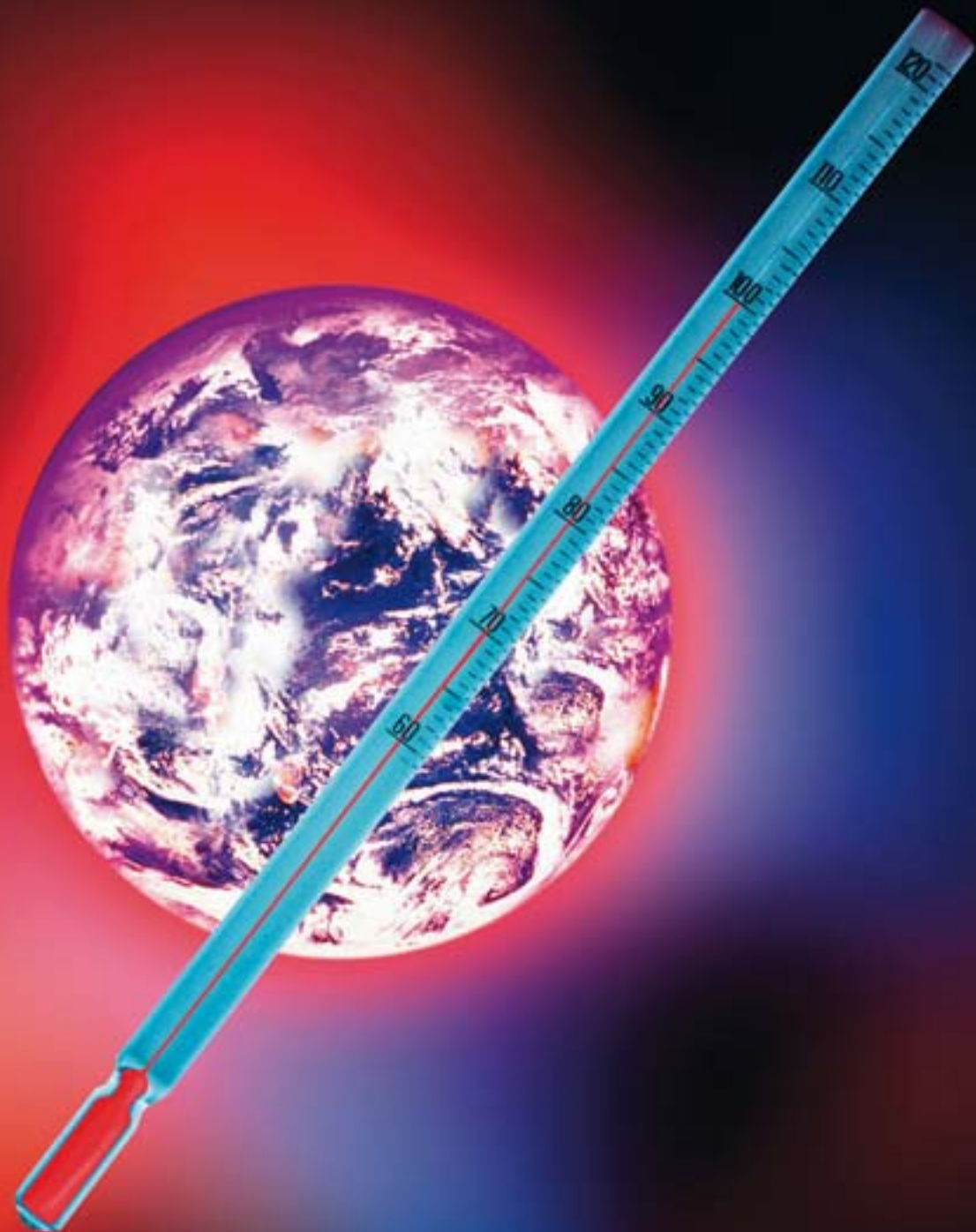


UK greenhouse gas emissions: measurement and reporting



This review was conducted by Eric Lewis, Tom Liptrot, Nicola Thomas and Abhishek Velani under the direction of Joe Cavanagh.

This review can be found on the NAO website at www.nao.org.uk/publications/select_committees.htm

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Summary

Introduction

1 The growing awareness of the challenge of climate change has led to much discussion in recent years of the need to reduce emissions of greenhouse gases (GHGs). There are many issues associated with this agenda, and the NAO has reported on two of them last year (the accuracy of emissions forecasting and the use of cost-effectiveness analysis). But the ability to measure and report GHG emissions accurately is a fundamental requirement underpinning any form of analysis and forecasting. This briefing, produced for the Environmental Audit Committee, aims to throw light on this process.

Key findings

2 Our review examined two main areas – the process of measuring GHG emissions and maintaining a UK Inventory of them, for which Defra is responsible; and the way in which GHG emissions are reported by government departments, particularly in relation to emissions targets which have been set. In terms of measuring GHG emissions, our key findings are as follows:

- International reporting requirements specify the basis on which emissions should be estimated. The UK's estimates follow best practice and have been reviewed favourably by international experts in GHG measurement appointed by the UN.
- Current methods of estimating and reporting greenhouse gas emissions are based on a territorial approach and measure emissions on a 'production' basis in accordance with international guidance. They do not take account of the emissions embedded within the manufactured goods and services which the UK imports and exports. However, the calculation of emissions on a 'consumption' basis would involve many uncertainties and cannot currently provide a robust, internationally agreed basis for reporting.
- GHG emissions are estimated not by directly measuring them but by calculating them from the fossil fuels used and from other relevant processes relating to industry and agriculture. To do this accurately requires detailed information and data from a wide range of source sectors and activities. Such an approach, based on economic activity data, complies with Inter-Governmental Panel on Climate Change (IPCC) guidelines.

- There is a delay of 15 months in final emissions estimates being produced, though provisional estimates are available at three months and near-final estimates at 13 months. The delay is due to the complexity involved in collecting and processing data on every GHG producing activity in the UK.
- Improvements in the methodology of estimating GHG emissions can necessitate retrospective adjustments to past emissions data, including the 1990/95 baseline. However, even though such adjustments will continue to be made, the 1990/95 baseline has now been fixed for the purpose of assessing performance in the first Kyoto commitment period (2008-2012).
- Uncertainty in estimating GHG emissions is relatively high: while the central estimate for 2005 is 655 MtCO₂e, the 95 per cent confidence interval ranges between 620 and 762 MtCO₂e. However, the uncertainty associated with the trend in emissions since 1990 is far lower and is estimated to be ± 3 per cent around a central estimate of a 15 per cent reduction. Moreover, the uncertainty relates mainly to estimates of non-CO₂ emissions arising from agriculture. These are hard to estimate with any accuracy due to their diffuse nature and the inherent uncertainties associated with them. By contrast, the uncertainty associated with CO₂ emissions is low (± 2 per cent).
- The overall structure and operation of the UK Greenhouse Gas Inventory is defined by international guidelines, and technical changes and improvements are comprehensively recorded. However, there is some scope for Defra to improve procedures by formalising agreements with public and private sector organisations which supply relevant activity data, and by maintaining a record of errors found in the data supplied.

3 We also examined the reporting of GHG emissions, particularly in relation to the targets which have been set. Our findings were as follows:

- The UK is subject to various emissions targets and reporting obligations, and there are differences between targets in their coverage and the precision with which they are specified. These differences are partly linked to legal reporting requirements, but they do increase the administrative complexity of the reporting process.
- The basis on which to report against the UK domestic goal of a 20 per cent reduction in carbon dioxide by 2010 is unclear. This reflects a lack of precision in the way in which the goal was originally defined, the absence of clear reporting standards, and insufficient consistency and coordination between departments in presenting emissions data. In particular, foreign credits purchased under the EU Emissions Trading Scheme now count towards this goal but not towards the UK headline indicators for carbon dioxide and greenhouse gas emissions or any other National Statistics publications.¹
- There are two different bases on which the government currently reports GHG emissions – that required for UNFCCC reporting purposes, and the Environmental Accounts prepared by the Office for National Statistics. The two differ significantly in their treatment of emissions associated with international aviation and shipping. In UNFCCC reports, these are not included in the UK's total but reported separately as memorandum items, in accordance with international guidelines. The Environmental Accounts are more comprehensive insofar as they include these emissions in UK totals, and they present UK progress in reducing emissions in a markedly different light.

¹ The term 'foreign credits' is used in this report to refer to the use of EU allowances and project credits from overseas.

- Emissions estimates can be presented in a variety of different ways – as carbon or carbon dioxide, by source or end-user, and by sector. Reporting requirements are tightly defined for international purposes, and the government has now agreed to base all reporting on carbon dioxide equivalents. Nevertheless, there remains considerable scope for aggregating and presenting data in different ways – particularly in relation to end-user sectors; and different figures can therefore be quoted for apparently similar areas of economic activity. The government is now creating a new analytical coordination role within Defra to improve the consistency with which departments present climate change data.
- The Climate Change Bill provides a new framework for setting UK targets. Its provisions will introduce concepts such as the ‘net UK carbon account’ and requirements to account for the contribution made by carbon credits and debits from emissions trading schemes. Such provisions could complicate the reporting framework further, or else provide an opportunity to develop a more comprehensive and transparent basis for presenting climate change statistics.

Issues for Committee scrutiny

4 Issues which the Environmental Audit Committee might be interested in pursuing include:

- i** the degree to which UK policy could or should take account of consumption-based emissions estimates – bearing in mind international reporting requirements, and the lack of reliable data and additional uncertainties involved in such estimates;
- ii** what steps the UK government is taking in an international context to promote greater coordination between different international reporting requirements and to develop more comprehensive ways of measuring greenhouse gas emissions;
- iii** what progress Defra is making in improving procedures for collecting the data required to calculate emissions, through developing formal data collection agreements with suppliers and through monitoring more systematically errors and revisions;
- iv** whether there is sufficient clarity in the basis on which to report progress against the UK’s domestic goal of a 20 per cent reduction in carbon emissions by 2010, particularly in relation to the purchase of foreign credits;
- v** why carbon reductions achieved through the purchase of credits under the EU Emissions Trading Scheme are currently not included in any National Statistics data; and what implications this may have for the reporting of greenhouse gas emissions and the UK sustainable development headline indicator for carbon dioxide;
- vi** the progress Defra is making in developing a new analytical coordination function to ensure that departments use and present greenhouse gas emissions data on a consistent basis; and
- vii** whether the Climate Change Bill is likely to increase the complexity of emissions reporting or alternatively could provide an opportunity to develop a more comprehensive and transparent framework for presenting climate change statistics.

Background

Introduction

1.1 The growing awareness of the challenge of climate change has led to much discussion in recent years of the need to reduce emissions of greenhouse gases (GHGs). There are many issues associated with this agenda, and the NAO has reported on two of them last year (the accuracy of emissions forecasting and the use of cost-effectiveness analysis). But the ability to measure and report GHG emissions accurately is a fundamental requirement underpinning any form of analysis and forecasting. This briefing, produced for the Environmental Audit Committee, aims to throw light on this process.

International agreements require the UK to measure and report its GHG emissions

1.2 The UK has measured and reported its emissions of GHGs since 1988, but these processes were revised and improved to support the UK's obligations under the United Nations Framework Convention on Climate Change (UNFCCC), which entered into force in March 1994.

1.3 It was within the framework of the UNFCCC that the Kyoto Protocol was negotiated in 1997, with most developed nations (including the UK as part of the EU) taking on specific targets for limiting or reducing their emissions. The Kyoto Protocol includes three 'flexible mechanisms' for helping countries reduce emissions in the most cost effective way: emissions trading, the Clean Development Mechanism (CDM),

and Joint Implementation (JI). These mechanisms allow countries to buy emission reductions that have taken place in other countries as a way of meeting their Kyoto targets, though their use has to be supplemental to domestic action.

1.4 In ratifying the UNFCCC, the UK committed itself to maintaining an inventory of GHG emissions, taking action to reduce them, and reporting regularly to the UNFCCC; and, since 1990, both national and international reporting has been based on this inventory. Technical aspects of the UNFCCC and Kyoto Protocol accounting and reporting processes are supported by an Inter-Governmental Panel on Climate Change (IPCC), a scientific body set up by the World Meteorological Organization (WMO) and by the United Nations Environment Programme (UNEP) in 1988 to provide decision-makers and others with an objective source of information about climate change.

1.5 In addition to the internationally agreed guidelines and standards for reporting against the UNFCCC, since 1994 the Office for National Statistics (ONS)² has also reported on UK GHG emissions, for the purposes of producing satellite Environmental Accounts alongside the main national accounts. The GHG element of the Environmental Accounts is based mainly on the GHG Inventory, with additional information from other sources. The work of the ONS and these environmental accounts are governed by European and international standards for accounts of this type.³

2. The Office for National Statistics (ONS) is the government department responsible for collecting and publishing official statistics about the UK's society and economy. Any government data published as "National Statistics" must conform to ONS criteria governing its accuracy, robustness, and presentation.

3. See, for example, the United Nations Handbook of National Accounting, 1994.

4. Under the provisions of Article 4 of the Kyoto Protocol, the EU-15 (as it was then) agreed to a legally binding target of eight per cent and then redistributed it to form differentiated emissions targets for each member state. The UK Kyoto target is measured against a baseline of 1990 for carbon dioxide, methane, and nitrous oxide; and 1995 for the three fluorinated gases (HFC, PFC, and SF₆). The term '1990/95 baseline' is used throughout this report to refer to the UK Kyoto baseline.

5. The target was originally endorsed in the March 2007 Spring Council. In January 2008, the EU Commission proposed differentiated targets for individual member states. The target proposed for the UK is to reduce greenhouse gas emissions from sectors not covered by the EU ETS to 16% below 2005 levels. See http://ec.europa.eu/energy/climate_actions/index_en.htm

6. These targets are discussed in paragraphs 3.9ff below.

7. See, for example, the European Commission press release of 23 January 2008 (IP/08/80).

1.6 In the UK, the GHG Inventory forms part of a more comprehensive inventory which records all atmospheric emissions – the National Atmospheric Emissions Inventory (NAEI). The NAEI is maintained by AEA Technology and Environment under contract with Defra (see Figure 1).

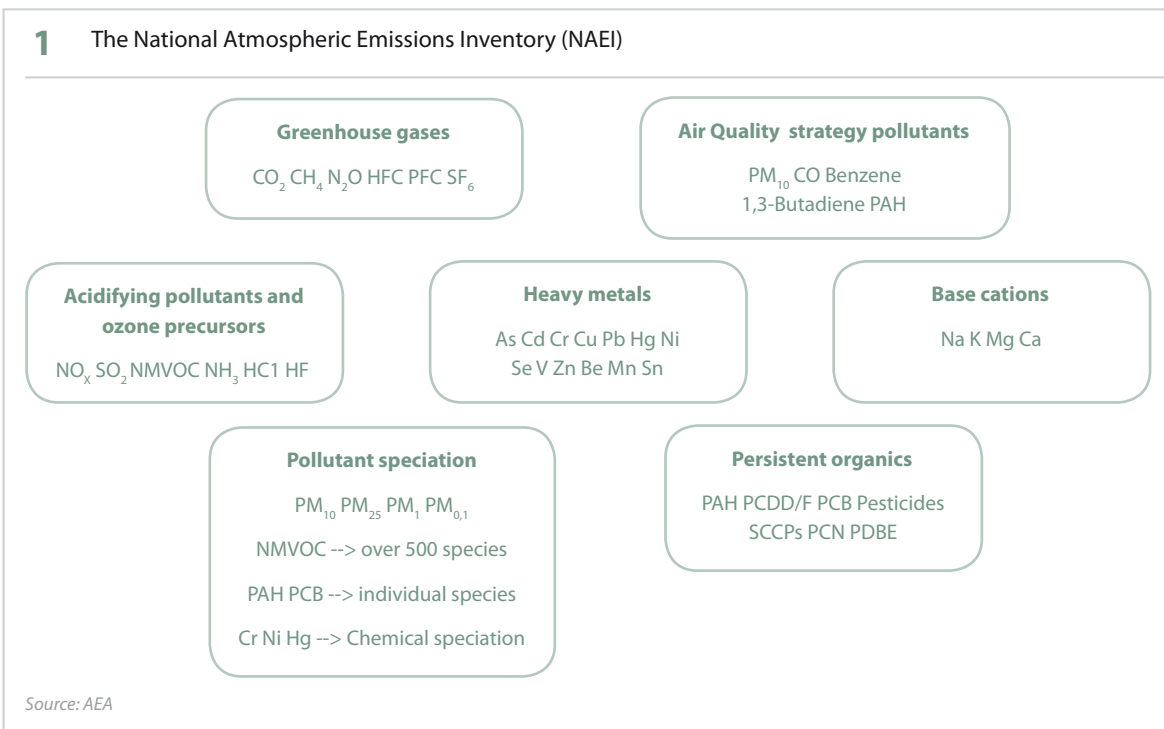
The UK is subject to various emissions targets and reporting obligations

1.7 In response to growing concerns about the environmental impacts of climate change, the UK has committed itself to various national, European Union (EU) and international targets for reducing its GHG emissions. These include:

- the UK Kyoto target of a 12.5 per cent reduction in GHGs by 2008-2012 against a 1990/95 baseline;⁴
- an EU target of a 20 per cent reduction in GHGs by 2020, rising to 30 per cent if other countries agree to similar goals, against the same baseline as for the Kyoto Protocol target;⁵

- three UK domestic goals, all against a 1990 baseline, of a 20 per cent reduction in CO₂ by 2010 and a 60 per cent reduction by 2050, with "real progress" by 2020;⁶ and
- a proposed new framework, set out in the Climate Change Bill, for translating into statute the 2020 and 2050 goals and for defining the emissions reduction pathway through a system of five year carbon budgets.

The EU has also been active in setting a range of other targets which would indirectly impact on overall GHG emissions. These include a proposed target for 20 per cent of all energy to come from renewable sources, and indicative targets for biofuels and for renewable electricity.⁷ In addition, the caps which the UK has set in relation to the EU Emissions Trading Scheme are also relevant in the context of efforts to reduce emissions.



1.8 There are a variety of obligations requiring the government to report GHG emissions, including at an international level annual submissions to the UNFCCC of the Common Reporting Format tables and the UK National Inventory annual report, and periodic National Communications reports which also cover projections and the effects of policies; to the United Nations Economic Commission for Europe (UN/ECE) of all atmospheric emissions including greenhouse gases; and to the European Commission on its performance against Kyoto targets and under the EU ETS. In terms of UK national reporting, requirements include the following:

- The Climate Change and Sustainable Energy Act (2006) places a legal requirement on the government to report the level of the UK's greenhouse gas emissions on an annual basis, together with the policy measures in place to reduce them.
- The UK Sustainable Development Strategy includes emissions of both GHGs and carbon dioxide as a key performance indicator, with annual internet-based updates of progress on both Defra and Office for National Statistics websites as and when the data becomes available.
- The Comprehensive Spending Review 2007 Public Service Agreement now includes the carbon budgets for 2008-12, 2013-17, and 2018-22 to be set in accordance with the provisions of the Climate Change Bill.⁸
- The ONS also publishes annually the Environmental Accounts, compiled in accordance with European standards for such accounts.⁹

1.9 In addition to these outputs, emissions of GHGs and carbon dioxide are frequently reported in a variety of other contexts – including the Budget and Pre-Budget Reports, the UK Climate Change Programme, the Energy Review, various White Papers and other policy documents, and regular publications such as *Energy Trends* (BERR). Statistics are also provided on both Defra and ONS websites.

How we approached this review

1.10 This briefing is based on interviews with staff in Defra, AEA Technology, BERR, and ONS, and on a review of available documentary material. It is important to note, however, that the NAO has not audited the robustness of the GHG Inventory itself and the data on which it is based. Instead, we have sought to establish what steps Defra has taken to ensure the validity and integrity of the emissions estimates, including the results of reviews carried out by the UNFCCC and others.

1.11 The review is structured as follows:

- Part 2 explains the role of the UK GHG inventory, and the manner in which emissions are measured; and
- Part 3 examines various issues relating to how emissions are reported, including the different targets and bases for reporting, the role of carbon trading, and the implications of the reporting procedures contained in the Climate Change Bill.

8. Both the UK Kyoto target and the 20 per cent carbon reduction target were included in previous PSAs but were dropped from the restructured PSAs which form part of the 2007 CSR. The only UK reduction targets included in the latter are the carbon budgetary targets of the Climate Change Bill (PSA Indicator 4).

9. ONS publishes the Environmental Accounts both separately and as part of the Blue Book.

Measurement

10. The Marrakesh Accords is a set of agreements reached at the Seventh Conference of the Parties (COP7) to the UN Framework Convention on Climate Change (UNFCCC), held in Marrakech, Morocco, in October 2001. The Accords provide the detailed procedural and legal basis for the operation of the Kyoto Protocol – including the compliance, accounting and reporting arrangements, and the use of flexible mechanisms and sinks.

11. Inventory activities include collecting activity data, selecting methods and emission factors appropriately, estimating anthropogenic GHG emissions by sources and removals by sinks, implementing uncertainty assessment and quality assurance/quality control (QA/QC) activities, and carrying out procedures for the verification of the inventory data at the national level, as described in these guidelines for national systems.

2.1 The UK GHG Inventory was developed to fulfil the UK's reporting obligations under the UNFCCC. It is also used to measure progress against all of the UK's GHG reduction objectives and to provide information for policy purposes. In addition, it forms the basis on which forecasts of future emissions are calculated.

2.2 The Inventory is compiled and maintained by AEA Energy and Environment under contract with the Climate, Energy and Ozone, Science and Analysis (CEOSA) Division in Defra. It incorporates estimates of emissions relating to land use and agriculture provided by the Centre for Ecology and Hydrology (CEH) and the Institute of Grassland and Environmental Research (IGER). In order to oversee the operation of the Inventory and approve reports submitted to the UN, Defra has established a cross-government Steering Committee with representation from government departments as well as the devolved administrations.

2.3 International reporting regulations agreed as part of the UNFCCC and Kyoto Protocol include detailed guidance on the way in which the Inventory should be structured and GHG estimates made. The current guidance consists of the *'Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories'* published by the IPCC in 2000; and the *'Good Practice Guidance for Land-use, Land Use Change and Forestry'*, published by the IPCC in 2003. These volumes are used in conjunction with the *'Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories'*. Adoption of the latest guidance, the five volume *'2006 IPCC Guidelines for National Greenhouse Gas Inventories'*, is currently under discussion and it is

expected eventually to supersede current guidance. In addition, the Marrakesh Accords (2001) set down detailed procedural regulations relating to national inventory systems, including the requirements that they should:

- ensure the transparency, consistency, comparability, completeness and accuracy of inventories;
- ensure the quality of the inventory through planning, preparation and management of inventory activities;¹¹
- support compliance with Kyoto Protocol commitments related to the estimation of anthropogenic (i.e. man-made) GHG emissions by sources and removals by sinks; and
- consistently estimate anthropogenic emissions by all sources and removals by all sinks of all GHGs.

Reporting requirements are based on a territorial approach and do not take account of the impact of foreign trade

2.4 IPCC, UNFCCC and Kyoto Protocol guidance for measuring and reporting emissions is based on a territorial approach, whereby individual countries calculate emissions arising from the consumption of fossil fuels within their borders. Other approaches are possible, though these would not conform to the reporting requirements of the UNFCCC and the Kyoto Protocol. As set out in Part 3, for example, the Office for National Statistics produce a set of Environmental

Accounts which include emissions from international aviation and shipping, and in which other transport emissions data are reported on the basis of UK residency rather than physical location.

2.5 Neither of these approaches take account of the embedded carbon balances involved in foreign trade and services. If the UK imports goods from other countries, the carbon emissions associated with the manufacture of the imported products will be reported in those other countries rather than the UK. The converse is also true: emissions relating to UK manufactured goods which are exported overseas will be entirely accounted for within the UK.

2.6 The structural changes which have taken place in the UK economy over the last 30 years have resulted in significant deindustrialisation. As a result, the carbon intensity of the UK economy has fallen and the UK now imports large quantities of products which are relatively carbon-intensive to manufacture. UK consumption is therefore indirectly responsible for the emissions associated with these imports. Were the balance of imports and exports to be taken into account, UK reported emissions would be significantly different. Recently, Dieter Helm and others have produced a report analysing UK emissions on a consumption basis, and they have argued that the UK has not only failed to reduce greenhouse gas emissions but that such emissions have actually increased.¹²

2.7 Concern over the impact of imported goods has existed for some time. In 2004, for example, the Welsh Assembly committed itself to developing a basket of sustainable development indicators, including one for the global impact of consumption in Wales.¹³ Moreover, the increasing prevalence of ecological footprint and mass-balance analyses highlights a widespread desire for more holistic and comprehensive reporting methodologies. Defra is carrying out research in this area and has commissioned a study to develop an indicator for measuring overseas embedded carbon dioxide emissions. It expects to publish a report on this in mid-2008. And, in the light of the increasing need for a standardised method for measuring the embedded greenhouse gas emissions of products and services

across their lifestyle, Defra and the Carbon Trust are co-sponsoring the British Standards Institute to develop a Publicly Accessible Specification on this topic. This is expected to be completed by summer 2008.

2.8 However, the calculation of emissions on a 'consumption' basis involves complex assumptions and much uncertainty. To reduce this uncertainty, far greater data would be required about the carbon-intensities of all imported (and exported) goods and services: even then, the calculations involved would be dauntingly complex. In addition, there would be issues of trade, policy jurisdiction and economic development to be considered. For these reasons, while consumption-based reporting might prove useful in highlighting policy issues, it is very unlikely that it could provide a robust, internationally agreed basis for reporting emissions.

National GHG emissions cannot be measured directly and have to be estimated using a complex model

2.9 In the UK and all other industrialised countries, GHG emissions are estimated not by directly measuring them but by calculating them from the fossil fuels used and from other relevant processes relating to industry and agriculture. To do this accurately requires detailed information and data from a wide range of source sectors and activities. Such an approach, based on economic activity data, complies with IPCC guidelines.

2.10 Some external verification of non-CO₂ GHG emissions is done through atmospheric measurements at the Mace Head Atmospheric Research Station on the Atlantic coastline of Ireland. Continuous atmospheric measurements are taken and modelled to determine their origin and this gives estimates for the non-CO₂ GHG originating in the UK. However, these estimates are less accurate than calculating emissions based on economic activity data, and this would remain the case even if a network of measuring stations were established. It is also difficult to measure directly carbon dioxide emissions in this way.¹⁴

12. *Too Good To Be True? The UK's Climate Change Record* (Helm, Smale, Phillips), December 2007.

13. Defra consultation, *Taking it on*, April 2004, page 38.

14. This is due to a number of factors including the diffuse nature of carbon dioxide emissions, the difficulty of distinguishing anthropogenic from naturally occurring emissions, and the levels of carbon dioxide naturally occurring in the atmosphere.

International requirements specify the basis on which emissions should be estimated and reported

Emissions are estimated using a 'bottom up' approach

2.11 The IPCC guidelines on GHG reporting specify in detail what methodologies to use for calculating emissions, and how trade offs between precision, accuracy and resources should be approached. They require emissions to be estimated using a bottom up approach. Using the economic activity data supplied by government departments, trade associations and businesses, AEA and sector specialists the Centre for Ecology and Hydrology (CEH) and the Institute of Grassland and Environmental Research (IGER) model emissions of all known anthropogenic sources of greenhouse gases in the UK within the following five specific source sectors:

- Energy.
- Industrial processes.
- Agriculture.
- Land Use, Land Use Change and Forestry.
- Waste.

2.12 These broad areas are then broken down into activity types, subtypes, and activities (**Figure 2 and Figure 3**). The emission-producing activities include the combustion of fuels such as coal in power stations, the use of petrol and diesel in road transport, industrial processes such as cement manufacture, agricultural sources such as enteric fermentation in cattle, and sources and sinks of CO₂ caused from changes in the way land is used. This classification follows the IPCC's guidance on producing emission inventories which in turn mirrors the standard UN classifications of economic activity.

2 Activity area and type breakdown			
Total	Activity area	Activity type	
Total	Energy	Fuel Combustion Activities	
		Fugitive emission from fuels	
	Industrial Processes	Consumption of Halocarbons and SF ₆	
		Mineral Products	
		Chemical Industry	
		Metal Production	
	Agriculture	Production of Halocarbons and SF ₆	
		Agricultural soils	
		Enteric Fermentation	
	Land Use, Land Use Change and Forestry	Manure Management	
		Cropland	
		Settlements	
		Other	
		Grassland	
	Waste	Forestland	
		Solid Waste Disposal on Land	
		Waste Water Handling	
			Waste Incineration

Source: IPCC

3 Further breakdown of fuel combustion activities

Activity type	Activity sub-type	Emissions producing activity
Fuel Combustion activities	Energy industries	Public Electricity and Heat Production
		Petroleum Refining
		Manufacture of Solid Fuel and other Energy Industries
	Manufacturing industries	Other manufacturing
		Iron and Steel
	Transport	Road transportation
		Navigation
		Civil Aviation
		Railways
		Aircraft support vehicles
	Other sectors	Residential
		Agriculture/Forestry/Fisheries
Commercial/Institutional		
Military Use		

Source: IPCC

15. See 2.18 below for emissions factors.

Emissions from each activity are estimated using different models

2.13 Emissions from each of these activities are estimated using methodologies recommended in the IPCC guidance. A country may choose a method from one of three tiers, each tier representing an additional layer of sophistication in the estimation techniques used.

- Tier one methods are generic methods that could be used by any country; aspects of the methods such as emissions factors are not calculated to reflect a country's specific situation.¹⁵ This is the default method and generally the least accurate and precise.
- Tier two methods are more complex and usually require country-specific input such as the calculation of emissions factors. They usually provide greater accuracy and precision over the Tier one methods.

- Tier three methods are the most complex and can require sophisticated bespoke modelling of data – for example, in calculating UK transport emissions where data on fuel use, fuel type, car type, road type, and miles driven is used to model total emissions.

2.14 In accordance with IPCC requirements, the UK use either tier two or tier three methods for all 'key categories', defined as those which account for 95 per cent of the total uncertainty in its emissions. Where tier one methods have been used, it is either because the activity produces such a small amount of emissions that using tier two would have a very small impact on the Inventory, or because the IPCC default methodology gives a result very similar to a UK specific methodology. **Figure 4 overleaf** provides some examples of the way in which emissions are calculated for various activities.

4 Some emissions producing activities and methods used to estimate emissions

Activity	GHG	IPCC tier	Method used to estimate emissions
Public electricity and heat production	CO ₂	2	An emissions factor is applied to fuel consumption data from DUKES. ¹ Some data are also collected from individual point sources at generation facilities. The emissions factors are UK specific factors obtained by sampling average UK carbon content of fuels.
Road transportation	CO ₂ , CH ₄ , N ₂ O	3	Emissions from road transport are estimated from a combination of total fuel consumption data taken from the Digest of UK Energy Statistics and fuel properties, and from a combination of drive related emission factors and road traffic data on fuel use, car type, miles driven, road types, and fuel type from DfT.
Domestic aviation	CO ₂ , CH ₄ , N ₂ O	3	Data from DfT and CAA on aircraft movements is broken down by aircraft type at each UK airport. The model takes into account the lengths of time spent on different parts of an aircraft's take off and landing cycle and different types of aircraft used in the UK.
Refrigeration and air conditioning equipment	HFC	2	Data on the numbers of UK domestic and commercial refrigerators is obtained from the UK Market Transformation Programme and activity data supplied by industry. Data on mobile air conditioning systems is obtained from the UK Society of Motor Manufacturers and Traders. Once the numbers and size of refrigerators is known, an emissions factor which was derived to reflect UK refrigeration fluids applied to estimate emissions.
Enteric Fermentation	CH ₄	2	Enteric fermentation is a digestive process in ruminant animals which produces methane. Emissions are estimated from animal production data from the June agricultural census. Emissions factors for milk producing cattle, lambs and deer are calculated using a tier 2 approach which takes into account the sizes, ages and types of UK animals.
Agricultural soils	N ₂ O	1 and 2	The method involves estimating the contributions from the use of inorganic fertilizer, biological fixation of nitrogen by crops, ploughing in crop residues, cultivation of organic soils, spreading animal manure on land, and manures dropped by animals grazing in the field using data from Defra and the British Survey of Fertiliser Practice. For some of these areas IPCC default methods are used and for others UK specific methods are used.
Wastewater handling	CH ₄ , N ₂ O	2	The estimate is based on the work of Hobson et al (1996) who estimated emissions of methane for the years 1990-95. Subsequent years are extrapolated on the basis of population. Sewage disposed to landfill is included in landfill emissions.

Source: AEA/National Audit Office

NOTE

1 The Digest of UK Energy Statistics, published annually by BERR.

Economic activity data on emissions producing activities is collected by the government and others

2.15 The way in which activity data are broken down to estimate emissions closely resembles the basis on which the government monitors economic activity. As a result, much of the economic activity data gathered by government is already classified in a format which can facilitate estimates of emissions.

2.16 One of the major sources of activity data, covering around 85 per cent of emissions, is the Digest of UK Energy Statistics (DUKES) which is produced annually by BERR and is the most authoritative source of annual data on energy use in the UK. The data are analysed by fuel type, economic activity, and by primary source and end-user; and therefore provide detailed information on the ways in which all the main fuel sources were used. DUKES is compiled through information gathered in surveys completed by all of the major consumers, producers, distributors and importers/exporters of fuel in the UK. As these suppliers and users of fuels must be licensed by the government, BERR can be sure that virtually all fuel produced, used, imported and exported legally in the UK is covered by these surveys. Consequently, BERR is able to build complete supply and demand figures for each type of fuel. The difference between these figures tends to be below one per cent, giving BERR a high degree of confidence in both their accuracy and completeness.

2.17 The rest of the activity data comes from a variety of sources some of which are listed in **Figure 5 overleaf**. Many of the data providers are government departments but some of the data used to estimate emissions are from trade associations and directly from industry. AEA requires each data provider to submit a quality control statement which sets out what procedures it has in place to ensure the accuracy of the data.

Emissions factors are applied to activity data to calculate emissions estimates

2.18 The method used to estimate emissions for many activities is to use emissions factors to convert activity data into gas emitted. Though more complex relationships are needed in some cases, in general the equation is:

$$\text{Total Emissions} = \text{Emissions Factor} \times \text{Activity Statistic}$$

For activities where emissions are created through the combustion of a fuel, the factor will represent how much GHG is typically emitted when the fuel is burnt. As the emissions will relate not only to the nature of the fuel itself but the efficiency of the process, emissions factors are typically derived experimentally from measuring a sample of representative fuel sources and the resulting factor applied to that activity across the whole UK. This means that the UK has unique emissions factors derived from the make-up of its fuel sources. Different emissions factors are derived for each fuel and activity and they generally vary from year to year.

Case study

Calculating CO₂ emissions from coal use in power stations

The estimate of CO₂ emissions arising from coal burnt in power stations is made by applying the UK coal emission factor to the tonnage of coal burnt as given in the Digest of UK Energy Statistics (DUKES).

- To calculate how much coal was burnt in UK power stations DUKES sends questionnaires to electricity companies and coal companies asking how much coal was bought, sold and imported over the previous calendar year. Using this data and import and export data from HMRC, DUKES obtains figures for both supply and demand of UK coal. These figures are within <1 per cent of each other, giving a high degree of confidence in their accuracy.
- The total figure for coal used by major power producers is made up of 49 Mt of steam coal and 1 Mt of anthracite giving a total of 50 Mt. The data is then checked by AEA. Using more detailed coal data from the British Cement Association AEA know that 1 Mt of this coal was used in cement production and should not be included in the power generators' activity total. This gives a final figure of 49 Mt of coal used for power generation.
- The emissions factor used for coal in power stations was derived by calculating the average carbon content of coal in the UK, taking into account the difference between imported and domestic coal, and the carbon ash content (i.e. the amount of unburnt carbon) as 630 KtC per million tonnes of coal.
- This means emissions from coal use = $49 \times 630 = 31 \text{ MtC}$ (114 MtCO₂).

5 Key data providers

Organisation	Data provided annually to the Inventory
Department for Business, Enterprise & Regulatory Reform	Energy use statistics, by fuel and by economic sector (DUKES)
Department for Transport	Transport statistics for road, rail, air and sea vehicles
British Geological Survey	Mineral extraction and industry end-use for specific minerals
Office of National Statistics	National and regional data pertaining to housing and economic activity
Department of Communities and Local Government	Housing and population data
HM Revenue & Customs	Import and export data for certain goods
The Environment Agency of England & Wales	Emissions data from industrial plant, from the Agency's Pollution Inventory
The Scottish Environmental Protection Agency	Emissions data from industrial plant, from the Agency's Pollution Inventory
The Scottish Executive	Industrial activity data, employment data
The Department for the Environment, Food & Rural Affairs	Agricultural data, employment data
The Welsh Assembly	Industrial activity data, employment data
The Northern Ireland Department of Environment	Emissions data from industrial plant, from the Agency's Pollution Inventory
CORUS Ltd	Steel production data
British Cement Association	Cement production data

Source: AEA

NOTE

In addition to these main data suppliers there are around 15 additional smaller suppliers of data, including individual industrial plants and trade associations.

2.19 In 2004 AEA conducted a major review of the carbon emissions factors used in the Inventory. In this review many of the emissions factors were updated. For example, emissions factors for coal burnt for power generation were changed after the 2004 review as a result of more accurate data on the amount of carbon left unburnt and to reflect an increase in imports of foreign coal, the carbon content of which was different. As a result, many of the emissions estimates were revised retrospectively, changing the historical time series by applying the new factors to historical activity data.

Because of the complexity there is an unavoidable delay in producing the Inventory

2.20 Provisional GHG emissions estimates are produced three months after the end of the calendar year they cover. These are based on an initial calculation by BERR of carbon dioxide emissions using provisional data for inland energy consumption. Simple estimates of non-CO₂ gases are also made using historical trend data in order to be able to give an indication of what the carbon dioxide estimate implies for the basket total; and a further adjustment is made in respect of emissions from Overseas Territories. BERR publishes its provisional estimate of carbon dioxide emissions as National Statistics in its March edition of Energy Trends; and at the same time Defra publishes the provisional GHG estimate in a National Statistics press release.

2.21 Near-final GHG estimates are sent to the European Union and published in a Defra National Statistics release at the end of January, thirteen months after the end of the calendar year they cover. Those for 2007 will therefore not be published until January 2009. Final estimates are published and submitted to the UN some three months later (**Figure 6**). There are a number of reasons for the length of time it takes to produce them:

- complete and accurate data on emissions-producing activities collected by government departments, trade associations and business do not become available until the summer – some six to eight months after the end of the calendar year to which they refer;
- after receiving the activity data, it takes several months to complete the complex process of data verification and modeling; and
- the UNFCCC review the previous year's inventory normally between February and June, and the UK has to respond in the following

months to the review and make any agreed improvements to future inventories arising from its recommendations.

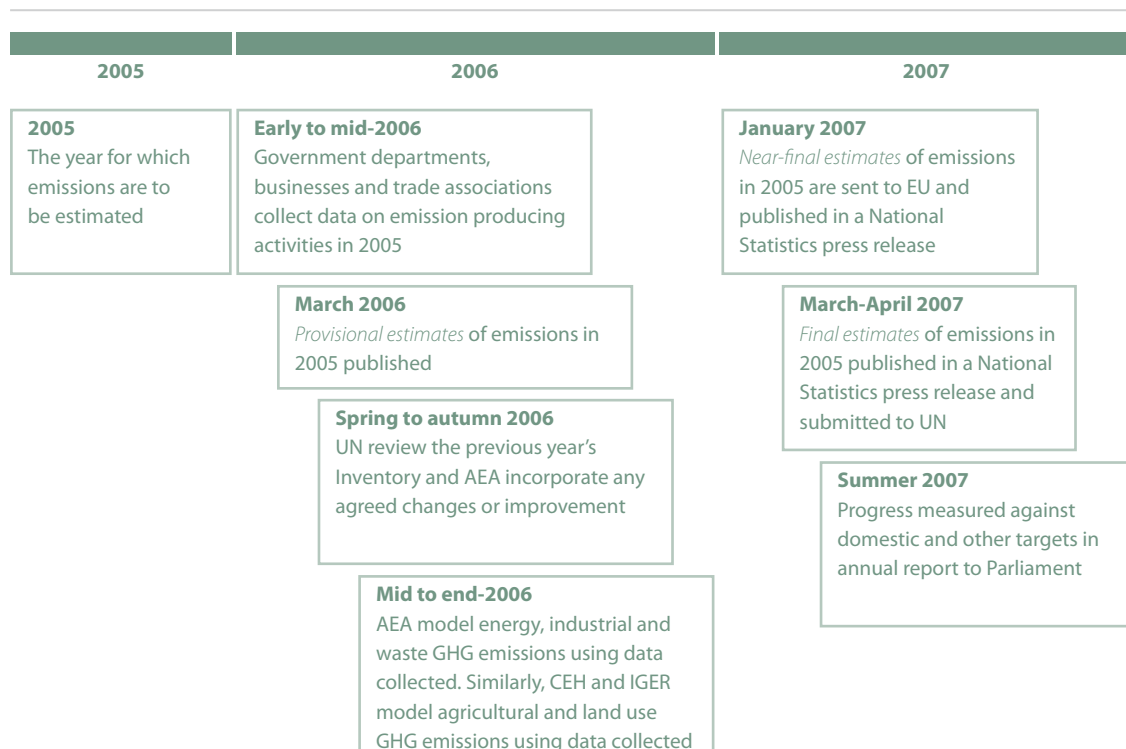
UN and external peer reviews of the Inventory have been favourable

2.22 The UN reviews the UK's inventory every year.¹⁶ Prior to the commencement of the Kyoto commitment period (2008-12), it also carried out more detailed reviews of all countries with emissions limitation or reduction commitments. As part of this process, a team of international experts visited the UK in 2006 to conduct an in-country review. This involved checks on all submitted data, a review of the Inventory Report and interviews with inventory staff. The team concluded that *"The United Kingdom's institutional arrangements are well organized and well functioning, leading to high quality, transparent, consistent, comparable, complete and accurate inventory reporting in accordance with the revised 1996 IPCC guidelines and the IPCC good practice guidance"*.¹⁷

16. This is generally carried out between February and June and is focussed on the previous years' inventory report.

17. Report of the individual review of the greenhouse gas inventory of the United Kingdom of Great Britain and Northern Ireland submitted in 2006 (UNFCCC, October 2007). See <http://unfccc.int/resource/docs/2007/irr/gbr.pdf>.

6 Inventory cycle, showing how 2005's emissions were estimated



Source: AEA, National Audit Office

18. Normally, Defra and AEA would have incorporated agreed changes in its current work – i.e. the processing involved in producing the Inventory report for the following year – rather than apply the changes retrospectively to the estimates already submitted.

2.23 In addition to the UN's review two external peer reviews have been completed on the UK inventory by international experts. These focused on specific activity areas of the inventory which either contribute a significant amount to the total or a significant amount to the uncertainty in the inventory. The first review looked at CO₂ from fossil fuel combustion and the second looked at emissions from agriculture. They both suggested some changes which were later incorporated in the inventory. Further reviews are planned for GHG emissions from waste-water treatment and emissions from the offshore oil and gas industry.

The 1990/95 Kyoto baseline has changed to reflect methodological improvements, but has now been fixed for the first commitment period

2.24 Each year before data collection begins AEA revise the methodology of the previous year to take into account new activity data, new emissions factors, new methodologies or a combination of these. These changes are applied retrospectively in order to improve the accuracy of estimates: emissions data for each year going back to 1990 are recalculated and a new year's emissions data is added. Examples of changes made in the 2007 inventory are revisions of fuel emission factors, revisions to rail transport statistics, changes to models, changes in geographical range, changes to livestock diets, revisions of poultry numbers, and changes to deforestation data.

2.25 Since 1998, methodological improvements have resulted in annual revisions of estimates. In particular the 1990/95 baseline that performance is measured against has altered (**Figure 7**). As a result, the emissions reductions needed to meet targets has also changed. For example, the absolute level of emissions required to meet the UK's Kyoto target has ranged from 660 MtCO₂e to 685 MtCO₂e (a difference

of around three per cent). Similarly, the estimate of the 1990 baseline for CO₂ emissions has fallen from 605 MtCO₂ in 1998 to 593 MtCO₂, and this means that the UK's 20 per cent CO₂ reduction goal has also fallen slightly. Improvements to the methodology have meant that the targets are now more accurate in absolute terms.

2.26 Under the Kyoto Protocol, all industrialised countries subject to the protocol must fix the baseline emissions before the start of the five year commitment period (2008-2012). This is because performance against Kyoto targets is measured over the whole period, and because there needs to be a firm basis for conducting emissions trading. The estimate compiled in 2006 of the 1990/95 baseline therefore represents the final figure against which the UK's 12.5 per cent reduction will be judged; and this is why, following the 2006 UN review referred to above, the UK not only incorporated agreed changes to the Inventory but revised and re-submitted the National Inventory Report and Common reporting format tables.¹⁸ Future recalculations of emissions due to new activity data or methodological changes will be applied to future inventory time series (including emissions back to 1990), but will not change the baseline against which performance under the first commitment period of the Kyoto Protocol is measured.

2.27 In considering data published earlier this decade, it is important to keep in mind the fact that the baseline has varied historically. In the past, for example, many policy documents and reports have quoted the baseline for carbon dioxide emissions as 605 MtCO₂ (165 MtC) and the 20 per cent domestic target as 484 MtCO₂ (132 MtC). Methodological changes have resulted in a fall in both these figures to 592 MtCO₂ (161.5 MtC) and 473 (129 MtC) respectively. But as these changes impact not only upon the baseline but on current emissions, they tend not to affect greatly relative performance against the target.

7 Revisions to the baseline have meant the absolute size of target reductions has changed

National Inventory Report	Carbon dioxide (MtCO ₂)		All GHG (MtCO ₂)	
	1990/95 Baseline	20% reduction	1990/95 Baseline	12.5% reduction
2000	605	484	766	670
2001	592	474	754	660
2002	592	474	754	660
2003	594	475	756	661
2004	593	474	755	661
2005	591	473	754	660
2006 ¹	593	474	771	674
2006 ²	593	475	782	685
2007	593	475	778	680

Source: Common reporting format tables, National Audit Office

NOTE

The left-hand column refers to the year of publication of the National Inventory Report. The baseline columns show the calculation of the 1990/95 baseline as contained in each of those reports, while the 20% and 12.5% columns show the actual level of emissions which these targets would imply. Estimates compiled in 2006, for emissions in 2004, were revised and re-submitted (see paragraph 2.26).

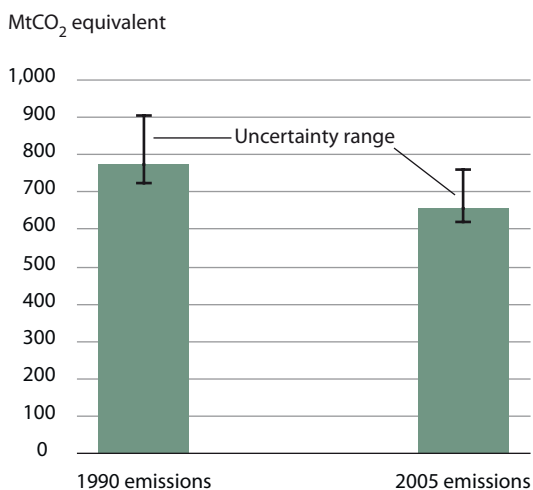
2.28 The fixing of Kyoto baselines may lead to some complications in reporting emissions. IPCC guidance makes it clear that further methodological improvements in measurement will be incorporated in emissions reporting, and AEA will therefore recalculate the historical data series in accordance with such changes. Current performance will therefore be based on a slightly different methodology to that used to calculate the fixed Kyoto baseline. Moreover, as further methodological changes are incorporated, the re-calculated baseline itself might alter giving rise to two slightly different figures – though any variation is likely to be relatively small.

There is considerable uncertainty in the emissions estimates, caused mostly by non-CO₂ emissions

2.29 There is inherent uncertainty in the emissions estimation process. AEA quantifies this annually, and for 2005 data estimated the uncertainty to be 14.3 per cent. This means that AEA were 95 per cent certain that total GHG emissions were between 620 and 762 MtCO₂e. AEA's central estimate was 655 MtCO₂e: this is the headline figure most often quoted. In **Figure 8 overleaf**, uncertainty is represented by the vertical line on 2005 emissions, with the 1990 emissions estimate shown for comparison.

19. The 2007 Annual Inventory Report contains a textual mistake to this effect which was due to a failure to take account of the specific work carried out by AEA to evaluate the uncertainty in the trend.

8 Total UK GHG emissions estimates showing 95 per cent confidence intervals, 1990 and 2005, All GHG, Mt CO₂e



Source: AEA

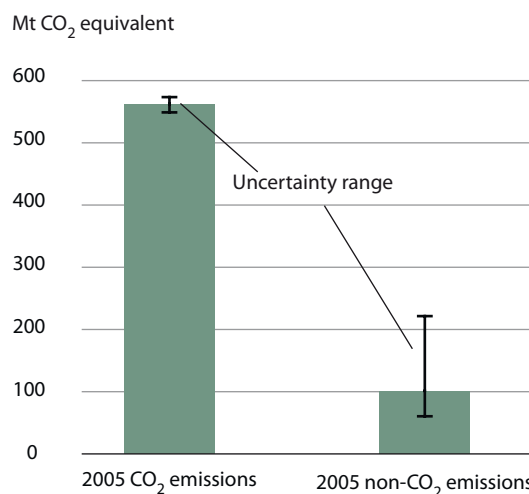
2.30 However, it would be wrong to conclude that the overall impact of this uncertainty is that the change in emissions between 1990 and 2005 lies somewhere between a 29 per cent reduction and no change, with a central estimate of a 15 per cent reduction.¹⁹ This is because the methodological uncertainties are correlated from year to year, and IPCC has provided a method to take this into account. When this is done, the uncertainty on the trend is considerably lower, with a 95 per cent confidence of being between ± 3 per cent of the central estimate of a 15 per cent reduction.

2.31 The majority of the uncertainty in GHG estimates relates to estimates of gases other than CO₂. **Figure 9** shows how the uncertainty associated with CO₂ emissions estimates is low at around ± 2 per cent of the total. This is because data on CO₂ producing activities are accurate and complete and the carbon content of the fuels is well known and measurable. As a result, emissions estimates arrived at by applying emissions factors to activity data are fairly accurate.

2.32 By contrast, the uncertainty arising from the non-CO₂ GHGs is much higher. The best estimate of total non-CO₂ emissions is 100 MtCO₂e, with a lower bound of 70MtCO₂e and an upper bound of 208 MtCO₂e. This uncertainty is dominated by nitrous oxide emissions in agriculture. The factors that contribute to these emissions are inherently variable and it is therefore more difficult to produce reliable estimates of emissions. For example, the release of N₂O from nitrogen in agricultural soils takes place over a long period of time and the rate is dependent on the weather.

2.33 The uncertainty involved in emissions estimates is an inherent aspect of the methodology and scientific uncertainty involved. The UK is less affected in this respect than other less-industrialised countries in which emissions from agriculture and Land Use, Land Use Change and Forestry (LULUCF) may be proportionally much larger. Moreover, the fact that any methodological changes are applied consistently across data sets back to the baseline year means that, while absolute levels of emissions may be subject to considerable uncertainty, relative changes in them can still be reliably identified. This is the reason for the lower level of uncertainty associated with the trend in emissions since 1990, as discussed in paragraph 2.30 above.

9 CO₂ and non-CO₂ emissions estimates showing 95 per cent confidence intervals, 2005



Source: AEA

There is some scope for Defra to improve procedures for collecting data

The Inventory relies on voluntary rather than formal agreements with activity data suppliers

2.34 Defra does not have formal agreements with those organisations which supply activity data for the Inventory (see Figure 5), although steps are in hand to introduce them. It relies on voluntary agreements with all suppliers, both public and private bodies, and it has experienced some problems arising from the provision of data late or in the wrong format. In 2005, the government introduced new legislation which gave Defra the legal right to obtain any information required for the preparation of the Inventory.²⁰ The legislation requires data suppliers to supply information if they have been formally notified of the information required, the form it is required in, and the time it is required by. However, Defra has not yet developed a system for formally notifying suppliers, and at present could not enforce this legislation in order to ensure it receives all of the data required to make emissions estimates.

2.35 The absence of such agreements means that there is a small risk that data essential to estimating emissions will not be collected. In this case, the inventory compilers (AEA) would make an estimate of the missing data and attempt to source it in the following year. Any non-compliance with the reporting requirements could result in the UNFCCC proposing an adjusted estimate, with implications for the UK in the Kyoto commitment period. However, the UK has successfully passed its first inventory review under the Kyoto Protocol without any adjustment.²¹

Any errors AEA find in activity data should be recorded in a central error log

2.36 AEA check activity data supplied to them, and occasionally find significant errors. They do this by comparing data to previous years to identify trends, similarities and differences. If such changes are found and errors suspected, AEA will contact the data provider to correct the error or provide a reason why there has been a large change in the data.

2.37 AEA is less able to identify smaller errors in the data and rely in part on the statement of quality control obtained from each data provider. This provides assurances that the latter has put in place appropriate procedures for data checking. In the case of DUKES and some other government data, a high degree of assurance exists as the data is classed as National Statistics and therefore is subject to a thorough review process. However, in the case of data from other sources, checking procedures may not be as thorough.

2.38 AEA keeps a record of technical improvements needed in the Inventory which is collated following feedback from the UNFCCC and from sector experts (AEA, IGER and CEH). All data, documentation and databases are archived and so it is possible to reconstruct any changes in the Inventory from year to year and the reasons for them. However, AEA do not currently maintain each year a log of errors found in the data supplied to them and any subsequent corrections which they make. Such a record might help to identify less reliable data sources and reduce the error rate in them. The development of data provision agreements with suppliers would also help in this respect by providing a vehicle for specifying the nature and quality of data required; while the maintenance of an error log would provide a basis for monitoring performance against these agreements.

20. Greenhouse Gas Emissions Trading Scheme (Amendment) and National Emissions Inventory Regulations 2005.

21. See paragraphs 2.22 and 2.23 above.

Targets and reporting

22. The UK's Fourth National Communication under the United Nations Framework Convention on Climate Change, p.14.

3.1 The Greenhouse Gas Inventory forms the basis for all reporting requirements. While its primary purpose is to enable the UK to comply with its reporting obligations under the UNFCCC, the data are publicly available and can be used in various ways by government departments and other bodies.

3.2 This part of the report examines how government departments present emissions data: including differences in the targets themselves and the bases of reporting, the consistency with which data is presented and used, the implications of the development of emissions trading schemes, and the extent to which recent initiatives might improve the current reporting framework.

Reporting is made more complex because of different bases for targets

3.3 The national, European, and international emissions targets relating to the UK vary in the amount of reductions required, in the gases they cover, the timescales over which they operate, and the extent to which they are legally binding. These differences are set out in **Figure 10**.

3.4 With regard to reporting emissions, the most significant difference between the various targets relate to the gases which they cover: in marked contrast to the Kyoto and EU targets, the UK goals set in the 1997 election manifesto and the 2003 Energy White Paper apply only to carbon dioxide emissions. The government has maintained this approach in

drawing up the Climate Change Bill, in view of the fact that CO₂ accounts for more than 80 per cent of total UK greenhouse gas emissions, the majority of the UK's CO₂ emissions are associated with energy use, and sustained reductions in carbon dioxide emissions (as opposed to other GHGs) have been more difficult to achieve. However, the Bill also allows for the purchase of foreign credits to count towards net UK emissions. As such credits could be based on the Kyoto basket of six GHGs, it is not entirely consistent in the extent to which it focuses only on carbon dioxide.

3.5 Other differences between the various targets are less significant in terms of their impact on reporting emissions, but nevertheless introduce further complexity in the process. They include:

- **the geographical scope of the target:** The Kyoto target is based upon emissions in the UK, and those Crown Dependencies (Jersey, Guernsey, and the Isle of Man) and Overseas Territories which are party to UK ratification of the Kyoto treaty. By contrast, the UK domestic 20 per cent goal excludes Overseas Territories, though the impact of this on reported emissions is minimal.
- **the treatment of carbon sinks:** Carbon sinks are included when measuring progress towards national goals and international targets, but to varying degrees. UNFCCC reporting guidelines require estimates of all anthropogenic sources minus sinks from the LULUCF sector, and it is on this basis that progress against the 20 per cent UK domestic goal is assessed.²² However, reporting against the Kyoto target is based on a narrower

10 Coverage and scope of emission reduction targets

	International (Kyoto)	EU Spring Council 2007	UK 1997 manifesto target	UK Energy White Paper (2003)	UK Climate Change Bill targets
Gases covered	6 gases	6 gases	CO ₂ only	CO ₂ only	CO ₂ (domestic) 6 gases (trading)
Target reduction	8 per cent (EU) 12.5 per cent (UK)	20 per cent 30 per cent (EU) UK target not yet agreed ¹	20 per cent	About 60 per cent	Interim: 26 per cent– 32 per cent Final: 60 per cent
Target date	2008-12	2020	2010	Around 2050, with 'real progress' by 2020	Interim: 2018-22 Final: 2050
Baseline	1990/1995	1990/1995	1990	Current level ²	1990
Emissions trading allowed	Yes	Likely	Not originally envisaged ³	Yes	Yes
Geographical scope	UK, Crown Dependencies, and some overseas territories	UK	UK & Crown Dependencies ⁴	Not clearly specified	UK
Legally binding	Yes	Uncertain	No	No	Yes

Source: National Audit Office

NOTES

- 1 The European Commission has proposed a target for the UK to reduce emissions from sources not covered by the EU ETS by 16% below 2005 levels by 2020. See footnote 5 on page 8.
- 2 The target was based on the RCEP recommendation which, in turn, was based on 'current levels' of emissions.
- 3 See paragraph 3.9 below.
- 4 The UK's Fourth National Communication under the United Nations Framework Convention on Climate Change, p.14.

definition of LULUCF which limits the accounting of removals from forests and in the UK's case excludes cropland or grazing land management.

3.6 The differences between the various targets increase the administrative complexity of monitoring and reporting performance against them. In addition, all targets can be regarded as incomplete in terms of their coverage as they exclude UK-related emissions from international aviation and shipping, due to the lack of international agreement on how these should be allocated to national inventories. However, data from these sources is recorded in the UK GHG Inventory for completeness and reported as memo items in accordance with UNFCCC guidelines.²³

3.7 The different bases against which targets are assessed can sometimes cause confusion. As an example of this, the government has stated that, if the Climate Change Bill's interim target of a 26 per cent to 32 per cent reduction in CO₂ by 2020 is achieved, greenhouse gas emissions would fall by 32 per cent to 37 per cent below the 1990/95 baseline. It is not immediately clear why a reduction in one gas should translate into a larger reduction in a basket of gases of which it only constitutes a part. This apparently anomalous result is explained by the fact that non-CO₂ GHG emissions fell significantly during the 1990s and the impact of this on total GHG reductions will continue to be very significant.

23. Aviation and shipping emissions are discussed in paragraphs 3.21 and 3.22 below.

24. eg as in the 2004 PSA targets for Defra.

25. In Trust for Tomorrow proposed a target of “at least” 20 per cent by 2010 in the context of the need for developed nations to reduce their own emissions. It is also worth noting that in the Defra technical note supporting Spending Review 2000 PSA targets, there is no mention of emissions trading and the UK headline indicator for carbon dioxide is specified as the basis for assessing progress.

26. RCEP, Energy – The Changing Climate, 2000. See especially page 171 (paragraphs 9.1 and 9.2). The scenario analysis in Chapter 9 is entirely based on the premise of a 60 per cent reduction in domestic emissions.

27. The EAC has itself shown that emissions from most countries will exceed the per capita level implied by a Contraction and Convergence approach even by 2025. See Fourth Report of 2004-05, The International Challenge of Climate Change: UK Leadership in the G8 and EU, HC 105, paragraph 82.

28. Op. cit. page 28, paragraph 12.

29. DTI, Updated Energy and Carbon Emissions Projections, May 2007.

3.8 Domestic goals have also been less clearly defined than international targets. The 2010 domestic carbon reduction goal, for example, has sometimes been expressed in terms of ‘moving towards’ a 20 per cent reduction,²⁴ in which case it is unclear what level of performance would constitute meeting the target. Similarly, when the 60 per cent carbon reduction target was announced in the 2003 Energy White Paper, the base year and the reference to ‘real progress by 2020’ were also imprecise. Moreover, the extent to which emissions trading and the use of foreign credits might contribute to both these targets has not been clearly specified. This issue is discussed in the following section.

The basis on which to report against the UK domestic goal for 2010 is unclear

3.9 Since 1997, the UK government has set itself two domestic goals for carbon dioxide reductions:

- a 20 per cent reduction in carbon dioxide emissions by 2010. This was originally proposed in the 1994 Labour Party policy document “In Trust for Tomorrow”, and subsequently incorporated in its 1997 Manifesto and confirmed in a December 1997 DETR press release.
- A 60 per cent reduction in carbon emissions by 2050. This was set out in the 2003 Energy White Paper in response to a specific recommendation made by the Royal Commission on Environmental Pollution in 2000.

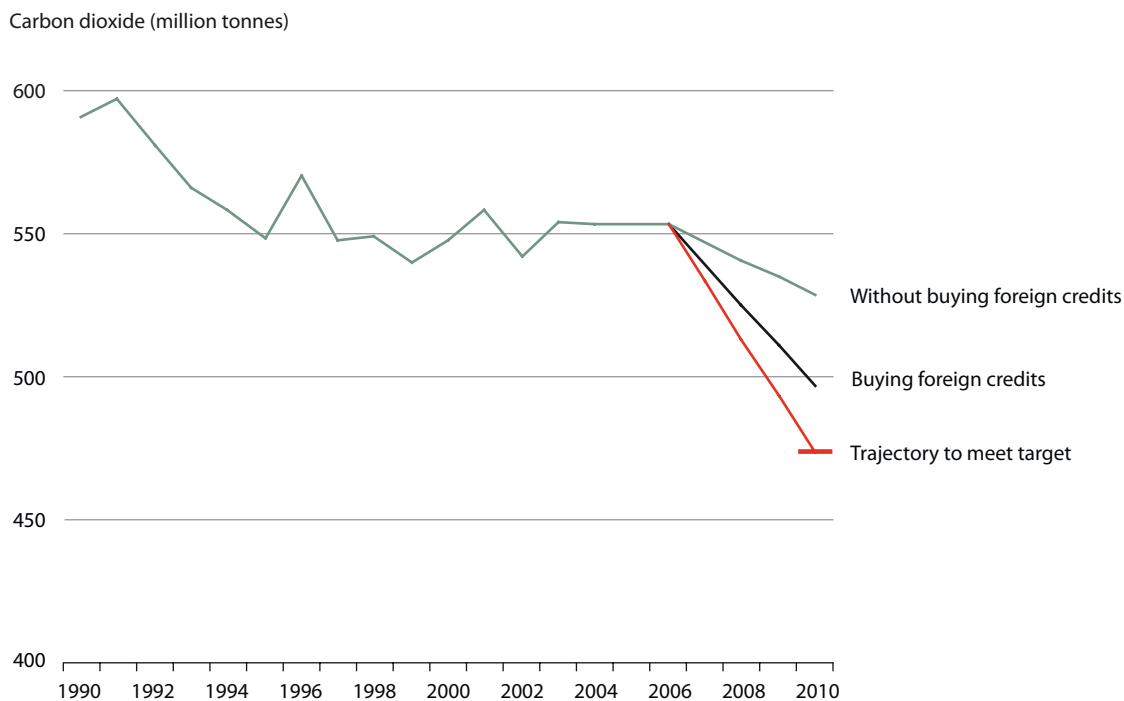
Both these goals have always been referred to in a domestic, as opposed to an international, policy context. Indeed, when the 2010 goal was first proposed, it was not envisaged that emissions trading might be used as a means of meeting such a target.²⁵ Similarly, the RCEP recommendation for a 60 per cent reduction in CO₂ (based on a ‘Contraction and Convergence’ approach) specifically referred to a reduction of 60 per cent in UK emissions and explored how such a reduction might be achieved.²⁶ Moreover, the scope for utilising emissions trading as

a means of meeting the 2050 goal is likely to become more limited as emissions from developing countries increase.²⁷

3.10 However, there has been a significant shift in the basis of the 2010 target since its first introduction. In *Climate Change: The UK Programme (2000)*, the government briefly stated that it “proposes to include any credits generated through the Kyoto mechanisms in its assessment of the UK’s progress towards its domestic goal.”²⁸ The government has not subsequently specified whether it will place a limit on the use of such credits in meeting its domestic goals.

3.11 The introduction of the EU Emissions Trading Scheme from 2005 has meant that the treatment of foreign credits has now become critically important in assessing performance in reducing GHG emissions against the 2010 target. In 2005, for example, UK domestic emissions of carbon dioxide were 554MtCO₂ (IPCC basis) – a reduction of 6.4 per cent against the 1990 baseline. But in that year, UK industries had to purchase foreign credits or borrow from future allocations some 27.1 MtCO₂e of allowances to meet their allocated emissions. If these are included in an assessment of domestic performance, UK emissions would fall to 527MtCO₂. The government set the UK emissions cap for Phase 2 of the EU ETS on the basis that foreign credits might constitute up to two-thirds of the total emission reductions which the scheme will deliver over the period 2008-12, and such credits will therefore impact significantly on performance against the domestic 20 per cent target. Projections published alongside the Energy White Paper in May 2007 suggest that UK domestic emissions might fall by 10.6 per cent below 1990 levels by 2010, but that this figure would rise to 16 per cent if foreign credits are included.²⁹ The following graph illustrates the extent to which the assessment of performance will vary (see **Figure 11**).

11 Forecast performance against the 20 per cent carbon reduction target for 2010



Source: National Audit Office analysis of DTI Updated Energy Projections (May 2007, table 4.2 central forecast)

30. Defra Statistical Releases, 29 March 2007 and 31 January 2008.
 31. <http://www.sustainable-development.gov.uk/progress/national/1.htm>

3.12 There have been some inconsistencies in the treatment of foreign credits by government departments when presenting UK domestic emissions. As the Environmental Audit Committee has noted, for example, there is a marked difference between the graphs published at similar times by the Treasury in Budget 2007 and by Defra in its March 2007 National Statistics release (see Figure 12 overleaf). Defra itself has made every effort to distinguish consistently the contribution of foreign credits, whether in graphs or statistical tables.³⁰ Moreover, the UK headline sustainable development indicator showing progress against the UK domestic targets makes no mention of foreign credits and does not include them in its assessment of performance.³¹

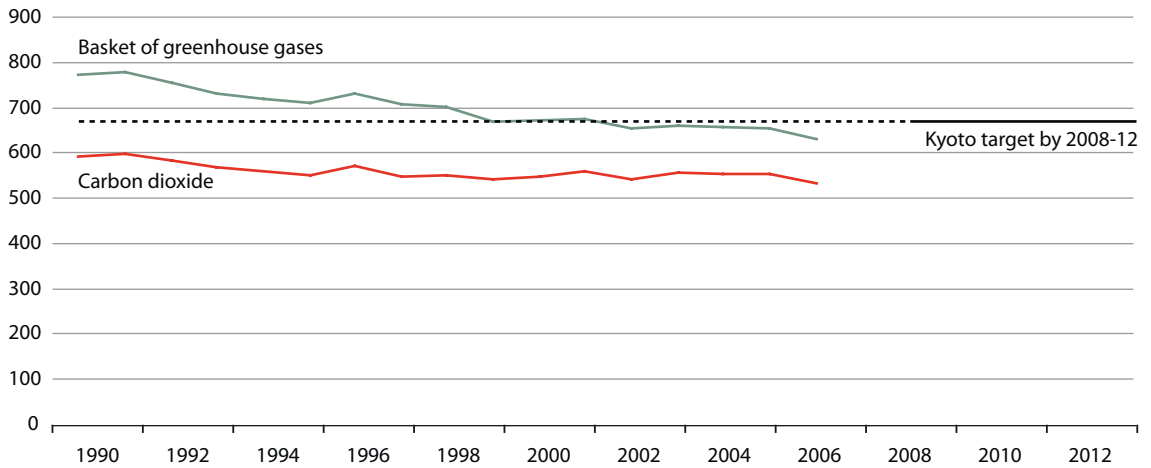
3.13 A number of factors have contributed to the degree of confusion which now surrounds the UK domestic goal for 2010:

- the failure by government to specify clearly, when setting the target, the basis on which performance would be assessed;
- the extent to which the language used to describe the target might imply, by referring to UK 'domestic' goals, that it would be met only by reducing emissions within the UK rather than by purchasing foreign credits as well;
- the absence of clear reporting standards and insufficient consistency and coordination between departments in presenting emissions data; and
- the extent of confidence in foreign emission credits and the consequent treatment of them in National Statistics publications.

12 Forecast performance against the 20 per cent carbon reduction target for 2010

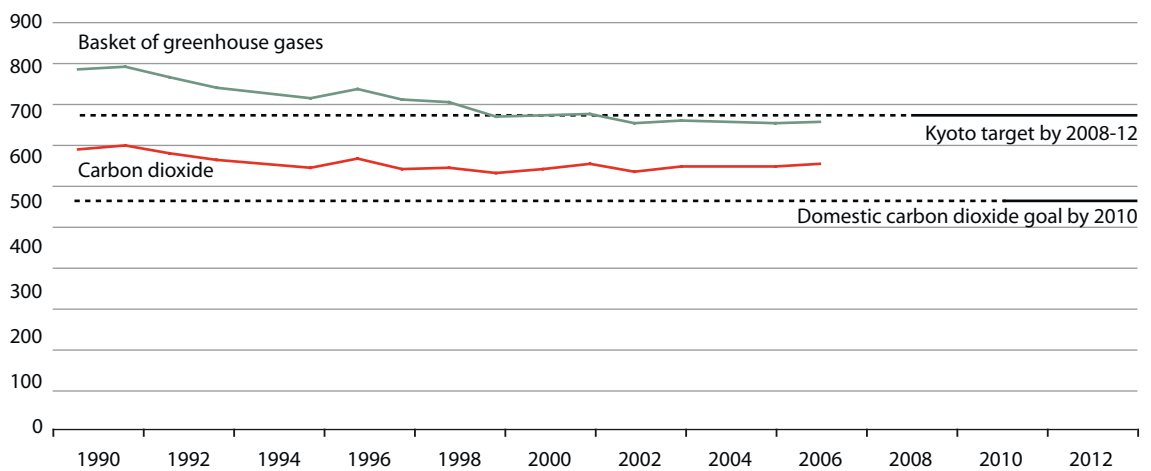
HMT: Budget Report (March 2007)

Million tonnes (carbon dioxide equivalent)



Defra: National Statistics press release (March 2007)

Million tonnes (carbon dioxide equivalent)



Source: EAC

The top graph suggests that emissions have fallen significantly in the latest year (2005), whereas in the bottom graph the trend lines remain flat. This is due to the fact that the purchase of foreign allowances is included in the Treasury's graph but not in Defra's.

3.14 Emission reductions achieved through the purchase of foreign credits are currently not included in any data classified as National Statistics – including the sustainable development headline indicator and the annual National Statistics releases which Defra issues recording UK performance in reducing emissions. This is because, for any data to be considered as National Statistics, it must

satisfy various criteria in terms of its integrity and presentation, and the underlying process used to compile the results. Defra statisticians explained that there were a number of reasons why the UK results for EU ETS trading did not currently meet these conditions. They had concerns about the difficulty of evaluating fully the reductions achieved until after the close of a trading period (i.e. 2013 in the case

of Phase 2 of the EU ETS) due to the banking and borrowing of allowances between years. They were also looking into how emissions reductions were reported in other countries. At present, given the over-allocation of allowances in Phase 1, they could not be certain that the purchase of foreign credits represented a real reduction in emissions.

3.15 If foreign credits were to count towards the UK target, the UK headline indicator for UK domestic CO₂ emissions would no longer reflect performance against the target and this could result in considerable confusion between two rival definitions of what constitutes 'UK domestic emissions'.

3.16 In view of the potential importance of foreign credits to UK targets, we also examined the current system for monitoring emissions trading allowances. This system – the UK Emissions Trading Registry – has been developed to track allowances issued under the EU ETS, and responsibility for managing it lies with the Environment Agency. The key points emerging from our discussion with Agency staff were:

- The UK Registry does not include any financial data relating to allowance transactions, but only details of legal ownership.
- Installations have to present sufficient allowances to cover their emissions on an annual basis, and compliance in 2006 was 100 per cent.
- The extent to which UK participants have relied on the purchase of foreign credits to meet National Allocation Plan targets can only be assessed at the highest aggregated level by comparing total allocations with total allowances presented.³²
- Where the allowances presented to cover reported emissions exceed those allocated, it is also impossible at a UK level to distinguish on an annual basis between the purchase of foreign credits and borrowings from future allocations. This can only be done at the end of an entire trading period (ie 2008 for Phase 1, and 2013 for Phase 2).³³

- All transactions in the UK Registry are mirrored in a centralised EU registry, and it is only at that level that comprehensive analysis of the UK's position with respect to the purchase of foreign credits and the use of banking and borrowing could, in principle, be carried out on an annual basis. It is also only at this level that the overall integrity of the system can be checked.
- The UK Emissions Trading Registry has been developed to take account of Clean Development Mechanism and Joint Implementation credits which might be traded from the start of the Kyoto commitment period (i.e. from 1 January 2008). Following a review by a UNFCCC team, it has now been authorised for use under the Kyoto Protocol.

There are some key differences in the bases on which GHG emissions are reported

Emissions can be reported in terms of either carbon or carbon dioxide

3.17 Emissions data can be presented either in terms of carbon or carbon dioxide. The relationship between the two is determined by the ratio of their atomic weights (12 and 44 respectively), and figures can easily be converted by using this ratio: one tonne of carbon is equivalent to 44/12 tonnes of carbon dioxide, while 1 tonne of carbon dioxide is equivalent to 12/44 tonnes of carbon. Given this difference, it is critically important to specify the basis on which figures are quoted, the convention being to refer to carbon as C and carbon dioxide as CO₂. On this basis, UK domestic GHG emissions in 2005 amounted to 655 million tonnes of carbon dioxide (MtCO₂), but only 178 million tonnes of carbon (MtC).³⁴ In addition, non-CO₂ GHGs are converted into carbon equivalents using internationally agreed factors.³⁵ In quoting emissions of GHGs (as opposed to emissions specifically of carbon dioxide), it is therefore customary to append an 'e' to indicate the carbon equivalence (e.g. MtCO₂e).

32. The origin of the individual allowances (ie whether they were issued by the UK or by other EU member states) is irrelevant in this respect. An individual UK installation could, for example, sell all of its allocated UK allowances and subsequently buy the same number of foreign allowances to meet its target. And even if the allowances presented exceeded allocations for an individual installation or group of installations, this would give no indication of whether the additional allowances had been purchased from other sectors of the UK economy or from abroad.

33. This is because banking and borrowing are currently not allowed between Phases. If this were to alter after 2013, the position with regard to monitoring the use of foreign allowances and borrowings would become still more complex.

34. IPCC basis.

35. These factors are referred to as the Global Warming Potentials.

36. There has been a recent error in the reporting of aviation emissions in the Environmental Accounts. This was due to the provision of incorrect flight kilometre data, and resulted in an overstatement of the year on year increase in emissions between 2004 and 2005. See the ONS press notice of 12 July 2007 at <http://www.statistics.gov.uk/pdfdir/enacc0607.pdf>.

3.18 In the past, there has been little consistency in government publications as to whether figures are quoted in carbon or carbon dioxide, although the units have always been specified. In accordance with international requirements, the UK has always compiled the Common Reporting Format tables as well as the UNFCCC annual report and the periodic National Communication reports on the basis of carbon dioxide. However, many documents produced for domestic policy purposes have often quoted figures in carbon. These include the Energy Trends (DTI, March 2007 edition), the Energy White Paper, and the accompanying Updated Energy Projections (May 2007). There can even be inconsistencies within the same document: the most recent UK National Inventory Report (April 2007), while based almost entirely on carbon dioxide, includes one appendix based on carbon.

3.19 Such differences partly reflect different practices in user communities, but the possibilities for confusion are clear. Defra officials informed us that there had recently been a cross-departmental agreement to report figures consistently on the basis of carbon dioxide, and that this was now beginning to be reflected in some of the recent documents published such as the Budget and Pre-Budget reports. This represents a positive development which will significantly reduce the scope for confusion and mistakes, but has yet to be fully reflected across central government.

The Environmental Accounts present a more comprehensive though less detailed picture of UK emissions than reporting against Kyoto and domestic targets

3.20 The Office for National Statistics (ONS) compile and publish emissions data on a significantly different basis to the reports which Defra submits for UNFCCC purposes. It does so as a satellite set of accounts within the National Accounts (the Blue Book) and also separately on its website as the Environmental Accounts. These accounts use similar concepts and classifications of industries to those employed in the National Accounts, and they reflect the recommended European Union and United Nations frameworks for developing such accounts.

3.21 The Environmental Accounts consist of a range of statistical information covering natural resource use, financial expenditure on environmental protection, and revenues raised from environmental taxes. For the atmospheric emissions data, ONS rely on analysis of NAEI data provided by AEA Energy and Environment. However, with respect to the reporting of GHG emissions, there are a number of differences between the Environmental Accounts and the data compiled for UNFCCC/Kyoto purposes:

- Under Kyoto reporting arrangements, emissions from international aviation and shipping are reported as memo items but excluded from national totals on the grounds that there is as yet no international agreement on the way to allocate them to national inventories. By contrast, the Environmental Accounts include international emissions relating to UK operators in national totals using the best available data. In the case of aviation, ONS utilise flight kilometre data which provides relatively accurate information on which to calculate aviation emissions; while for shipping it has to rely on the consumption of bunker fuels.³⁶
- The statistics presented in the Environmental Accounts are on a UK residency basis, as opposed to being based on fuel purchases in the UK. This means that they measure the emissions caused by UK residents and UK-registered businesses, including emissions they are directly responsible for in other countries (e.g. on holiday); and discount emissions caused by foreign visitors to the UK. The principle is that this is the same basis on which the National Accounts are produced, so environmental impacts can be directly compared with economic indicators such as Gross Output and Gross Domestic Product.

- The Environmental Accounts break down emissions using the Eurostat industry classification, which looks at the economic sector of the person or company responsible for the activity, rather than the activity itself.³⁷ The level of information they contain is also far less detailed than the sectoral breakdowns available in the full UNFCCC inventory report.
- There are also various other minor differences relating to the treatment of biomass emissions, Crown Dependencies, and land-use change.

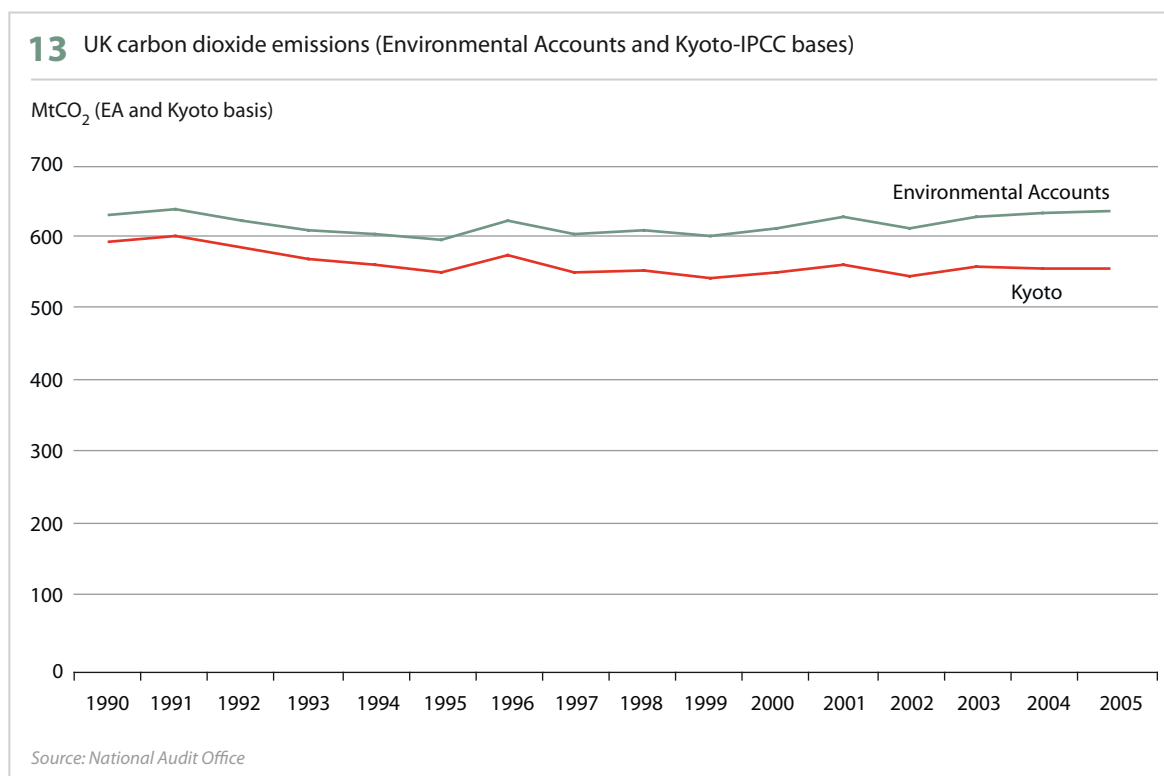
3.22 The difference between these two approaches in terms of reported emissions is significant. For 2005, for example, the Environmental Accounts reported total greenhouse gas emissions of 733 million tonnes of carbon dioxide equivalent, as against the Kyoto-based IPCC measure of 655 million tonnes. Over 50 per cent of the difference was due to the treatment of international aviation and shipping, which together constituted almost 10 per cent of total UK emissions in 2005. A further 30 per cent of the difference is accounted for by cross-boundary adjustments for UK residents abroad and foreign residents in the UK. The difference between the two

approaches is particularly marked if trends in carbon dioxide emissions are analysed over time. **Figure 13** demonstrates that there have been no reductions in UK carbon dioxide emissions if measured on the basis of the Environmental Accounts rather than on the basis of the IPCC/Kyoto reporting requirements.

3.23 Even though the Environmental Accounts present a more comprehensive picture of UK-related emissions, they still understate the full impact of GHG emissions for two reasons. Firstly, they do not take into account the impact of indirect GHGs such as carbon monoxide,³⁸ and secondly, while they incorporate emissions from international aviation, they do not take account of the fact that these emissions may have greater global warming impact than ground-based emissions of carbon dioxide. The scale of this radiative forcing additional impact is thought to be at least a factor of two, although the uncertainties are considerable and there is no internationally agreed basis for aggregating these indirect effects into national totals.

37. The Environmental Accounts include, for example, 'wholesale and retail trade', 'education, health, and social work', and 'transport and communication'.

38. Indirect greenhouse gases do not directly contribute to global warming, but can react in the atmosphere to form products which do. Examples of indirect greenhouse gases include sulphur dioxide, nitrogen oxides, carbon monoxide and non-methane volatile organic compounds. Although not included in UK totals, emissions data on these four indirect greenhouse gases are included in the UK National Inventory annual report.



39. DfT, Transport Trends 2006, pages 107-109.

40. This is currently reported in carbon as opposed to carbon dioxide for the historical reasons discussed above. However, from 2008 onwards it will be reported in carbon dioxide.

3.24 Government departments have used data from both the Inventory reports and the Environmental Accounts in different contexts and for different purposes – in one case within the same document on successive pages.³⁹ While it is clear in most contexts the basis on which figures are being reported, there remains some potential for confusion.

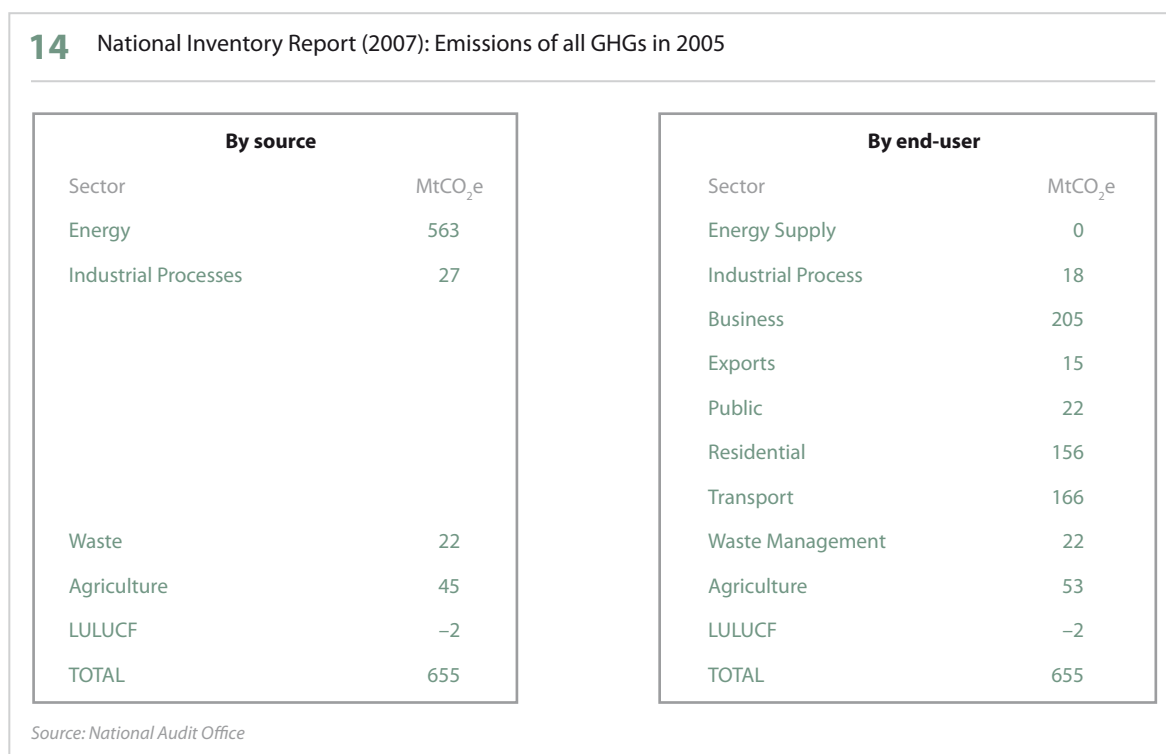
As with energy statistics, carbon emissions can be reported by source or end-user, and sectoral analyses can be done in a variety of different ways

3.25 In producing energy statistics, BERR regularly produces data on both a primary consumption and end-user basis. In order to calculate the latter, energy consumption relating to the energy supply industry is re-allocated to other sectors in proportion to their energy consumption. Similarly, carbon emissions data can be reported by source or end-user. For the purposes of Kyoto / IPCC reporting, all data is reported by source, using the categories set out in Part 2 above. However, Defra also asks AEA to provide an analysis of emissions by end-user, and this

is included in the National Inventory Report as an appendix.⁴⁰ **Figure 14** sets out a breakdown of GHG emissions by source and end-user.

3.26 The table demonstrates that there is a fundamental difference in the definition of sectors for IPCC and domestic policy presentation purposes. It is impossible to obtain easily from the National Inventory Report itself 'by source' data which corresponds to the end-user analysis provided in Appendix 11, though the Appendix does set out how source data is mapped onto end-user categories. Indeed, it is precisely because of the fact that the IPCC reporting categories are not particularly helpful for policy presentation and development that Defra ask AEA to provide the end-user analysis.

3.27 Apart from the source/end-user distinction referred to above, we noted more generally that there is no single way of defining sectors. There are, for example, significant differences between the sectors used in the Environmental Accounts and those used in other reporting contexts. The Environmental Accounts distinguish 13 sectors on the basis of economic activity which cut across the 10 sectors used in National Communication



reports. Nor is there any standard approach even within these other reporting contexts. There are, for example, significant differences between the sectoral definitions used in the IPCC end-user tables and those used in the Fourth National Communication report, as **Figure 15** demonstrates.

3.28 The position becomes even more confused in the context of the use made of emissions data by other public sector organisations. In its Transport and Climate Change report (September 2007), for example, the Commission for Integrated Transport publish graphs of emissions by source and end-user which offer a somewhat different sectoral analysis to those contained in either the IPCC or National Communication reports. Indeed, they state elsewhere that “A further challenge has arisen because of revisions to official projections of emissions and presentation of the same basic data in often different ways or using different bases. The latter point has been a particular issue when examining the current literature on the cost-effectiveness of adopting different transport measures to reduce carbon emissions.”⁴¹

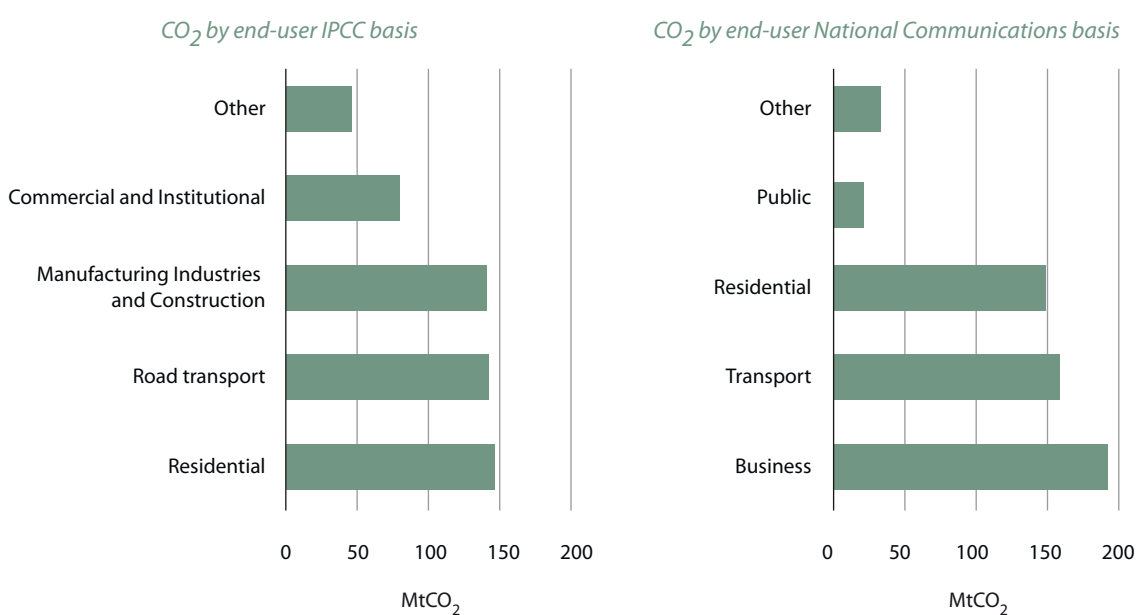
There could be greater coordination within government to ensure that data are used by departments on a consistent basis

3.29 As set out in Part 1 of this report, government departments and other organisations present and make use of emissions data in a wide variety of ways. There are existing mechanisms to try to ensure consistency in the use of data – in particular, through close contacts between analysts in individual departments, and via the Interdepartmental Analysts Group (IAG) which brings together statisticians and economists from a range of departments. But, as the above analysis has shown, different ways of aggregating data can still give rise to considerable confusion and misunderstanding.

3.30 A recent analysis carried out by the Office of Climate Change has highlighted similar concerns, and concluded that there was a need for an analytical coordination role within central government.⁴² Defra statisticians informed us that the IAG had now accepted this and had agreed that Defra would itself take on this role. They anticipated that it would take the form of a new

41. op. cit. page 16 paragraph 1.18.
42. The OCC published its wide-ranging Analytical Audit of climate change in November 2007. See <http://www.occ.gov.uk/activities/aa.htm>

15 Differences in bases used for sectoral analyses



Source: National Audit Office

43. Op.cit. clause 24(2)
 44. Climate Change
 Bill Explanatory Notes
 paragraph 103.

website to provide a single comprehensive source of information available to departments. This would initially contain the main data sets but might also be extended to include information on emissions factors and sectoral breakdowns. The small team responsible for managing the new website might also undertake analytic work to ensure that data are being used consistently.

3.31 While this development might help, the Climate Change Bill and the reporting requirements it includes represent a significant development and one which Defra will need to take account of in developing their analytical coordination role. The potential impact of the Climate Change Bill on reporting is discussed below.

The Climate Change Bill offers an opportunity to develop a better framework for reporting

3.32 The Climate Change Bill, which is currently being considered by Parliament, sets out a fundamentally new and more structured approach to the setting of emission reduction targets and the monitoring of performance against them.

- It will translate into UK legislation the goal which the Government announced in the 2003 Energy White Paper – namely, a 60 per cent reduction in carbon dioxide by 2050 against a 1990 baseline.
- It will create a system of five-year carbon budgets to place the UK on a trajectory to meet its long term goal, and require the Secretary of State to set and meet carbon budgets for up to 15 years in advance. The first three carbon budgets would cover the period 2008-12, 2013-17, and 2018-22, and must be set by 28 February 2009. The provisions of the Bill include a specific interim target for 2018-2022 of a reduction in carbon dioxide of between 26 per cent and 32 per cent.
- A newly created Committee on Climate Change will be responsible for advising the government on the level of carbon budgets to be set, and for monitoring emissions through annual

reports to Parliament which will include a more comprehensive assessment of performance after the end of each five year budgetary period.

3.33 In particular, the Climate Change Bill introduces the new concept of a 'net UK carbon account' in terms of which the carbon budgetary targets are defined and are to be annually reported. This consists of two elements:

- 'net UK emissions' (i.e. UK carbon dioxide emissions from sources in the United Kingdom, less removals of carbon dioxide from the atmosphere due to LULUCF in the United Kingdom); and
- the balance of carbon credits and carbon debits arising from the implementation of emissions trading schemes. A net credit balance would reduce the overall reported level of emissions under the Bill, and would be due mainly to purchasing GHG reductions occurring outside the UK or borrowing allowances from future allocations. A net debit balance would increase UK reported emissions and might arise, for example, from the sale of UK allowances to foreign entities.

The Bill specifies that the reporting of net UK emissions "*must be determined consistently with international carbon reporting practice*";⁴³ but it imposes no limit on the use of carbon credits and allows the Secretary of State to define what carbon credits can count towards the net UK carbon account. The overall intention is "*to establish an accounting system broadly similar to that used to keep track of the UK's assigned amount units (AAUs) and other units issued under the Kyoto Protocol*".⁴⁴

3.34 In relation to the role of the Committee on Climate Change, the Bill requires it to advise on:

- the level of the carbon budget for each period;
- the extent to which the carbon budget for each period should be met by reducing the amount of net UK emissions (and, conversely, by the use of carbon credits – i.e. emissions reductions purchased from abroad); and

- the respective contributions towards meeting the carbon budget that should be made by the sectors of the economy covered by trading schemes (and, conversely, by those which are not).

In order to fulfil these functions, it is generally expected that the Committee will need to carry out extensive analysis of the scope for savings in different sectors of the economy, and that this analysis will be published. However, apart from the split into trading and non-trading sectors of the UK economy, the Bill does not specify on what basis any sectoral analyses should be conducted.

3.35 With regard to the reporting of emissions, the Bill specifies that the Government should report annually on not only the net UK carbon account, but also its two separate components – net UK emissions and the use of carbon credits. In addition, it will be required to report on emissions of all GHGs (even though these are not included in the net UK carbon account), and on emissions from international aviation and shipping.

3.36 These arrangements could potentially introduce a further layer of complexity in the way GHG emissions are reported:

- The net UK carbon account figures will include the purchase of emissions trading credits from overseas to be offset against UK domestic emissions, and therefore will need to be carefully distinguished from emissions relating geographically to the UK. Indeed, the term ‘UK emissions’, as used in normal speech, would become highly ambiguous as there are at least three very different ways in which it could be interpreted.⁴⁵
- As performance in emissions trading schemes will only become fully apparent after the end of trading periods (eg 2013 in the case of Phase 2 of the EU ETS), it will not be possible to assess reliably overall performance against the net UK carbon account on an annual basis.⁴⁶
- The carbon accounting provisions are intended to be ‘broadly similar’ to Kyoto reporting requirements, but will not be the same. Emissions of non-CO₂ GHGs arising in the UK will not be included, while for the purposes of the net UK

carbon account, the government could include a narrower or wider range of carbon credits and debits than those recognised by the UNFCCC.

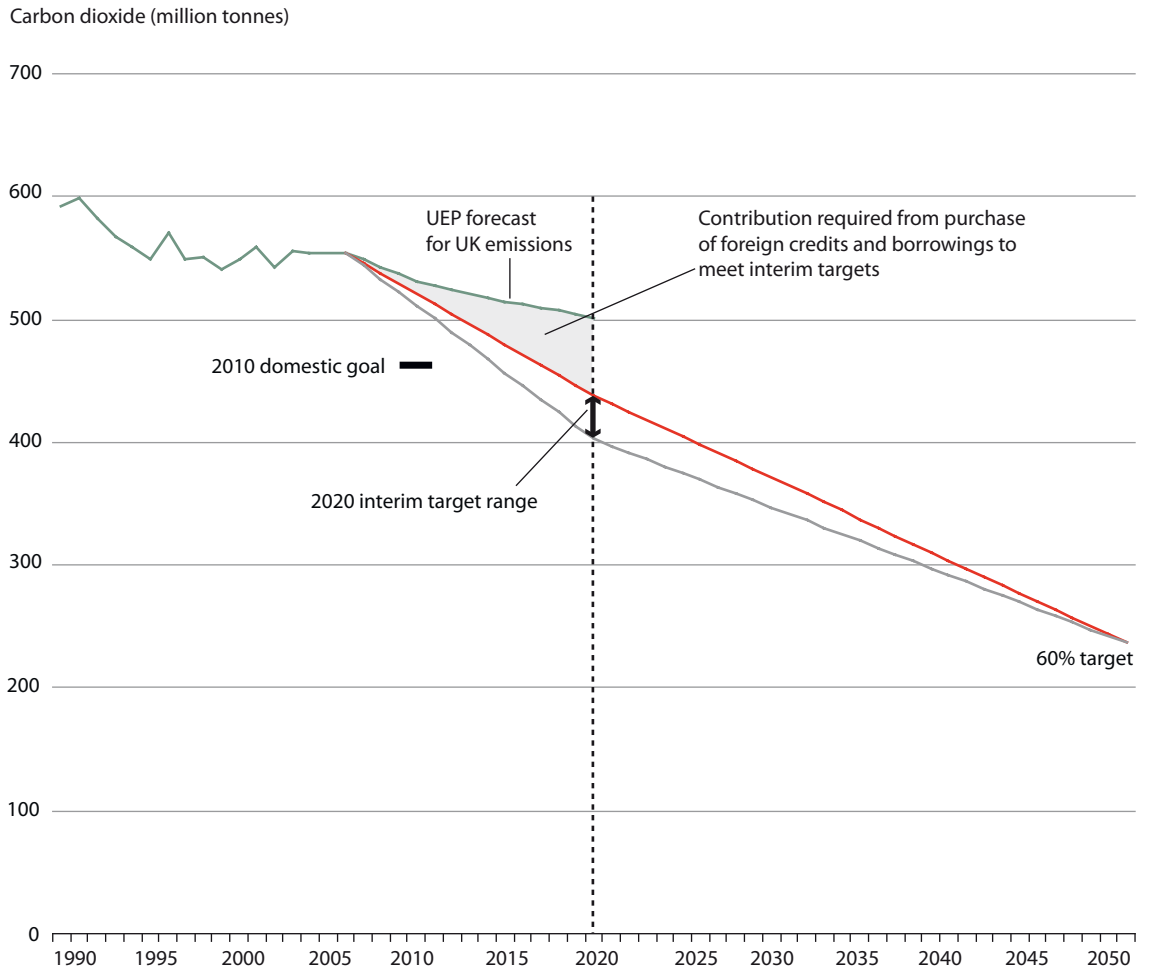
- The requirement to analyse separately trading and non-trading sectors of the economy could increase the complexity of forecasting and reporting, as it may extend beyond the level of analysis currently required for the EU ETS. Moreover, the basis on which the Committee on Climate Change might carry out sectoral analyses is not defined, and the Committee could develop its own distinctive approach.

3.37 Given the responsibilities on developed countries to demonstrate leadership by cutting their own emissions, it will be particularly important for the scale of UK activity in reducing its own emissions to be clearly distinguished within the net UK carbon account. While the Bill proposes a statutory interim target for the net UK carbon account of a 26 per cent to 32 per cent reduction in CO₂ by 2018-2022, no targets are to be set for net UK emissions and the trajectories implied do not specify the potential contribution of carbon credits purchased from abroad. The following graph illustrates historical emission trends and current forecasts in relation to the interim and final targets (see Figure 16 overleaf).

3.38 Under the Climate Change Bill, primary responsibility for reporting emissions remains with the government. However, given its remit, the Committee on Climate Change will be well placed to help develop a more comprehensive framework for reporting which could act as an authoritative source of emissions data and statistics. This could distinguish between various bases for reporting (e.g. Environmental Accounts, IPCC/Kyoto, and net UK carbon account), different approaches to sectoral analyses (eg by source and by end-user, taking account of the various ways in which sectors can be defined; and by sectors of the economy subject to emissions trading schemes, and those which are not), and the different GHGs themselves (including indirect GHGs, and the impact of radiative forcing). The Committee might also consider whether there is a need to develop further indicators to reflect the complexities of the new reporting framework, and whether more information is required from the EU to enable it to report annually and transparently on the contribution from emissions trading schemes.

45. As ‘net UK carbon account’ emissions, as ‘net UK emissions’, and ‘as UK emissions as reported for UNFCCC purposes’.
46. As highlighted in paragraph 3.16 above, it will not be possible for the UK to distinguish on an annual basis between purchases of foreign allowances and borrowings from future allocations.

16 UK CO₂ targets set by the Climate Change Bill



Source: National Audit Office and Department of Trade and Industry

NOTE

The forecast for UK emissions is based on assuming central impact of Energy White Paper measures and an oil price of \$70 per barrel increasing to \$80 by 2020 (see DTI's Updated Energy and Carbon Emissions Projections (UEP), May 2007, page 12, table 4.3 "high fossil fuel prices"). It does not include the impact of any additional policies which might be introduced (including Phase 3 of the EU ETS).

UK greenhouse gas emissions in 2005

Table 1: UK GHG emissions by activity area and type, 2005, All GHGs million tonnes CO₂e

Total		Activity area	Activity type	
Total	655	Energy	560	
			Fuel Combustion Activities	550
			Fugitive emission from fuels	15
			Industrial Processes	27
			Consumption of Halocarbons and SF6	10
			Mineral Products	8
			Chemical Industry	6
			Metal Production	3
			Production of Halocarbons and SF6	0.4
			Agriculture	45
			Agricultural soils	25
			Enteric Fermentation	16
			Manure Management	4
	Land Use, Land Use Change and Forestry	-2		
	Cropland	15		
	Settlements	6		
	Other	0.1		
	Grassland	-8		
	Forestland	-16		
	Waste	22		
	Solid Waste Disposal on Land	20		
	Waste Water Handling	2		
	Waste Incineration	0.5		
	International Bunkers	41		
	Aviation	35		
	Marine	6		
Memo items ¹	50	CO ₂ Emissions from Biomass	9	

NOTES

- 1 International aviation and marine and CO₂ from biomass are included in the inventory but not in the UK emissions total.
- 2 Figures have been rounded so sums may not total.

Table 2: Carbon Dioxide emissions from energy production, UK, 2005, million tonnes CO₂

Activity area	Activity type	Activity sub-type	Emissions producing activity						
Energy	544	Energy industries	210	Public Electricity and Heat Production	170				
			Manufacturing industries	85	Petroleum Refining	18			
					Manufacture of Solid Fuel and other Energy Industries	18			
			Fuel Combustion activities	537	Transport	130	Other manufacturing	67	
		Other sectors					110	Road transportation	120
								Navigation	4
		Fugitive emissions from fuels ¹	6	Solid Fuels	0.1	Civil Aviation	2		
						Oil and Natural Gas	5.7	Railways	2
								Aircraft support vehicles	0.4
						Residential	84		
				Agriculture/Forestry/Fisheries	45				
				Commercial/Institutional	23				
				Military Use	0.3				
				Solid fuel transportation	0.1				
				Venting and Flaring	4.6				
				Oil	1.0				

NOTES

1 Fugitive emissions are intentional or unintentional releases of gases from anthropogenic activities. In particular, they may arise from the production, processing, transmission, storage and use of fuels, and include emissions from combustion only where it does not support a productive activity (e.g., flaring of natural gases at oil and gas production facilities) Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual.

2 Figures have been rounded so sums may not total.

Greencoat is produced using 80% recycled fibre,
10% TCF virgin fibre and 10% ECF fibre

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