Too Good To Be True?

The UK's Climate Change Record

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Comments—and criticisms—welcome

Contents

1 Introduction 1

2 Measurement 3

3 UK's record and targets 6

4 The historical pattern 8

5 Alternative measures 13

6 A consumption account 17

7 Conclusions 25

8 References 27

List of tables

Table 1 Comparison of accounting approaches 14

List of figures

Figure 1 The rise and rise of China's greenhouse gas emissions, 1990–2015 4

Figure 2 UK, European and USA greenhouse gas emissions, 1990–2005 6

Figure 3 UK greenhouse gas emissions and targets, 1990–2005 7

Figure 4 UK CO_2 emissions by fuel source, 1970–2000 9

Figure 5 UK imports and CO_2 emissions, 1970–2005 11

Figure 6 UK greenhouse gas emissions on territorial and residents' accounting bases, 1990–2005 15

Figure 7 Rising carbon dioxide emissions attributable to tourism, 1986–2003 18

Figure 8 Greenhouse gases associated with imports and exports, 1992–2006 20

Figure 9 Projections for aviation passenger demand and carbon dioxide emissions, 2000–2050 22

Figure 10 International aviation and shipping carbon dioxide emissions, 1990–2005 23

Figure 11 Greenhouse gas emissions on a consumption basis, 1990–2003 24

1 Introduction

At first glance Britain has one of the best records in Europe on climate change; greenhouse gas emissions fell in the 1990s and it has already surpassed its 2012 Kyoto target. The energy ratio has improved, reflecting a decoupling of economic growth from energy demand. This record has been trumpeted by politicians as part of a British claim to European and global leadership on climate change, notably at the Gleneagles G8 summit in 2005 (Gleneagles 2005). The British argument has been that, by adopting tough domestic targets, it is possible to show that sharp reductions can be achieved at low cost, and by this demonstration, others (especially the US) will be encouraged to follow suit. The commissioning of the Stern Report, following the Gleneagles Summit, is a further component of this leadership role (Stern 2006). Indeed, the Stern Report reinforces the British argument that, with early action, combating climate change might cost as little as 1% GDP, and that it can be tackled without significant harm to GDP growth.

This paper examines whether the claimed superiority of Britain's approach is solidly based on performance, or whether it owes much to the accounting methodology for measuring emissions. It sets out the UK's official record in managing the *production* of greenhouse gases within the UK's borders and considers the drivers of its performance to date—notably the 'dash-for-gas' in electricity generation; and de-industrialisation, as the UK moved away from energy-intensive manufacturing towards services. Then it builds, block by block, a more complete picture of the greenhouse gas *consumption* of the UK economy, adding in omitted emissions from international transport and net imports—including energy-intensive manufactured goods replacing those previously provided in the UK. Though the empirical evidence is anything but complete, the result is a rather different, and more complex, picture—of rising greenhouse gas consumption—with implications for policy towards developing countries that supply the UK economy with raw materials,

manufactured goods and services, some of which were previously produced in the UK.

The paper is structured as follows. Section 2 considers the methods for measuring greenhouse gas emissions. Section 3 turns to the UK record and its progress against both its Kyoto and domestic targets. Section 4 considers the causes of UK reductions, notably the dash-for-gas, the closure of much of the coal industry in the 1990s, and de-industrialisation. Section 5 looks at alternative measurements. Section 6 incorporates greenhouse gas consumption data to create a more complete picture. Finally, section 7 concludes.

2 Measurement

The conventional and most widely used accounting methodology for measuring greenhouse gas emissions is that of the UN Framework Convention on Climate Change (UNFCCC). It was invented, primarily by the industrialised nations, for the implementation of the Kyoto Protocol after 1997. It determines the reported level and trend in emissions, and in doing so provides a basis for setting the accountability for aggregate emissions, and the incentives for governments to reduce emissions.

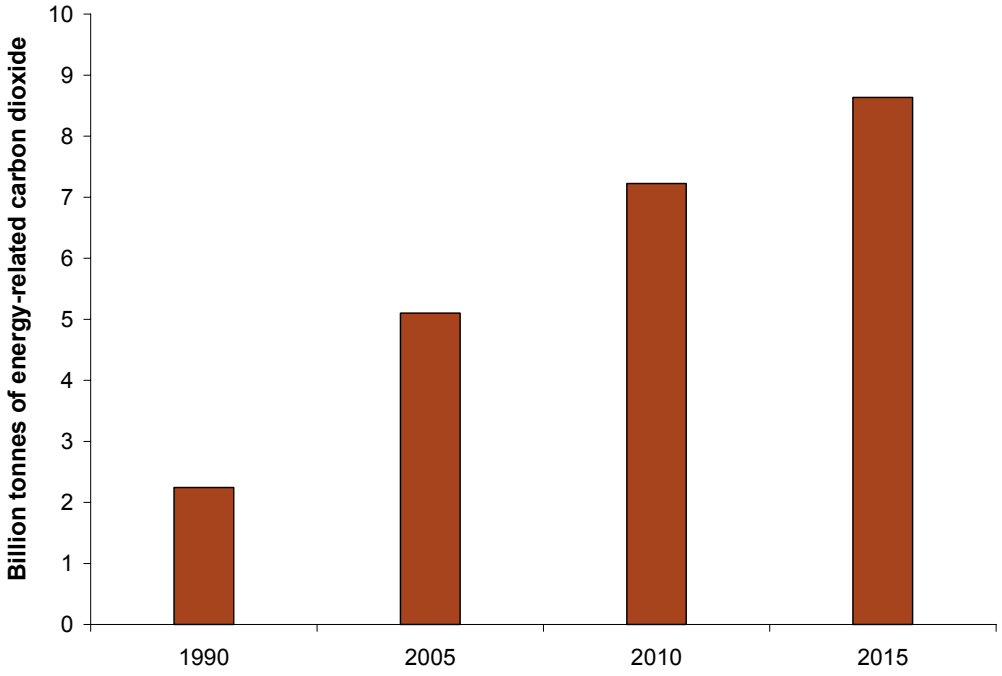
The UNFCCC methodology takes a geographical approach to emissions responsibility. All (and only) emissions generated from *productive* activities within a country's territory are attributed to that country's emissions total.

The differences between accounting methodologies can be substantial. For example, the UK's National Environmental Accounts, using a different methodology, reported carbon dioxide (CO_2) emissions in 2005 some 14% higher than under the UNFCCC methodology (ONS, 2007, p.28–29 and authors' calculations). Reported greenhouse gas emissions under the UNFCCC approach were 11% lower than the equivalent figures reported in the UK's environmental accounts (ONS, 2007, p.28–29 and authors' calculations). The divergence is partly attributable to minor geographical adjustments (the inclusion of crown dependencies and overseas territories), but principally due to four important methodological factors. The National Environmental Accounts: exclude emissions from land-use change and forestry; include 'bunker emissions' from international aviation and shipping attributable to the UK; include emissions of CO_2 from biomass; and include 'cross-boundary' emissions traceable to UK residents and firms abroad.

Both these methodologies are based on the location of the *production* of greenhouse gases. This, however, is a somewhat misleading and partial basis for policy purposes. For a country could have a very low *production* of greenhouse gases, but at

the same time have a high *consumption* level. It could *produce* low-GHG-intensity goods, but import and consume high-GHG-intensity goods. Thus, a developed country might cease to produce steel, aluminium, glass and chemicals domestically, but import the manufactured goods from abroad. In the UK's case, the shift of production in such activities to China, India and other developing countries in the last two decades suggests that this effect may be considerable. The corollary is dramatically increasing emissions from countries such as China, as shown in Figure 1.

Figure 1 The rise and rise of China's greenhouse gas emissions, 1990–2015



Source: IEA (2007)

From a global policy perspective, the allocation of the burden of greenhouse gas emissions involves international negotiations that necessarily include considerations of equity and fairness, as well as economic efficiency. Thus, China might argue that, although it produces high emissions, these are *on behalf of* consumers in developed

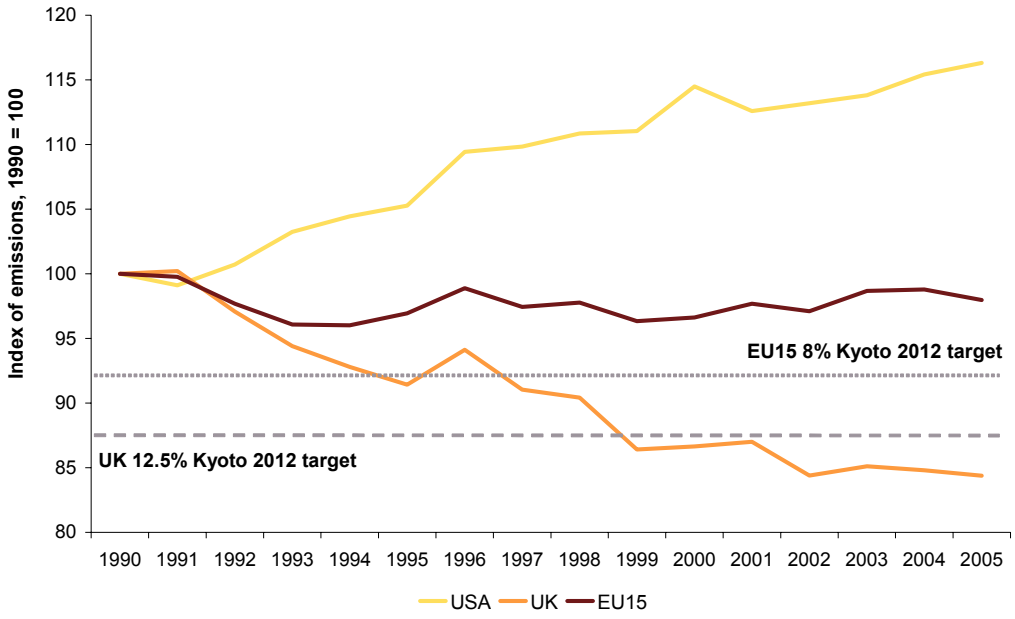
countries, and therefore the consumers should pay for the relevant reductions. In this way, the polluter is not the producer, but rather the consumer.

Whilst measurements under the UNFCCC (production) accounting are commonly reported, those for greenhouse gas consumption are not. We provide some crude estimates for the UK below. Before we examine those figures, a quick review of the UK's record is in order, using the conventional methodology and within the context of its own Kyoto and domestic targets.

3 UK's record and targets

At first glance, the UK's record on the UNFCCC basis is impressive. There has been a consistent fall in the UK's reported greenhouse gas emissions since 1990, and the UK is now virtually sure of meeting its 2008–12 target of a 12.5% reduction in emissions measured under the Kyoto Protocol (see Figure 2). This is in marked contrast to the EU15, which is only one-quarter of the way towards its Kyoto target after two-thirds of the measurement period has elapsed. The UK's performance is even more impressive when compared with the 16% increase in greenhouse gas emissions in the United States to the present date over the period since 1990.

Figure 2 UK, European and USA greenhouse gas emissions, 1990–2005



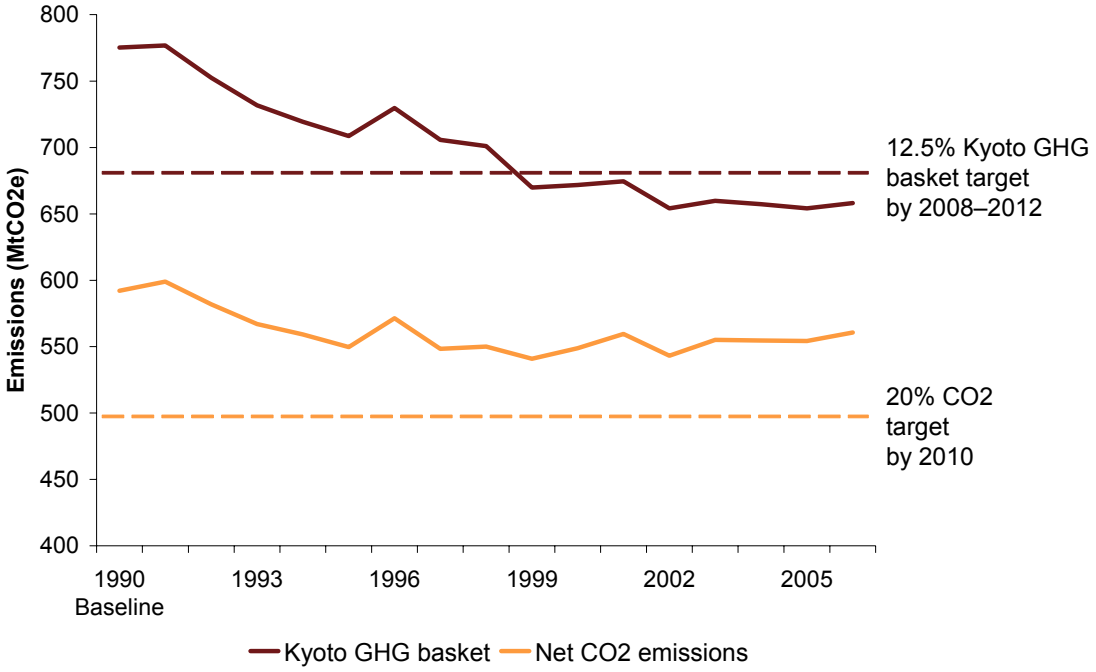
Note: Using the UNFCCC/Kyoto method. Excludes emissions from land-use change and forestry.

Source: Defra (2007), European Environment Agency (2007), and US Environmental Protection Agency (2007)

In 1997, the Labour Party Manifesto proposed an additional and unilateral UK target of reducing *carbon dioxide* emissions by 20% by 2010 (Labour Party, 1997). The assessment involved the use of the same measurement guidelines as those outlined

in the UNFCCC and the same baseline as that set out in 1990 (HM Government, 2006). Figure 3 illustrates this narrower measure, against which the UK's performance is considerably less impressive. It shows CO_2 emissions *increasing* since 2002 and now lying 2.2% above the level in 1997 when the Labour Government came into office (calculated from Defra, 2007). It is particularly notable that the Government created the UK Climate Change Programme in 2000 (DETR et al, 2000) with a focus on controlling carbon dioxide emissions, since which date carbon dioxide emissions have risen.

Figure 3 UK greenhouse gas emissions and targets, 1990–2005



Source: Defra (2007)

4 The historical pattern

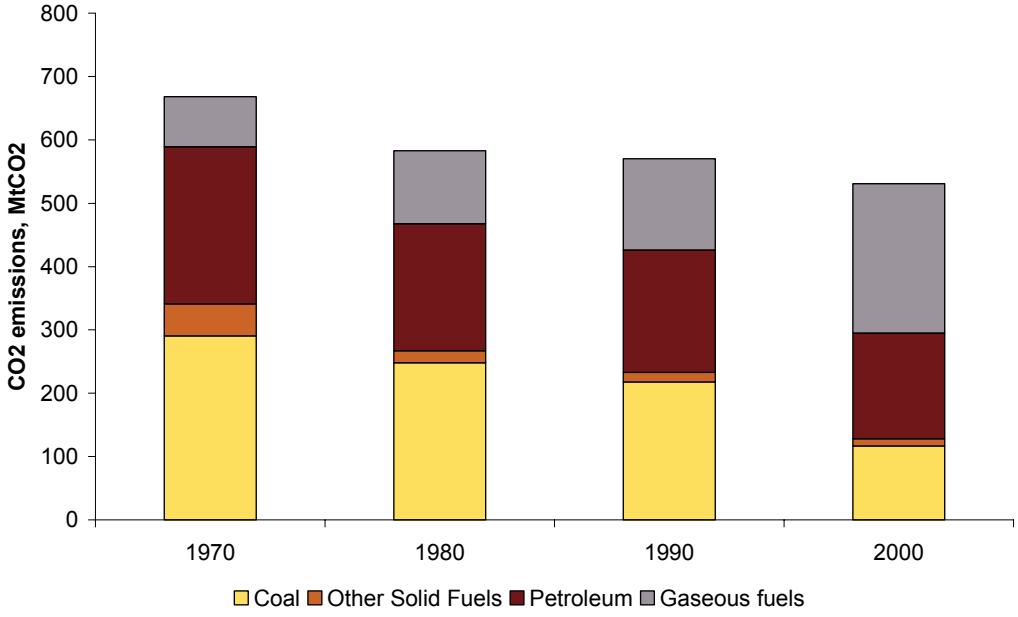
The causes of the fall in UK emissions since 1990 (and, indeed, from the 1970s) are many and various. However, two stand out: the accelerating change in mix of fuels used in power generation from 1990, and the reduction in activity in energy-intensive manufacturing industries in the 1970s and 1980s.

The changing fuel mix and the 'dash for gas'

When the electricity industry was privatised in 1990, it was overwhelmingly dominated by coal (65%) and nuclear (21%) (BERR, 2007). Gas fuelled only 0.7% of electricity production. After 1990 there was a significant dash-for-gas, complementing the switch from oil to gas in industry as natural gas from the North Sea had come on stream. By 2006, the mix was 41% coal, 31% gas and 20% nuclear (BERR, 2007). Since 1990, there has therefore been a significant shift from being coal-sourced to being gas-sourced. The drivers for this were principally economic, reflecting cheaper wholesale gas prices and improved technology—in particular, combined-cycle gas turbines (CCGT)—but also reflecting a desire by firms to distance themselves from the troubled coal industry in the post-privatisation period (Helm, 2004).

Beyond electricity generation, industry and transport have also taken advantage of the dash-for-gas. Figure 4 illustrates the decline in overall emissions since 1970 and the breakdown by fuel source.

Figure 4 UK CO_2 emissions by fuel source, 1970–2000



Source: Defra (2006)

The government's Inter-Departmental Analysts Group (IAG, 2002) calculated the rate of CO_2-intensity reduction across the economy between 1970 and 2000. Underlying CO_2-intensity improvements had been 2.1%, but had been boosted to 3.0% by the dash-for-gas (IAG, 2002, pp.17 and 24) and the impact of fuel switching in final demand. The dash for gas contributed only in the period since 1990. An underlying rate of 2.1% is exactly half the 4.2% that is estimated to be required to meet the 2050 target of a 60% reduction in emissions while maintaining economic growth at 2.25% (Oxera, 2005).

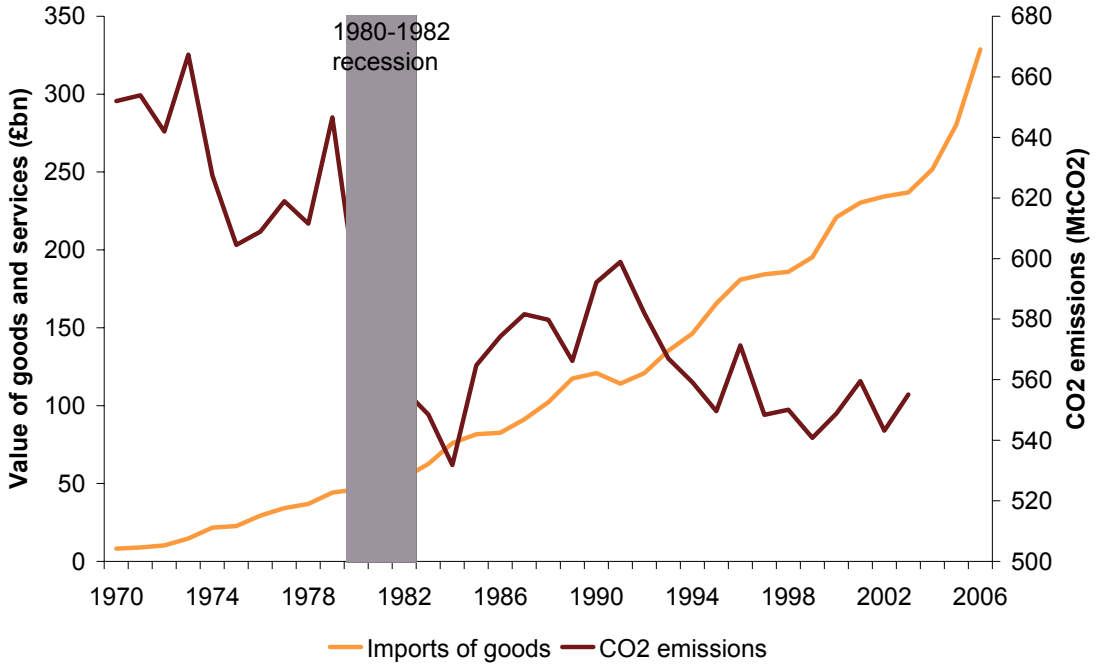
The IAG modelled various scenarios to 2050. One scenario removed the effect of the dash-for-gas on the rate of change of CO_2 intensity (IAG, 2002, p. 99). Across all industries, CO_2-intensity rates measured in carbon dioxide per unit of energy between 1970 and 2000 would have fallen by 0.27 rather than 1.16 units per annum (IAG, 2002, p. 102) without the dash-for-gas in the decade 1990 to 2000.

De-industrialisation

A second major effect is de-industrialisation. At the end of the 1970s, the second OPEC oil shock witnessed oil prices rising to $39 a barrel at peak (over $110 in current prices). The incoming Conservative Government introduced the Medium Term Financial Strategy and, faced with rising inflation (which peaked at 22%, in part exacerbated by the sharp increase in VAT), raised interest rates sharply (to 17% at peak). This, in itself, was strongly deflationary, but its impact was reinforced by the sharp rise in the exchange rate which accompanied it (exacerbated in this case by North Sea oil and gas and Sterling's new role as a petrol currency). Sterling rose to a peak of $2.40 from a base of around $1.50 in the late 1970s. Manufacturing output, having experienced sharp decline in the 1970s, especially in internationally competitive activities like steel and chemicals, contracted further. Within the space of just 18 months, manufacturing output fell by around 25%. The recession in the early 1980s was itself associated with a 14% fall in carbon dioxide emissions between 1979 and 1982 (CAIT, 2007). By 1993, manufacturing output had stabilised, and has fallen only slowly since. This structural break with the historic trajectory and the ushering in of a primarily service-based economy changed the carbon dioxide and energy intensity of the economy from a domestic perspective.

However, the critical issue is not whether production in the UK was stripped of greenhouse gas emissions, but whether consumption of greenhouse gases fell—whether the UK now imported what it had previously produced. The economy continued to grow, and with it, the import of manufactured goods in particular. Import growth has been a feature of the 1990s and 2000s. Figure 5 shows the fall in CO_2 emissions from the UK between 1970 and the present day and the coincident growth in goods imports.

Figure 5 UK imports and CO_2 emissions, 1970–2005



Note: current prices

Source: Defra (2007), ONS data and Vivid Economics calculations

The emissions savings that the dash-for-gas delivered were real (it was a switch of technique from high to lower emissions for a given output), but de-industrialisation may not have delivered a real saving at the global level, instead displacing those emissions abroad.

There remains scope for further displacement of coal-fired electricity generation by gas-fired generation. Indeed, in the next decade, it is expected that much of the remaining coal capacity will close. However, this benign effect on emissions will increasingly be offset by the closure of nuclear capacity. Much of the existing nuclear capacity (except the Sizewell B Pressurised Water Reactor) will be phased out over the same period, and hence some of the 15% of zero-carbon dioxide generation may be replaced by gas. A switch from coal to gas reduces emissions: a switch from nuclear to gas increases them. Whilst renewable energy sources will make up some

of the shortfall, when demand growth is also taken into account, current renewables projects do not cover much of the capacity withdrawal.

It should also be noted that a further dash-for-gas carries its own risks in terms of security of supply, with the UK moving towards reliance on external gas sources as the North Sea's rapid depletion takes effect. Given the European-wide expected dash-for-gas, there may be a sharp rise in the relative price of gas, perhaps inducing a shift back towards coal. Old coal may be replaced by new coal. Though carbon dioxide sequestration and storage is a medium-term option, in the next decade (or even two decades) new coal is likely to remain at best carbon dioxide capture ready (but not sequestered).

The de-industrialisation may, however, be largely completed and the scope for further changes may be modest. Further, since the service sector involves energy consumption, and as it has grown to constitute a larger proportion of the economy, the percentage reductions from further switching are likely to have a smaller impact on UK emissions. There may, too, be offsetting trends to increase service sector emissions, notably from air conditioning and transport requirements. Thus, the historic sources of emissions reductions may not significantly contribute to future emissions reductions. The UK will have to turn to other sources.

5 Alternative measures

There are several accounting approaches to emissions. As noted above, the methodology used by the UK government to assess its performance (the UNFCCC methodology) counts solely emissions released within the UK. This might be called the **territorial** basis. The UK's figures show a recent failure to stabilise CO_2 emissions counted on this basis, but a fall in overall greenhouse gas emissions.

A comprehensive and complete measure of UK emissions on either a production or consumption basis is unlikely to be feasible, at least for the time being, and hence a more pragmatic approach is to sequentially add in additional components. This is the approach taken here, beginning with transport. Adding emissions for transport involved in trade brings into play the greenhouse gas footprint for international aviation and shipping, which are sectors with rapidly growing emissions—in both cases, facilitated through government policies. Emissions from UK economic activities overseas can be repatriated, such as the emissions of UK firms overseas, to give figures that more closely reflect the basis upon which UK economic activity is assessed. These additions form the **residents'** basis.

The **residents'** basis has been applied by the ONS in the National Environmental Accounts. The ONS also makes an adjustment for emissions from biomass. Table 1 summarises some of the key differences between the accounting approaches (here we ignore minor geographical differences such as the inclusion of Crown dependencies, overseas territories and we also ignore land-use change and forestry).

Table 1 Comparison of accounting approaches

	UNFCCC methodology	National Environmental Accounts methodology
Emissions from production in the UK	✓	✓
Travel: Adding emissions from UK companies and households abroad and subtracting emissions by foreign residents in the UK. National Statistics uses the label 'cross-boundary' for this class of emissions	×	✓
International aviation	×	✓
International shipping	×	✓
Emissions from biomass	×	✓

Note: The UNFCCC methodology reports international aviation and shipping emissions only as a memorandum item and the figures are not used to assess performance against targets.

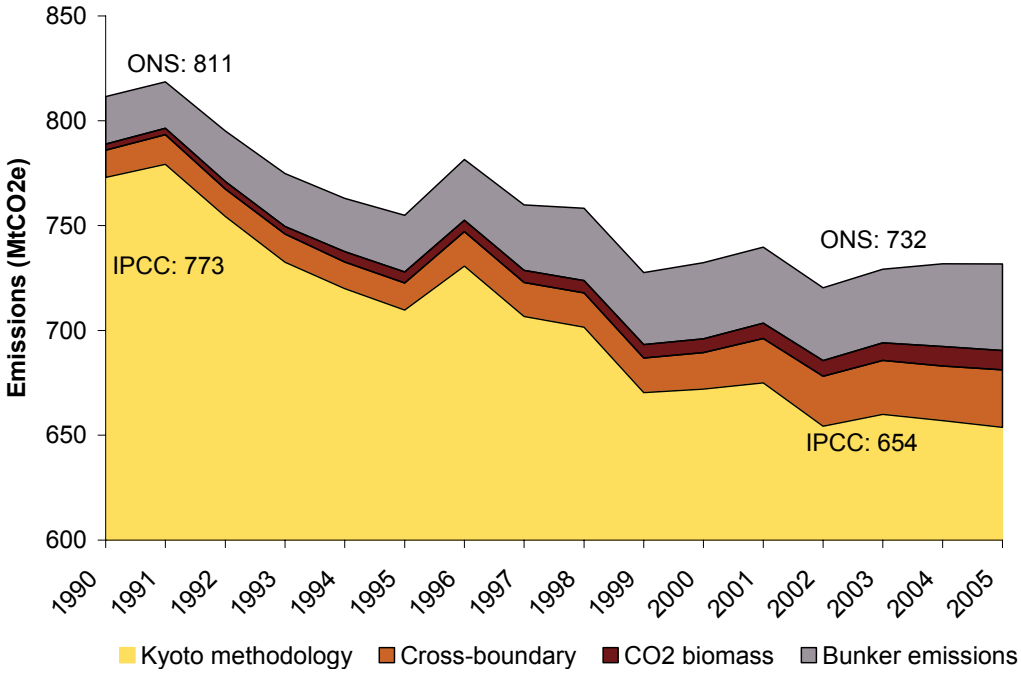
Source: Vivid Economics.

Figure 6 shows results from the two accounting bases from 1990 to the present day. The residents' greenhouse gas emissions are considerably higher than the territorial emissions and they have been falling more slowly over time. The chart shows a 15.4% fall in emissions using the territorial basis, but only a 9.7% reduction for the residents' figures from 1990. Furthermore, emissions are 11.9% higher in 2005 than the territorial base indicates when reported on the residents' basis. These trends are partly due to increased economic activity outside the UK by UK-based firms and in larger part due to increased international transport. The absolute size of the difference between the two measures has doubled between 1990 and 2005 to 78 $MtCO_2e$. In 1990, 59% of the difference was due to international transport, 8% due to CO_2 biomass and 34% due to cross-boundary emissions. In 2005, 53% of the difference was due to international travel, 12% due to CO_2 biomass and 35% due to cross-boundary emissions. In absolute terms, international transport creates the largest adjustment.

These adjustments do not, however, go far enough. The global warming effect of aviation is greater than its emissions of carbon dioxide alone. As explained in the

Government's White Paper on air transport (DfT, 2003, page 40), aviation causes cloud and ozone formation high in the atmosphere, both of which have warming effects. The net warming effect of a tonne of CO_2 burned by an aircraft is the equivalent of between two and four tonnes of CO_2 released from a conventional ground-based source.

Figure 6 UK greenhouse gas emissions on territorial and residents' accounting bases, 1990–2005



Note: For consistency with ONS data, the UNFCC methodology used here excludes overseas territories and the values therefore differ slightly to those reported earlier.

Sources: ONS (2007b), UNFCCC; Vivid Economics

As part of its work in this area, the ONS explored the pattern of *consumption* of fuel. It tracked purchases of fuel abroad by businesses, airlines, the military and tourists, and added these to the UK's emissions totals. This showed that the UK's CO_2 emissions would have been a further 2.4% higher in 1997 on this basis, although it is not clear whether the gap has widened or narrowed between 1990 and the present day.

None of the ONS's calculations repatriates emissions associated with consumption by UK residents of goods and services produced abroad. Imports are an essential part of the UK economy and the energy embedded within them is part of the energy requirement of the UK. The UK's environmental impact is as significant from the resources exploited to produce its imports as from the domestic resources it consumes. It mandates counting emissions on a **consumption** basis.

6 A consumption account

A comprehensive consumption account seeks to capture the full global warming potential associated with consumption by UK residents. It requires:

— capturing consumption in a non-UK territory, for example during business trips and foreign holidays;

— capturing consumption between countries, for example through international aviation and shipping;

— capturing consumption of greenhouse gases embedded in imported goods;

— measuring the full global warming impact (for example, in aviation).

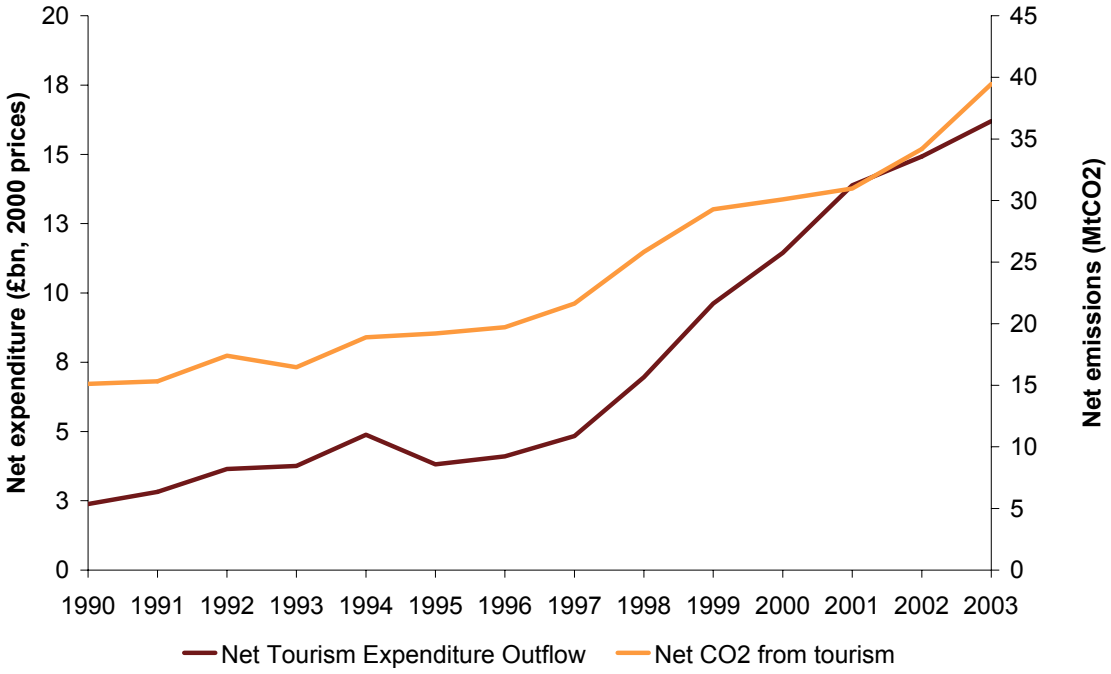
Conversely, there are some activities within the UK which are not consumed by UK residents. Thus, it is necessary to subtract both consumption within the UK by non-UK residents (eg, tourists), and exports from the UK. Some of these factors are illustrated below, starting with tourism.

Tourism

Foreign tourism by UK residents is currently not accounted for in the UNFCCC methodology. Figure 7 below shows that emissions associated with UK residents in other countries are greater than those associated with non-UK residents in the UK. There is a tourism emissions deficit, and it is growing.

The figures combine expenditure on tourism with average greenhouse gas intensities for the UK and the rest of the world. UK tourists spend more abroad than non-UK tourists do in the UK, and the greenhouse gas intensity of goods and services produced in the rest of the world is higher than in the UK. Data on other purposes of visit are not included. The methodology used to account for cross-border travel in the ONS National Environmental Accounts is broader, including all purposes of visit, and shows the same trends as tourism alone. In 2003, the ONS adjustment was 26 $MtCO_2e$.

Figure 7 Rising carbon dioxide emissions attributable to tourism, 1986–2003



Note: A number of technical issues arise in this analysis such as the use of exchange rate, inflation and purchasing power parity adjustments. Simple assumptions are made here to illustrate the trend, but a more detailed analysis would be required to obtain precise figures.

Source: ONS (2000–2006), CAIT (2007) and Vivid Economics

Net imports of greenhouse gases

Estimating the adjustment for the trade deficit in greenhouse gas emissions is complex, and a precise estimation is beyond the scope of this paper. Nevertheless, crude calculations give some indication of the magnitude of the impact of taking this aspect of greenhouse gas consumption into account, and illustrate the path for further research and refinements of the numbers. The calculation makes use of the following data from the period 1992–2006:

— the level of imports relative to exports (the balance of trade);

— the relative greenhouse gas intensity of the UK versus the rest of the world;

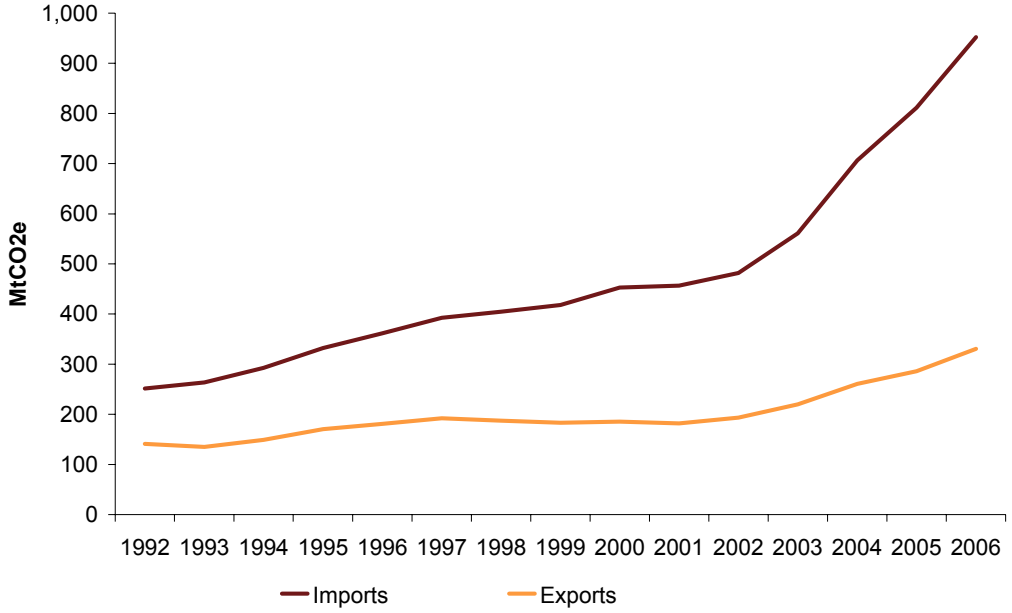
— the pattern of trade (the geographical sourcing of imports to the UK).

The data were obtained from Office for National Statistics (ONS 2007*b*) and the Climate Analysis Indicators Tool. The Climate Analysis Indicators Tool is a database for analysis of climate change developed by the World Resources Institute. It provides a comprehensive and comparable database of greenhouse gas emissions data (including all major sources and sinks) and other climate-relevant indicators.

The result of the calculation is sensitive to the assumed level of greenhouse gas intensity of imports. Ideally, the greenhouse gas intensity of imports would be estimated individually for each good and service traded and for each country of origin. In this way, an accurate picture could be built up reflecting both the mix of goods and services and the original energy sources in the country of origin. For this paper, where the purpose is only to illustrate the outcome of a consumption-based account of greenhouse gas emissions, a simpler approach has been taken which is less data intensive. Imports from each country of origin are measured by their value in US dollars in year 2000 prices. The greenhouse gas intensity of those imports is assumed to be equal to the average greenhouse gas intensity of the originating country's economy, also in year 2000 prices. The same approach is applied to exports from the UK. Implicit in this assumption is that the goods and services manufactured for export have the average greenhouse gas intensity of all the goods and services manufactured within the economy of the country of origin. It is not clear whether this assumption will bias the estimates upwards or downwards.

The results are shown in Figure 8. The UK has a trade deficit in greenhouse gases, and the ratio of imports to exports in greenhouse gases is much larger than the standard trade ratio in value terms. By 2006, the trade deficit in greenhouse gases was 341 $MtCO_2e$, around 50% of domestic UK greenhouse gas emissions.

Figure 8 Greenhouse gases associated with imports and exports, 1992–2006



Source: ONS (2007c), CAIT Database and Vivid Economics calculations

China is one component of the trend. In 1992, the UK imported £890 million (year 2000 prices) from China at an intensity of 7,450 tCO_2e/$m, equivalent to 13 $MtCO_2e$. By 2006, imports had grown to £17 billion (year 2000 prices) and the intensity of production had fallen to 4,140 tCO_2e/$m (year 2000 prices), equivalent to 130 $MtCO_2e$, a ten-fold increase over 14 years. Offsetting this were UK exports to China of £568m in 1992 (year 2000 prices) at an intensity of 608 $MtCO_2e$/$m (year 2000 prices), equivalent to 0.6 $MtCO_2e$. UK exports to China also grew rapidly, reaching £4.7 billion in 2006 (year 2000 prices), while the greenhouse gas intensity fell to 458 tCO_2e/$m (year 2000 prices), giving equivalent emissions of 4.2 $MtCO_2e$. Net imports in 2006 from China were therefore around 125 $MtCO_2e$ in 2006. The large difference in greenhouse gas intensities (as measured on a production basis) between the Chinese and UK economies and the scale of trade activity drives this significant greenhouse gas trade deficit.

Looking beyond China to the full range of exporters to the UK, in 2000, while the UK's greenhouse gas intensity was 458 tCO_2e/$m (year 2000 prices), the weighted

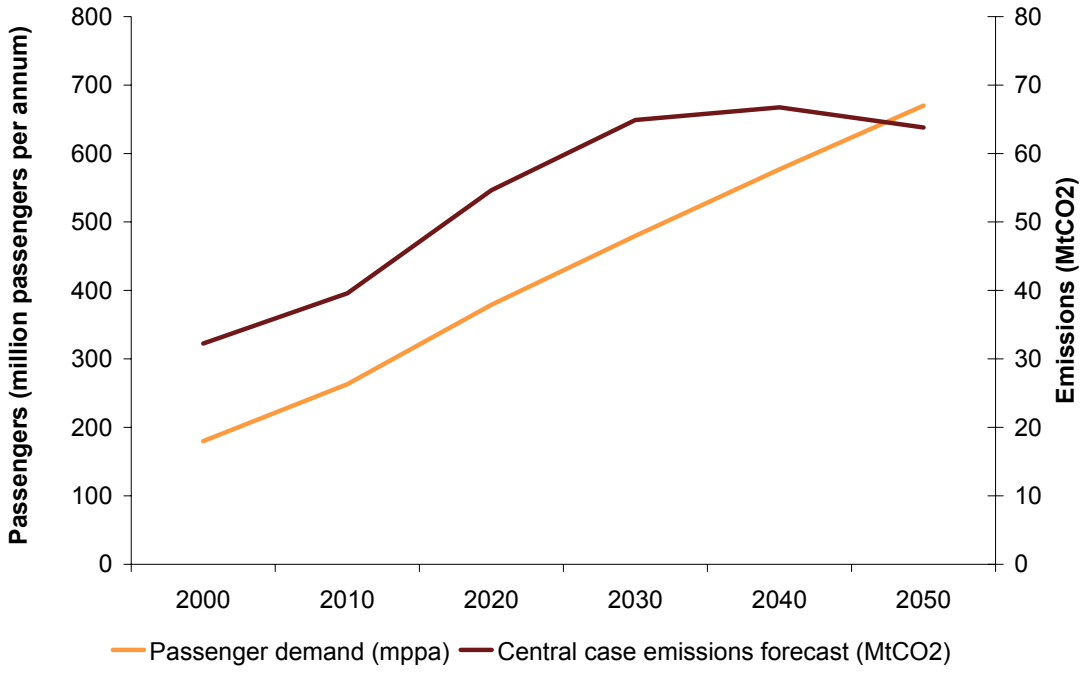
average of exporters to the UK was 1,149 tCO_2e/$m (year 2000 prices). The UK has an increasing propensity to import from more greenhouse gas-intensive economies. In 1992, 15% of imports to the UK (in value terms) came from countries with higher than the world average greenhouse gas intensity, and these imports accounted for 45% of greenhouse gas imports. In 2006, 25% of imports came from countries with higher than the world average greenhouse gas intensity, accounting for 64% of greenhouse gas imports. The data show that prior to 2003, the UK's imports were on average from economies which were less greenhouse gas intensive than the world average, but this position was reversed after 2003.

The overall position is that the greenhouse gas trade deficit has increased six-fold from 110 $MtCO_2e$ in 1990 to 620 $MtCO_2e$ in 2006.

International aviation and shipping

Bunker emissions (those associated with international aviation and shipping) are only reported as a memorandum item in the UNFCCC process, in large part due to the lack of any consensus on how to attribute emissions between countries. However, Figure 6 suggested that bunker emissions are a substantial and growing component of global emissions. Their importance is likely to increase in the future given strong growth projections for aviation despite efficiency improvements (see Figure 9).

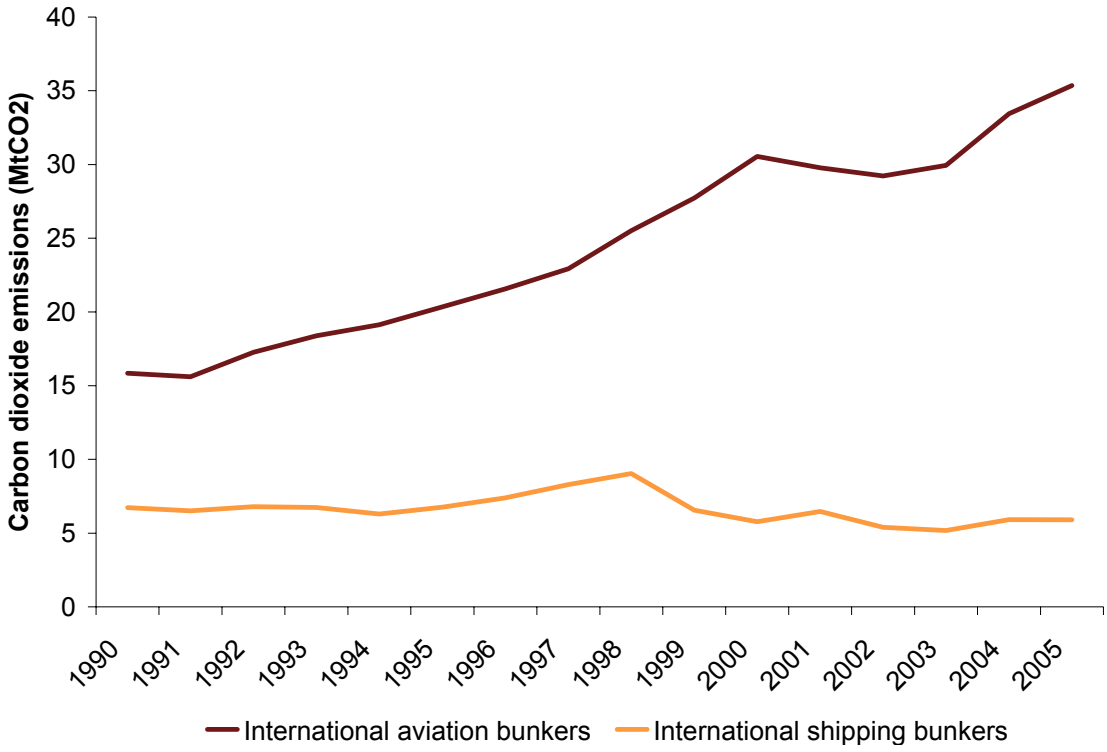
Figure 9 Projections for aviation passenger demand and carbon dioxide emissions, 2000–2050



Source: DfT (2004), pp.19–20

Figure 10 shows the UNFCCC reported memorandum data (which reflects international departures), inflated by a radiative forcing multiple of 3, which is the middle of the range presented in the Air Transport White Paper (DfT, 2003). The total global warming effect of the UK's international transport is around 40 $MtCO_2e$ per annum.

Figure 10 International aviation and shipping carbon dioxide emissions, 1990–2005

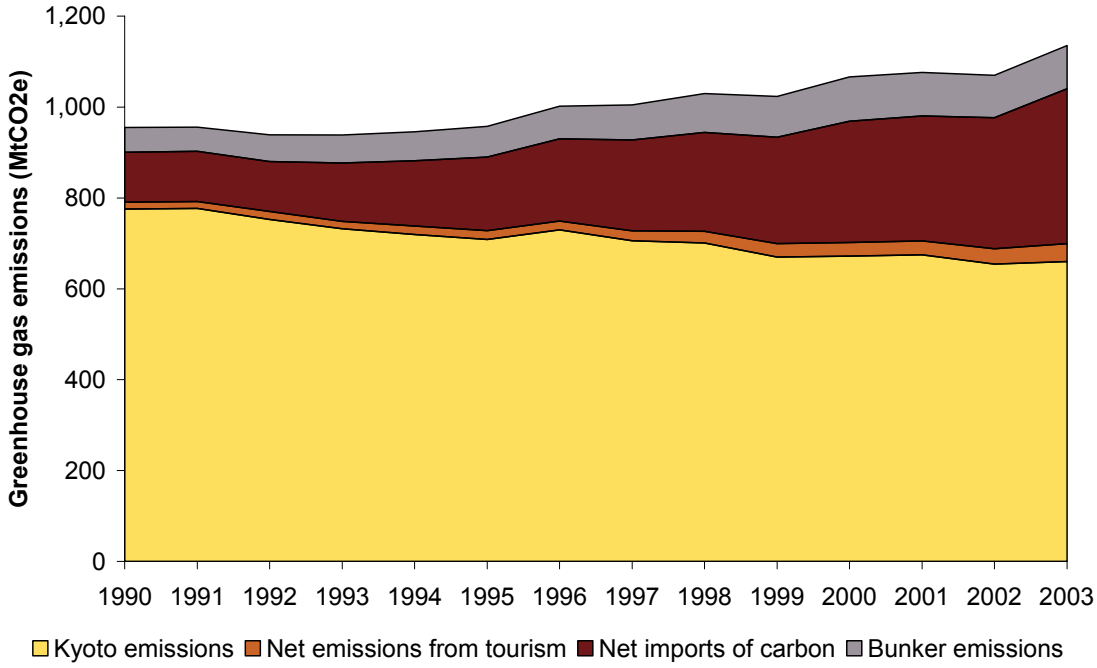


Source: Defra (2007)

A consumption basis

The above adjustments are collated together in Figure 11. On the UNFCCC basis, UK greenhouse gas emissions have fallen by 15% since 1990. In contrast, on a consumption basis, the illustrative outcome is *a rise in emissions of 19% over the same period*. This is a dramatic reversal of fortune. It merits an immediate, more detailed and more robust assessment. It suggests that the decline in greenhouse gas emissions from the UK economy may have been to a considerable degree an illusion. Trade may have displaced the UK's greenhouse gas appetite elsewhere.

Figure 11 Greenhouse gas emissions on a consumption basis, 1990–2003



Note: Bunker emissions include a radiative forcing factor of 3 for international aviation. Source: ONS (2007) and Vivid Economics

Source: ONS (2007c), CAIT Database and Vivid Economics calculations

This illustration of consumption-based measurement delivers a total for UK emissions that is 72% higher in 2003 than under the UNFCCC method. The difference in methods has widened over time: it was only 23% in 1990.

7 Conclusions

The UK's record against the UNFCCC greenhouse gas indicator is impressive, achieving a fall in emissions between 1990 and 2005. It has already beaten its Kyoto target of 12.5% by 2008–12.

Against its own domestic goal of a 20% CO_2 reduction by 2010, progress has been less impressive. The UK's CO_2 emissions have risen slightly recently, and last year lay only 5.3% below 1990 levels. This is despite the fact that the UK's climate change policy programme focuses effort on tackling CO_2.

All of the above figures were produced on a territorial accounting basis. When the account is extended to the Office for National Statistics' residents' basis, by including international transport and overseas activities, the picture looks worse. Emissions fell by only 11.9%, as shipping and international aviation boomed. Furthermore, airline passengers and firms from the UK consumed more greenhouse gases during their visits and activities abroad than overseas visitors and firms did in the UK, weakening the UK's overall performance when these trade activities are included. The trend is an adverse one.

Yet, even this extended scope of measurement does not represent the true picture of the UK economy's impact on the climate. To understand the UK's true impact, the greenhouse gas accounts should be reported on a 'consumption basis'. On this basis, all greenhouse gases embodied in UK consumption are counted, and by adding greenhouse gases embedded in imports and subtracting greenhouse gases embedded in exports, the crude calculations presented here suggest that UK emissions have been rising steeply. Between 1990 and 2003 the crude calculation indicates a rise of 19%. The scale of the effect is highly uncertain because of the highly aggregated level of data used to make the calculation, and considerably more research on a disaggregated basis is required.

The use by the UK government of the UNFCCC methodology gives the impression that the UK is winning the fight against climate change and it leads people to think that the UK is reducing its dependence on greenhouse gas emissions. However, these recent gains have in large measure been caused by the dash-for-gas in power generation . Such benign circumstances are unlikely to be sustained in the next decade—gas may displace nuclear rather than coal. On trade and imports, we have argued that the exclusion of imports give a false picture and that the degree of under-reporting of the greenhouse gas footprint of the economy could be substantial.

Using the production accounting basis, the UK has enjoyed a 2.1% per annum downward underlying trend in emissions intensity over recent decades. Its *UK Climate Change Programme* (DETR *et al*, 2000) has been designed to boost that rate of improvement to nearer 4.2% per annum, which is the trend which would achieve a 60% reduction in emissions by 2050. However, the task ahead may be much more daunting. Instead of a 2.1% per annum underlying trend of decarbonisation (carbon dioxide production basis), the economy's appetite for greenhouse gases may have been growing. If, when more robust data is collected, this turns out to be the case, climate change policy will have to deliver a much stronger correction to change the course of the greenhouse gas economy.

The UK has a long history of trade. It is time to recognise the importance of trade in climate change. Three policy conclusions emerge. First, the UK should check its progress using accounts based on greenhouse gas consumption. Second, with a substantial portion of its greenhouse gas footprint overseas in China and among other trade partners, the UK is itself partially responsible for the rapid emissions growth in developing countries, and this responsibility has implications for the allocation of future international greenhouse gas targets. Third, if the UK wishes to back its leadership claim in the global climate change debate, it would imply more aggressive policy geared to reducing greenhouse gas consumption.

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