1.1	0.2	0.2	0.1	0.1	0.1
Total GHG emissions	56.8	46.9	26.2	18.3	18.0	15.9	16.1	16.2
Change from base year levels for row above		-17.5%	-53.9%	-67.8%	-68.4%	-72.0%	-71.7%	-71.4%
Percentage changes and emission estimates may differ slightly due to rounding								

Table 4.24 Greenhouse gas emissions from transport by end user, $MtCO_2$ eq (UNFCCC coverage)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide	140.6	142.7	146.7	152.2	151.5	144.8	147.6	146.2
Methane	2.2	1.9	1.3	0.9	0.8	0.7	0.5	0.4
Nitrous oxide	1.5	2.7	4.6	5.7	5.8	6.4	6.6	6.7
Total GHG emissions	144.2	147.4	152.6	158.8	158.1	151.8	154.7	153.4
Change from 1990 levels for row above		2.2%	5.8%	10.1%	9.6%	5.3%	7.3%	6.3%
Percentage changes and emission estimates may differ slightly due to rounding								

Table 4.25 Greenhouse gas emissions from the residential sector by end user, $MtCO_2$ eq (UNFCCC coverage)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide	155.7	143.5	146.8	149.5	149.0	135.7	126.7	113.2
Methane	11.6	8.4	5.8	3.8	3.6	3.3	2.8	2.4
Nitrous oxide	0.9	0.7	0.5	0.5	0.6	0.4	0.4	0.4
HFCs	0.0	0.4	2.1	2.7	2.8	2.5	2.5	2.5
Total GHG emissions	168.2	153.0	155.3	156.6	155.9	142.0	132.4	118.5
Change from 1990 levels for row above		-9.0%	-7.7%	-6.9%	-7.3%	-15.6%	-21.3%	-29.6%
Percentage changes and emission estimates may differ slightly due to rounding								

Table 4.26 Greenhouse gas emissions from the public sector by end user, $MtCO_2$ eq (UNFCCC coverage)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide	29.2	26.6	22.3	21.6	21.5	20.4	20.0	18.4
Methane	1.7	1.4	0.8	0.5	0.5	0.5	0.5	0.4
Nitrous oxide	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total GHG emissions	31.1	28.1	23.3	22.2	22.1	21.0	20.5	18.9
Change from 1990 levels for row above		-9.6%	-25.3%	-28.7%	-28.9%	-32.6%	-34.0%	-39.3%

Table 4.27 Greenhouse gas emissions from agriculture by end user, $MtCO_2$ eq (UNFCCC coverage)

Gas	1990	1995	2000	2005	2006	2010	2015	2020
Carbon dioxide	8.8	8.2	7.3	7.2	7.1	6.7	6.8	6.6
Methane	21.8	21.1	20.2	18.4	18.7	18.1	17.9	17.8
Nitrous oxide	32.8	31.3	29.6	27.1	25.9	26.1	26.7	26.5
Total GHG emissions	63.4	60.6	57.0	52.8	51.6	51.0	51.3	50.8
Change from 1990 levels for row above		-4.4%	-10.1%	-16.7%	-18.5%	-19.6%	-19.0%	-19.8%
Percentage changes and emission estimates may differ slightly due to rounding								

4.6.2 UK Coverage tables

Table 4.28 Carbon dioxide emissions by source, $MtCO_2$ eq (UK coverage)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
Energy supply	242.3	207.5	199.8	217.6	220.8	187.3	190.0	172.6
Business	108.9	103.7	104.2	93.4	91.9	83.4	84.1	84.8
Industrial processes	16.3	14.9	14.7	13.9	13.9	12.5	13.2	13.5
Transport	122.5	122.1	126.6	131.9	133.5	128.1	131.3	131.3
Residential	79.8	81.1	87.0	84.6	81.3	78.6	68.5	60.5
Public	13.5	13.2	11.7	10.9	10.5	10.4	10.3	10.2
Agriculture	5.1	5.3	4.7	4.5	4.3	4.6	4.6	4.6
LULUCF (net)	2.9	1.2	-0.4	-2.1	-2.0	-1.4	0.8	2.7
Waste management	1.2	0.9	0.5	0.4	0.4	0.4	0.4	0.4
Total net CO_2 Emissions	592.4	549.8	548.6	555.2	554.5	503.8	503.2	480.7
Change from 1990 levels for row above		-7.2%	-7.4%	-6.3%	-6.4%	-15.0%	-15.1%	-18.9%

Table 4.29 Methane emissions by source, $MtCO_2$ eq (UK coverage)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
Waste disposal on land	49.8	44.2	31.0	19.5	19.5	18.9	17.8	16.9
Agriculture	21.5	20.9	20.0	18.3	18.6	18.0	17.8	17.7
Coal mining	18.3	12.6	7.0	4.1	3.8	3.7	3.2	3.1
Natural gas distribution	8.0	7.4	6.6	4.7	4.5	4.1	3.7	3.3
Offshore oil and gas	2.3	2.3	1.4	0.9	0.8	0.8	0.5	0.4
Fuel combustion	2.6	1.8	1.6	1.2	1.1	1.0	0.9	0.9
Wastewater treatment	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9
Other	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.1
Total	103.5	90.2	68.4	49.6	49.1	47.3	44.9	43.3
Change from 1990 levels for row above		-12.9%	-33.9%	-52.0%	-52.5%	-54.3%	-56.6%	-58.1%

Table 4.30 Nitrous oxide emissions by source, $MtCO_2$ eq (UK coverage)

Sector	1990	1995	2000	2005	2007	2010	2015	2020
Energy Supply	1.93	1.49	1.28	1.64	1.68	1.38	1.34	1.11
Business	1.59	1.46	1.30	1.29	1.31	1.40	1.48	1.56
Industrial Process	24.71	14.94	5.61	2.86	2.42	2.16	1.69	1.46
Transport	1.35	2.53	4.39	5.47	5.59	6.17	6.38	6.55
Residential	0.29	0.22	0.18	0.12	0.12	0.09	0.07	0.07
Public	0.06	0.03	0.02	0.01	0.01	0.01	0.01	0.01
Agriculture	32.81	31.25	29.54	27.11	25.86	26.10	26.66	26.45
Land Use Change	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Waste Management	1.08	1.08	1.23	1.26	1.29	1.33	1.37	1.42
Total	63.83	53.00	43.56	39.77	38.29	38.65	39.02	38.63
Change from 1990 levels for row above		-17.0%	-31.8%	-37.7%	-40.0%	-39.5%	-38.9%	-39.5%

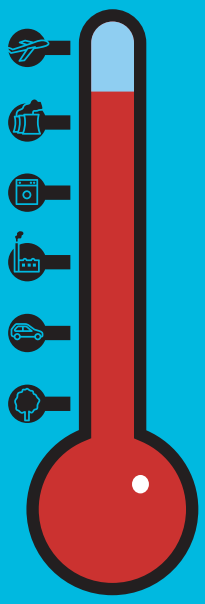
Percentage changes and emission estimates may differ slightly due to rounding

Table 4.31 Fluorinated gas emissions by market sector, $MtCO_2$ eq (UNFCCC coverage)

Sector	1990	1995	2000	2005	2006	2010	2015	2020
HFCs								
Refrigeration/air conditioning	0.000	0.940	4.062	5.100	5.018	5.417	4.621	3.118
Foams (excluding OCF)	0.000	0.000	0.061	0.563	0.619	0.535	0.664	0.779
General aerosols and OCF	0.000	0.572	1.350	1.278	1.293	0.936	0.936	0.936
Metered dose inhalers	0.002	0.002	0.894	1.579	1.585	1.583	1.586	1.586
HFC-23 from HCFC-22 manufacture and fugitive losses from HFC manufacture	11.374	13.981	2.677	0.341	0.303	0.174	0.174	0.174
Solvents	0.000	0.000	0.003	0.046	0.058	0.107	0.107	0.107
Fire fighting	0.000	0.003	0.061	0.298	0.305	0.204	0.214	0.225
HFC used as a cover gas in magnesium foundries	0.000	0.000	0.000	0.002	0.002	0.002	0.002	0.002
Total HFC emissions	**11.375**	**15.498**	**9.107**	**9.206**	**9.182**	**8.958**	**8.304**	**6.927**
PFCs								
Electronics	0.035	0.082	0.180	0.086	0.083	0.069	0.085	0.105
Aluminium smelting	1.333	0.286	0.244	0.055	0.123	0.056	0.056	0.056
Refrigeration/air conditioning	0.000	0.009	0.032	0.000	0.000	0.000	0.000	0.000
Other PFC emissions	0.034	0.094	0.028	0.110	0.090	0.055	0.055	0.055
Total PFC emissions	**1.402**	**0.471**	**0.485**	**0.251**	**0.296**	**0.179**	**0.196**	**0.215**
SF_6								
Magnesium smelting	0.426	0.426	1.093	0.240	0.184	0.139	0.142	0.145
Electrical insulation	0.598	0.802	0.623	0.522	0.509	0.507	0.504	0.496
Electronics	0.006	0.011	0.023	0.013	0.013	0.015	0.020	0.025
Other SF_6 uses	0.000	0.000	0.059	0.321	0.172	0.037	0.001	0.001
Total SF_6 emissions	**1.030**	**1.239**	**1.798**	**1.095**	**0.878**	**0.699**	**0.667**	**0.667**
Total UK emissions of HFCs, PFCs and SF_6	**13.807**	**17.208**	**11.390**	**10.553**	**10.357**	**9.836**	**9.166**	**7.808**
Change from 1995 levels for row above			-33.8%	-38.7%	-39.8%	-42.8%	-46.7%	-54.6%
Percentage changes and emission estimates may differ slightly due to rounding								

5

Adapting to Climate Change



Adapting to Climate Change

Key developments

Government Action
In July 2008, the UK Government's Adapting to Climate Change (ACC) Programme launched an adaptation website and published *Adapting to Climate Change in England: A Framework For Action.* The website is a hub of information about adapting to climate change, covering issues such as how the climate is likely to change, what the UK Government's ACC Programme is doing, and what is happening in the different regions of England. Each UK Government Department involved in the Programme has a dedicated page on this site, that sets out what they have already done in relation to adaptation, and their future plans. It also signposts users to other relevant sources of information, such as the UK Climate Impacts Programme (UKCIP). The website is regularly updated and can be viewed at www.defra.gov.uk/adaptation, and will provide further information about the elements of the Programme set out in this response.

Climate Change Act
The Climate Change Act 2008, which gained Royal Assent on 26 November 2008, makes the UK the first country in the world to have a statutory framework for adapting to climate change. The Climate Change (Scotland) Bill is currently making progress through the Scottish Parliament.

UK Climate Projections
New climate projections for the UK will be launched in summer 2009. These new projections will give information on current and projected future climate change for the UK up to 2099. The new projections will be the fifth generation of UK climate change scenarios, describing how the climate of the UK might change during the 21st century.

NI188 Local Authority Indicator
In recognition of the role that local authorities should be taking, in 2008 the UK Government introduced an adapting to climate change indicator (NI188) in the new Local Government Performance Framework[99] for England.

UK action overseas
Through the Department of Energy and Climate Change (DECC) and the Department for International Development (DfID), the UK is working internationally on adaptation through the UNFCCC and bilateral agreements.

Introduction

5.1 This chapter describes how the UK is developing adaptation strategies. It provides an overview of the work of the UK Government and the devolved administrations of Scotland, Wales and Northern Ireland on adapting to climate change, including the implementation of the UK Climate Change Act, and explains how climate change is likely to be experienced in the UK, based on information on the impacts provided by the UK Climate Impacts Programme and other research. It also describes the work of the UK Government internationally on adapting to climate change.

The Intergovernmental Panel on Climate Change (IPCC) defined adaptation as "any adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities"[100].

Leading the global effort to avoid dangerous climate change is one of thirty cross-UK Government priorities[101] (PSA27[102]). The UK Government's Delivery Agreement for this priority states that: "As a complement to our mitigation efforts, the UK will develop a robust approach to domestic adaptation to climate change, shared across government". Under this indicator, the UK Government measures the increase in the proportion of areas which have sustainable abstraction of water in England and Wales. This measure captures efforts to reduce demand and use water efficiently, as well as long term planning to ensure resilience of water supply.

The UK has a well established foundation for assessing the impacts of climate change, and progressing understanding, guidance and action on adaptation. The UK Climate Impacts Programme was set up in 1997 to advance stakeholder-led assessments of climate impacts, and adaptation has been incorporated in the UK's Climate Change Programme since 2000.

The Stern Review on the economics of climate change found that as people and organisations become aware of the changing climate they will adapt their behaviour to reduce the potential costs, as well as to take advantage of any opportunities. However, though the Stern Review indicated that much adaptation will happen in this way through the workings of the market, there may be barriers that hinder the process of adaptation.

99 http://www.communities.gov.uk/localgovernment/performanceframeworkpartnerships/

100 http://www.ipcc.ch

101 Further details can be found in the 2006 UK Climate Change Programme at http://www.defra.gov.uk and in the Climate Change Delivery Agreement at http://hm-treasury.gov.uk

102 See http://www.hm-treasury.gov.uk/d/pbr_csr07_psa27.pdf and Chapter 3 of this report for further details

The UK Government and the devolved administrations are working to understand these barriers better, identify ways in which they can be overcome and take any necessary action to help. The earlier we start adapting, the better equipped we will be to cope with higher temperatures, increased rainfall and the other potential changes. That might mean ensuring homes, buildings and transport links are protected against flooding or heatwaves.

The UK Climate Change Act

The UK Climate Change Act 2008 makes the UK the first country in the world to have a legally binding long-term framework to cut carbon emissions. It also creates a framework for building the UK's ability to adapt to climate change, by establishing that:

- a UK-wide Climate Change Risk Assessment must take place every five years;
- a National Adaptation Programme must be put in place and reviewed every five years to address the most pressing climate change risks to England;
- the Government has the power to require public authorities and statutory undertakers (companies like water and energy utilities) to report on how they have assessed the risks of climate change to their work, and what they are doing to address these risks;
- the Government is required to publish a strategy outlining how this new power will be used, and to provide guidance on what reporting authorities need to do;
- An Adaptation Sub-Committee of the independent Committee on Climate Change should be created in order to oversee progress on the Adapting to Climate Change Programme and advise on the Risk Assessment.

Adapting to Climate Change Programme in England

5.2 The UK Government has set up the Adapting to Climate Change (ACC) Programme, to bring together the work already being led by the UK Government and the wider public sector on adaptation in England, and to co-ordinate and drive forward the development of the UK Government's work on adapting to climate change in the future. The UK Government wants every sector of society to play its part in ensuring that the country is adapting to the risks posed by climate change. It is taking the lead in providing information, tools, capacity building and a regulatory structure to help organisations consider the risks that a changing climate might impose on their activities. It is also planning what actions should be taken to increase resilience and reduce those risks, and take the necessary action in the most sustainable manner. The Government is also keen to ensure that local government, key public authorities and statutory undertakers are making satisfactory progress in planning for the changes in climate that we expect to see.

The devolved administrations in Scotland, Wales and Northern Ireland are each responsible for considering how climate impacts will affect their jurisdictions. The ACC Programme is responsible for the co-ordination of the UK Government's work on adaptation in England, and also throughout the UK on reserved matters[103] only. However, we need to ensure coherence across the Administrations, and take a UK-wide approach on cross-border issues. The UK Government and the devolved UK Administrations are therefore working closely together to ensure the sharing of best practice and cross-border co-operation.

The cross-Government Adapting to Climate Change (ACC) Programme is working with the Department of Energy and Climate Change (DECC) to ensure that policies on both adaptation and mitigation are joined up and complementary. The ACC Programme in England is in two phases. Phase 1, from 2008-2011 will lay the groundwork necessary to implement Phase 2 – a statutory National Adaptation Programme, as required by the Climate Change Act. Phase 2 will be developed during Phase 1, but will be finalised once the Climate Change Risk Assessment provides the full evidence of key risks to the UK. The Government's intention is to have the Phase 2 statutory Programme in place by 2012, to fulfil the requirements of the Climate Change Act. The Programme will then report progress to Parliament on a regular basis.

The ACC Programme is essentially domestic in scope. However, the consequences of climate change in other countries, and their ability to adapt, will have an impact on the UK, because of the interconnected nature of our globalised world. The ACC Programme will therefore address those effects where there is potentially a significant domestic impact from international developments. The ACC Programme is keen to work, and share ideas, with other countries.

Full details of the ACC Programme can be found at www.defra.gov.uk/adaptation

[103] Reserved matters are those policy decisions affecting Scotland, Wales, Northern Ireland and the regions of England that are still taken by the UK Parliament at Westminster.

5.2.1 **Phase 1 Programme: 2008-2011**

5.2.1.1 *Objectives*

The objectives of Phase 1 of the ACC Programme are to:

- develop a more robust and comprehensive evidence base about the impacts and consequences of climate change on the UK;
- raise awareness of the need to take action now and help others to take action;
- measure success and take steps to ensure effective delivery; and
- work across government at the national, regional and local level to embed adaptation into UK Government policies, programmes and systems.

5.2.1.2 *Workstream A: Providing the evidence*

A great deal of work has already been done to provide the evidence base on which adaptation decisions can be taken. To be able to take effective decisions on how to adapt, individuals and organisations need a reliable understanding about the likely consequences of climate change. The ACC Programme will therefore work to continue the provision of a robust, accessible evidence base, building on work undertaken by the Met Office Hadley Centre, the UK Climate Impacts Programme and other work funded by Defra, the Research Councils and other bodies.

a) UK Climate Projections

We cannot predict exactly how the climate in the UK will change in detail, partly due to uncertainties about future greenhouse gas emissions and partly due to the intrinsic uncertainties about modelling atmospheric processes, as well as natural variability. However we will be better placed to understand the likelihood and magnitude of different changes, with the publication of the UK Climate Projections in summer 2009[104].

b) Assessing the risk of climate change for the UK

The UK Climate Change Act commits the UK Government to carrying out an assessment of the risks of climate change. This national climate change risk assessment will build on the existing body of evidence, identify gaps in our knowledge, and help prioritise our strategic objectives. It will look at current vulnerabilities, future impacts and adaptive capacity.

The Climate Change Risk Assessment must be presented to the UK Parliament within three years of the Climate Change Act gaining Royal Assent, i.e. by 26th November 2011. After this, a risk assessment will be carried out every five years, and will inform the statutory National Adaptation Programme. The Risk Assessment will be complemented by an economic analysis of the options for taking adaptation action. In Scotland, Scottish Ministers will respond to those aspects of the risk assessment that relate to devolved matters.

5.2.1.3 *Workstream B: Raising awareness of the need to take action now, and helping others to take action*

A comprehensive evidence base is essential, but it is only effective if it is well used. Individuals and organisations need to know that there is an issue that needs to be addressed, how to find the information that they need, and how to use it.

The ACC Programme works with a range of organisations from the public, private and third sectors to:

- Raise awareness of the need for action;
- Provide and promote the information and tools needed to take action; and
- Build capacity and capability within organisations to understand the impacts of climate change and take action.

a) The UK Climate Impacts Programme (UKCIP)

UKCIP was set up in 1997 and is funded by Defra and the Devolved Administrations (around £900,000 a year). It is an advisory service helping organisations make decisions on adapting to climate change. UKCIP serves as a boundary organisation between scientists and stakeholders, working to enhance the uptake of robust evidence on potential climate change impacts and ensure that research is carried out with end users in mind, as well as creating new tools and methods to advise decision makers on how they can adapt[105].

b) Guidance on assessing the risks of climate change and taking action

The UK Climate Change Act 2008 introduces a new power for the Secretary of State to direct a "reporting authority" to prepare reports on how they are adapting to climate change. Further details about this power are provided under workstream C. In order to ensure that this power is used effectively, the Government will produce statutory guidance on adaptation. This guidance will set out the processes that organisations need to go through to assess the risks from climate change and draw up adaptation plans.

104 UK Climate Projections is delivered by UKCIP, The Met Office Hadley Centre, British Atmospheric Data Centre and Newcastle University.

105 Further information can be found at www.ukcip.org.uk

c) Action at the regional and local level

The impacts of climate change will vary, even within a relatively local area, and action will need to be taken at the most appropriate level. This will often be regional and local, rather than national. In addition many of the actions that need to be taken early but have a long-term impact are delivered at local and regional level. These include spatial planning and investments in schools, houses, hospitals and roads, and the provision of a wide range of essential public services.
The ACC Programme is working with a range of organisations in England at the local and regional level to ensure adaptation across the country.

The Programme is working with several partners including UKCIP, the Government Office network, local and regional organisations and Nottingham Declaration[106] Partnership members through the Local and Regional Adaptation Partnership (LRAP) Board. The LRAP Board, chaired by Government Office for London, is developing a programme of support on adaptation for local and regional bodies. The board has made supporting the delivery of NI188[107] (the Local Government Performance Indicator), which 56 Local authorities have adopted, as its current priority. The first stage of this has been nine regional workshops focussing on sharing of approaches and current case studies and consultation and development of NI188 guidance[108].

5.2.1.4 *Workstream C: Ensuring and measuring progress*

In order to see results on the ground we need to have ways of knowing if the ACC Programme is successful and how widely its influence is being felt. It will also be important to have strong external challenge to help keep up momentum. We will need to measure real world outcomes, but because we know that some of the most important outcomes won't be measurable for decades to come, we will need some intermediate measures. In addition, success measures may be very local, depending on the geographic, social and economic character of an area.

a) Measuring successful adaptation – indicators of success.

The ACC Programme has produced an indicator to measure progress on adaptation in local government in England. This is the Local Government Performance Indicator (NI188).

The ACC Programme will put forward proposals for a new basket of performance measures for adapting to climate change. These will cover the need to raise awareness, to build capacity in the public, private and third sectors, and changes in policy and practice to deliver real world outcomes. The ACC Programme will engage with stakeholders in the development of these indicators.

b) Ensuring delivery across the public sector and utilities

The Reporting Power under the UK Climate Change Act

The Climate Change Act 2008 introduces a new power for the Secretary of State to direct "reporting authorities" to prepare reports on how they are adapting to climate change. Each report will need to be in line with the Direction by the Secretary of State and have regard to Statutory Guidance. A report should include an assessment of risks to that authority presented by climate change, and a programme of measures to address the risks and opportunities presented by the changing climate[109]. This power does not extend to the direction of authorities in relation to work they might conduct on devolved functions in Scotland. Reporting arrangements in Scotland for devolved functions may be considered in the Climate Change (Scotland) Bill

The Local Government Performance Framework

In 2008 the UK Government set out an indicator (NI188) for all English local authorities on embedding adaptation in the full range of their work. This is one of the National Indicators for local authorities and Local Strategic Partnerships, which is the single route through which central government sets priorities for local government in England.

c) External Scrutiny

Expertise on adaptation, whether inside Government, business or universities, must be put to good use in the ACC Programme. We want to have open and robust debate about the challenges that face us as a society in adapting effectively, in line with the principles of sustainable development. We have established a Partnership Board, involving a wide range of stakeholders, to help develop the ACC Programme and challenge UK Government to make progress on implementation.

106 The Nottingham Declaration recognises the central role of local authorities in leading society's response to the challenge of climate change. By signing the Declaration councils pledge to address systematically the causes of climate change and to prepare their community for its impacts. For more information see http://nottinghamdeclaration.co.uk

107 For further information – http://www.defra.gov.uk/environment/climatechange/adapt/action/local-authorities.htm

108 http://www.defra.gov.uk/environment/localgovindicators/ni188.htm

109 Full details can be found at http://www.defra.gov.uk/environment/climatechange/adapt/legislation/reporting.htm

The UK Climate Change Act 2008 requires the UK Government to report progress regularly to the UK Parliament, to ensure transparency.

In addition, the UK Climate Change Act 2008 introduces a new independent Committee on Climate Change (CCC) to provide expert advice and scrutiny on the Government's climate change work. It also introduces a new Adaptation Sub-Committee (ASC) of the CCC[110]. This is currently being recruited and will be in place by summer 2009.

5.2.1.5 *Workstream D: Government policy and process: embedding adaptation*

This workstream will ensure that as UK Government policies and investment decisions are planned, the risks from climate change to public policy objectives and to the efficient use of public resources are taken into account. As an example of the type of project carried out under this workstream, under the auspices of HM Treasury, sponsored jointly with the ACC Programme, a cross-Government working group is examining whether additional Green Book guidance is required to enable climate change to be built properly into the decision making process for future spending and investment proposals. (The Treasury Green Book[111] is the central point across Government for guidance on the economic assessment of spending and investment).

Embedding adaptation into key Government Programmes

A major challenge for all Government Departments and Agencies, as with any other organisation in the public and private sector, is to review their policies and operations in the light of the risks of climate change, and consider the options for adaptive action. This process will be helped by the publication of the new UK Climate Projections, and the statutory guidance to be provided under the UK Climate Change Act.

The Climate Change Risk Assessment and Adaptation Economic Assessment will also help Government and the devolved administrations, as well as the rest of society, target where to focus action given the key risks and vulnerabilities. However, action must start to be taken now and cannot be delayed until those projects are finalised.

All UK Government Departments and the devolved administrations are looking at the need to adapt their policies in the light of climate change.

As part of the ACC Programme's work, each UK Government Department has been identifying those areas where the need to adapt is the greatest. These relate to the priority areas identified by each Department on their web-pages of the adaptation website. The ACC Programme is considering how best to take this work forward but examples of the areas in which we will take initial action includes:

- Working with the Department of Communities and Local Government (CLG) to look at strengthening adaptation within the planning process including looking at mechanisms such as Building Regulations and the Code for Sustainable Homes.
- Working with the Cabinet Office (CO), Department for Business Enterprise and Regulatory Reform (BERR), Department for Transport (DfT) and CLG to ensure critical national infrastructure is adapting to changes in our climate.
- Working with DfT to ensure that a risk-based approach to adaptation is integrated into the New Approach to Transport Appraisal (NATA), which is the framework used to appraise the costs and benefits of transport schemes requiring the Department's funding or approval.
- Working with the Departments for Children, Schools and Families (DCSF), Department for Work and Pensions (DWP) and Department of Health (DoH) to consider the social impacts of climate change and how we can reduce the susceptibility to the most harmful impacts of the most vulnerable members of society.

Further information on all these work areas is available at www.defra.gov.uk/environment/climatechange/adapt/programme/index.htm

UK Administrations

5.3 The UK Administrations are committed to working closely together to share best practice and develop cross-border initiatives. To do this we have set up the Adapting to Climate Change UK group who meet every six months.

5.3.1 **Scottish Government Programme**

The Scottish Government is seeking effective options to help build Scotland's resilience to the unavoidable consequences of climate change.

110 For further details on the ASC – http://www.defra.gov.uk/environment/climatechange/adapt/legislation/subcommittee.htm

111 The Green Book is HM Treasury guidance on appraisals and evaluations in central Government and its agencies. It aims to ensure the continuous improvement and value for money in the delivery of public services.

In many cases, Scotland already has in place legislation, regulation or policies to protect against those impacts likely to pose the greatest risk, such as the risk of more frequent flooding events.

The Scottish Government is developing a complementary Climate Change Adaptation Framework by providing consistent guidance for a sustainable approach to climate change adaptation and increasing the potential to recognise opportunities for greater whole-of-government policy development. The Framework will identify key factors contributing to Scotland's vulnerability to changes in climate and set out the roles of key stakeholders and the Government's actions to address these.

The Framework will be published in 2009. Two consultations held to inform the development of the Framework can be accessed at: www.scotland.gov.uk/climatechangeadaptation

More recently, the Scottish Government has adopted a climate change adaptation risk onto its main strategic risk register and has given a commitment in principle to increase its funding to support the Scottish Climate Change Impacts Partnership which works with private and public sector stakeholders to develop awareness of climate change and the need to take adaptive action.

5.3.2 Welsh Assembly Programme

The Welsh Assembly Government's programme for Government, *One Wales,* made a clear commitment to addressing climate change. The Wales Environment Strategy contained a commitment to develop a Climate Change Adaptation Action Plan, setting out what action the Welsh Assembly Government, partner organisations and people across Wales needed to take in response to climate change. To adapt to the impacts of climate change we need to build consideration of the risks and opportunities it poses, all sectors need to factor it into their planning and decision making processes.

To build adaptation to climate change into our decision making, deliver action that enhances Wales' ability to respond to the challenges and opportunities and to meet our statutory obligations under the Climate Change Act, we will develop a framework that focuses on:

1. Developing a more robust and comprehensive evidence base about the impacts and consequences of climate change in Wales. This will help individuals and organisations to make effective decisions on how to adapt. Key activity planned includes:
   - The new UK Climate Projections (UKCP 09) scenarios will be used to update Wales Scoping Study focusing on key sectors such as agriculture, marine and environment and the built environment.
   - Supporting the development of Local Climate Impact Profiles and consideration of climate impacts by local authorities.
   - The first UK Climate Change Risk Assessment (CCRA) will be published within three years of the Climate Change Act gaining Royal Assent with a cost – benefit analysis of the adaptation options to address those risks.
2. Work across the Welsh Assembly Government, regional bodies and local government to embed adaptation as a process into policies programmes and systems and in the delivery of services. Some specific actions to support this will include:
   - mainstreaming risk assessment and building capacity for key decision makers in all sectors through training on using the scenarios and using UKCIP tools
   - building climate change impacts into funding decisions
   - producing comprehensive guidance on adaptation as part of the requirements of the Climate Change Act
3. Raise awareness of the need to take action now in all sectors and help others to take action, by
   - signposting to tools and building capacity within organisations to understand the impacts of climate change.
   - supporting people to respond to the impacts of climate change rather than simply raising awareness of them.

Wales has just finished consulting on the first stage of its Climate Change Strategy, and will be undertaking the next stage of consultation in June 2009. The responses from the consultation and the comments of the Climate Change Commission for Wales Adaptation sub-group, will aim to develop proposals for specific actions on how to adapt to the impacts of climate change.

5.3.3 Northern Ireland Government Programme

In Northern Ireland, the Department of the Environment (DOE) takes the lead on climate change issues. It works closely with Defra and the Devolved Administrations of Scotland and Wales.

On 30 January 2007, *The Scotland and Northern Ireland Forum for Environmental Research* (SNIFFER), launched a report called 'Preparing for a Changing Climate in Northern Ireland'.

Published on behalf of DOE and Northern Ireland Environment Agency, the report examines the potential impacts of climate change in Northern Ireland across a broad range of sectors. It looks at measures already being undertaken and considers what else may be required to adapt to the impacts.

The importance of a regional approach to reducing the causes and responding to the impacts of climate change has been widely recognised. The Northern Ireland Climate Change Impacts Partnership (NICCIP) was established to widen the understanding and knowledge of the impacts of climate change within Northern Ireland and the adaptation actions necessary to deal with it. The Objectives of NICCIP are as follows:

- To promote, through partnership, the ownership across relevant social, economic and environmental sectors of issues relating to climate change adaptation;
- To increase the adaptive capacity of organisations across all sectors;
- To provide a forum for discussion and a link between organisations concerned with climate change adaptation issues;
- To develop a programme of activities e.g. joint research, study, events, visits, seminars etc;
- To provide members with information and links to regional, national and international activities on impacts and adaptation;
- To consider the relevance of mitigation to the interests of the partnership; and To develop and consolidate membership of appropriate organisations and develop governance arrangements.

Impacts of a Changing Climate in the UK

5.4 Climate change is happening now. Eight of the ten warmest years since records began have occurred since 1990. In the UK we can expect to see much higher summer temperatures, even in the next 20-30 years. Current climate projections also suggest continued warming at least up to the end of the century.

Scientists at the Met Office Hadley Centre have suggested that in the next few years, natural climatic variability may partially offset man-made global warming. However, temperatures are expected to continue rising.

Scenarios produced by the Met Office Hadley Centre, Tyndall Centre and UK Climate Impacts Programme in 2002 (UKCIP02)[112] suggest that for the UK climate change means, on average, hotter drier summers and milder, wetter winters combined with more extreme weather events such as heatwaves and periods of heavy rainfall. These changing climatic conditions mean that we can expect to experience the following more often in future years:

- periods of continuously higher temperatures than we are used to – the summer heatwave experienced in 2003 is likely to become a normal event by the 2040s and considered cool by the 2060s;
- decreased rainfall in summer leading to drought, lower river flow and increased water stress;
- more frequent periods of heavy rainfall, especially in winter, leading to increased flooding;
- faster rates of coastal erosion and increased frequency of coastal flooding. Storm surges are expected to be experienced more frequently – by 2100 they could occur up to 20 times more frequently for some coastal locations; and
- continuing global sea level rise – by 2100 it could have risen by as much as 80cm around some parts of the UK coast.

The impacts of these changes will vary from place to place, just as weather and the effect it has on society varies across the country. For example, the UKCIP02 scenarios suggest that under a high emissions scenario, average summer temperatures in southern England will increase by over 4.5°C by the 2080s, whereas for northern Scotland and Northern Ireland the increase may be less than 3°C. Certain features in England are likely to represent particular 'hotspots', where a number of climate impacts will be felt in one location, for example, floodplains, coast, estuaries and large urban areas.

The impacts experienced will also change over time. The IPCC has suggested that in Northern Europe generally, climate change is initially projected to bring mixed effects, including some benefits such as reduced demand for heating, increased crop yields and forest growth. Raised temperatures could provide increased tourism opportunities for many parts of Northern Europe. However, as climate change continues, the negative impacts (including more frequent

112 http://www.ukcip.org.uk

winter floods, endangered ecosystems and increasing ground instability) are likely to outweigh its benefits[113].

Overall, there will be both positive and negative impacts on every aspect of our economy, society and environment. A series of regional scoping studies for the UK has been undertaken, supported by the UKCIP. These identified a range of impacts[114], including:

Critical national infrastructure

- water and sewerage infrastructure; increased risk of summer water shortages; increase in water quality problems.
- solid waste management – increased rate of degradation and leaching at landfill sites.
- transport – less risk of disruption from cold weather and fog, increased pressure on infrastructure due to heat, changing rainfall patterns and extreme weather events.
- energy infrastructure and networks vulnerable to flooding, storms and extreme heat.

Public services

- emergency planning and security – increased risk of extreme weather events and more pressure on emergency services.

Healthcare

- health and healthcare – reduced winter mortality; more heat-related health problems.

Households

- homes – increased risk of subsidence; discomfort in buildings in summer
- increased flooding risk in some areas.

Natural Environment

- changes in the timings of seasonal events, leading to loss of synchrony between species and the availability of food, and other resources upon which they depend.
- shifts in suitable climate conditions for individual species leading to change in abundance and range.
- changes to the composition of plant and animal communities.
- changes to habitats and ecosystems, such as altered water regimes, increased rates of decomposition in bogs and higher growth rates in forests.
- terrestrial biodiversity – some species and habitats may be gained and others lost.
- marine environment – some species and habitats may be gained and others lost.
- damage to ecosystems services[115], loss of carbon storage in peat soils, reduction in soil quality, increased risk of invasive species taking hold.

Land based economy

- agriculture and horticulture – potential to grow new crops, reduced yield for others, more/different pests and diseases.
- forestry – increased growth and productivity; increased drought risk, new and intensified threats from pests, diseases and weather (including drought, wind and fire risk)

Wider economy

- heritage – increased risk of extreme weather damage to historic buildings and ancient monuments.
- business – disruption to supply chains, new markets and opportunities; changing consumer demand.
- financial/insurance services – new financial products required to manage risks; increase in insurance premiums as a result of extreme weather.
- tourism and leisure – positive and negative changes in tourism; increased opportunities for outdoor sports; increased pressure on green space for leisure.

Examples of adaptation in the UK

5.5 There are numerous examples of adaptation in practice in the UK. The following examples highlight some of the issues for adaptation, but it is not an exhaustive overview of adaptation in the UK.

5.5.1 Water

Hotter, drier summers, milder wetter winters, and more frequent extreme weather events such as flooding, heatwaves and drought, as described by UKCIP scenarios , could mean, higher water

113 http://www.ipcc.ch

114 Measuring Progress: Preparing for climate change through the UK Climate Impacts Programme, UKCIP Technical Report, June 2005.

115 The Term "ecosystem services" refers to the wide range of goods and services provided by the natural environment that underpin human health, wellbeing and prosperity. For further information please see the Defra website: www.defra.gov.uk

demand, more widespread water stress with increased risk of drought, more water quality problems, as well as more extreme downpours with a higher risk of flooding.

Defra has published Future Water, which sets out a long-term vision for water policy and management; by 2030 we will have embedded continuous adaptation to climate change throughout the water sector and put in place a requirement for water companies to prepare and maintain drought plans. Future Water can be viewed at www.defra.gov.uk.

The Welsh Assembly Government Strategic Policy Position Statement on Water was published on 2 April 2009 and highlights the challenges posed by a changing climate for water services in the future. The Statement can be viewed at http://wales.gov.uk/topics/environmentcountryside/epq/waterflooding/policystatement/?lang=en

5.5.2 Flood Management

Making Space for Water is the cross-UK Government programme taking forward the developing strategy for flood and coastal erosion risk management in England. It does this by effectively embedding flood and coastal erosion risk management across a range of UK Government policies, including planning, urban and rural development, agriculture, transport, nature conservation and conservation of the historic environment. Equally, it is also vital that other relevant UK Government policies are reflected in the policies and operations of flood and coastal erosion risk management.

The involvement of a broad range of Government partners and external stakeholders in the Making Space for Water Programme is ensured through the Flood Management Stakeholder Forum. We have also sought to strengthen the integrated framework for delivering the programme by assigning individual project responsibilities to other Government Departments/Stakeholders where appropriate, namely:

- Land Use Planning (Department of Communities and Local Government – CLG)
- Resilience Standards for New Buildings (CLG)
- Encouraging and Incentivising Flood Resilience (Association of British Insurers, in conjunction with Defra).

Similar activity is underway in Wales as part of the New Approach Programme which was launched in July 2007 and aims to transform the way flood and coastal erosion risk is managed in Wales. The Programme has evolved to take account of the findings of the Pitt Review[116] and is focused on ensuring that all sources of flood risk are managed effectively looking both at immediate and longer term pressures including as a result of climate change, that a seamless service is provided with all the relevant operating authorities and that people at flood risk are at the heart of service design and response.

The Thames Estuary 2100 Project

Thames Estuary 2100 (TE2100) is an Environment Agency project to develop a tidal flood risk management plan for the Thames Estuary through to the end of this century. Using the latest climate change scenarios and models, and taking account of future sea level rise, the final plan will recommend what flood risk management measures will be required in the Estuary, where they will be needed, and when they will need to be in place by.

The final plan will also be flexible to ensure that it can be adapted if sea levels rise faster, or storm surges become more intense than anticipated.

Preliminary findings show that the Thames Barrier, with some adaptation, will continue to provide protection through to the end of the century. However, by 2050 we may need to improve many of the flood defence walls and embankments, and create new inter-tidal habitats to offset the impact of rising sea levels before 2030.

Further information:
www.environment-agency.gov.uk/te2100

5.5.3 Planning and Construction

In the planning and construction sector, adaptive capacity is being built into planning policy regulations.

CLG has:

- published PPS (Planning Policy Statement): Planning and Climate Change, a supplement to Planning Policy Statement 1, which sets out clear expectations on how adaptation should be integrated into planning
- published PPS 25: Development and Flood Risk, which sets out policy on development and flood risk
- developed proposals for eco-towns, which will need to be resilient to the climate of the future and the economic and social circumstances that future climate conditions will bring

116 http://archive.cabinetoffice.gov.uk/pittreview/thepittreview.html

- introduced higher standards for buildings new affordable housing – Level 3 of the Code for Sustainable Homes which sets an independently assessed standard of 105 litres of water use per person per day
- removed permitted development rights for hard surfacing, encouraging installation of permeable surfaces which absorb storm water
- published in 2006 regulations on energy efficiency (part L) which introduced a requirement on the builder to consider heat gains as well as heat losses in domestic buildings and to prevent solar gain.

CLG in conjunction with the Department for Culture, Media and Sport (DCMS) sponsor the Commission for Architecture and the Built Environment (CABE) to carry out their work in raising design standards and ensure significant new developments consider adaptation issues, through design review, their enabling programme, CABE guidance documents and targeted education.

A number of specific action have been taken to implement improved flood risk management in **Wales:**

- Technical Advice Note 15 – Development and Flood Risk (TAN 15), provides a precautionary framework which guides development away from the floodplain where this is possible and ensures that decisions that allow development on the floodplain must take into account the consequences of flooding over the lifetime of that development.
- The Assembly Government commissioned pilot studies following severe localised flooding in Wales in 2007. These projects, which are currently being evaluated, demonstrate how flood consequences can be managed through strong partnership working and close public engagement.
- Ensured mapping critical surface water drainage areas across Wales

Redhill School

The redevelopment of Redhill School, Worcestershire undertook possibly the first climate change impact assessment at the start of a design process in an English school.

The £2.7 million project involves a replacement primary school on the site of the former 1960s building. The school aims to have a low carbon building that is able to cope with climate change and will provide a comfortable teaching environment over its lifetime.

Some of the adaptation features of the school to help it to withstand climate change impacts include:

- a sustainable urban drainage scheme using swales, ponds and underground box storage.
- a rainwater harvesting scheme, used for flushing toilets, takes rain from approximately half the roof area. Other roof areas have a planted roof finish (sedum) to reduce run-off.
- extra shade for pupils and teachers, provided by overhanging eaves and external canopies to the classrooms.
- zinc sheet roof coverings, with standing seams, that may be less vulnerable to high winds than roofing tiles.

5.5.4 Biodiversity and conservation

Defra has published guidance, on behalf of the UK Biodiversity Partnership, for those delivering conservation, summarising how existing plans and projects can adapt to climate change. This guidance can be viewed on the Defra website www.defra.gov.uk .

Species adapting to climate change

A study by RSPB and Aberystwyth, Manchester and Newcastle Universities is exploring if climate change will have a negative effect on populations of golden plovers breeding on upland moors and peatlands and whether simple measures could help them adapt.

In golden plovers, growth and survival of chicks depends on abundance of cranefly prey. Warmer springs may change the timing of both golden plover nesting and cranefly emergence, and are predicted to cause small reductions in breeding success.

Ongoing research suggests a more severe consequence of climate change may occur through summer warming. When August temperatures are high, cranefly larvae may desiccate as peatland dries out.

This means that in the next year, fewer craneflies emerge, resulting in low golden plover chick survival. Subsequently, declines in the population are being seen in the following year.

Drainage ditches on peatland are being blocked to restore habitat condition and promote ecosystem services of water management and carbon storage.

Raising water levels may also increase the resilience of cranefly populations to future warming. This active management of the peat bog could be a simple way to help these two species adapt to the impacts of climate change For further information please see www.rspb.org.uk.

5.5.5 Agriculture

The effects of climate change on agriculture include, longer growing seasons with potential higher yields and opportunities to diversify, potential changes in the suitability of some areas to produce existing crops, lower soil moisture levels, higher levels of wind and water erosion. Lower soil organic matter levels, new pests and diseases affecting crops and livestock with the increased likelihood of animals suffering from heat stress and also higher water demand. There will also be more widespread water stress with increased risk of drought.

Defra has provided funding for Farming Futures, which gives practical advice to farmers on how and why they need to adapt to climate change, and reduce their greenhouse gas emissions. In September 2008, 60 per cent of farmers surveyed in England as part of the Farming Futures project said they were already affected by climate change and more than half expect to be affected in the next ten years. Further information on the Farming Futures Project can be found at www.farmingfutures.org.uk.

Defra has also set up, and worked closely with, the Rural Climate Change Forum, which brings together the key organisations with an interest in the rural sector and works to raise awareness of climate change, to catalyse and coordinate work on climate change, and to advise on rural climate change policies and research priorities.

The Welsh Assembly Government has established a Land Use Climate Change Group for Wales as a Sub Group of the Climate Change Commission for Wales in January 2009. The Group brings together key stakeholders to advise on actions that will help to deliver the *One Wales* commitment to 3 per cent annual reductions in emissions of greenhouse gases by 2011 onwards on a longer term basis. In addition, the Group is intended to help land use to adapt to the challenges and opportunities of a changing climate.

5.5.6 Forestry

The Forestry Commission is the Government Department responsible for forestry in Great Britain. Research and international policy are reserved issues while domestic forestry policy is devolved to country administrations. By agreement with the devolved administrations, the Forestry Commission (through its Plant Health Service) develops and implements Plant Health Regulations at EU and GB level.

Hotter, drier summers, milder wetter winters, and more frequent extreme weather events such as flooding and storms, as described by UKCIP could result in, changing forest productivity as a result of warming, rising CO_2 levels in the atmosphere and changing rainfall patterns. As a generalisation, these impacts are likely to be positive in the north and west and negative in the south and east. This may lead to changes in the identity, location and productivity of commercial forests affecting the timber processing industry. There will be increased frequency of water-logging in winter limiting access for management activity and enhancing the risk of windblow and changing frequency and severity of tree disease and insect pest outbreaks. Changes will also be seen in the distribution of species and the composition of native woodland vegetation communities.

The Forestry Commission has established a comprehensive climate change research programme, largely undertaken by its Forest Research Agency, held a high level conference on forestry and climate change, and established a climate change communication initiative. It has

also announced the establishment of a Centre for Forests and Climate Change.

The Forestry Commission has incorporated climate change as one of the 5 aims for delivering the revised strategy for England's Trees, Woods and Forests (2007), with the following objectives relating to adaptation:

- to increase the resilience of trees, woods and forests to climate change
- to increase the role of trees and woodland in adapting the rural landscape to climate change
- to enhance the role of street trees and urban woodland in minimising the impacts of climate change on our towns and cities
- to use trees, woods and forests to help communicate and improve understanding of climate change issues and bring about behavioural change.

In Scotland, the Scottish Forestry Strategy (2006) identifies climate change as one of its seven key themes. The theme's primary purpose in relation to adaptation is to ensure that Scotland's woodlands and the forestry sector meet their full potential in facilitating ecological, economic and social adaptation to climate change. It sets out three key actions:

- Improve understanding of climate change impacts on woodland ecosystems and silviculture, and implement precautionary measures, such as forest habitat network creation.
- Maintain preventative measures and ensure readiness for pests, diseases and other threats, such as fire and wind.
- Increase the role of forestry in environmental protection including sustainable flood and catchment management, and soil protection.

Early in 2009 Forestry Commission Scotland published a Climate change action plan (2009 –2011). It describes what the Commission will do to increase the contribution and response of Scottish forestry to the challenges of climate change and focuses on what needs to be done both as early actions and to increase future preparedness. The focus for adaptation is to:

- plan and manage forests and woodlands in a way that minimises future risks from climate change, for example through the creation of forest habitat networks, and using different timber species, including hardwoods, or silvicultural systems.
- assist in environmental protection such as helping to tackle slope instability, reducing riverbank erosion, contributing to natural flood management and increasing the contribution of trees and woodland to climate control in urban areas.

5.5.7 Transport

The Department for Transport (DfT) works to deliver a transport system that balances the needs of the economy, society and the environment. The changing climate could have a range of impacts on transport networks.

Risks due to a changing climate that could affect transport in the UK are increased flooding of transport infrastructure during winter, though less disruption due to ice, snow and fog. Network disruption in summer as a result of road deformation and rail buckling, as well as the risk of passenger heat exhaustion. Increased risk of structural failures in bridges, tunnels and embankments due to changes in soil moisture content and greater risk to ports and ships due to rising sea levels, coastal erosion and storm surge is also predicted.

DFT has completed research on adapting materials and techniques in highway works to the changing climate, which will be published as a guide for local authorities. The Highways Agency is making a full assessment of how to manage the risk from climate change to its roads network, and has already improved drainage and road surface standards to increase resilience. DFT has also established a cross-rail industry forum and commissioned research to identify and address challenges to the railway. This complements work undertaken by Network Rail to design increased resilience into its renewal work and produce hazard maps highlighting vulnerable areas.

DFT's priorities are now to:

- ensure that key transport networks – national, international, city and regional – continue to operate effectively because assets and infrastructure are planned, designed and maintained to be resilient to future climate impacts
- engage with key stakeholders to raise awareness of the legislative requirements set out in the UK Climate Change Act, the tools available to them to assess the impacts of climate change on their operations and the potential benefits and opportunities that adapting to climate change may present
- build on initiatives already underway to develop a coherent, system-wide picture of the biggest transport risks and the most cost-effective remedies – the Department will also look for synergies between adaptation measures for transport and for other sectors

- ensure that a risk-based approach to adaptation is integrated into the New Approach to Transport Appraisal (NATA), which is the framework used to appraise the costs and benefits of transport schemes requiring the Department's funding or approval
- ensure that regional and local transport authorities are encouraged and supported in taking action to assess and address climate change impacts
- support the development of a national resilience planning forum to identify and address the risks from climate change to Britain's ports.

International co-operation on adaptation

5.6 The Government works on adaptation overseas as part of its commitment to being a world leader in tackling climate change, and eradicating extreme poverty worldwide. The formation of a new UK Department of Energy and Climate Change (DECC) provides a new impetus in the international negotiations on the UNFCCC. DECC and the Department for International Development (DFID) have joint responsibility for leading on the UK's international policy work on adaptation.

5.6.1 **Increasing access for developing countries to climate information and tools**

The UK Government support a range of regional and sectoral research initiatives, such as £130m of core support to the 15 international research centres of the Consultative Group on International Agricultural Research (CGIAR). This will support a range of programmes addressing adaptation to climate change, like breeding drought-resistance maize in twenty countries with potential direct benefits to over 320 million people.

The UK Government has been supporting the development of the Climate for Development in Africa (ClimDev-Africa) Programme. This programme will help countries identify actions they need to take to build resilience and adapt to climate change. The programme has been developed jointly by the African Union Commission (AUC), United Nations Economic Commission for Africa (UNECA) and the Africa Development Bank.

The UK is also supporting the South Asia Water Initiative (SAWI) which brings together seven countries that share rivers that drain from the Himalayas (Afghanistan, Bangladesh, Bhutan, China, India, Nepal and Pakistan). The initiative aims to improve cooperation over water sharing through building knowledge, relationships and institutions. We are supporting improved access to climate change knowledge and approaches in individual countries too, including Nepal, Bangladesh and Pakistan.

DECC is funding the second phase of a collaborative project with the Indian Ministry of Environment and Forests to develop further understanding of the potential impacts of climate change in India. The project due to start in 2009 will improve current climate change scenarios for India, revise impacts assessment at the national level and assess the socio-economic impacts of extreme events.

The UK Government is also supporting a five-year research and capacity development programme in Africa to help African researchers and policy makers to identify practical ways that rural and urban people can adapt to climate change. DFID is contributing £24 million to the programme. Examples of its work are:

- How small scale farmers in Ethiopia, Kenya, Sudan and Tanzania can modify working practices to cope with increased drought.
- How farmers in Zambia could adopt new agricultural practices, such as using different crop varieties and improved technologies to deal with a more variable climate.
- Malaria epidemic prediction in Kenya and Tanzania in response to changes in climate so that health officials can intervene more effectively.

The UK Government is also supporting initiatives at country and regional level, such as an economic and social analysis of the costs of climate change to Afghanistan, South-East Asia, the Caribbean, Brazil, Central America, South America and East Africa.

The Welsh Assembly Government has signed an agreement with the UNDP which confirms that the UNDP and Wales intend to work together on a UN-Association of Regions partnership programme called 'Toward Carbon Neutral and Climate Change Resilient Territories'.

The aim of the UNDP's partnership programme is to sensitise 500 regions from the global south to the issues around climate change and its threats, using experts from developed regions.

Through the programme, 50 of the developing country regions will then receive help, training and support to develop their own Integrated Territorial Climate Plan and access the different available sources of funding for its implementation.

In Wales we have a particularly strong community link between Rhondda Cynon Taff and Mbale in Uganda, through the community organisation PONT (which is part of the Gold Star Communities project funded by the Welsh Assembly Government's Wales for Africa programme). Both Wales and Mbale were successfully selected as two of the pilot regions for the UNDP partnership programme.

5.6.2 Capacity-building and incentives

The UK Government is supporting capacity-building in developing countries on: developing understanding of climate change impacts; assessment of risks and vulnerabilities; development of adaptation options and mainstreaming climate resilience into development planning through multilateral and bilateral channels. The UK Government works bilaterally to promote an integrated approach to adaptation and development planning. In some countries we are working bilaterally to help countries go beyond vulnerability assessment and a list of urgent adaptation priorities, to a more comprehensive adaptation strategy and putting in place institutions to oversee this.

- For example, in **Malawi,** DFID is working with UNDP and Norway to support the government in developing its Strategic Framework on Climate Change. This will build on the government's National Adaptation Programme of Action (NAPA) and co-ordinate and drive existing and new government and donor action.

- In **Ghana**, DFID is working with the World Bank, Netherlands, France and the EC to support the Ghanaian Government to plan programmes in forestry, environmental protection and minerals. This includes developing a national strategy to cope with impacts of climate change.

- In **Bangladesh**, DFID has supported the Government to develop a 10-year climate change strategy and action plan that explicitly sets out the need to integrate this work into mainstream development planning. The strategy will be supported by donors through a multi-donor trust fund.

- In **Nepal**, we are funding the government to develop its NAPA with UNDP and Danida. We are encouraging them to learn from the experience of other countries' NAPA processes, and to produce a high level strategic framework for action, as well as immediate priorities in a NAPA. Government, civil society and donors will then be able to harmonise their support behind the framework.

- In **China**, we funded Phase II of a bilateral project with the Chinese Ministry of Science and Technology. The national component examined the impacts of climate change on agriculture, taking into account availability of water resources and socio-economic developments. A regional level study, in which stakeholder involvement was an important element, assessed the impacts of climate change on agriculture; identifying effects on society, those most at risk from climate change and a framework adaptation strategy.
  Full details of the project are available at:
  www.china-climate-adapt.org

- A Memorandum of Understanding between the UK and **Indonesia** was signed at COP 14 in Poznan. The pact will see the formation of a UK-Indonesia working group dedicated to the environment and climate change which plans to improve forest conservation, develop renewable energy supplies, promote energy efficiency measures, and work with communities to establish how they can adapt to the impacts of climate change.

5.6.3 Adaptation Finance

The UK Government currently provides finance for adaptation through multilateral and bilateral channels. At the multilateral level, we fund the UN through the Global Environmental Facility (GEF), Least Developed Countries Fund (LDCF) and Special Climate Change Fund (SCCF) and (through our start-up funding) the Adaptation Fund. We also contribute funding through our International Development Association (IDA) contributions to the World Bank, which focuses on the poorest countries. Details of our contributions are at Chapter Six.

The UK Government's bilateral development assistance, particularly on natural resource management and disaster risk reduction, also helps to build resilience amongst poor communities to the impacts of climate change. We are also working with the private sector to help raise awareness about why it is critical for businesses to increase private investment in adaptation in developing countries (e.g. from ensuring that businesses and the jobs they support are resilient, to the provision of insurance). We emphasise how the actions of the private sector can be designed in collaboration with local communities and stakeholders to improve their adaptive capacity.

For instance, in **Mozambique** DFID is working with Save the Children to help communities in the Zambezi flood plain improve resilience to flooding that will be made worse by climate change.

The programme will develop alternative sources of income to traditional farming and fishing, such as processing agricultural products. This will help communities cope with increasing shocks and adapt to change. DFID is helping fund insurance for **Malawi** to purchase and distribute international grain in the event of significant drought. A payout is triggered based on severity of the drought when future maize production is predicted to fall below certain levels. Similar insurance schemes have been used in advanced agricultural markets but not in poor countries.

UK Contribution to European Union work on adaptation

5.7 The European Commission has an important leadership role to play to ensure that all EU programmes and policies take full account of the changing climate. A White Paper, *Adapting to climate change: Towards a European Framework for Action,* was published in April 2009. The Commission White Paper on adaptation proposes a framework to reduce the EU's vulnerability to climate change. The framework is intended to evolve as further evidence becomes available and will complement actions by member states, supporting wider international efforts to adapt, especially in developing countries. The framework adopts a phased approach with Phase 1 (2009 – 2012) laying the ground work for the preparation of a comprehensive adaptation strategy for the EU to be implemented during Phase 2 from 2012.

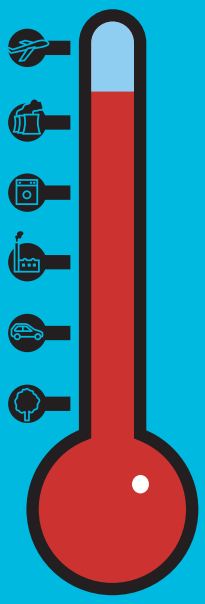
Phase 1 will focus on four pillars of action:

- building a solid knowledge base on the impacts and consequences of climate change for the EU;
- integrating adaptation into EU key policy areas;
- employing a combination of policy instruments (market-based instruments, guidelines, public-private partnerships) to ensure effective delivery of adaptation; and
- strengthening international co-operation on adaptation. (DECC will lead on this area)

The ACC Programme will take the lead, in co-ordination with the other UK Administrations, in providing a response to the EU White Paper.

6

Financial Assistance and support for technologies



Financial Assistance and Support for Technologies

Key developments

- The UK government has increased its efforts on international climate change over the past 3 years. A new Department of Energy and Climate Change (DECC) has been created, which co-ordinates the UK effort. The Department for International Development (DFID) has set up a new Climate and Environment Group in London and created eleven new climate posts in country offices. The Foreign & Commonwealth Office (FCO) has developed a large overseas network of attaches working specifically on climate and energy and appointed a UK Climate Security Envoy for Vulnerable Countries.
- The UK has played a pivotal role in the design of the multi-donor World Bank-administered **Climate Investment Funds** (CIFs). The UK supported the World Bank and worked with other donors to design and establish the Funds. The funds aim to address the short-term financing gap between now and 2012 and to pilot approaches for the longer term.
- The UK considerably scaled up its International Development Association (IDA) contribution last year (£2.134 billion against a contribution of £1.430 billion in the previous replenishment round) partly in recognition of the need to respond to the challenges of climate change.

New and Additional Financial Resources

6.1 Over the past three years, new and additional resources have been made available to tackle climate change. The UK's development assistance programme is increasing. We are on target to meet the 0.7 per cent GNI ODA commitment by 2013. The UK has more than met its share of the commitment made by donors in Bonn in July 2001.

The UK is funding research into what **low carbon growth** could look like in developing countries, and what policy frameworks are needed to bring this about. We have funded low carbon growth studies in China, India and Brazil through the Centre for Clean Air Policy (CCAP). The FCO's Strategic Programme Fund (SPF) Low Carbon High Growth Programme (established in April 2008) seeks to promote a low carbon, high growth, global economy through bilateral activity around the world, including in many developing countries. It was formally known as the Global Opportunities Fund (GOF). Previously, the GOF spent £2.3m between 2006 and 2008 on its Climate Change programme. Examples of both Funds' work can be found below in the sections on China and India, and figures for capacity building can be found in Annex D.

The Climate Investment Funds have been designed to complement and support other key initiatives including the Adaptation Fund and the Global Environment Facility (GEF). The funds include a sunset clause so that they do not pre-empt future financing arrangements. The UK has committed £800 million to an Environmental Transformation Fund – International Window (ETF-IW) which will be used to part capitalise these funds. Approximately two thirds of the £800 million will be allocated for clean energy and the remaining third will be allocated for adaptation. The CTF is now operational, with detailed funding criteria agreed. Country investment plans have been endorsed for Egypt, Mexico and Turkey and a further tranche of country investment plans is expected at the next round of meetings. The Expert Group of the Pilot Programme for Climate Resilience (PPCR) has identified eight appropriate host countries using stringent objective criteria: Bangladesh, Bolivia, Cambodia, Mozambique, Nepal, Niger, Tajikistan and Zambia. These have been submitted to and approved by the PPCR sub-committee.

The Climate Investment Funds (CIFs)

The CIFs are comprised of: the Strategic Climate Fund – with spending programmes on adaptation (the Pilot Programme for Climate Resilience); forestry (Forest Investment Programme) and renewable energy (Scaling-up Renewable Energy Programme); and the Clean Technology Fund – which will stimulate ambitious clean energy projects by topping up existing finance from public and private sources. The Strategic Climate Fund will provide a forum to receive lessons from the different programmes, to be discussed and disseminated to inform the development community and the climate change negotiations.

The funds were approved by the World Bank board in July 2008, endorsed by the G8 at the Hokkaido Summit, and now have $6.1 billion in pledges from 10 donor countries. The funds' design includes an innovative governance structure: each fund has a Trust Fund Committee and each programme a Sub-Committee, all of which have equal representation from donor and recipient countries with decisions on the use of funds made by consensus. Activities carried out under the CIFs will be country-led and integrated in countries' development strategies.

The UK is working closely with other countries and key stakeholders, including the World Bank and the UN, to reach agreement on an incentive mechanism for **reducing emissions from deforestation and degradation** (REDD) under

the UNFCCC. The UK has committed £15 million from the ETF-IW to supporting demonstration efforts under the World Bank's Forest Carbon Partnership Facility (FCPF). The FCPF aims to build developing countries' capacity to engage in a future REDD mechanism and tests ways of making payments in return for emissions savings through the sustainable management of forests, in the period up to 2012.

The UK was instrumental in securing a joint Ministerial statement on forestry at the 14th Conference of Parties to the UNFCCC, held in Poznan in December 2008, and has committed up to £100 million from the ETF-IW to support this work. A further £60 million has been committed to the Congo Basin Forest Fund (£50 million from the ETF-IW).

Multilateral Activities

6.2 The UK plays a leading role in tackling climate change at an international level. One of the UK Government's key objectives is to bring about a step change in global investment in low carbon technologies that will deliver a transition to a low carbon economy, including through an effective carbon market. We are working through the European Union, G8 and UN Framework Convention on Climate Change (UNFCCC) processes to develop and support a number of bilateral and multilateral initiatives for scaling up investment in low carbon energy, particularly energy efficiency.

The UK has supported the World Bank and regional development banks to develop **Clean Energy Investment Frameworks** (CEIFs) which aim to accelerate public and private investments in clean energy. Since 2006, the UK has committed $30 million to support this work. The CEIFs have started to stimulate the increased finance needed to make sustainable energy investments more viable propositions. The CEIFs are expected to result in at least $117 billion over the next three years in new global energy investments, including finance leveraged from private sector sources.

In addition to new capital resources, the UK has engaged with the World Bank Group on the development of its **Strategic Framework on Climate Change,** which was agreed at the World Bank's Annual Meetings in October 2008. It includes new targets on increasing lending to cleaner energy projects. It provides a framework for the integration of climate actions into the World Bank's country, regional and sector strategies and operations. We will continue to push the World Bank and the other Multilateral Development Banks (MDBs) to go further. We are also providing targeted resources to support new climate change posts within the MDBs.

The UK is the fourth largest donor to the **Global Environment Facility** (GEF) having committed £140 million over four years of which one third goes to climate change. The GEF finances the incremental costs to developing countries of protecting the global environment in five focal areas: climate change, biodiversity, depletion of the ozone layer, persistent organic pollutants and the pollution of international waters. It supplements the funds provided for sustainable national development from national resources and by aid donors and international development agencies. The UK is the second largest donor to the Least Developed Countries Fund (LDCF) having committed £12 million of which £7 million has been disbursed and the Special Climate Change Fund (SCCF) having committed £10 million of which £10 million has been disbursed.

The UK is also supporting the design and implementation of the Adaptation Fund (AF) both as a Board member and through provision of £1 million start-up funding (£0.5 million disbursed).

Following its launch during the G8 Presidency in 2005, the UK was an active participant in the Gleneagles Dialogue on climate change, clean energy and sustainable development with the G8 and +5 countries. Four ministerial meetings of the Gleneagles Dialogue were held: London, 2005; Monterrey, 2006; Berlin, 2007; Chiba, 2008. These covered the economic impacts of climate change, the scale of the technological challenge and assessment of the finance needed to transition to a low carbon economy. In addition a number of workshops were held to support the Dialogue, including ones in London, Mexico City, Santiago, Bangkok, Seoul and Veracruz, both for the dialogue members as well as regional consultations on opportunities to implement the Gleneagles action plan. These focused on mainstreaming climate change policies, scaling up the response to climate change, adaptation finance and the carbon market – successfully broadening and deepening understanding of issues in these areas. The workshops also identified opportunities for the implementation and financing of large scale programs and activities both in member countries and those from the consultations. The UK provided support for attendance by developing country participants at these meetings. The ministerial meetings also considered the progress of the Stern Review (discussed at the Dialogue), the IEA and World Bank Group in delivering aspects of the ideas outlined and the work tasked to them under the Gleneagles Plan of Action. This also helped develop and implement the various Clean Energy Investment

Frameworks implemented at both the World Bank and various Regional Development Banks, with these frameworks now currently in operation.

Bilateral Activities

6.3 The UK has worked with a broad range of partner developing countries and institutions to broaden understanding, build capability and deliver action on climate change mitigation and adaptation.

The UK has financially supported (by around £250k) regional dialogues on mainstreaming climate change and scaling up responses to climate change in Latin America and Asia, with participation of more than 40 countries. These have also explored how low carbon investment and finance could be advanced in developing countries, side by side with their own development objectives, and with the support of the multilateral development banks, and reporting back both to the UNFCCC and to the G8 processes. The UK has also contributed resources to make possible regional negotiators meetings in Latin America and in Asia, as well as studies that evaluate the regional economics of climate change in almost all of Latin America, as well as South East Asia.

The UK has funded a number of Regional Economics of Climate Change Studies (RECCS) which explore alternative mitigation scenarios for key countries and developing regions, and the costs and benefits of adaptation. For example, the UK government provided £200,000 in support of an economic study that comprised assessment of the impacts of climate change on Mexico, analysis of costs of adaptation to climate change, analysis of costs and benefits of mitigating climate change and policy recommendations. It is known as the *Galindo Report* and is expected to be published in late spring 2009. Studies have also been conducted in Brazil, Southeast Asia, Central America, the Caribbean and East Africa and the results of several of these are expected this year.

Initiatives that have been pioneered by the UK range from a global partnership for overcoming policy, regulatory and financing barriers to renewable energy and energy efficiency (REEEP)[117], to cooperation with China to demonstrate potential for near zero emissions from coal in China[118], to exploring jointly with India the barriers to technology transfer[119], including the issue of Intellectual Property Rights. Technology and investment is also a major focus of the UK initiated Gleneagles Dialogue amongst twenty countries with large and growing energy needs.

In addition, the UK is working with countries to improve information and awareness of the broader impacts of climate change, for example through our funding of a vulnerability assessment by the South Asia Water Initiative to look at seven countries that are dependent on water sources from the Himalayas.

These, and other bilateral activities, are described in the adaptation and support for technologies in developing countries sections below, and summarised in Annex D.

Under the UK/Mexico sustainable development dialogue (SDD) the UK contributed: £235,000 in support of a project to create a prototype of Transit-Oriented Development applicable in the Mexican context by supporting the Secretary of Urban Development (SEDUVI) to focus investment and development around major urban corridors in Mexico City; and £345,000 in support of the Mexican Industrial Symbiosis Programme that trains Mexican partners in the industrial symbiosis approach, encouraging companies to look outside their own sector boundaries for efficient use of resources and sustainable market opportunities.

Under the UK-Brazil SDD between April 2006 and June 2009, the UK contributed £510,000 to projects supporting low-carbon development and better forest governance, including £200,000 to foster sustainable public procurement (a project which is already facilitating considerable emission savings in Sao Paulo and Minas Gerais States) and £130,000 to develop technical and legal capacity for Amazonian forest governance at both national and federal levels.

Under the UK-China SDD between April 2006 and June 2009 the UK contributed £760,000 to promote low-carbon development and build capacity for adaptation including £358,000 to a pilot of China's resource-efficient 'Circular Economy' concept in Yunnan province, and £170,000 to developing a sustainable Chinese timber industry.

DFID-SA is investing £7m in a Regional Climate Change Programme for Southern Africa. The purpose is to provide appropriate adaptation to government, business and civil society using good local scientific information in planning.

117 www.reeep.org

118 www.nzec.info/en

119 www.sussex.ac.uk/sussexenergygroup/1-2-9.html

Emissions reduction

6.4 **Carbon market**

The UK government considers a global carbon market is the key to securing the long term shift to low carbon economies. By placing a price on carbon and reflecting the true cost to society of greenhouse gases, emissions trading will drive global emission reductions at lowest cost (key to making ambitious goals politically acceptable), and stimulate business to innovate and to invest in low carbon technology and energy efficiency by rewarding those who take action.

In only a few years we have built the foundations of a global carbon market which encompasses many developed countries and much of the developing world. The carbon market has grown substantially in recent years, its value trebling from 2005 to $30bn in 2006, and more than doubling again to $64bn in 2007. The EU Emissions Trading System continues to be the largest carbon market, trading $50 billion worth of credits in 2007, up from around $24.5 billion in 2006, and nearly six times the volume and value transacted in 2005. According to the World Bank the market has been successful in its mission of reducing emissions through internal abatement and of stimulating emission reductions abroad. The current market mechanism operating in developing countries, the Clean Development Mechanism, accounted for 91 per cent of the worth of the project credit market in 2007, with trading accounting for 634 million credits, worth in the region of $8.2bn.[120]

The recently revised EU Emissions Trading System (ETS) Directive contains specific provisions for facilitating the linking of the EU System with other comparable systems. The UK Government has been active in promoting the development of Emissions Trading Systems in countries and regions outside of Europe, and is working through the International Carbon Action Partnership to establish links between those schemes and the EU ETS.

Adaptation

6.5 The UK is supporting a wide range of initiatives aimed at helping developing countries **adapt to climate change.**

The UK is providing multi-donor support for lesson-learning on adaptation through the Pilot Programme on Climate Resilience (PPCR). Approximately one third of the UK's £800m ETF-IW will be allocated to the PPCR and supplemented by funds from other donors. The PPCR's objectives are to: deliver country-led programmatic funding at scale in highly vulnerable countries to enable them to go to the most advanced level – integrating resilience into core development planning and budgeting; provide lessons on how to invest in climate resilience through national development planning to inform the evolving operation of the Adaptation Fund; and demonstrate that a scaled up country-led, mainstreamed approach is possible and effective, influencing how a post-2012 deal will support developing countries to adapt to climate change.

The UK has delivered on its 2005 G8 commitment to develop a tool for assessing climate risks to its development programmes. DFID has conducted assessments of its programmes in Bangladesh, India, China and Kenya. We are now sharing lessons from this process with other donors and the multilateral development banks. We have provided consultancy and advice to help develop the Climate for Development in Africa (ClimDev) Programme, to improve information on the impacts of climate change across Africa.

DFID is also working to design a 'Centre for Climate and Development' which will deliver a suite of services (knowledge management, research and tailored advice) to support developing country policy-making on adaptation and low carbon development. DFID will contribute around £50 million over five years to support the services run by the Climate Centre.

Because the true costs of adaptation are poorly understood, the UK is jointly funding work with the World Bank, the Netherlands and Switzerland on the Economics of Adaptation. This study is looking at Bangladesh, Vietnam, Ethiopia, Mozambique, Ghana and Bolivia. Results are due in the second half of 2009, and will be used to help inform the UNFCCC negotiations in Copenhagen in December.

The UK also works bilaterally to promote an integrated approach to adaptation and development planning. In some countries we are helping countries go beyond vulnerability assessment and a list of urgent adaptation priorities, to a more comprehensive adaptation strategy and putting in place institutions to oversee this. The UK and Bangladesh jointly hosted a high-level conference in London in September 2008 to raise awareness of the impact of climate change in Bangladesh and to share lessons from the Bangladeshi experience. Bangladesh outlined their Climate Change

[120] Capoor & Ambrosi, World Bank, State and Trends of the Carbon Market 2008, Washington DC, May 2008. http://siteresources.worldbank.org/NEWS/Resources/State&Trendsformatted06May10pm.pdf

Strategy and Action Plan, which focuses on practical adaptation and mitigation measures which can be put in place, and announced a new trust fund, which will be used to implement the action plan. The UK announced a new grant-funded programme of £75 million to help the Government of Bangladesh fund its response to climate change. More examples of bilateral assistance for adaptation are set out in Chapter 5.

Finally, because the UK believes that we will not get a good deal at Copenhagen unless developing countries have a strong **voice in the negotiations,** the UK has provided financial support (in the region of £550,000 since mid-2006) to help developing country negotiators and journalists prepare for and engage in key UN meetings. We have also supported developing country negotiators bilaterally and the Government makes an annual contribution to the UNFCCC fund for Developing Country Participation to enable developing country participants to attend meetings.

Building adaptative capacity

6.6 The UK works bilaterally to promote an integrated approach to adaptation and development planning. In some countries we are working bilaterally to help countries go beyond vulnerability assessment and a list of urgent adaptation priorities, to a more comprehensive adaptation strategy and putting in place institutions to oversee this. See the adapting to Climate change chapter (page 86) for some examples of this work.

The UK believes that a global deal in Copenhagen later this year should include support for capacity building on adaptation, and that the way finance is provided should allow countries to move from a project approach to adaptation (as illustrated by NAPAs), to a more strategic, national plan (as Bangladesh has recently done – see box above), and eventually to full integration of adaptation into national planning and budgeting. This experience will inform long-term adaptation practice in-country, not least through lessons learnt. The global deal should build on the lessons learned from aid effectiveness, enabling country-led planning, and supporting the integration of adaptation responses into national development planning and budgets. The UK is testing this transformational approach to adaptation practice through the Pilot Programme on Climate Resilience.

Supporting Bangladesh's 10 year Climate Change Strategy

- The UK helped Bangladesh develop a 10-year Climate Change Strategy and Action Plan (CCSAP) building on the National Adaptation Programme of Action (NAPA). CCSAP was launched at the Climate Change Conference co-hosted by UK (DFID) on 10 September 2008.
- UK support through UNDP provides technical assistance to the GoB Climate Change Cell, which facilitates capacity building across Government and civil society, and action research on climate change.

Research & Development

6.7 The UK is also currently working with international partners to enable delivery of a set of research and tailored advisory services on climate change and development. The aim is to enable developing countries to access and use high quality, timely, and relevant research and information on climate change, to build the capacity of developing countries in climate research, and to provide the basis for transformational policy-making on adaptation and low carbon development.

CDM

6.8 Despite its successes, the CDM is burdened by problems including an unequal geographic distribution of projects, high transaction costs, and difficulties in proving that projects are additional. Given that this is an entirely new and innovative market created solely through regulation, there is an ongoing process of evolution and learning by doing. Countries with large volumes of emissions available at lowest cost e.g. China, India, and Brazil have been the most successful at attracting carbon finance flows. Low income countries have been less successful at attracting CDM investments in part due to their low emissions profiles, limited capacity to implement projects, weak institutions and poor investment climates.

Africa accounts for only 2 per cent of the project pipeline – less than their share of developing country emissions (4-5 per cent). In recognition of this the Nairobi Framework was launched as a multi agency effort to scale up carbon finance in Africa. The UK government is supporting this effort in Africa through working with the UK private sector to establish AfriCarbon – an

initiative intended to work closely with local project developers to get projects off the ground. Other initiatives to improve the operating environments in LICs such as the Investment Climate Facility are also important for this. For carbon finance to deliver real long term benefits for LICs, it needs to be aligned to their energy access needs.

Support for technologies in Developing Countries

6.9 The UK is a major contributor to the Renewable Energy and Energy Efficiency Partnership (REEEP), which has supported more than 100 energy efficiency and renewable energy projects worldwide.

The UK contributes to and participates in the Climate Technology Initiative (CTI) which supports technology needs assessments and provides technical assistance to foster the development of clean energy markets, the sharing of technology information and the diffusion of associated environmentally sound technologies and practices. The CTI has launched the Private Financing Advisory Network, (PFAN), which will leverage private capital into clean technology projects by connecting investors with project developers, and providing technical and financial assistance to developers to attract investment.

The UK has contributed £30,000 to the Renewable Energy and International Law Network (REIL), an informal network of decision makers and change agents in clean energy and climate change, drawn from business, government, finance, technology and academia which cuts across sectors, and spheres of influence. Its events, publications and ongoing non-traditional dialogue help spur innovative approaches to climate change and clean energy and help inform and implement key policies. The UK has also contributed to the Methane to Markets Partnership[121], which seeks to promote and support projects that recover methane emissions for use in energy systems. The Partnership concentrates on methane emissions from agriculture, waste, mining and oil & gas systems.

The UK Met Office Hadley Centre and a consortium of UK Universities are transferring state-of-the-art modelling expertise on climate change. More detail is provided in Chapter 7.

The UK participates in a range of bilateral technologies initiatives, which have included the following:

India

6.10 Under the UK India Structured Dialogue on Climate Change established in 2006, a number of activities have been pursued that have enhanced our bilateral relationship. The *UK – India Study to Assess the Barriers to Low-Carbon Technology Transfer* started in 2006 and has successfully completed its first phase. The second phase study, *UK-India Collaborative Study on the Transfer of Low Carbon Technology* will focus around three key areas, namely: the development of a taxonomy of barriers to low carbon technology transfer; further work on intellectual property rights (IPRs), including the development of policies that could help to overcome IPR barriers; and developing recommendations of mechanisms and technologies to foster joint research, development, demonstration and deployment (R,D,D&D) between developed and developing countries. This is due to report in mid-2009.

China

6.11 The UK China Working Group on Climate Change, established in 2004, has met several times to take forward the UK and China's bilateral engagement on climate change. In January 2008, during Prime Minister Gordon Brown's visit to China for the UK-China Summit, the UK and China signed a Joint Declaration on Climate Change to further strengthen co-operation through a partnership in this field, in particular, co-operation on adaptation to climate change, low carbon technology development and transfer, clean energy, energy efficiency, research on programmatic CDM and the Near Zero Emissions Coal Project. The partnership involves a wide range of partners across government, NGOs, academia, private sector and financial institutions.

The UK has a number of initiatives in China, which include:

- Capacity building: using the Foreign Office's Strategic Programme Fund (SPF) to work with international and domestic institutions (E3G, Ecofys, EC, Tsinghua, China Business Council for Sustainable Development) to build China's ability to analyse the costs and benefits of different scenarios including on key sectors (power, cement, transport, iron and steel)
- Promoting low carbon business growth, by helping UK Carbon Trust set up a China office and work at provincial level

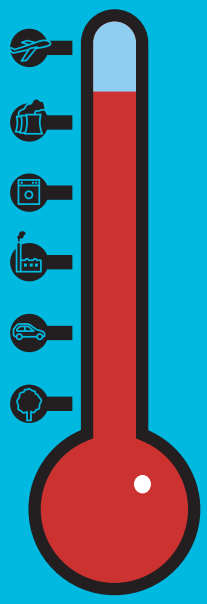
121 http://www.methanetomarkets.org/

- Carbon Capture and Storage (CCS): We are supporting the development of commercial scale CCS demonstrations to allow early and widespread deployment across China, and provide lower cost technology for the rest of the world. The EU-China Near Zero Emissions Coal (NZEC) agreement was announced under the UK Presidency of the EU as part of the EU-China Partnership on Climate Change at the EU-China Summit in September 2005. Commitment was for demonstration of CCS by 2020.[122]
- Coordinating with key players (Japan, Australia, Norway) involved in other CCS projects to maximise synergies and avoid duplication
- Raising awareness with Chinese companies of the business opportunities of the demonstration plants planned in the UK and EU.
- Supporting top economists (China Academy for Social Sciences and the 50 Leading Economists Group) to produce economic analyses for the Chinese leadership. DFID are financing and co-chairing a group of key domestic and international experts have formed a 'Low Carbon Economy Taskforce' to look at how China can develop a low carbon economy.
- Working on Impacts and Adaptation: to strengthen the development of a cross-cutting adaptation policy framework at national and provincial level, DFID/DEFRA are launching a new £3m programme to strengthen scientific research, climate risk assessments and adaptation planning policies.
- UK and Chinese researchers are jointly using science to underline the impacts of climate change, through the UK sponsored Climate Change Public Diplomacy Programme, for example, a joint study by the University of York and the Royal Botanic Garden in Edinburgh with Sichuan University and the Kunming Institute of Botany focused on the effect of climate change on the survival of the Giant Panda.

122 Demonstration will be achieved in three Phases. Phase 1 is exploring options for demonstration and capacity building for CCS in China, and includes UK and European Commission funded projects, both of which will be completed by November 2009. The UK has set aside £3.5 million pounds to finance Phase 1. Phase 2 will carry out further development work on storage and capture options, leading to Phase 3, which will construct a demonstration plant by 2020, though we are hopefully that this will be brought forward to 2015. The European Commission is working during 2009 to agree an approach with the Chinese Government to progress Phases II and III.

7

Research and Systematic Observations



Research and Systematic Observations

Key developments

- *Living With Environmental Change* (LWEC) – launched in 2007 as a major new £1-billion 10-year interdisciplinary research and policy partnership programme led by the Natural Environment Research Council (NERC), involving other funders of environmental research in the UK (including other Research Councils). The research will, among other things, help to improve the prediction of climate and other environmental change and inform society's ability to adapt appropriately.
- In February 2009 the UK government launched the AVOID programme. AVOID aims to provide policy-relevant evidence and research on avoiding dangerous climate change. It will attempt to identify risks associated with different levels of climate change, emission pathways that can deliver mitigation targets as well as adaptation strategies needed to respond globally to different levels of climate change.
- The Met Office Hadley Centre in conjunction with UK university collaborators has developed a fully coupled Earth-System model (HadGEM2-ES) including representation of the terrestrial and oceanic ecosystems and atmospheric chemistry. This model will be a valuable tool for predicting future climate change, studying mitigation pathways and understanding climate feedbacks within the earth system. It will be assessed in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.
- The Department of Energy and Climate Change (DECC) was created in October 2008, bringing together energy policy with climate change mitigation and international adaptation policy. Its three overall objectives are: Ensuring the UK's energy supply is secure, affordable and efficient; bringing about the transition to a low-carbon Britain; achieving an international agreement on climate change at Copenhagen in December 2009.
- The Energy Technologies Institute (ETI) was formally established in December 2007 as a novel partnership, involving government and industry, together contributing funding of up to £1 billion over ten years. ETI brings together the complementary capabilities of global industrial groups in a unique approach with Government to fund technology development projects which will accelerate the progress of industrially applicable innovative energy technologies through the innovation chain to enable some commercial deployment.
- The Stern Review on the Economics of Climate Change, the most comprehensive review ever carried out on the economics of climate change, was published on October 30 2006 and was lead by Lord Stern, the then Head of the Government Economic Service and former World Bank Chief Economist. Several UK research organisations contributed extensively to this review, including the Met Office which contributed climate change scenarios to feed into the economic risk assessments that were central to the report. The report re-emphasised the need for urgent action to reduce climate change, making it clear that this was also the best option economically.

Introduction

7.1 The UK government and devolved administrations are committed to evidence-based environmental policy-making and seeks to maintain a robust evidence base to support this type of policy development. This approach to policy-making is at the core of climate change policy in the UK. Climate research is thus directly linked with policy-making and is of high priority to the Government.

A wide range of research on climate change is funded in the UK to improve the understanding of the climate system, the impacts of climate change on society, and the response of human and natural systems to climate change.

This chapter describes some of the UK's activities in the area of climate change research and systematic climate-related observations. It covers the UK's policy on promoting and funding climate-related scientific research and observations. It provides an overview of research activities funded by Government departments and Research Councils and the UK's contribution to international research and capacity-building in research. It includes a summary of the UK's activities in information and data exchange and some of highlights of recent UK research.

UK Government strategy on climate change research and observations – evidence based policy

7.2 The UK government believes strongly in supporting climate research and the procurement of climate-related observations. Research is sponsored by various government departments to

support a range of responsibilities and policy requirements. In addition, some research is increasingly being funded from a wider stakeholder base in both public and private sectors, particularly in the area of climate impacts and adaptation.

The policy areas of energy and climate change are inextricably linked and reflecting this the **Department of Energy and Climate Change** (DECC) was formed in October 2008, bringing together energy policy (previously with BERR – the Department for Business, Enterprise and Regulatory Reform) with climate change mitigation policy (previously with Defra – the Department for Environment, Food and Rural Affairs). DECC leads on climate change policy and provides funds for climate research and observations to advise the UK's policy and its impacts and response strategies.

The **Department for Environment, Food and Rural Affairs** (Defra) contributes to the funding of cutting edge climate research through the Met Office Hadley Centre. Defra hold the policy lead for UK adaptation, and fund research into climate change impacts and adaptation including the UK Climate Projections, and the statutory (Climate Change Act, 2008) Risk Assessment.

The **Department for International Development** (DfID) has launched a new research strategy under which DfID is committed to spending over £100 million on climate change research for which it has identified the following research priorities:

- Climate science, especially in Africa
- Climate change in national and international policy
- Adaptation strategies
- Reducing the impact of climate change and promoting low carbon growth
- Ecosystem services for poverty alleviation.

DfID also recognises the need to tackle relevant climate change and environmental issues within agriculture, livelihoods, water and health research programmes. It has also committed a substantial portion of its research budget to the Centre for Climate and Development, the aim of which is to support developing countries to design improved development policies, programmes and investments, based on a sound understanding of climate change and its implications by 2015.

The **Ministry of Defence** (MoD) funds the Public Weather Service (PWS) on behalf of all government departments. This supports the Met Office contribution to world meteorological organisation (WMO), EUMETSAT[123] and European Centre for Medium Range Weather Forecasting (ECMWF) so pays directly for a large observational programme in support of weather forecasting, which is carried across to climate modelling, and supports WMO's coordinated global programme in weather observing.

The **Department for Innovation, Universities and Skills** (DIUS) funds work on new technologies and provides funding for the research councils. Funding for new technologies is via the Technology Strategy Board, which operates at arm's length from Government and has a cross-Government leadership role in delivering a national technology strategy and advising on policies which relate to technology innovation and knowledge transfer. The Research Councils are responsible for maintaining the science base and also operate at a distance from Government, though they participate in the **Global Environmental Change Committee** (GECC) and Environment Research Funders' Forum (ERFF) coordination processes described below. The Research Council with the greatest direct interest in climate observations is the Natural Environment Research Council (NERC). NERC is responsible for basic research on climate prediction and processes and for some monitoring activities.

Systematic observations in the UK and its overseas territories are made by a number of national agencies and organisations. The **UK Met Office** is the national meteorological agency and leads in making and collecting meteorological and atmospheric observations – and the Hadley Centre within the Met Office undertakes leading climate research. Observations are also made by others including the **Natural Environment Research Council's** (NERC) Centres and Surveys. Collection of oceanographic (and marine) observations is widely distributed throughout the UK with many government departments and laboratories, universities and commercial companies involved. Terrestrial observations are made or coordinated by NERC, the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), the Northern Ireland Environment Agency (NIEA), the Forestry Commission, and others.

The UK also contributes to space-based observations through the European agencies, the **European Space Agency** (ESA) and the **European Organisation for the Exploitation of Meteorological Satellites.** It participates in the

[123] http://www.eumetsat.int/Home/index.htm

relevant European and International space observation coordination mechanisms, including the Global Monitoring for Environment and Security Initiative (GMES), under which ESA will launch several relevant Earth-observation satellites and which has a developing Climate Service, and the Group on Earth Observations (GEO), which also has a Climate Theme. The UK has also made significant intellectual and practical contributions to the development of the Global Climate Observing System (GCOS) described later in this document.

Although the UK does not have a national programme for climate research and observations, it reviews such activities through the **Global Environmental Change Committee** (GECC). The GECC is an Inter-Agency committee reporting to the UK Government's Chief Scientific Adviser. Its membership is drawn from UK Government Departments and Research Councils and Institutions.

Main functions of the Global Environmental Change Committee

- Provide a forum for the coordination of the UK's involvement in climate change and other global environmental change science and technology, nationally and internationally, taking into account the work of other relevant coordination mechanisms and fora.
- Review the effectiveness of the national capacity, capability and performance in these areas and to make recommendations.
- Make recommendations to the UK Government's Chief Scientific Adviser on developments and the need for funding in Climate Change Science and Technology and other global environmental change science, and in areas of science and technology where the responsibility may cover multiple organisations.
- Ensure that Government policy on climate change and other global environmental change issues is both sufficiently informed by and informs the work undertaken by the science base.
- Support effective UK participation in international climate change and other global environmental change science and technology programmes.
- Encourage effective communication of climate change and other global environmental change science and technology.

The range of work of the GECC is executed through a number of Subgroups on Observations, Global Environmental Research, Science and Policy, Biodiversity and Supercomputing.

The UK's **Environment Research Funders' Forum**[124] (ERFF) brings together the UK's major public sector sponsors of environmental science, aiming to maximise the coherence and effectiveness of UK environmental research funding. The ERFF provides broader co-ordination for funding of climate change related research for activities that clearly add value, could not be done by a single member acting alone, and have the potential to advance environmental research in the UK and internationally.

Recently, the ERFF has developed the UK Environmental Observation Framework (UK-EOF)[125], which was launched formally in July 2008. This initiative stemmed from work to catalogue the full range of UK environmental monitoring activities carried out in 2006. It was clear from this work that a more strategic approach to observation activities would be valuable both for UK needs and to enhance UK participation in international activities; the UK-EOF seeks to provide this. Many of the observation activities are of value for climate change assessments and for this reason, the UK-EOF has established close links to the Observation Subgroup of the GECC.

In the marine sector, the newly established **Marine Science Coordination Committee** (MSCC) has taken over the role of the former Inter Agency Committee on Marine Science and Technology (IACMST). The MSCC is expected to work closely with bodies involved in the implementation of the UK Marine Monitoring and Assessment Strategy (UKMMAS). Within UKMMAS, climate-related observations are currently the responsibility of the Healthy and Biologically Diverse Seas Evidence Group (HBDSEG) but are expected to transition to a new Ocean Processes Evidence Group (OPEG).

Research

7.3 Research Highlights

- **The Tyndall Coastal Simulator** is the world's first to produce a local analysis applied to a coastal region and has been welcomed by stakeholders. It has quantified what has been argued qualitatively: sediments washed away from eroding cliffs protect neighbouring low lying lands from flooding. Specifically, the Simulator has

124 Terms of reference for the UK's Environmental Research Funders' Forum are available from www.erff.org.uk/about/tors.aspx

125 http://www.erff.org.uk/publications/reports/2008-05-uk-eof.aspx

shown that the protection of Norfolk's cliffs from erosion is increasing the flood risk of neighbouring low-lying lands by starving their beaches of sediment. The costs show that this flood risk is an order of magnitude greater than the erosion risk.

- **The British Geological Survey** has started a new science theme to perform research into Climate Change, which is intended to fill the current gap in the collaborative development of a high-resolution climate-change impact model and contribute to the reduction of uncertainties in climate prediction models that arise from feedbacks and thresholds in the climate system.
- **The European Project for Ice Coring in Antarctica –** carried out by twelve partners from ten European nations – was successful in retrieving past climate records which are key for the assessment of current climate change. Temperatures and greenhouse gas concentrations for the last 800,000 years could be measured. The results have shown, inter alia, that the recent rise in greenhouse gas concentration is beyond any historical comparison, leading to climate change at an unprecedented rate. In addition, the ice cores allowed scientists to study in detail the coupling of the northern and southern hemisphere. In March 2008 the project was awarded the prestigious Descartes Prize for Collaborative, Transnational Research.
- **The NERC Centre for Polar Observation and Modelling** (part of the National Centre for Earth Observation) has produced the first definitive evidence that arctic sea ice is thinning as well as shrinking in area. From 2002 to 2008 the European Space Agency's Envisat satellite was used to measure ice thickness throughout the Arctic winter. The Centre is currently preparing to launch CryoSat-2, the first radar satellite specifically designed to measure ice thickness, at the end of 2009.
- **The Rapid-WATCH programme** has taken the first measurements to secure a decade's worth of variability data on the Atlantic Heat Conveyor which partly determines Europe's temperate climate. Rapid-WATCH is the successor to the seven year Rapid Climate Change programme, supported by NERC in partnership with the United States, the Netherlands and Norway. The Rapid programmes will improve quantification of the likelihood and size of abrupt and dramatic climate change driven by changes in the global ocean circulation, caused by on-going climate change.
- **The Met Office Hadley Centre** in conjunction with UK university collaborators has developed a fully coupled Earth-System model (HadGEM2-ES) including representation of the terrestrial and oceanic ecosystems and atmospheric chemistry. Developments to the atmosphere and ocean sub-models in HadGEM2-ES have improved the representation of some key processes and modes of variability including the El Nino Southern Ocean continental land surface temperatures. The Met Office Hadley Centre is also further developing the physical Atmosphere and Ocean models towards a new model (HadGEM3) with the aim of having a model that is fit for the purpose for application from daily to centennial timescales and for regional prediction. This is an ambitious goal which they aim to deliver through targeted work on long standing systematic biases using the Met Offices Unified Modelling system.
- The **UK Energy Research Centre** (UKERC) has begun work on the UKERC Energy 2050 project. The core aims of the project are to generate evidence relevant to meeting the UK's principal long-term energy goals to achieve deep cuts in carbon dioxide emissions by 2050, and to develop a "resilient" energy system that ensures consumers' energy service needs are met reliably. The project combines "systems level" models, such as MARKAL, "sector specific models", such as a unique combined gas and electricity model, and social and technological understanding, to develop future UK energy system scenarios under specific constraints.

7.3.1 Policy-driven research funded by Government Departments

The Government funds a wide range of climate change research directly to inform UK policy development, contribute towards the science base for the Intergovernmental Panel on Climate Change (IPCC) and to support negotiations on international action on climate change through the UNFCCC.

The key aims of DECC's and Defra's climate change research programme are to:

- improve understanding of uncertainty in climate predictions
- improve climate impact assessments and adaptation strategies
- meet the UK's national and international commitments for assessing trends in greenhouse gas emissions and future projections
- improve assessment of mitigation options and costs

- help to build internationally acceptable approaches to responding to climate change in the long term
- continue long-term measurement of changes occurring in the ocean and the atmosphere

The scope of this research broadly reflects the areas covered by the three Working Groups of the IPCC), namely the scientific basis of climate change; impacts, adaptation and vulnerability; and mitigation (i.e. the reduction of greenhouse gas emissions).

The MoD, DECC and Defra commission research from the **Met Office Hadley Centre** for Climate Prediction and Research. The **Integrated Climate Programme (ICP),** launched in September 2007, combines the requirements of all three departments for information from the Hadley Centre on climate change. That is, the science to help policymakers and other stakeholders in the UK and internationally to deal with climate change in the future. The value of the Integrated Climate Programme has increased to £15 million pa, and the overall driver continues to be to address policy relevant questions concerning future climate. The key outputs of the ICP fall under a number of themes:

7.3.1.1 *Evidence Basis for Climate Change*

This output will provide policy relevant information to DECC, Defra and MoD on observed climate change, including extremes, and information on climate change and variability to the media and the public. It becomes increasingly important to not just monitor climate but to explain causes of observed variability and change and put it into the context of expected changes in the near future. The components of this activity are monitoring, attribution, modelling climate variability, and seasonal forecasting.

7.3.1.2 *Quantify and Reduce Uncertainty; Build Capability*

This output underpins many, if not all, of the policy relevant science outputs on Adaptation, Mitigation and Dangerous climate change and hence the key focuses here will feed into all of these areas. The range of uncertainty in model predictions of climate change means that decisions made now on adaptation or mitigation strategies are potentially more costly than may ultimately be necessary. Hence, one of the key outputs of the Met Office Hadley Centre is to quantify and ultimately reduce this uncertainty through better understanding and improved capability. This is at the heart of all work on providing reliable probabilistic predictions of climate change at a range of space and time scales.

7.3.1.3 *Defining and assessing the risks of dangerous climate change*

Some forms of climate change may not occur as a continuously increasing response to increasing emissions. Dangerous climate change (DCC) includes rapid events, irreversible effects, and plausible possible outcomes with high impact. The goal is to develop rapid response modelling tools that are quick to run but that encapsulate the key driving factors for DCC, as derived from comprehensive climate models calibrated against observations.

7.3.1.4 *Scientific assessment of future mitigation options*

This theme will provide the robust information about the impact of different scenarios for greenhouse gas emissions on the climate system necessary to develop international mitigation policies.

7.3.1.5 *Science for Adaptation*

This theme puts the Met Office Hadley Centre in a unique position to integrate climate change information into planning and decision making processes in government and industry and to integrate weather and climate information into contingency planning. In particular, the aim will be to present many of the results probabilistically in order to provide the best possible basis for planning and policy decisions. Delivery of the UK Climate Projections (UKCP09) is a key short term priority.

7.3.1.6 *Climate Products*

The aim of this theme is to develop and supply climate prediction products that distil complex information from a range of climate prediction models and other sources including expert assessment into agreed practical formats that can be readily used to educate stakeholders and inform planning and policy. Climate products cover timescales ranging from monitoring of present day climate anomalies through predictions to monthly, seasonal, inter-annual and multi-decadal (30-year) timescales.

7.3.1.7 *Communication Products*

A key aspect of the programme is to communicate its results widely to the scientific community, government policy makers and other stakeholders, the public etc. It will do this through peer reviewed scientific publications, brochures, its website and the media.

Prior to the establishment of the ICP in 2007, Defra and the Ministry of Defence jointly funded an independent review of the Hadley Centre.[126] The review examined all aspects of the operation of the Hadley Centre, including its quality as a climate research and modelling establishment and as a source of advice on climate change; and whether it is meeting the needs of its internal and external stakeholders. The results of the review conclude that the Hadley Centre's climate science is world leading and unique, represents excellent value for money and provides excellent policy relevant scientific outputs to UK Government clients.

In addition to the work done through the ICP, the **AVOID** programme, led by the Hadley Centre, will provide core research for understanding dangerous climate change and its implications to support international negotiations for agreement on greenhouse gas emissions. AVOID will build into a multi-disciplinary, multi-stakeholder programme, encouraging the integration and communication of scientific and socio-economic research on climate change. To this end AVOID is accredited as a component of the wider UK Inter-agency Living With Environmental Change (LWEC) Programme (see page 118).

Defra funds the **UK Climate Impacts Programme**[127] (UKCIP) on behalf of the UK government and devolved administrations, to provide a co-ordinated framework for assessing climate change impacts and identifying potential adaptation strategies in the UK.

The **Foresight** team within the Government Office for Science continues to assimilate and present expert consideration of key future challenges, providing a rich resource for today's policy makers. Launched in November 2008, the Foresight study *Powering our Lives: Sustainable Energy Management and the Built Environment* explored how the UK built environment could evolve to help manage the transition over the next five decades to secure, sustainable, low carbon energy systems that meet the needs of society, the requirements of the economy, and the expectations of individuals. Current Foresight projects include the *Food and Farming Futures* project which will identify and analyse future challenges to the global food system as climate change combines with other important drivers of change such as population growth, the drive towards low-carbon economies and evolving consumption patterns. The *Land Use Futures* project will explore how land-use in the UK could change over the next 50 years and will create an evidence-based analysis to help policy makers gain a better understanding of whether existing land use patterns, practices and governance structures are fit for the future.[128]

A considerable amount of climate-related research is also funded by other Government bodies, including the Scottish Government, the Welsh Assembly, the Department of Environment (Northern Ireland), the Forestry Commission, the Environment Agency, the Scottish Environment Protection Agency, and the statutory conservation agencies.

The Scottish Government funds significant research programmes in areas relating to Environment, Fisheries, Rural Affairs and Health. One of the major drivers for this policy related research is adaptation to, and mitigation of, climate change impacts on Scotland's, people, environment and economy. Reduction of carbon emissions including greenhouse gases and the sustainable development of renewable energy resources to meet the challenging targets set by the Scottish Government in its recent Climate Change Bill will be an important ongoing focus for the research. The potential positive and negative effects of climate change on Scotland's important primary production industries (farming, fishing, forestry, energy), tourism, health and disease risk and demographic are also an important topics for current and future research programmes. Scotland's research base links with the UK, EU and international researchers to share understanding and interpretation of the causes, challenges and opportunities of climate change.

7.3.2 Policy & Technology Research

As detailed in the recent DIUS Innovation Nation White Paper[129], UK government sees innovation as essential to meet the challenge of living within our environmental limits and addressing climate change. The UK Government's policy recognises the need to create the conditions that allow innovation to flourish, by removing barriers and other disincentives and through support for research, development and demonstration. These supply-side innovation measures must be complemented with demand side policies, such as government procurement and regulation, to drive innovation to meet new, low-carbon resource efficient needs.

126 Available from http://www.defra.gov.uk/environment/climatechange/research

127 More information about the UKCIP was provided in Chapter 5, and is available at www.ukcip.org.uk

128 Foresight programme website at www.foresight.gov.uk

129 Available from http://www.dius.gov.uk/publications/innovation-nation.html

The quality of the UK's research is world renowned, and Government has delivered a major increase in funding for research and is committed to continue with this increase.

In July 2007, the UK Government established the **Technology Strategy Board** as a business led executive Non Departmental Public Body (NDPB) to play a cross-Government leadership role in delivering a national technology strategy and advising on policies which relate to technology innovation and knowledge transfer. The Technology Strategy Board operates across all important sectors of the UK economy to stimulate innovation in those areas which offer the greatest scope for boosting UK growth and productivity.

With a wide remit covering the whole of the UK economy, the Technology Strategy Board will invest around three main themes as highlighted in its recently published strategy *Connect and Catalyse*: challenge-led innovation, technology-inspired innovation and the innovation climate[130].

A major focus of the Technology Strategy Board's activities is its Innovation Platforms. An Innovation Platform creates the opportunity to bring together key partners (Government and business) to address a major societal challenge and to open up market opportunities to increase business investment in R&D and innovation.

To date, it has launched six Innovation Platforms, of which two are directly relevant:

- Low Impact Buildings – this will assist business to harness the growing market for low carbon, environmentally sustainable buildings. This will be done initially for new build housing through markets affected by the Code for Sustainable Homes.
- Low Carbon Vehicles – seeks to position the UK's automotive sector to benefit from growing public and private sector demand for lower carbon vehicles. The programme, worth over £100m, will co-ordinate the UK's low carbon vehicle activity from initial strategic research through collaborative research and development, leading to the production of demonstration vehicles.

In addition to Innovation Platforms, the Technology Strategy Board has a significant portfolio of business led research projects focused on developing low carbon energy and energy efficiency technologies. Its current portfolio (Government and industry funding for projects) is worth over £140m.

The **Energy Technologies Institute** (ETI) was formally established in December 2007 as a novel partnership, involving DIUS and industry (currently BP, Caterpillar, EDF Energy, EON.UK, Rolls-Royce and Shell) to invest in the development of low carbon energy technologies and solutions and thus help to shorten lead time to deployment and commercialisation. DIUS has committed to provide up to £500m over 10 years, to be matched by private sector partners.

ETI brings together the complementary capabilities of global industrial groups in a unique approach with Government. ETI addresses the challenge of climate change and low carbon energy by:

- Demonstrating energy technologies and systems
- Improving energy usage, efficiency, supply and generation
- Developing knowledge, skills and supply chains
- Informing development of regulations, standards and policy
- Enabling deployment of affordable, secure, low carbon energy systems.

The ETI Technology Strategy, launched in January 2009, outlines its current portfolio of technology programmes in Off-Shore Wind, Marine Energy, Distributed Energy, Carbon Capture & Storage, Energy Networks, Transport and Buildings Efficiency[131].

The **Environmental Transformation Fund** (ETF) is a new initiative to bring forward the development of new low carbon energy and energy efficiency technologies in the UK. The fund began operation in April 2008, and is co-ordinated through DECC. It aims to accelerate the commercialisation of low carbon energy and energy efficiency technologies in the UK.

The fund specifically focuses on the demonstration and deployment phases of bringing low carbon technologies to market. It provides funding to a range of bodies and projects in order to deliver its aims.

The ETF works closely with other organisations funding earlier stage research and development including the Energy Technologies Institute, Technology Strategy Board, and the Research Councils' Energy Programme.

130 http://www.innovateuk.org/

131 http://www.energytechnologies.co.uk/Home.aspx

Also significant in the area of low carbon technology research, the **Carbon Trust** is an independent company funded by the Government. It works with UK business and the public sector to cut carbon emissions and develop commercial low carbon technologies. The Carbon Trust's Applied Research Programme is open to UK businesses and research institutions and aims to support the development and commercialisation of technology with the potential to reduce UK carbon dioxide emissions.

The **Energy Saving Trust** (EST) manages research into the health impacts of living in inefficiently heated homes and into ways of helping people who live in homes where conventional methods of cutting fuel bills cannot be applied.

7.3.3 Research Councils programmes

Science, technology and innovation are key elements to meeting the UK's national and international obligations and commitments on the environment, sustainability and climate change. UK scientists are at the forefront of climate change science and the application of this basic knowledge to understand the challenges the UK will face in mitigating or responding to the impacts of climate change.

DIUS continues to give a high priority to addressing sustainability issues, including understanding, mitigation and adaptation to climate change, and development of low carbon technologies and solutions. Their science Budget (at ca £3.68 billion in 2008-9) provides funds for the **Research Councils** to support basic, strategic and applied research and related postgraduate training across the sciences, engineering and humanities. They fund a variety of research work, both individually and through Cross-Council programmes

Individual Research Councils

Natural Environment Research Council (NERC) funds world-class science in universities and research centres that increases knowledge and understanding of the natural world. NERC strategy 'Next Generation Science for Planet Earth'[132] identifies seven strategic science themes, the first of which is the climate system. This theme has the overarching goal that: '*NERC will play a leading role, in collaboration with others, in developing risk-based predictions of the future state of climate – on regional and local scales, spanning days to decades*'.

A number of significant research activities are being developed that relate to climate change science:

- A joint climate research programme with the Met Office, to strengthen the UK's capability in climate science.
- Changing water cycle, in collaboration with other organisations within the Living With Environmental Change partnership.
- Ocean acidification, including current and likely future ocean acidification and feedbacks to the Earth system.
- Storm risk mitigation.

Many NERC funded scientists are world-leading authorities on the climate, and have been both authors of and provided input to the latest report from the IPCC.

NERC supports a number of research centres, all of which have programmes relating to climate change. In addition it supports many responsive mode grants which are critical to maintaining a healthy and diverse research base in the UK and also provides research that is critical to our understanding of climate change.

The **Engineering and Physical Sciences Research Council** (EPSRC) funds a broad range of research and training aimed at tackling climate change. EPSRC leads the Research Councils 2019 Energy Programme, whose key drivers are to ensure secure and affordable energy supplies, whilst reducing carbon dioxide emissions and therefore mitigating against climate change. EPSRC specific focus is on engineering and scientific research into new low carbon energy technologies, both for energy generation and supply and for managing and reducing demand for energy in buildings, industries and transport. A key element is the provision of training to ensure sufficient researcher capacity to underpin future energy options. Research areas specific to the engineering and physical sciences include aspects of sustainable power generation and supply, conventional generation including carbon abatement technologies, nuclear fission and nuclear fusion.

The **Biotechnology and Biological Sciences Research Council** (BBSRC) supports climate change related research under the science areas covered by its four research committees: Animal Systems, Health and Wellbeing; Plants, Microbes, Food & Sustainability; Technological and Methodological Development; Molecules,

132 http://www.nerc.ac.uk/publications/strategicplan/nextgeneration.asp

Cells and Industrial Biotechnology. It has identified several research priorities relevant to climate change which include Living with Environmental Change, Bioenergy and Crop Science (including food security).

Three BBSRC sponsored institutes have been particularly active in research into impacts of climate change on the function and behaviour of plants, animals and soils. BBSRC has also invested £20M to establish the BBSRC Sustainable Bioenergy Centre which will contribute to meeting the global challenges of climate change and reducing carbon emissions.

In 2008, BBSRC published a review of its research related to environmental change[133]. The report recognises that research will be essential to enable analysis and prediction of the changes and to allow the development of strategies for adaptation and mitigation of their impacts, and makes recommendations on future priorities for BBSRC research as well as on mechanisms for their successful implementation.

BBSRC estimated spend on environmental change and bioenergy research in 2007/08 was £13.6M.

Environment and climate change is central to the **Economic and Social Research Council's** (ESRC) Strategic Plan. ESRC's work in this field involves funding high quality interdisciplinary research and postgraduate training alongside stakeholder engagement to maximise the impact of the research it funds. ESRC research will be: informing how a fully sustainable economy would differ from the fossil-fuelled one of today and how we should most effectively move toward such an economy; providing a better understanding of how we can adapt to environmental change; and, developing understandings of how practices and habits change and can be influenced in regard to the climate change agenda.

The ESRC contributes to the *Living with Environmental Change Programme* and the *Research Councils' Energy Programme*. In addition, ESRC funds the ESRC Centre for Climate Change Economics and Policy (CCCEP), and supports three internationally recognised large research groups focussing on energy and a range of climate change fellowships and related projects (see below for details).

The **Medical Research Council** (MRC) supports research into climate change through its response mode schemes. Projects/centres currently being funded which are relevant to climate change are:

- Heat waves in the UK: impacts and public health responses, led by Dr P Wilkinson at the London School of Hygiene & Tropical Medicine. This project is investigating the impacts and public health consequences of heat waves in the UK.
- MRC Centre for Outbreak Analysis and Modelling, led by Professor N M Ferguson at Imperial College of Science Technology and Medicine.

The MRC spends approximately £3 million per annum on research related to environmental influences on health. In addition, it has recently awarded funding for a joint MRC and Health Protection agency (HPA) Centre for Environment and Health at Imperial College. The MRC also supports the Integrative Toxicology Training Programme (ITTP), which is managed by the MRC Toxicology Unit in Leicester, at a level of approximately £3 million over 5 years. The MRC is a partner in LWEC, and the environmental impacts on health are a priority in the MRC's strategic plan.

Key cross-council research programmes

The **Living With Environmental Change (LWEC)** programme, which began in 2007, represents an unprecedented partnership spanning research councils, government and business. The ten year LWEC programme (to which £1 billion has been committed for the first five years) aims to provide decision makers with the best information to effectively manage and protect vital ecosystem services on the time and space scales on which the economy is managed. It will aim to strengthen the evidence base for policy, not least by addressing the uncertainties that remain about the impacts of environmental change and the links between natural resources and human well-being. Through interdisciplinary research activities, knowledge exchange, actions and training opportunities, LWEC aims to deliver:

- whole-system assessments and risk-based predictions of environmental change and the effects on ecosystem services, economies and communities on local-to-regional, and seasonal-to-decadal time scales,
- integrated analyses of the potential economic, social and environmental costs, benefits and impacts of different mitigation and adaptation responses,
- guidance for more effective sustainable management of ecosystem services, as a foundation for resilient economic development and social progress,

133 www.bbsrc.ac.uk/organisation/policies/reviews/scientific_areas/0810_environmental_change.pdf

- new technology and infrastructure solutions in the management of environmental change,
- a more research-informed dialogue and debate about the environmental challenges and choices that we face and their economic and social consequences.

To address these aims, LWEC will focus on six broad objectives – climate change, ecosystems, food and water, health, infrastructure and communities. LWEC will help to deliver effective mitigation, adaptation and resilience to environmental change. This will include preparedness for changes to the intensity and frequency of extreme events, so that human health, well-being, and a healthy natural environment are ensured through use of sustainable and socially acceptable environmental management approaches and technologies.

Research Councils Energy Programme (RCEP). Research Council investments on energy related basic, strategic and applied research and postgraduate training have trebled since 2003. Over the period 2008-11, expenditure under the Programme, which brings together within one framework all the Research Council activities on energy research and training, will exceed £300M. The vision for the Energy Programme is to bring together engineers with physical, natural environment, biological, social and economic scientists from many areas to tackle the research challenges involved in creating new energy technologies and understanding of the environmental, social and economic implications. The aim is to position the UK to develop, embrace and exploit sustainably, low carbon and/or energy efficient technologies and systems to enable it to meet national energy and environmental targets for 2020 and beyond.

Priorities for the Energy Programme include continuing support for a broad research portfolio in power generation and supply (including renewables, fusion, distribution networks and energy storage), and to grow the portfolio in demand reduction, transport, security of supply, research capacity building and international engagement. It includes investments in large research consortia, "whole-system" research, strategic partnerships with leading companies and support for the UK Energy Research Centre (UKERC), as well as support for fundamental science based energy research through responsive mode.

The flagship **Sustainable Power Generation and Supply** initiative is a multidisciplinary initiative managed and led by EPSRC in partnership with BBSRC, ESRC, NERC and the Carbon Trust. The programme has invested over £55 million since 2003 to improve the sustainability of power generation and supply. Establishing multi-disciplinary partnerships between industry and universities, the programme has been highly successful in generating new ideas and the transfer of research results in, for example, bio-fuels, photovoltaics, offshore wind, and energy storage.

Research council centres

The **Tyndall Centre** is an interdisciplinary research entity core-funded by NERC, EPSRC, and ESRC from 2000 to 2010. The Tyndall Centre brings together scientists, economists, engineers and social scientists, working to develop sustainable responses to climate change. This is done through trans-disciplinary research and dialogue on both a national and international level – not just within the research community, but also with business leaders, policy advisors, the media and the public in general. It has established a worldwide reputation for high quality research into climate change response options, tackled from an inter-disciplinary perspective addressing the physical and natural environment, economics, societal perceptions and governance and policy issues. Pioneering work has included low-carbon energy supply and demand, integrated assessments of emissions, incorporating climate change into international development thinking and practice, and adapting coasts and cities to protect vulnerable people and places from climate change. It made a major contribution to the IPCC 4th Assessment, the UN Human Development Report and the OECD Vulnerable Port Cities report.

The **UK Energy Research Centre** (UKERC) aims to promote cohesion within the UK energy research effort and to act as a focal point for collaborative international energy research. Co-ordinating a network of environmental, engineering, economic, life and social scientists, UKERC is also the focal point for UK university-based research on sustainable energy and a research centre in its own right. It takes an independent, whole-systems approach, drawing on engineering, economics and the physical, environmental and social sciences.

UKERC's research is organised around four themes: energy demand, energy supply, environment and energy, and energy systems. Other key activities include research road-mapping activity to inform funding decisions, technology and policy assessment, an interdisciplinary doctoral training programme and a research portal which maps out the UK energy research landscape. UKERC has funding of £32.4m over 2004-2014 from NERC, EPSRC and ESRC through the Research Councils' Energy Programme.

Key NERC research centres include:

The **British Antarctic Survey** (BAS) which is responsible for undertaking the majority of Britain's scientific research on and around the Antarctic continent. Some of the recent research highlights relevant to climate change include:

- Research into the Southern Ocean which acts as the largest ocean sink of anthropogenic carbon and whether its effectiveness is reducing as a consequence of an anthropogenically-induced strengthening of the winds over the Southern Ocean.
- To understand the trends about Antarctic Peninsula warming , the break-up of ice shelves and the implications for marine life in the Antarctic.

The **Centre for Ecology and Hydrology** (CEH) undertakes integrated research in terrestrial and freshwater systems, contributing to UK and European monitoring and research into global climate systems and climate change. As a provider of atmospheric, terrestrial and hydrological observations within the UK and Europe, CEH coordinates approximately two-thirds of the UK's terrestrial and hydrological environmental monitoring. CEH has contributed to the IPCC 4th Assessment report, and model development of climate model sub-components such as the Joint UK Land-Environment Simulator, a community model jointly developed and managed by CEH and the Met Office. CEH has responsibility for a number of core datasets which contribute to global climate change studies and reports including the National River Flow Archive, Countryside Survey and related Land-Cover Map of the UK; and the Biological Records Centre (BRC). CEH also provides the land-use, land use change and forestry components of the UK greenhouse gas inventory.

The **British Geological Survey** (BGS) is the UK's principal supplier of objective, impartial and up-to-date geological expertise and information for decision making for governmental, commercial and individual users. The BGS carries out research in strategically important areas including energy and natural resources, vulnerability to environmental change and hazards, and earth system science, often in collaboration with the national and international scientific academic community. BGS undertakes surveying, modelling, research and environmental and geological monitoring. It also works overseas, where it plays an important role in building geological infrastructure and capacity in developing countries. BGS Climate Change Projects include[134]:

- *Evidence of Sea Level Changes:* Reconstruction of palaeoenvironments, climate and rates of sea-level change during the Late Pleistocene and Holocene.
- *Cryosphere and Climate Interactions:* Investigation of the interactions between the cryosphere and climate which aims to understand the coupling between external drivers such as solar insolation and the response of the environment.
- *Integrated modelling of groundwater flooding* including assessment of the impacts from climate change.
- Various projects looking at impact of climate change on groundwater resources both in the UK and overseas.

7.3.4 Information exchange (within UK and internationally)

Since 1991, the government-funded **Climate Impacts LINK** project has acted as the interface between the Met Office Hadley Centre and the national and international climate change impacts communities. In 2007, this project was refocused to make available more model data from the Hadley Centre to support a growing number of climate change impact investigations by the wider research community. The Hadley Centre has developed streamlined data dissemination software to package, quality check and deliver model data to the British Atmospheric Data Centre (BADC), which makes it available to research scientists. This facility has been used to deliver more than 50 Terabytes of data from the model simulations that are most in demand; this represents a ten-fold increase in Hadley Centre model data available through BADC.

At the same time, the Hadley Centre has been investing in tools and processes to create and maintain metadata which describe model simulations and their outputs. With the dramatic growth in the number of data sets available and the importance of model inter-comparison projects, the ability to accurately describe model data sets is critical to their effective use by the research community.

The LINK project facilities will be used to support the transfer of data to the IPCC Data Distribution Centre to be hosted by BADC for the upcoming IPCC Fifth Assessment Report.

The **UK Climate Impacts Programme** (UKCIP) is an established link between stakeholders and researchers, and helps to make connections between partners and researchers to stimulate climate change impacts studies. UKCIP facilitates the sharing of information, provides core data sets

134 http://www.bgs.ac.uk/research/climateChange.html

(such as the UK Climate Projections, UKCP09), and other tools for impacts assessments and adaptation studies. The UKCIP website is a key means of data and information exchange.

A high profile international conference "Climate change impacts and adaptation: Dangerous rates of change", organised by the Met Office and Exeter University, was hosted by the University of Exeter, in the UK between 22nd and 24th September 2008. The Conference was broadly concerned with moving from passive projection of climate change towards active management of the climate system, and was divided into five themes: Improving predictions of climate change; Climate change impacts on ecosystem services; Technology for adaptation and mitigation; Policy responses and behavioural change; and Coupled human-environment system. Key messages from the conference were that better regional projections on seasonal-to-decadal timescales, improved prediction of impacts, and an understanding of human responses to environmental stresses, were all required to manage future climate change.

The **AVOID** programme will also play a key role in communicating policy-relevant research on climate change across government and beyond. AVOID aims to provide policy-relevant evidence and research on avoiding dangerous climate change through stabilisation of GHG concentrations in the atmosphere. AVOID will build on the core funding and become a multi-disciplinary, multi-stakeholder programme. To this end AVOID will be accredited as a key component of the UK Inter-agency Living With Environmental Change (LWEC) Programme.

The portable regional climate model, **PRECIS,** developed by the Hadley Centre is provided to countries in conjunction with a workshop to give scientific advice on designing model experiments and how to interpret results. Since January 2005 PRECIS workshops have been held in the UK, Belize, Malaysia, Ghana and Kenya. A special meeting was held in Thailand in 2007 as a follow up to the Malaysia workshop in 2006, where countries in the region discussed their results.

PRECIS is being used in several projects: the FCO-funded Dangerous Climate Change in Brazil Project; the UNEP/UNESCO funded Nile project, providing guidance on water resources in Egypt; a Hadley Centre post in Saudi Arabia to help with its 2nd National Communication under the UNFCCC. India is also using PRECIS for its 2nd National Communication; in addition the PRECIS team has visited India and scientists have visited the UK in order to exchange expertise.

In addition, **CEH** makes its research available in a variety of means including direct contact with stakeholders and policymakers, peer-reviewed papers, international committees and web portals which all greatly increase the potential for wider economic impact. For example, CEH produces the Flood Estimation Handbook which provides standard methods of estimating flood frequency for various stakeholders including the insurance industry. This has been independently estimated to be worth an average present value of £8 – £30 million per year.

7.3.5 International research, capacity building and observations

The government supports the research and assessments of the IPCC, and many UK scientists are involved. The UK has taken a leading role on the steering committee, provided lead authors and contributing authors for the AR4 and also worked on revising the IPCC inventory guidelines.

Defra-funded work at the **Met Office Hadley Centre** was instrumental in the success of the Coupled Climate Carbon Cycle Inter-comparison Project (C4MIP)[135] activity under the International Geosphere-Biosphere Programme (IGBP). This compared carbon cycle models across the international research community. Results show the importance of ecosystems and the carbon cycle in determining future climate change and its impacts. The Hadley Centre's earth system model HadGEM2-ES provides a continuation of this work and remains at the forefront of international climate research and will contribute to IPCC AR5.

Following the collaborative project with the Ministry of Environment and Forests in India that was completed in 2005, DECC is funding the second phase of the UK-India collaborative research to further develop understanding of the potential impacts of climate change in India. The project due to start in 2009 will improve current climate change modelling for India, and consider the impacts on four sectors (water resources, agriculture, forestry and human health) in a more integrated way than was possible in the first phase. Two projects will consider adaptation options at the regional level.

A second three-year project jointly funded by **Defra** and the **Department for International Development** (DfID) in partnership with the Chinese Ministry of Science and Technology (MoST) investigating the impacts of climate change on Chinese agriculture (ICCCA) concluded in 2008. It refined and widened the national level analysis carried out in phase one of the project. It also incorporated a major regional component

[135] Friedlingstein et al, 2006: Climate–carbon cycle feedback analysis, results from the C4MIP model intercomparison, J. Clim., 19, 3337-3353.

and engaged a range of stakeholders to assess the impact of climate change on rural livelihoods, and to develop the first regional adaptation framework in China – for the northern province of Ningxia. The national component examined the impacts of climate change on agriculture, taking into account availability of water resources and socio-economic developments, and re-assessed the impact of CO_2 fertilisation on crop yields.

A new UK-China collaborative project on strengthening climate change adaptation in China is due to start in 2009, developing the science, building capacity and mainstreaming adaptation planning and management. It will include studies in three provinces.

The **FCO** has been funding work through Strategic Programme Fund (formerly the Global Opportunities Fund) Low Carbon High Growth programme. Projects include:

- A series of studies on the Regional Economics of Climate Change (RECCS, sometimes referred to as 'mini-Sterns') in a number of countries and regions.
- Studies on the security implications of climate change. Recently confirmed funding for studies in Colombia, Mexico and Central America and the Sahel region (Africa).
- EU/China Interdependencies on Energy and Climate Change paper. The analysis and findings from this report were drawn from over twenty separate studies prepared by the project team based at Chatham House as well as researchers from Chinese Academy of Social Sciences, the Energy Research Institute and French think tank IDDRI.
- A series of Hadley Centre studies on the impacts of climate change on specific countries.
- Related work on achieving energy objectives, including funding studies into implementing energy efficiency plans in partner countries.
- Building Capacity in Regional Climate Change Scenario production using PRECIS to inform impacts, vulnerability and adaptation studies in the Middle East, and empower Saudi Arabian, Omani and Bahraini scientists and policy makers to take early action on climate change.

A key output of several projects is to enable the host countries to develop their National Communications to the UNFCCC.

DfID Research has recently launched a new Research Strategy under which the research budget is set to rise up to £220 million per year by 2010/11. By this time, the UK is likely to fund more development research than any OECD DAC member, including the World Bank.[136]

Existing research programmes include:

- The ongoing £30 million Climate Change Adaptation in Africa programme (2006-2011), which is probably the largest adaptation research programme in Africa. DfID has partnered with the International Development Research Centre of Canada in the implementation of this programme. The programme now has over 25 research and capacity building projects across Africa, including agriculture, coastal zone management, disease prediction models and (recently) urban issues.[137]
- Climate Change Adaptation in China – this programme is co-funded with Defra, and will be launched soon.
- Economics of Adaptation – World Bank is the lead partner in this programme which is implemented in collaboration with the Dutch Ministry of Foreign Affairs and Swiss Development Cooperation.
- Aid effectiveness and climate change funding – a small study being carried out by IIED and IDS.

DfID has also committed a substantial portion of its research budget to the Centre for Climate and Development, the aim of which is to support developing countries to design improved development policies, programmes and investments, based on a sound understanding of climate change and its implications by 2015.

UKERC has made significant contribution towards G8 talks. Its workshop in 2005, a follow-up to the Washington meeting in 2004 on implementing the Evian Action Plan, saw Energy science and technology managers, researchers and other interested individuals from the G8 plus five developing nations (Brazil, China, India, Mexico, South Africa) engage in high-level discussion on improving collaboration on clean energy. UKERC also continues to be heavily involved in a series of 'Low Carbon Society' workshops held as part of the international Low Carbon Society established by the Japanese Ministry of Environment and Defra. Outputs have fed into G8 and UNFCCC meetings and have included an international modelling exercise undertaken by nine national teams.

CEH is engaged in major international networks such as the Partnership for Environmental Research (PEER), A Long-Term Biodiversity,

136 For more information see http://www.dfid.gov.uk/research/.

137 For more information see www.idrc.ca/ccaa

Ecosystem and Awareness Research Network (ALTER-NET), and the EurAqua Network of European Freshwater Research Organisations. CEH also coordinates and Chairs several internal initiatives such as Chairing the International Cooperative Programme for the Effects of Air Pollution on Natural Vegetation and Crops which reports into the UN Convention on Long-Range Transboundary Air Pollution; and the coordination of two major FP6 European Commission funded initiatives NitroEurope (62 institutions across Europe, Russia, China and Africa) and WATCH (25 organisations across Europe).

Systematic Observations

7.4.1 Introduction

The UK government has always been very dedicated to the funding of observations and measurements needed to address climate-related issues. This is reflected in the recent publication of the *UK Report on national activities with respect to the GCOS Implementation Plan*[138] which provides an assessment of the UK contribution towards the realisation of the Global Climate Observing System (GCOS) Implementation Plan (GIP). The report focuses on those UK observations that relate to the designated GCOS networks (i.e. are relevant to global climate needs) as defined in the GIP and, as a result, need to be sustained in the longer-term, with data provided to the appropriate international data centres (IDCs). A brief overview of the UK observations outlined in the report is given in the following sections.

GCOS is the climate component of the Global Earth Observation System of Systems (GEOSS). The GIP forms the basis of the GEOSS 10-year Implementation Plan[139] for climate, which has been formally endorsed by the UK Government.

Systematic observations in the UK and its overseas territories are made by a number of national agencies and organisations. The UK Met Office is the lead agency for making and collecting meteorological and atmospheric observations. Observations are also made by others including the Natural Environment Research Council's (NERC) Centres and Surveys. Collection of oceanographic (and marine) observations is widely distributed throughout the UK with many government departments and laboratories, universities and commercial companies involved. Terrestrial observations are made or coordinated by NERC, the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), the Northern Ireland Environment Agency (NIEA), the Forestry Commission and others. The UK also contributes to space-based observations through the European agencies; the European Space Agency and the European Organisation for the Exploitation of Meteorological Satellites.

The GECC sub-group on Observations coordinates observational activities, which are contributions to GEOSS, GCOS, GMES (Global Monitoring for Environment and Security) etc. and various satellite programmes.

The Marine Science Coordination Committee (MSCC) was formed in 2008 to develop and implement a Marine Science Strategy for the UK, and to improve UK marine science co-ordination. The MSCC consists of Six government departments[140] and nine agencies[141] and will be establishing a number of working groups to help take forward the Committee's business, and these groups will involve wider stakeholder involvement.

7.4.2 Atmospheric Observations

The UK's contribution to the GCOS Surface Network (GSN) comes from the national network (for the UK itself) of 20 stations within the UK's Regional Basic Climate Network (RBCN) and the 34 stations within the UK's Reference Climate Network. The 6 UK GSN stations run by the Met Office are Lerwick, Stornoway, Eskdalemuir, Valley, Waddington, Camborne and additionally 2 overseas stations: St Helena and Ascension Island.

The British Antarctic Survey (BAS) runs 3 Overseas GCOS Surface Network stations: Halley, Rothera and Fossil Bluff. BAS has upgraded the station at Grytviken, South Georgia and will investigate whether this could be designated as a GSN station. This site has a record back to 1903. All 3 of the UK BAS GSN stations operate to GCOS standards and historic data have been supplied to the IDCs, for their operational periods where the data have been digitised. BAS also operates Larsen, Uranus Glacier, Butler Island and Ski Blu Automatic Weather Stations in the Antarctic.

138 Available online at http://unfccc.int/methods_and_science/research_and_systematic_observation/items/4499.php

139 GEOSS 10-Year Implementation Plan Reference Document. Ad hoc Group on Earth Observations (GEO), GEO-204, February 2005. Conference, September 2005. http://earthobservations.org/docs/GEOSS%2010-Year%20Implementation%20Plan%20(GEO%201000).pdf

140 Defra (chair); the Scottish Government; DfID; Department for Business, Enterprise & Regulatory Reform (BERR); MOD; DIUS

141 Met Office; United Kingdom Hydrographic Office (UKHO); Fisheries Research Services (FRS); NERC; Centre for Environment, Fisheries and Aquaculture Science (Cefas); Agri-Food and Biosciences Institute (AFBI); Joint Nature Conservation Committee (JNCC); Environment Agency (EA): Scottish Environment Protection Agency (SEPA)

There are additional stations for which the UK is not directly responsible, though the UK Public Weather Service does fund the Pitcairn station. These 3 overseas GCOS Surface Network stations (UK Overseas Territories) are Gough Island, Bermuda and Pitcairn: Gough Island is run by the South African Weather Service (SAWS); Bermuda is run by Serco for the Bermudan Government; and Pitcairn is funded by the National Meteorological Programme (NMP) and serviced by NZWS.

The UK land surface observing network currently comprises 282 climate stations, 157 synoptic stations and 44 climate data loggers. There are an additional 2824 rainfall-only stations. These stations are partially compliant with GCOS standards, but are much more subject to site changes or closures than those in the GSN, Regional Basic Climate Network and the UK's Reference Climate Network.

The UK contribution to the GCOS Upper Air Network (GUAN) network is 2 stations, plus 6 overseas stations. The 2 in the UK are Lerwick and Camborne. There are 3 GUAN stations overseas: Gibraltar, St Helena and Mt. Pleasant, and 3 GUAN stations in UK overseas territories: Ascension, Gough Island (run by SAWS) and Bermuda. There is one BAS GUAN station at Halley. Lerwick, Camborne and St Helena are NMP funded so secure. Gibraltar and Mt. Pleasant are on RAF airfields, so cannot be guaranteed against closure. The 6 UK-run stations provide data to the IDCs. These are the 2 in the UK, the 3 UK-run stations overseas and the BAS station at Halley. The 3 run by others on UK overseas territories are also presumed to provide their data to the IDCs.

In addition to GUAN stations, the Met Office also operates 4 autosonde stations in the UK making routine ascents and 2 range stations that make ascents during range hours. The Met Office also operates 6 wind profilers as part of the EUCOS wind profiler network. The 4 autosonde sites are at Ablemarle, Castor Bay, Herstmonceaux and Watnall. These stations meet the minimum requirement for profiles to 100 hPa but not the target of 5hPa, although GCOS's Atmospheric Observation Panel for Climate (AOPC) has reduced this target to 30hPa. Additionally, the BAS station at Rothera has commenced a regular upper air monitoring with a commitment to continue in the long term.

Further information on satellite data and atmospheric composition measurements is included in the *UK Report on national activities with respect to the GCOS Implementation Plan* *(see footnote139 on page 123)*.

7.4.3 Oceanic observations

The Met Office routinely produces many ocean products which contribute to larger international observational programmes. These observations under taken by the Met office include:

- Marine Automatic Weather Stations (MAWS) network consisting of 11 moored buoys and seven systems on lightships and islands. Nine of the buoys are in open-ocean locations — seven to the west of the British Isles and two (which are owned jointly with the French Met. Service Meteo-France) in the Bay of Biscay — and two are in coastal inshore waters.
- A fleet of around 350 Voluntary Observing Ships (VOS) on which the crew make weather observations. These observations are made in support of the International Maritime Organization's SOLAS (Safety of Life At Sea) Convention and are carried out under the WMO VOS programme. Within Europe VOS operations are co-ordinated through the EUCOS Surface Marine programme (E-Surfmar).

The Met Office also acts as one of two Global Collecting Centres (GCC) (alongside the German Met Service DWD) for VOS data, with responsibility for basic quality control of ship data, and collection of those data not available in real-time (e.g. ship's logbooks). As part of its role as a real-time monitoring centre for marine data the Met Office routinely monitors VOS data.

UK involvement in the international programme to maintain a global array of temperature/salinity profiling floats, known as **Argo**[142], is supported by a wide range of governmental and research organisations. NERC funding (~£125k pa) is agreed to March 2012 through the Oceans2025 programme, with the expectation that it will continue after this time. This covers effort at NOCS and BODC on data processing and science leadership. Funding through the Met Office is from MoD (Research Acquisition Organisation (RAO) and Defence Intelligence, Intelligence Collection Strategy and Plans (DIICSP)) and DECC. The RAO funding is through the Integrated Climate Programme and the DIICSP funding through the Defence Oceanography Programme.

Proudman Oceanographic Laboratory (POL) operates 11 GLOSS stations: Lerwick, Stornoway, Newlyn, Gibraltar, Rothera (with BAS), Signy, St Helena (currently not operational whilst the harbour is being reconstructed), Port Stanley, Ascension, Tristan da Cunha (not currently operational because the gauge was washed away

142 http://www.argo.ucsd.edu/

in a storm, but a new gauge has been purchased and will be installed in the future) and South Georgia (King Edwards Point).

All 11 tide gauge stations currently producing data, or which have produced data in the past, provide these to PSMSL (based at POL) and to the two GLOSS data centres (BODC and UHSLC). Vernadsky, Bermuda and Diego Garcia provide data to international data centres. All 11 stations have complete historical records in international data centres (PSMSL, BODC, UHSLC). The first 3 stations (Lerwick, Stornoway, Newlyn) are part of the UK Tide Gauge Network.

DECC (since 2008; previously Defra) sponsors the **Advanced Along Track Scanning Radiometer** (AATSR) satellite instrument, which monitors sea surface temperatures to within an accuracy of 0.3K. It was launched in 2002 on the European Space Agency ENVISAT satellite platform and continues to operate successfully, having exceeded its expected 5-year operating lifetime. The AATSR instrument is extending the record of highly accurate sea surface temperature measurements obtained from its precursor instruments ATSR and ATSR-2, launched in 1991 and 1996 respectively. Validation and data processing activities have also been supported by Defra, and now by DECC, to promote the use of these new datasets in climate studies. A 17-year archive record, starting from 1991, has now been developed for research use. This latest dataset is currently being analysed to determine trends in global and regional sea surface temperatures over the period 1991 to 2008. This long term record will help to improve our understanding of trends in climate, and important natural cycles, like the El Nino Southern Oscillation.

Records of the variability and changes in ocean circulation in the seas around the UK are maintained through long-term support by Government to Marine Scotland's Marine Laboratory (Aberdeen) and the Centre for Environment Fisheries and Aquaculture Science (Lowestoft). The geographical position of the UK means that these time series are of international importance.

7.4.4 Terrestrial observations

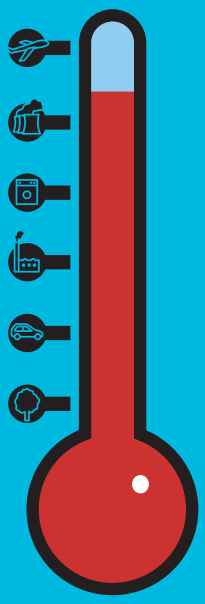
The UK reports 6 river discharge measurements to **Global Terrestrial Network for River Discharge** (GTN-R). These sites are at: Ballathie on the River Tay, Blairstone on the River Clyde, Colwick on the River Trent, Kingston on the River Thames, Norham on the River Tweed and at Redbrook on the River Wye. In addition, the National River Flow Archive currently supplies the Global Runoff Data Centre with data for the 200 gauging stations whose daily records have been reconciled with UK measuring authorities. The majority of sites discussed have a complete historical record with GRDC.

For snow cover, of the 167 stations in the UK that are part of the **World Weather Watch/Global Observing System** (WWW/GOS) network, 54 have automatic snow depth sensors (at 3 of those sites there is also a manual observer who may choose to override the automatic observation) and there are another 22 sites making manual observations of snow depth. Of the 22 sites making manual observations, 3 will close this year, 1 may close by 2010 and 1 will probably be converted to an automatic site. The other 17 are projected to remain open past 2010 in the UK there are an additional 78 climate stations that are not part of the WWW/GOS network that report snow depth. 54 automatic snow depth sensors have been deployed since 2004 to improve observations of snow cover and snow fall.

The UK does not have any glaciers, nor any locations with year-round permafrost. BAS does have networks of GPS stations measuring the movement of key icestreams, and one station that contributes to the determination of isostatic recovery of Antarctica.

8

Education, Training and Public Awareness



Education, Training and Public Awareness

Key developments

Publication of England's Department for Children, Schools and Families' (DCSF) updated Sustainable Development Action Plan, *Brighter Futures – Greener Lives*, setting out strategic objectives to ensure children's well being now and in a changing world.

Publication of Wales' Education for Sustainable Development and Global Citizenship – a common understanding for each of the education sectors (schools, youth work, work based learning, further education and adult and community learning).

The ACT ON CO_2 campaign was launched in 2007 (building on previous Government initiatives) to help encourage sustained behaviour change to reduce individual CO_2 emissions. Independent research shows that 73 per cent of people say they had taken action to reduce their CO_2 emissions or were planning to as a result of the campaign.

The award-winning online **Act on CO_2 calculator** has received over 1.5 million unique visitors since its launch in June 2007.

Education

8.1.1 England

Much of the work relating to the education of children and young people in England about climate change is being taken forward under the wider banner of our National Framework for Sustainable Schools. This was published in May 2006 and was followed by action to develop guidance and support for schools and local authorities. This has included guidance on planning and evaluating sustainable schools, top tips and training for school governors, the National College of School Leadership's programme for leadership of sustainable schools, an annual Teaching Award for Sustainable Schools, and a national competition for children leading to the publication of "Teach your Granny to text and other ways to change the world".

The National Curriculum ensures that there are many opportunities for young people to study sustainable development and climate change. Sustainable development permeates teaching across the curriculum at all ages and is an explicit teaching requirement in Science, Citizenship/PSHE (Personal, Social, Health and Economic education), Design and Technology, and Geography. For example, under the science curriculum pupils aged 11-14 are taught about renewable energy and the possible impact of human activity, such as the burning of fossil fuels, on the environment. The geography curriculum for 11-14 year olds requires pupils to be taught about resource planning and management issues, for example, developing alternative energy sources. 'Environmental interaction and sustainable development' is one of the key concepts in the new geography curriculum for 11-14 year olds introduced in September 2008 with a requirement to study climate change.

The Department for Children, Schools and Families' (DCSF) Sustainable Development Action Plan *Brighter Futures – Greener Lives* was published in May 2008 and explains how the DCSF core business of children's well being and ensuring that children have the skills and knowledge they need in a changing world will be delivered in a way that supports the Government's commitment to sustainable global development.

8.1.2 Wales

In Wales, 'One Wales', the programme for government in Wales, illustrates the Welsh Assembly Government's commitment to this issue, with proposals to achieve annual 3 per cent reduction in CO_2 emissions in areas of devolved competence by 2011. These have implications for education both in the provision and management of buildings and the curriculum and learning outcomes that are delivered. The new curriculum for schools, introduced in September 2008, enhances opportunities for the development of key government policies such as sustainable development and climate change.

It has an increased focus preparing young people for the challenges they will face in the 21st century and their role as global citizens. Education for Sustainable Development and Global Citizenship (ESDGC) is a theme promoted through all subject orders and it is inspected by Estyn (Her Majesty's Inspectorate of Education and Training in Wales).

In particular, the new curriculum has increased opportunities to focus on current events in the news (geography), has a focus on active citizenship (PSHE) and has climate change as a clear theme within ESDGC.

Within other education sectors, ESDGC has been included within qualifying teacher training standards, is part of the youth work curriculum statement, and is a requirement of work based learning providers to show progress in delivering ESDGC. All universities have undertaken an audit

of their curriculum to assess both the quantity and depth of ESDGC. They have also been required to develop an environmental management system that will have external accreditation within three years.

Working with practitioner representatives, a 'common understanding' for ESDGC has been produced for each of the sectors (schools, youth work, work based learning, further education and adult and community learning). This sets out the breadth of ESDGC in each sector and climate change is included as a major theme. The higher education sector will shortly be completing a review of best practice which will examine and evaluate progress to date and provide clear recommendations for future development.

Specific additional materials have been produced by Welsh Assembly Government to support climate change communications in education. A secondary school pack was sent out to all schools and Further Education colleges, and further updates provided. The Welsh Assembly Government has actively supported research on climate change with significant capital investment in The Low Carbon Research Institute and the Bioscience and Environment Research Alliance.

Over 90 per cent of schools in Wales are registered with the Eco-Schools programme, which aims to promote awareness and action on a range of environmental issues in schools including climate change. The emphasis now is on moving schools through the scheme and achieving the highest level of accreditation.

8.1.3 Scotland

Developing an understanding of environmental issues and how we lead sustainable lifestyles is a key element of becoming a responsible citizen – one of the 4 capacities of Curriculum for Excellence – the new Curriculum for 3-18 year olds in Scotland. Sustainable Development is an intrinsic part of the Curriculum for Excellence which aims, amongst other things, for young people to develop an ability to evaluate environmental, scientific and technological issues as well as debate informed, ethical views on complex issues, such as climate change. Education has an increasingly important role to play in climate change and sustainable development with its focus on green and environmental issues. The role of Eco-Schools and the learning opportunities of green school buildings and facilities is also relevant.

Learning and Teaching Scotland (a non-departmental public body) hosts a well-researched climate change resource for secondary schools as part of its sustainable development education website, to encourage young people to investigate, communicate and act to tackle climate change.

Eco-Schools Scotland (jointly funded by Education and Environment portfolios) makes Scotland one of the leading countries in the international Eco-Schools movement, which covers over 40 countries world-wide. The Eco-Schools Scotland Programme promotes pupil-led activity across a range of issues, including water and energy use, waste minimisation, bio-diversity, and sustaining our world.

The Scottish Government supports the Local Footprints project which aims to help local authorities and schools to play their part in reducing Scotland's global footprint. Local Footprints is a joint project between WWF Scotland and the Sustainable Scotland Network with funding and support from Eco-Schools Scotland, The Improvement Service, the Scottish Government and Scottish Power. Schools' Global Footprint resources and training are available to help schools to examine, measure and take action to reduce their impact on the environment locally and globally, as part of the Eco-Schools programme. The resources were piloted in 17 primary and secondary schools in Aberdeen City, Aberdeenshire and North Lanarkshire and are now being made available, with training, to all schools in Scotland.

In January 2009, the Scottish Government announced a package of measures to help local authorities work towards a lower carbon school estate:

- working with Carbon Trust to "up-skill" authority client teams to ensure they have the appropriate competencies and confidence to secure sustainable school design;
- funding 2 Schools Renewables Development Officers to work with authorities to increase the uptake of micro-renewables in schools, to help deliver the manifesto commitment to having renewable capacity in every school; and
- developing a sustainable schools knowledge 'portal', hosted on the government website, to act as an authoritative source of advice and guidance on creating a low carbon school estate.

In further and higher education, two thirds (42) of Scotland's universities and colleges have signed up to the Universities and Colleges Climate Commitment for Scotland (UCCCfS).

This is a public commitment from the further and higher education sectors to allocate time and resources to implementing measures that will reduce their greenhouse gas emissions and carbon footprints. It also welcomes the opportunity to expand Scotland's ability through its research capacity, knowledge transfer activity and the provision of skills, modules and courses to create solutions to the challenges posed by climate change.

Within 12 months, universities and colleges signed up will publish a 5-year climate change action plan that will include measurable targets and timescales to achieve a significant reduction in emissions from all business operations and activities.

Public Awareness

8.2.1 The ACT ON CO_2 campaign

ACT ON CO_2, launched in 2007, is a major Government-led multimedia campaign (including advertising, face-to-face events, partnerships and so on) which aims to engage citizens on climate change issues, address the confusion and powerlessness which can impede people taking action, and encourage genuine and sustained behaviour change to help reduce CO_2 emissions and meet UK emissions targets. The ACT ON CO_2 brand is Government-led and multi-partnered. It aims to help provide clarity and consistency across different communications.

The **ACT ON CO_2 website** aims to signpost, interact, coordinate and engage consumers on climate change, providing a clear, consistent, authoritative and credible voice. The website allows other government departments to build and add further climate change information as and when necessary.

The award-winning **ACT ON CO_2 calculator** has received over 1.5 million unique visitors since its launch in June 2007. Further enhancements are being added to allow users to calculate their CO_2 emissions from renewable technologies and public transport as well as providing interactive results and action plans. This is an integral part of the Government's strategy to engage with and educate the public as part of the mobilisation of society to adopt low carbon lifestyles.

Independent research shows that 73 per cent of people say they have taken or are planning to take action to reduce their CO_2 emissions as a result of the campaign – an increase of 23 percentage points since summer 2007. There were around 600,000 unique visitors to the campaign website between September 2008 and May 2009 and almost 400,000 calls to the ACT ON CO_2 advice line run by the Energy Saving Trust, from September 2008 to February 2009 – this is double the number of calls over the same period in 2007/2008.

The **ACT ON CO_2** campaign won two Green Awards in 2008 in best audio visual and best integrated campaign, adding to the two it won in 2007.

8.2.2 The Climate Change Initiative

The success of the ACT ON CO_2 campaign built on the achievements of the Climate Change Communications Initiative (CCCI) which was launched in 2005 to raise awareness of the issue and inspire collective action.

Defra developed an environmental segmentation model, predominantly used for advising policy and communications development. It is based on people's responses to a broad range of attitudinal questions which were included in Defra's 2007 Attitudes and Behaviours Towards the Environment Survey. The model divides the public into seven clusters each sharing a distinct set of attitudes and beliefs towards the environment, environmental issues and behaviours. There has been a recent increase in the number of research projects and government bodies using the model. In addition, a web based tool, designed for use by a range of stakeholders to inform the public of which segment they best fit into and how they can make environmental changes, is currently in development.

The work of the Initiative included the initial development of the web-based ACT ON CO_2 calculator, two short filler films, a DVD/booklet pack *Climate Change: Your guide to inspiring action*, which gives guidance to those wishing to encourage individuals to take action to tackle climate change (and is still available), and 83 local and community-level communications projects led by local government and the third sector.

Over 6,000 hard copies of our first booklet *A Guide to Communicating Climate Change* were distributed – including to a large number of community and local organisations. The current version of the booklet, *Climate Change: A Guide to Inspiring Action*, was launched on 5 June 2007 and over 2000 copies have been distributed to businesses, schools, councils, public bodies, NGOs and individuals.

The Climate Challenge Fund sponsored 83 wide-ranging projects with grants totalling £8.5 million over two years. These projects generated over 700,000 promotional items, 140,000 visits to websites and direct contact with over 60,000 people at exhibitions, with overall direct engagement on almost 450,000 occasions. There were also over 24 million opportunities to communicate climate change through posters and billboard advertising.

8.2.3 The Big Energy Shift

Between January and March 2009, a series of nine citizen forums took place in England, Wales and Northern Ireland to seek people's views on Government's plans for a big shift in the way people's houses and communities are insulated, heated and powered. The project was commissioned and supported by the Department of Energy and Climate Change (DECC), the Northern Ireland Executive and Welsh Assembly Government.

8.2.4 Climate Change Champions in England

Defra funded a three-year youth engagement initiative on climate change, the Climate Change Champions (CCC), from 2006-2009. This project formed part of the wider ACT ON CO_2 campaign. The CCC project recruited eighteen young people across England, aged between 11 and 18, who, following a competition, spent a year 'in office' as regional ambassadors. In the second year of the project, Champions were each awarded £1,000 by Defra to either organize their own event or project on climate change or put this towards an existing climate change community project. The project has been successful with six of the nine Champions in the second year of the project using their £1,000 to instigate lasting change. One Champion secured £10,000 from the private sector for her primary school to install an automated energy efficiency system. Another used his £1,000 to transform a derelict space at his school into a 'climate change awareness garden', which included an automated weather station that the school could use as part of their future geography lessons.

As a new department DECC is looking at new, more interactive ways of engaging with the public on climate change. In 2009/2010, the campaign will build on the successes to date by building literacy around the reality of climate change and scientific consensus around the causes, and encouraging behavioural change.

8.2.5 Climate change communication and engagement in Wales

The Welsh Assembly Government has been running a major climate change campaign since September 2008, which informs people across Wales about the daily actions which contribute to climate change, encourages people to measure their carbon footprint by using the carbon calculator for Wales and provides information on how to reduce it. The campaign uses a number of media, including television, radio, the internet, and street advertising (both stationary and on buses). This first stage of the campaign is currently being evaluated, and the lessons learnt from this will be used to plan the next stage of the campaign.

The Climate Change Commission Sub Group on Communications helped to inform the development of this campaign and to ensure that we maximise the links with other organisations who are communicating on this subject.

The Assembly Government is also looking at how we can develop a workplace-based component to the campaign and are interested in working with the Trade Unions and businesses on this.

The Assembly Government is working to support community action on climate change. Activities have included:

- Holding a series of community events to find out more about what communities are doing and how we can support them better as well as providing an opportunity for learning, sharing experiences and networking
- Completing a scoping report on the action underway in communities and how this can be supported by the Assembly Government
- Producing a Community Action Pack and associated DVD showcasing good practice which provides information on how communities and other groups can take action to tackle climate change

The Assembly Government has produced a number of other resources including a householder guide which provides details of simple projects which people can undertake to improve the carbon performance of their homes. The document is being distributed via local planning offices for people seeking advice on home improvements and planning, and through branches of B&Q and independent retailers of DIY products.

The Welsh Climate Change Champions 2008 concluded their successful first year with the release of a single, "Carbon Soldier". The Climate Change Champions 2009 were selected through a national competition, and were announced in January 2009.

The incoming Champions undertook a fact-finding expedition to Flanders, where they developed their knowledge of the climate change agenda and discussed issues with EU politicians and officials, as well as their Flemish youth counterparts. They are now actively promoting action on climate change in communities across Wales.

The Assembly Government supports the Wales Youth Forum for Sustainable Development, which enables young people to design and lead events on sustainability and climate change. Amongst other events, the group is planning a second Carbon Cycle following last year's successful cycle trip from Machynlleth to Cardiff which raised awareness and support for sustainable transport.

The Assembly Government is planning a major conference for young people on climate change in July 2009.

8.2.6 The Carbon Trust Campaign

The Carbon Trust is an independent company set up by government in response to the threat of climate change, to accelerate the move to a low carbon economy by working with organisations to reduce carbon emissions and develop commercial low carbon technologies. In February 2009 the Carbon Trust launched a new multi-media integrated campaign to mobilise UK business and help them in the recession by saving at least £1 million a day through cost-effective action on climate change.

The campaign was backed by business groups, leading companies, and BBC *Dragons' Den* entrepreneur Theo Paphitis, who urged business to immediately prioritise saving energy in order to cut carbon and cut costs.

The 'One Million A Day' campaign urged businesses of all sizes to join up and prioritise actions to kick-start immediate energy savings, reduce carbon emissions and make significant direct costs savings. SMEs were also encouraged to take advantage of a £35 million Carbon Trust fund to upgrade or replace existing equipment to more energy efficient versions using unsecured, interest-free loans ranging from £5,000 up to £200,000.

As part of the campaign small and medium sized businesses are also being encouraged to get involved and use its new online carbon saving advice, with practical action guides, web tools and videos and a range of sector-specific guides including offices; retail and distribution; hospitality; engineering and mining and quarrying.

The campaign's target is to help save the UK economy £1 billion over the next three years and reduce the UK's carbon emissions by at least 17 million tonnes of CO_2 – the equivalent to annual emissions from heating nearly 5.5 million average UK homes. Although it is too early to measure the key performance goals, there has been a significant increase in contacts to the Carbon Trust for advice and information.

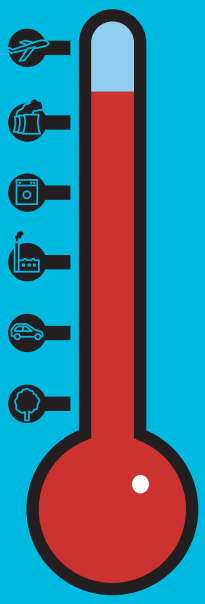
8.2.7 The Energy Saving Trust

The Energy Saving Trust (EST) is grant-funded by DECC, the Department for Transport and the Devolved Administrations, as well as by the EU and the private sector. A key part of the EST programme for 2008/09 is the ACT ON CO_2 advice line and nationwide network of regional advice centres which provides the consumer with comprehensive and tailored advice on how to reduce their carbon footprint. The 'one-stop-shop' offers consumers a range of free and impartial advice on energy efficiency, microgeneration and renewable energy, low carbon transport, water efficiency and waste reduction and a range of independent services that will help them action that advice.

In a similar approach in Scotland, the Scottish Government funds the EST to manage the network of Energy Saving Scotland advice centres which will deliver the new Scottish Government fuel poverty programmes through the new Energy Assistance Package.

The Welsh Assembly Government provided funding to the EST to bring forward the rollout of its enhanced energy advice service in Wales.

Annexes



Inventory Tables

Summary Table for National Greenhouse Gas Inventories – 1990

		Net CO_2 emissions/removals	CH4	N2O	HFC P	HFC A	PFC P	PFC A	SF6 P	SF6 A	NOX	SO2	VOC	CO
Greenhouse Gas Source and Sink Categories		**Gg**			**CO2 equivalent (Gg)**						**Gg**			
Total National Emissions and Removals		**594,194**	**4,975.89**	**208.43**	**11.88**	**11,385.55**	**73.65**	**1,401.60**	**0.08**	**0.04**	**2,747.58**	**3,731.51**	**2,602.53**	**8,551.84**
1. Energy	1A1. Energy Industries	237,170	9.71	6.54							849.48	2,886.29	8.07	133.53
	1A2. Manufacturing Industries and Construction	99,046	15.40	5.24							393.79	417.47	27.92	724.92
	1A3. Transport	117,187	33.40	4.70							1,206.64	94.45	917.78	5,866.18
	1A4. Other Sectors	109,416	73.23	3.08							212.84	233.38	104.18	1,176.19
	1A5. Other	5,285	0.15	0.16							42.18	9.33	2.89	13.37
	1B1. Solid Fuels	856	870.94	0.01							0.58	20.68	0.34	38.35
	1B2. Oil and Natural Gas	5,760	490.67	0.14							13.34	7.78	555.72	21.49
1. Energy Total		**574,720**	**1,493.49**	**19.86**							**2,718.86**	**3,669.39**	**1,616.90**	**7,974.03**
2. Industrial Processes	2A. Mineral Products	10,119	1.12				0.00					4.27	13.08	5.31
	2B. Chemical Industry	2,885	8.07	79.49			0.00				8.49	41.60	165.80	82.12
	2C. Metal Production	2,309	0.78	0.04		–	0.00	1,332.75	–	0.02	4.85	8.94	2.05	194.03
	2D. Other Production						0.00						77.67	
	2E. Production of Halocarbons and SF6				–	11,373.73	0.00	10.90						
	2F. Consumption of Halocarbons and SF6				11.88	11.82	73.65	57.95	0.08	0.03				
2. Industrial Processes Total		**15,313**	**9.97**	**79.52**	**11.88**	**11,385.55**	**73.65**	**1,401.60**	**0.08**	**0.04**	**13.33**	**54.80**	**258.60**	**281.46**
3. Solvent and Other Product Use	3. Solvent and other Product Use												670.64	
3. Solvent and Other Product Use Total													**670.64**	
4. Agriculture	4A. Enteric Fermentation		875.66											
	4B. Manure Management		170.89	7.16										
	4D. Agricultural Soils			98.11										
	4F. Field Burning of Agricultural Residues		12.67	0.25							9.07		26.06	266.04
4. Agriculture Total			**1,059.22**	**105.53**							**9.07**		**26.06**	**266.04**
5. Land Use, Land-Use Change and Forestry	5A. Forest Land	(12,155)	0.20	0.02							0.05			1.79
	5B. Cropland	15,822		–										
	5C. Grassland	(6,130)	0.15	0.00							0.04			1.28
	5D. Wetlands													
	5E. Settlements	7,074	0.45	0.00							0.11			3.90
	5F. Other Land													
	5G. Other	(1,657)												
5. Land Use, Land-Use Change and Forestry Total		**2,954**	**0.80**	**0.03**							**0.20**			**6.97**
6. Waste	6A. Solid Waste Disposal on Land		2,372.22										23.72	
	6B. Waste-water Handling		33.79	3.33										
	6C. Waste Incineration	1,207	6.40	0.15							6.12	7.32	6.61	23.34
6. Waste Total		**1,207**	**2,412.41**	**3.49**							**6.12**	**7.32**	**30.33**	**23.34**
Aviation_Bunkers		15,706	0.31	0.50							75.34	3.00	5.40	13.18
Marine_Bunkers		6,765	0.11	0.17							153.71	89.17	7.44	15.73
International Bunkers Total		22,471	0.42	0.67							229.05	92.17	12.84	28.91

Summary Table for National Greenhouse Gas Inventories – 2007

Greenhouse Gas Source and Sink Categories		Net CO_2 emissions/removals	CH4	N2O	HFC		PFC		SF6		NOX	SO2	VOC	CO
		Gg			P	A	P	A	P	A				
		CO2 equivalent (Gg)									Gg			
Total National Emissions and Removals		**544,610**	**2,331.91**	**110.62**	**64,936.39**	**9,611.19**	**148.36**	**215.60**	**0.03**	**0.03**	**1,487.63**	**596.09**	**940.38**	**2,104.82**
1. Energy	1A1. Energy Industries	210,586	11.54	5.02							441.58	372.99	5.51	103.52
	1A2. Manufacturing Industries and Construction	79,335	12.89	4.30							249.45	93.23	24.84	520.08
	1A3. Transport	131,763	7.29	5.27							603.83	54.01	98.72	847.01
	1A4. Other Sectors	101,104	25.67	1.94							162.39	29.87	61.60	389.14
	1A5. Other	3,489	0.10	0.11							23.45	5.09	1.74	8.88
	1B1. Solid Fuels	138	126.20	0.00							0.25	9.82	0.13	10.00
	1B2. Oil and Natural Gas	5,092	259.27	0.13							2.17	0.37	208.05	11.25
1. Energy Total		**531,506**	**442.96**	**16.76**							**1,483.12**	**565.38**	**400.59**	**1,889.88**
2. Industrial Processes	2A. Mineral Products	8,668	0.88		–		0.00					15.86	10.01	3.45
	2B. Chemical Industry	3,070	3.63	8.88	–		0.00				1.11	5.80	32.78	29.18
	2C. Metal Production	2,658	0.87	0.03	–	2.34	0.00	81.67		0.01	1.41	8.14	1.70	146.27
	2D. Other Production				–		0.00						79.16	
	2E. Production of Halocarbons and SF6				–	175.60	0.00	54.56						
	2F. Consumption of Halocarbons and SF6				64,936.39	9,433.25	148.36	79.36	0.03	0.03				
2. Industrial Processes Total		**14,396**	**5.38**	**8.91**	**64,936.39**	**9,611.19**	**148.36**	**215.60**	**0.03**	**0.03**	**2.52**	**29.80**	**123.65**	**178.90**
3. Solvent and Other Product Use	3. Solvent and other Product Use	–											399.87	
3. Solvent and Other Product Use Total		**–**											**399.87**	
4. Agriculture	4A. Enteric Fermentation		740.99											
	4B. Manure Management		136.78	5.63										
	4D. Agricultural Soils			75.10										
	4F. Field Burning of Agricultural Residues		–	–							–		–	–
4. Agriculture Total			**877.77**	**80.73**							**–**		**–**	**–**
5. Land Use, Land-Use Change and Forestry	5A. Forest Land	(14,173)	0.73	0.01							0.18			6.37
	5B. Cropland	15,288		–										
	5C. Grassland	(7,967)	0.43	0.00							0.11			3.78
	5D. Wetlands	–												
	5E. Settlements	6,330	0.31	0.00							0.08			2.69
	5F. Other Land	–												
	5G. Other	(1,234)												
5. Land Use, Land-Use Change and Forestry Total		**(1,756)**	**1.47**	**0.01**							**0.36**			**12.84**
6. Waste	6A. Solid Waste Disposal on Land	–	965.30										9.65	
	6B. Waste-water Handling	–	38.73	4.05										
	6C. Waste Incineration	465	0.31	0.16							1.63	0.91	6.61	23.20
6. Waste Total		**465**	**1,004.33**	**4.21**							**1.63**	**0.91**	**16.27**	**23.20**
Aviation_Bunkers		34,970	0.09	1.11							156.22	9.66	6.32	18.90
Marine_Bunkers		7,150	0.11	0.18							160.90	95.07	7.79	16.47
International Bunkers Total		42,120	0.20	1.29							317.12	104.73	14.11	35.36

Emission Trends – Carbon Dioxide **kt CO2**

Greenhouse Gas Source and Sink Categories		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
		Gg																	
Total National Emissions and Removals		**594,193.84**	**601,507.24**	**584,328.24**	**569,404.99**	**563,359.50**	**554,593.27**	**576,803.37**	**553,123.91**	**555,237.32**	**544,638.02**	**552,766.28**	**564,271.98**	**546,688.21**	**558,035.72**	**557,828.74**	**555,075.37**	**553,055.49**	**544,610.09**
1. Energy	1A1. Energy Industries	237,170.24	237,304.97	226,173.10	208,301.29	205,584.42	203,232.49	205,348.80	192,119.39	196,826.91	187,038.19	197,567.53	207,896.58	205,270.50	212,782.68	211,015.75	211,060.77	214,761.56	210,585.66
	1A2. Manufacturing Industries and Construction	99,045.52	99,016.94	95,985.91	95,180.71	95,657.97	92,301.96	93,437.69	93,437.93	91,721.13	92,329.96	92,144.39	91,880.95	83,589.13	84,638.29	83,090.08	82,974.46	81,670.13	79,334.91
	1A3. Transport	117,187.24	116,607.31	117,858.15	119,048.27	119,198.18	118,178.93	122,971.34	124,400.81	123,678.11	124,440.92	123,681.45	123,349.56	125,368.53	126,774.27	128,230.99	129,523.45	131,185.44	131,763.44
	1A4. Other Sectors	109,415.95	120,789.12	117,734.77	121,182.53	116,263.59	112,045.21	125,310.54	116,003.53	117,284.39	116,709.03	116,352.62	119,249.58	111,824.87	112,971.03	114,950.94	110,462.86	105,667.68	101,103.69
	1A5. Other	5,284.82	4,292.42	4,086.79	4,140.93	3,959.80	3,886.18	3,804.99	3,630.71	3,194.00	3,149.63	2,916.31	2,921.90	3,056.63	2,815.12	2,903.23	2,788.38	2,746.81	3,488.61
	1B1. Solid Fuels	856.42	519.42	450.00	344.83	163.25	225.84	366.77	459.63	158.41	112.08	102.36	101.68	107.95	111.87	168.08	111.98	138.77	137.96
	1B2. Oil and Natural Gas	5,760.18	5,696.02	6,120.04	6,543.24	6,943.14	8,413.09	8,896.60	6,974.65	6,904.51	5,908.71	5,615.99	5,812.86	5,532.52	5,250.61	5,099.64	5,747.65	4,883.23	5,091.68
1. Energy Total		**574,720.36**	**584,226.19**	**568,408.75**	**554,741.80**	**547,770.36**	**538,283.68**	**560,136.72**	**537,026.65**	**539,767.47**	**529,688.52**	**538,380.65**	**551,213.10**	**534,750.14**	**545,343.88**	**545,458.71**	**542,669.53**	**541,053.62**	**531,505.95**
2. Industrial Processes	2A. Mineral Products	10,119.29	8,611.32	8,023.20	8,053.44	9,029.83	9,155.67	9,443.12	10,289.48	10,248.30	9,709.73	9,208.41	8,361.93	8,185.79	8,369.08	8,497.53	8,362.34	8,467.25	8,667.77
	2B. Chemical Industry	2,884.58	2,920.52	2,978.08	3,021.49	3,059.19	3,065.28	3,073.51	2,612.38	2,812.40	2,846.55	3,028.83	3,117.14	3,029.91	2,970.13	3,076.03	2,975.66	2,719.78	3,069.92
	2C. Metal Production	2,309.27	1,683.72	1,450.46	1,364.97	1,639.35	1,938.24	2,225.45	1,961.90	1,786.87	2,090.98	1,982.75	1,515.02	1,171.60	1,847.60	2,051.92	2,456.57	2,125.95	2,657.97
2. Industrial Processes Total		**15,313.15**	**13,215.55**	**12,451.74**	**12,439.90**	**13,728.38**	**14,159.18**	**14,742.07**	**14,863.76**	**14,847.57**	**14,647.27**	**14,219.98**	**12,994.10**	**12,387.30**	**13,186.82**	**13,625.48**	**13,794.57**	**13,312.98**	**14,395.66**
3. Solvent and Other Product Use	3. Solvent and other Product Use	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3. Solvent and Other Product Use Total		**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
5. Land Use, Land-Use Change and Forestry	5A. Forest Land	(12,155.07)	(12,635.55)	(13,320.03)	(13,678.57)	(14,164.06)	(13,727.88)	(13,604.66)	(13,360.12)	(13,321.59)	(13,489.27)	(13,755.67)	(14,280.31)	(14,986.41)	(15,595.04)	(16,238.04)	(15,721.42)	(15,090.61)	(14,173.38)
	5B. Cropland	15,822.10	15,978.23	15,983.46	15,566.14	15,618.32	15,749.94	15,787.97	15,529.82	15,417.91	15,320.53	15,339.05	15,286.51	15,312.53	15,384.30	15,315.52	15,233.03	15,279.27	15,288.35
	5C. Grassland	(6,130.33)	(6,074.88)	(6,177.50)	(6,609.50)	(6,547.73)	(6,460.78)	(6,704.72)	(6,821.67)	(7,219.86)	(7,124.11)	(7,221.49)	(7,175.78)	(7,511.89)	(7,320.87)	(7,640.07)	(7,689.08)	(7,789.54)	(7,967.05)
	5D. Wetlands	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	5E. Settlements	7,074.34	6,989.43	6,907.44	6,848.20	6,803.12	6,722.26	6,707.07	6,709.90	6,669.02	6,604.51	6,566.55	6,543.21	6,474.94	6,459.58	6,422.96	6,384.15	6,328.71	6,329.81
	5F. Other Land	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	5G. Other	(1,657.21)	(1,392.17)	(1,084.86)	(978.86)	(770.42)	(1,020.59)	(1,163.57)	(1,341.10)	(1,444.54)	(1,489.78)	(1,249.58)	(817.55)	(246.24)	88.81	394.78	(81.95)	(485.48)	(1,233.93)
5. Land Use, Land-Use Change and Forestry Total		**2,953.81**	**2,865.05**	**2,308.50**	**1,147.42**	**939.23**	**1,262.95**	**1,022.08**	**716.83**	**100.95**	**(178.12)**	**(321.14)**	**(443.92)**	**(957.07)**	**(983.22)**	**(1,744.85)**	**(1,875.29)**	**(1,757.65)**	**(1,756.19)**
6. Waste	6C. Waste Incineration	1,206.51	1,200.45	1,159.24	1,075.87	921.54	887.46	902.50	516.67	521.34	480.35	486.79	508.70	507.84	488.25	489.40	486.55	446.54	464.67
6. Waste Total		**1,206.51**	**1,200.45**	**1,159.24**	**1,075.87**	**921.54**	**887.46**	**902.50**	**516.67**	**521.34**	**480.35**	**486.79**	**508.70**	**507.84**	**488.25**	**489.40**	**486.55**	**446.54**	**464.67**

Emission Trends – Methane **kt CH4**

Greenhouse Gas Source and Sink Categories		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
		Gg																	
Total National Emissions and Removals		**4,975.89**	**4,939.27**	**4,866.78**	**4,720.39**	**4,387.63**	**4,341.05**	**4,226.07**	**3,997.19**	**3,788.52**	**3,539.19**	**3,325.65**	**3,040.41**	**2,897.36**	**2,612.36**	**2,526.10**	**2,435.62**	**2,403.31**	**2,331.91**
1. Energy	1A1. Energy Industries	9.71	9.73	9.76	9.96	11.37	11.40	12.21	12.30	13.52	13.27	12.55	13.38	13.74	13.05	13.58	13.06	11.27	11.54
	1A2. Manufacturing Industries and Construction	15.40	15.18	14.48	14.51	15.24	15.51	16.01	16.62	16.08	15.72	15.15	14.00	12.81	13.65	13.30	13.03	13.22	12.89
	1A3. Transport	33.40	32.71	31.28	29.51	27.63	25.56	24.10	22.05	20.14	18.28	16.24	14.27	12.57	11.09	9.82	8.77	7.99	7.29
	1A4. Other Sectors	73.23	76.60	70.64	69.86	55.79	42.92	46.00	42.29	43.83	46.66	36.42	33.26	27.96	26.36	25.61	23.63	24.17	25.67
	1A5. Other	0.15	0.12	0.11	0.12	0.11	0.11	0.11	0.10	0.09	0.09	0.08	0.08	0.09	0.08	0.08	0.08	0.08	0.10
	1B1. Solid Fuels	870.94	895.22	887.17	825.64	547.72	599.65	556.22	532.68	454.48	380.84	333.43	301.86	301.96	259.87	234.90	194.71	180.42	126.20
	1B2. Oil and Natural Gas	490.67	480.59	476.14	462.19	458.16	462.19	449.05	423.96	414.65	395.65	378.53	380.93	369.55	274.70	286.06	274.35	258.45	259.27
1. Energy Total		**1,493.49**	**1,510.14**	**1,489.58**	**1,411.79**	**1,116.03**	**1,157.34**	**1,103.70**	**1,050.00**	**962.80**	**870.50**	**792.39**	**757.77**	**738.68**	**598.81**	**583.35**	**527.63**	**495.60**	**442.96**
2. Industrial Processes	2A. Mineral Products	1.12	0.91	0.82	0.69	0.77	0.77	0.72	0.71	0.71	0.59	0.59	0.58	0.59	0.62	0.61	0.51	0.83	0.88
	2B. Chemical Industry	8.07	8.03	8.64	7.59	8.95	6.84	8.00	6.62	4.80	4.03	3.78	3.46	3.47	4.35	4.09	3.52	3.21	3.63
	2C. Metal Production	0.78	0.53	0.46	0.44	0.56	0.70	0.79	0.69	0.63	0.73	0.68	0.42	0.29	0.59	0.66	0.84	0.66	0.87
2. Industrial Processes Total		**9.97**	**9.48**	**9.92**	**8.71**	**10.28**	**8.31**	**9.51**	**8.02**	**6.14**	**5.35**	**5.04**	**4.46**	**4.35**	**5.56**	**5.36**	**4.88**	**4.70**	**5.38**
4. Agriculture	4A. Enteric Fermentation	875.66	862.45	868.64	867.46	872.00	862.48	869.88	858.35	856.18	855.73	827.67	777.13	769.75	773.19	775.07	757.17	755.15	740.99
	4B. Manure Management	170.89	169.66	169.68	170.94	172.09	168.25	168.91	170.52	170.89	165.51	157.22	149.60	147.36	144.52	144.45	139.45	140.41	136.78
	4F. Field Burning of Agricultural Residues	12.67	10.85	7.87	0.17	–	–	–	–	–	–	–	–	–	–	–	–	–	–
4. Agriculture Total		**1,059.22**	**1,042.96**	**1,046.19**	**1,038.56**	**1,044.10**	**1,030.73**	**1,038.79**	**1,028.87**	**1,027.07**	**1,021.24**	**984.89**	**926.73**	**917.11**	**917.71**	**919.52**	**896.62**	**895.56**	**877.77**
5. Land Use, Land-Use Change and Forestry	5A. Forest Land	0.20	0.35	0.09	0.15	0.12	0.96	0.50	0.65	0.36	0.06	0.20	0.28	0.23	0.20	0.26	0.06	0.64	0.73
	5C. Grassland	0.15	0.16	0.17	0.13	0.14	0.16	0.18	0.15	0.16	0.39	0.59	0.77	0.67	0.63	0.57	0.57	0.51	0.43
	5E. Settlements	0.45	0.40	0.36	0.34	0.35	0.29	0.34	0.39	0.39	0.38	0.40	0.42	0.36	0.38	0.36	0.34	0.29	0.31
5. Land Use, Land-Use Change and Forestry Total		0.80	0.90	0.62	0.63	0.61	1.41	1.02	1.20	0.91	0.83	1.19	1.47	1.27	1.21	1.18	0.96	1.44	1.47
6. Waste	6A. Solid Waste Disposal on Land	2,372.22	2,337.78	2,279.20	2,220.43	2,176.26	2,104.71	2,033.22	1,872.15	1,753.66	1,604.45	1,504.43	1,312.08	1,197.85	1,050.74	978.14	966.75	967.10	965.30
	6B. Waste-water Handling	33.79	31.67	35.17	34.87	36.38	34.75	35.69	36.63	37.58	36.44	37.31	37.56	37.78	38.01	38.23	38.46	38.59	38.73
	6C. Waste Incineration	6.40	6.35	6.09	5.41	3.98	3.81	4.15	0.33	0.37	0.38	0.39	0.33	0.33	0.33	0.32	0.31	0.31	0.31
6. Waste Total		**2,412.41**	**2,375.80**	**2,320.47**	**2,260.70**	**2,216.62**	**2,143.27**	**2,073.06**	**1,909.11**	**1,791.60**	**1,641.28**	**1,542.14**	**1,349.97**	**1,235.96**	**1,089.07**	**1,016.69**	**1,005.52**	**1,006.00**	**1,004.33**

Emission Trends – Nitrous Oxide **kt N2O**

Greenhouse Gases Sources and Sinks		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
		Gg																	
Total National Emissions and Removals		**208.43**	**208.28**	**187.29**	**172.65**	**177.01**	**173.38**	**171.22**	**174.72**	**172.84**	**138.46**	**135.29**	**127.53**	**121.81**	**119.89**	**121.56**	**117.63**	**112.84**	**110.62**
1. Energy	1A1. Energy Industries	6.54	6.55	6.27	5.52	5.48	5.37	5.18	4.71	4.96	4.49	4.95	5.21	5.25	5.30	5.12	5.25	5.45	5.02
	1A2. Manufacturing Industries and Construction	5.24	5.11	5.14	4.93	4.96	4.82	4.70	4.57	4.45	4.44	4.35	4.39	4.28	4.26	4.30	4.28	4.33	4.30
	1A3. Transport	4.70	4.71	4.86	5.55	6.79	8.48	6.30	6.39	6.50	6.51	6.46	6.21	6.03	5.84	5.71	5.53	5.44	5.27
	1A4. Other Sectors	3.08	3.17	3.04	3.10	2.94	2.72	2.79	2.74	2.64	2.61	2.46	2.42	2.31	2.25	2.19	2.08	2.00	1.94
	1A5. Other	0.16	0.13	0.12	0.12	0.12	0.12	0.11	0.11	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.11
	1B1. Solid Fuels	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
	1B2. Oil and Natural Gas	0.14	0.14	0.15	0.16	0.16	0.20	0.20	0.18	0.18	0.17	0.15	0.15	0.14	0.12	0.13	0.15	0.12	0.13
1. Energy Total		**19.86**	**19.81**	**19.58**	**19.38**	**20.45**	**21.71**	**19.28**	**18.70**	**18.83**	**18.32**	**18.44**	**18.48**	**18.10**	**17.86**	**17.53**	**17.38**	**17.42**	**16.76**
2. Industrial Processes	2B. Chemical Industry	79.49	79.99	65.04	52.42	53.02	47.95	47.65	48.26	49.16	17.28	17.87	15.52	8.60	9.08	11.51	9.02	7.62	8.88
	2C. Metal Production	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.03	0.02	0.03
2. Industrial Processes Total		**79.52**	**80.02**	**65.07**	**52.44**	**53.05**	**47.99**	**47.69**	**48.29**	**49.19**	**17.31**	**17.90**	**15.54**	**8.61**	**9.10**	**11.53**	**9.05**	**7.65**	**8.91**
4. Agriculture	4B. Manure Management	7.16	7.16	6.67	6.73	6.84	6.70	6.68	6.75	6.93	7.16	6.60	6.45	6.21	6.07	5.95	5.79	5.76	5.63
	4D. Agricultural Soils	98.11	97.60	92.30	90.61	92.93	93.47	93.94	97.02	93.89	91.80	88.36	82.95	84.81	82.77	82.45	81.32	77.81	75.10
	4F. Field Burning of Agricultural Residues	0.25	0.21	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Agriculture Total		**105.53**	**104.97**	**99.13**	**97.34**	**99.77**	**100.17**	**100.62**	**103.76**	**100.82**	**98.97**	**94.96**	**89.40**	**91.02**	**88.84**	**88.40**	**87.11**	**83.57**	**80.73**
5. Land Use, Land-Use Change and Forestry	5A. Forest Land	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	5B. Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5C. Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	5E. Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Land Use, Land-Use Change and Forestry Total		**0.03**	**0.03**	**0.03**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.01**	**0.02**	**0.02**	**0.02**	**0.02**	**0.01**	**0.01**	**0.01**	**0.01**
6. Waste	6B. Waste-water Handling	3.33	3.30	3.34	3.32	3.60	3.37	3.48	3.87	3.82	3.70	3.81	3.93	3.90	3.92	3.92	3.92	4.02	4.05
	6C. Waste Incineration	0.15	0.15	0.15	0.15	0.12	0.12	0.13	0.07	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
6. Waste Total		**3.49**	**3.45**	**3.48**	**3.46**	**3.72**	**3.49**	**3.61**	**3.94**	**3.98**	**3.85**	**3.97**	**4.08**	**4.06**	**4.08**	**4.08**	**4.08**	**4.18**	**4.21**

Emission Trends – HFCs **in 4NC, all F-gas emission trends were presented as Gg CO2 equivalents**

Greenhouse Gases Sources and Sinks		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
		Gg CO_2 equivalent																	
Total National Emissions and Removals		**11386**	**11854**	**12323**	**13013**	**14057**	**15588**	**16957**	**19561**	**17604**	**11086**	**9988**	**10726**	**11054**	**11397**	**9989**	**10176**	**9980**	**9611**
2. Industrial Processes	2C. Metal Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	2
	2E. Production of Halocarbons and SF6	11374	11842	12310	12780	13265	13981	14321	15622	12117	4882	2620	2387	2034	1981	445	442	387	176
	2F. Consumption of Halocarbons and SF6	12	12	13	233	792	1607	2636	3939	5487	6205	7368	8338	9019	9415	9544	9731	9591	9433
2. Industrial Processes Total		**11386**	**11854**	**12323**	**13013**	**14057**	**15588**	**16957**	**19561**	**17604**	**11086**	**9988**	**10726**	**11054**	**11397**	**9989**	**10176**	**9980**	**9611**

Emission Trends – PFCs **in 4NC, all F-gas emission trends were presented as Gg CO2 equivalents**

Greenhouse Gases Sources and Sinks		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
		Gg CO_2 equivalent																	
Total National Emissions and Removals		**1402**	**1171**	**574**	**491**	**491**	**471**	**493**	**417**	**412**	**396**	**498**	**420**	**315**	**271**	**337**	**256**	**301**	**216**
2. Industrial Processes	2C. Metal Production	1333	1096	490	381	345	286	282	220	208	188	257	218	150	111	153	60	128	82
	2E. Production of Halocarbons and SF6	11	11	11	27	49	71	77	38	42	19	23	54	57	56	90	110	90	55
	2F. Consumption of Halocarbons and SF6	58	64	72	82	97	114	134	158	161	189	218	148	107	105	94	86	83	79
2. Industrial Processes Total		**1402**	**1171**	**574**	**491**	**491**	**471**	**493**	**417**	**412**	**396**	**498**	**420**	**315**	**271**	**337**	**256**	**301**	**216**

Emission Trends – SF6 **in 4NC, all F-gas emission trends were presented as Gg CO2 equivalents**

Greenhouse Gases Sources and Sinks		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
		Gg CO_2 equivalent																	
Total National Emissions and Removals		**1030**	**1078**	**1124**	**1167**	**1183**	**1239**	**1267**	**1226**	**1263**	**1426**	**1798**	**1425**	**1509**	**1324**	**1129**	**1110**	**875**	**794**
2. Industrial Processes	2C. Metal Production	426	426	426	426	426	426	426	428	471	687	1093	756	847	672	388	254	180	148
	2F. Consumption of Halocarbons and SF6	604	652	698	741	757	813	841	797	791	739	705	669	662	652	740	856	695	645
2. Industrial Processes Total		**1030**	**1078**	**1124**	**1167**	**1183**	**1239**	**1267**	**1226**	**1263**	**1426**	**1798**	**1425**	**1509**	**1324**	**1129**	**1110**	**875**	**794**

Summary by Gas

Mt CO2 equivalent

Greenhouse Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	Mt CO2 eq																	
Carbon	594.19	601.51	584.33	569.40	563.36	554.59	576.80	553.12	555.24	544.64	552.77	564.27	546.69	558.04	557.83	555.08	553.06	544.61
CH4	104.49	103.72	102.20	99.13	92.14	91.16	88.75	83.94	79.56	74.32	69.84	63.85	60.84	54.86	53.05	51.15	50.47	48.97
N2O	64.61	64.57	58.06	53.52	54.87	53.75	53.08	54.16	53.58	42.92	41.94	39.53	37.76	37.17	37.68	36.46	34.98	34.29
HFC	11.39	11.85	12.32	13.01	14.06	15.59	16.96	19.56	17.60	11.09	9.99	10.73	11.05	11.40	9.99	10.18	9.98	9.61
PFC	1.40	1.17	0.57	0.49	0.49	0.47	0.49	0.42	0.41	0.40	0.50	0.42	0.31	0.27	0.34	0.26	0.30	0.22
SF6	1.03	1.08	1.12	1.17	1.18	1.24	1.27	1.23	1.26	1.43	1.80	1.43	1.51	1.32	1.13	1.11	0.87	0.79
Total National Emissions and Removals	**777.12**	**783.90**	**758.61**	**736.72**	**726.10**	**716.80**	**737.35**	**712.43**	**707.65**	**674.79**	**676.83**	**680.23**	**658.17**	**663.05**	**660.01**	**654.23**	**649.66**	**638.49**

Summary by Source

Mt CO2 equivalent

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	Mt CO2 eq																	
1. Energy	612.24	622.08	605.76	590.40	577.55	569.32	589.29	564.87	565.82	553.65	560.74	572.86	555.87	563.46	563.14	559.14	556.86	546.00
2. Industrial Processes	53.99	52.32	46.85	43.55	46.12	46.51	48.44	51.21	49.50	33.03	32.16	30.48	28.03	29.12	28.77	28.24	26.94	27.89
3. Solvent and Other Product Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Agriculture	54.96	54.44	52.70	51.99	52.86	52.70	53.01	53.77	52.82	52.13	50.12	47.18	47.48	46.81	46.71	45.83	44.71	43.46
5. Land Use, Land-Use Change and Forestry	2.98	2.89	2.33	1.17	0.96	1.30	1.05	0.75	0.13	-0.16	-0.29	-0.41	-0.93	-0.95	-1.72	-1.85	-1.72	-1.72
6. Waste	52.95	52.16	50.97	49.62	48.62	46.98	45.56	41.83	39.38	36.14	34.10	30.12	27.72	24.62	23.10	22.87	22.87	22.86
Total National Emissions and Removals	**777.12**	**783.90**	**758.61**	**736.72**	**726.10**	**716.80**	**737.35**	**712.43**	**707.65**	**674.79**	**676.83**	**680.23**	**658.17**	**663.05**	**660.01**	**654.23**	**649.66**	**638.49**

Summary Report for CO_2 equivalent – 1990

Greenhouse Gas Source and Sink Categories		CO_2	CH4	N2O	HFCs	PFCs	SF6	Total
		Mt CO_2 equivalent						
Total National Emissions and Removals		**594.19**	**104.49**	**64.61**	**11.39**	**1.40**	**1.03**	**777.12**
1. Energy	1A1. Energy Industries	237.17	0.20	2.03				239.40
	1A2. Manufacturing Industries and Construction	99.05	0.32	1.62				100.99
	1A3. Transport	117.19	0.70	1.46				119.34
	1A4. Other Sectors	109.42	1.54	0.96				111.91
	1A5. Other	5.28	0.00	0.05				5.34
	1B1. Solid Fuels	0.86	18.29	0.00				19.15
	1B2. Oil and Natural Gas	5.76	10.30	0.04				16.11
1. Energy Total		**574.72**	**31.36**	**6.16**				**612.24**
2. Industrial Processes	2A. Mineral Products	10.12	0.02					10.14
	2B. Chemical Industry	2.88	0.17	24.64				27.70
	2C. Metal Production	2.31	0.02	0.01	0.00	1.33	0.43	4.10
	2E. Production of Halocarbons and SF6				11.37	0.01		11.38
	2F. Consumption of Halocarbons and SF6				0.01	0.06	0.60	0.67
2. Industrial Processes Total		**15.31**	**0.21**	**24.65**	**11.39**	**1.40**	**1.03**	**53.99**
3. Solvent and Other Product Use	3. Solvent and other Product Use	0.00						0.00
3. Solvent and Other Product Use Total		**0.00**						**0.00**
4. Agriculture	4A. Enteric Fermentation		18.39					18.39
	4B. Manure Management		3.59	2.22				5.81
	4D. Agricultural Soils			30.41				30.41
	4F. Field Burning of Agricultural Residues		0.27	0.08				0.34
4. Agriculture Total			**22.24**	**32.71**				**54.96**
5. Land Use, Land-Use Change and Forestry	5A. Forest Land	-12.16	0.00	0.01				-12.14
	5B. Cropland	15.82		0.00				15.82
	5C. Grassland	-6.13	0.00	0.00				-6.13
	5D. Wetlands	0.00						0.00
	5E. Settlements	7.07	0.01	0.00				7.08
	5F. Other Land	0.00						0.00
	5G. Other	-1.66						-1.66
5. Land Use, Land-Use Change and Forestry Total		**2.95**	**0.02**	**0.01**				**2.98**
6. Waste	6A. Solid Waste Disposal on Land		49.82					49.82
	6B. Waste-water Handling		0.71	1.03				1.74
	6C. Waste Incineration	1.21	0.13	0.05				1.39
6. Waste Total		**1.21**	**50.66**	**1.08**				**52.95**
Aviation_Bunkers		15.71	0.01	0.15				15.87
Marine_Bunkers		6.76	0.00	0.05				6.82
International Bunkers Total		**22.47**	**0.01**	**0.21**				**22.69**

Summary Report for CO_2 equivalent – 2007

Greenhouse Gas Source and Sink Categories		CO_2	CH4	N2O	HFCs	PFCs	SF6	Total
		Mt CO_2 equivalent						
Total National Emissions and Removals		**544.61**	**48.97**	**34.29**	**9.61**	**0.22**	**0.79**	**638.49**
1. Energy	1A1. Energy Industries	210.59	0.24	1.56				212.38
	1A2. Manufacturing Industries and Construction	79.33	0.27	1.33				80.94
	1A3. Transport	131.76	0.15	1.63				133.55
	1A4. Other Sectors	101.10	0.54	0.60				102.25
	1A5. Other	3.49	0.00	0.03				3.52
	1B1. Solid Fuels	0.14	2.65	0.00				2.79
	1B2. Oil and Natural Gas	5.09	5.44	0.04				10.58
1. Energy Total		**531.51**	**9.30**	**5.20**				**546.00**
2. Industrial Processes	2A. Mineral Products	8.67	0.02					8.69
	2B. Chemical Industry	3.07	0.08	2.75				5.90
	2C. Metal Production	2.66	0.02	0.01	0.00	0.08	0.15	2.92
	2E. Production of Halocarbons and SF6				0.18	0.05		0.23
	2F. Consumption of Halocarbons and SF6				9.43	0.08	0.65	10.16
2. Industrial Processes Total		**14.40**	**0.11**	**2.76**	**9.61**	**0.22**	**0.79**	**27.89**
3. Solvent and Other Product Use	3. Solvent and other Product Use	0.00						0.00
3. Solvent and Other Product Use Total		**0.00**						**0.00**
4. Agriculture	4A. Enteric Fermentation		15.56					15.56
	4B. Manure Management		2.87	1.75				4.62
	4D. Agricultural Soils			23.28				23.28
	4F. Field Burning of Agricultural Residues		0.00	0.00				0.00
4. Agriculture Total			**18.43**	**25.03**				**43.46**
5. Land Use, Land-Use Change and Forestry	5A. Forest Land	-14.17	0.02	0.00				-14.16
	5B. Cropland	15.29		0.00				15.29
	5C. Grassland	-7.97	0.01	0.00				-7.96
	5D. Wetlands	0.00						0.00
	5E. Settlements	6.33	0.01	0.00				6.34
	5F. Other Land	0.00						0.00
	5G. Other	-1.23						-1.23
5. Land Use, Land-Use Change and Forestry Total		**-1.76**	**0.03**	**0.00**				**-1.72**
6. Waste	6A. Solid Waste Disposal on Land		20.27					20.27
	6B. Waste-water Handling		0.81	1.26				2.07
	6C. Waste Incineration	0.46	0.01	0.05				0.52
6. Waste Total		**0.46**	**21.09**	**1.30**				**22.86**
Aviation_Bunkers		34.97	0.00	0.34				35.32
Marine_Bunkers		7.15	0.00	0.06				7.21
International Bunkers Total		**42.12**	**0.00**	**0.40**				**42.52**

Summary of Policies and Measures

Name of policy or measure	Objective and/or activity affected	GHG	Type of Instrument	Status	Implementing entity or entities	Carbon savings (GgCO2eq) 2010	2015	2020
With existing measures and with addition measures								
Energy Supply								
Renewable Obligation	Electricity generation and supply	CO_2	Regulatory	Implemented	Department of Energy and Climate Change (DECC)	9000	13000	13300
Subsidy for biomass heat	Heat production	CO_2	Fiscal	Implemented	Department of Energy and Climate Change (DECC)	264	264	264
Business								
UK emissions trading scheme	The UK emissions trading scheme was a voluntary scheme that began in 2002 and closed to direct participants in 2006. It covered indirect and some direct emissions of the basket of six greenhouse gases.	CO_2, CH_4, N_2O, HFC, PFC, SF_6	Economic, Voluntary/ negotiated agreement,	Expired	Department of Energy and Climate Change (DECC)	600	300	0
Climate change agreements	Energy use by energy intensive sectors and those regulated by IPPC	CO_2	Voluntary/ negotiated agreement	Implemented	Department of Energy and Climate Change (DECC)	10600	10600	10600
EU Emissions Trading System 2008-2012	Industrial energy use	CO_2	Economic	Implemented	Department of Energy and Climate Change (DECC)	Emissions from installations covered by the EU ETS are now projected to be significantly lower over the five years of the second phase than at the time the NAP was submitted to the European Commission for approval in 2006. They still show the UK as a net purchaser of allowances overall.	0	0
EU Emissions Trading System 2013-2020	Industrial energy use	CO_2	Economic	Adopted	Department of Energy and Climate Change (DECC)	0	61500 (61.5Mt) (Not all additional - Total change in UK emissions in the traded sectors - above figures include individual policy	82500 (82.5Mt) (Not all additional - Total change in UK emissions in the traded sectors - above figures include individual policy
Carbon Trust	Delivery of carbon reductions in business and public sector organisations, now and in the future.	CO_2, CH_4, N_2O, HFC, PFC, SF_6	Fiscal, Information and Research, Planning	Implemented	Department of Energy and Climate Change (DECC), Independent company funded by government	700 (CT savings support CRC and CCAs in many cases, only additional to figures above included here)	700 (CT savings support CRC and CCAs in many cases, only additional to figures above included here)	700 (CT savings support CRC and CCAs in many cases, only additional to figures above included here)
Building Regulations 2002 in the business sector	Improve energy efficiency of buildings	CO_2	Voluntary/ negotiated agreement	Implemented	Department of Communities and Local Government	1700	1600	1300
F-gas regulations	To implement controls of F-gas emissions	HFCs, PFCs, SF_6	Regulatory	Implemented	Defra	2200	2200	2200
Energy Performance Certificates for Business outside of CRC and CCAs	Encourage uptake of energy efficiency measures							

Summary of Policies and Measures continued

Name of policy or measure	Objective and/or activity affected	GHG	Type of Instrument	Status	Implementing entity or entities	Carbon savings (GgCO2eq) 2010	2015	2020
Transport								
Renewable transport fuel obligation (RTFO)	Reducing carbon content of transport fuels	CO_2	Regulatory	Adopted	Department for Transport	4400	5500	5900
EU level voluntary agreements on CO_2 from cars, backed up by changes to company cars taxation and vehicle excise duty	Improve Vehicle fuel efficiency	CO_2	Fiscal, voluntary/ negotiated agreement	Implemented	Fuel duty and taxation issues regulated by Her Majesty's Treasury	8400	11400	13200
EU level regulation on CO_2 from cars, supported by fiscal measures and information provision in the UK	Improve Vehicle fuel efficiency	CO_2	Fiscal, Regulatory, Information	Adopted	DfT as probable Competent Authority and continued policy lead	100	1100	7600
Air Passenger Duty	Reducing aviation emissions through sending a stronger environmental signal to passengers and industry	CO_2	Fiscal	To be implemented	Fuel duty and taxation issues regulated by Her Majesty's Treasury	400		
UK 2050 aviation emissions target	Limiting of long term aviation emissions through encouragement of efficiency measures and changes to operating practices	CO_2	Information	Adopted	Department for Transport (DfT), Devolved Administrations			
Sustainable distribution in Scotland and Wales	Reduce transport emissions	CO_2	Regulatory	Implemented	Devolved Administrations	400	400	400
Fuel Duty	Transport demand and fuel efficiency	CO_2	Fiscal	Adopted	Her Majesty's Treasury	500		
Fuel Duty Escalator	Transport demand and fuel efficiency	CO_2	Fiscal	Expired	Her Majesty's Treasury	6966.67	6966.67	6966.67
Domestic								
Supplier Obligation	Energy use in homes	CO_2	Regulatory	Planned	Department of Energy and Climate Change	0	5,600.00	12600.00
Energy Efficiency Commitment (EEC) (2002-2005)	Energy use in homes	CO_2	Regulatory	Implemented	Social housing providers, energy supply companies, Department of Energy and Climate Change	1000	700	400
Energy Efficiency Commitment (EEC) (2005-2008)	Energy use in homes	CO_2	Regulatory	Implemented	Department of Energy and Climate Change (DECC), energy supply companies, social housing providers	2000	1700	1400
Carbon Emissions Reduction Target (CERT) (2008-2011)	Energy use in homes	CO_2	Regulatory	Implemented	Department of Energy and Climate Change, energy supply companies	5400	5400	5400
Buildings regulations 2010, 2013	Energy use in domestic buildings	CO_2	Regulatory	Adopted	Department for Communities and Local Government	0	500	1300
Building Regulations 2002 and 2006 in the domestic sector	Improve energy efficiency of buildings	CO_2	Regulatory	Implemented	Department for Communities and Local Government	3900	3600	3000
Warm Front and fuel poverty programs	Tackling fuel poverty	CO_2	Economic	Implemented	Department of Energy and Climate Change	2400	2600	2600

Summary of Policies and Measures continued

Name of policy or measure	Objective and/or activity affected	GHG	Type of Instrument	Status	Implementing entity or entities	Carbon savings (GgCO2eq) 2010	2015	2020
Energy using Products	Energy use in homes, and businesses including public sector	CO_2	Voluntary/ negotiated agreement, Regulatory, Information	Implemented		500	1400	2500
Building regulations 2006 including 2005 condensing boiler update	Energy use in domestic buildings	CO_2	Regulatory	Implemented	Department for Environment, Food and Rural Affairs	0.51 MtC pa in 2010 (of which 0.41MtC pa in 2010 is from 2005 condensing boiler amendment)	2933.33	2933.33
Community Energy Saving Programme (CESP) 2008-2012	Energy use in homes	CO_2	Regulatory	Planned	Department of Energy and Climate Change	75	121	121
Better Billing	Energy use in homes		Information	Implemented	Department of Energy and Climate Change,electricity and gas regulator	0	0	0
Smart Metering	Energy use in homes		Information	Planned	Department of Energy and Climate Change, electricity and gas regulator	0	1700	1500
Agriculture and Forestry								
Woodland Grant Scheme (England)	Aforestation			Implemented		700	700	700
Woodlands Planting (Scotland)	Aforestation			Implemented		1800	1800	1800
Non Food Crops	Energy crops and renewable raw material	CO_2, CH_4	Economic, Fiscal, Regulatory, Information, Education, Research	Adopted	Defra, DTI, DfT and HMT, Regional development agencies, National Non-Food Crops Centre, various research institutes, UK Forestry Commission	400	400	400
Cross cutting								
Integrated pollution prevention and control (IPPC)	High level of protection (from industrial emissions) for the environment taken as whole		Regulatory	Implemented	Department of Environment, Food and Rural Affairs			
Waste								
landfill tax escaltor	Reduce waste to landfill emissions	CO_2	Fiscal	Implemented	Her Majesty's Treasury	290	250	
With additional measures								
CCS Demo Project	Demonstration of use of CCS technology in post combustion coal fired power stations at commercial scale.	CO_2	Information, Research	Planned	Department of Energy and Climate Change	0	0	1800
Renewable Heat Incentive	Financial incentive mechanisms for the generation of renewable heat in all sectors from large industrial sites down to the household	CO_2	Economic	Planned		0	0	0

Summary of Policies and Measures continued

Name of policy or measure	Objective and/or activity affected	GHG	Type of Instrument	Status	Implementing entity or entities	Carbon savings (GgCO2eq) 2010	2015	2020
Carbon Reduction Commitment	UK's new mandatory emissions trading scheme targeting emissions from large public and private sector organisations. The CRC will start in April 2010, and deliver emissions savings of at least 4.4 million tonnes of CO2 per year by 2020.	CO_2	Economic, Regulatory	Planned	Department of Energy and Climate Change (DECC), Devolved Administrations	0	1900	3600
To be implemented								
Vehicle Excise Duty	Reduce transport emissions	CO_2	Fiscal	To be implemented	Her Majesty's Treasury	Supports CO_2 standards	Supports CO_2 standards	Supports CO_2 standards
Other								
Public Sector								
Additional effort by local authorities: indicator NI 185	To reduce carbon dioxide emissions from the local authority estate.	CO_2, CH_4, N_2O	Fiscal	In process of being implemented	DECC has responsibility for NI 185 but Communities and Local Government have responsibility for the overall local government performance framework. The (regional) Government Office Network has responsibility for negotiating performance targets against NI 185. All local authorities must report performance against this indicator. 35 (out of a total of 150) Local Area Agreeements have committed themselves to targets against the indicator.			
Additional effort by local authorities: indicator NI 186	To reduce carbon dioxide emissions from the local authority estate.	CO_2, CH_4, N_2O	Fiscal, Economic, Research	In process of being implemented	DECC has responsibility for NI 186 but CLG have responsibility for the overall local government performance framework. Other Government departments are expected to help support local government in performing effectively against NI 186.The (regional) Government Office Network has responsibility for negotiating performance targets against NI 186. All local authorities must report performance against this indicator. 100 (out of a total of 150) Local Area Agreeements have committed themselves to targets against the indicator.	0.00		

Reconciliation of UNFCCC and KP Reporting bases

	Fixed Base Year***	Base Year****	1990	1995	2000	2005	2006	2010	2015	2020
A: UNFCCC reporting basis (Total GHG sources minus total sinks)	782.5	778.3	774.9	711.6	673.4	656.7	653.8	601.1	597.8	572.0
B: Total LULUCF sources and sinks	2.9	2.9	2.9	1.2	-0.4	-2.0	-2.0	-1.4	0.9	2.8
C: Total without any LULUCF (A minus B)	779.5	775.4	772.0	710.4	673.8	658.7	655.8	602.5	597.0	569.3
D: Article 3.3 LULUCF (all three gases)*			0.2	-0.1	-1.0	-1.9	-2.1	-2.7	-2.9	-3.5
E: Article 3.4 Forest Management*			-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-0.7
F: Article 3.7 Deforestation estimate in 1990**	0.4	0.3								
Kyoto Protocol reporting basis (Total of C:F above)	779.9	775.7	770.8	709.0	671.4	655.5	652.3	598.5	592.7	565.1

Notes

*Articles 3.3 and 3.4 LULUCF not added to the base year.

**Article 3.7 'D' estimate only added to base year.

***Fixed Base Year is the Base Year calculated from the 2004 inventory, from which the UK's Assigned Amount is calculated.

****Base Year calculated from the 2008 inventory.

The Geographical Coverage of this table includes the UK and all Crown Dependencies and Overseas Territories that have signed up to the UK's instruments of ratification to the UNFCCC and the Kyoto Protocol.

Emission units are $MtCO_2e$.

Estimates may not sum due to rounding.

Bilateral and regional financial contributions related to the implementation of the convention (£ million)

Recipient Country/Region	Research and Knowledge Dissemination	Mitigation	Adaptation			Organisation through which project funded	Year of financing	Comments
		Energy	Capacity-building	Coastal zone management	Other vulnerability assessment			
India/ Bangladesh/ Africa	Allocated- 100, 08/09 Spend - 1.3					DFID	2008-2013	Research into climate change through DFID country offices and divisions.
Global	7.2					FCO	2006-2009	Development of UK attaches network for climate change and energy and appointed a UK security Envy for vulnerable countries.
Global (China, India, Brazil)	0.36					Centre for Clean Air policy (CCAP)	2007-2009	Funding research into low carbon growth policy frameworks in developing countries.
South America	0.7					Regional Economics of Climate change Studies (RECCS)	01/11/2008 – 01-03-2010	Alternative mitigation scenarios for key countries and developing regions.
Central America	0.45					Regional Economics of Climate change Studies (RECCS)	01/11/2008 – 01/03/2010	Alternative mitigation scenarios for key countries and developing regions.
Africa	3.8					Climate for Development (ClimDev)	2009	To improve information on the impacts of climate change across Africa.
Asia					0.5 Start up. 2.6 Project.	South Asia Water Initiative (SAWI)	Start up 2007-2009 Project 2009-2012	Brings together seven countries that share rivers that drain from the Himalayas.
Global						Consultative Group on International Agricultural research (CGIAR)		This will Support a range of programmes addressing adaptation to climate change.
China		3.5						For UK-China NZEC initiative.

Bilateral and regional financial contributions related to the implementation of the convention (£ million) continued

Recipient Country/Region	Research and Knowledge Dissemination	Mitigation Energy	Adaptation Capacity-building	Coastal zone management	Other vulnerability assessment	Organisation through which project funded	Year of financing	Comments
Africa	24					Climate Change Adaptation in Africa (CCAA)	2006-2011	Five year research and capacity development programme in Africa to help African researchers and policy makers to identify practical ways that rural and urban people adapt to climate change.
Global	50					DFID- Centre for Climate and Development	2009-	Working to design a centre which will deliver a suite of service (knowledge management, research and tailored advice) to support developing country policy making.
Global (Bangladesh, Vietnam, Ethiopia, Mozambique, Ghana and Bolivia.					1.5	World Bank	2008/9 - 2010	Economics of Adaptation Work with Netherlands Switzerland and bank. To help inform UNFCCC negotiations.
Global	0.55					DFID	2006 - 2009	Giving a voice to developing country negotiators.
Global	0.38					UNFCCC and IPCCC Trust Funds	annual	Annual contribution enabling developing country participants to attend meetings.
Africa					5.0	DFID	2005-2010	Support to the integration of climate risk information in decision making processes and increase availability of climate observations.
Asia/Africa					0.99	DFID	2004-2006	Linking local adaptation needs to policy and institutional structures.

Bilateral and regional financial contributions related to the implementation of the convention (£ million) continued

Recipient Country/Region	Research and Knowledge Dissemination	Mitigation	Adaptation			Organisation through which project funded	Year of financing	Comments
		Energy	Capacity-building	Coastal zone management	Other vulnerability assessment			
Bangladesh					6.0	DFID	2005-2010	Comprehensive disaster management programme
Angola			0.05				2006-2008	FCO SPF fund
Bolivia			0.04				2008-2009	FCO SPF fund
Brazil			1.28				2007-2009	FCO SPF fund
China			2.63				2006-2009	FCO SPF fund
Colombia			0.02				2008-2009	FCO SPF fund
Global			0.49				2006-2009	FCO SPF fund
India			1.20				2006-2009	FCO SPF fund
Indonesia			0.36				2008-2009	FCO SPF fund
Kazakhstan			0.32				2007-2009	FCO SPF fund
Mexico			0.89				2006-2009	FCO SPF fund
Nigeria			0.30				2006-2009	FCO SPF fund
Philippines			0.05				2008-2009	FCO SPF fund
Regional			0.32				2007-2009	FCO SPF fund
Saudi Arabia			0.59				2006-2009	FCO SPF fund
South Africa			0.88				2006-2009	FCO SPF fund
Venezuela			0.01				2008-2009	FCO SPF fund

Financial contribution to the Global Environment Facility and other multilateral institutions and programmes

Institution or programme	Contribution (£ millions)			
	2005-2006	2006-2007	2007-2008	2008-2009
Global Environment Facility	10.4	10.4	11.66	11.66
UNFCCC funds such as SCCF, LDCF and other voluntary funds	3.33	3.33	10.84	4.5
Climate Investment Funds	n/a	n/a	n/a	100
REEEP		2.5	2.5	2.5
International climate change subscriptions (inc. UNFCCC)* *per calendar year	1.4	1.7	2	1.6
IBRD	–	–	–	–
International Finance Corporation (PEP MENA)	1	1	2	–
African Development Bank	0.85	0.84	4.15	–
Asian Development Bank	–	–	–	0.76
EBRD	6.58	–	–	–
Inter-American Development Programme	–	2	2	3.4
UNDP	52.27	50.67	65.72	–
International Development Association (IDA)	364.8	493.33	493.33	–
Clean Energy Investment Frameworks (World Bank)	–	–	1.2	0.73
Adaptation Fund	–	–	–	0.5
UNCCD	–	–	0.37	0.45
UNEP	–	–	1	1

Annex E

Reporting of information under Article 7 Paragraph 2

National systems (i.e. emissions inventories) under article 5 para 1	Reported
• Contact details of organisation with responsibility for inventory	National Inventory Report (NIR) 2009[143]
• Roles/responsibilities of those involved with development of inventory as well as associated institutional/legal/procedural arrangements	NIR
• Methodology of inventory – e.g. collection of activity data, choice of emission factors, development of estimates.	NIR
• Process/results of key source identification	NIR
• Process to reassess previously submitted data	NIR
• Description of QA/QC plans, internal/external review procedures etc	NIR
• Description of procedures for approval of inventory	NIR
• An explanation if above incomplete/partially completed	NIR

Mechanisms - related to Articles 6, 12 & 17 (JI, CDM & Emission Trading respectively)	
• Provide details of how the use of such mechanisms is supplemental to 'domestic' action	5th NC Chapter 3

P&Ms – related to article 2	
• Reporting of all P&Ms linked to emissions reduction including co-operation with other parties	5th NC Chapter 4 & 6
• Steps taken to implement decisions by ICAO and IMO to reduce GHG emissions from aviation/marine bunker fuels not controlled by the Montreal Protocol.	5th NC Chapter 3
• Provide information (not reported elsewhere) on how party aims to implement P&Ms whilst minimising adverse affect on international trade and social/econ/env impacts on other parties – in particular developing countries.	5th NC Chapter 3

[143] UK Greenhouse Gas Inventory , 1990–2007, Annual report for submission under the Framework Convention on Climate Change, April 2009, will be available from http://www.airquality.co.uk/archive/reports/reports.php?report_id=400

Legislative arrangements and enforcement and admin procedures	Reported
• Description of regional/domestic legislative arrangements and enforcement and administrative procedures the party has - to meet its commitments under the KP. Legal authority for such programmes, procedures for non-compliance etc.	5th NC – Chapter 1 and 3
• Provision to make info on above procedures publicly accessible.	5th NC – Chapter 1/3
• Description of institutional arrangements and decision-making procedures in place to coordinate activities under articles 6,12 & 17.	5th NC – Chapter 3
• Description of legislative/admin procedures for implementation LULUCF activities, and also any elected activities under these that contribute to conservation of biodiversity, sustainable use of natural resources etc.	5th NC – Chapter 3
• Description of QA/QC plans, internal/external review procedures etc	NIR
• Description of procedures for approval of inventory	NIR
• An explanation if above incomplete/partially completed	NIR

Info under article 10	
• Steps taken to promote/facilitate/finance tech transfer to developing countries.	5th NC – Chapter 6

Financial resources	
• Report on any financial contributions made to the 'adaptation fund' (established in accordance with decision 10/CP.7)	5th NC – Chapter 5

Glossary of Terms

ACC	Adapting to Climate Change Programme
AD	Anaerobic Digestion
ACEA	European Automobile Manufacturers Association
AEA	AEA Technology plc
ASC	Adaptation Sub Committee
BADC	British Atmospheric Data Centre
BAS	British Antarctic Survey
BAT	Best available technology
BBSRC	Biotechnology and Biological Sciences Research Council
BERR	Department for Business, Enterprise and Regulatory Reform
BGS	British Geological Survey
CO_2	Carbon Dioxide
CABE	Commission for Architecture and the Built Environment
CAP	Common Agricultural Policy
CAT	Carbon Abatement Technology
CAT	Carbon Account for Transport
CCA	Climate Change Agreements
CCC	Committee on Climate Change
CCL	Climate Change Levy
CCR	Carbon Capture Readiness
CCS	Carbon Capture and Storage
CCRA	Climate Change Risk Assessment
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CEH	Centre for Hydrology
CERT	Carbon Emissions Reduction Target
CET	Central England Temperature
CFC	Chlorofluorocarbon
CHP	Combined Heat and Power
CH_4	Methane
CCL	Climate Change Levy
CLG	Department of Communities and Local Government
CO	Cabinet Office
COGAP	Code of Good Agricultural Practice
COP	Conference of the Parties
CORINAIR	European inventory system for air pollutants
CRC	Carbon Reduction Commitment
CT	Carbon Trust
DCC	Dangerous Climate Change
DCMS	Department for Culture, Media and Sport
DCSF	Department for Children, Schools and Families
Defra	Department for Environment, Food and Rural Affairs
DECC	Department of Energy and Climate Change
DfT	Department for Transport
DFID	Department for International Development
DOE	Department of Environment (Northern Ireland)
DoH	Department of Health
DWP	Department for Work and Pensions
EA	Environment Agency
ECA	Enhanced Capital Allowances
EEC	Energy Efficiency Commitment
EPBD	Energy Performance of Buildings Directive
EPSRC	Engineering and Physical Sciences Research Council
ERFF	Environment Research Funders' Forum
ESA	European Space Agency
ESDGC	Education for Sustainable Development and Global Citizenship
ESRC	Economic and Social Research Council
EST	Energy Savings Trust
ETF	The Environmental Transformation Fund
ETI	The Energies Technologies Institution
ETS	Emissions Trading System
EU	European Union
EUP	Energy Using Products
FCO	Foreign and Commonwealth Office
FPAG	Fuel Poverty Advisory Group
G8	Group of 8
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environment Fund
GECC	Global Environmental Change Committee
GEO	Group on Earth Observations
GMES	Global Monitoring for Environment and Security Initiatives
GPP	Green Public Procurement
GUAN	GCOS Upper Air Network

GVA	Gross Value Added
GWP	Global warming potential
HFCs	Hydrofluorocarbons
HEES	Home Energy Efficiency Scheme
HIE	Highland and Islands Enterprises
HIS	Home Insulation Scheme
HMT	Her Majesty's Treasury
ICAO	International Civil Aviation Organisation
ICP	Integrated Climate Programme
IDA	International Development Association
IPCC	Intergovernmental Panel on Climate Change
IPPC	Industrial Pollution Prevention and Control
JI	Joint Implementation
LDCF	Least Developed Countries Fund
LDEDC	The Local Democracy Economic Development and Construction Bill
LRAP	Local and Regional Adaptation Partnership Board
LULUCF	Land Use and Land Use Change and Forestry
LWEC	Living with Environmental Change
MAA	Multi Area Agreement
MRDF	Marine Renewable Deployment Fund
MOD	Ministry of Defence
MRC	Medical Research Council
MSCC	Marine Science Co-ordination Committee
Mt CO_2 eq	Million tonnes of carbon dioxide equivalent
MTP	Market Transformation Programme
N_2O	Nitrous Oxide
NAP	National Allocation Plan (for the ETS)
NATA	New Approach to Transport Appraisal
NDPB	Non Departmental Public Body
NERC	National Environmental Research Council
NI	National Indicator
NICCIP	Northern Ireland Climate Change Impacts Partnership
NIEA	Northern Ireland Environment Agency
NIR	National Inventory Report
NISC	National Inventory Steering Committee
NTS	National Transport Strategy
Ofgem	Office for Gas and Electricity Markets
Ofreg	Northern Ireland Office for Regulation of Electricity and Gas
PFC	Perfluorocarbon
POL	Proudman Ocenaographic Laboratory
PSA	Public Service Agreement
RDA	Regional Development Agencies
RBCN	Regional Basic Climate Network
RCEP	Research Councils Energy Programme
REEEP	Renewable Energy and Energy Efficiency Partnership
RHI	Renewable Heat Incentive
RESs	Regional Economic Strategies
RIEPS	Regional Improvement and Efficiency Partnerships
ROC	Renewables Obligation Certificate
ROS	Renewables Obligation Scotland
RSPB	Royal Society for the Protection of Birds
RSS	Regional Assemblies and Regional Spatial Strategies
RTFO	Renewable Transport Fuel Obligation
SF_6	Sulphur hexafluoride
SCCF	Special Climate Change Fund
SE	Scottish Enterprise
SDD	Sustainable Development Dialogue
SEPA	Scottish Environment Protection Agency
SME	Small and medium sized enterprises
SPAP	UK Government Sustainable Procurement Action Plan
SPP	Scottish Planning Policies
UEP	Updated Energy Projections
UK-EOF	UK Environment Observation Framework
UKERC	UK Energy Research Centre
UKMMAS	UK Marine Monitoring and Assessment Strategy
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme
UKCIP	UK Climate Impacts Programme
VED	Vehicle Excise Duty
WAG	Welsh Assembly Government
WRAP	Waste & Resources Action Programme

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