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**UNITED KINGDOM OF GREAT BRITAIN  
AND NORTHERN IRELAND**

Report on the in-depth review of the third national communication of the  
United Kingdom of Great Britain and Northern Ireland

Review team:

Anthony Adegbulugbe (Nigeria)  
Miroslav Maly (Czech Republic)  
Martin Walsh (Australia)  
Shardul Agrawala (OECD)  
Xin Ren (UNFCCC secretariat)  
June Budhooram (UNFCCC secretariat, coordinator)

## I. INTRODUCTION AND NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

### A. Introduction

1. The United Kingdom of Great Britain and Northern Ireland (UK) ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 8 December 1993. It signed the Kyoto Protocol to the Convention on 31 May 2002, and ratified it, with the other members of the European Community (EC), on the same day. The first national communication (NC1) of the UK was received by the UNFCCC secretariat in 1995, the second (NC2) in 1997, and the third (NC3) on 30 October 2001.

2. The Global Atmosphere Division<sup>1</sup> within the Department for Environment, Food and Rural Affairs (DEFRA) is responsible for the preparation of the NC3 and reporting under the UNFCCC. Other concerned ministries and agencies, government departments and devolved administrations had input into the NC3 via a series of open interdepartmental consultations and meetings for feedback during the process. Research institutes and consulting firms were also contracted to prepare specific studies and reports. Environmental and business non-governmental organizations (NGOs) were also actively involved in the preparation of the NC3.

3. The in-depth review of the NC3 was conducted from September 2002 to April 2003 and included a visit by a review team to London from 14 to 18 October 2002. The team consisted of Mr. Anthony Adegbulugbe (Nigeria), Mr. Miroslav Maly (Czech Republic), Mr. Martin Walsh (Australia), Mr. Shardul Agrawala (Organisation for Economic Co-operation and Development – OECD), Ms. Xin Ren (UNFCCC secretariat) and Ms. June Budhooram (UNFCCC secretariat, coordinator). During the visit, the team met experts who participated in the preparation of the NC3 and representatives of business and environmental NGOs.

### B. National circumstances

4. The UK is an island territory covering 24 million hectares. Its climate is maritime – variably cool, moist and temperate, with a moderate annual temperature within a limited range. The NC3 reports that, as an island, the UK is vulnerable to impacts of climate change such as sea level rise and that its climate is expected to change with global warming. The population has been growing at a rate of 0.2 per cent annually since 1990, and in 2000 was estimated at 58.8 million.

5. The UK is a constitutional monarchy made up of England, Scotland, Wales and Northern Ireland. Since the NC2, devolution legislation was introduced in 1999 to establish the Scottish Parliament, the National Assembly for Wales and the Northern Ireland Assembly. The UK Government has overall responsibility for ensuring that the UK delivers on international commitments including on the Kyoto target, and with the devolved administrations it sets the overall strategy and goals for climate change to meet the country's commitment on greenhouse gas (GHG) reductions. The devolved administrations share responsibility for implementing national policies within their legislative competence, through legislation, regulations, voluntary agreements and public awareness, and local governments are responsible for implementing local policies such as infrastructure planning, waste management and local transport.

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<sup>1</sup> The Global Atmosphere Division is responsible for policy on both climate change and protection of the stratosphere ozone layer. It leads the UK in international and EC negotiations on the UNFCCC and the Kyoto Protocol. The Division also provides assessments/advice on the scientific aspects of global atmosphere changes and monitoring. See [www.defra.gov.uk](http://www.defra.gov.uk)

6. After a recession in the early 1990s, when growth in gross domestic product (GDP) fell from 5 per cent in 1990 to –1 per cent in 1993, the economy regained momentum and has since experienced steady growth of around 2.3 per cent annually, exceeding both OECD and EC averages. Over the past decade, per capita GDP has grown by 20 per cent and economic growth by 25 per cent in constant terms, while per capita GHG emissions have declined by 9.5 per cent. This growth in GDP was driven primarily by rapid growth in transport, communications, and financial and business services, which together accounted for about 70 per cent of total output in 2000. This important shift in economic structure from traditional heavy manufacturing industry to light manufacturing and services, along with changes in sources for energy supply as a result of a liberalized electricity market, enabled the UK to reduce GHG emissions from 761.8 to 664.1 Tg CO<sub>2</sub> equivalent between 1990 and 2000, a sizeable reduction of 12.8 per cent. In returning GHG emissions to their 1990 level by the end of the 1990s, the UK has been able to decouple its economic growth from energy intensity and emissions intensity, as shown in table 1.

**Table 1. Main macro-economic indicators and GHG emissions for the UK**

	1990	2000	Change (%) <sup>a</sup>
Population (millions)	57.6	58.8	2.1
Gross domestic product – GDP (billions of US\$ of 1995)	1 008.0	1 263.4	25.3
Total primary energy supply – TPES (Mtoe <sup>b</sup> )	213.7	233.4	9.2
Electricity consumption (TWh)	309.4	371.6	20.1
GHG emissions <sup>c</sup> (Tg <sup>d</sup> CO <sub>2</sub> equivalent)	761.8	664.1	–12.8
GHG emissions per capita (Mg CO <sub>2</sub> equivalent)	13.2	11.1	–15.9
GHG emissions per GDP unit (kg CO <sub>2</sub> equivalent per US\$ of 1995)	0.76	0.53	–30.3

*Source:* The population data are from the NC3 and data provided during the review. Data for GDP are from “Energy Balances from OECD countries, 1998–1999”, OECD. Electricity and TPES data are from “UK Energy in Brief – July 2000”, Department of Trade and Industry (DTI). GHG emission data are from NC3.

<sup>a</sup> The change is calculated as:  $[(2000 - 1990)/1990] \times 100$ .

<sup>b</sup> Millions of tonnes of oil equivalent.

<sup>c</sup> Without accounting for land-use change and forestry (LUCF).

<sup>d</sup> One teragram (Tg) is equal to 1,000 gigagrams (Gg) or one million tonnes.

7. The UK has diverse primary energy sources. It is a major producer of natural gas and oil, and a net exporter of oil. In the 1990s, gas became the main fuel of choice for generating power and its share in the industrial, commercial and residential sectors increased. The increasing share of gas and the decreasing share of coal in electricity production over the decade (see figure 1) helped reduce GHG emissions. The large share of nuclear energy (around 22 per cent) in electricity generation in 2000 also contributed to keeping emissions in check. However, as existing nuclear power generating stations retire over the next 20 years, the UK will face the challenge of replacing this energy source with non-GHG emitting alternatives.<sup>2</sup>

8. DEFRA is responsible for overall climate change policies and for coordinating appropriate actions in the UK. The Environment Agency for England and Wales, the Scottish Environment Protection Agency and the Environment and Heritage Service of Northern Ireland enforce environmental regulations, including relevant directives issued by the EC. Climate policy is developed following national consultations among devolved administrations, ministries, agencies and government departments,<sup>3</sup> regional assemblies and stakeholders affected, including NGOs. Some policies or aspects of certain policies require primary or secondary legislation, and thus need to be approved by Parliament,

<sup>2</sup> The Energy White Paper, which sets out the UK’s energy strategy, was published on 24 February 2003 and is available together with supporting documents on the following web sites:

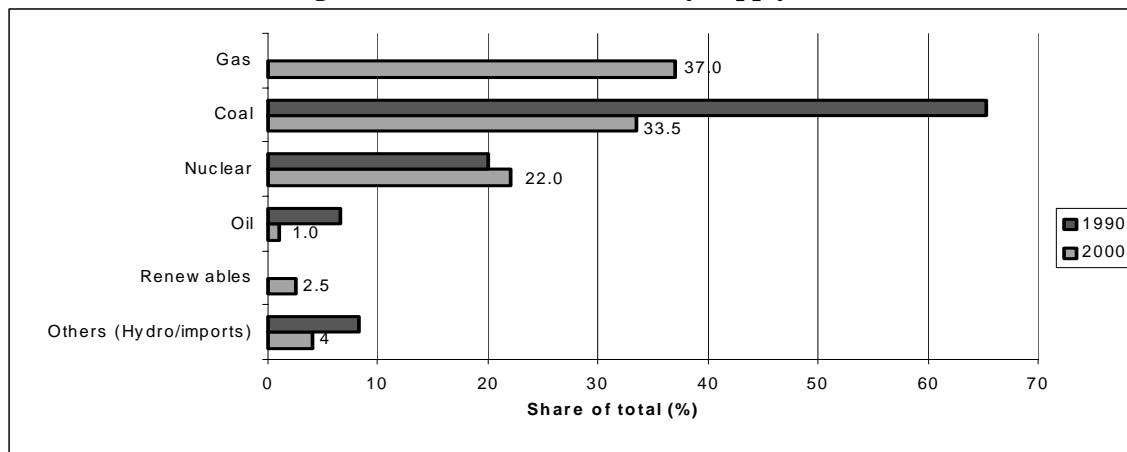
<http://www.dti.gov.uk/energy/whitepaper/index.shtml>

<http://www.defra.gov.uk/environment/climatechange/ewpscience/index.htm>

<sup>3</sup> These include the Department for Transport (formerly the Department for Transport, Local Government and the Regions), the Department of Trade and Industry, HM Treasury, the Foreign and Commonwealth Office, the Forestry Commission and the Department for International Development.

for example, penalties for emissions trading and the Renewables Obligation of the Climate Change Programme. All relevant ministries agreed to the Climate Change Programme before it was published. After that, the Parliament arranged a general debate and hearings to assess the policies therein. A similar process was followed for the climate change programmes of the devolved administrations.

**Figure 1. Structure of electricity supply in the UK**



Source: "UK Energy in Brief – July 2002", Department of Trade and Industry (DTI).

Note: The sum of shares may not be exactly 100 per cent because of rounding.

9. The UK is outstanding in its rigorous verification and evaluation scheme<sup>4</sup> for determining the effectiveness of climate change policies and measures in different areas ranging from the inventories to policies and measures and work undertaken in the scientific and research fields, all of which are well documented in the NC3. Plans are also under way to continue the internal monitoring and ex-post analysis in 2004 by independent consultants for policies and measures, prior to the preparation of the NC4. The government also intends to develop a framework for evaluating its Climate Change Programme, which will identify the key elements to evaluate their impact, effects and costs and benefits to government and to other stakeholders. This will feed into the formal review of the programme in 2004.

### **C. Relevant general, energy, and environmental policies**

10. Within the EU 'bubble' agreement under the Kyoto Protocol, the UK has a target of reducing six GHG emissions to 12.5 per cent below the 1990 level in the first commitment period (2008–2012). In November 2000, the UK's Climate Change Programme was published. The programme contains a broad package of policies and measures across all sectors of the economy from transport to agriculture. The programme estimates that these measures could reduce GHG emissions by 23 per cent below 1990 levels by 2010. On this basis, and in fulfilling its desire to lead early action, the government has gone even further in its GHG reduction policies by adopting a domestic goal of reducing CO<sub>2</sub> emissions by 20 per cent below 1990 levels by 2010.<sup>5</sup> The domestic goal is based on using policies that have a range of benefits and builds on the partnership between the UK Government and the devolved administrations. Specific reduction targets have not been set for any of the devolved administrations or for any sector, but they can set up their own programmes and targets if they so desire.

<sup>4</sup> The National Audit Office has a standing obligation to review policy and report to Parliament. The Environment Select Committee also reviews certain policies.

<sup>5</sup> A recent report by the Royal Commission on Environmental Pollution, "Energy – The Changing Climate" recommended that the UK Government should adopt a strategy for the long-term goal of reducing GHG emissions by 60 per cent by 2050.

11. The UK's Climate Change Programme formulated in 2000 comprises policies such as the Climate Change Levy package, including Climate Change Agreements (CCA); a new Carbon Trust to accelerate the take-up of cost-effective, low-carbon technologies; support of £30 million per annum for the five-year domestic emissions trading scheme; targets to deliver 10 per cent of electricity from renewable energy sources; the Ten Year Plan for transport; and increased budget for impacts and adaptation efforts.

12. As part of the European Union (EU), the UK is obliged to implement measures contained in the EC Directives on the environment. Some recent initiatives include voluntary agreements between the EC and car manufacturers to improve fuel efficiency of new cars, the European Best Practices Initiative, regulations such as the Integrated Pollution Prevention and Control (IPPC) and Landfill Directives, and measures to increase energy efficiencies of appliances and equipment.

13. A sustainable development strategy is in place. There are also a series of new policy strategies, which are in the pipeline but not yet adopted, for meeting general development objectives that have GHG mitigation benefits. Some of these include the Energy White Paper, published in February 2003, which will address, among other issues, the long-term strategy for energy and its compatibility with the objectives of the Climate Change Programme; and a conservation strategy.

## II. GREENHOUSE GAS INVENTORY INFORMATION

### A. Inventory preparation<sup>6</sup>

14. DEFRA is responsible for planning, overall coordination and submission of the UK greenhouse gas inventory<sup>7</sup> to the UNFCCC and to the EC. DEFRA contracts out the compilation and updating of the National Atmospheric Emissions Inventory (NAEI) to a private consulting company – the National Environmental Technology Centre (NETCEN), a division of AEA Technology plc, a consultancy company. As the NAEI does not cover all the emission sources, NETCEN obtains estimates for emissions and removals from land-use change and forestry (LUCF) from the Centre for Ecology and Hydrology (CEH) and estimates for agricultural emissions from the Institute of Grassland and Environmental Research (IGER). The Department of Trade and Industry (DTI), the Department for Transport (DfT) and the Forestry Commission are also pivotal in providing data and assisting in developing the methodologies for their respective areas.

15. NETCEN obtains energy and fuel statistics from the Digest of UK Energy Statistics (DUKES) compiled and published by the DTI. Information on industrial processes is provided either directly to NETCEN by individual sectors and/or through the Environment Agency (EA) Pollution Inventory. Large companies are required to report emissions of key pollutants to the EA. Some data are also obtained from reports of DEFRA-funded research contracts. For example, emissions estimates for methane in landfill sites are obtained from commissioned research contracts. Similarly, Enviro March, a consulting company, prepares estimates of emissions of HFCs, PCFs and SF<sub>6</sub>, in consultation with industry.

16. The inventories presented in the NC3 were prepared using the *Revised 1996 Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as IPCC Guidelines). The methodologies employed for the estimates correspond mostly to the detailed Tier 2/3 methods of the IPCC Guidelines. Inventories are presented for the period 1990 to 1999 and include estimates for CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, PFCs, HFCs, SF<sub>6</sub> and GHG sinks. Emissions from biomass and international bunker fuels are also presented. The GHG emission trends in the NC3 are very well presented.

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<sup>6</sup> The UK's GHG inventory includes emissions from the Channel Islands and the Isle of Man. Emissions from Gibraltar will be included in the near future.

<sup>7</sup> The inventory is disaggregated each year to the devolved country level.

17. Emission factors used in the inventories were mainly from national sources, supplemented with some IPCC default values. For the energy sector, these factors were obtained from industry sources such as British Coal and the UK Petroleum Industries Association. All emission factors, with the exception of that of coke oven gas (which seems very high) are reasonably close to IPCC values. Most of the factors applied for this sector are dated 1989. Although they may still be adequate, the review team is of the opinion that they may need to be revised to reflect the changes in fuel sources over the years. The team noted that an external peer review<sup>8</sup> of these factors had in fact been completed in 2002. All non-CO<sub>2</sub> emission factors for transport are estimated using experimental measurement. Emission factors for N<sub>2</sub>O from the production of adipic acid are obtained from actual measurements. In the case of CH<sub>4</sub> and N<sub>2</sub>O in the agriculture sector, IPCC default values were applied.

18. A detailed presentation of the national inventory system was given to the review team. The system involves team and database management as well as a formal quality assurance/quality control procedure. The team also learned that sectoral experts are responsible for the quality of inventories. Recently, a system of staged reviews of the inventories and their preparation was also established to ensure the highest quality of the inventory. As part of this system the major sectors of the inventory are peer reviewed by an independent expert. The recent peer review report, which covers CO<sub>2</sub> emissions from fuel combustion, was presented to the review team during the visit. Research is underway to determine the level of CH<sub>4</sub> emissions from abandoned mines for which no internationally agreed methodology currently exists.

19. During the review, the latest inventory submission to the UNFCCC<sup>9</sup> was presented to the review team. The report updated emission estimates in comparison with the NC3. Recalculations had been performed on all the sectors and for all the years 1990 to 2000 based on changes to emission factors and in methodology for some activities. These recalculations have resulted in an overall upward revision of the estimates, although some emissions decreased. The overall magnitude of the estimates has not changed significantly. For example, in 2000 the GHG total increased by 5.06 Tg CO<sub>2</sub> equivalent (less than 1 per cent). The recalculated values are used in the discussion on GHG emission trends in this report.

20. Although uncertainties of the emission estimates were not discussed in the chapter dealing with the inventory in the NC3, they were presented in detail in the inventory report. The review team commended the UK inventory team on the extensive quantitative estimation of the uncertainties, which is a strong point of the UK inventory. The uncertainties were estimated using both the Tier 1 and Tier 2 approaches in the IPCC Guidelines. The result of the simpler Tier 1 approach showed an uncertainty of 18 per cent in the overall GHG emissions in 2000 and an uncertainty of 2 per cent in the trend between 1990 and 2000. In the Tier 2 approach, a Monte Carlo simulation technique was employed and uncertainty distributions were assigned to emission factors and activity data for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O.

21. The Tier 2 uncertainty estimate for the total of GHG in 2000 was 15 per cent compared to 14 per cent in 1990. This indicates that there is little change in estimates of uncertainty from 1990 to 2000. Agricultural soils contribute most to the overall uncertainties. The review team noted the high uncertainty associated with activity data on aviation fuel. Inventory experts explained that there was no system of data collection currently in place to distinguish aviation fuel used for domestic and international flights, so the split is calculated by subtracting fuel consumption by domestic civil aircraft from the total aviation spirit delivered in the UK. However, NETCEN is currently upgrading this

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<sup>8</sup> "Peer Review of the UK Greenhouse Gas Inventory CO<sub>2</sub> from Fuel Combustion 1990–1999", Tim Simmons, Avonlog Ltd, July 2002.

<sup>9</sup> "UK Greenhouse Gas Inventory, 1990 to 2000: An annual report for submission under the Framework Convention on Climate Change", NETCEN, March 2002, <http://www.aeat.co.uk/netcen/airqual/reports/ghg/ghg3.html>

approach to make it compatible with the CORINAIR 'Detailed' (Tier 3) methodology for both domestic and international contributions. This will greatly improve both domestic and international estimates.

### B. Overall emission trends

22. The total GHG emissions without CO<sub>2</sub> removals by sinks declined by 12.8 per cent between 1990 and 2000. An examination of the individual gases (see table 2 and figure 2) indicates that emissions of five of the six gases declined in that period. CO<sub>2</sub> fell by 7.5 per cent, CH<sub>4</sub> by 33.4 per cent, N<sub>2</sub>O by 35.4 per cent. Total emissions of the fluorinated compounds (HFCs, PCFs and SF<sub>6</sub>) fell by 24.2 per cent. In the same period, the share of CO<sub>2</sub> emissions in the GHG total increased slightly from 79.1 per cent to 84 per cent, while the share of CH<sub>4</sub> emissions declined from 10.0 per cent to 7.7 per cent and N<sub>2</sub>O from 8.9 per cent to 6.6 per cent. The fluorinated compounds have remained more or less constant (change from 1.8 per cent to 1.7 per cent). Although removals of CO<sub>2</sub> by the LUCF sector have increased between 1990 and 2000 by 10.4 per cent, the sector has been a net source of CO<sub>2</sub> emissions (see table 3).

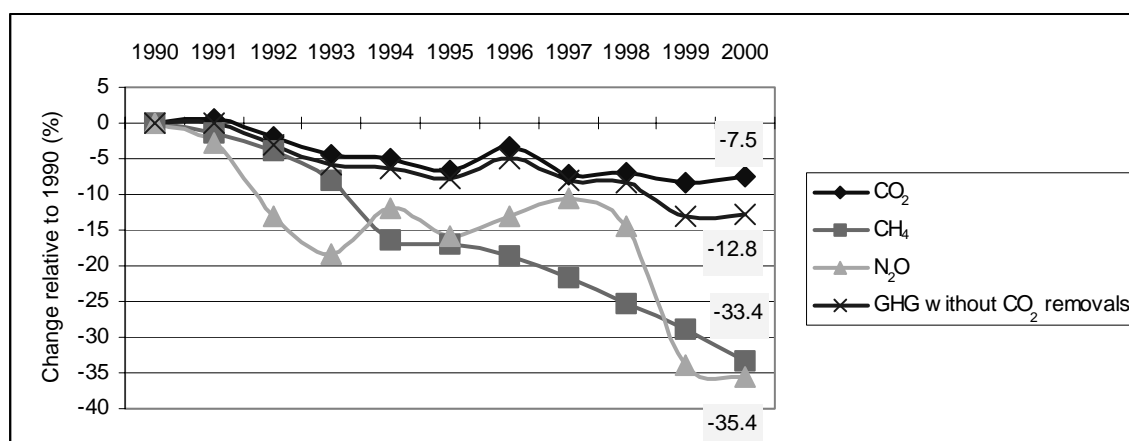
Table 2. GHG emissions by gas

	Tg CO <sub>2</sub> equivalent											Change (%) <sup>a</sup>
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
CO <sub>2</sub>	603.1	606.8	592.1	576.6	572.6	563.6	583.5	559.0	561.6	552.9	557.7	-7.5
CH <sub>4</sub>	76.5	75.4	73.6	70.4	63.9	63.6	62.2	59.9	57.2	54.4	51.0	-33.4
N <sub>2</sub> O	67.9	66.0	59.1	55.4	59.8	57.1	59.1	60.8	58.0	44.9	43.8	-35.4
HFCs	11.4	11.9	12.3	12.9	13.8	15.2	16.3	18.4	20.2	8.6	9.3	-18.1
PFCs	2.3	1.8	1.0	0.8	1.0	1.1	0.9	0.7	0.7	0.7	0.7	-70.7
SF <sub>6</sub>	0.7	0.8	0.8	0.9	1.1	1.1	1.3	1.3	1.5	1.5	1.5	113
HFCs+PFCs+SF <sub>6</sub>	14.4	14.4	14.1	14.6	15.9	17.4	18.5	20.4	22.4	10.8	11.5	-24.2
GHG without CO <sub>2</sub> removals	761.8	762.6	738.9	717.1	712.2	701.7	723.3	700.1	699.1	662.9	664.1	-12.8
CO <sub>2</sub> removals	-10.6	-10.7	-10.8	-11.1	-11.3	-11.5	-11.6	-11.6	-11.5	-11.5	-11.7	-10.4
GHG with CO <sub>2</sub> removals	751.3	751.9	728.1	706.0	700.9	690.2	711.7	688.5	687.6	651.3	652.4	-13.2

Source: This table uses the data from the 2002 inventory submission to the UNFCCC.

<sup>a</sup> The change is calculated as:  $[(2000 - 1990)/1990] \times 100$ . Values in this table are rounded, so the calculation may not be exactly as shown in this column.

Figure 2. Trends in the main GHG emissions of the UK



### C. Key emission sources and sectoral trends

23. Table 3 presents GHG emissions by major sectors for the period 1990–2000. The energy category<sup>10</sup> remains the key contributor to the GHG total (about 85 per cent in 2000) but its emissions

<sup>10</sup> Includes fuel combustion in the energy industry, manufacturing, industry and transport sectors.

decreased by almost 9 per cent over the decade. All sectors within this category, except transport, experienced overall reductions in emissions. The largest reductions between 1990 and 2000 were achieved in industrial processes, fugitive emissions and waste. The review team noted four important trends: a notable decrease in energy-related CO<sub>2</sub> emissions (about 8 per cent); a substantial decrease in CH<sub>4</sub> emissions (about 33 per cent) and in N<sub>2</sub>O emissions (35 per cent); and mixed changes in emissions of the fluorinated gases, with an overall decrease.

24. **Notable decrease in energy-related CO<sub>2</sub> emissions.** The decline is due mainly to a reduction in CO<sub>2</sub> emissions from power plants, which fell by about 29 per cent in spite of an increase of 16 per cent in electricity consumption in the same period. The major reason that emissions did not increase proportionately to generation was fuel substitution from coal to gas. For example, coal accounted for 70 per cent of fuel used for electricity generation in 1990 but only 33 per cent in 2000. On the other hand gas utilization for electricity generation increased from less than 1 per cent to 38 per cent between 1990 and 2000. Other reasons for the decrease in CO<sub>2</sub> emission are the increases in the use of renewable energy and cogeneration (combined heat and power), and higher efficiency of the combined cycle gas power plants.

25. Other trends in CO<sub>2</sub> emissions are the declining emissions from the manufacturing and construction sector and an increase in emissions from transport. Emissions from the manufacturing sector decreased by 7.62 Tg CO<sub>2</sub> or 8 per cent between 1990 and 2000. Improved energy efficiency and fuel substitution of coal by gas are among the reasons for this trend. Emissions from transport have increased by 8 per cent between 1990 and 2000. The emissions from this sector are dominated by the contribution from road transport, which rose by about 6 per cent over the period. Road transportation, measured in passenger-km, has continued to increase, although petrol usage decreased by around 12 per cent since 1990. However, this decrease was offset by increased diesel fuel utilization owing to an increase in the stock of diesel cars and trucks. There had been a reduction of 7.3 per cent in CO<sub>2</sub> emissions per km driven between 1990 and 2000.<sup>11</sup>

**Table 3. GHG emissions by sector and subsector**

	Tg CO <sub>2</sub> equivalent										Change (%) <sup>a</sup>	
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999		2000
1. Energy	604.8	610.9	596.3	580.4	570.8	563.2	581.7	557.8	559.2	548.5	553.6	-8.5
A1. Energy industries	230.5	228.5	218.4	201.6	199.0	200.3	200.3	186.2	192.0	184.0	194.2	-15.7
A2. Manufacturing industries	95.6	96.3	95.3	93.9	95.3	93.1	94.0	94.6	91.7	91.0	87.7	-8.3
A3. Transport	118.6	118.1	119.6	121.0	121.7	120.9	126.0	127.3	126.8	127.8	127.6	7.6
A4-5. Others	120.0	130.3	126.3	129.5	123.9	119.1	132.4	122.3	123.3	122.2	122.4	2.0
B. Fugitive emissions	40.2	37.7	36.8	34.4	31.0	29.8	29.1	27.3	25.3	23.5	21.7	-46.1
2. Industrial processes	58.0	53.8	47.7	45.0	50.7	49.1	52.3	53.9	53.2	29.7	30.9	-46.7
3. Solvents	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
4. Agriculture	53.6	53.1	51.5	50.8	51.7	51.7	52.0	52.7	51.9	51.2	48.6	-9.3
5. LUCF	8.8	8.9	8.3	6.6	5.4	4.7	5.0	4.8	5.0	4.8	3.4	-61.8
6. Waste	26.0	25.2	24.2	23.2	22.3	21.5	20.7	19.4	18.4	17.1	16.0	-38.5
<b>Total (without LUCF)</b>	<b>742.5</b>	<b>743.0</b>	<b>719.8</b>	<b>699.4</b>	<b>695.5</b>	<b>685.5</b>	<b>706.7</b>	<b>683.8</b>	<b>682.6</b>	<b>646.5</b>	<b>649.1</b>	<b>-12.6</b>
<b>Total (with LUCF)</b>	<b>751.3</b>	<b>751.9</b>	<b>728.1</b>	<b>706.0</b>	<b>700.9</b>	<b>690.2</b>	<b>711.7</b>	<b>688.5</b>	<b>687.6</b>	<b>651.3</b>	<b>652.5</b>	<b>-13.2</b>

<sup>a</sup> The change is calculated as: [(2000 – 1990)/1990] x 100.

26. **Substantial decrease in CH<sub>4</sub> emissions.** The large reduction in CH<sub>4</sub> emissions is mostly due to decreasing emissions from coal mines and landfill sites. CH<sub>4</sub> emissions from deep mined coal production have fallen by 68 per cent from 17.2 to 5.56 Tg CO<sub>2</sub> equivalent between 1990 and 2000. This is due to the general decline in deep coal mining production, which fell from 72.9 to 17.2 Mt in the same period. Similarly, CH<sub>4</sub> emissions from landfill sites have declined by 41 per cent since 1990, because of an

<sup>11</sup> National Atmospheric Emissions Inventory 2002 (NAEI).



improvement in gas collection for energy production and environmental control. This trend is likely to continue because new landfill sites are expected to have CH<sub>4</sub> recovery systems.

27. **Substantial decrease in N<sub>2</sub>O emissions.** The most notable contributor to the decline in N<sub>2</sub>O emissions is the large decline in emissions from industrial processes, particularly in the production of adipic and nitric acid, which fell by 79 per cent from 29.27 Tg CO<sub>2</sub> equivalent in 1990 to 6.18 Tg CO<sub>2</sub> equivalent in 2000. N<sub>2</sub>O emissions from adipic acid fell sharply in 1998 and 1999 as a result of the retrofitting of an emissions abatement system in those industries; N<sub>2</sub>O emissions decreased by 92 per cent in its first year of operation. In addition, the closure of a nitric acid plant in 1999 led to a further decline in N<sub>2</sub>O emissions. The agriculture sector experienced a 12 per cent decline in emissions between 1990 and 2000, driven by reduced fertilizer use and a reduction in animal population.

28. **Overall reduction in the emissions of fluorinated gases<sup>12</sup> but doubling of SF<sub>6</sub>.** HFCs emissions almost doubled between 1990 and 1998. But in 1999, with the installation of an HFC destruction system fitted to the largest HCFC production plant operating in the UK (accounting for 43 per cent of total emissions of HFCs in 2000), total HFC emissions fell by 43 per cent compared to the previous year; they fell by 18 per cent between 1990 and 2000. The decline in the PFCs was even more remarkable, with emissions falling by 71 per cent between 1990 and 2000 owing to process improvements and increased recycling in the aluminium industry, as well as process improvements in the electronics sector. SF<sub>6</sub> emissions doubled between 1990 and 2000, largely as a result of increases in gas emissions from electrical transmissions and distribution equipment. Emissions from the production of magnesium remained unchanged between 1990 and 2000.

### III. POLICIES AND MEASURES

29. The NC3 is in full compliance with the reporting guidelines in presentation and organization of the information. The report is organized by sector and by gas, with discussion and data presented within each sector by gas. The summary table of policies and measures, their GHG reduction potential, and types of instruments applied for each type of measure, was provided in annex B of the NC3. However, the review team felt that providing a more detailed description of each measure would have helped a third party to have a better appreciation of the depth, breadth and scope of the full package of measures, and would have allowed the NC3 to be a 'stand alone' reference document. The report does include extensive references to additional material in footnotes throughout the document and the review team was provided with additional material during the country visit, which added transparency and clarity to the information contained in the NC3 on policies and measures.

30. In terms of reporting on the specific sectors, the review team felt that policies and measures in the waste sector would benefit from being cross-referenced with those in the energy supply, agriculture and forestry sectors in terms of the management of non-municipal waste and the links between CH<sub>4</sub> recovery and utilization at waste sites and energy supply opportunities.

31. The UK Climate Change Programme is coordinated by DEFRA. The review team noted the importance for DEFRA to work in close collaboration with a wide range of other government departments and devolved administrations and the success of these efforts in ensuring consistency in the preparation of the NC3 as well as in policy formulation for GHG mitigation. However, the review team also noted the increased challenge of harmonizing the development and delivery of policies and measures in the new regime of reserved and devolved executive powers of government. That said, there might also be strengths in diversity of ideas and approaches and regional considerations.

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<sup>12</sup> The UK uses 1995 as the base year for the fluorinated gases. Experts believe that 1995 data for these compounds are more reliable and that the EU will use 1995 as the common base year.

32. The level of development and strengthening of climate change policies since the NC2 is impressive. The main policy thrust since the preparation of the NC2 is the UK Climate Change Programme, which sets out how the government intends to meet its Kyoto target and a domestic goal of a 20 per cent reduction in CO<sub>2</sub> emissions by 2010. The package of cost-effective, flexible policies and measures for all sectors of the economy, identified in the programme, could potentially reduce the UK's GHG emissions to 23 per cent below 1990 levels by 2010.

33. The government has given very strong policy signals both domestically and to the international community about its commitment on tackling the climate change problem and making deeper cuts in the UK's domestic emissions in the longer term. There is a clearly stated aim of seeking to achieve a 'first mover' advantage for the economy in general and for UK industry in particular, in moving towards low net emissions. The domestic policy environment is much firmer with the introduction of emissions trading, more emphasis on fiscal measures, and strengthened obligations and agreement.

34. The review team noted the high level of harmonization between industry, government and non-government organizations in terms of the commitment to tackle climate change, and also the increasing harmonization of approaches to implementing measures. For example, in the country visit, NGOs commented very favourably on the recent development of the voluntary domestic emissions trading scheme being undertaken in close collaboration between DEFRA and industry, in contrast to the more widely used approach of developing policies and measures in draft, before undertaking consultation. Another example of increasing harmonization was noted in the comprehensively secular governance of the Carbon Trust, which was established to play a central role in the UK's transition to a low-carbon economy by encouraging the development and deployment of low carbon technologies.

35. The review team noted the growing importance of collaborative action led at the European level in delivering GHG abatement in some sectors, notably transport, industrial processes and agriculture. Increasingly, the UK's 'first mover' approach to achieving GHG cuts will generate issues of coordination with action by the EU. This is being seen in the area of emissions trading, where a period of adjustment appears likely as participants in the UK's voluntary domestic scheme translate to a new EU scheme, possibly with different design features and administrative arrangements. Also, with the growing importance of climate change and the liberalization of energy markets, the EC seems likely to play an increasingly important role in UK energy policy.

36. Independent verification of the UK Government's performance on developing and implementing policies and measures is conducted by the National Audit Office and through the process of parliamentary scrutiny. The Climate Change Programme places more emphasis on the provision of information as a means of strengthening the internal monitoring and ex-post analysis, underlining it as an important pre-requisite for its successful implementation.

#### **A. Cross-sectoral policies and measures**

37. A key cross-sectoral measure of the Climate Change Programme is the Climate Change Levy (CCL), introduced on 1 April 2001. It is a tax instrument<sup>13</sup> that applies to energy consumption in industry, commerce and the public sector (excluding the residential sector), with no increase in the tax burden on industry as a whole and no net gain for the public finances. Combined heat and power and renewable sources of electricity are exempt from the CCL. Rates of levy are 0.15 pence/kWh for gas, 1.17 pence/kWh for coal, 0.07pence/kWh for liquefied petroleum gas (LPG) and 0.43 pence/kWh for

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<sup>13</sup> The government will return revenues from the CCL to the non-domestic sector, principally through a cut of 0.3 per cent in the rate of employers' National Insurance Contributions. Businesses will benefit from schemes aimed at promoting energy efficiency and take-up of renewable energy sources. The government will also provide £120 million of additional support for energy saving measures.

electricity. The levy is expected to raise £1 billion in a full year and reduce CO<sub>2</sub> emissions by 2.0 Mt C/year by 2010.

38. The levy package also establishes Climate Change Agreements (CCAs), which provide an 80 per cent discount in levy rates for those energy intensive sectors of industry that have agreed to improve energy efficiency or reduce GHG emissions. Carbon savings from CCAs have been estimated at 2.5 million tonnes of carbon annually by 2010. CCAs have already been completed with almost all eligible sectors. There are 10 major energy-intensive sectors namely aluminium, cement, ceramics, chemicals, food and drink, foundries, glass, non-ferrous metals, paper and steel. DEFRA has responsibility for the CCAs which are operated only through sectoral trade associations (44 sectors, 5,000 operators and 13,000 facilities). These agreements will extend over a 12-year period with reviews every two years. A report will be presented to the government on the performance of the agreements by mid-February 2003. The CCL has been criticized for not including domestic consumers, but these consumers are targeted via the Energy Efficiency Commitment and Renewables Obligation on energy suppliers (see chapter III.B below).

39. Another key cross-sectoral measure is the UK voluntary domestic emissions trading scheme, the world's first economy-wide GHG permit trading scheme. Government support of £215 million between 2002 and 2006 is available to 34 companies that, at an auction in March 2002, successfully bid to take on binding emission reduction targets. The scheme has only recently been established so there is little information available on the indicative price of permits, or trends, although it is understood that early trades have taken place in the range of £11–44/tonne of carbon.

40. The scheme has been designed to have limited fungibility. Carbon reductions under the Renewables Obligation Certificates (ROCs) scheme can be traded into the emissions trading scheme, although this cannot happen in reverse (i.e. permits from the emissions trading scheme cannot be used to meet obligations under the Renewables Obligation). There is a limited interface with Energy Efficiency Commitments. In general, electricity generators were excluded from the scheme, but there is a possibility for generators, or generators in conjunction with a project developer, to carry out domestic projects generating credits once the Energy Efficiency Commitment has already been met.

41. The interface between the UK emissions trading scheme and the proposed EC scheme (due to be implemented in 2005) is uncertain and may present a challenge to the UK. It is likely that the two schemes differ, and that the government will need to assist the transition of participants in its domestic scheme to the EC scheme.

## **B. Energy production and transformation**

42. The energy category<sup>14</sup> accounts for the lion's share (about 85 per cent in 2000) of the UK's total GHG emissions. Emissions from the industries have declined in the past decade, despite healthy economic growth over most of the period. A key objective of the government is to sustain the ongoing real reductions in GHG emissions from the energy sector while at the same time maintaining low-cost energy supply to consumers and diversity and security of supply. The government's future success in making deeper emissions cuts will hinge in large part on its ability to successfully balance these key policy imperatives.

43. The main policy instrument for determining the appropriate policies and measures to balance and achieve these objectives is the Energy White Paper<sup>15</sup> and it will also address the longer-term viability and GHG reduction potential of electricity generation from coal and nuclear energy.

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<sup>14</sup> Includes fuel combustion in the energy industry, manufacturing, industry and transport sectors.

<sup>15</sup> The Energy White Paper is not discussed in this report, as it was still under discussion at the time of the visit to the UK.

44. Emissions reduction over the past decade has come mostly from the rapid increase in the use of gas, which was driven by a range of factors including deregulation of the electricity sector and the availability of cheap gas. Although coal-fired electricity generation still makes a major contribution to GHG emissions, the UK is in a position to tap the future potential of clean coal technologies such as coal gasification and geological sequestration, which are still some years away from economic deployment. In this regard, the Climate Change Programme makes provision for developing cleaner conventional fuels technology. Nuclear generation is constrained primarily by concerns about the disposal of nuclear waste. However, as it is a carbon-free source of large-scale generation, the government has signalled its interest in keeping the nuclear option open for the longer term, in the event that other options to reduce GHG emissions from the energy supply sector are not effective.

45. There is a continued focus on liberalization of the gas and electricity markets, which are now fully open to competition. This was achieved through (a) the Utilities Act 2000, which aims to reform regulation of the gas and electricity sector through the use of a single regulator with a new principal objective of protecting the interests of consumers; and (b) the New Electricity Trading Arrangements (NETA), which aims to remove market distortions to ensure security and diversity of supply. The new market arrangements have been successful in achieving the government's primary objective of reducing the price of energy to the consumer. Prices over the first year of the NETA (March 2001 – March 2002) fell by 20 per cent.

46. Important initiatives for reducing GHG emissions from the energy sector include reducing consumer demand for power through the Energy Efficiency Commitment, and increasing renewable sources through the Renewables Obligation<sup>16</sup> and renewables support programme. The Energy Efficiency Commitment and Renewables Obligation measures are both market-based instruments that place an obligation on energy suppliers to meet targets, but at the same time allow them to choose the means by which the targets are met, including trading of the property rights to the achievement of individual targets. The Energy Efficiency Commitment is designed to encourage or assist consumers to take up energy saving opportunities over the period 2002–2005. The total obligation on all suppliers is 62 TWh, which is equivalent to about 1 per cent of domestic consumption. The review team also noted that there have been calls for an energy efficiency target of 20 per cent improvement by 2010 and a further 20 per cent by 2020, but that this will depend on the government's consideration in the context of the Energy White Paper.

47. In keeping with the objectives of the Climate Change Programme, the Renewables Obligation requires licensed electricity suppliers to supply an increasing proportion of electricity, rising to at least 10.4 per cent by 2010, from renewable sources. Suppliers liable under the measure use a system of certificates to demonstrate compliance. The certificates are tradable, which encourages the market to find the most economically efficient means of achieving the target. The Renewables Obligation initiative has a buyout price of £30/MWh, yet it is understood that some forward trades have occurred at well above the buyout price, at around £45/MWh. The review team noted that this might be a reflection of industry expectations that there will be difficulty in meeting the target and thus a shortage of certificates under the Renewables Obligation. Also, because the funds obtained from non-complying suppliers paying the buyout price are redistributed to complying supplies, there appears to be some possibility that they can achieve compliance at the cost of the certificate net of the buyout charge.

48. The Renewables Obligation contains no special arrangements to encourage small generators (e.g. at the residential or small-business scale) to participate.<sup>17</sup> All small generators under the Renewables Obligation must separately meter their output. The review team noted that there is potential

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<sup>16</sup> A separate Renewables Obligation exists in Scotland.

<sup>17</sup> For example, one possibility can be making the renewable electricity output mandatory as is the case in the Australian Mandatory Renewable Energy Target.

for some market transformation towards distributed generation based on increased use of solar hot water systems and solar photovoltaics and, although relatively generous subsidies are available to assist with the purchase of household-scale renewable energy equipment, more could be done to encourage this transformation.

49. Early strong signs that the NETA is discouraging small generation, including renewables and combined heat and power, appear to have weakened somewhat with the Office of Gas and Electricity Regulation (OfGEM) reporting in July 2002 that smaller generators were producing about the same amount of electricity as before the NETA. Prices for smaller generators were reported to have fallen in line with prices in the market as a whole. The government has attempted to address ongoing concern about smaller generators of renewable electricity by providing financial support from the Renewables Obligation and other programmes. It also provides support to non-renewable combined heat and power through a specific tax relief and exemption of Good Quality CHP<sup>18</sup> from the Climate Change Levy.

50. A target for new combined heat and power of at least 10,000 MWh by 2010, representing a doubling of present capacity, has also been adopted. The UK currently has around 4,700 MWh of combined heat and power in operation, estimated to save around £800 million and 4 Mt C annually. Combined heat and power provides one of the most cost-effective approaches for reducing CO<sub>2</sub> emissions, and with further savings by 2010 it is expected to play a crucial role in the Climate Change Programme. It was not clear to the review team how the new target, which is not mandated in any way, will be achieved, but the government intends to address these issues through a combined heat and power strategy, in the context of the Energy White Paper.

51. It is expected that the renewable energy target will be extended to 20 per cent by 2020, but, like the call for an increased energy efficiency target, this will depend on the government's consideration of these issues in the context of the Energy White Paper. The NC3 notes that without the Renewables Obligation, under the stimulus provided by the previous Non-Fossil Fuel Obligation measure, the proportion of renewable electricity would have increased to only about 5 per cent by 2010. To meet a 10 per cent target therefore implies that the Renewables Obligation will need to achieve a further increase of about 5 per cent.

52. Table 4 compares costs and impacts of selected emissions reduction measures in the energy sector. Although the figures incorporate a fair degree of uncertainty, owing to the early stage of implementation of the schemes, it seems reasonable to assert that targeting emissions reductions from increasing the uptake of renewables is likely to come at a much higher cost than the other measures, which tend to draw out lower cost emissions savings in energy efficiency. This is a global phenomenon which is justified by governments for various reasons, including the longer-term potential for cost reductions through increased sales volumes and improvements in technology and manufacturing processes, domestic industry development, employment, energy security and environmental factors.

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<sup>18</sup> Good Quality CHP refers to combined heat and power (CHP) generation that is energy efficient in operation, in accordance with the CHP Quality Assurance Programme (CHPQA) launched in May 2000. Certification under CHPQA is used to determine the eligibility of schemes. More information is available at [www.chpqa.com](http://www.chpqa.com)

**Table 4. GHG reduction potential by 2010 of key measures in the energy sector**

Measure	Cost (£/tonne of carbon)	GHG reduction potential (Mt C)
Renewables Obligation	210–380	2.5
Energy Efficiency Commitment	–270–60 <sup>a</sup>	0.4
Climate Change Levy (excluding CCAs)	17–40	2.0
Climate Change Agreements (CCA)		2.5
UK Domestic Emissions Trading Scheme	11–44	0.8

Source: OfGEM submission to Energy Policy Review, August 2002.

<sup>a</sup> Note that there is a minus sign before 270, given that the energy efficiency commitment is expected to create financial savings. Only in some instances may there be a cost, hence the large range –270 to +60.

### **C. Residential and commercial sectors**

53. GHG emissions in the residential and commercial sectors come from combustion of fuels for space and water heating. Mitigation measures in these sectors focus mainly on measures to improve and promote energy efficiency in homes and buildings and through a number of policy instruments, including building regulations, energy conservation, incentives for using energy-efficient equipment, education and public awareness. The Carbon Trust includes an integrated programme to accelerate the take-up of energy saving measures.

54. The Energy Efficiency Commitment also contributes to the alleviation of fuel poverty; at least 50 per cent of the energy savings must be focused on a priority group of low income consumers. To encourage suppliers to offer customers packaged and efficient energy service solutions, the Energy Efficiency Commitment also offers an incentive to suppliers who achieve energy savings under an energy services agreements. In this context, the suppliers have the freedom and incentive to tailor programmes to achieve the savings in the most cost-effective way. However, the review team noted that there is no overarching strategy in place to link the actions of utilities to longer term change in behaviour by consumers, who may spend money from energy savings on additional energy-consuming products or improved heating. One notable development mentioned in the NC3 is the amendment of the Building Regulations, which were reviewed in 2000, with a first stage being put into force in 2002. Further stages will be developed for 2008 to strengthen these regulations, which would lead to a reduction in GHG emissions of about 1.4 Mt C in 2010 for both the commercial and residential sectors.

55. The Energy Efficiency Commitment is being supported by the revision of building regulations in up to three stages, including adequate performance of heating and hot water systems, higher standards of insulation and use of energy efficient lights in new buildings. The NC3 forecasts possible savings of 1.4 Mt C by 2010, from implementation of all three stages of the full programme.<sup>19</sup> Appliance standards and labelling are being addressed through a market transformation programme, which includes mandatory labelling of some appliances, in accordance with EC Directives. A separate energy efficiency endorsement scheme operated by the Energy Savings Trust will provide funds for improving energy efficiency in homes through a series of information sharing campaigns; this scheme was reported to be attracting good recognition from UK consumers.

56. Other notable initiatives under the fuel poverty policy for fuel poor households include the new Home Energy Efficiency Scheme, which was launched in England in June 2000, the Central Heating Programme in Scotland introduced in April 2001 and the Warm Homes scheme in Northern Ireland.

### **D. Transport**

57. The transport sector accounted for about 20 per cent of the UK's total GHG emissions in 2000. There is a close correlation between growth in the economy and growth in transport use, and emissions

<sup>19</sup> The review team noted that the information presented in the NC3 (annex B, p.108) implies that all stages of the programme have already been adopted, but this was found not to be the case during the review.

are forecast to grow in line with the expected growth in road traffic. Road transport is the dominant mode of transport for both passengers and freight.

58. The institutional arrangements for managing terrestrial modes of travel are quite complicated as there are varying responsibilities between the UK Government, devolved administrations and local authority administrations. The network of 'strategic roads' is run by a national agency for England. These roads are only 4 per cent of total length of road, but carry the largest share of transport volume. Local authorities undertake the rest of transport management. The big cities tend to have passenger transport authorities. London now has a single strategic authority for transport. Local authorities are in charge of local roads, cycle ways, road maintenance and local transport plans, which are developed for a five-year period as a statutory requirement.

59. Ensuring good integration of the management of transport, particularly in respect to inter-modal travel, is key to achieving slower growth of emissions, and reductions over time. This is apparent in the approach to improving the use of rail systems for freight transport; considerable new funding to repair and upgrade the rail infrastructure has been allocated at the national level, but the success of the initiative is likely to depend on the success of local authorities to adequately address inter-modal transport issues in their local transport plans.

60. The most important policy development in the sector since the NC2 is the 10 Year Transport Plan, effective to 2010. This plan was prepared in partnership with industry to address key transport challenges, including growing traffic congestion on the roads; overcrowding and declining performance on the railways; poor quality public transport; and environmental impacts, including GHG emissions reduction. The plan is supported by a commitment to increase investment in transport infrastructure by 75 per cent in real terms, with £180 billion of public funding over 10 years. This would be more than twice the annual investment in transport in the 1990s. The plan is expected to reduce GHG emissions by 1.6 Mt C per year by 2010.

61. With the plan, the government expects to achieve a 50 per cent increase in rail passenger use; eliminate road maintenance backlog; increase bus use by 10 per cent; treble cycling trips; reduce air pollution; reduce congestion on inter-urban networks in urban areas; and double light rail use. Many of the objectives in the plan are potentially favourable for achieving multiple benefits, including GHG emissions reduction. For example, reducing traffic congestion by improving use of public transport could also reduce CO<sub>2</sub> and N<sub>2</sub>O emissions. However, much (about one third, or about £59 billion) of the funding that is available under the plan is allocated to improving roads. In February 2003 the Greater London Authority introduced a new congestion-pricing scheme; motorists now pay £5 for access to central London.<sup>20</sup> The charge applies weekdays from 7.00 am to 6.30 pm and revenues are earmarked to improve public transport infrastructure. This measure is also expected to enhance the attractiveness of public transport.

62. Action at the European level is thought to be having an increasing effect on reducing GHG emissions from the sector. The review team was informed that the voluntary agreements between the European Commission and European, Japanese and Korean car manufacturers to improve new car fuel efficiency by at least 25 per cent below 1995 levels by 2008–2009<sup>21</sup> might be one key reason why road

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<sup>20</sup> The congestion charging zone covers the most central, heavily congested part of London. The 'boundary' of the zone is formed by the Inner Ring Road, on which there will be no charge to drive. The scheme was introduced by the Mayor of London (see [www.cclondon.com/](http://www.cclondon.com/)). Other UK local authorities are also introducing a charge to drive through parts of towns and cities; for example, the City of York has introduced a charge to drive through parts of the city. The Transport Bill contains provisions to give local authorities the power to introduce congestion charging and workplace parking levies, and the Greater London Authority Act 1999 grants similar powers to the Mayor of London.

<sup>21</sup> Average CO<sub>2</sub> emissions from new cars are expected to be down to 140 g/km by 2008.

transport emissions actually dropped in 2000. Another key measure cited as being responsible for reducing GHG emissions from the sector was the impact of the Fuel Duty Escalator,<sup>22</sup> which was introduced in 1993 and maintained until 1999. It resulted in a stepwise increase in the annual tax rates on petrol and diesel and prompted motorists to consider alternatives to the car, and manufacturers to design more efficient vehicles.

63. There is a range of other measures in place to reduce emissions from road transport, and a range of taxation instruments. The Vehicle Excise Duty, an annual vehicle tax charge in existence for decades, was reformed in 2001 to encourage the use of less polluting vehicles. Previously differentiated for two classes by engine size, it is now differentiated for five classes by CO<sub>2</sub> emission level. Another initiative is the company car taxation. This is a personal income tax on the private use of company cars. As company cars in the UK account for almost 20 per cent of total car mileage, taxation relating to these vehicles was reformed such that, as of 2002, tax rates are based on a percentage of a car's list price, graduated according to one of 21 CO<sub>2</sub> emission bands. This move has encouraged a clear shift to diesel-fuelled cars. In 1999, the cost of converting company cars to gas has been excluded from the list price used to calculate the tax. Emissions reduction from these measures combined is estimated at 4 Mt C per year.

64. Looking to the future, a government strategy, *Powering Future Vehicles*, completed in July 2002, sets a range of emission targets for new cars and buses by 2012. A target for selling ultra low carbon cars by 2020 is being developed. Some of these cars will offer zero emissions (measured at the tail pipe), and other targets will be developed for other types of road vehicles. The strategy encompasses a range of current and possible policies and measures, including taxation incentives, to encourage deployment of low carbon vehicles (LCVs) and new fuel distribution infrastructure.

65. Alternative fuels, such as natural gas and LPG, are being encouraged through fuel duty incentives. For example, biodiesel (sourced mostly from recycled vegetable oil, incorporating waste reduction benefits) has a 20 pence/litre lower fuel duty than diesel. The review team was informed that this incentive amounts to a greater incentive than is available through the Renewables Obligation for electricity generation. The government is also considering a similar approach for hydrogen-fuelled vehicles, noting that they may only become commercial at the earliest by 2020. The uptake of hydrogen as a transport fuel will depend on the development of the required refuelling and other infrastructure. The government has set up various programmes to support the demonstration and early introduction of alternative fuel and low carbon vehicles. For example, the PowerShift programme provides support towards the additional cost of buying gas, electric or hybrid vehicles.

66. Domestic passenger air travel is currently growing at about 3.5 per cent per year. Total passenger numbers on national and international flights rose from 32 million in 1970 to 180 million in 2000 and are expected to reach 500 million by 2030. This growth is expected to have an effect on the growth in GHG emissions from air transport. Airfreight is also steadily increasing, by about 7 per cent annually. The government is planning a long-term framework for the aviation industry, looking ahead some 30 years, with the aim of ensuring that UK air transport will have a safe and sustainable future. A consultation paper, *The Future of Aviation*, was published in December 2000 and the government intends to publish an Air Transport White Paper following consultation on airport development options.

67. The review team noted that a key challenge for the government is to more accurately identify the impact of policies and measures on transport emission trends so that the selected mix is optimal, transparent and complementary. Access to this data and analysis will be important for the development of the government's Energy White Paper.

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<sup>22</sup> This is an annual fuel duty increase above the rate of inflation. In November 1999, the government decided to set the level of fuel duties on a budget-by-budget basis.



### **E. Industry**

68. Industry (excluding energy production) accounted for about 5 per cent of GHG emissions in 2000. A decline in CO<sub>2</sub> emissions experienced over the 1990–2000 period was attributed to process changes and fuel shifts in many of the energy-intensive industries such as cement, aluminium, glass, and pulp and paper. Emissions of non-CO<sub>2</sub> gases from industrial processes have dropped, as a result primarily of regulatory controls on larger industrial sites but also of the closure of some plants. Overall N<sub>2</sub>O emissions from industrial sources have decreased considerably (by 79 per cent) since 1990. This was due to voluntary and commercially driven reductions in the manufacture of adipic and nitric acids.

69. Emissions of HFCs make a relatively low contribution to the UK's overall emissions (about 1.8 per cent in 2000). The installation of abatement technology has reduced these emissions, but there is an upward trend in the use of HFCs for refrigeration, reflecting the mandated move away from ozone-depleting gases under the Montreal Protocol, and the government has committed itself to longer-term action on this front.

70. The EC's Integrated Pollution Prevention and Control (IPPC) directive provides the regulatory basis for reducing emissions of CH<sub>4</sub>, N<sub>2</sub>O, HFCs and PFCs from large stationary sites, as well as for improving energy efficiency in most of the energy-intensive sectors of industry.

71. Voluntary agreements for smaller and more diffuse industrial sites were developed in the late 1990s. These agreements are useful for information exchange and awareness raising, and the NC3 states that there had been some success in achieving emissions reductions greater than 'business as usual', but this claim appears not to be verifiable. The Carbon Trust will also focus specifically on reducing GHG emissions from business through fiscal measures and a vigorous programme of awareness raising and education. The Carbon Trust has available £100 million of climate change levy receipts over three years to accelerate uptake of cost-effective, low carbon technologies and other measures by business and levy payers. The Trust also administers the £150 million per year Enhanced Capital Allowances Scheme.

### **F. Agriculture**

72. The agriculture sector accounted for about 8 per cent of total GHG emissions in 2000. Agricultural policy in the UK is primarily directed from the European level, through the Common Agricultural Policy (CAP). Emission reductions in the sector are being obtained through increased productivity, mainly in the dairy industry, and in efficient use of fertilizer, primarily driven by CAP limits. The UK is leading the world in electricity generation from burning poultry litter, with three power plants. The agriculture sector is also being influenced by a government scheme to encourage growth in biomass crops. The Climate Change Levy is also applied to agricultural businesses, so as to improve energy efficiency in agricultural operations. The government has provided the horticulture and the pig and poultry rearing sectors with temporary discounts from the Levy, of 50 and 80 per cent, respectively, for 5 years.

### **G. Land-use change and forestry**

73. In 2000, CO<sub>2</sub> removals by sinks amounted to 11.7 Tg CO<sub>2</sub> equivalent. According to the inventory data, sink capacity increased by about 11 per cent between 1990 and 2000. However, the sector as a whole was a net source of CO<sub>2</sub> between 1990 and 2000. Forestry policy in the UK is implemented by the devolved administrations.

74. The review team was informed that the main drivers of environmental activity in forest management are the Convention on Biodiversity and the Rio Declaration on Environment and Development. Sequestration of carbon by woodlands is estimated at up to 3.4 Mt C in 2010, of which

0.6 Mt C would be due to afforestation activities that were started in 1990. This implies that by 2005 sequestration will more than compensate for land-use change emissions, at 3.4 Mt C.

75. There could be competition for resources between improving management of existing woodland and planting new woodland, and efforts to encourage the establishment of single species plantation forests for renewable electricity production. Given the devolved nature of forestry responsibilities in the UK, this issue will require monitoring and coordinated government action to ensure an acceptable balance.

#### **H. Waste**

76. Emissions from waste contributed about 3 per cent to total GHG emissions in 2000. By far the largest single source of emissions in the waste category is CH<sub>4</sub> from landfill, which has declined by 41 per cent since 1990 because of the implementation of economic CH<sub>4</sub> recovery systems, largely through the stimulation provided by the Non-Fossil Fuel Obligation (NFFO). The main measure on the sector is a landfill tax, in place since 1996, which will escalate to £15 per tonne in 2004, after which it will be reviewed. The main policy driver that promotes GHG emission reductions from the sector is the EC Landfill Directive, which imposes, inter alia, legally binding limits on the amount of biodegradable municipal solid waste (MSW) that is landfilled (with stepped targets to 35 per cent of the 1995 level by 2020). Some 83 per cent of municipal solid waste is sent to landfill sites in the UK, and about 9 per cent is recycled or composted; this is among the lowest rates in Europe. The government has addressed this and other priorities in its Waste Strategy 2000, which is comprehensive in its coverage, proposing actions covering waste from all sectors of government, industry and the community.

77. The government is currently consulting on its intention to legislate a new tradable permits scheme for local authorities in England to restrict the amount of biodegradable municipal solid waste sent to landfill sites. The review team identified some key issues that still need to be resolved, including: how permits and the EU Directive targets could be allocated to individual authorities; how the trade mechanism will function to ensure integrity of the system – for example, would an authority which chose to invest in recycling be able to trade permits which it no longer needed with an authority which remained reliant on landfill monitoring arrangements; would the system allow the UK to achieve its targets; and what are possible sanctions to prevent non-compliance.

#### **IV. PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES**

78. The NC3 contains a complete set of projections for all GHGs to 2020. The general responsibility for development of GHG emission projection is with DEFRA which shares the work with some other specialized government departments and agencies and also involves, to a large extent, universities and private companies to deliver projections for specific sectors or activities. The structure of emission sources and the GHGs covered in the projections are consistent with those covered in the inventory, and projections have been prepared for each gas, namely CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs and SF<sub>6</sub>. Emissions of individual GHGs are presented in Mt C. GHG projections are presented for 2000, 2005, 2010, 2015 and 2020, and a comprehensive data set, in tabular format, is included for each sector and gas. Projections are consistent with the 2000 inventory submission except for the LUCF projection, which had been revised to reflect a change in inventory methodology between the 2000 and 2001 submissions that resulted in a large difference in LUCF data.

79. The DTI is responsible for preparing projections for CO<sub>2</sub> emissions, and these are derived from the DTI's energy model, which comprises a set of sub-models of final user energy sectors and the electricity supply sector. It is a combination of a 'top down' model, based on econometrically estimated relationships between energy demand, economic activity (income) and energy prices, and a linear optimization model for the electricity industry (this model uses a 'bottom-up' approach). The models

provide possible future levels and composition of energy demand, based on a set of different assumptions for economic growth and world energy prices, rather than one single forecast.

80. The energy model was designed in the 1970s for energy planning purposes and has since evolved, notably in the mid to late 1980s, to deal with environmental issues, particularly with the incorporation of an emissions module for calculating CO<sub>2</sub> and SO<sub>2</sub> emissions. The model covers 13 sectors of the UK economy, aggregated into the nine main sectors of the inventory: Energy Supply, Business, Industrial Processes, Transport, Residential, Public, Agriculture, Land-Use Change and Forestry (LUCF), and Waste Management. Electricity supply is modelled at a plant-by-plant level, whereas other supply sectors are modelled at an aggregated level using outputs of sectoral bottom-up models, which are designed and overseen by different sectoral departments (e.g., transport, oil refinery models).

81. Estimates for the LUCF sector are derived from a spreadsheet model developed by the Centre for Ecology and Hydrology, under contract to DEFRA. The model uses land-use data derived from periodic surveys, supplemented by an annual census of agricultural land use. This method guarantees the coherence between the data used for preparing the inventory and the projections. The Centre also develops scenarios for carbon uptake by afforestation. Projections of the non-CO<sub>2</sub> GHGs were prepared by WS Atkins, a UK private company, in close consultation with sector representatives and other government departments. DEFRA finalized the calculations for the NC3. The methodologies for calculating projected emissions are refined as and when improved information is available. Projections are calculated using a specially built spreadsheet model that calculates emissions based on activity statistics, emission factors and sector-specific assumptions.

#### **A. Scenario definitions and key assumptions**

82. The NC3 presents two GHG emission projections: the 'with measures' projection and the 'with additional measures' projection. The 'without measures' projection is not presented. The 'with measures' projection also serves as a 'baseline' scenario. The scenarios are derived from the Climate Change Programme. The baseline scenario originated from the work published by DTI in its Energy Paper 68<sup>23</sup> in 2000, which identified six core scenarios based on three GDP growth rate assumptions and two energy price assumptions. The baseline scenario is an average of two central scenarios with the same GDP growth rate assumption but each with a different energy price. The scenario 'with additional measures' was not obtained from modelling; instead, it was prepared by deducting the estimated emission reductions due to the additional measures from the 'with measures' projections.

83. The key assumptions for the baseline scenario are: GDP growth of 2.55 per cent annually between 2001 and 2005 and 2.25 per cent a year between 2006 and 2020; population growth of 5 per cent by 2021; oil price at US\$ 10 and US\$ 20 a barrel in 1999 prices; a tax structure assumed to be maintained in real terms; and a continuing upward trend in temperature.

84. The base year for emission projections is 1999, as this was the latest year for which inventory data were available at the time of preparation of the NC3. Projections are presented for the years 2000, 2005, 2010, 2015 and 2020. Data on energy use relating to the 'with measures' projection and 'with additional measures' projections are not presented in the NC3. However, the projection experts explained that this was not done for the following reasons: GHG emissions in the 'with measures' scenario are an average of emissions data in two central scenarios presented in the DTI report,<sup>24</sup> and corresponding energy data were not calculated; GHG emissions in the 'with additional measures'

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<sup>23</sup> Energy Projections for the UK – Energy Use and Energy-Related Emissions of Carbon Dioxide in the UK, 2000 to 2020. Energy Paper 68, DTI.

<sup>24</sup> Energy Projections for the UK – Energy Use and Energy-Related Emissions of Carbon Dioxide in the UK, 2000–2020. Energy Paper 68, DTI.

projection were calculated by subtracting GHG abatement of individual additional measure from the 'with measures' projection, and again corresponding energy data were not calculated.

### **B. Projected emission trends**

85. Figure 3 shows the latest inventory data at the time of the review<sup>25</sup> and the GHG projections for the period 1990–2020. The 'with measures' projection includes a wide range of currently implemented and adopted policies, such as, the price effect of the Climate Change Levy; the Renewables Obligation based on the 10 per cent renewable target; Fuel Duty Escalator to 1999; and the Waste Strategy and EU Landfill Directive. These policies and measures have all been implemented since the Kyoto Protocol was adopted in 1997, except for the Fuel Duty Escalator, which was introduced in 1993. The UK's Kyoto target is a GHG reduction of 12.5 per cent. Based on the 'with measures' projection (baseline), the UK's emissions of GHGs are expected to be about 13 per cent below the 1990 level in 2010, and CO<sub>2</sub> emissions about 8 per cent below.

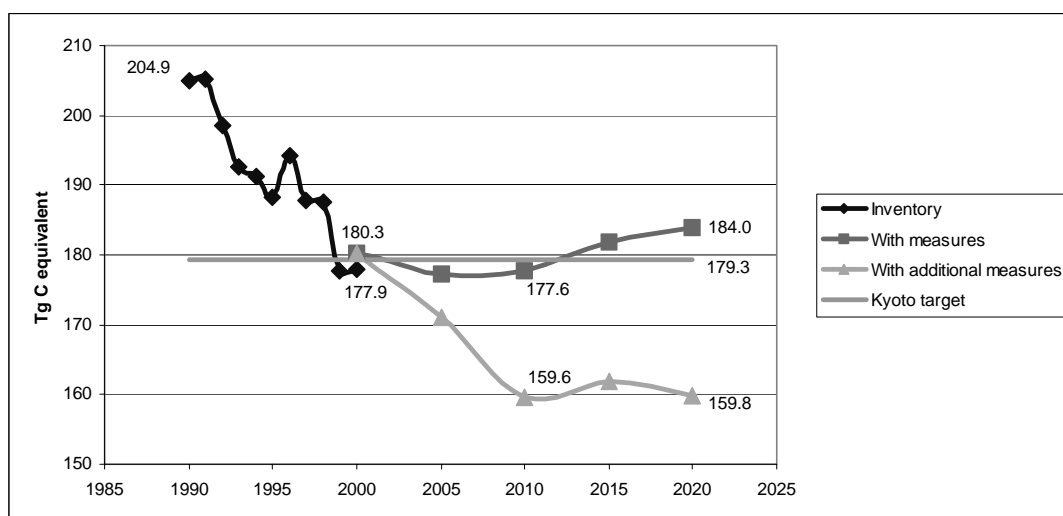
86. The 'with additional measures' projection includes the following planned policies and measures: Climate Change Agreement and the IPPC energy efficiency measures under the Climate Change Levy package; emission trading scheme; amendment of building regulations; appliance standards and labels; improving the quality of local authority housing stock and community heating; public sector targets; 10 Year Transport Plan; voluntary carbon offset schemes; and afforestation.

87. Based on the 'with additional measures' projection, the national GHG emissions are expected to decline by an additional 8 per cent in 2010 compared to the 1990 level, with CO<sub>2</sub> emissions about 11 per cent below. In total, the UK's emissions of GHGs are expected to be about 22 per cent below the 1990 level in 2010, with CO<sub>2</sub> emissions about 19 per cent below. The 'with additional measures' projection contains a very wide range of policies and measures and thus low performance of one policy or measure would not have a critical impact on meeting the Kyoto target.

88. In 2002, GHG emissions increased compared to 1999, the most recent year taken account of in the CO<sub>2</sub> projections, and thus inventory data for the year 2000 are slightly above projected data for 2000 in the NC3 (by about 1 Tg CO<sub>2</sub> equivalent). The difference in projected data for the year 2000 between the 'with measures' projection and the 'with additional measures' projection is about 2.5 Tg CO<sub>2</sub> equivalent. In 2010 the difference in GHG emissions between scenarios is 18 Tg CO<sub>2</sub> equivalent and in 2020, 24 Tg CO<sub>2</sub> equivalent. This increase in emissions between 1999 and 2002 was due mainly to an increase in the use of coal for electricity supply. Although this fuel shift may influence meeting the Kyoto target without the additional measures quantified in the NC3, the target should be met by a significant margin with these additional measures, as indicated in figure 3.

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<sup>25</sup> UK Greenhouse Gas Inventory, 1990–2000, NETCEN, March 2002.

**Figure 3. Comparison of projections of the total GHG emissions by scenario**

89. The NC3 presents a sensitivity analysis. The following sources of uncertainty in projections are assessed: combination of GDP and fuel prices (the estimated effect is  $\pm 4$  Mt C per year in 2010); economic modelling process for energy-related CO<sub>2</sub> ( $\pm 9$  Mt C per year); area and parameter assumptions driving land-use change emission projection ( $\pm 2$  Mt C per year); and the non-CO<sub>2</sub> GHG range ( $\pm 1$  Mt C per year). The resulting total uncertainty is estimated as  $\pm 10$  Mt C in 2010, which is much less than the difference between the ‘with additional measures’ scenario and the Kyoto target.

90. A comparison of the projected data between the NC2 and the NC3, presented in the NC3, shows a substantial reduction of projected GHG emissions between the NC2 and the NC3. Although base year emissions agree to less than 0.6 per cent, the future projections diverge increasingly. This is reported to be mainly due to lower projected emissions from power stations (including increased renewables and conventional fuel switching), and from industry and road transport.

### C. Effects of policies and measures

91. In accordance with the reporting guidelines, the NC3 contains a ‘with measures’ projection and a ‘with additional measures’ projection. However, it does not contain any ‘without measures’ projection. Nevertheless, the effects of the already implemented measures are estimated in the NC3. Table 5 presents a breakdown of emissions reductions by major policies for the ‘with measures’ projections. The two measures that contribute the most to reducing emissions are the Renewables Obligation and the Fuel Duty Escalator to 1999. Together, they account for more than 50 per cent of the mitigation effect in the baseline (‘with measures’) projection. The projected contribution of the Climate Change Levy to the emission reductions grows between 2010 and 2020.

**Table 5. Mitigation effect<sup>a</sup> of implemented measures for the ‘with measures’ scenario**

Measure	Tg C equivalent <sup>b</sup>		
	2000	2010	2020
Non-fossil fuel obligation	0.7	1.5	1.5
Renewables Obligation	0.0	2.5	2.5
Climate Change Levy	0.0	1.0	2.0
Fuel Duty Escalator to 1999	n.q.	1–2.5	1.8
Waste Strategy and EU Landfill Directive	0.0	0.1–0.5	n.q.
<b>Total</b>	<b>0.7</b>	<b>8.0</b>	<b>7.8</b>

n.q. – Not quantified

<sup>a</sup> The mitigation effect is the contribution of measures in the ‘with measures’ projection.

<sup>b</sup> Estimates are based on data presented in the annex B of the NC3.

92. The NC3 contains a comprehensive set of additional measures that are included in the ‘with additional measures’ projection. These measures are identified for all sectors. Table 6 presents a breakdown of the contribution of individual policies and measures aggregated by sector.

**Table 6. Mitigation effect<sup>a</sup> of additional measures for the ‘with additional measures’ projection**

Sector	Mt C equivalent <sup>b</sup>		
	2005	2010	2020
Business, public and commercial services	4.4	7	8.3
Residential	2	4.7	5.4
Transport	0	5.7	9.2
Forest	0.5	0.6	1.2
<b>Total effect</b>	<b>6.9</b>	<b>18</b>	<b>24.1</b>

<sup>a</sup> The mitigation effect is the difference in annual GHG emissions between the ‘with measures’ projection and the ‘with additional measures’ projection.

<sup>b</sup> Estimates are based on data presented in the annex B of the NC3.

93. In 2000, the achieved reduction relates mostly to the business sector, public and commercial services, and the residential sector. For the future, the reduction of GHG emissions becomes nearly equally distributed among major sectors: business, public and commercial services, residential and transport. In the longer term, major expectations on GHG emission reduction are related to the transport sector. Without these additional measures the transport sector would record the highest growth of GHG emissions.

#### **D. Overall evaluation of the projections**

94. In reporting on the projections, the NC3 follows, in general, the UNFCCC guidelines. The definition of scenarios and the modelling assumptions are presented comprehensively. This can be attributed to the early and continuous involvement of various parties in the development of GHG emission projections, a process that seems to have given excellent results. Most importantly, the projections are consistent with the inventory and they serve as a tool to validate the overall effect of mitigation measures. The work done in the UK in coordinating this exercise between DEFRA and other organizations to ensure consistency with the reporting requirements is highly commended by the review team.

95. Projections are regularly checked and verified by comparing trends in actual historical emissions with future emission estimates. If there is a significant variation, project methodologies and assumptions are revised accordingly. The projection methodologies are verified using a combination of ‘bottom-up’ and ‘top down’ approaches.

96. The NC3 meets all requirements of the reporting guidelines on projections, including the incorporation of the total effect of policies and measures. Many policies and measures<sup>26</sup> in the ‘with additional measures’ scenario are innovative and thus could be recommended for use in other countries.

97. The scope of policies and measures is very impressive. However, the review team recommends that the success of individual policies and measures be monitored to ensure that measures are achieving their projected GHG mitigation effects, especially in the transport sector, which is projected to achieve large GHG emissions reduction in the ‘with additional measures’ projections. The modelling tool being developed by the Department for Transport could be valuable for modelling sectoral GHG projections; however, this is currently not possible as these models have different objectives. Nevertheless, efforts are being made to provide some level of integration of Department for Transport modelling into the existing model.

<sup>26</sup> Policies such as the Renewables Obligation, emissions trading and the Climate Change Levy are considered innovative.

98. CO<sub>2</sub> emissions from flue-gas desulphurization (FGD) with limestone at power plants are not included in either the emission inventory or projections. Due to an expected increase in the number of power plants equipped with FGD technology, emissions released from this technology should be included in an updated inventory and also in the projections. A key assumption, which could be highly influential in future GHG projections, is the projected closure dates of the nuclear power plants. The review team proposes that the effects of the closure of these nuclear plants on GHG emissions be analysed in more detail.
99. Energy demand and emission projections are sensitive to changes in energy prices, as shown by the increase of GHG emissions between 1999 and 2002 when more coal was used for energy production. The review team recommends that the assumptions on low oil/gas prices in projections be revised to gauge the price effects on both projection scenarios.
100. The scenario “with additional measures” presented in the NC3 was not modelled but estimated using individual emission reductions from additional measures. A more comprehensive analysis of additional measures including full-scope modelling, similar to the modelling used for the “with measures” scenario, could improve the quality of this scenario.
101. Although the presentation of a ‘without measures’ scenario is not mandatory, the review team is of the opinion that preparing such a scenario would help greatly in understanding the contribution of different policies and measures implemented by the UK Government in previous years. In addition, even though presenting projections of the indirect GHGs (carbon monoxide, nitrogen oxides and non-methane volatile organic compounds, as well as sulphur oxides) is not mandatory, in light of the commendable progress made by the UK in reducing emissions of these gases, it is recommended that they be included in order to give an overall picture of emissions.
102. The NC3 describes in detail the key assumptions used for developing the projections (GDP, energy prices, tax structure, population, vehicles, industrial production, etc.). However, the main assumptions for the non-CO<sub>2</sub> GHGs were not always clear and could also be presented in tabular form, e.g. projected development of livestock, land use, waste management, in the future. For clarity, the ‘with measures’ and ‘with additional measures’ projection curves should be identified. In the text, it would also be helpful to clearly distinguish between the base year and the reference year, and the base year used as a starting point for the CO<sub>2</sub> emissions projection.
103. When reporting on each policy and measure, it would be helpful to state clearly from what year it is assumed that they are implemented. The emphasis is on estimating GHG emission abatement for 2010, but many policies and measures make a large contribution to abatement even earlier.
104. The review team believes that the models used for preparing projections are quite robust, but the strengths and weaknesses of the model approach used in the projections of UK’s GHG emissions could be discussed in more detail. This can help further develop the projection methodology, and also support any adjustment needed for the reporting guidelines.
105. GHG emissions in the ‘with measures’ projection are slightly below the Kyoto target but in the ‘with additional measures’ projection emissions they are well below the Kyoto target. **Therefore, it appears likely that the UK will meet its Kyoto target.** The low-carbon-economy strategy would make the trends presented in the GHG emission projections sustainable and consistent with broader national objectives. Coordination is an important component in preparing GHG emissions projections. It has been exemplary, and should be supported even more in future efforts.

## V. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

106. The NC3 complies adequately with the reporting guidelines on vulnerability assessment, climate change impacts and adaptation measures. Climate change is projected to have major impacts on the UK. The risk of flooding is expected to increase in many lowland areas due to more frequent river flooding and more severe storm surges. Increased water demands and more droughts could aggravate the water situation in many areas, particularly in the South East. Rare flora and fauna currently at the edge of their natural geographic ranges might be lost due to their inability to migrate with a shifting climate. Increased weather variability and flooding could affect UK businesses through impacts such as disruption in supply of goods. In health and agriculture, the effects of climate change are expected to be mixed. Growing seasons might lengthen due to warmer winters, but pest populations might increase due to more conducive climates. In health, summer heart-related deaths are expected to increase.

107. The UK is a leader in climate modelling through the Hadley Centre and its role in the IPCC Working Group I between 1990 and 2001. Over the past decade, considerable progress has also been made on impacts and adaptation work. On climate modelling, the spatial scale of climate model projections has been improved through downscaling techniques to make model outputs more useful for impacts research. The UK Climate Impacts Programme (UKCIP) was set up by the government in 1997 to provide a coordinated framework for assessing impacts and adaptation strategies. UKCIP is advised by a Steering Committee comprising representatives from relevant government departments, public agencies, the private sector, and NGOs. A Science Advisory Panel oversees the scientific integrity of the work. To date, several sectoral (such as biodiversity, health, water, marine environment) and regional (such as Scotland, Wales, West Midlands, South East England) studies have been initiated as part of the UKCIP. A key feature of these studies is that they are led by the stakeholders, with the UKCIP providing common frameworks and tools, as well as access to the relevant experts.

108. The NC3 does not discuss economic impacts of climate change but such studies were currently under way. A methodology document for costing of impacts and adaptation options had recently been produced. The NC3 does not discuss implications for the insurance sector. The review team was informed that this was because of difficulties in getting data from individual companies.

109. At an international level, work under the Fast-track programme is ongoing to develop quantitative estimates of climate change impacts worldwide. The UK is also engaged in more in-depth collaborative studies on climate change impacts in India and China. The Department for International Development (DFID) meanwhile is engaged in mainstreaming climate change considerations in development planning.

110. On adaptation, good progress has been made since the NC2. The government and the devolved administrations aim to ensure a strategic response to adapt to climate change, while actively involving the public and private sectors. Sectors that involve planning decisions of several decades for infrastructure have been identified as current priority areas for adaptation (water resources, flood and coastal defences and buildings). The adaptation responses documented in the NC3 for water resources are largely related to water conservation, and it is not clear to what extent climate concerns are factored into such “no regrets” strategies. The 25-year water resource strategies and plans of the Environment Agency and water companies are adjusted as knowledge of the implications of climate change is developed. As knowledge evolves, the plans and strategies will indicate any potential future shortfall in water resources, and the development of new resources will be recommended if necessary. In flood and coastal defences, work is ongoing to incorporate climate change and sea level rise projections in Shoreline Management Plans, Coastal Management Plans, and River Catchment Flood Management Plans. In Scotland, the Scottish Executive has conducted research to consider Potential Adaptation Strategies for Climate Change in Scotland that includes flood and coastal protection, as well as the



residential sector. However, currently only new building stock is considered. Adaptation concerns are also being considered for agriculture and biodiversity conservation.

111. The NC3 outlines efforts to educate farmers on potential climate change impacts, but it is not clear how that might be achieved because farming decisions are more likely to be influenced by seasonal variability. On conservation policies, there is an apparent conflict between site protection policies that are geographically specific and climate change adaptation that would need to respond to large-scale impacts on the distribution of species and habitats as climate changes. The review team was informed that government agencies and experts are aware of this and are working to ensure the integrity of the protected site network and developing policies which regard biodiversity as a component of larger ecosystems operating across whole landscapes and seas.

## **VI. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY**

112. The chapter on financial assistance and technology transfer is very comprehensive and generally in compliance with the reporting guidelines. The NC3 reports UK contributions to the Global Environment Facility and multilateral institutions (including the World Bank, the International Finance Corporation, the Asian Development Bank, the African Development Bank, the United Nations Development Programme, the United Nations Environment Programme, UNFCCC and the World Meteorological Organization). However “new and additional” financial resources as required under the reporting guidelines are not explicitly identified. The review team was informed that it was difficult to find an operational definition.

113. DFID has overall responsibility for advancing development aspects of UK climate policy as well as its commitments on financial assistance. It works in close cooperation with other government departments such as DEFRA, the Foreign and Commonwealth Office (FCO), the Department for Transport (DfT) and the Department of Trade and Industry (DTI). The UK development assistance programme has increased between the NC2 and the NC3 and has continued to do so since the publication of the NC3. According to the Development Assistance Committee (DAC) of the OECD there was a 40 per cent increase in UK development assistance between 1999 and 2000, making it the fourth largest donor to poor countries. The international development budget is set to continue to increase between 2000 and 2003 to £3.6 billion, representing about 0.33 per cent of GNP (but that is still below the 0.7 per cent Rio commitment). Contributions by the UK to multilateral institutions have declined from £189 million in 1997–1998 to £167 million in 1999–2000.

114. Other trends since the publication of NC2 include an evolution in thinking within the government with regard to mainstreaming climate concerns within its development planning and assistance activities. A major project was initiated in 2001 in China that focuses on incorporating climate concerns in the agricultural sector. Enhancing the capacity of poor countries and poor people to cope with climate change and climate variability is recognized by DFID as being central to the achievement of the Millennium Development Goals. In 2000 the government conducted a study that concluded that roughly 30 per cent of all resources within its development portfolio were used in activities that contribute to dealing with climate change, both on mitigation and adaptation. The table in the NC3 on reporting bilateral contributions to various countries (annex C) does not provide figures for contribution to adaptation or capacity-building activities. The review team was informed that this was because of difficulties in isolating such estimates, based upon available statistics on development assistance.

115. With regard to technology transfer, the UK participates mainly through its involvement in multilateral activities, particularly through the EC, and the Climate Technology Initiative of IEA/OECD. Domestic programmes include the UK Technology Partnership Initiative that provides know-how to developing countries on a commercial basis, and the Climate Change Projects Office (CCPO) established in 2001 to facilitate the UK's participation in JI/CDM projects. Details of policies to encourage the role of the private sector, as required by the reporting guidelines, are not provided in the NC3. It does not

mention successes or failures, or give specific instances of technology transfer, as recommended by the reporting guidelines. Such information is provided as part of the electronic version of the NC3.<sup>27</sup>

## VII. RESEARCH AND SYSTEMATIC OBSERVATION

116. The NC3 has complied with the reporting guidelines on research and systematic observation activities. The UK has a strong domestic programme on climate modelling and impacts research, and also contributes to several international research, assessment and monitoring efforts. Climate research and systematic observation are highly devolved activities in the UK and there are therefore no “national plans” for climate research and observations. However, such activities are coordinated nationally through the Global Environmental Change Committee chaired by DEFRA, which provides about £12 million for climate research, observations and policy formulation. Other funding agencies include DTI, DFID, FCO, the Forestry Commission and national research councils.

117. The Hadley Centre of the UK Met Office has been a centre of excellence in climate modelling since its establishment more than a decade ago. In particular, its modelling effort has been a major contributor to IPCC Working Group 1. Highlights of important Hadley Centre work since NC2 include climate model runs without the need for “flux adjustments” that had earlier cast some doubt on the credibility of General Circulation Models projections. There is also promising ongoing research at the Hadley Centre on backward mapping of atmospheric GHG concentrations that holds promise for independent verifications of location-specific emissions. An independent scientific review conducted in 2000 concluded that it remained “second to no other climate modelling centre worldwide”.

118. A more recent development has been the establishment, in October 2000, of an interdisciplinary centre for climate change research – the Tyndall Centre – by three of the research councils of the UK (the Natural Environment Research Council, the Economic and Social Research Council, and the Engineering and Physical Sciences Research Council). Established with a core funding support of £10 million over five years by the three research councils, the Tyndall Centre seeks to break new ground in innovative research on several themes connected with policy responses, including mitigation and adaptation. It is too early to assess the impact of the Tyndall Centre on the climate research or policy process, but it does reflect an innovative institutional experiment by the UK to confront complex interdisciplinary issues that face climate research and policy.

119. The UK also makes large contributions to several international research, assessment and monitoring efforts, including the World Climate Research Programme, the International Geosphere–Biosphere Programme, the International Human Dimension Programme and the Global Climate Observing System (GCOS). The UK GCOS report was submitted to the UNFCCC secretariat in 2001. With regard to capacity-building the FCO established the Climate Change Challenge Fund (CCCF) in 1999 to facilitate research to help developing countries and countries with economies in transition move towards less-carbon-intensive growth. One area where the NC3 does not completely follow the reporting guidelines is that opportunities for and barriers to the free and open international exchange of data and information are not discussed. The review team was informed, however, that a number of initiatives are ongoing both within the UK and internationally to facilitate such data access. Climate model data, for example, are made available to climate impacts researchers through the University of East Anglia; the IPCC Data Distribution Centre facilitates access to IPCC scenarios; and Natural Environment Research Council has seven designated data centres including the British Atmospheric Data Centre that provide access to climate related data. At the international level, monthly temperature and rainfall data are available from weather stations worldwide through an international agreement, but many countries are reluctant to share daily or shorter-time-scale data that have commercial value.

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<sup>27</sup> [www.defra.gov.uk/environment/climatechange/3nc](http://www.defra.gov.uk/environment/climatechange/3nc)

### VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

120. The section on education, training and public awareness in the NC3 is well prepared in accordance with the reporting guidelines. The UK has put in place a diverse and innovative package of measures to promote capacity-building on climate change at all levels. The target audience ranges from primary and secondary level school children, to consumers, and the private and public sectors. Recent developments include the establishment of the Sustainable Development Education Panel for England in 1998. The panel advises on gaps, opportunities, and priorities for action in providing sustainable development education and to highlight good practice. It has put forth a 10-year plan with various goals for central and local government, schools, higher education, and the workplace. The revised Schools National Curriculum for England and the curriculum for Wales, which came into effect in September 2000, provide many opportunities for education on climate change issues for children between the ages of 5 and 14. There is no statutory curriculum in Scotland. However, national guidelines for the 5–14 curriculum stress the importance of providing to pupils appropriate knowledge and understanding of issues relating to weather and climate. It is, however, not clear to what extent such changes in curriculum in the various devolved administrations are complemented by comparable investment in re-training of teachers who would be responsible for implementing such changes in curriculum, or how such new requirements might conflict with other competing requirements (such as information technology) for teacher re-training.

121. The government and devolved administrations place great emphasis on public awareness campaigns as a means of changing consumer behaviour. These include the Energy Efficiency Campaign conducted by the Energy Savings Trust that aims to create a long-term shift in consumers' attitude to energy efficiency. The approach is multi-pronged, and includes direct mail, advertising, hotline, energy labelling, and national campaigns. A December 2001 evaluation found that two-thirds of consumers recognize the Energy Efficiency Recommended label, reflecting the success of this campaign. The review team felt that such campaigns could serve as a model to other countries.

### IX. CONCLUSIONS

122. The NC3 of the UK is comprehensive and consistent, covering all major sectors and GHG emissions for the six gases. Key climate change policies and measures are reflected sufficiently and concisely. Presentation of the information follows, for the most part, the reporting guidelines. Since the NC2, the UK has made commendable progress in achieving a number of its stated objectives in the NC2.

123. The most notable achievement was the sizeable reduction in GHG emissions of **12.8 per cent** between 1990 and 2000. In this regard, the UK has succeeded remarkably in returning its GHG emissions to their 1990 level. This objective was achieved and exceeded mainly as a result of the policies and measures that were put in place for liberalizing the electricity market and also a shift in economic structure from heavy industries to light manufacturing and services as well as an aggressive effort in reducing non-CO<sub>2</sub> GHGs in industry. In meeting this objective the UK has successfully been able to decouple its economic growth from energy intensity and emissions intensity. Notable decreases were obtained for the three main GHGs, namely N<sub>2</sub>O (35 per cent), CH<sub>4</sub> (33 per cent) and CO<sub>2</sub> (8 per cent).

124. Notable progress was achieved with respect to climate change impacts and adaptation. There was no discussion of these in the NC1. The NC2 reported on the establishment of the UK Climate Change Impacts Review Group and some early steps towards adaptation. The NC3 outlines key developments that have advanced both integrated research and policy analysis on impacts and adaptation.

125. In 2000, the government approved the comprehensive UK Climate Change Programme. This programme identifies a series of strengthened measures to reduce, through domestic action, GHG emissions in accordance with UK's commitments under the Kyoto Protocol and the EC burden-sharing

agreement (a 12.5 per cent reduction in 2008–2012 compared to 1990). The programme signifies a more focused approach to GHG mitigation and an increase in the use of economic and fiscal instruments for pursuing environmental objectives. Important policies in meeting the reduction target include the Domestic Emissions Trading Scheme, the Climate Change Levy and the Renewables Obligation.

126. The NC3 projections indicate that the UK is likely to meet its Kyoto target. However, to ensure that GHG reductions are sustained, the government needs to vigorously pursue the measures outlined in the ‘with additional measures’ scenario. Ensuring compatibility between the Climate Change Programme and the Energy White Paper, is of particular importance for meeting the Kyoto target. The low-carbon economy strategy currently being discussed in the UK would make the trends in GHG emission projections sustainable and consistent with broader national objectives. Should the Climate Change Programme be implemented to its fullest potential, GHG mitigation under the programme may go significantly beyond the Kyoto Protocol target in the direction of its domestic goal to reduce CO<sub>2</sub> by 20 per cent.

127. The review team noted the high level of harmonization between industry, government and non-government organizations in the commitment to tackle climate change, and also the increasing harmonization of approaches to implementing measures. This level of confidence has been accomplished because the policy-making and review processes have become more transparent with more public consultation. The systematic use of quantified targets and indicators to monitor progress in the Climate Change Programme will help in ensuring commitment by all stakeholders in meeting the UK’s GHG reduction objectives.

128. The review team highly recommends regular monitoring of the success of individual policies and measures in order to adjust the projections accordingly. The transport sector is a major contributor to GHG emission reduction in the ‘with additional measures’ projections. It is recommended that the projections data be revised using the modelling tool being developed by the Department for Transport, to include assumptions presented in the 10 Year Plan regarding competition of various transport modes: railway, air and road transport.

129. According to the Development Assistance Committee of the OECD there was a 40 per cent increase in UK development assistance between 1999 and 2000, making it the fourth largest donor to developing countries. The international development budget is set to continue to increase between 2000 and 2003 to about 0.33 per cent of GNP, higher than the OECD average of 0.22 per cent.

130. The UK has put in place a diverse and innovative spectrum of measures to promote capacity-building on climate change at all levels.

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