



Chapter 1: Progress developing a legal framework and reducing emissions

Introduction and key messages

Since the Committee's advice on appropriate levels of carbon budgets was published in December 2008, there has been progress in developing a legal framework both internationally and in the UK:

- The EU agreed a package to support delivery of its 20% greenhouse gas (GHG) emissions reduction target, for 2020.
- The G8 has agreed an objective to limit global average temperature increase to 2°C and cut developed country emissions by 80% in 2050.
- The UK has put into legislation its first three carbon budgets.

Further, the UK – and other countries – have experienced a recession with impacts not anticipated in our earlier work.

This chapter reviews progress in developing a legal framework to underpin UK and international effort that will together reduce the risks of dangerous climate change.

The chapter also considers trends in UK aggregate, sectoral and regional emissions; with more detailed discussion provided in Chapters 4-6 of this report.

The key messages in the chapter are:

- The overall ambition of the EU package is reasonable provided there is a timely switch to the 30% GHG target with deep cuts in other developed countries such that global emissions peak before 2020. It is therefore crucial to achieve an ambitious global deal and to trigger the switch to the 30% target. It is also important that any free allowances allocation within the EU ETS is very limited.
- Legislated UK carbon budgets are fully consistent with the Committee's advice. The Government accepted the Committee's proposals that the Interim budget should be based on a 34% cut in emissions in 2020, that this should relate to all GHGs rather than just CO₂, and that this should be achieved through domestic emissions cuts rather than purchase of credits in the non-traded sector.
- UK GHG emissions have reduced only slightly in recent years, with increases in some sectors. Whilst emissions currently appear to be falling as a result of the economic recession, this will be largely reversed when the economy returns to growth. There is, therefore, a need for a step change if we are to achieve the 1.7-2.6% average annual reduction necessary to meet the first three carbon budgets.

The chapter is structured in 4 sections:

1. The EU framework
2. Copenhagen and the international framework
3. Carbon budgets legislated by the UK
4. Progress reducing emissions in the UK.

1. The EU framework

The EU agreed at its Spring Council in 2007 to adopt a unilateral target to reduce GHG emissions by 20% in 2020 relative to 1990, moving to a 30% target following a new global deal to reduce emissions. In January 2008 the EC published a draft package to support achievement of the 20% and 30% targets including EU-wide caps for non-traded and traded sectors, mechanisms for distributing these caps across member states and sectors, and limits on the use of credits to meet caps. This draft package was one factor that the Committee considered in developing its advice on carbon budgets. Since our advice was published in December 2008, a final EU package has been agreed (Box 1.1).

This section provides a summary of the agreed EU package and considers:

- (i) The non-traded sector
- (ii) The traded sector
- (iii) Transitioning from 20% to 30% targets.

It concludes with a high level Committee view on the agreed package, drawing out implications for carbon budgets.

(i) The non-traded sector

The non-traded sector cap

The non-traded sectors of the economy include direct CO₂ emissions from buildings, transport and less energy-intensive industry, as well as non-CO₂ emissions, and account for around 60% of total EU emissions. Proposals in the January package for non-traded sector emissions reductions, reflected in the Committee's budget advice, were carried through to the agreed package:

- The EU-wide target for non-traded sector emissions is a 10% cut in 2020 relative to 2005 for a 20% GHG target.
- This is allocated across countries based on ability to pay as measured by GDP per capita.
- The EU's non-traded sector target for the UK is to cut emissions by 16% in 2020 relative to 2005 for a 20% GHG target.

- The Committee's proposals included a 17% cut in emissions in non-traded sector emissions in 2020 under the Interim budget. This is consistent with the EU's 20% GHG target after allowing for accounting differences between the EU and UK frameworks (e.g. the UK framework includes land use change and forestry).

Use of offset credits

The agreed package allows use of offset credits up to 3% of 2005 emissions to meet non-traded sector targets. The Committee advised, however, that the UK should not plan to use offset credits to meet the Interim budget. The Committee argued that the Interim budget should be met through domestic emissions reductions both to support the transition to the Intended budget following a global deal, and to be on track to meeting the 80% emissions reduction target for 2050.

Box 1.1 EU Greenhouse gas emission reduction targets

EU ambitions for overall GHG emission reductions by 2020:

- a unilateral commitment to a 20% reduction (we sometimes refer to this as a **'20% world'**)
- agreement to move to a 30% reduction following a global deal to reduce emissions (we sometimes refer to this as a **'30% world'**)

are set against 1990 levels of emissions.

EU targets for the non-traded and traded sectors in 2020:

- a 10% reduction in non-traded sector emissions
- a 21% reduction in traded sector emissions

are established for the '20% world' and against 2005 levels of emissions.

In the event of a new global deal to reduce emissions, and a move to a '30% world', the non-traded and traded sector targets will be reconsidered.

(ii) The traded sector

The traded sector cap

The traded sectors of the economy include energy-intensive industries (e.g. iron and steel, cement, refining) and power generation and account for around 40% of EU emissions. Proposals in the January package for traded sector emissions reduction, reflected in the Committee's budget advice, were carried through to the agreed package:

- The traded sector cap requires an EU-wide 21% reduction in 2020 relative to 2005 for a 20% GHG target.
- This is allocated across countries via mechanisms for distributing auction revenues to governments and free allowances to firms.
- The traded sector cap for the UK requires a 31% cut in 2020 relative to 2005 for a 20% GHG target.
- The Committee's proposals reflected a 28% cut in 2020 relative to 2005 under the Interim budget. This is consistent with the 20% GHG target after allowing for differences in accounting between the EU and UK frameworks (e.g. the Committee's proposals included domestic aviation in the traded sector) and slight differences in assumptions on free allowance allocation to UK firms.

Auctioning of EU ETS allowances

The Committee highlighted the general need to auction EU ETS allowances in order both to provide carbon price signals to consumers, and to avoid windfall profits for EU ETS participants. The Committee noted that it may, however, be desirable to issue free allowances where energy-intensive firms are subject to competition in the global market from firms operating in countries without carbon constraints. Alternatively, the Committee argued that risks of carbon leakage could be mitigated through introduction of carbon-related border tariff adjustments.

The agreed framework requires:

- Phasing out of free allowances for the power sector from 2013.

- Phasing out of free allowances for other sectors starting at 80% in 2013 falling to 30% in 2020 and zero in 2027.
- Free allowances for sectors subject to global competition. The EC will publish a list of sectors regarded as being globally competitive at the end of 2009, with an in-depth assessment to follow in 2010.

Use of offset credits

The Committee argued that limited use of offset credits to meet traded sector targets should be accepted with the caveat that this should not undermine the carbon price and hence incentives for investment in low carbon technologies. The agreed package limits the use of offset credits to 50% of the emissions reduction required to meet the traded sector cap under a 20% GHG target; this is unchanged from the January proposal.

(iii) Transitioning from the 20% to the 30% world

The EU's January package included detailed proposals for a 30% world (EU non-traded and traded sector caps, member state burden shares for the non-traded sector, use of credits to meet non-traded and traded sector caps, etc.). The agreed package, however, no longer includes details of the 30% world. Instead, following any Copenhagen agreement, there will be a political process involving both the European Parliament and the European Council (i.e. member states) to agree detailed arrangements to deliver a 30% GHG target.

(iv) Summary of the Committee's position

Agreement of a package is a positive step forward. In particular, the non-traded sector cap for the UK under the agreed package would support, if met through domestic emissions reduction, the transition to the Intended budget and be on the path to meeting the 80% emissions reduction target for 2050.

The Committee is concerned, however, about the traded sector cap and the resulting carbon price, particularly given lower emissions from energy intensive sectors as a result of the recession. There is a risk that the carbon price will not be sufficiently high to incentivise investments in low carbon technologies. We set out our analysis of the carbon price and options to strengthen incentives for investment in low-carbon technologies in power generation in Chapters 2 and 4 of this report.

The move to full auctioning of EU ETS allowances for the power sector will transfer windfall profits away from energy companies. There are questions over whether auctioning could be introduced to other sectors at a faster pace, and how extensive auctioning will be. The Committee stresses the need to ensure that the definition of sectors requiring special treatment be limited to those which are clearly shown to be subject to global competition and that these sectors should not necessarily receive 100% free allowances.

In our December report we argued that the 20%-30% range straddles the sort of developed country emissions reductions which are likely to be required to meet global climate stabilisation goals: 20% would be too low, but 30% would be adequate if other countries were making commensurate commitments.

The crucial point for the Committee, therefore, is the early transition from the 20% to the 30% target and the UK's transition from the Interim to the Intended carbon budgets. Following Copenhagen, the EU will have to decide whether the 30% target should be triggered, and the Committee will have to advise on whether to move to the Intended budget.

It is important to note that the recommendations by the Committee for the Intended budget were to be revisited following a Copenhagen agreement. Once agreement is reached, questions to be answered will include the level of emissions reduction ambition underpinning any Intended budget and the extent to which this should reflect

any new detailed arrangements to meet the EU's 30% GHG target. The Committee will consider budget revisions following Copenhagen with the current intention that new, more ambitious budgets could be legislated either in 2010 or early 2011.

2. Copenhagen and the International framework

The Committee's advice on required global emissions reductions

The Committee based its advice on the appropriate level of global emissions reduction on consideration of evidence about climate change damage from the IPCC's Fourth Assessment and more recent studies. This led us to adopt a climate change objective that central estimates (i.e. 50% probability) of global average temperature increase over the 21st century should be limited at or close to 2°C and that the probability of an extreme 4°C change should be kept to very low levels (e.g. less than 1%). We assessed a range of emissions trajectories and concluded that, in order to achieve the climate objective, emissions should peak in the period before 2020 with 3%-4% annual cuts beyond the peaking year leading to a minimum 50% cut in 2050 across all Kyoto gases and all sectors (Box 1.2).

The UK negotiating position

The Government's published negotiating position for the Copenhagen meeting in December 2009 to agree a successor deal to the Kyoto agreement is in line with the Committee's advice.

In particular, the Government will seek an agreement in Copenhagen based on emissions peaking before 2020 with a global emissions cut of 50% in 2050 across all Kyoto gases and all sectors including aviation and shipping (Box 1.3). The Government also took the Committee's recommendation that the UK should cut emissions by 80% in 2050 as the basis for its position that all developed countries should achieve a similar target.

Box 1.2 The long-term target

The UK emissions targets outlined in the Committee's 2008 report are designed as a fair contribution to an ambitious global climate objective. In setting these targets it is important to recognise that there are uncertainties in our understanding of the climate system, making it difficult to aim precisely for a specific temperature outcome. There is strong scientific confidence in the link between GHG emissions and global warming, but different climate models predict different levels of temperature increase because of the alternative ways by which they represent some processes.

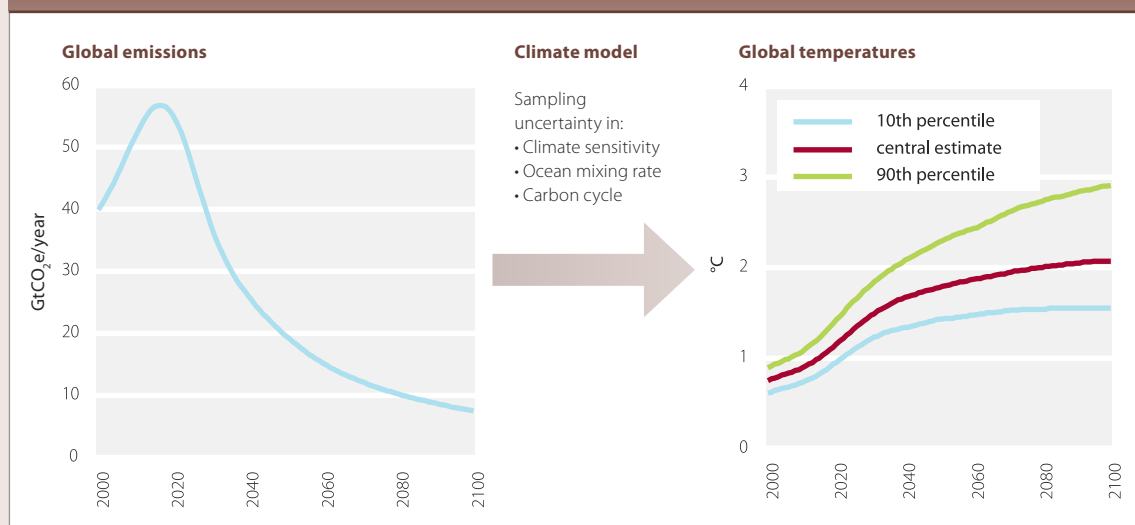
Recognising this uncertainty, the Committee took a risk-based approach to setting targets. Work carried out by the Met Office Hadley Centre¹ accounted for the spread in model projections by giving probabilities of temperature increase based on current understanding (see Figure B1.2). Results show that global emissions of Kyoto GHGs must peak before 2020, and then reduce at a rate of 3-4% per annum throughout the century, in order to keep a 50% chance of remaining close to 2°C above pre-industrial levels. Reductions of this magnitude would also keep the chance of a 4°C increase very low (i.e. of the order of 1%). On this

pathway, global Kyoto GHG emissions would be halved by 2050.

Stronger emissions reductions will result in a greater chance of staying within temperature limits. The Committee therefore recommended that the world should cut emissions in 2050 by at least 50%. It was also emphasised that climate change is not just driven by the level of emissions in a given target year (e.g. 2020 or 2050), but by the accumulated total of long-lived GHGs over time. As a result, if global emissions peak in 2020 or later, or if they grow faster before peaking, further subsequent cuts will be required in order to conserve total emissions by 2050.

More recent studies have reached similar conclusions; for instance, a science conference convened in Copenhagen during March stated that 'if peak greenhouse gas emissions are not reached until after 2020, the emission reduction rates required thereafter to retain a reasonable chance of remaining within the 2°C guardrail will have to exceed 5% per annum². The Committee will continue to monitor scientific developments closely, and will assess any implications for UK emissions targets when advising on the fourth carbon budget in 2010.

Figure B1.2 Schematic of modelling process for relating emissions pathways to temperature targets.¹



¹ See Technical Appendix to Chapter 1 of the Committee's December 2008 report: *Projecting global emissions, concentrations and temperatures*.

² Richardson et al (2009) *Climate Change: global risks, challenges and decisions Synthesis Report*.

Box 1.3 Aviation and Shipping – progress towards international agreements

In our 2008 report, we recommended that both international aviation and shipping emissions needed to be covered by an international agreement. This box summarises the context, developments and ongoing discussions regarding international agreements in these two sectors in the run-up to Copenhagen:

UNFCCC (Kyoto Protocol)

Article 2.2 of the Kyoto Protocol stated that ‘the parties included in Annex I shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO) respectively’.

ICAO and IMO progress

Both organisations have made progress towards targets and/or measures to improve fuel efficiency:

Fuel efficiency

- The ICAO Council has adopted medium and long-term fuel efficiency goals and undertaken to develop a CO₂ standard for new aircraft types.
- The IMO, meanwhile, has made progress on its Energy Efficiency Design and Operational Indices (EEDI & EEOI) for new and existing ships respectively.

Market-based measures

- Both organisations remain open to market-based measures as a mechanism to reduce emissions.
- The key challenge in getting a widespread agreement on emissions reduction to-date, however, has been the difficulty in reconciling the ‘parties included in Annex I’ with the organisations principles that all contracting or member states are treated equally. This is due to the reality that some have interpreted Article 2.2 of the Kyoto Protocol to imply that non-Annex I countries shouldn’t be required to make commitments and/or reductions.

EU progress

In January 2009 the Directive to include aviation in the EU ETS was published in the Official Journal of the EU. From 2012, all flights departing from and arriving at EU airports (both domestic and international) will be included in the EU ETS. The cap in the medium term (2013 to 2020) will be 95% of the average annual 2004-06 emissions. Aircraft operators have reporting and monitoring obligations in 2010 and 2011.

The European Commission (EC) is also now looking at options to reduce GHG emissions from international shipping. The EC have contracted an in-depth study, due to be published later this year, which is considering various market-based and/or technical regulatory options that could achieve emissions reduction in this sector.

Negotiating text for Copenhagen

In June the UNFCCC published the revised negotiating text in the lead-up to Copenhagen. In respect of international bunker fuels four main options are being considered:

1. IMO to be encouraged to continue its work on reducing GHG emissions without delay and regularly report back to the Conference of the Parties (COP).
2. UNFCCC to set reduction target and then parties to work through ICAO and IMO to enable effective international agreements, developing mechanisms by 2011.
3. Parties to work through ICAO and IMO (similar to Kyoto Protocol Article 2.2), although there is flexibility regarding whether this applies to Annex I countries or all countries.
4. UNFCCC to set reduction target and then parties to start negotiations on two global sectoral agreements in 2010, with a view to concluding by 2011.

Committee position on international aviation

In a recent letter to the Secretaries of State for Transport and Energy and Climate Change, the Committee set out their advice to Government on a framework for reducing global aviation emissions. The key messages were as follows:

- Aviation CO₂ emissions should be capped, either through a global sectoral deal or through including (domestic and international) aviation emissions in national/regional (e.g. EU) emissions reduction targets.
- Ideally all aviation CO₂ emissions would be capped. It may be necessary, however, that there is an interim phase where the cap applies to all departing and arriving flights in developed countries with exemptions for intra-developing country flights.
- The level of emissions reduction ambition under any international agreement should be no less than that already agreed by the EU (i.e. developed country net emissions in 2020 should be no more than 95% of average annual emissions from 2004–06).

For shipping, a global cap would be appropriate and both sectors need to plan for deep cuts in gross emissions relative to baseline projections in the longer term, with emissions trading providing flexibility in the near to medium term.

Positions of the G8 and others

The G8 had already agreed in July 2008 a willingness to share with all countries a target to cut global emissions by 50% in 2050. Building on this, in July 2009 the G8 recognised the broad scientific view that global average temperature increase ought not to exceed 2 degrees and agreed a goal that developed countries should cut emissions by 80% in 2050 as an appropriate contribution to the 50% global cut; these commitments are consistent with the Committee's advice on global and UK emissions reductions.

In the US, new legislation (the Waxman–Markey Bill) was proposed in Congress in March 2009. Under this legislation, US emissions would be capped and a number of measures introduced to support required emissions cuts (e.g. energy efficiency regulations, renewable electricity obligations, etc.). The draft bill has passed through the House of Representatives and is scheduled for discussion in the Senate in Autumn 2009.

There have been changes in the positions of other countries too. For example, Japan has recently announced a target to reduce emissions by 25% in 2020 as against 1990 levels. India has indicated a willingness to reduce emissions through unilateral mitigation measures. China also has plans for substantial reductions in emissions as against business as usual, and has announced an intention to reduce carbon intensity by 2020.

The Committee's position on Copenhagen

The Committee has set out what it sees as a broad shape for an appropriate deal in Copenhagen (e.g. global emissions peaking before 2020, 50% cut in global emissions by 2050, etc.). The Committee therefore views the UK negotiating position, agreements by the G8 and progress in various countries as positive steps, though securing a global agreement remains challenging.

It is not, however, the role of the Committee to take a view on detailed negotiating positions (e.g. the appropriate cap for the US and a possible cap for China) or what the outcome of negotiations is likely to be. The Committee will monitor closely outcomes in Copenhagen with a view to assessing implications for the UK and, in particular, to assess whether moving from the interim to the intended budget would be appropriate and to assess the precise level of the intended budget.

3. Carbon budgets legislated by the UK

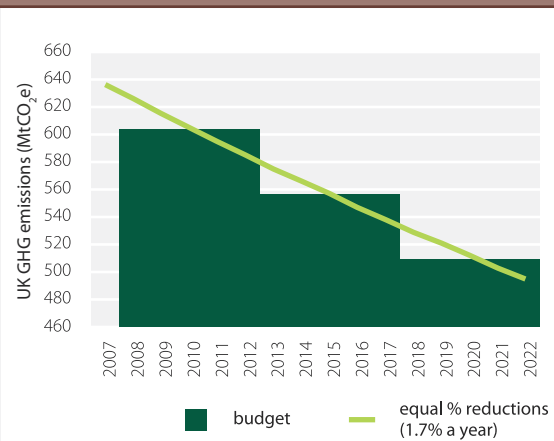
In April 2009 the Government announced carbon budgets, which subsequently passed into legislation in May 2009 (Table 1.1). We welcome that these fully reflected the Committee's advice on the level of ambition, the use of credits, and the high level set of measures to meet carbon budgets:

- The legislated budget is based on a 34% cut in 2020 relative to 1990 with an annual average emissions reduction of 1.7% over the first three budget periods (i.e. it is the Committee's Interim budget) (Figure 1.1).
- The budget split between the non-traded/traded sectors reflects that proposed by the Committee (i.e. it has the result that non-traded sector emissions account for 60% of total allowed emissions over the first three budget periods).
- The budgets, in line with the Committee's advice, exclude emissions from international aviation and shipping. Aviation is, however, included within the EU's 20% and 30% GHG emission reduction targets. Our budget proposals were based on that framework and do, therefore, implicitly take account of international aviation emissions.
- The Government does not intend to use offset credits to meet the Interim budget. It has legally committed to this for the first budget (the Climate Change Act makes provision for legal commitment on the use of offset credits for the

first – and not second/third – budget periods at the current time).

- The document containing the Government's budget proposals and the subsequent 'UK Low Carbon Transition Plan' set out an ambitious high level vision of how budgets will be met through the range of measures in the Committee's December 2008 report: decarbonisation of the power sector, energy efficiency improvement in buildings, increased penetration of renewable heat, reduced transport emissions through more carbon-efficient vehicles and changes in consumer behaviour, reduced agricultural emissions through soils and livestock measures.

Figure 1.1 Indicative annual percentage emissions reductions required to meet legislated carbon budgets



Source: CCC calculations.

Table 1.1 Legislated carbon budgets and split between traded and non-traded sectors

| | Budget 1 | Budget 2 | Budget 3 |
|---|------------------|------------------|------------------|
| | 2008-2012 | 2013-2017 | 2018-2022 |
| Carbon budgets (MtCO ₂ e) | 3018 | 2782 | 2544 |
| Percentage reduction below 1990 levels | 22% | 28% | 34% |
| Traded sector (MtCO ₂ e) | 1233 | 1078 | 985 |
| Non-traded sector (MtCO ₂ e) | 1785 | 1704 | 1559 |

Source: HM Government's 'Building a low-carbon economy: implementing the Climate Change Act 2008' (April 2009)
Table 3.B: Proposed carbon budget levels.

The Government also committed to a more ambitious budget following a global deal in Copenhagen, without stating what this budget would be. This is consistent both with provisions under the Climate Change Act and the Committee's advice:

- Under the Climate Change Act, the Government must consult the Committee before any change to carbon budgets is made.
- The Committee's Intended budget is to be revisited with final proposals to be determined following a global agreement.

For the period before the Intended budget is legislated, the Government will aim to outperform the Interim budget through a range of measures proposed in the Extended and Stretch Ambition scenarios in our December 2008 report. This will support the transition to the Intended budget, and provide the option to meet the Intended budget largely through domestic emissions reductions rather than the purchase of offset credits.

Legislation of carbon budgets is the first step towards realising deep emissions cuts in the UK, which together with cuts in other countries will limit the risk of dangerous climate change. The challenge now is to move from legal commitments and high level visions to detailed implementing frameworks, both at the national and regional levels. The Committee's view on the detailed measures that will be required to meet carbon budgets and the policies that will drive these measures is summarised in Chapter 3 and set out in more detail in chapters 4-6.

4. Progress reducing emissions in the UK

The ultimate test of success for the framework established under the Climate Change Act is that emissions fall sufficiently to meet carbon budgets.

Going forward, as required under the Act, the Committee will report on progress in reducing emissions and meeting budgets in annual reports to Parliament.

There is limited scope for such reporting at the current time given that we are in the second year of the first budget period, with preliminary emissions data only available for the first year. It is therefore not possible to make analytically robust and meaningful statements about whether we are on track to meet the first budget.

It is useful, however, to consider emissions trends in recent years³ with a view to assessing the extent of the change in trend required to meet carbon budgets. This section therefore summarises:

- (i) Economy-wide emissions trends
- (ii) Sectoral emissions trends
- (iii) Regional emissions trends.

In considering trends, we look at data from 1990 for completeness. A better predictor, however, is more recent data. We therefore assess emission trends over the period 2003-2007 at the economy-wide and sectoral level. Our conclusion is that emissions have reduced only slightly in recent years, with increases in some sectors. The most recent provisional data show emissions falling as a result of the economic recession, but these reductions will be reversed once the economy starts to grow again. It is clear that action is therefore required if we are to achieve the 1.7-2.6% average annual reduction necessary to meet the first three carbon budgets.

We note that, whilst emissions reduction can be achieved sustainably through implementation of measures (e.g. to improve energy efficiency, decarbonise the power sector, etc.), they can also be driven by a number of other factors (e.g. changes in GDP, fossil fuel prices, population change, external temperature, etc). In understanding progress towards meeting carbon budgets, it is therefore important to monitor implementation of measures that will result in sustainable emissions reductions; we consider this issue further in Chapter 2 and set out our view of the detailed measures required to reduce emissions and meet carbon budgets in Chapters 3-6 of this report.

³ In our December 2008 report the final year of available historic data was generally 2006. For the current report we are able to update to include 2007 and, sometimes, 2008 data. Where the 2008 data is provisional, or reflects estimates from other sources, this is generally represented by a dotted, rather than solid, line to the data point in the relevant chart. In the text we are sometimes able to draw on part year data for 2009.

(i) Economy wide emissions trends

Total GHG emissions in 2007 – the last year for which final data are available – were 636 MtCO₂e, comprising 85% CO₂ and 15% non-CO₂.

Over the period 1990-2007, GHG emissions fell by 18%, at an average annual rate of 1.2%. This was driven by an 8% reduction in CO₂ emissions and a 49% reduction in non-CO₂ emissions, and notwithstanding that energy demand increased in most sectors (Figures 1.2, 1.3):

- A significant factor driving CO₂ emissions reductions was a 13% reduction in power sector emissions due to the dash for gas (i.e. replacement of coal with gas-fired power generation) in the 1990s, which was partially offset by increasing electricity demand.
- Direct (i.e. non-electricity) emissions reductions of 40% reflecting fuel switching and lower energy demand due to industry restructuring were also important in reducing CO₂ emissions.
- Transport emissions increased by 11% over the period 1990-2007 due to increased demand which was only partially offset by increasing carbon efficiency of vehicles.
- The reductions in non-CO₂ emissions occurred mainly in waste and industry.

More recently, however, GHG emissions have reduced at a lower rate:

- GHG emissions fell by 3.8% between 2003 and 2007 and 0.95% on average per year. Emissions reductions have therefore slowed relative to the preceding decade.
- Preliminary data for 2008 suggests a 2% reduction in CO₂ emissions relative to 2007, reflecting a switch from coal to gas in power generation, combined with lower fossil fuel consumption in industry and transport.
- Data for the first quarter of 2009 suggests that energy consumption fell relative to the same period in the previous year as a result of the economic recession, although the impact of this on emissions may have been offset by switching from gas to coal in power generation.

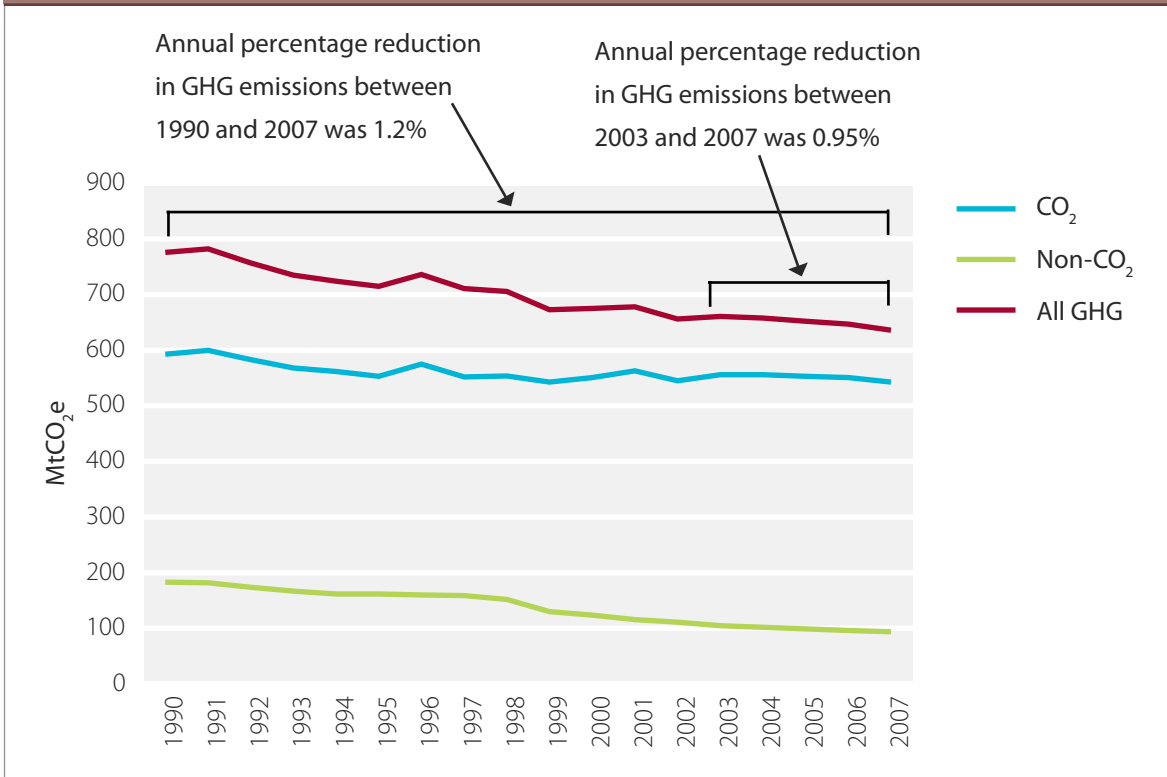
It may be the case that full year data for 2009 shows a significant emissions reduction relative to 2008. This would not, however, signal the downward trend required through the first three budget periods (i.e. annual emissions reductions of 1.7% to meet the Interim budget, and 2.6% to meet the Intended budget), under an assumption that economic growth is likely to resume in the near term and allowing for a further increase in population of 9% from 2009 to 2022 (Figure 1.4).

This conclusion is even more apparent when we look separately at CO₂ emissions. Most of the reduction in GHG emissions since 1990 has reflected a fall in non-CO₂ emissions (Figure 1.2). However, there is limited potential for continued non-CO₂ emission reduction. CO₂ emissions in 2007 are no lower than in 1999, and fall at only 0.6% annually from 2003 to 2007. A much greater reduction will therefore be required going forward (Figure 1.5).

Given the relatively flat emissions trend in recent years, reduced potential for reductions from non-CO₂ and the fact that there has been very limited progress reducing emissions through implementation of measures that will be required going forward to meet budgets (e.g. loft and solid wall insulation in homes, investment in renewable heat and electricity, transport emissions reductions, carbon efficiency improvement in agriculture, etc.), a fundamental step change is required in order that deep emissions cuts are achieved going forward.

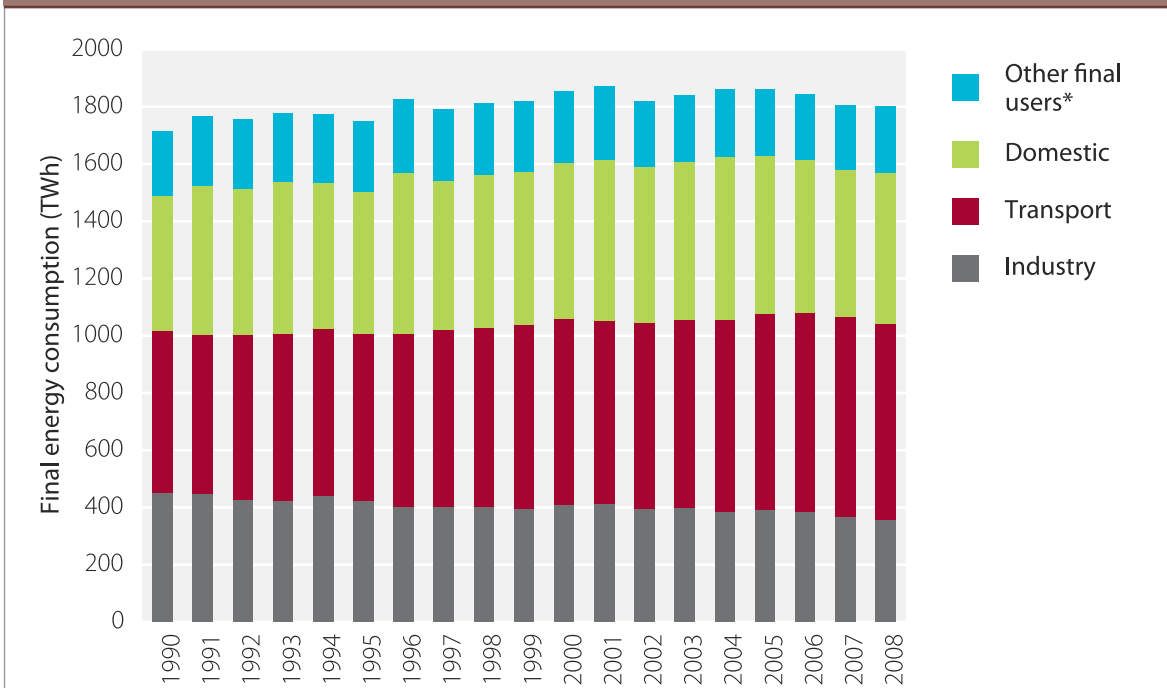
We set out what in the Committee's view will drive these cuts in Chapters 3-6, and the set of measures that we will monitor together with emissions trends when assessing progress meeting budgets in Chapter 3.

Figure 1.2 UK greenhouse gas emissions 1990-2007



Source: NAEI (2009); DECC (2009), *Energy Trends March 2009*.

Figure 1.3 Energy demand by final users 1990-2008



* mainly public administration, commerce and agriculture

Source: DECC (2009); DUKES.

Figure 1.4 Recent UK GHG emissions and indicative reductions required to meet carbon budgets

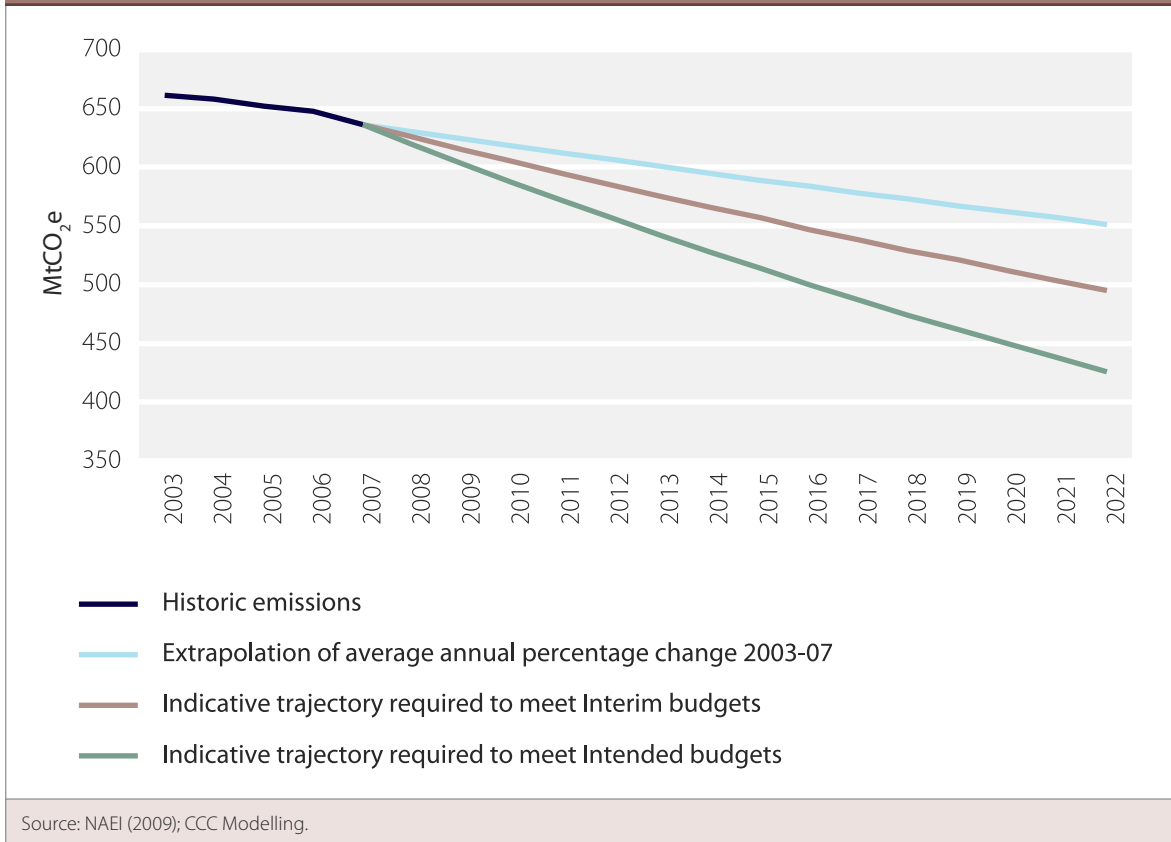
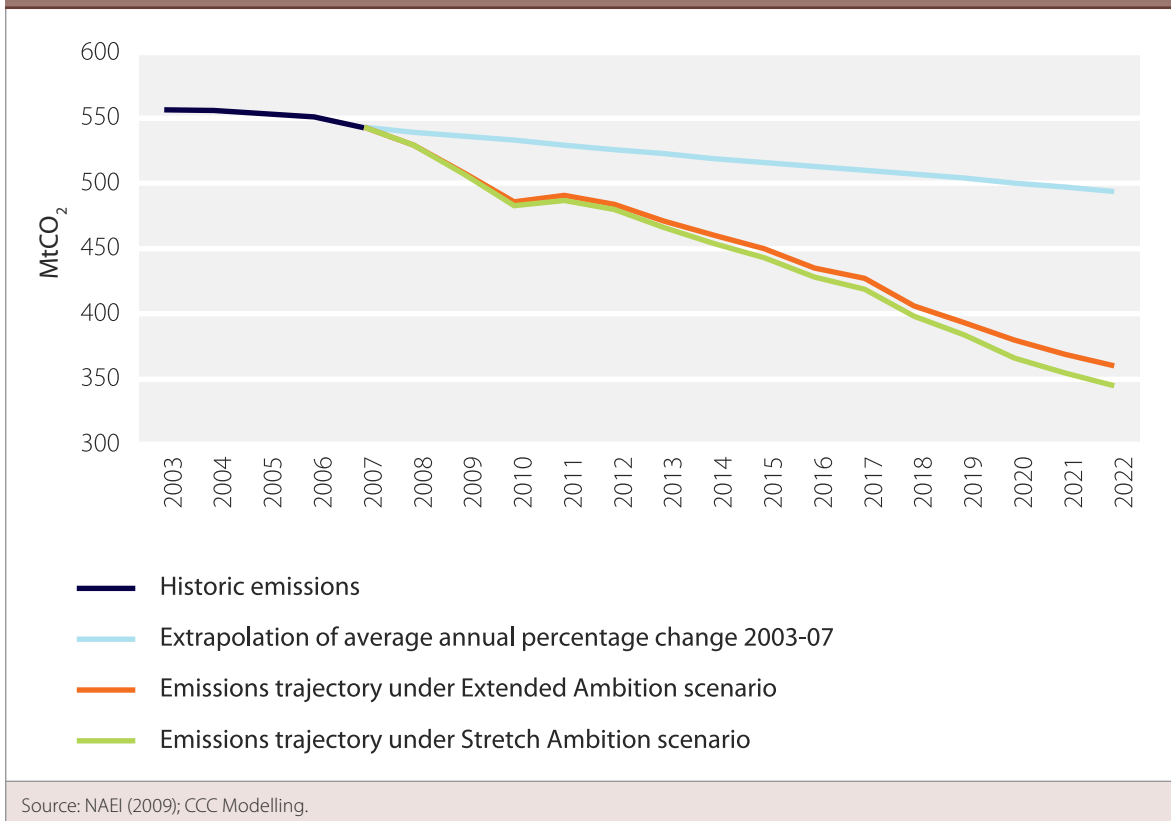


Figure 1.5 Recent UK CO₂ emissions and reductions under CCC emission scenarios



(ii) Sectoral emissions trends

Power sector emissions

UK CO₂ emissions from power generation have fallen significantly since 1990 due to fuel switching from coal to gas (Figure 1.6), which more than offset demand growth (Figure 1.7):

Demand

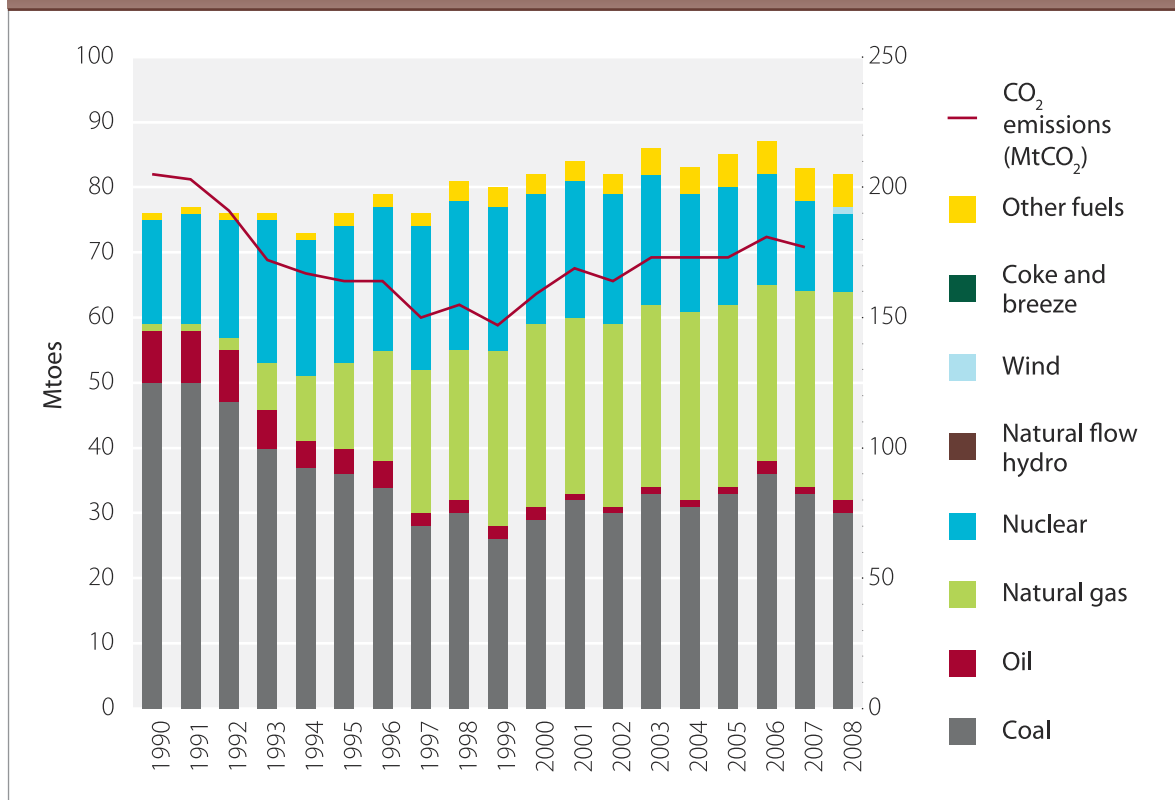
- Demand over the period 1990-2005 increased at an annual rate of around 1.6%.
- More recently, there was a 1.5% demand reduction between 2005 and 2007, with flat demand in 2008. Preliminary data for 2009 suggests that demand may fall significantly as a result of the recession (e.g. generation in the first quarter of 2009 was 5.1% lower than in the same period in 2008).

Generation

- Fuel switching occurred in the 1990s as a result of the dash for gas.
- Since this fundamental shift, there has been a changing balance of coal and gas-fired generation in response to changes in relative coal and gas prices and carbon prices. Gas generation rose and coal generation fell in 2008, but coal generation in the first quarter of 2009 was 12% higher, and gas generation 22% lower than in the same period in 2008.

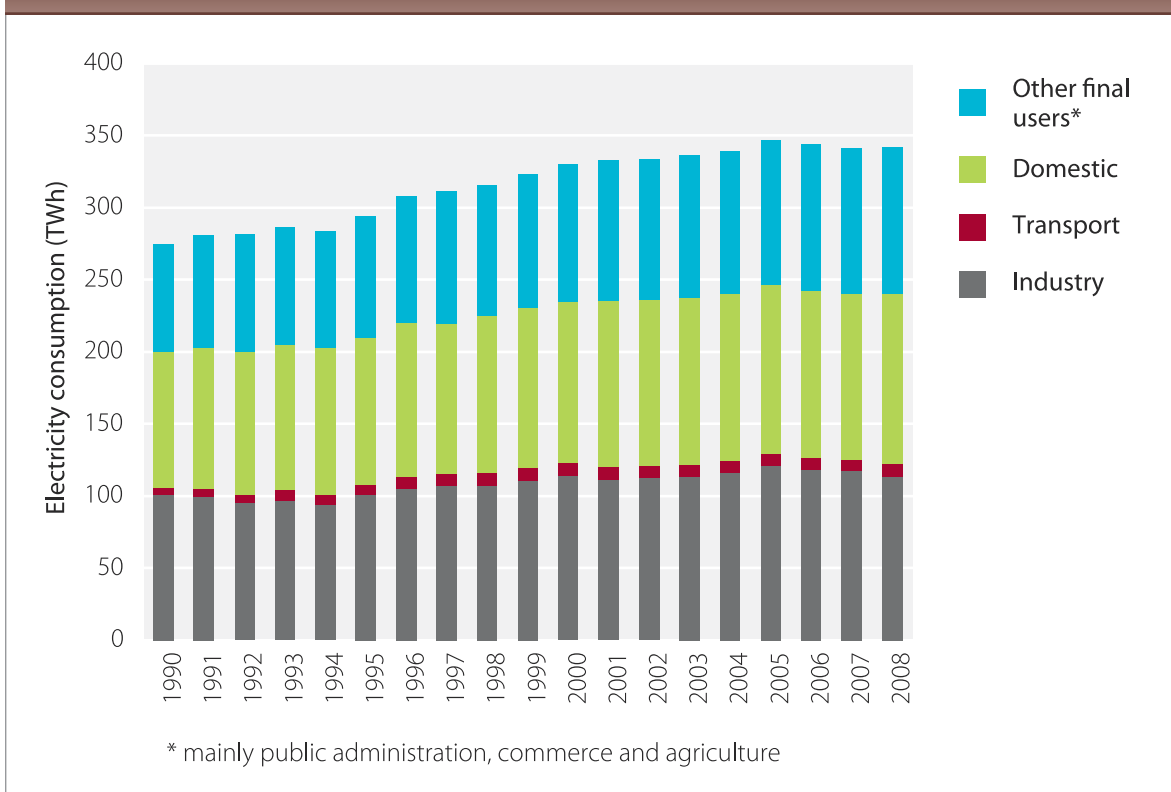
The combination of these factors has resulted in significant reductions in the carbon intensity of power generation since 1990, but fluctuating intensity in recent years (Figure 1.8). The change in emissions intensity in recent years is therefore not consistent with the deep power sector emissions cuts required to 2020 and beyond (Figure 1.9, and see Chapter 4).

Figure 1.6 Fuel input and emissions from power generation 1990-2008



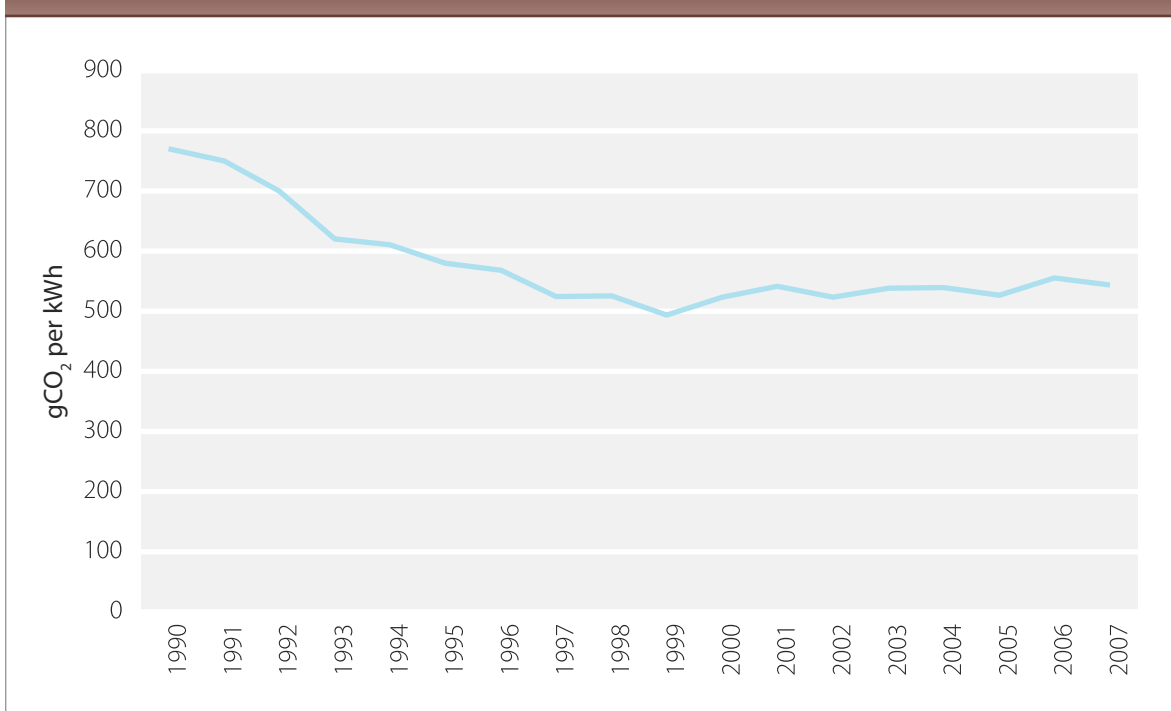
Source: NAEI (2009); DECC (2009); DUKES.

Figure 1.7 Electricity demand by final users 1990-2008



Source: DECC (2009); DUKES.

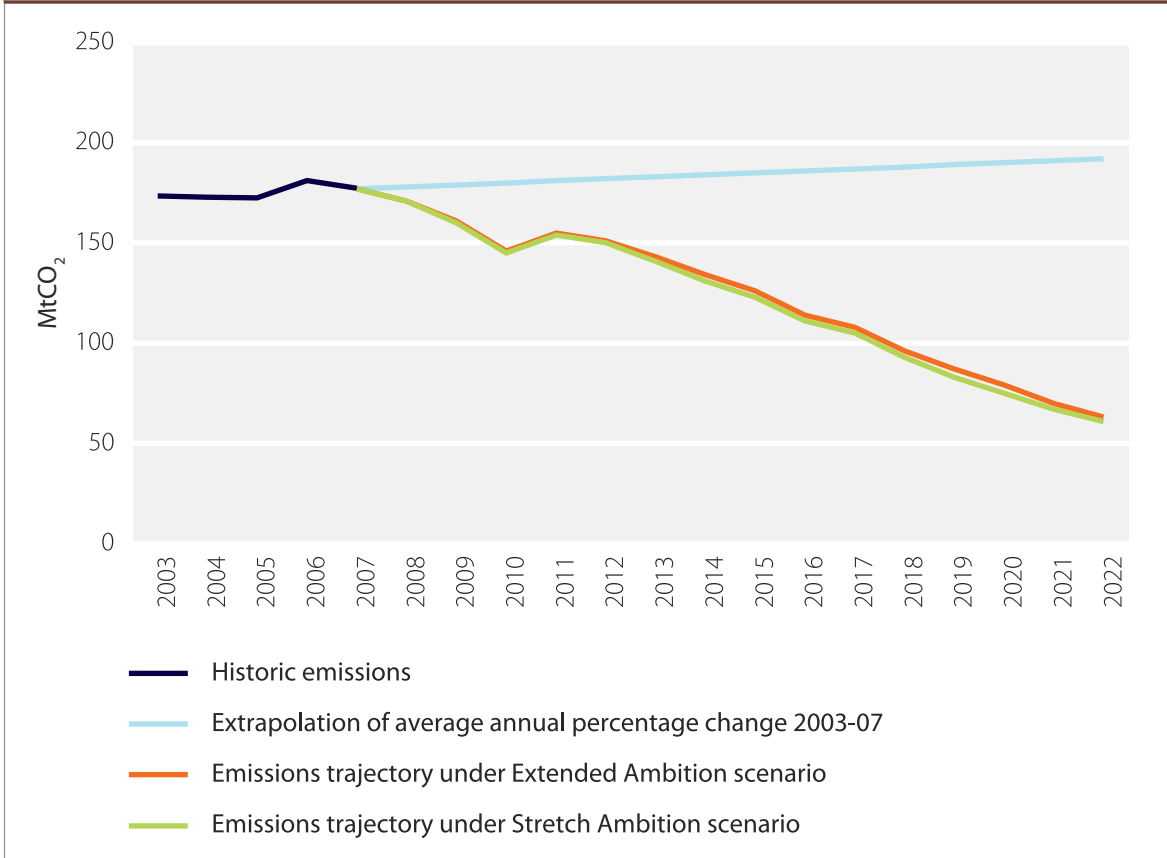
Figure 1.8 Carbon intensity of electricity generation 1990-2007



Source: Defra (2009), GHG conversion factors for company reporting.

Note: These emission intensity figures represent the average CO₂ emissions from the UK national grid per kWh of electricity used at the point of final consumption. Transmission and distribution losses are included. These cannot be compared directly to Figure 8 and Figure 4.28, which are modelled differently and do not include transmission and distribution losses.

Figure 1.9 Recent power sector CO₂ emissions and reductions under CCC emissions reduction scenarios



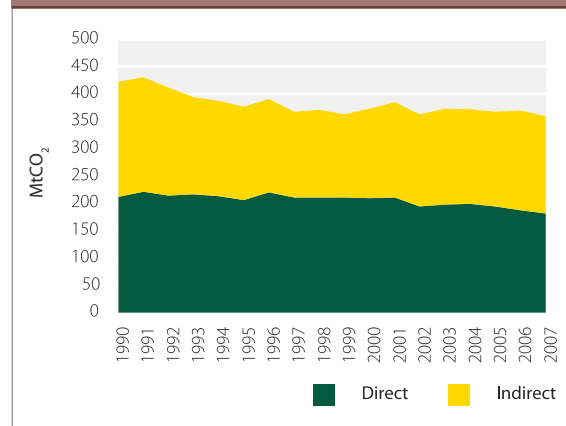
Source: NAEI (2009); CCC Modelling.

Emissions in buildings and industry

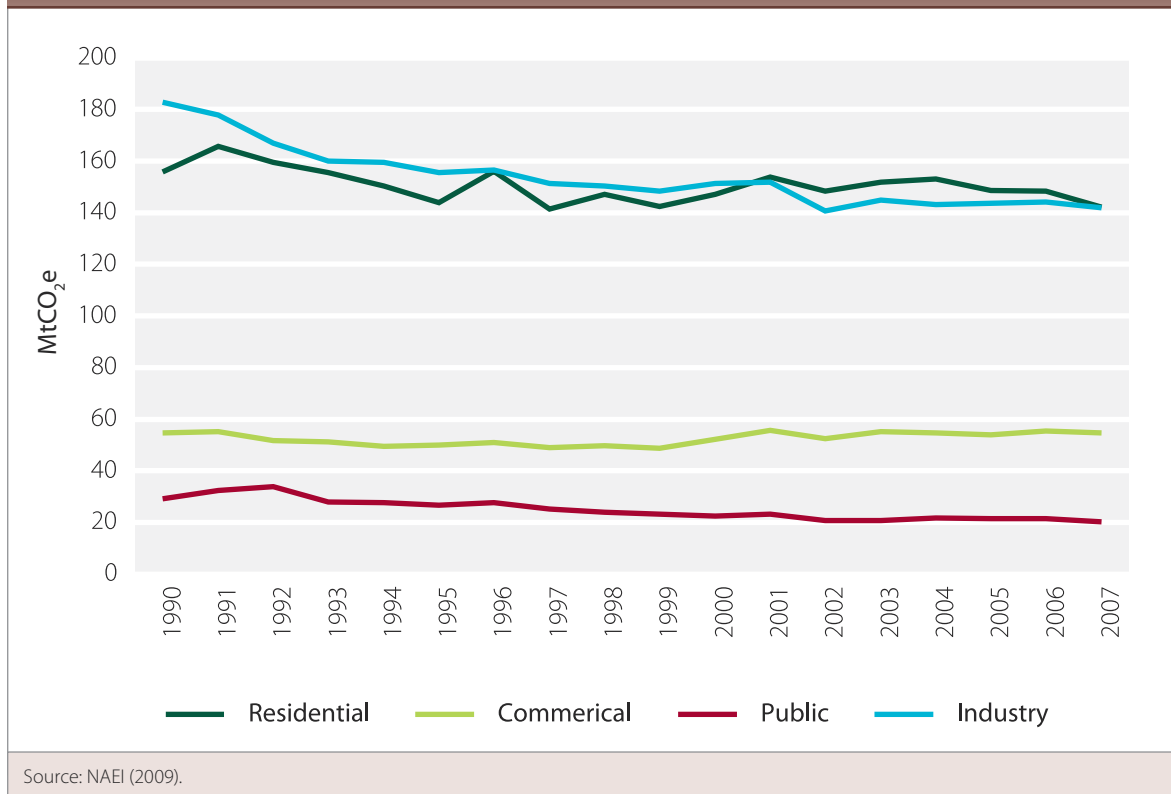
Emissions from buildings and industry account for around two-thirds of all CO₂ emissions in the UK, comprising around 50% each from direct (e.g. due to burning of fuel for heat) and indirect (predominantly electricity-related) emissions. Total emissions from buildings and industry fell by 15% over the period 1990-2007, with direct emissions falling by 14% and indirect emissions by 16% (Figures 1.10-1.11):

- Emissions reductions of 9% in the residential sector were largely due to lower indirect emissions as a result of reduced carbon intensity of power generation in the 1990s.
- Emissions reductions of 30% were achieved in the public sector through the use of more carbon-efficient fuels rather than reduced energy consumption.

Figure 1.10 Total direct and indirect CO₂ emissions from buildings and industry 1990-2007



Source: NAEI (2009).

Figure 1.11 CO₂ emissions from buildings and industry by sector 1990-2007

- Commercial sector emissions in 2007 were broadly at the same level as in 1990.
- Industry emissions fell by 22% between 1990 and 2007 as a result of industry restructuring, the use of more carbon-efficient fuels, and switching from coal to gas in power generation.

In the period 2003-2007, reductions of 8% have been achieved for direct emissions from buildings and industry while indirect emissions were broadly flat:

- Direct emissions from the residential sector fell by 11% at least partially due to increased energy prices, while indirect emissions were broadly flat. Provisional data for 2008 suggests a 5% increase in direct emissions.
- Public sector emissions fell by 2% over the period 2003-2007 with indirect emissions increases partly offsetting direct emissions reductions of 5%.
- Commercial sector emissions were broadly flat between 2003 and 2007 with increases in indirect emissions (which account for around 80% of commercial sector emissions) largely offsetting direct emissions reductions of 12%.

- Industrial emissions remained broadly flat from 2003-2007, with reduced direct emissions being offset by increased indirect emissions. Provisional data suggest direct emissions fell in 2008 as a result of the recession; energy consumption in the first quarter of 2009 was lower than a year earlier.

Based on recent trends, therefore, there has been some reduction in direct emissions from residential, public and industrial sectors.

Going forward, however, a much faster pace of direct and indirect emissions reduction will be required (Figure 1.12), to be achieved primarily through implementation of measures to improve energy efficiency and increase renewable heat penetration. We set out our view of the required emissions trajectory for buildings and industry and measures to achieve this trajectory in Chapter 5.

Figure 1.12 Recent buildings and industry CO₂ emissions and reductions under CCC emissions reduction scenarios

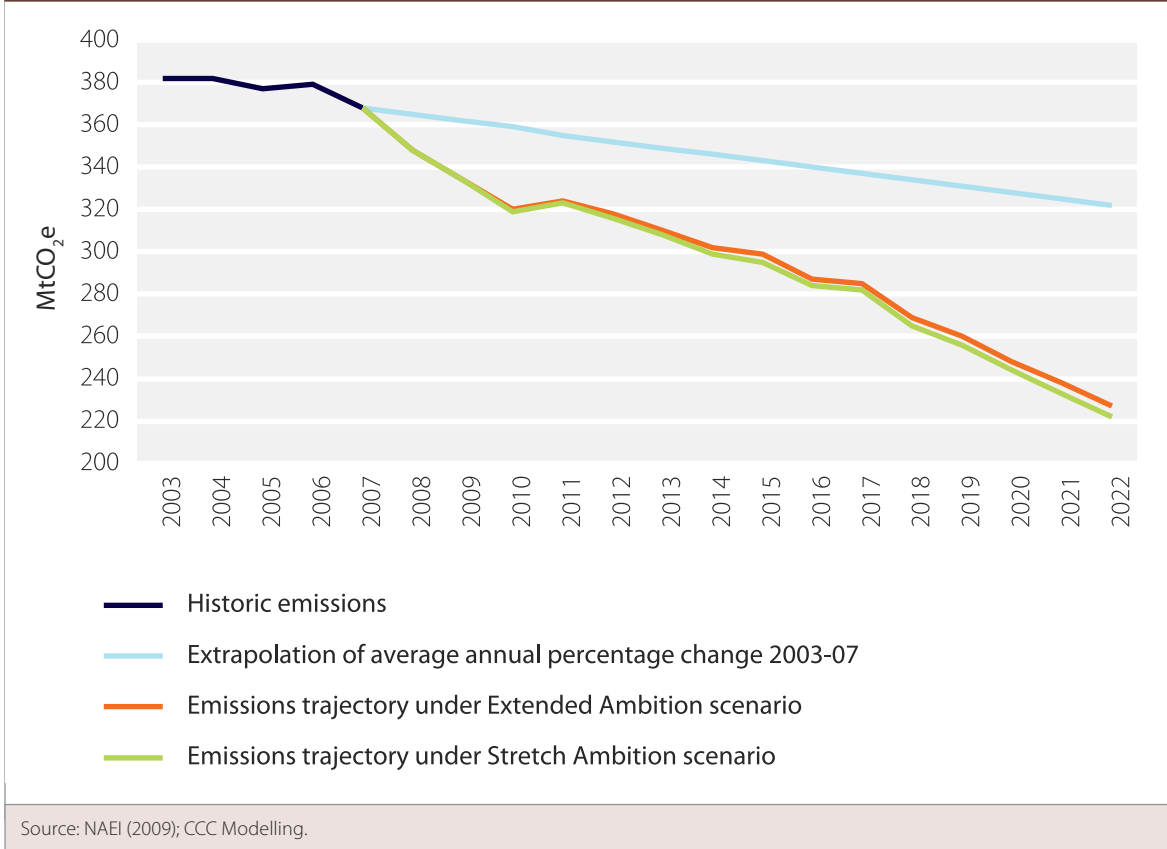


Figure 1.13 CO₂ emissions from transport by mode 1990-2007

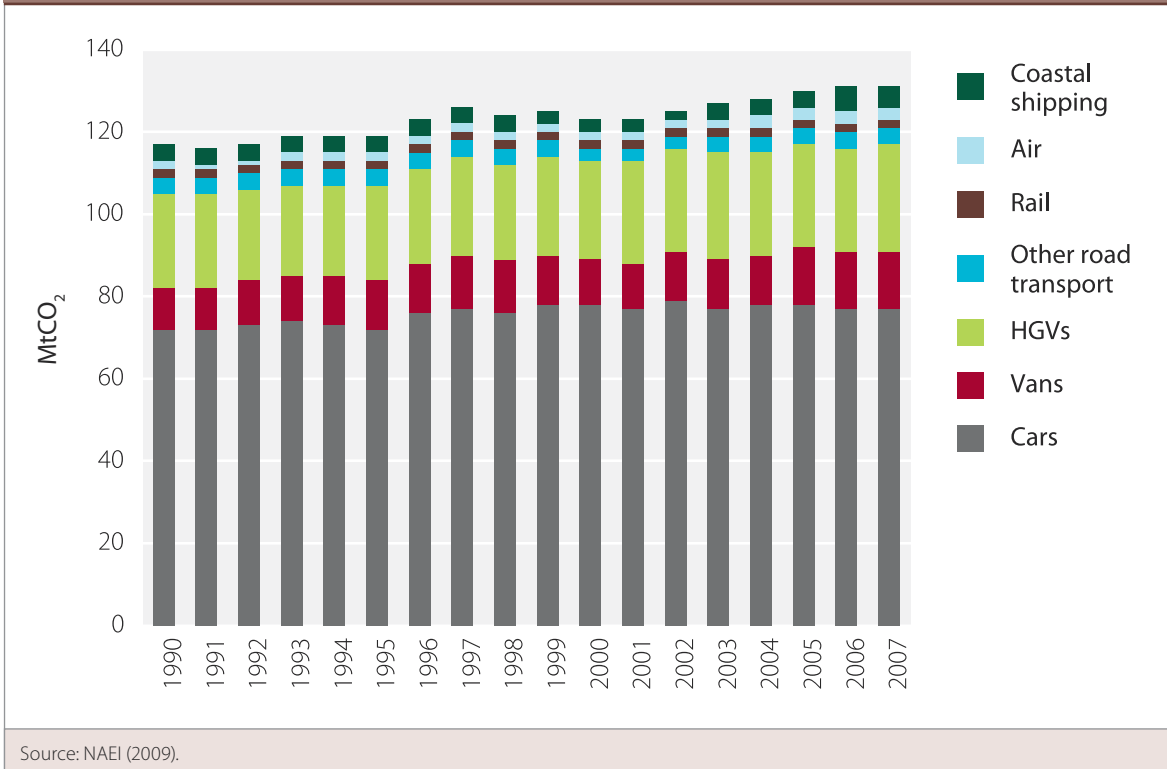
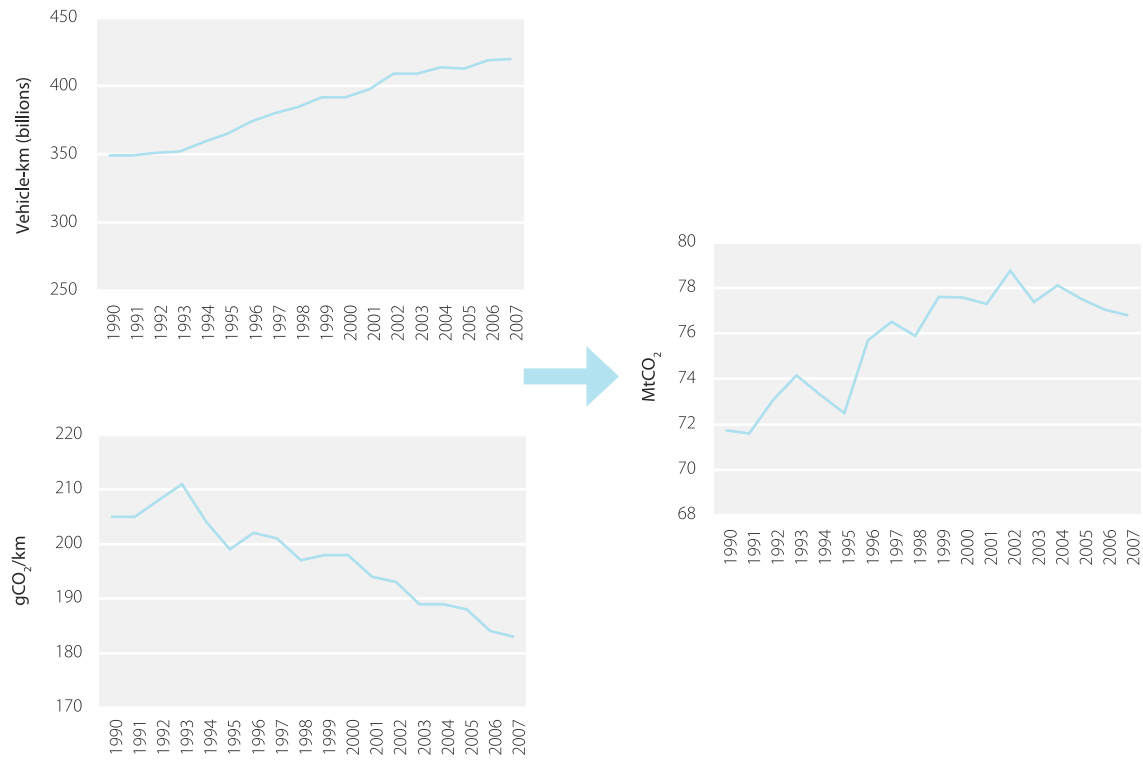
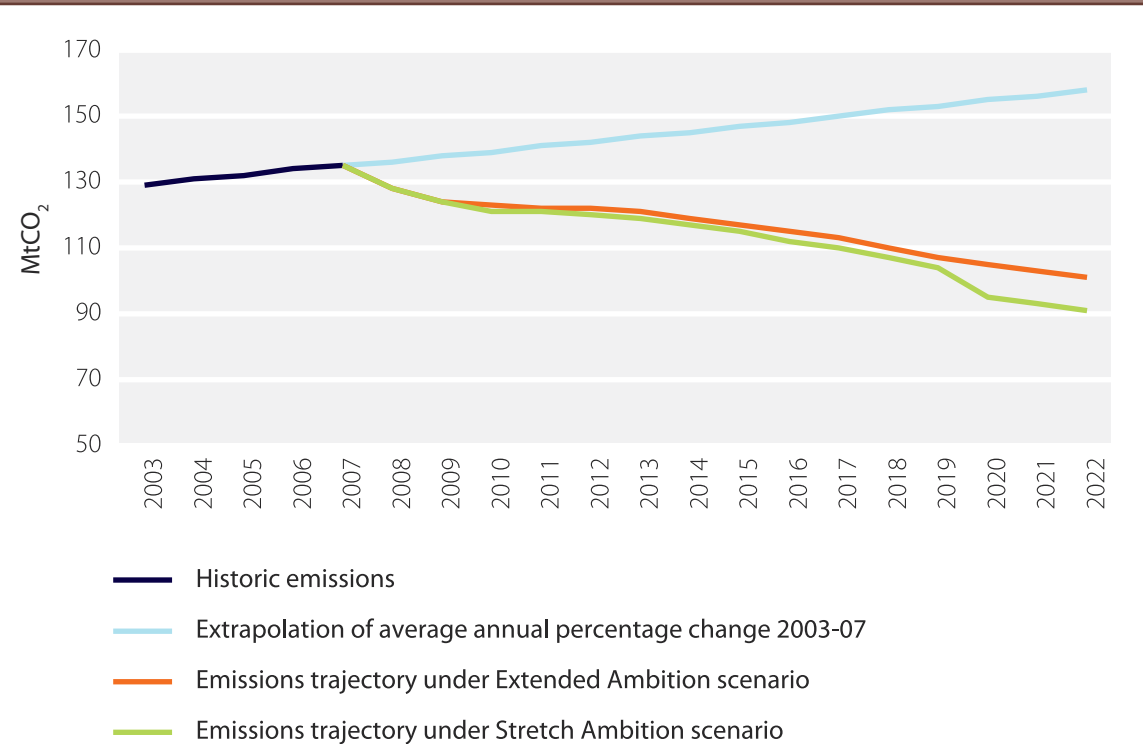


Figure 1.14 Car vehicle-kms, carbon intensity of car travel and CO₂ emissions from cars 1990-2007



Source: DFT (2008), *Transport Statistics Great Britain*; NAEI (2009).

Figure 1.15 Recent transport CO₂ emissions and reductions under CCC emissions reduction scenarios



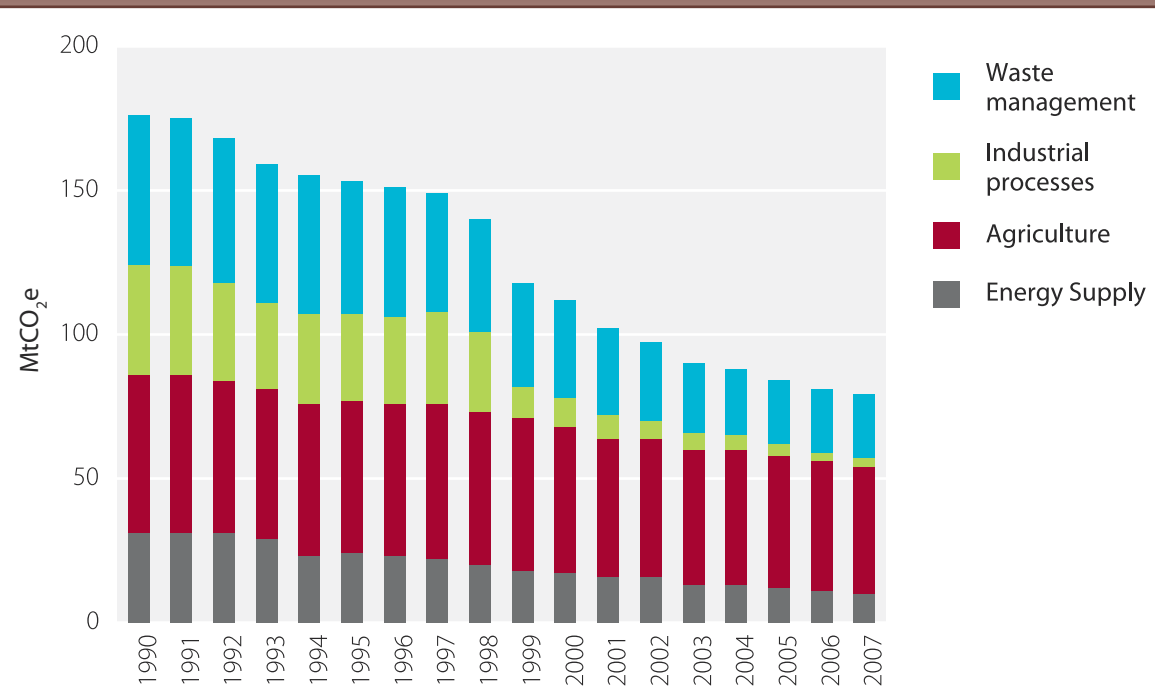
Source: NAEI (2009); CCC Modelling.

Transport emissions

Domestic transport emissions accounted for 24% of total CO₂ emissions in 2007 on a source basis, having increased by 11% over the period 1990-2007 and by 4% between 2003 and 2007 (Figure 1.13):

- Car emissions account for the majority (58%) of domestic transport emissions. Over the period 1990-2007, car emissions increased by 7% as demand increases of 20% offset fuel efficiency increases of 11% (Figure 1.14).
- For the period 2003-2007, car emissions remained broadly constant, as increasing demand (ie. vehicle-km) was offset by carbon efficiency increases. Preliminary data for 2008 suggests that demand fell by 0.6% in 2008 and by a further 0.8% (1.5% on an annualised basis) in the first two quarters of 2009 as a result of the recession.
- Van emissions increased by 40% over the period 1990-2007 due to mileage increases of 71%. Although the effects of mileage increases were partially offset by a reduction in the carbon intensity of the van fleet to 1998, there has been no strong downward trend in carbon intensity since then. The long-term trend has continued in recent years, with emissions growth of 25% over the period 2003-2007, although DfT's provisional estimates suggest that van traffic fell by 0.4% in 2008 and again very slightly (0.1% on an annualised basis) in the first two quarters of 2009.
- HGV emissions increased by 13% from 1990-2007 and by 2% from 2003-2007 due to increased demand, partially offset by reduced carbon intensity, which has improved on average by around 1% per year. DfT's provisional estimates suggest that HGV traffic fell by 2.4% in 2008 and by a further 4.4% (8.7% on an annualised basis) in the first two quarters of 2009.
- Provisional estimates indicate that transport emissions as a whole fell by 2.5% between 2007 and 2008, largely due to lower petrol consumption stemming from reduced demand as a result of the recession. Such a decline is consistent with expectations in the context of the recession, and it is currently considered that as economic growth resumes, demand will return to its long-term upward trend.

Figure 1.16 Non-CO₂ emissions by sector 1990-2007



Source: NAEI (2009).

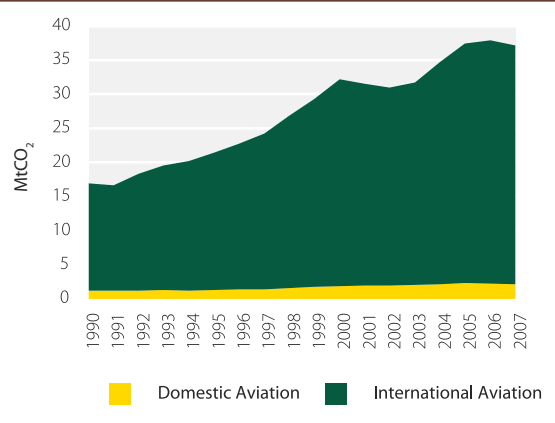
An upward trend for transport emissions is not sustainable, and significant emissions reductions will be required going forward (Figure 1.15). We consider measures to reduce transport emissions (e.g. through more low carbon vehicles, greater use of public transport, etc) in Chapter 6.

Non-CO₂ emissions

Non-CO₂ emissions accounted for 24% of total emissions in 1990 and 15% of total emissions in 2007, with the changing share reflecting non-CO₂ emissions reduction of 49% from 1990-2007 (Figure 1.16):

- Methane emissions fell by more than 50% from 1990-2007 due mainly to reduced emissions from landfill.
- A 79% reduction in emissions of N₂O emissions was achieved through more widespread use of clean technology in industry.
- Fugitive emissions from the gas distribution network and coal mines were reduced by around 70%.

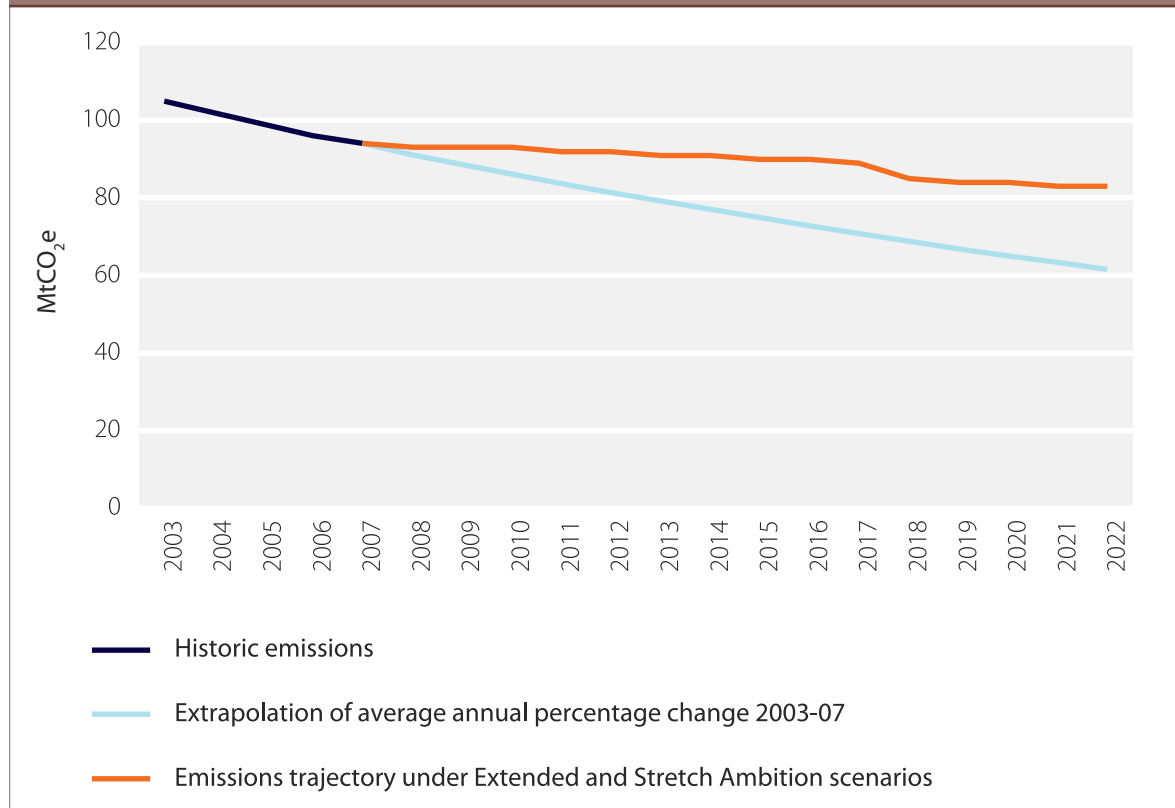
Figure 1.18 UK Aviation CO₂ emissions (bunker fuels basis)



Source: NAEI (2009).

- Agricultural emissions were reduced by around 20%, mainly due to falling livestock numbers and reduced fertiliser use.

Figure 1.17 Recent non-CO₂ emissions and reductions under CCC emissions reduction scenarios



Source: NAEI (2009); CCC Modelling.

The recent trend for emissions reduction is consistent with the longer term trend (e.g. non-CO₂ emissions fell by 11% from 2003-2007). Going forward, there is scope for some further reduction in non-CO₂ emissions, particularly in agriculture, though these are likely to be significantly less than achieved in the previous five years (Figure 1.17).

Our December report provided a preliminary assessment of opportunities for emissions reduction in agriculture and a high level set of policy options for consideration. Following the Government's acceptance of the Committee's recommendations on agriculture (in the UK Low Carbon Transition Plan), we will undertake further analysis of emissions reduction opportunities and policies, which we will publish in our report to Parliament in June 2010.

Aviation emissions

UK aviation emissions doubled over the period from 1990 to 2007, reflecting strong underlying growth in both passenger and freight demand (Figure 1.18). Passenger numbers fell by 2% in 2008 and are likely to fall further in 2009 as a result of the recession, but then growth is expected to resume once GDP increases. Going forward, aviation emissions cannot increase at the rates of the last two decades given the target adopted by the Government in January 2009 to reduce gross UK aviation emissions in 2050 back to 2005 levels; the Committee will report on options for meeting this target in December 2009.

Shipping emissions

We noted in our December 2008 report that allocation of international shipping emissions to the national level is difficult. Ships travelling to the UK may, for example, fuel in other countries, and under the UNFCCC convention emissions would therefore be allocated to these countries.

On a UK bunker fuel basis, shipping emissions (domestic and international) in 2007 were 11.8 MtCO₂, relative to 10.8 MtCO₂ in 1990, a 9% rise. As a comparison, international port traffic to/from the UK grew by 37% over the comparable period. Since international emissions grew by only 3% on a bunker fuel basis, this suggests increased movements to/from the UK are not fully reflected in the UK fuel sales data.

Shipping emissions are potentially very significant relative to total allowed global emissions in the period to 2050 and should therefore be covered by an international agreement (e.g. a global cap and trade scheme). If there were a global agreement, allocation of emissions to the national level would not be required, thus avoiding the complexities identified above. At a global level, the IMO has made progress (see Box 1.3) and the Committee will comment on this, and progress at the EU and UK levels, in our report to Parliament in June 2010.

(iii) Regional emissions trends

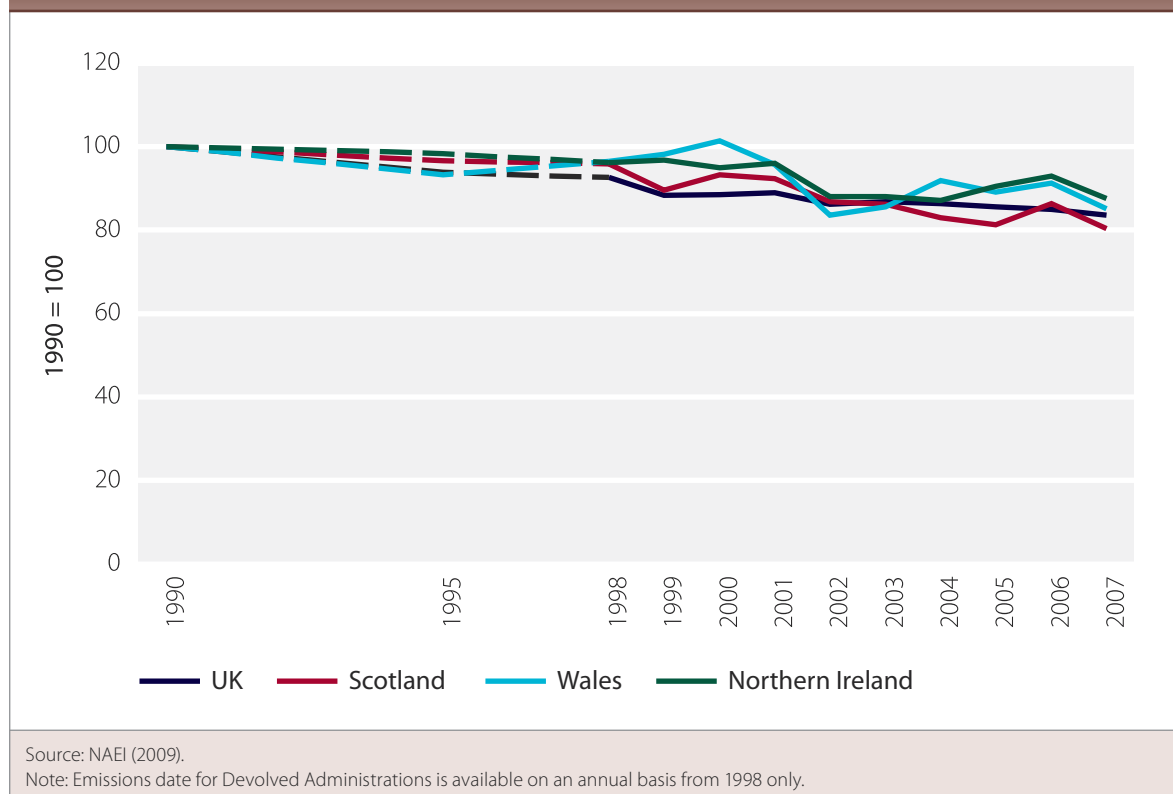
GHG emissions fell in each of the Devolved Administrations between 1990 and 2007 (Figure 1.19; Box 1.4):

- GHG emissions fell in Scotland by 20%, due mainly to emissions reductions in residential buildings, industry, waste and agriculture.
- In Wales, reductions in emissions from residential buildings, services, industry, waste and agriculture resulted in total GHG emissions reductions of 15%.
- GHG emissions reductions of 12% were achieved in Northern Ireland, driven by emissions reductions in power, residential buildings, services and industry, waste and agriculture.

Due to their smaller size, emissions in the Devolved Administrations are more sensitive to specific changes in the power sector (eg. individual station outages or closures). Excluding power, emissions have fallen by 27% in Scotland, 19% in Wales and 12% in Northern Ireland.

Going forward, a faster pace of emissions reductions will be required in order that Devolved Administrations meet their own targets (Box 1.5) and, based on emissions reduction opportunities identified in our December 2008 report, make an appropriate contribution to meeting UK carbon budgets.

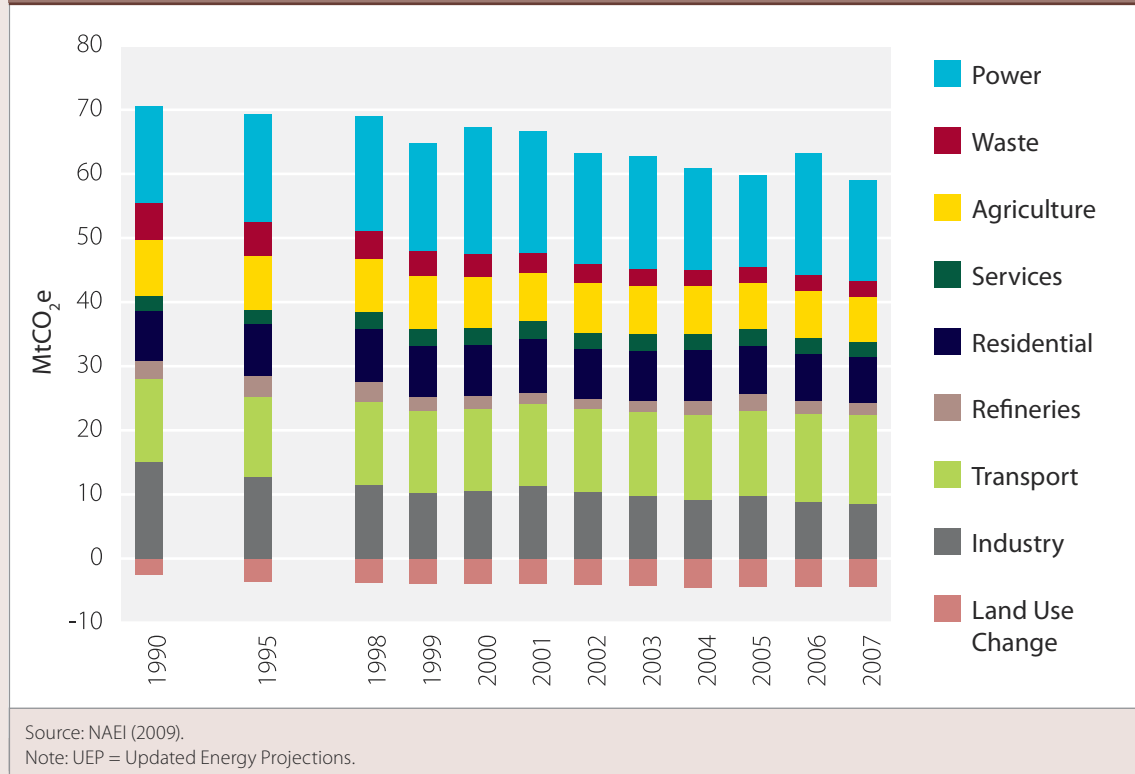
Figure 1.19 Greenhouse Gas Emissions in the UK and Devolved Administrations 1990–2007



Box 1.4 GHG emissions in the Devolved Administrations 1990-2007

Scotland

Figure B1.4a Scotland Greenhouse Gas Emissions by UEP sector 1990–2007



Net GHG emissions in 2007 were 54.5 MtCO₂e, 20% below 1990 levels and 7% below the previous year. Excluding power, emissions have fallen 27% from 1990 and 2% in the last year.

- Power station emissions accounted for over a quarter of Scotland's total GHG emissions in 2007. Emissions are up 4% on 1990 levels, although they have dropped 17% since 2006.
- GHG emissions from industry accounted for 16% of Scottish GHG emissions. Emissions in 2007 were down 43% on 1990 levels, and 3% on the previous year.
- Transport emissions accounted for a quarter of the Scottish GHG total. They have grown on average 0.4% per annum since 1990, driven by

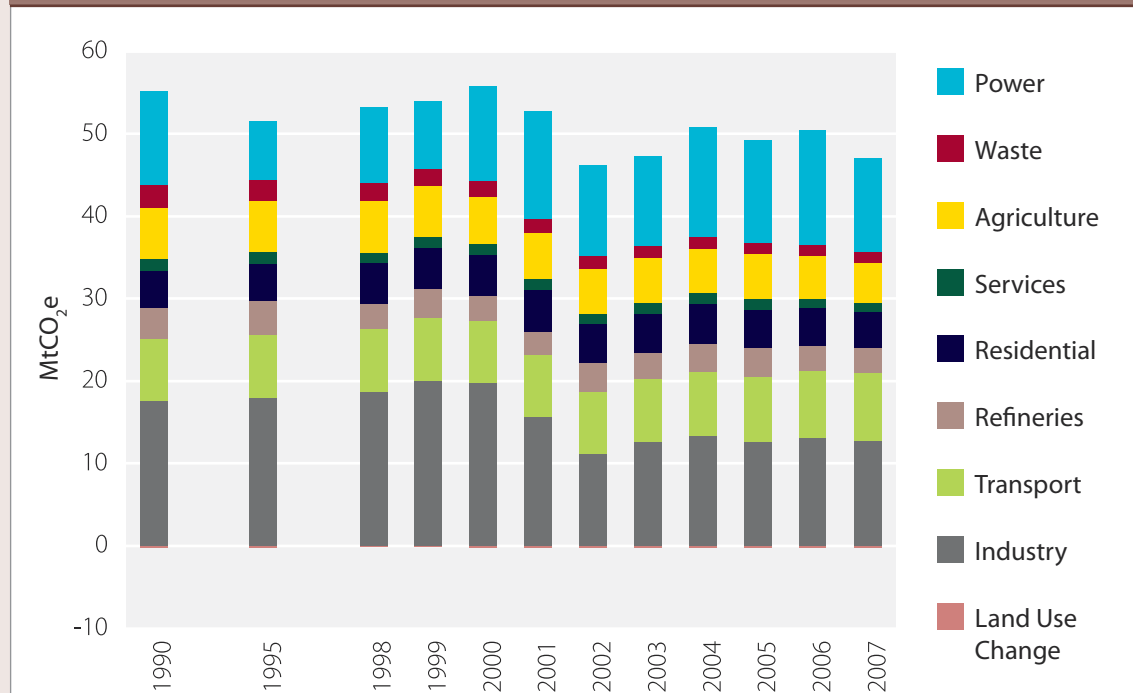
increasing demand for road transport (which accounts for three-quarters of all transport emissions), and grew by 1% between 2006 and 2007.

- Residential emissions continued on a long-term downwards trend, falling 7% on 1990 levels and 3% on the previous year.
- Emissions from public and commercial services fell by 1% between 1990 and 2007, and dropped by 4% between 2006 and 2007.
- Agriculture emissions were down 21% on 1990 levels, falling 4% between 2006 and 2007.
- Waste emissions were down 54% on 1990 levels, up 1% on the previous year.

Box 1.4 continued

Wales

Figure B1.4b Wales Greenhouse Gas Emissions by UEP sector 1990–2007



Source: NAEI (2009).

Net GHG emissions in 2007 were 46.8 MtCO₂e – 15% below 1990 levels, 7% below the previous year. Excluding power, emissions have fallen 19% from 1990 and 2% in the last year.

- Power station emissions accounted for a quarter of total GHG emissions in 2007. Emissions in 2007 were comparable to 1990 levels, having dropped by 18% on 2006.
- GHG emissions from industry accounted for over 27% of Welsh GHG emissions. Emissions were down 27% on 1990 levels, and 2% lower than the previous year.
- Transport accounted for 17% of Wales' GHG emissions. Transport emissions have grown on average 0.4% per annum since 1990, driven by

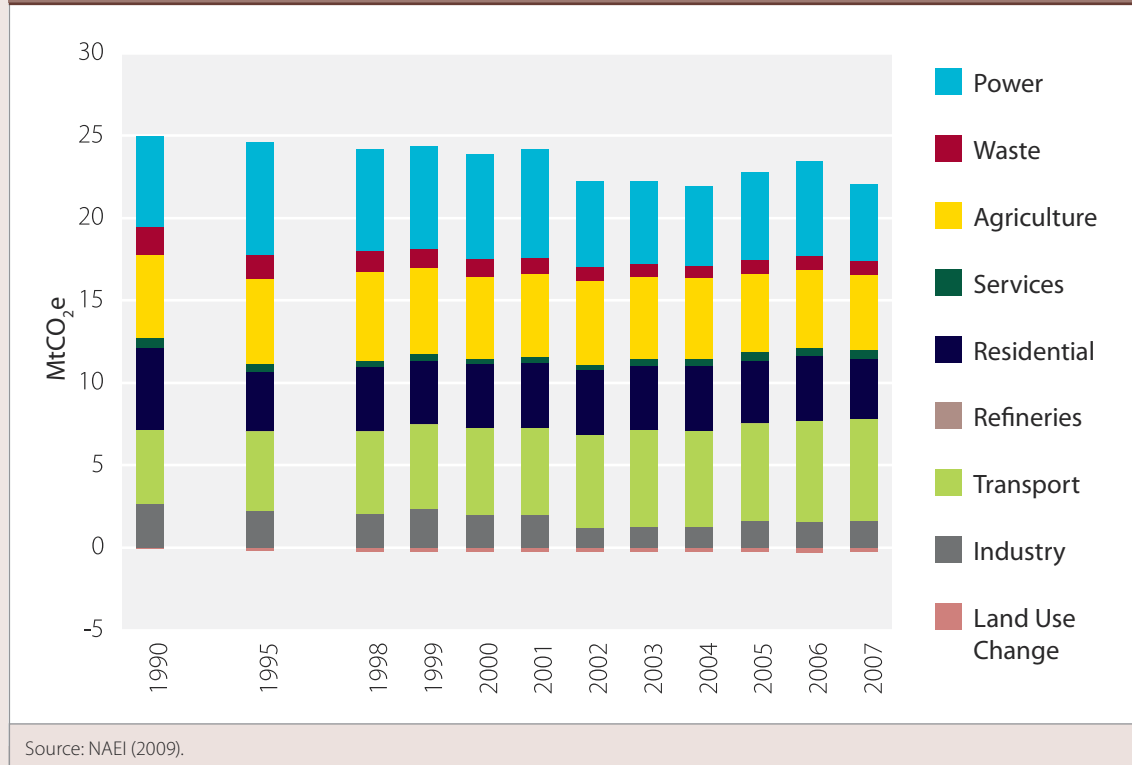
increasing demand for road transport (which accounts for three-quarters of all transport), and in 2007 were up 0.7% on the previous year.

- Residential emissions were down 9% on 1990 levels and 6% on the previous year.
- Emissions from public and commercial services fell by 20% between 1990 and 2007, and dropped by 5% between 2006 and 2007.
- Agriculture emissions were down 19% on 1990 levels and down 6% compared to the previous year.
- Waste emissions have more than halved since 1990, although there have been no further significant reductions in the past few years.

Box 1.4 continued

Northern Ireland

Figure B1.4c Northern Ireland Greenhouse Gas Emissions by UEP sector 1990–2007



Net GHG emissions in 2007 were 21.8 MtCO₂e – 12% below 1990 levels, 6% below the previous year. Excluding power, emissions have also fallen 12% from 1990, but by 2% in the last year.

- Power station emissions accounted for over a fifth of total GHG emissions in Northern Ireland in 2007. In 2007, emissions were 15% lower than in 1990 and 19% lower than in 2006, returning to 2003–2004 emission levels.
- GHG emissions from industry accounted for only 7% of Northern Ireland's GHG emissions. Emissions were down 38% on 1990 levels, although up 2% on the previous year.
- Emissions from transport accounted for 28% of Northern Ireland's GHG emissions. They have grown on average 1.9% per annum since 1990 and by 1.4% between 2006 and 2007, entirely driven by increasing demand for road transport which accounts for almost 80% of all transport emissions.
- Residential emissions continued on a long-term downwards trend since 1998, falling 26% on 1990 levels and 7% on the previous year.
- Public and commercial services emissions fell by 25% between 1990 and 2007, and by 3% between 2006 and 2007.
- Agriculture emissions were down 8% on 1990 levels and 3% down on the previous year.
- Waste emissions were down 50% on 1990 levels, but rose by 2% between 2006 and 2007.

Box 1.5 Recent developments in climate change policy and the legislative framework in the Devolved Administrations

Scotland

- The Climate Change (Scotland) Act received Royal Assent on 4th August 2009.
- The Act commits Scotland to reduce its emissions by at least 80% by 2050 compared to 1990 levels, with an interim target for 2020 of a 42% reduction (subject to advice from the Committee).
- In July the Scottish Government published the Climate Change Delivery Plan⁵, which identifies the key sectors for abatement in Scotland and the high level measures required in each sector to deliver both a 34% and 42% emissions reduction target by 2020.

Wales

- Wales has set a target to reduce emissions under devolved competence by 3% per year from 2011.
- In June, the Welsh Assembly Government published its *Programme of Action*⁴, a consultation on the government's climate change strategy.

The consultation sets out in more detail the actions the WAG are proposing to deliver their climate change objectives.

- The final Climate Change strategy will be developed following the consultation and is expected by the end of 2009.

Northern Ireland

- Northern Ireland aims to reduce greenhouse gas emissions by 25% in 2025.
- Northern Ireland has made a number of recent announcements and publications relevant to action on climate change mitigation:
 - Draft strategic Energy Framework⁶, which proposes new and ambitious renewable electricity and renewable heat targets by 2020.
 - Draft Cross Departmental Bioenergy Action Plan⁷.
 - The Northern Ireland Executive agreed on 30 July to extend the Carbon Reduction Commitment to all NI government Departments regardless of whether they meet the minimum criteria for the scheme.

4 Available at: <http://new.wales.gov.uk/consultations/environmentandcountryside/climatechangeaction/>

5 Available at: <http://www.scotland.gov.uk/Publications/2009/06/18103720/0>

6 Available at: http://www.detini.gov.uk/cgi-bin/get_builder_page?page=4861&site=5&parent=149

7 Available at: <http://www.detini.gov.uk/cgi-bin/moreutil?utilid=1223>