Meeting Carbon Budgets – 3rd Progress Report to Parliament

Committee on Climate Change
June 2011

Preface

The Committee on Climate Change (the Committee) is an independent statutory body which was established under the Climate Change Act (2008) to advise UK and Devolved Administration governments on setting and meeting carbon budgets, and preparing for climate change.

Setting carbon budgets

In December 2008 we published our first report, *'Building a low-carbon economy – the UK's contribution to tackling climate change'*, containing our advice on the level of the first three carbon budgets and the 2050 target; this advice was accepted by the Government and legislated by Parliament. In December 2010, we set out our advice on the fourth carbon budget, covering the period 2023-27, as required under Section 4 of the Climate Change Act; the Government has accepted our advice on the level of the fourth carbon budget.

Progress meeting carbon budgets

The Climate Change Act requires that we report annually to Parliament on progress meeting carbon budgets; this is our third annual progress report, the previous two reports were published in October 2009 and June 2010.

Advice requested by Government

We provide ad hoc advice in response to requests by the Government and the Devolved Administrations. Under a process set out in the Climate Change Act, we have advised on reducing UK aviation emissions, Scottish emissions reduction targets, UK support for low-carbon technology innovation, design of the Carbon Reduction Commitment and conducted a Review of Renewable Energy. In September 2010, we published our first report on adaptation, assessing how well prepared the UK is to deal with the impacts of climate change. We will publish further advice on this in July 2011. We will also provide advice in the Autumn of 2011 on shipping emissions, and a review of bioenergy by the end of the year.

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Foreword

In May this year the Government accepted our advice on the fourth carbon budget. We recommended that this should limit UK greenhouse gas emissions to a maximum of 1,950 $MtCO_2e$ over the period 2023-27, and that the aim should be to meet this budget through domestic emissions reductions.

Our analysis showed that this would be feasible through deep cuts in emissions from power generation, heat in buildings and surface transport. We showed that such cuts are required if the UK is to meet its 2050 target of reducing emissions by 80% below 1990 levels, and could result in wider economic, security of supply and environmental benefits. To achieve these deep emission cuts in the 2020s will require significant reductions over the next decade.

It is crucial to gauge whether we are making progress towards the medium-term targets. Our annual reports to Parliament, required by the Climate Change Act, are therefore designed to measure progress against budget commitments, distinguishing short-term fluctuations from underlying trends.

In our first annual report published in 2009, we set out a framework of forward indicators: these enable us to track whether steps are being taken which will produce required emission reductions in subsequent years. For our second report in 2010, we developed analytical tools to isolate the impact of short-term economic fluctuations: these showed that the 10% emissions reduction in 2009 was largely due to the recession.

This report builds on the techniques developed in the first two. It adjusts recorded emissions in 2010 for weather as well as macroeconomic impacts, showing that the underlying trend is one of broadly flat emissions. Analysis of the indicators meanwhile reveals mixed progress in implementing abatement measures. While emissions are continuing to run significantly below the first budget cap, an acceleration in the pace of emissions reduction will be needed if future carbon budgets are to be achieved.

The report highlights some key policies to drive this acceleration, including the Electricity Market Reform and the Green Deal.

Following this report, we will be focusing on reviews of shipping emissions and bioenergy. These will lead up to our advice on the inclusion of aviation and shipping emissions in carbon budgets, which we will publish in Spring 2012, prior to a Government decision later next year.

On behalf of the Committee, I would like to thank the Secretariat for their very hard work over the last months to produce this report, together with our renewable energy review and the fourth budget advice.

Lord Adair Turner Chair

Acknowledgements

The Committee would like to thank:

The team that prepared the analysis for the report. This was led by David Kennedy and Adrian Gault and included: Alice Barrs, Owen Bellamy, Russell Bishop, Ute Collier, Neil Golborne, David Joffe, Jonathan Haynes, Alex Kazaglis, Anna Leatherdale, Eric Ling, Laura McNaught, Nina Meddings, Meera Sarda, Stephen Smith, Jonathan Stern, Mike Thompson and Indra Thillainathan.

Other members of the secretariat that contributed to the report: Kristofer Davies, Philip Hall, Swati Khare-Zodgekar, Sarah Noah, Joanna Ptak, Emily Towers and Jo Wilson.

A number of individuals who provided significant support: Mark Broadmeadow (Forestry Commission), Matthew Brown (Defra), Paul McDonnell (Defra), Kathryn Morley (Defra), Claire Worsdall (DfT).

A number of organisations for their support, including the Association of Electricity Producers, DCLG, DECC, Defra, DfT, Energy Saving Trust, Energy Technologies Institute, Environment Agency, European Commission, Financial Services Authority, Forestry Commission, HMT, Infrastructure UK, Market Transformation Programme, Northern Ireland Executive, Office for Renewable Energy Deployment, Ofgem, Renewable Energy Association, RenewableUK, Scottish Government, Society of Motor Manufacturers and Traders, UK Business Council for Sustainable Energy, Welsh Government.

A wide range of stakeholders who engaged with us, attended our expert workshops, or met with the Committee bilaterally.

The Committee

Lord Adair Turner, Chair

Lord Turner of Ecchinswell is the Chair of the Committee on Climate Change and Chair of the Financial Services Authority. He has previously been Chair at the Low Pay Commission, Chair at the Pension Commission, and Director-general of the Confederation of British Industry (CBI).

David Kennedy, Chief Executive

David Kennedy is the Chief Executive of the Committee on Climate Change. Previously he worked on energy strategy at the World Bank, and the design of infrastructure investment projects at the European Bank for Reconstruction and Development. He has a PhD in economics from the London School of Economics.

Professor Samuel Fankhauser

Professor Samuel Fankhauser is acting Co-Director of the Grantham Research Institute on Climate Change at the London School of Economics and a Director at Vivid Economics. He is a former Deputy Chief Economist of the European Bank for Reconstruction and Development.

Sir Brian Hoskins

Professor Sir Brian Hoskins, CBE, FRS is the Director of the Grantham Institute for Climate Change at Imperial College and Professor of Meteorology at the University of Reading. He is a Royal Society Research Professor and is also a member of the National Science Academies of the USA and China.

Professor Julia King

Professor Julia King CBE FREng is Vice-Chancellor of Aston University. She led the 'King Review' for HM Treasury in 2007/8 on decarbonising road transport. She was formerly Director of Advanced Engineering for the Rolls-Royce industrial businesses. Julia is one of the UK's Business Ambassadors, supporting UK companies and inward investment in low-carbon technologies.

Lord John Krebs

Professor Lord Krebs Kt FRS, is currently Principal of Jesus College Oxford. Previously, he held posts at the University of British Columbia, the University of Wales, and Oxford, where he was lecturer in Zoology, 1976-88, and Royal Society Research Professor, 1988-2005. From 1994-1999, he was Chief Executive of the Natural Environment Research Council and, from 2000-2005, Chairman of the Food Standards Agency. He is a member of the U.S. National Academy of Sciences. He is chairman of the House of Lords Science & Technology Select Committee.

Lord Robert May

Professor Lord May of Oxford, OM AC FRS holds a Professorship jointly at Oxford University and Imperial College. He is a Fellow of Merton College, Oxford. He was until recently President of The Royal Society, and before that Chief Scientific Adviser to the UK Government and Head of its Office of Science & Technology.

Professor Jim Skea

Professor Jim Skea is Research Director at UK Energy Research Centre (UKERC) having previously been Director of the Policy Studies Institute (PSI). He led the launch of the Low Carbon Vehicle Partnership and was Director of the Economic and Social Research Council's Global Environmental Change Programme.

Executive summary

This is our third annual report to Parliament on the progress made in reducing emissions under the Climate Change Act. It follows our previous two annual reports, in which we showed that the large reduction in emissions in 2009 was mainly due to the recession and where we highlighted the need for a step change in the underlying pace of emissions reduction in order to meet carbon budgets. It also follows the Government's acceptance of a challenging fourth carbon budget covering the period 2023-2027, which reinforces the need for near-term action.

In this report we do three things:

- We report the latest data on progress reducing emissions.
- We assess *underlying* progress in reducing emissions (e.g. after allowing for impacts of the recession and cold weather).
- We report on progress made against our indicators, which cover abatement measures and policy milestones.

Our key messages are:

- **Progress reducing emissions.** Economy-wide emissions increased by 3% in 2010, mainly due to increased energy consumption for heating in the cold winter months. However, the level of emissions in 2010 was below the annual average for the first carbon budget, due to ongoing impacts of the recession.
- **Underlying progress reducing emissions.** After adjusting for the impact of the cold weather, emissions were broadly flat in 2010. This underlying trend is incompatible with the need for deep emissions cuts required to meet carbon budgets.
- **Progress against indicators.** Performance on the implementation of measures has been mixed. A step change in the pace of emissions reduction is *still* required.
  - Our indicator framework recognises the lead time for policy development, and therefore reflects a relatively low level of ambition for the implementation of key measures in the first budget period, with a significant ramping up required in the second budget period.
  - There has been a shortfall in professional installations of lofts and cavity wall insulation, which fell by 30% relative to 2009. There has been very limited progress on solid wall insulation, relative to the 2 million installations required by 2020.
  - Boiler replacement is ahead of schedule, primarily as a result of the boiler scrappage scheme.
  - Renewable heat penetration remains very low (under 2%) in 2010, in comparison to the 12% penetration required by 2020.
  - New car emissions continued to fall in 2010, and now significantly outperform our indicator – actual new car emissions were 144 gCO_2/km compared to an indicator of 156 gCO_2/km and a 2020 indicator (and EU target) of 95 gCO_2/km.
  - Renewable power generation indicators have been largely achieved to date, but a significant ramp up in the pace of investment will be required from the second budget period.
  - There is a risk of slippage on carbon capture and storage (CCS) demonstration, which should be addressed if this potentially important technology is to be developed for roll-out in the 2020s.
- **Progress against policy milestones.** The Electricity Market Reform and the Green Deal will be crucial in driving emissions reductions required to meet carbon budgets.
  - **Electricity Market Reform.** New electricity market arrangements based on long-term contracts (e.g. Contracts for Differences) will be crucial to delivering the fourth carbon budget to which the Government recently committed. These should be announced in the July White Paper, along with arrangements to ensure a smooth transition from the current renewables support regime. The alternative of premium feed-in tariffs would raise risks and cost of delivering required low-carbon investment.
  - **Residential energy efficiency.** Government proposals should help to strengthen incentives for the take-up of energy efficiency measures. However, there is a significant risk that these will not adequately address the range of financial and non-financial barriers. In order to provide more confidence over delivery, we recommend that the Government should build on current proposals by aligning the Green Deal and the Energy Company Obligation (ECO) with the ambition to insulate all lofts and cavity walls by 2015, as well as 2 million solid walls by 2020. Using mortgage finance in conjunction with the ECO where possible would reduce funding costs, therefore easing energy bill and fuel poverty impacts.
- **Aiming to outperform Interim budgets.** Given new policies and a step change in the pace of emission reductions, our analysis suggests that it is possible to outperform currently legislated first, second and third Interim budgets through domestic abatement. This should be the aim given the deep emissions cuts needed to meet the fourth carbon budget, to which the Government recently committed. Although the Government has retained the option to purchase credits to meet the second carbon budget, reverting to this would make achievement of the fourth carbon budget very difficult.

We summarise the analysis that underpins these messages in nine parts and set out more details in the full progress report:

1. Economy-wide emissions

2. Emissions in the non-traded sector

3. Emissions in the traded sector

4. Power sector emissions

5. Buildings and industry emissions

6. Transport emissions

7. Agriculture emissions

8. Devolved administrations

9. Next steps in preparing for the fourth carbon budget

1. Economy-wide emissions

Economy-wide greenhouse gas emissions increased by around 3% in 2010, driven by increases in CO_2 emissions (Figure 1):

- CO_2 emissions increased by 4% in 2010, mainly due to increased emissions from heat in buildings, and partly due to nuclear outages resulting in increased fossil fuel generation and emissions in power (Figure 2).
- Non-CO_2 emissions fell by 2% in 2010, continuing recent trends in agriculture and waste.

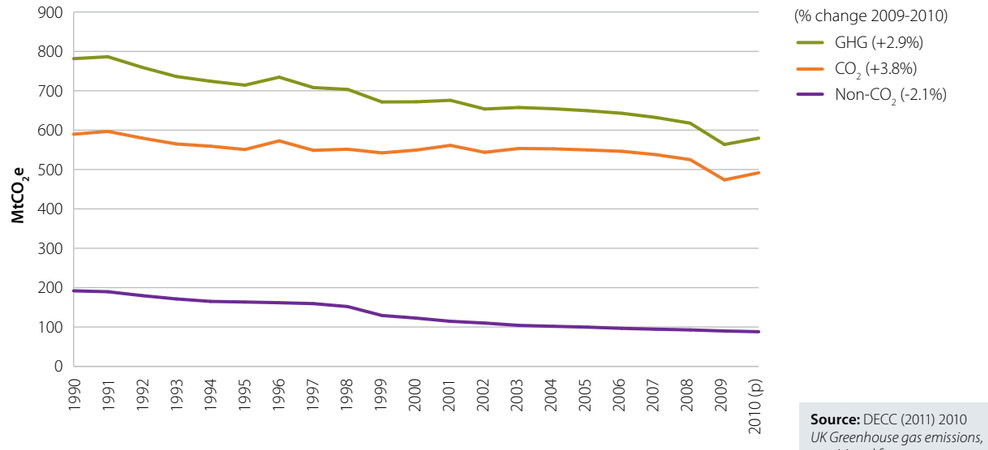
The 3% increase in GHG emissions in 2010 followed a 9% reduction in 2009. The reduction in 2009 was largely due to the impact of the recession, resulting in emissions which were well below the first carbon budget. This remained the case in 2010, given the significant net emissions reduction from 2008 to 2010.

Although there has been a downward shift in emissions due to the recession, there is no evidence of a change in the underlying pace of emissions reduction. A reversion to the pre-recession trend would leave emissions above levels for subsequent budgets (Figure 3). This implies the need for acceleration in underlying progress in reducing emissions if future budgets are to be met.

- We have assessed the underlying pace of emissions reduction by adjusting for the effects of the cold weather (set out below and discussed in detail in the full report). This reflects that average temperatures across the winter months of 2010 were 2°C lower than in 2009, which temporarily increased the demand for energy for heating.
- We have not adjusted for economic growth, which at 1% in 2010 was below the long-term trend of over 2%. Within this, there was relatively high growth in manufacturing output (4%). Future projections are for lower manufacturing growth, and higher growth in the rest of the economy. The impacts of these on energy use are likely to be broadly offsetting.
- Therefore, our analysis suggests an underlying trend of emissions reduction in 2010 that is flat or slightly declining. This follows the pre-recession trend of under 1% per year reductions in CO_2 emissions. However, annual reductions of close to 3% are required to meet the fourth carbon budget, and reductions of around 6% are required beyond 2025.

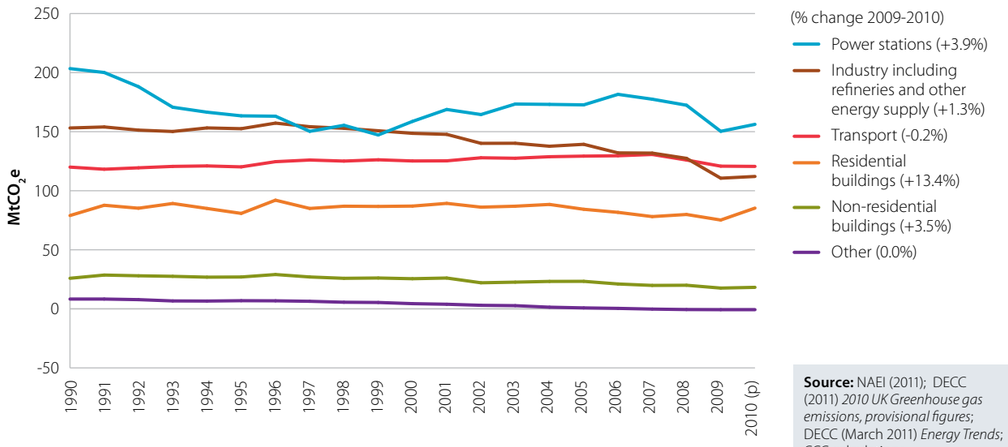
In order to properly understand the extent to which emissions are and will remain within budgeted levels, analysis of sectoral emissions and drivers is required. We now consider emissions in non-traded and traded sectors, and then in specific sectors (power, buildings, etc.).

Figure 1: UK greenhouse gas emissions (1990-2010)



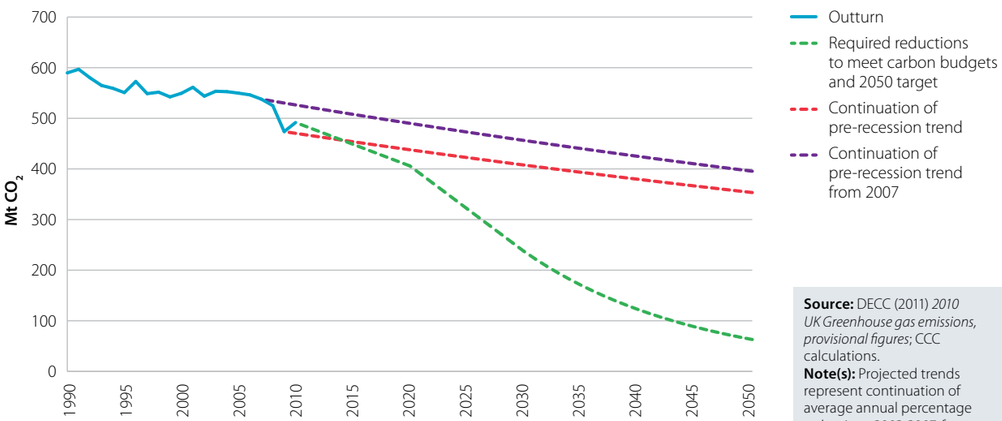
Source: DECC (2011) 2010 *UK Greenhouse gas emissions, provisional figures.*

Figure 2: UK CO_2 emissions by sector on a source basis (1990-2010)



Source: NAEI (2011); DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; DECC (March 2011) *Energy Trends*; CCC calculations.

Figure 3: CO_2 emissions under pre-recession trend versus required reductions (1990-2050)



Source: DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; CCC calculations.
Note(s): Projected trends represent continuation of average annual percentage reductions 2003-2007, from different starting points and are therefore not parallel.

2. Emissions in the non-traded sector

Emission trends and drivers

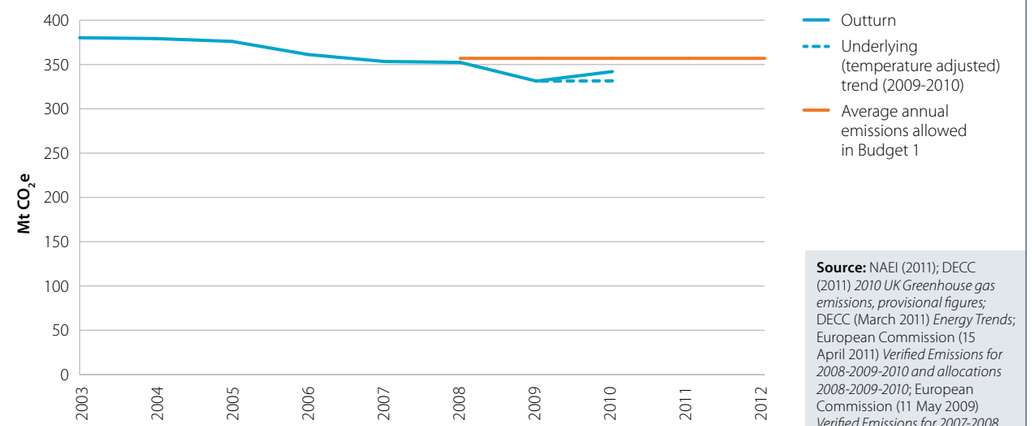
The non-traded sector includes all emissions outside the EU Emissions Trading Scheme (i.e. direct emissions from buildings and non-energy-intensive industry, surface transport, and most non-CO_2 emissions, including from agriculture and waste).

In our previous two progress reports we showed that non-traded sector emissions in 2008-2009 were well below what is required to meet the first carbon budget. Our analysis suggested that this was largely due to the impact of the recession, rather than the implementation of abatement measures.

Non-traded sector emissions increased by 3% in 2010, but remained within budgeted levels (Figure 4). The main driver of this increase was the cold weather, with a 2 °C reduction in average winter temperatures between 2009 and 2010.

Adjusting for the impacts of the cold weather, non-traded sector emissions were roughly flat in 2010 (shown by the dotted line in Figure 4). Therefore continued performance at the underlying (i.e. weather-adjusted) rate of progress achieved in 2010 would be insufficient to meet carbon budgets, which require significant emissions reductions over the next decade (Figure 5). This is particularly the case given that GDP growth was only 1% in 2010, compared to the trend growth of 2.5-3% envisaged as the economy recovers.

Figure 4: Non-traded sector emissions versus budget (2003-2012)



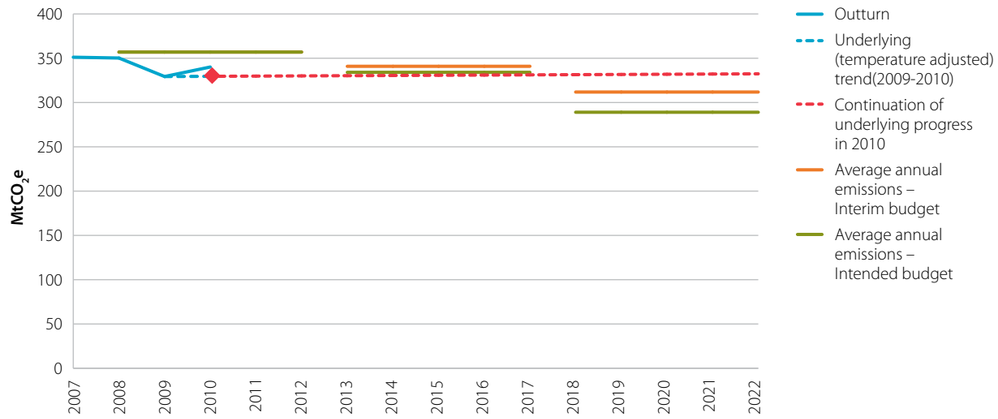
Source: NAEI (2011); DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; DECC (March 2011) *Energy Trends*; European Commission (15 April 2011) *Verified Emissions for 2008-2009-2010 and allocations 2008-2009-2010*; European Commission (11 May 2009) *Verified Emissions for 2007-2008 and allocations 2008*; CCC calculations.

Progress on the implementation of abatement measures

In our previous progress reports we have emphasised the need to track not only outturn emissions, but also indicators of future emissions. We therefore developed a framework of indicators for the implementation of abatement measures, consistent with decarbonisation required under carbon budgets. Together these indicators make up our *Extended Ambition scenario*, and are broadly consistent with high-level policy ambition from Government.

When considering progress implementing abatement measures, it is important to note that the level of ambition in our indicator framework for the first budget period is relatively low.

Figure 5: Non-traded sector emissions based on continuation of underlying progress in 2010 (2007-2022)



Source: NAEI (2011); DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; DECC (March 2011) *Energy Trends*; European Commission (15 April 2011) *Verified Emissions for 2008-2009-2010 and allocations 2008-2009-2010*; European Commission (11 May 2009) *Verified Emissions for 2007-2008 and allocations 2008*; CCC calculations.
Note(s): Excludes emissions from domestic aviation as they will be included in the EU ETS from 2012.

This reflects that policy development and delivery generally has a lead time of several years. Therefore our indicator framework envisages a significant acceleration in the pace at which measures are implemented going into the second budget period (Table 1).

However, there was mixed progress implementing abatement measures in the non-traded sector (Table 2):

- Professional installations of loft and cavity wall insulation fell in 2010 relative to 2009, with cavity wall measures below levels in our indicator framework. Levels of solid wall insulation remained very low.
- Boiler replacement is ahead of schedule, due to the scrappage schemes operated in 2010.
- There has been very limited investment in renewable heat technologies. This is in line with our indicator framework, with increased investment expected as new policies are introduced.
- New car emissions in 2010 were significantly below levels in our indicator framework.

Therefore there is *still* a need for a step change in the pace of installing building insulation and investment in renewable heat, and a need to continue progress achieved on boiler replacement and new vehicle efficiency.

Table 1: Required ramp up of measures in the non-traded sector

	Annual uptake/improvement		
	Budget 1 average	**Budget 2 average**	**Budget 3 average**
Residential buildings			
Loft insulation (CERT professional)	0.9m	2.1m	n/a
Loft insulation (DIY and other schemes)			
Cavity wall insulation	0.8m	1.4m	n/a
Solid wall insulation	90,000	150,000	220,000
Efficient boilers	1.0m	0.9m	0.7m
Renewable heat			
Increase in renewable heat penetration	+0.1%	+0.8%	+2.4%
Road transport			
Improvement in new car CO_2	-4 gCO_2/km	-6 gCO_2/km	-6 gCO_2/km
Electric cars registered each year (PHEV/BEV)	5,000	130,000	450,000
Increase in biofuels penetration (by vol)	+0.7%	+0.7%	+0.4%
Car drivers undertaking eco-driving training each year	300,000	320,000	340,000

Source: CCC modelling.

Table 2: Progress against indicators in the non-traded sector

	Annual uptake/ improvement 2009		Annual uptake/ improvement 2010	
	Indicator	**Outturn**	**Indicator**	**Outturn**
Residential buildings				
Loft insulation (CERT professional)	0.6m	0.8m	0.6m	0.5m
Loft insulation (DIY and other schemes)		0.3m		0.8m
Cavity wall insulation	0.7m	0.7m	0.7m	0.4m
Solid wall insulation	70,000	15,000	95,000	13,000
Efficient boilers	1.0m	1.2m	1.0m	1.3m
Renewable heat				
Increase in renewable heat penetration	+ <0.1%	+0.2%	+ <0.1%	n/a
Road transport				
New car CO_2	-2 gCO_2/km	-8 gCO_2/km	-4 gCO_2/km	-5 gCO_2/km
Electric cars registered each year (PHEV/BEV)	0	101	5,000	167
Biofuels penetration (by vol)	+0.5%	+0.6%	+0.5%	+0.7%
Car drivers undertaking eco-driving training each year	300,000	5,000	300,000	10,000

Source: OFGEM (2011) CERT update quarter 11; DCLG (2011) Housing statistics – Table 241; Heating and Hotwater Council (2011); DECC (2011) Estimates of home insulation levels in Great Britain; DECC (2010) DUKES Table 7.7; SMMT (2011) New Car CO_2 Report; SMMT (2011); HMRC (February 2011) Hydrocarbon Oils Duties Bulletin; Energy Saving Trust (2011); CCC modelling and calculations.
Note: Data on 2010 renewable heat penetration is not yet available.

Outperforming currently legislated budgets

If abatement measures are delivered in line with our indicator framework, then on current projections this would lead to outperformance of legislated carbon budgets (Figure 6). This is necessary to lay the foundations for deep emissions cuts required in the 2020s, and reflected in the fourth budget agreed by the Government; lower emissions reductions would leave an unfeasibly high/expensive acceleration in the pace of emissions reductions between the third and fourth budgets.

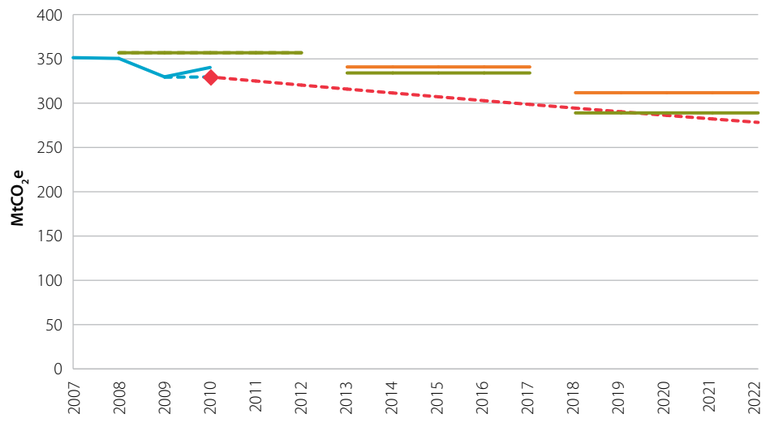
In our advice on the fourth carbon budget, we therefore argued that the second and third budgets should be tightened, and that any outperformance of the first carbon budget should not be banked through to the second budget period.

The Government's response was that such tightening of the second and third budgets would undermine the UK negotiating position in the context of EU burden sharing discussions.

In the absence of tightening, and in order that the legislated fourth budget remains feasible, it will be crucial that abatement measures are implemented in line with our indicator framework.

The level of ambition in our indicator framework is broadly consistent with the ambition in the Government's draft Carbon Plan, published in March. The implication is that policy ambition should be maintained in the final version of the Carbon Plan, to be published later this year.

Figure 6: Non-traded sector emissions under Extended Ambition measures (2007-2022)



Source: NAEI (2011); DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; DECC (March 2011) *Energy Trends*; European Commission (15 April 2011) *Verified Emissions for 2008-2009-2010 and allocations 2008-2009-2010*; European Commission (11 May 2009) *Verified Emissions for 2007-2008 and allocations 2008*; CCC calculations.
Note(s): Excludes emissions from domestic aviation as they will be included in the EU ETS from 2012. The projected trajectory has been smoothed.

If measures are implemented in line with our indicator framework, this should result in outperformance of the second legislated carbon budget. Therefore although the Government has left open the option to purchase offset credits to meet the second budget, this should not be necessary in practice. It follows that purchase of credits to substitute for implementation of abatement measures would increase risks for meeting future carbon budgets.

Going forward, our approach will be to monitor progress relative to legislated budgets and relative to our indicator framework, where delivering the latter would lead to outperformance of the legislated budgets on current projections.

3. Emissions in the traded sector

UK traded sector emissions

The traded sector includes the power sector and those industries that are covered by the EU Emissions Trading Scheme (EU ETS). The traded sector budget is defined to be compatible with the EU ETS cap[1], and will always be met by definition (i.e. if gross emissions increase, the budget will be achieved on a net basis through purchase of emission allowances or offset credits, as required in the EU ETS and as reflected in the UK net carbon account under the Climate Change Act).

However, it is important to track gross traded sector emissions, which are required to fall over time to meet longer-term emissions targets. It is also important to track underlying progress through indicators on investment, for which we particularly focus on the power sector (see section 4).

Traded sector emissions in the UK rose by 2% (to 237 $MtCO_2e$) but remained below the UK share of the EU ETS cap (246 $MtCO_2e$):

- Power sector emissions increased 4%, due to an increase in demand and nuclear outages resulting in increased fossil fuel generation.
- Emissions from energy-intensive industries were broadly flat, with modest output growth likely to have been offset through fuel switching.

The implication of emissions being below the cap is that UK firms were able to sell allowances into the EU market, or to bank them towards meeting future caps.

1 Our calculations allow for the fact that the EU ETS phases do not align to the UK carbon budget periods (e.g. Phase III of the EU ETS runs from 2013-2020, whereas the second carbon budget runs from 2013-2018).

EU traded sector emissions

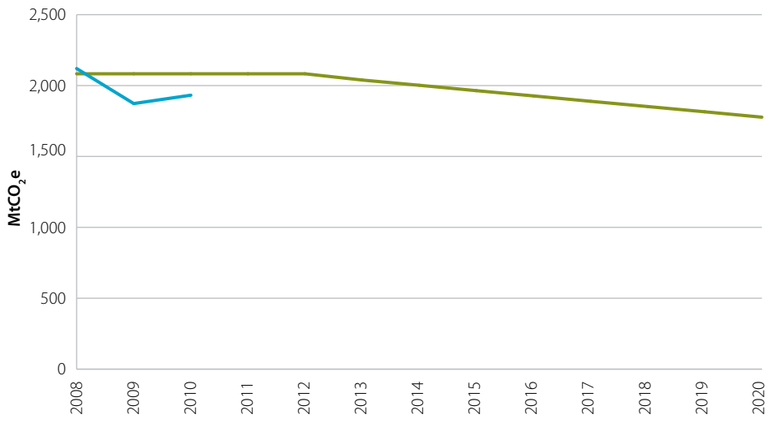
EU traded sector emissions are relevant to the UK given that they determine the EU ETS carbon price.

Traded sector emissions increased slightly in 2010, after a very significant fall in 2009. Emissions therefore remain below the cap, but reflecting the impact of the recession rather than improvements in carbon efficiency. The carbon price therefore remains low and there is limited pressure to further reduce emissions (Figure 7):

- EU-level traded sector emissions increased by 3% in 2010.
- Resulting emissions of 1932 $MtCO_2e$ were well below the EU ETS cap of 2083 $MtCO_2e$.
- As in 2009, the EU ETS cap can be met with significantly less emissions reduction effort than envisaged when the cap was set. Therefore the carbon price in 2010 remained at a similar level as reported in our last progress report (on average around €14/tCO_2).

The lack of a strong price signal supports the Government's decision to introduce a UK carbon price floor. The proposed level for this floor in 2020 (£30/tCO_2) and 2030 (£70/tCO_2) is consistent with longer-term emissions targets and should strengthen incentives for emission reductions, subject to the caveat that any competitiveness impacts for electricity-intensive industries are addressed.

Figure 7: European emissions within the EU ETS sectors versus cap (2008-2020)



Source: European Commission (26 October 2007) *Press release IP/07/1614*; European Commission (22 October 2010) *Commission Decision 2010/634/EU*; European Commission (15 May 2011) *Press release IP/11/581*.
Note(s): Excludes international aviation.

4. Power sector emissions

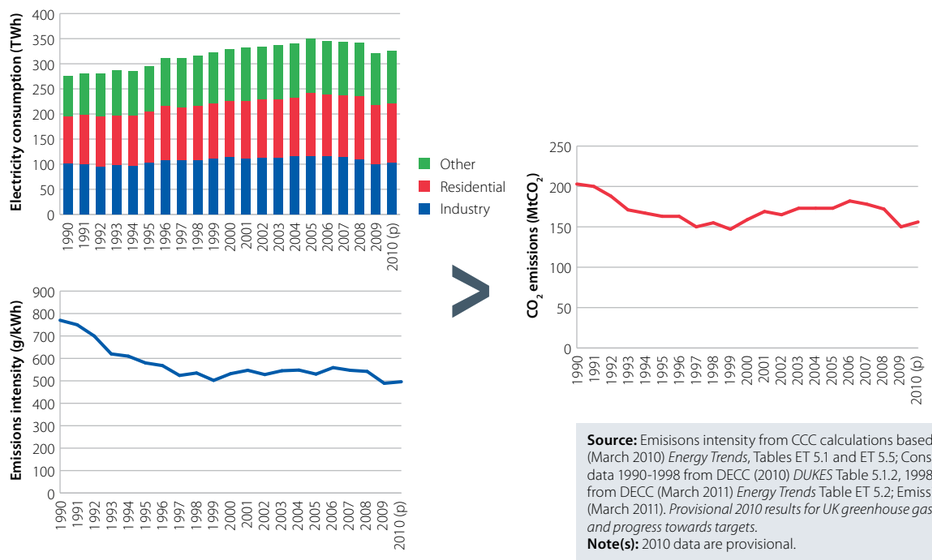
Emission trends

Power sector emissions increased by 4% in 2010, driven by increased demand and increased carbon intensity of generation (Figure 8):

- Emissions increased from 150 $MtCO_2$ in 2009 to 156 $MtCO_2$ in 2010, accounting for around 27% of total greenhouse gas emissions.
- Demand for electricity increased by 1%, having fallen by 6% in 2009. Without the cold weather, demand may have fallen by up to 2%.
- Emissions intensity increased from 489 g/kWh to 496 g/kWh, reflecting a temporary reduction in nuclear generation (10%) due to outages, and a compensating increase in coal and gas generation.

The underlying trend is a move to a less carbon-intensive mix. One way to measure this is by looking at the lowest emissions intensity that could be achieved if power plants were despatched to the grid in order of least emissions rather than least cost, and if they were available to generate as often as in an average year. This *achievable* emissions intensity fell from 335 g/kWh in 2009 to 316 g/kWh in 2010, reflecting investment in gas-fired and renewable generation in 2010.

Figure 8: Electricity demand, emissions intensity of supply and emissions from power (1990-2010)



Source: Emisisons intensity from CCC calculations based on DECC (March 2010) *Energy Trends*, Tables ET 5.1 and ET 5.5; Consumption data 1990-1998 from DECC (2010) *DUKES* Table 5.1.2, 1998-2010 data from DECC (March 2011) *Energy Trends* Table ET 5.2; Emissions: DECC (March 2011). *Provisional 2010 results for UK greenhouse gas emissions and progress towards targets*.
Note(s): 2010 data are provisional.

Progress against indicators

There was progress on forward indicators for nuclear new build. However, in light of events in Japan, there have been minor delays to crucial elements, subject to the full findings of the Weightman review later this year. Provided any safety concerns are addressed, there is a pressing need for approval of the National Policy Statement and reactor designs so that civil works may begin in 2012 for the first plant in 2018.

Progress against forward indicators for renewables was generally on track in 2010, with an adequate flow at each stage of the project pipeline (i.e. going into planning, receiving planning approval, entering construction, completing construction).

- In total, 4 GW onshore and 1.3 GW offshore wind capacity was installed and operational at the end of 2010, as envisaged in our indicators.
- There are around 5 GW offshore and 4 GW onshore of wind projects in or awaiting construction. This would be enough to support capacity additions envisaged in our indicators over the next five years.
- There remain a significant amount of projects currently in the planning system (e.g. over 8 GW onshore and 2.5 GW offshore), albeit with concerns over the speed and rate of approval for these.

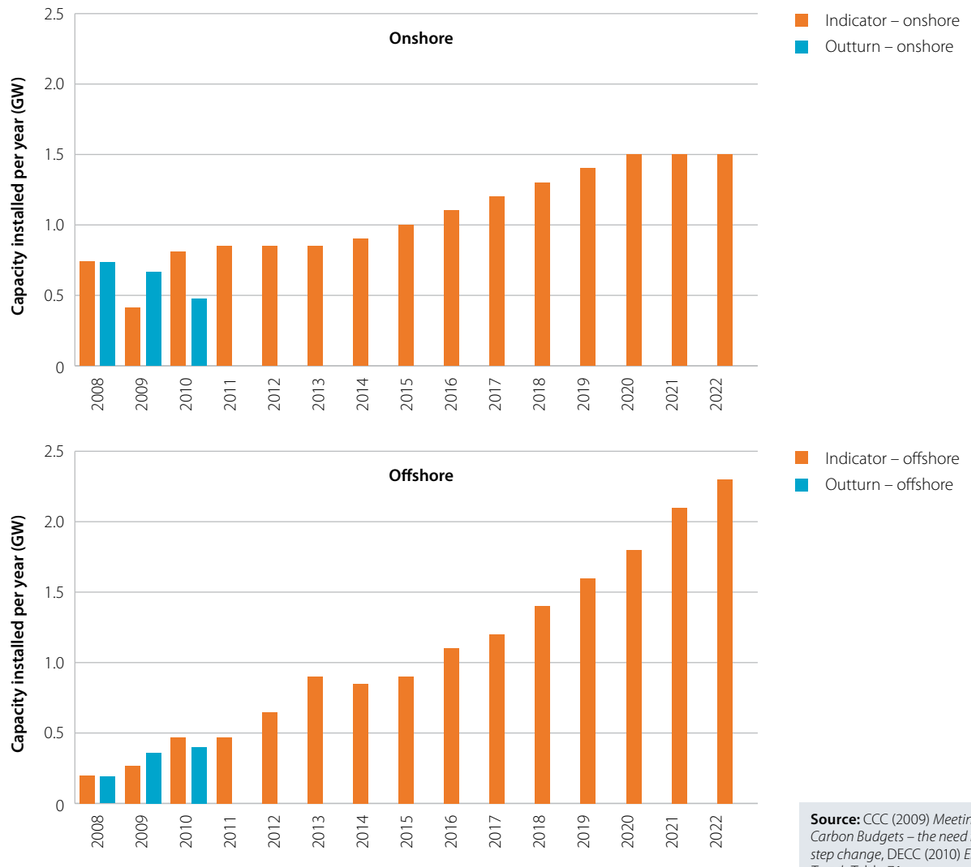
However, it is also important to note that the current project pipeline will support only relatively low levels of investment required over the next several years, rather than the higher levels of investment required from 2015-2020 (Figure 9).

On CCS demonstration the picture is mixed:

- There have been some positive developments, both as regards the first demonstration project and the second set of projects:
  - In particular, the allocation of up to £1 billion for the first demonstration project is an important step forward.
  - For the second set of projects (i.e. demonstrations two to four), seven applications have been made for EU funding (i.e. more than the rest of Europe combined).
  - The Government accepted our recommendation that gas CCS should be included in the demonstration programme. This recognised the potential value of gas CCS as flexible low-carbon plant, possibilities for retrofit of gas-fired plant, and potentially favourable costs in a low gas price world.
- However, there is uncertainty over the schedule for taking forward the second set of projects, which have already been delayed.

It is crucial now that the first project is signed, and that the second set of projects is taken forward through early clarification of funding and commencement of the bidding process, with selection of the winning projects to follow in 2012.

Figure 9: Additional operational wind capacity per year (2008-2022)



Source: CCC (2009) *Meeting Carbon Budgets – the need for a step change*, DECC (2010) *Energy Trends* Table 7.1.

In this respect, possible funding of the second set of projects via new electricity market arrangements could be problematic. This is because new arrangements are unlikely to be determined within the timeframe for these projects to proceed, therefore waiting for new arrangements would require further delay.

Progress against policy milestones – electricity market reforms

Given the Government's acceptance of our recommended fourth carbon budget, it is crucial that new electricity market arrangements are in place to support the transition to a largely decarbonised power system over the next two decades.

In December 2010 the Government opened a consultation on new electricity market arrangements. In response, we wrote to the Secretary of State in March 2011, welcoming the proposals and setting out high-level recommendations on the Electricity Market Reform.

To ensure that the required investments progress, at least cost to the consumer, it is important that new arrangements:

- Should be based on long-term contracts (e.g. Contracts for Differences) rather than premium feed-in tariffs in order to bring forward investments at least cost to the consumer.
  - Premium feed-in tariffs would result in an uncertain return on low-carbon investments, weakening investment incentives and raising associated costs.
  - They would maintain the link between rising carbon prices and the electricity price, which could be particularly problematic in terms of the impact on consumer bills at higher carbon prices (e.g. £70/tCO_2 in 2030).
  - They would also arguably result in a subsidy for nuclear investment, which would be in conflict with the Government's stated policy.
- Reflect the need to provide support over the next two decades for less mature technologies that are likely to be of benefit in the longer term. For example, a proportion of total contracts available could be set aside for such technologies, subject to conditions on cost reduction being achieved.
- Provide a smooth transition from current arrangements. There is a risk of an investment hiatus in moving from the current regime for renewable investment to new market arrangements. In order to address this, the current ROC regime should not be phased out prematurely, and new arrangements should be designed to reflect specific characteristics of renewable generation.

Basing new arrangements on these pillars will be key to ensuring that sector decarbonisation is achieved, which in turn will be key to ensuring that fourth and subsequent carbon budgets are achieved.

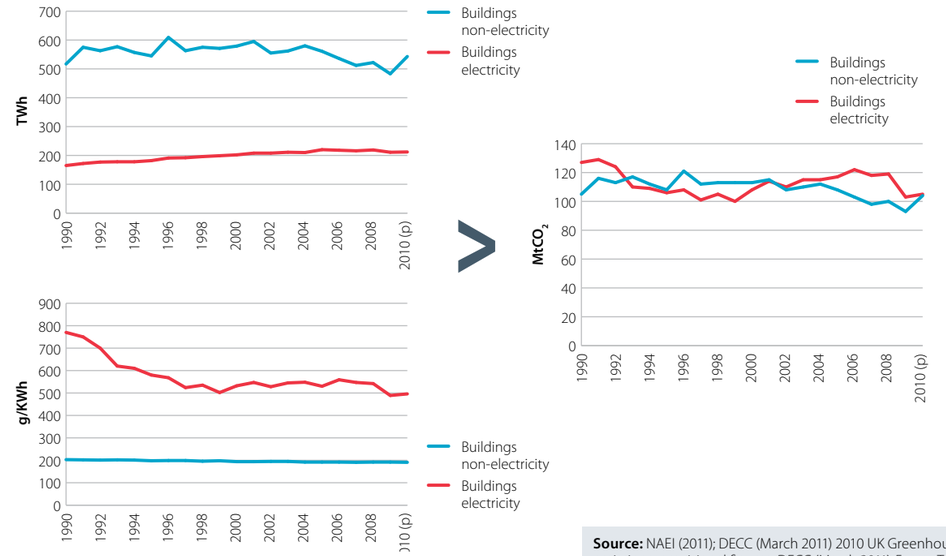
5. Buildings and industry emissions

Emission trends – buildings

Total buildings emissions increased by around 6% in 2010 (Figure 10):

- Residential buildings emissions increased by 8% in 2010.
  - Direct residential emissions (i.e. emissions from burning fuel) increased by 13% in 2010, reflecting a 15% rise in gas use. Resulting emissions accounted for 15% of total UK greenhouse gas emissions.
  - Indirect residential emissions (i.e. emissions from electricity use) increased by 2%, reflecting the 2% increase in carbon intensity of electricity generation (i.e. residential electricity consumption stayed flat). Resulting emissions accounted for 10% of total UK greenhouse gas emissions on an end-use basis.

Figure 10: Energy demand, emissions intensity and emissions from buildings (1990-2010)



Source: NAEI (2011); DECC (March 2011) 2010 UK Greenhouse gas emissions, provisional figures; DECC (March 2011) *Energy Trends*; CCC calculations.

- Non-residential (commercial and public) buildings emissions increased by 2%:
  - Direct non-residential buildings emissions went up by 4%, with public sector emissions increasing by 5% and commercial sector emissions increasing by 2%. Total direct emissions from non-residential buildings in 2010 accounted for 3% of UK greenhouse gas emissions.
  - Indirect emissions from non-residential buildings went up by 2%, again reflecting the increase in the carbon intensity of electricity. While total electricity consumption stayed flat, a fall in public sector electricity consumption of 7% was offset by a 2% rise in the commercial sector. Overall, indirect emissions from non-residential buildings in 2010 accounted for 8% of total greenhouse gas emissions.

Emissions in the residential sector in 2010 were above those expected in our previous progress reports, and non-residential emissions were below:

- In the residential sector, this was because the temporary impact of the cold winter months was greater than the permanent emissions reductions due to the recession in 2009.
- In the non-residential sector, outperformance against the indicator in 2010 resulted because legacy recession impacts outweighed weather impacts.

Emission trends – industry

Industry emissions increased by 2% in 2010, reflecting increased industry output and suggesting that recovery from the recession was a key driver.

- Industry output increased by around 4% in 2010. This was above projected trend growth over the next decade (e.g. 2%) and reflected a bounce back from the recession.
- Direct industry emissions in 2010 increased by 1%. This is less than would be expected given output growth, and suggests that this was partially offset by some fuel switching towards less carbon-intensive fuels. Resulting emissions accounted for around 19% of total UK greenhouse gas emissions.
- Indirect emissions increased by 5%. Resulting emissions accounted for around 8% of total UK greenhouse gas emissions.

This followed a 13% reduction in output across 2008 and 2009, generating a 13% direct and 17% indirect reduction in emissions. Given those reductions, 2010 emissions remained below levels expected before the recession.

Further progress reducing industry emissions will require additional fuel switching and implementation of abatement measures.

Progress against indicators

In terms of specific abatement measures, our indicator framework for buildings and industry largely focus on those in the residential buildings sector and renewable heat.

There has been limited progress implementing renewable heat measures in 2010, with penetration remaining at low levels of less than 2%. There has been some progress on developing an enabling framework (e.g. the Renewable Heat Incentive – RHI), which we considered in detail in our Renewable Energy Review. In this we concluded that ongoing financial support would be required alongside accreditation of installers, and that the RHI and Green Deal should be integrated.

In the residential buildings sector, there was mixed progress in 2010 against our indicators:

- **Loft insulation.** Professional installations of loft insulation fell by around 30%. While DIY measures appeared to significantly increase, there is considerable uncertainty over the level of emissions savings that these will produce.
- **Cavity wall insulation.** There was a 30% decline in the number of cavity walls insulated in 2010.
- **Solid wall insulation.** Rates of solid wall insulation remained very low and 15% fewer solid walls were insulated under Carbon Emission Reduction Target (CERT) in 2010 than in 2009.
- **Boilers.** Performance here was better than our indicator with 1.3 million boilers replaced in 2010.

The slow progress on insulation highlights the need for strong incentives under new policies to drive the required residential energy efficiency improvements over the next decade.

Progress against policy milestones – the Green Deal and the Energy Company Obligation

Given the importance of delivering energy efficiency for both reducing emissions and making savings on energy bills, our indicator framework includes milestones for developing policy to deliver abatement measures in this area.

The Government has proposed a new policy approach to encourage energy efficiency improvement:

- The Green Deal will provide money for the upfront costs of energy efficiency improvements secured against a charge on properties, to be paid back through energy bills.
- The Energy Company Obligation (ECO) will provide funding for energy efficiency improvement targeted at the fuel poor, and for more expensive measures such as solid wall insulation.
- Regulation of energy efficiency in the private rented sector will be introduced from 2018.

These aspects could form part of an effective policy, but much of the detail is yet to be developed.

We set out an assessment of the Green Deal and ECO in the full report, summarising our recommendations in Box 1. Our two key recommendations are:

- In order to address the full range of non-financial and financial barriers, the Government's energy efficiency programme should commit to insulating all lofts and cavity walls by 2015, and 2 million solid walls by 2020. The ECO should be aligned with this ambition on solid walls or equivalent emission reductions. In addition, it should be aligned to ambition on lofts and cavity walls unless other means can be found to provide confidence that these will be delivered. Failure to design the ECO in this way would leave significant risk of under-delivery relative to what is required to meet carbon budgets.
- In order to reduce funding requirements and ease energy bill and fuel poverty impacts, the ECO should be combined with relatively low cost mortgage finance where possible (i.e. where loan to value ratios allow). Our analysis suggests that this could result in cost savings of up to £4 billion for the consumer to 2020.

Box 1: The Energy Company Obligation and the Green Deal

To address the range of barriers to the uptake of energy efficiency measures, we make the following recommendations for the Green Deal and the ECO:

- **Comprehensive and ambitious obligation.** In order to provide confidence over the scale of delivery, the Government's energy efficiency programme and the ECO should cover the full range of measures at a level of ambition commensurate with that required to achieve carbon budgets.
  - Between 2012 and 2022, our analysis suggests that insulation of 8.3 million lofts, 5.7 million cavity walls and over 2 million solid walls will be required to meet carbon budgets.
  - Current underperformance highlights the need for strong delivery incentives.
  - In the case of lofts and cavity walls, it is unlikely that these would be delivered through market mechanisms, based on past experience. Therefore these should be delivered under the ECO, unless alternative means can be found to provide confidence over delivery (e.g. through tendering of contracts).
  - In the case of solid wall insulation, which is a key abatement measure, this will not happen at scale without funding from the ECO. An ambitious obligation would result in significant emissions reductions, and make more houses suitable for roll-out of heat pumps.
  - Such an obligation should be adequately funded (e.g. within any HMT spending limits related to DECC policies).
  - Delivery under the ECO could be in partnership with large retailers and other private sector participants, who could enter the market via partnerships with energy companies.
  - Such partnerships could work within a whole-house and area-based approach, which would address barriers to uptake and bring economies of scale.
- **Use of mortgage finance.** Mortgage rates are likely to be lower than those for the Green Deal. Many mortgage holders have loan-to-value ratios that could allow increased borrowing. Given that this is the case, there may be an opportunity for reducing costs through financing energy efficiency improvement through extending mortgages. For example, Green Deal assessors might offer homeowners with acceptable loan-to-value ratios a choice between mortgage and Green Deal finance, with additional incentives reflecting the cost savings associated with mortgage finance. We estimate that this could reduce ECO funding costs by up to £4 billion to 2020. This would ultimately result in lower energy bills, given that the costs of the ECO are likely to be passed through to consumer bills.

6. Transport emissions

Emission trends

Data for surface transport emissions in 2010 are not yet available. Final data for 2009 indicate that surface transport emissions fell by around 4% in 2009 as a result of car and HGV efficiency improvements, reduced distance travelled and increased penetration of biofuels.

- Surface transport emissions in 2009 accounted for 20% of total UK greenhouse gas emissions, and were dominated by car (61% of surface transport GHG emissions), van (13%) and HGV (18%) emissions.
- Car emissions fell by 3% in 2009, reflecting a combination of more efficient vehicles, increased penetration of biofuels, and reduced distance travelled (Figure 11).
- Van emissions fell by 3% in 2009, mainly due to a reduction in distance travelled.
- HGV emissions fell by around 9% in 2009, mainly due to reduced distance travelled.

Our preliminary assessment for 2010 suggests that further emissions reductions are likely, arising from car efficiency improvements, reduced car and HGV distance travelled, and increased penetration of biofuels.

- Car emissions are likely to have fallen in 2010, as distance travelled fell by 2% and car biofuels penetration increased from 2.1% in 2009 to 3.2% in 2010. In addition, new car emissions fell (see below).
- Van emissions are likely to have risen in 2010, as distance travelled rose by 1% and van biofuels penetration remained unchanged.
- HGV emissions are likely to have fallen in 2010, as distance travelled fell by 4% while HGV biofuels penetration decreased from 4.0% in 2009 to 3.9% in 2010.

Emissions in 2010 are therefore likely to be on track with our expected trajectory. However, this is likely to be largely due to ongoing impacts of the recession and high fuel prices on distance travelled and new car purchase behaviour along with possible reductions in distance travelled caused by adverse weather conditions. Therefore, close monitoring of trends will be required as GDP increases and in light of further movements in fuel prices.

Progress against indicators: new car emissions

Average emissions of new cars in 2010 continued to fall and outperformed our indicator (Figure 12):

- Average new car emissions in 2010 were 144 gCO_2/km, down from 150 gCO_2/km in 2009, and 158 gCO_2/km in 2008. This compares to our indicators of 156 gCO_2/km for 2010 and 95 gCO_2/km (the EU target) for 2020.
- Our analysis indicates that efficiency improvements occurred within all car market segments.

It will be important to closely monitor new car emissions as the economy recovers and in light of fuel price movements, with the possible need for use of fiscal levers to ensure continued progress.

Progress against indicators: electric vehicles

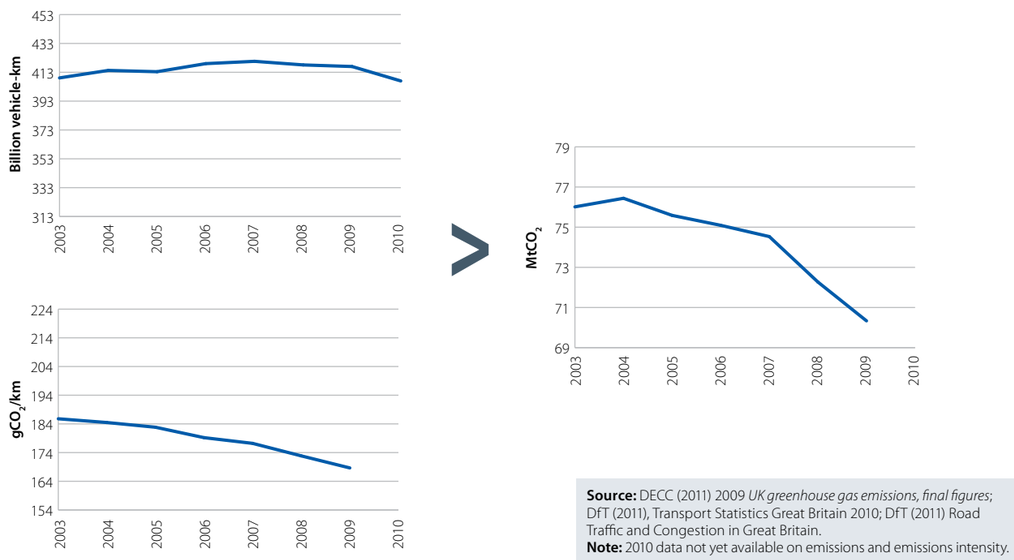
Electric vehicles are key to longer-term emissions reductions. Registrations in 2010 were mostly limited to pilot schemes, with full electric cars only reaching dealers in late 2010. There has been progress in developing electric vehicle markets, with financial commitments made in the November 2010 Spending Review, and moves towards rolling out of charging infrastructure.

Progress against indicators: behaviour change

Progress on travel behaviour change has been mixed, with possible funding for wider roll-out of Smarter Choices:

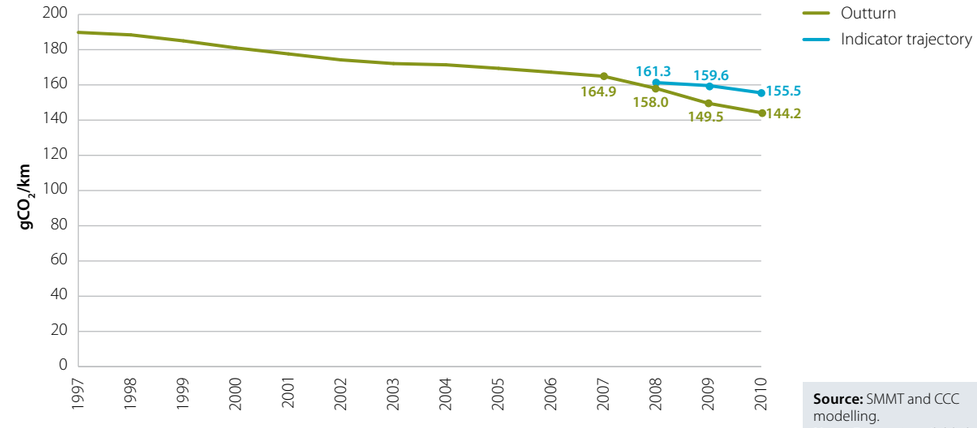
- The Local Sustainable Transport Fund announced at the November 2010 Spending Review *could* support roll out of Smarter Choices. However, it remains unclear how this fund will be spent, and the extent to which this will be used to support roll-out of Smarter Choices rather than other projects with lower emissions reductions.
- There was only the most limited progress on eco-driving training. In order that this opportunity to reduce emissions is addressed, delivery mechanisms for large-scale roll-out should be assessed, funded and implemented. Mandating of gear shift indicators currently being considered by the EU could make a useful contribution here, and should therefore be supported by the UK Government, given relatively low associated costs relative to carbon benefits.
- Revision of the land-use planning framework provides an opportunity to ensure that impacts of development on transport emissions are fully accounted for in the planning process. For example, developments in larger urban areas are likely to result in lower transport emissions than out-of-town developments.
- There was increased violation of speed limits on motorways in 2009, resulting in increased emissions. Any increase in speed limits would significantly raise emissions. In contrast, there is an opportunity to significantly reduce emissions through enforcement of the existing speed limit.

Figure 11: Vehicle km, emissions intensity and emissions from cars (2003-2010)



Source: DECC (2011) 2009 *UK greenhouse gas emissions, final figures*; DfT (2011), Transport Statistics Great Britain 2010; DfT (2011) Road Traffic and Congestion in Great Britain.
Note: 2010 data not yet available on emissions and emissions intensity.

Figure 12: New Car CO_2 – indicator trajectory and outturn (1997-2010)



Source: SMMT and CCC modelling.
Note: Data not available before 1997.

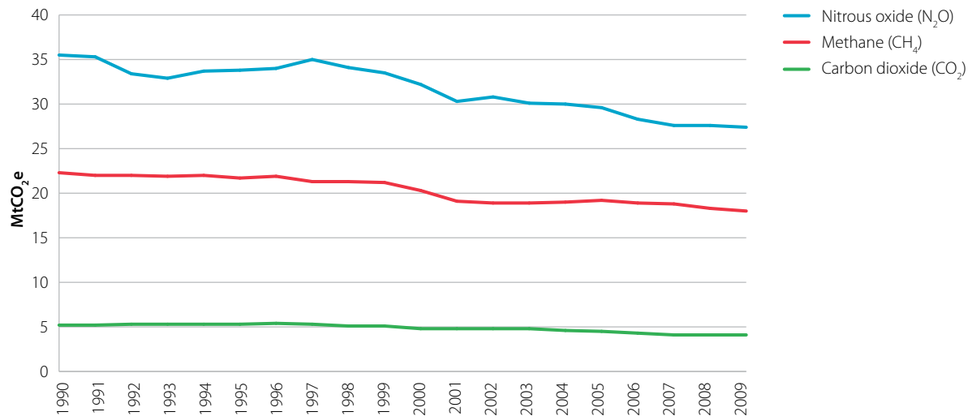
7. Agriculture emissions

Emissions trends

The latest available agriculture emissions data relates to 2009. This suggests a small emissions reduction, driven mainly by reduced production (Figure 13):

- Agriculture emissions in 2009 accounted for around 9% of total UK greenhouse gas emissions.
- Compared to 2008, GHG emissions fell by around 1% in 2009 to 49.5 $MtCO_2e$. Similar annual reductions were observed across the range of gases:
  - N_2O emissions fell by 0.7%, and accounted for 56% of agriculture emissions.
  - CH_4 emissions fell by 1.6%, and accounted for 36% of agriculture emissions.
  - CO_2 emissions fell by 1.1%, and accounted for 8% of agriculture emissions.
- N_2O emissions reduction in 2009 was driven by a 2% decline in total agricultural production. This was partially offset by an increase in the use of fertiliser on grasslands, which increased N_2O emissions intensity for the year.
- The decline in CH_4 emissions is largely explained by reduced livestock production (i.e. beef, lamb and poultry), which accompanied a decline in meat consumption.

Figure 13: Agricultural CO_2e emissions by greenhouse gas (1990-2009)



Source: NAEI (2011).

Monitoring progress reducing emissions: the need to improve the evidence base

The high degree of uncertainty over agriculture emissions and abatement potential makes it difficult to monitor progress reducing emissions. In particular, there is uncertainty over current farming practice, scientific uncertainty, and an inventory methodology which is not able to fully reflect implementation of abatement measures.

In the full report we highlight challenges in resolving these uncertainties. For example, the current evidence base on farming practice should be consolidated and a process introduced to ensure that data required for ongoing performance monitoring is available. Defra is taking forward work in each of the relevant areas, which should therefore provide the basis for a framework of progress indicators such as we have developed for other sectors.

Progress against policy milestones

In the preliminary indicator framework that we set out in last year's progress report, we highlighted delivery risks under the current industry-led approach. In the policy review scheduled for 2012 there is therefore a need to consider the full range of options.

In this report we further consider incentives under current policies and conclude that the policy review in 2012 should include:

- A mapping of incentives under current policies to abatement measures.
- A full assessment of policy options going beyond the voluntary approach.
- Performance triggers for introduction of new policies.

In the meantime, there is scope for the UK Government to influence CAP reform and improve the attractiveness of anaerobic digestion to strengthen incentives for the implementation of abatement measures.

8. Devolved administrations

Final emissions data for 2008 (the most recent data available for the devolved administrations) shows a fall in Scotland and Northern Ireland but an increase in Wales:

- Emissions fell 2.9% in Scotland in 2008 to 53.7 $MtCO_2e$, mainly resulting from a fall in power sector emissions.
- Emissions fell 0.4% in Northern Ireland in 2008 to 22.2 $MtCO_2e$.
- Emissions rose 4.7% in Wales in 2008 to 49.5 $MtCO_2e$, primarily as a result of a coal-fired power station coming back on to the system.

Energy data for 2009, together with EU ETS data, suggests that emissions fell significantly across the devolved administrations, mainly due to the recession. However, economic and temperature data suggest rising emissions are likely in 2010.

Progress has been made in the last year by each of the devolved administrations in setting out emissions reduction strategies and targets:

- The Scottish Government made both its target for a 42% reduction in emissions by 2020 and its series of annual targets legally-binding. It also outlined the range of confirmed policies and policy proposals to meet targets.
- The Welsh Government published its climate change strategy, which confirmed a target to reduce emissions by 3% each year from 2011 in areas of devolved competence.
- The Northern Ireland Executive published its greenhouse gas action plan. This outlines how each department in the Executive will contribute towards meeting the target to reduce emissions by 25% relative to 1990 by 2025.

Now these strategies are in place, the key challenge is to implement policies and measures that both deliver against devolved targets and contribute to UK carbon budgets. We will be working with the devolved administrations over the next year to develop our approach to measuring progress at the devolved level.

9. Next steps in preparing for the fourth carbon budget

The Government accepted the Committee's advice on the fourth carbon budget (2023-27) in May 2011. This requires an emissions cut of 50% on 1990 levels by 2025.

Our analysis suggests that achieving the fourth budget is feasible and cost-effective through deep cuts in emissions from power, buildings and transport, and some emissions cuts in industry and agriculture.

The analysis also suggests that action is required during the first three budget periods to make the fourth budget feasible.

This reinforces the need to achieve our progress indicators, and particularly those which are designed to prepare for deep emissions cuts in the 2020s (e.g. investment in low carbon power generation, renewable heat, electric vehicles).

Under the Climate Change Act, the Government is required to publish a strategy to deliver the fourth carbon budget, and is aiming to do this in the autumn of 2011. We expect that this will include a full set of abatement measures to achieve the budget, supporting policies, and a set of criteria against which success delivering the strategy can be assessed. We will assess the Government's strategy against our indicator framework in our next progress report to Parliament in June 2012.

Key findings

ES UK economy-wide **emissions increased by 3%** across the economy in 2010

ES The **underlying trend** in emissions was broadly **flat**.

ES Meeting carbon budgets requires an **acceleration in the rate** of emissions reduction.

ES **Progress has been mixed** in terms of the implementation of measures:

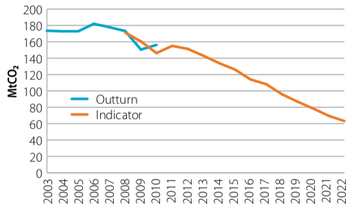
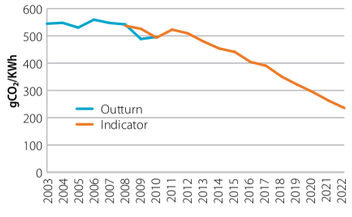
- ES The rate of improvement in **building insulation** and investment in **renewable heat** needs to increase.
- ES Good progress was made in 2010 in improving the efficiency of **new cars and in boiler replacement**.
- ES Progress adding **renewable power generation** was **broadly on track**, whilst moving forward with **Carbon Capture and Storage (CCS)** projects remains an **urgent priority**.

ES Effective implementation of **Electricity Market Reform** and the **Green Deal** will be crucial in driving emission reductions required to meet carbon budgets.

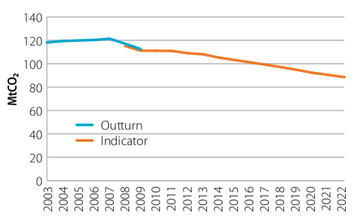
Summary of progress against indicators and future challenges

Economy-wide

3% rise in emissions reflects cold weather in 2010. Underlying trend roughly flat when adjusting for weather.
Implementation of measures was mixed against the low ambition in our indicators. A step change in the rate of emissions reduction is *still* required.
Development of key policies has begun, needs effective implementation to drive the step change.

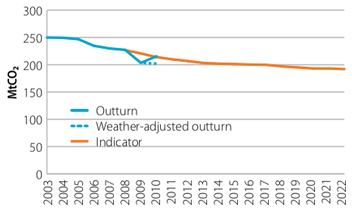
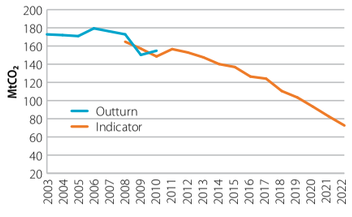
		Progress against indicators and miletones	Challenges
Power			
Emissions  **Emissions intensity**  	**Market**	Consultation on new electricity market arrangements completed in spring 2011. Proposed four pillars – long-term contracts for low-carbon generation, carbon price underpin, capacity payments and an Emissions Performance Standard.	White Paper due in July 2011. Should set objectives for new arrangements, provide certainty for investors through long-term contracts and support less mature low-carbon technologies. Risk of investment hiatus until new arrangements are clear.
	Transmission	Some new investment funding approved by Ofgem, progress on gaining planning approval for some key investments, charging system for transmission network still under review.	Still need: approvals for remaining funding, planning approvals, and certainty on charging arrangements.
	Planning	The amount of onshore wind capacity gaining planning approval fell. The average time for wind projects awaiting determination increased, remaining well above indicators.	More timely determinations and higher approval rates will be required to facilitate acceleration of investment beyond 2015.
	Wind	Total installed capacity in line with our indicators.	Significant acceleration in the pace of investment required in mid-2010s.
	Nuclear	Regulatory justification and regulations on waste and decommissioning approved.	Need for approval of the Nuclear National Policy Statement and reactor designs, which may have been delayed by 6-12 months. Awaiting first planning application.
	CCS	2010 Spending Review allocated up to £1 billion in capital for first demonstration project.	Urgent need to award funding so first demonstration plant becomes operational in 2016, with further pressing need to invite bids for projects two to four.

Summary of progress against indicators and future challenges

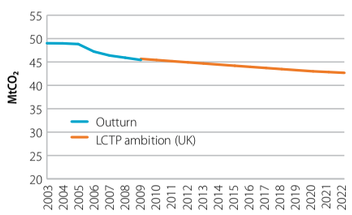
		Progress against indicators and miletones	Challenges
Road transport			
Direct emissions  	**New car fuel efficiency**	Significant improvement in new car gCO_2/km, reduced by small shift towards larger, higher-emitting cars.	To ensure continued progress, potentially through use of fiscal levers if required.
	Reducing van emissions	EU framework for new van emissions agreed in December 2010 setting a target of 147 gCO_2/km for new vans by 2020.	To ensure new vans in the UK achieve the EU target.
	Development of electric car market	Price support for purchase of electric cars confirmed. Confirmation of funding for existing Plugged-in Places (PiP) pilots and new funding for five additional PiP projects. Commitment to mandate and to deliver a nationwide strategy for national recharging network for electric vehicles.	Need deployment targets for 2020. Greater price support may be required to support early market.
	Increased use of biofuels	Increasing as expected.	Need to understand likely availability of sustainable biofuels beyond 2020.
	Smarter Choices	Local Sustainable Transport Fund could support roll out of Smarter Choices.	To ensure funding is allocated to schemes which deliver significant total reduction in car travel, and to extend funding to support full roll out by 2020.
	Eco-driving	Very low levels of eco-driving training in 2010.	Assessment, funding and implementation of delivery mechanisms for large-scale roll out.
	Speed limiting	Increased violation of speed limits on motorways in 2010, resulting in increased emissions.	To minimise emissions from speeding through stricter enforcement of existing speed limits.
	Land use/transport planning	Revision of the land use planning framework underway.	To ensure that impacts of development on transport emissions are fully accounted for in the planning process.

Note:
1. Please refer to chapters for sources and notes to tables.

Summary of progress against indicators and future challenges

		Progress against indicators and miletones	Challenges
Buildings & industry			
Direct emissions  **Indirect emissions** 	**Residential**	Implementation of professional loft and cavity wall insulation fell by 30% in 2010 with limited progress on solid wall insulation. Good progress on boilers. Energy Bill going through Parliament setting the framework for the Green Deal and the Energy Company Obligation as successor to CERT. Cost of solid wall insulation to be subsidised through ECO. Minimum energy efficiency standards for private rented properties to be introduced in 2018. Definition of Zero Carbon for new homes clarified (i.e. excludes energy use not covered by building regulations).	Need to increase pace of rollout of cavity, loft and solid wall insulation to meet required insulation up take by 2022. Need for more clarification around ambition, finance and delivery. Potential fuel poverty implications of large solid wall programme if passed through to energy bills. Standards could be introduced earlier. Will mean higher emissions than previously assumed from new homes, unless demand is met by additional off-site low carbon capacity.
	Non-residential	Green Deal provisions in Energy Bill will cover non-residential sector. CRC recycling mechanism dropped. Minimum standards for rented premises proposed from 2018. Public sector – central government 10% reduction target for 2010 achieved.	Difficult to make 'Golden Rule' work as payback often not sufficient. Implications unclear but may have reduced incentives as now seen as just another tax. Standards could be introduced earlier. Abolition of national indicators for local authorities – unclear whether there are now enough incentives for emission reductions across all local authorities.
	Industry	CCAs to be agreed to 2023.	New CCAs should address the full range of options, including both short-term and long-term, and require implementation of those which are cost-effective.
	Renewable heat	RHI details announced in March 2011. Limited progress to date in uptake of renewable heat.	Strengthened incentives will be required to achieve 12% renewable heat penetration by 2020. The success of RHI also depends upon providing confidence to investors to support supply chain expansion and increasing consumer confidence to ensure uptake.

Summary of progress against indicators and future challenges

		Progress against indicators and miletones	Challenges
Agriculture			
GHG emissions 	**Agriculture**	Industry led GHG Action Plan launched early 2011 and Government has committed to a review in 2012. EBLEX and BPEX industry road maps published in 2011. Development of improved smart inventory (first stage) by 2014 – new funding of £12.6m over next four years to support this. Launch of integrated advice pilot in Feb 2011.	Government needs to establish clear criteria for measuring the Action Plan's success in advance of its review of the Plan in 2012. Opportunity to obtain a greener CAP in order to support the delivery of the EU's GHG emissions reduction targets.

Note:
1. Please refer to chapters for sources and notes to tables.

Chapter 1: Overview of progress towards meeting carbon budgets

Introduction and key messages

In our 2010 progress report we showed that the fall in emissions of almost 9% in 2009 was largely due to the recession. We noted some progress on implementation of abatement measures, but stressed that continued progress at this rate would be insufficient to meet the second and third carbon budgets.

In this chapter we do five things:

- We assess the latest data on progress reducing emissions at the economy-wide level and for the non-traded and traded sectors.
- We assess *underlying* progress in reducing emissions (e.g. after allowing for impacts of the recession and cold weather).
- We report progress against our indicators, which cover abatement measures and policy milestones.
- Given this assessment, we consider what is possible and desirable in terms of emission reductions to 2020, given ongoing impacts of the recession and potential for implementation of abatement measures.
- We also consider the implications of the fourth carbon budget for actions required now.

Our key messages are:

- Economy-wide emissions increased by 2.9% in 2010. However, without the impacts of the cold weather, emissions would have been broadly flat.
- Although non-traded sector emissions remain below limits for the first budget, this is largely due to the recession. Progress implementing measures to reduce emissions was mixed against the modest ambition built into our indicator framework for 2010. Going forward, a step change in the pace of underlying emissions reductions is *still* required.
- Given such a step change, the result would be outperformance of the second and third carbon budgets. This should be the objective given recent commitment to the fourth carbon budget. Simply achieving the currently legislated third carbon budget would leave an excessively challenging pace of emissions reductions beyond 2020 to meet the fourth and subsequent carbon budgets.
- In the traded sector, emissions are below the level required in the first carbon budget, implying that the UK is currently a net seller or banker of emissions allowances. Progress adding low-carbon capacity was broadly on track against our indicator framework. Going forward, however, a significant ramp-up in the rate of investment is required.

- There is a need to prepare now for meeting the fourth carbon budget, for example, through electricity market reform, and development of options for decarbonising heat and transport sectors.

We set out the analysis that underpins these messages in five sections:

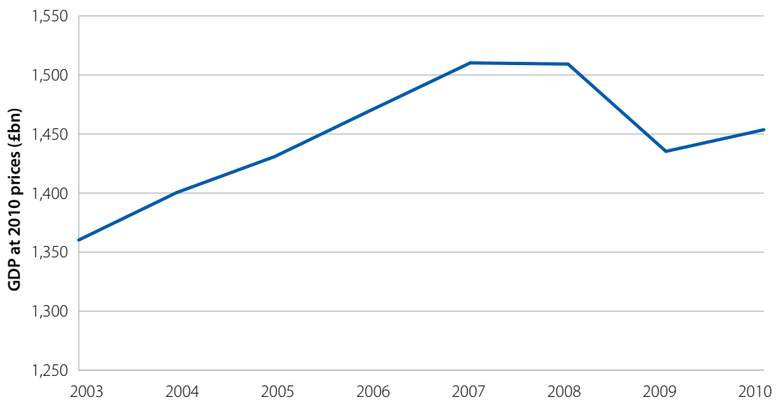
1. Economy-wide emission trends
2. Non-traded sector emissions
3. Traded sector emissions
4. Emission projections
5. The fourth carbon budget

1. Economy-wide emission trends

The context for 2010 emissions is one of slightly rising GDP, falling energy prices, rising transport fuel prices and relatively cold winter months:

- GDP grew in 2010 by around 1.3%, following a 2009 reduction of 4.9% (Figure 1.1). Within this, manufacturing growth grew slightly above trend (4%, compared to around 2% expected in future), while the rest of the economy grew relatively slowly.
- Gas price reductions in 2010 resulted in a 9% real reduction in the price faced by residential users, and a 5% real reduction in the electricity price (Figure 1.2).

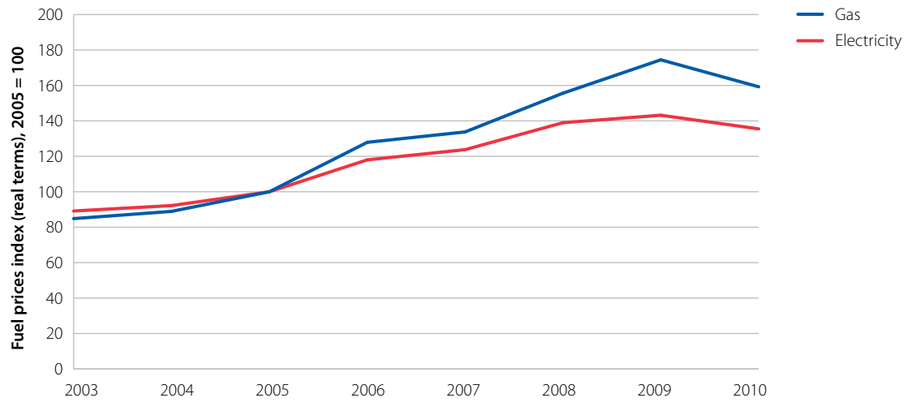
Figure 1.1: UK GDP (2003-2010)



Source: HMT (May 2011) *Pocket Databank.*

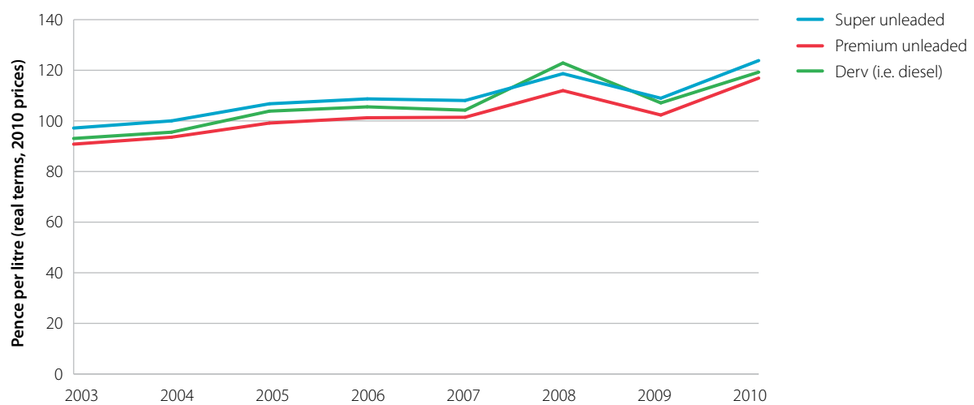
- In the transport sector, the petrol price rose by 14% and the diesel price rose by 11% in real terms (Figure 1.3).
- The winter months in 2010 (January, February and December) were around 2 °C colder than the previous year and there were 20% more heating degree days (HDD)[1] over the year (Figure 1.4).

Figure 1.2: Fuel prices in the residential sector (2003-2010)



Source: DECC (March 2011) *Quarterly Energy Prices* Table.

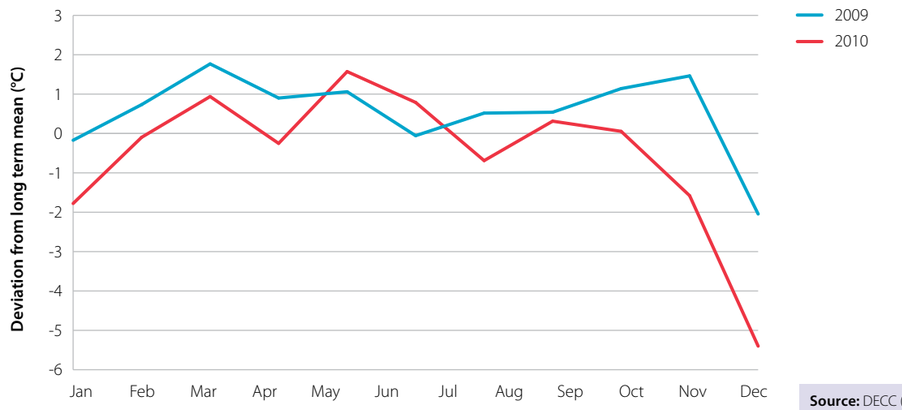
Figure 1.3: Petrol and diesel prices (2003-2010)



Source: DECC (March 2011) *Quarterly Energy Prices* Table 4.1.1.

1 HDD are calculated relative to a baseline temperature, typically 15.5°C, which is the outside temperature above which a building needs no heating. One HDD is the number of degrees centigrade deviation from the base temperature of the actual temperature on a given day (e.g. if the temperature was 5.5°C for one day the number of HDD would be 10).

Figure 1.4: Average daily temperature – deviation from long-term mean (2009 and 2010)



Source: DECC (March 2011) *Energy Trends* Table 6.1.
Note: The long-term mean is the 1971-2000 average.

Within this context GHG emissions rose 2.9% in 2010. This was driven by increased CO_2 emissions in residential buildings and power stations, which were partially offset by non-CO_2 emissions reductions (Figure 1.5 and Figure 1.6):

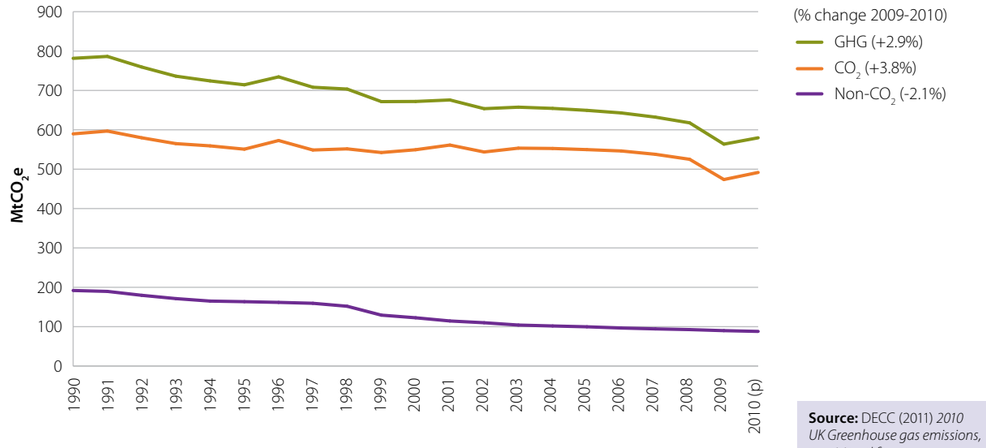
- CO_2 emissions rose by 3.8%, reflecting increased emissions from buildings (residential and non-residential) and industry, and power generation.
  - Direct emissions (e.g. related to burning fossil fuels for heat) from buildings and industry rose by 6.0%. This was driven by increases in all sectors, but especially residential buildings, where direct emissions increased by around 13.4%.
  - Emissions from power generation rose by 3.9%, due to increased electricity demand and increased emissions intensity as temporary nuclear outages led to increased generation from power stations burning fossil fuels.
  - Although emissions from cars and HGVs are likely to have fallen in 2010, total transport emissions were broadly flat.
- Non-CO_2 emissions fell by 2.1%, continuing long-term trends.

However, adjusting for one-off impacts (e.g. low temperatures in winter months, nuclear outages) suggests that the underlying trend in GHG emissions was broadly flat (see section 2 and Chapter 2).

The increase in outturn emissions in 2010 followed an 8.8% reduction in GHG emissions in 2009[2], which we showed in our 2010 progress report was largely due to the impact of the recession:

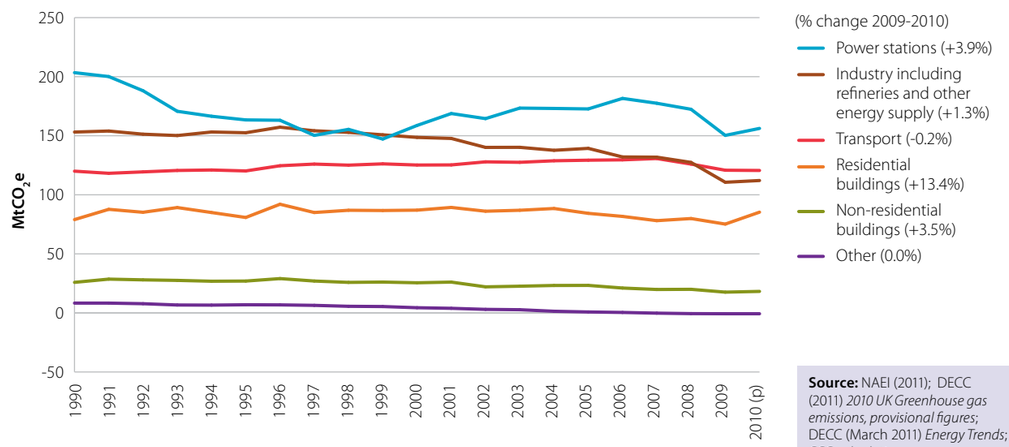
2 The 8.8% reduction is based on final data for 2009, and is slightly higher than the 8.6% reduction documented in our 2010 report based on preliminary data. The difference between preliminary and final data is due to different methods for estimating emissions and varies by sector.

Figure 1.5: UK greenhouse gas emissions (1990-2010)



Source: DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures.*

Figure 1.6: UK CO_2 emissions by sector on a source basis (1990-2010)



Source: NAEI (2011); DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures;* DECC (March 2011) *Energy Trends;* CCC calculations.

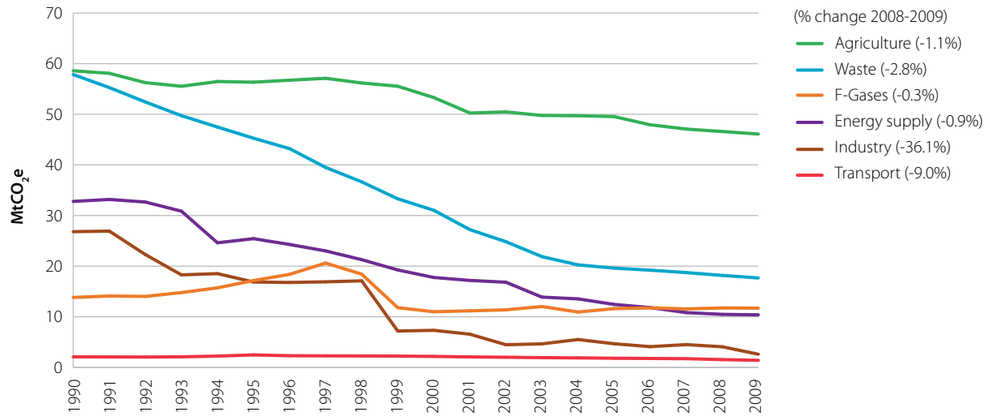
- CO_2 emissions fell by 9.8% in 2009 with reductions of 13% in power, 7% in buildings, 13% in industry[3] and 4% in transport.
- Non-CO_2 emissions fell by 3.0% in 2009 with reductions of 1.1% in agriculture, 2.8% in waste, 0.7% in the energy sector and 0.3% in F-gases (Figure 1.7)[4].

3 Including refineries and other energy supply.
4 Provisional data did not include a sectoral breakdown.

CO_2 emissions in the five years before the recession fell by only 0.7% per year on average. Although there has been a downward shift in emissions due to the recession, there is no evidence of a change in the underlying pace of emissions reductions. A reversion to the pre-recession trend would mean that future budgets would be missed, notwithstanding that emissions in 2010 were below budgeted levels (Figure 1.8).

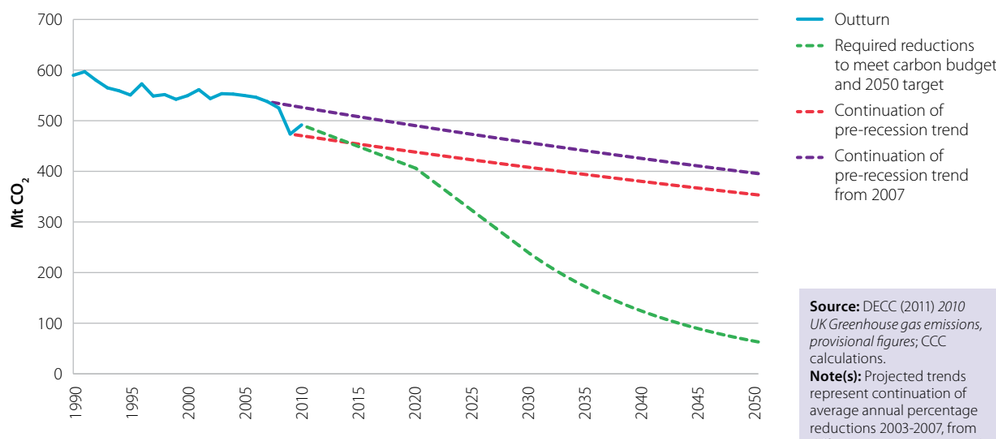
We now consider this question in more detail, where our focus is on the extent to which underlying emissions trends are consistent with meeting carbon budgets, and whether a step change in the pace of emissions reduction is still required.

Figure 1.7: UK non-CO_2 emissions by sector (1990-2009)



Source: NAEI (2011).

Figure 1.8: CO_2 emissions under pre-recession trend versus required reductions (1990-2050)



Source: DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; CCC calculations.
Note(s): Projected trends represent continuation of average annual percentage reductions 2003-2007, from different starting points and are therefore not parallel.

2. Non-traded sector emissions

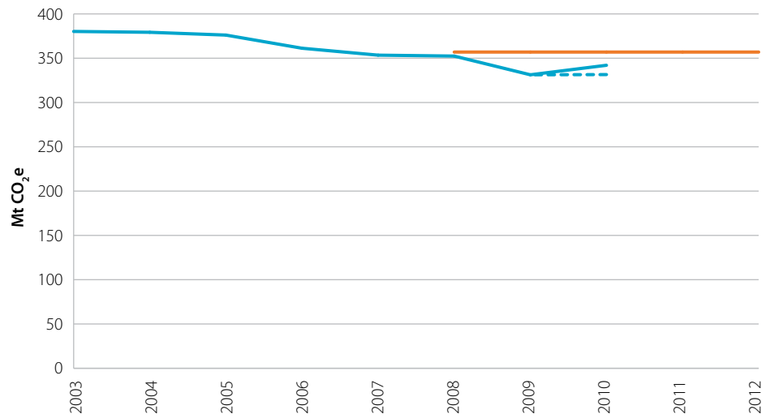
Emission trends

The non-traded sector includes all sectors not covered by the EU ETS, most notably heat in buildings and less energy intensive industry, transport and most non-CO_2 emitting sectors (e.g. agriculture and waste).

Non-traded sector emissions rose by 3% in 2010, but remained below the legislated level of the first carbon budget given the significant recession impact in 2009.

The main driver of the emissions increase was the cold weather in 2010. Without the impact of the cold winter months, emissions in 2010 would have been broadly flat, and further below the budget level (Figure 1.9, Box 1.1).

Figure 1.9: Non-traded sector emissions versus budget (2003-2012)



Source: NAEI (2011); DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures;* DECC (March 2011) *Energy Trends;* European Commission (15 April 2011) *Verified Emissions for 2008-2009-2010 and allocations 2008-2009-2010;* European Commission (11 May 2009) *Verified Emissions for 2007-2008 and allocations 2008;* CCC calculations.

Box 1.1: The impact of weather on energy demand, and the Committee's approach to 'temperature adjusting'

The effect of external temperatures and weather has been shown empirically to have a direct relationship to energy consumption and therefore emissions.

- When external temperatures are colder than average, energy consumption typically rises due to increased demand for heating fuels.
- Conversely when external temperatures are warmer than average, demand for energy is reduced as demand for heating fuels is reduced.
- There are also other auxiliary effects of different weather patterns such as disruption to travel due to snow or loss of worker productivity due to heatwaves.
- Warmer temperatures in summer currently have a much smaller effect, given that energy demand for cooling remains significantly lower than energy demand for heating in the UK.

The winter months of 2010 (January, February and December) were significantly colder than 2009 and the recent average[5]. This has resulted in increased emissions, particularly in the residential sector. We have therefore produced a "temperature adjusted" estimate of the change in energy consumption from 2009 to 2010, which can be interpreted as how energy consumption would have changed without the fall in winter temperatures. We have then used the adjusted energy consumption to calculate the effect on emissions. This allows us to assess underlying progress, abstracting from year-to-year variations in weather, which is useful in assessing future prospects for emissions.

Total CO_2 emissions in 2010 rose 4%, but adjusting for the effects of the cold winter emissions would have been broadly flat[6].

- The largest effect can be observed in the residential sector. Direct emissions rose 13% but temperature adjusted would have fallen 1%. Indirect emissions (from electricity generation) increased 2% but would have fallen 1%.
- In the non-residential sector direct emissions went up 4%, but temperature adjusted would have fallen 4%. Indirect emissions rose 2% but would have fallen 1%.
- In industry, we have not adjusted for temperature. While the cold weather may have increased demand for heating and the snowfall may have reduced output, there are uncertainties around the precise impact on emissions.
- In transport, the snowfall in 2010 is likely to have had some effect on emissions due to decreased road traffic[7] and after adjusting for the cold weather transport emissions may have risen up to 1%.

Overall, non-traded sector GHG emissions, which rose by 3%, would have been flat without the impact of the cold winter months, while traded sector emissions which rose 2% would have fallen 2%.

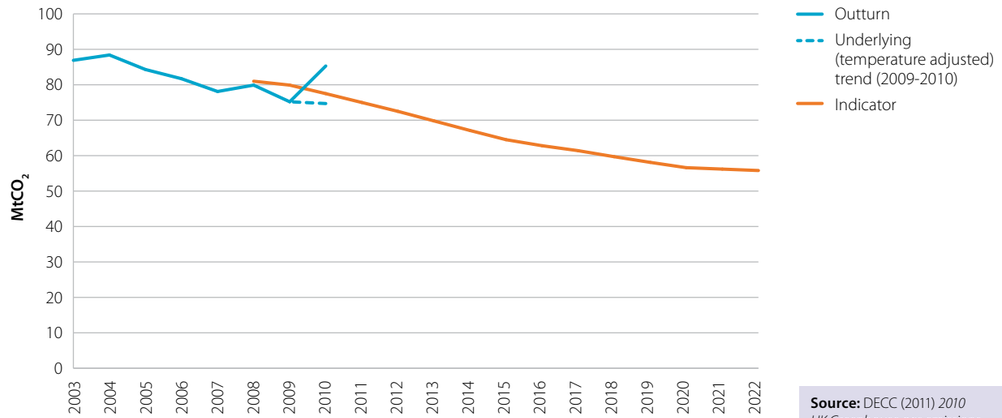
This analysis is based on an initial methodology used by DECC for energy consumption estimates. We intend to look further at the methodology for temperature adjusting GHG emissions for future reports.

This reflects trends at the sectoral level (e.g. buildings), where emissions would also have been broadly flat after allowing for weather impacts. As a result, and given the fall in emissions in 2009 due to the recession, sectoral emissions in 2010 would have been lower than in the expected trajectories set out in our 2009 progress report, which did not fully reflect the impact of the recession on emissions:

5 Despite the short-term fall in winter temperatures in 2010, we expect average UK temperatures in the long-term to increase as a result of increasing GHG concentrations in the atmosphere.
6 Non-CO_2 emissions and some CO_2 sectors have not been adjusted for temperature.
7 DFT Quarterly road traffic estimates – Q4 2010.

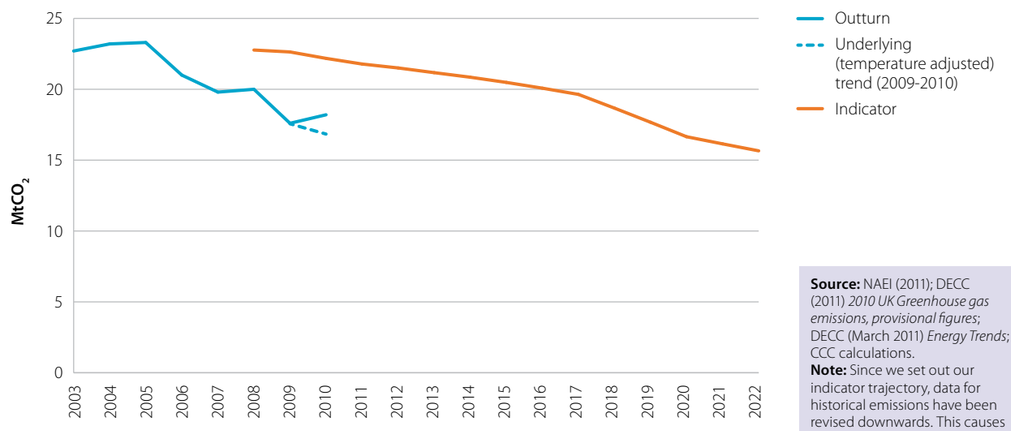
- Direct emissions from residential buildings rose by 13% and were above our 2009 trajectory. However, adjusting for the cold weather, emissions would have been roughly flat and remained below expected emissions (Figure 1.10).
- Direct emissions from non-residential buildings rose by 4% but remained below our expected trajectory; adjusting for weather, emissions would have been further below this trajectory (Figure 1.11).

Figure 1.10: Direct CO_2 emissions from residential buildings vs indicator trajectory (2003-2022)



Source: DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; CCC calculations .

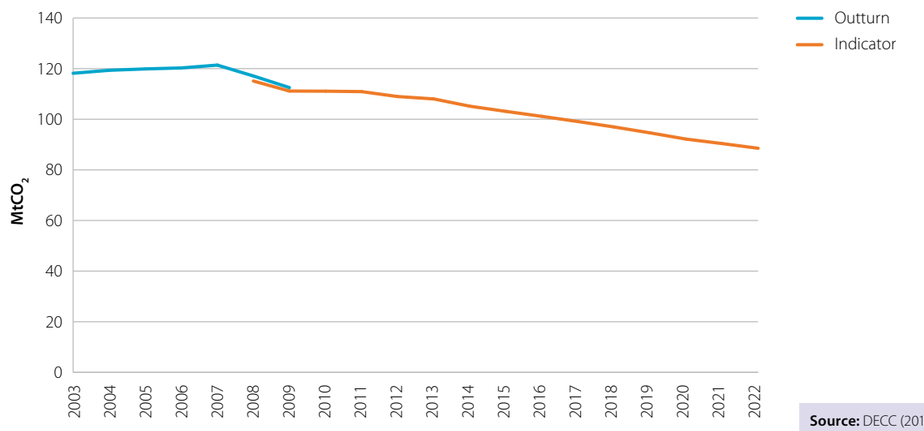
Figure 1.11: Direct CO_2 emissions from non-residential buildings vs indicator trajectory (2003-2022)



Source: NAEI (2011); DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; DECC (March 2011) *Energy Trends*; CCC calculations.
Note: Since we set out our indicator trajectory, data for historical emissions have been revised downwards. This causes the gap between the lines in 2008.

- Data for road transport emissions are not yet available for 2010. However, in 2009 these emissions were close to the expected trajectory (Figure 1.12). Preliminary data for transport as a whole suggest a small reduction in emissions in 2010.

Figure 1.12: Direct CO_2 emissions from road transport vs indicator trajectory (2003-2022)



Source: DECC (2011) *2009 UK Greenhouse gas emissions, final figures*; CCC calculations.

The combination of flat weather-adjusted emissions and limited GDP growth in 2010 suggests only limited progress on implementation of abatement measures.

Progress against indicators

In our previous progress reports we have emphasised the need to track not only outturn emissions, but also indicators of future emissions. We therefore developed a framework of indicators for the implementation of abatement measures, consistent with decarbonisation required under carbon budgets. Together these indicators make up our *Extended Ambition scenario*, and are broadly consistent with high-level policy ambition from Government.

Given lead-times for developing and delivering new policy, the level of ambition in our indicator framework for the first budget period is relatively low, with a significant acceleration in the pace at which measures are implemented and emissions reduced going into the second and third budget periods (Table 1.1).

Table 1.1: Required ramp up of measures in the non-traded sector

	Annual uptake/improvement		
	Budget 1 average	**Budget 2 average**	**Budget 3 average**
Residential buildings			
Loft insulation (CERT professional)	0.9m	2.1m	n/a
Loft insulation (DIY and other schemes)			
Cavity wall insulation	0.8m	1.4m	n/a
Solid wall insulation	90,000	150,000	220,000
Efficient boilers	1.0m	0.9m	0.7m
Renewable heat			
Increase in renewable heat penetration	+0.1%	+0.8%	+2.4%
Road transport			
Improvement in new car CO_2	-4 gCO_2/km	-6 gCO_2/km	-6 gCO_2/km
Electric cars registered each year (PHEV/BEV)	5,000	130,000	450,000
Increase in biofuels penetration (by vol)	+0.7%	+0.7%	+0.4%
Car drivers undertaking eco-driving training each year	300,000	320,000	340,000

Source: CCC modelling

Against the low level of ambition envisaged for 2010, there was mixed progress implementing abatement measures in the non-traded sector.

- In buildings, there was limited progress on all measures other than boiler replacement (Table 1.2).
  - There was a slowdown in the rate of professional loft and cavity wall insulation, with annual installations below levels in our indicator framework. Levels of solid wall insulation remained very low.
  - Boiler replacement was ahead of schedule, with accelerated replacement due to the boiler scrappage scheme operated in 2010.
- Investment in renewable heat technologies was very limited. This is in line with our indicator framework, with increased investment expected as new policies are introduced (Table 1.3).
- In road transport, the carbon-intensity of new cars was well ahead of our indicator, whilst eco-driving training was well behind (Table 1.4).
  - New car emissions fell from 150 gCO_2/km in 2009 to 144 gCO_2/km in 2010, significantly below the 156 gCO_2/km level for 2010 in our indicator framework.
  - While sales of electric vehicles were very low, this is in line with our indicator framework, with increased sales expected as new policies are introduced and as markets develop.
  - Biofuels penetration reached 3.6%, in line with our indicator trajectory.
  - There was only the most limited progress on eco-driving.

Table 1.2: Progress against indicators in the residential sector

	Annual uptake/ improvement 2009		Annual uptake/ improvement 2010		Overall progress to 2010	
	Indicator	**Outturn**	**Indicator**	**Outturn**	**Indicator**	**Outturn**
Loft insulation (CERT professional)	0.6m	0.8m	0.6m	0.5m	1.6m	1.8m
Loft insulation (DIY and other schemes)		0.3m		0.8m		1.3m
Cavity wall insulation	0.7m	0.7m	0.7m	0.4m	1.8m	1.6m
Solid wall insulation	70,000	15,000	95,000	13,000	200,000	39,000
Efficient boilers	1.0m	1.2m	1.0m	1.3m	3.0m	3.6m

Source: OFGEM (2011) *CERT update quarter 11*; DCLG (2011) *Housing statistics – Table 241*; Heating and Hotwater Council (2011); DECC (2011) *Estimates of home insulation levels in Great Britain*; CCC calculations.
Note: Overall progress to 2010 represents total additional installations compared to 2007 levels.

Table 1.3: Progress against indicators in renewable heat

	Annual uptake/ improvement 2009		Annual uptake/ improvement 2010		Overall progress to 2009	
	Indicator	**Outturn**	**Indicator**	**Outturn**	**Indicator**	**Outturn**
Renewable heat penetration	+ <0.1%	+0.2%	+ <0.1%	n/a	1-2%	1.6%

Source: DECC (2010) DUKES Table 7.7; CCC modelling
Note: Data on 2010 renewable heat penetration is not available. Overall progress to 2009 represents total renewable heat penetration.

Table 1.4: Progress against indicators in road transport

	Annual uptake/ improvement 2009		Annual uptake/ improvement 2010		Overall progress to 2010	
	Indicator	**Outturn**	**Indicator**	**Outturn**	**Indicator**	**Outturn**
New car CO_2	-2 gCO_2/km	-8 gCO_2/km	-4 gCO_2/km	-5 gCO_2/km	156 gCO_2/km	144 gCO_2/km
Electric cars registered each year (PHEV/BEV)	0	101	5,000	167	5,000	167
Biofuels penetration (by vol)	+0.5%	+0.6%	+0.5%	+0.7%	3.4%	3.6%
Car drivers undertaking eco-driving training	300,000	5,000	300,000	10,000	600,000	15,000

Source: SMMT (2011) *New Car CO2 Report;* SMMT (2011); HMRC (February 2011) *Hydrocarbon Oils Duties Bulletin;* Energy Saving Trust (2011).

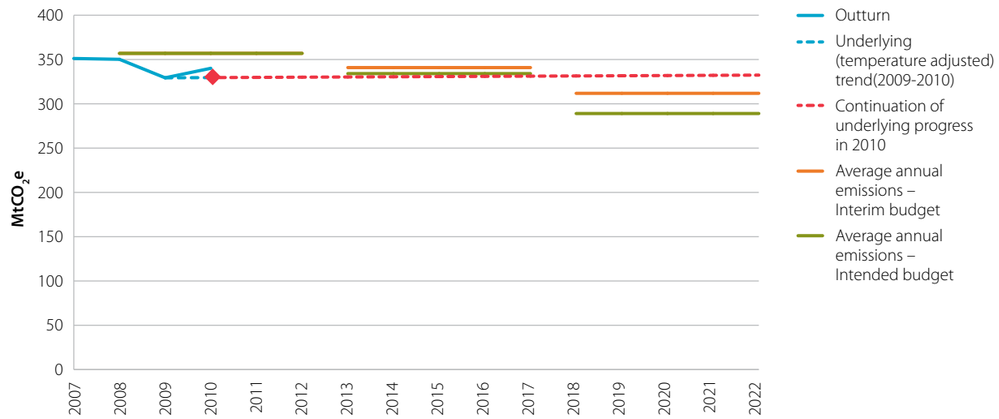
The need for a step change

The pace of underlying emissions reductions achieved in 2010 would, if continued, be insufficient to meet the second and third carbon budgets (Figure 1.13).

In addition, it is not clear whether this rate of progress could be sustained under current policies. For example it is likely that the reduction in new car CO_2 was driven partly by ongoing recession impacts on consumer purchasing behaviour, reinforced by high fuel prices, and residual impacts of the scrappage scheme operated in 2009 (see Chapter 4). These changes in behaviour may be reversed as the economy continues to recover.

Therefore a step change in the pace of underlying emissions reductions is *still* required to meet the currently legislated budgets. This becomes more pronounced given the need to aim to outperform currently legislated budgets in order to be on track to meeting the fourth carbon budget (see section 4). Driving the step change will require development and implementation of new policies (e.g. the Green Deal, support for renewable heat – discussed in Chapters 3-5).

Figure 1.13: Non-traded sector emissions based on continuation of underlying progress in 2010 (2007-2022)



Source: NAEI (2011); DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; DECC (March 2011) *Energy Trends*; European Commission (15 April 2011) *Verified Emissions for 2008-2009-2010 and allocations 2008-2009-2010*; European Commission (11 May 2009) *Verified Emissions for 2007-2008 and allocations 2008*; CCC calculations.
Note(s): Excludes emissions from domestic aviation as they will be included in the EU ETS from 2012. See glossary for definition of Interim and Intended budgets.

3. Traded sector emissions

(i) UK traded sector emissions

Emission trends

The traded sector covers power generation and energy-intensive industrial sectors (e.g. oil refineries, cement, iron and steel).

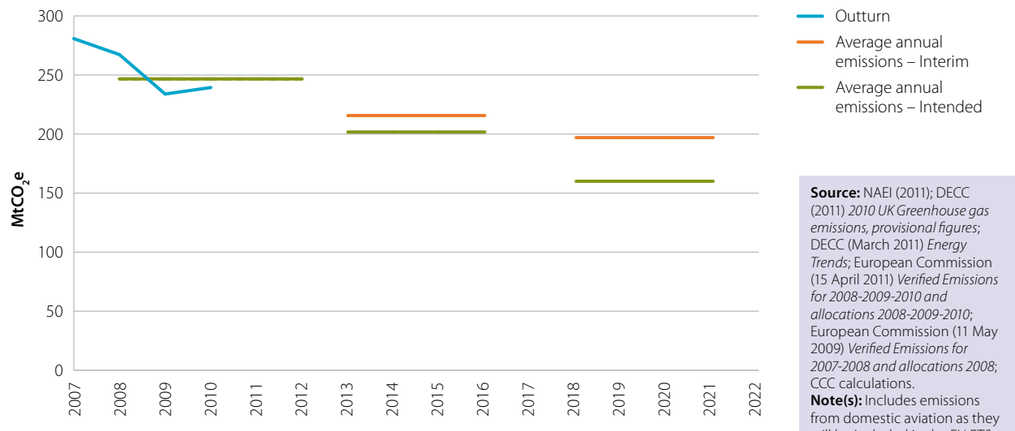
The carbon budget for the traded sector is defined by the UK's share of the EU ETS cap. Given the way that the EU ETS is designed, the cap and therefore the traded sector budget will always be exactly achieved, through a combination of domestic emissions reductions and purchase of allowances.

However, reducing (gross rather than net) UK traded sector emissions is of crucial importance over the next decade, particularly given the need for decarbonisation of the power sector over the next two decades and in the context of rising carbon prices expected beyond 2020.

In 2010 gross UK traded sector emissions rose by 2.4%, driven by increased power sector emissions and, to a lesser extent, increased industry emissions. However, emissions remained below the budget level, given recession impacts in 2009 which were even more significant than in the non-traded sector (Figure 1.14).

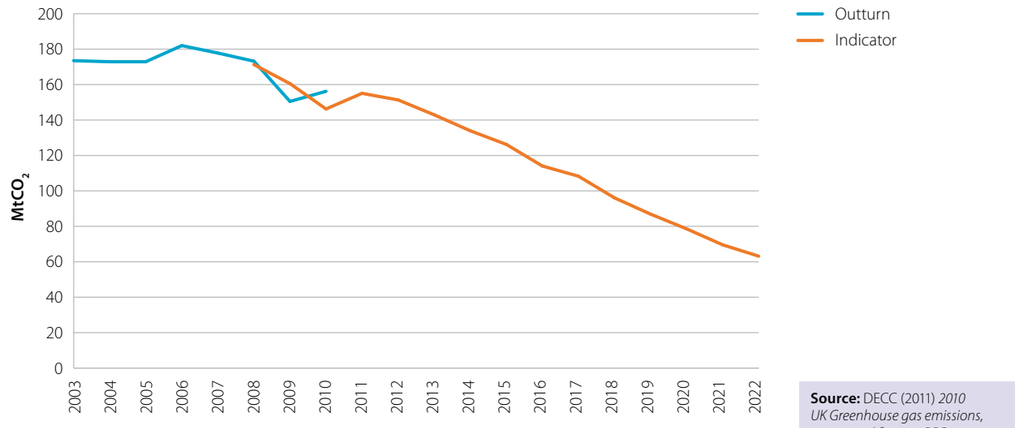
- Power sector emissions increased by 4% in 2010 and were above the trajectory set out in our 2009 progress report (Figure 1.15).
  - The increase in emissions was due to increased demand for electricity (up 1%) and increased carbon intensity of generation as nuclear output was reduced.
  - After adjusting for cold weather impacts, demand would have fallen by up to 2%.
  - Further adjusting for temporary nuclear outages suggests that emissions – without the impact of these outages and cold winter months – would have been broadly flat, but still above the level anticipated in our 2009 report.
- Direct emissions from industry rose by 1% in 2010, but remained below the expected emissions trajectory (Figure 1.16).
  - Traded sector industry emissions were broadly flat, as reduced emissions in some key sectors (e.g. iron and steel) were offset by increased emissions from other sectors (e.g cement).

Figure 1.14: Traded sector emissions compared to budgets (2003-2022)



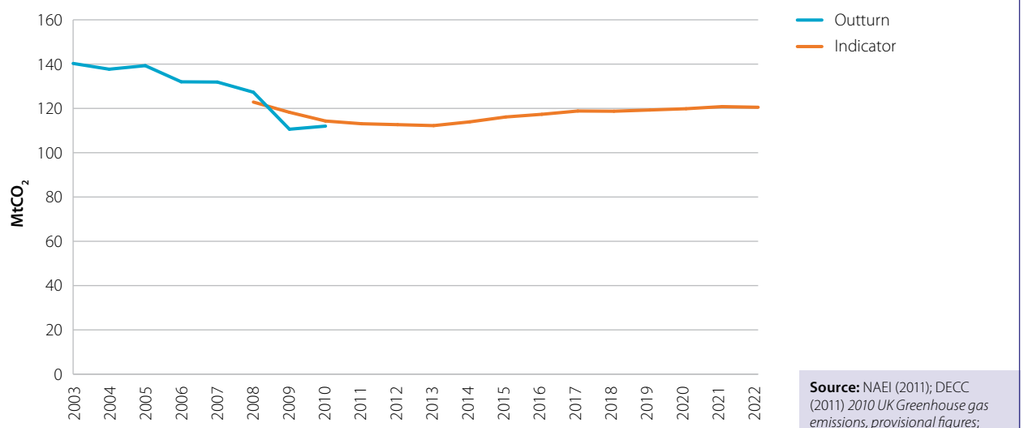
Source: NAEI (2011); DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; DECC (March 2011) *Energy Trends*; European Commission (15 April 2011) *Verified Emissions for 2008-2009-2010 and allocations 2008-2009-2010*; European Commission (11 May 2009) *Verified Emissions for 2007-2008 and allocations 2008*; CCC calculations.
Note(s): Includes emissions from domestic aviation as they will be included in the EU ETS from 2012.

Figure 1.15: CO_2 emissions from power vs indicator trajectory (2003-2022)



Source: DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; CCC calculations.

Figure 1.16: Direct CO_2 emissions from industry vs indicator trajectory (2003-2022)



Source: NAEI (2011); DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; DECC (March 2011) *Energy Trends*; CCC calculations.

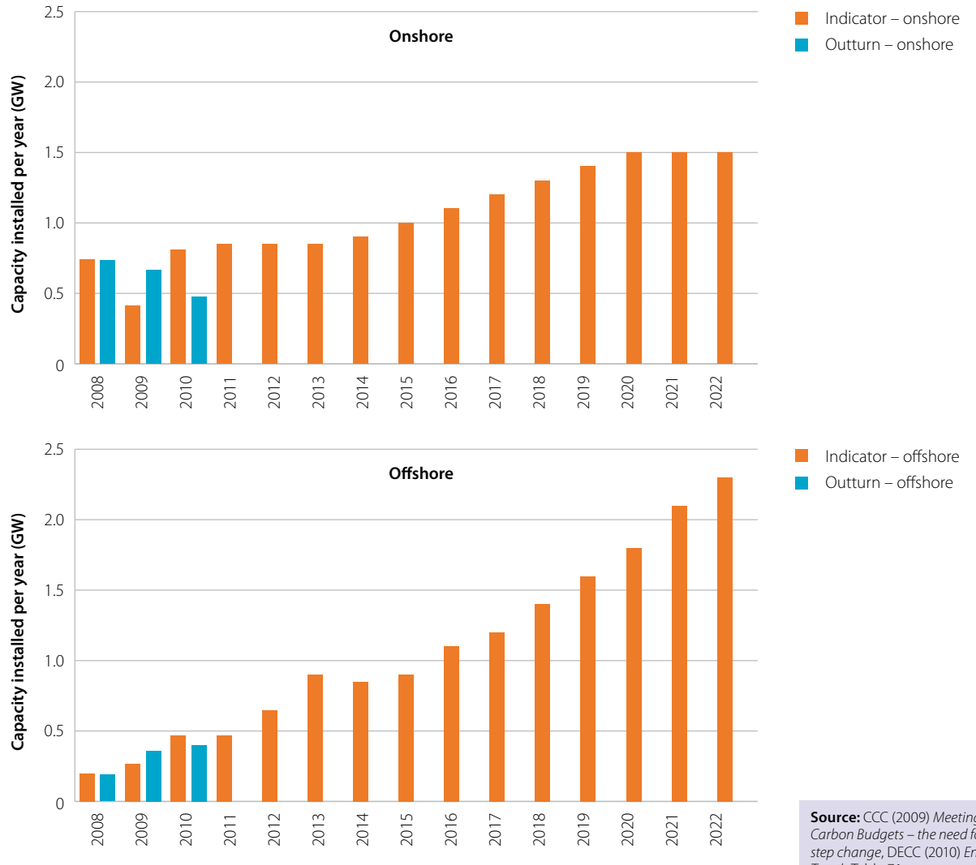
Progress against indicators

As for the non-traded sector, our indicator framework includes not only emissions in the traded sector but also forward indicators of progress towards meeting future budgets. We focus on low-carbon investments in the power sector, which are key to long-term sector decarbonisation. Progress in 2010 was broadly on track against our indicator framework. However, the indicators include a relatively low level of ambition in 2010 relative to what is required to achieve sector decarbonisation over the next decades (Figure 1.17).

While our framework does not include trajectories for specific abatement measures in industry, the clear correlation seen historically between emissions and output highlights the need for implementation of abatement measures if emissions are to be reduced in the context of increasing manufacturing output.

Therefore, as in the non-traded sector, a step change in the pace of underlying emissions reductions is still required in the traded sector. In turn this will require development and implementation of new policies (e.g. the Electricity Market Reform, CCS support – discussed in Chapter 2).

Figure 1.17: Additional operational wind capacity per year (2008-2020)



Source: CCC (2009) *Meeting Carbon Budgets – the need for a step change*, DECC (2010) *Energy Trends* Table 7.1.

(ii) EU traded sector emissions

Emission trends

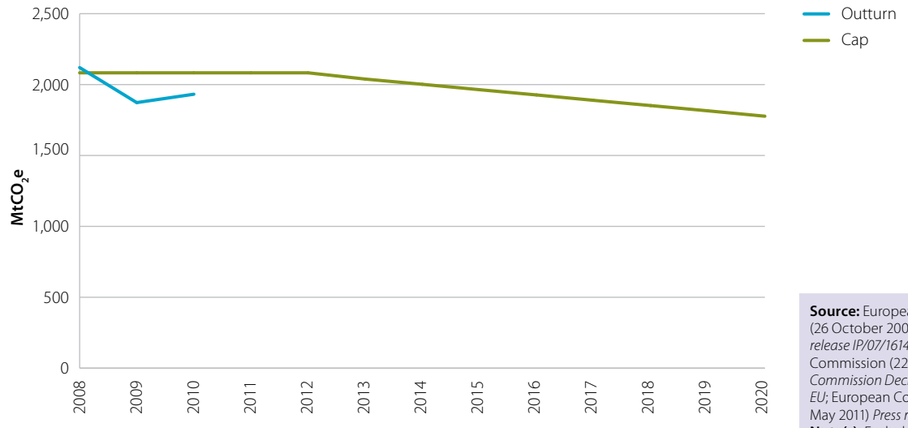
EU traded sector emissions are highly relevant for the UK since, for a given EU ETS cap, these determine the carbon price, which in turn influences the investment climate for the power sector and other energy-intensive industries in the UK.

In 2010 EU traded sector emissions rose by 3%, following an 11% reduction in 2009:

- The key driver of increased emissions was a 7% increase in EU industrial output.
- In turn, this was driven by a 12% increase in German industrial output, which accounted for around 40% of the increase in total EU ETS emissions in 2010.

The result was a level of EU ETS emissions in 2010 still below the EU ETS cap but reflecting the impact of the recession rather than improvements in carbon efficiency. This raises questions about the strength of the EU ETS price signal (Figure 1.18).

Figure 1.18: Emissions within the EU ETS versus cap (2008-2020)



Source: European Commission (26 October 2007) *Press release IP/07/1614*; European Commission (22 October 2010) *Commission Decision 2010/634/EU*; European Commission (15 May 2011) *Press release IP/11/581*.
Note(s): Excludes international aviation.

Carbon price trends

The carbon price in 2010 remained at a similar level as reported in our last progress report (Figure 1.19), with a similar outlook to 2020:

- The carbon price during 2010 was, on average, around €14/tCO_2.
- From January to March 2011 the carbon price rose from just over €14/tCO_2 to close to €16/tCO_2. Following events in Japan at the Fukushima nuclear plant the price rose to over €17/tCO_2 and is currently around €16/tCO_2. This effect is probably permanent as it reflects nuclear shutdown in Germany as opposed to transient market sentiment.
- Most market analysts continue to project a carbon price for 2020 consistent with those we reported in October 2009 and June 2010 (on average around €30 /tCO_2)[8].

In previous reports we noted that a low and uncertain carbon price undermines investor confidence and weakens the signal for low-carbon investment. Recognising this and the difficulties in strengthening the carbon price signal at the EU level, the UK Government has now committed to a carbon price underpin (see below).

8 For example, a Reuters survey of analysts published earlier this year found an average forecast of €30/tCO_2 (in real terms) for 2020.

Figure 1.19: Carbon price (January 2008-May 2011)

Source: European Carbon Exchange (www.ecx.eu).

Strengthening the carbon price signal at the EU level

The preferred means for strengthening the carbon price signal would be through a tight, predictable, long-term EU ETS cap.

- The current EU target is for a 20% emissions reduction by 2020, with the possibility of moving to a 30% target also included in the Copenhagen Accord pledges. Moving from a 20% to a 30% emissions reduction target for 2020, and doing this largely via a tightening of the EU ETS cap and with limited increase in allowed use of offset credits, could drive up the carbon price significantly (e.g. the European Commission has estimated a carbon price in the EU ETS of €30/tCO_2 in 2020 for a 30% target).
- Moving beyond the 20% target would also be consistent with the least-cost path towards the EU's target to reduce 2050 emissions by at least 80% relative to 1990 levels (see section 5 below).

Whilst some progress was made on international policy in Cancun last December, there is still deep uncertainty over the nature and timing of any legally-binding global deal. As a result it is not yet clear when an EU move to 30% will be triggered (Box 1.2).

Box 1.2: Progress on international policy – Cancun

In December 2010 Cancun hosted the latest United Nations Climate Change Conference. The parties reached agreement on a number of mechanisms which will help ensure that pledges to reduce emissions are effectively monitored and acted upon. Specifically:

- The high-level commitments outlined in the 2009 Copenhagen Accord gained official UN standing for the first time (including the 2°C limit, pledges for 2020 emissions targets, and fast-start finance increasing from an initial $30bn).
- Developed countries will publish strategies for delivering their 2020 targets, and report on progress every two years. Developing countries will also step up reporting on progress and have submitted plans for meeting their 2020 pledges, detailing the assistance they require.
- Structures were created to ensure effective long-term flows of finance and technology, including the Green Climate Fund, Technology Executive Committee and the Climate Technology Centre and Network.

Despite this there is still a need for greater progress on global mitigation:

- Current pledges imply a range for global emissions in 2020, in part because many are conditional (e.g. the EU 20%/30% pledge). If the most ambitious pledges are delivered then the 2°C limit may be achieved, but this requires deep and rapid cuts after 2020. Stronger pledges would give greater confidence of staying below 2°C.[9]
- No agreement has been reached on extending the Kyoto Protocol. Hence no countries are bound by international law to any emissions targets beyond 2012, and it is uncertain that such a deal can be reached before the current commitment phase expires.
- In 2010 global CO_2 emissions from energy use reached 30.6 Gigatonnes (Gt), following a previous high of 29.3 Gt in 2008 and a small fall in 2009. This represents an almost complete return to the growth trend before the economic downturn and leaves little room for further increases before 2020.

The next major conference is scheduled for December 2011 in Durban, South Africa.

Even with a 30% target, an EU-wide carbon price underpin should be considered:

- Although the expected carbon price would be higher in a 30% world, it would still be uncertain, given movements in underlying macroeconomic variables, fossil fuel prices and technology costs.
- There is also considerable uncertainty over the EU ETS cap, and hence the carbon price, for the 2020s.
- A carbon price underpin could reduce this uncertainty and therefore could improve the investment climate.
- A carbon price underpin could be implemented, for example, through setting a reserve price in the auction of EU ETS allowances.

Strengthening the carbon price signal at the UK level

Given current uncertainties around commitment to strengthening the carbon price at the EU level, strengthening the carbon price through a UK-level instrument is appropriate. While this will not lead to greater emissions reductions at the EU level to 2020, it will strengthen incentives for UK investment in low-carbon technologies. These are required to prepare for future carbon budgets and to avoid locking in to high-carbon alternatives, which will be expensive in future as the carbon price does rise.

This has been recognised by the Government, which set out details of a UK carbon price floor in the March 2011 Budget:

- The carbon price floor will be introduced from 1 April 2013, starting at around £16/tCO_2 and following a linear path to £30/tCO_2 in 2020 (in real terms). The detailed policy announcement published after the budget confirmed that the carbon price floor will rise to £70/tCO_2 in 2030.
- Final support rates will be determined two years in advance and will reflect the difference between the expected future EU ETS carbon price and the price floor.

The current proposal would therefore leave a degree of uncertainty around carbon prices, given that support rates will be set for one year at a time, and will be based on expected EU ETS carbon prices.

There is also an issue around electricity price impacts for a small number of electricity intensive industries (e.g. iron and steel). We argued in our Renewable Energy Review that options for addressing this impact should be considered in order to avoid leakage of production to other countries.

However, assuming that means can be found to provide more certainty, and to address competitiveness impacts, the carbon price floor could result in a number of benefits:

- It would provide a signal not to invest in unabated coal-fired generation.
- It would provide a positive signal to invest in low-carbon power generation.
- It would provide a basis for deciding whether to invest in coal and gas CCS in the new electricity market.
- It would limit divergence between wholesale electricity prices and contract prices under new market arrangements, which may be beneficial from a public finance perspective.
- It would strengthen incentives for investment in energy efficiency improvement.
- It would be a first step towards a broader system of green taxes, in line with the Government's objectives, and appropriate in the context of increasingly challenging carbon budgets.

Therefore the commitment to a rising carbon price, and policies consistent with this, could help to reduce emissions as required to achieve carbon budgets over the next decade and in the 2020s.

9 United Nations Environment Programme (2010) *The emissions gap report*

4. Emission projections

The focus in this chapter so far has been progress reducing emissions in 2010. In this section, we consider emissions in the period to 2020. We recap existing emissions projections to 2020, then set out new analysis based on work that we have commissioned from Cambridge Econometrics, and draw out implications for the approach to meeting carbon budgets. We do this in three sections as follows:

(i) Existing CCC and Government emissions projections

(ii) New analysis of emissions projections

(iii)Implications for the approach to meeting carbon budgets

(i) Existing CCC and Government emissions projections

Our methodological approach to projecting emissions is to start with a reference emissions projection (i.e. reflecting limited abatement under current policies) from the DECC Energy Model, and to net from this our assessment of abatement potential that should be addressed, either because this is cost-effective, or because it is associated with developing options for emissions cuts required further out in time.

We have highlighted in sections 2 and 3 above that continued progress implementing abatement measures at 2010 rates would be insufficient to meet carbon budgets.

However, where progress is accelerated and measures are implemented in line with our Extended Ambition scenario, projections published in our fourth carbon budget advice suggest that, together with impacts of the recession, this would result in outperformance of the currently legislated budgets and achievement of the Intended budget for the non-traded sector (Figure 1.20).

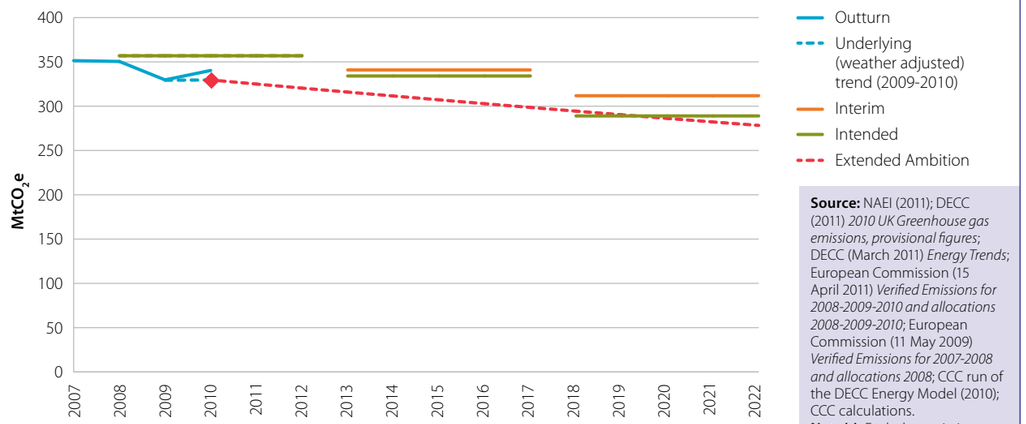
Government analysis leads to a broadly similar conclusion (Figure 1.21).

Scope for outperforming currently legislated budgets may be greater to the extent that the DECC model is not able to fully capture emissions impacts of the recession:

- A review of the model by Oxford Economics in 2008 highlighted a low response of energy demand to income in the transport sector, and a negative response in the residential sector (i.e. when incomes fall the model predicts that energy demand will rise).
- In industry, the model predicts no long-term impact of the recession on energy intensity, whereas in reality energy intensity may decline (e.g. permanent output reductions may be in the most inefficient installations).

- Alternative projections from Cambridge Econometrics which we commissioned in 2009 suggested a larger impact of the recession on emissions over the first budget period (-7%) than projected by the DECC Energy Model (-3%).
- The model projects a lower long-term impact of the recession on energy demand than was actually observed in 2009.

Figure 1.20: Non-traded sector emissions under Extended Ambition measures (2007-2022)



Source: NAEI (2011); DECC (2011) *2010 UK Greenhouse gas emissions, provisional figures*; DECC (March 2011) *Energy Trends*; European Commission (15 April 2011) *Verified Emissions for 2008-2009-2010 and allocations 2008-2009-2010*; European Commission (11 May 2009) *Verified Emissions for 2007-2008 and allocations 2008*; CCC run of the DECC Energy Model (2010); CCC calculations.
Note(s): Excludes emissions from domestic aviation as they will be included in the EU ETS from 2012. The projected trajectory has been smoothed.

Figure 1.21: Government projections for non-traded sector emissions (2007-2022)

Source: DECC (June 2010) *Updated emissions projections*, CCC calculations.
Note(s): Excludes emissions from domestic aviation as they will be included in the EU ETS from 2012. The projected trajectory has been smoothed. Data for historical emissions has been revised since projections were produced.

We therefore commissioned Cambridge Econometrics to assess the DECC model and to provide alternative emissions projections. Specifically, we asked Cambridge Econometrics to:

- Consider whether projections from the DECC Energy Model may be systematically too high or too low as the economy exits recession.
- Assess wider evidence from energy and emissions modelling and draw implications for modelling approaches for the UK.
- Develop alternative emissions projections to 2020 with a particular focus on the impact of the recession, and growth in industry emissions as the economy recovers.

(ii) New analysis of emissions projections

The analysis from Cambridge Econometrics suggests that while its overall approach to emissions projections is sensible, the DECC model is not able to fully capture the impacts of the recession and other macroeconomic impacts on emissions. For example, the analysis has highlighted that emissions fell more during the recession than projected by the DECC model, that the model assumes no effect of the recession on the relative growth rates of industry sectors and that the recession does not impact on carbon intensity of industry in the model. The issues they identify suggest that emissions may turn out lower than projected by the DECC model.

In order to address this, Cambridge Econometrics have made specific recommendations for development of the DECC model (Box 1.3). It is important that these are considered in the context of DECC's current review of its Energy Model.

Box 1.3: Recommendations for development of the DECC Energy Model

Key opportunities for developing the DECC model include:

- Making greater use of the most recent outturn data in forming projections, including responding to recent forecast errors.
- More regular updating of key input projections – specifically for industry GVA at the sectoral level.
- Increased transparency over the functioning of the model, the input assumptions and the drivers behind changes in the published projections.
- In the longer term there may be scope to re-estimate the key relationships in the model and build in more bottom-up components (e.g. to better explain improvements in energy efficiency).

The full report by Cambridge Econometrics will be published on our website alongside this report.

We commissioned new projections to 2020 from Cambridge Econometrics' own model based on updated inputs including lower GDP as a result of the recession. These projections suggest that the impact of the updated inputs on 2020 emissions may be up to 40 $MtCO_2$ greater than projected by the DECC model (i.e. emissions in 2020 could be up to 40 $MtCO_2$ lower than the DECC model projects).

These findings reinforce the conclusion in our fourth budget report, that implementation of measures together with the impacts of the recession would lead to outperformance of the currently legislated third carbon budget, and achievement of the Intended budget.

(iii) Implications for the approach to meeting carbon budgets

Aiming to outperform currently legislated budgets

It is important that current policy measures and ambition are delivered in practice, both to meet the first three carbon budgets and to prepare for deep emissions cuts required through the 2020s.

Failure to reduce emissions sufficiently over the next decade would then require an excessively challenging acceleration in emissions reductions in the 2020s to meet the fourth and subsequent carbon budgets (Figure 1.22).

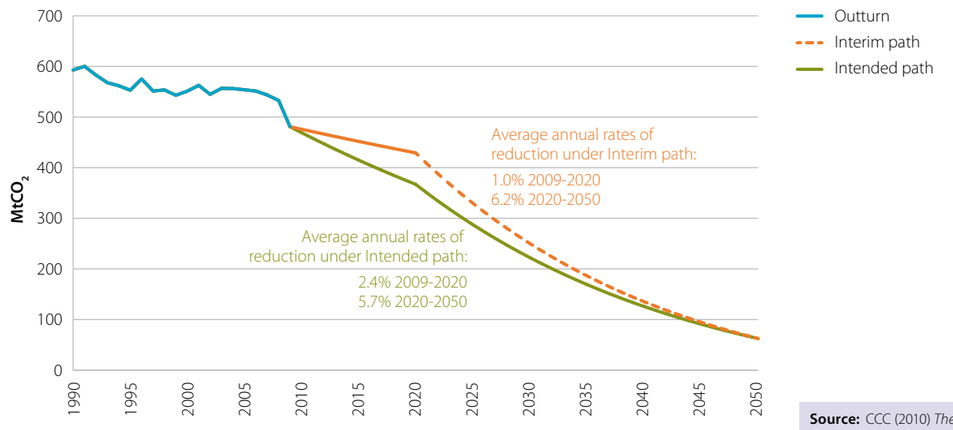
The new analysis from Cambridge Econometrics summarised above are consistent with our previous analysis suggesting that implementation of measures in line with our indicator framework, together with the impact of the recession, would outperform the currently legislated budget, and would achieve the Intended budget for the non-traded sector.

Ideally, and as recommended in our fourth budget advice, the legislated non-traded sector budget would now be tightened to the Intended level to prepare for meeting the fourth budget; this would result in an economy-wide cut of 37% in 2020 on 1990 levels (Figure 1.23).

The Government has argued that it would be premature to tighten the budget now given envisaged EU negotiations around increasing ambition; this could result in the UK being pushed to go further still as part of a new EU agreement.

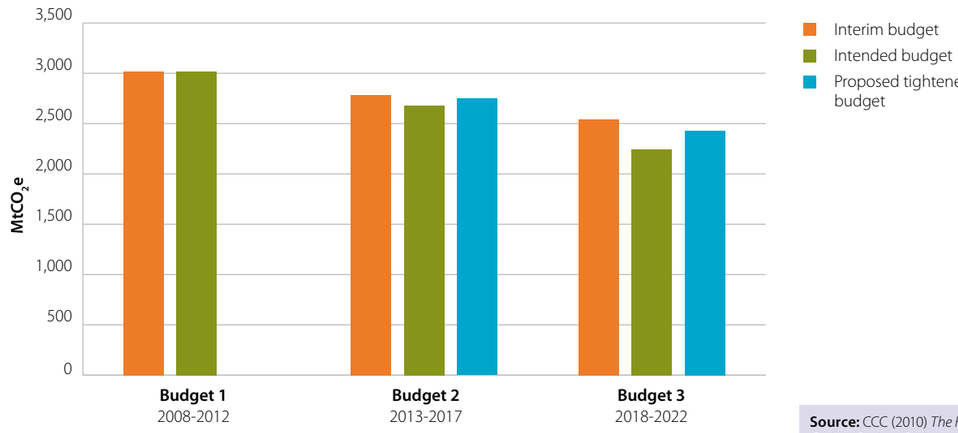
In the absence of tightening, and in order that the legislated fourth budget remains feasible, abatement measures should be implemented in line with our indicator framework.

Figure 1.22: Required CO_2 emissions reductions to 2050 under Interim and Intended budgets (1990-2050)



Source: CCC (2010) *The Fourth Carbon Budget: Reducing emissions through the 2020s.*

Figure 1.23: First three UK carbon budgets (2008-2022)



Source: CCC (2010) *The Fourth Carbon Budget: Reducing emissions through the 2020s.*

The level of ambition in our indicator framework is broadly consistent with the ambition in the Government's draft Carbon Plan, published in March. The implication is that policy ambition should be maintained in the final version of the Carbon Plan, to be published later this year.

Going forward, our approach will be to monitor progress relative to legislated budgets and relative to our indicator framework, where delivering the latter would lead to outperformance of the legislated budgets on current projections.

Implications for use of offset credits

In March 2011, we advised the Government that there should be no planned use of offset credits to meet the second carbon budget. This reflected the analysis and arguments above, that there is a need and an opportunity to outperform the currently legislated second and third carbon budgets to be on track to meeting the fourth carbon budget.

The Government agreed that the aim should be to meet the second budget through domestic emissions reductions. However, it also noted the need for flexibility and therefore did not rule out the possibility of credit purchase, allowing up to 55 $MtCO_2$ (i.e. 3% of the non-traded sector budget).

While in principle we can see the benefits in retaining flexibility, in practice it would be problematic to have to revert to purchase of credits to meet the second budget. This would signify failure to achieve the required step change in the pace of emissions reductions, and would have knock-on effects for meeting subsequent budgets.

Therefore this reinforces the need to focus on maintaining and delivering current policy ambition, and monitoring implementation of abatement measures in line with our indicator framework. To the extent that it appears that credits may be required to meet the second budget, we will aim to identify this early and to suggest how it can be avoided through actions to reduce domestic emissions.

5. The fourth carbon budget

Our advice and the Government's response

Our recommended fourth carbon budget of 1,950 $MtCO_2e$ (an emissions cut of 50% on 1990 levels by 2025) was designed to be feasible and cost-effective in the context of the 2050 target. Any less ambitious budget would imply an infeasible/expensive degree of back-ending to 2050.

In May 2011 the Government accepted our recommendation in a statement to Parliament. Specifically, the Government has proposed that Parliament should legislate a budget of 1,950 $MtCO_2e$, and that the aim should be to deliver this through domestic action (although the use of credits to meet the budget has not been ruled out).

The Government highlighted the need for the carbon budget to be aligned with EU targets. Specifically, given the accounting framework under the Climate Change Act, the traded sector of the budget will be defined by the UK's share of the EU ETS cap for the 2020s. Therefore in order to ensure consistency with the evolving framework, the Government has stated that there will be a review of the fourth carbon budget, to be carried out by the Committee in 2014.

Significant uncertainties currently exist about the EU framework for the 2020s. However, the European Commission has recently published an EU low-carbon roadmap to 2050 which proposes a similar pathway to that underpinning the fourth carbon budget. Although there is a slower pace of EU-average power sector decarbonisation in the roadmap, this does not suggest that lower ambition is currently appropriate in the UK, given differences in capital stock and investment opportunities (Box 1.4).

Box 1.4: Comparison of carbon budget with European Commission low-carbon roadmap

In March 2011 the European Commission outlined a roadmap to 2050 for delivering a competitive low-carbon European economy[10]. Several themes are consistent between the roadmap and the CCC's fourth carbon budget analysis:

- Both are designed to deliver an 80% reduction in domestic emissions by 2050, relative to 1990 levels, at least cost.
- The key measures which deliver these emissions reductions include a zero-carbon power sector by 2050, improvements in energy efficiency, and increased electrification of transport and buildings.
- Fewer cost-effective reductions are found in other sectors such as agriculture, based on current technologies and measures.

The roadmap shows that the long-term path is consistent with a 25% emissions reduction in 2020 relative to 1990, compared to the current EU 20% target, with which the Interim carbon budget is aligned.

However, even if ambition for 2020 increased, the EU path from 2020-2050 appears more back-ended than the UK pathway underpinning the fourth carbon budget, leaving very ambitious EU reductions for the 2030s and 2040s.

On a comparable accounting basis (i.e. excluding aviation emissions from both ambitions) the EU aim is to reduce emissions by 42-46% by 2030, compared to the 60% UK cut implied by the fourth carbon budget. The differences between EU and UK pathways can mainly be explained in terms of different assumptions on power and transport sector decarbonisation:

- Power sector decarbonisation proceeds more slowly in the EU pathways. This may be appropriate to some extent given differences between UK and EU-average capital stock (most UK coal stations will have been retired by 2030) and investment opportunities (the UK is planning for a major roll-out of nuclear in the 2020s, which appears likely to be the lowest cost low-carbon option on current estimates).
- In the transport sector, assumptions on conventional vehicle efficiency improvement appear pessimistic. In contrast, assumptions on use of biofuels in surface transport and aviation appear optimistic, given sustainability constraints.

Therefore further analysis is required to provide confidence that the back-ending in the EU pathways to meet the 2050 target would be feasible and cost-effective. In addition, a strongly back-ended path leads to greater EU cumulative carbon emissions by 2050 and hence greater climate change.

For now, the fourth carbon budget is appropriate for planning domestic emissions reductions in the UK. It is consistent with the EU pathways in the sense that they represent average progress across 27 countries, and the UK is well placed to be ahead of that average. Whether the exact level of the budget should change, and whether the UK should become a net seller or buyer in the EU ETS, will become clear when the EU ETS cap for the 2020s is set.

10 European Commission *(2011) A roadmap for moving to a competitive low carbon economy in 2050.*

Next steps implementing the fourth carbon budget

Our analysis suggests that achieving the fourth budget is feasible and cost-effective through deep cuts in emissions from power, buildings and transport, and some emissions cuts in industry and agriculture. The analysis also confirms that action is required during the first three budget periods. This reinforces the need to achieve the indicators and milestones set out in our indicator framework, and particularly those which are designed to prepare for deep emissions cuts in the 2020s (e.g. investment in low-carbon power generation, renewable heat, electric vehicles).

Under the Climate Change Act, the Government is required to publish a strategy to deliver the fourth carbon budget, and is aiming to do this in the autumn of 2011. We expect that this will include a full set of abatement measures to achieve the budget, supporting policies, and a set of criteria against which success delivering the strategy can be assessed. We will assess the Government's strategy against our indicator framework in our next progress report to Parliament in June 2012

Key findings

- Economy-wide emissions **increased by 3%** in 2010.
- The winter months of 2010 were **2˚C colder** than the previous year. This, alongside a slight rise in GDP, falling energy prices and rising transport fuel prices, had an impact on emissions.
- Without the cold weather, emissions would have been **broadly flat**.
- The **recession reduced emissions** by 9% in 2009. Outperformance of the 1st budget should not reduce our domestic ambition – we should **aim to outperform** the 2nd and 3rd carbon budgets.
- Progress has been mixed in terms of the implementation of measures – the rate of implementation of abatement measures needs to **accelerate** in future.
- In order to **prepare for the 4th carbon budget**, there needs to be effective implementation of Electricity Market Reform, and development of policies to decarbonise heat and transport sectors.

Introduction and key messages

1. Progress reducing power sector emissions
2. Recap of our power sector indicator framework
3. Investment in renewable generation
4. Demonstration of CCS
5. Deployment of new nuclear
6. Electricity market reform

Chapter 2: Progress decarbonising the power sector

Introduction and key messages

In our last progress report, we showed that power sector emissions fell by 13% in 2009[1]. This reflected improved carbon efficiency and reduced demand due to the recession. We highlighted the need for a step change in the pace of investment in wind generation, and a set of actions to support demonstration of carbon capture and storage (CCS) and investment in nuclear new build.

In this report we consider latest emissions data (i.e. final for 2009 and preliminary for 2010). We also assess the extent to which investment in wind generation is on track, relative both to our indicators, and to increased investment required beyond 2015. We consider progress moving forward with CCS demonstration projects and the enabling framework for investment in nuclear new build. Finally we summarise our recommendations on electricity market reform to support investment in low-carbon generation.

Our key messages are:

- Emissions increased by 4% in 2010 due largely to transitory factors. Demand increased (reflecting unusually cold weather) and the carbon-intensity of generation increased (reflecting supply outages for nuclear capacity).
- There was some underlying progress reducing emissions, with investment in new gas-fired and wind capacity. However, an acceleration in the pace of investment to 2020 will be required to support sector decarbonisation over the next two decades.
- There was also some progress against our forward indicators, but significant challenges remain and should be addressed in the near term:
  - **Renewables.** Investment in wind generation is on track compared to our indicators, with a pipeline in place to support required investment over the next five years. However, a significant increase in the pace of investment is required from 2015. To support this, shorter planning periods and higher approval rates will be needed, along with a supportive regulatory regime and favourable financing conditions. Additionally the transmission network requires regulatory and planning approval and implementation of investments to support increased levels of wind generation.
  - **CCS.** Negotiations over the first CCS demonstration project are close to conclusion. However, the second set of projects has slipped, and further slippage would limit the potential for CCS to contribute to sector decarbonisation through the 2020s. It is therefore important that funding arrangements are confirmed for the second set of demonstrations, that bids for funding are invited, and that this is supported by development of a CCS infrastructure strategy.

1 CCC (2010) *Meeting Carbon Budgets – ensuring a low-carbon recovery, 2nd Progress Report to Parliament*

  - **Nuclear**. Progress has been made on regulatory justification and funding of waste and decommissioning. It is now important to gain approval for the National Policy Statement and of reactor designs, together with planning approval, in order that civil works for the first investment are able to go ahead in 2012. This enabling framework should incorporate any lessons learned from the Fukushima experience in Japan.

- The Electricity Market Reform should be based on long-term contracts rather than premium feed-in tariffs, in order to provide confidence about delivery of investments at least cost to the consumer. The new arrangements should include support for less mature technologies, so as to develop a portfolio of technology options for investment in the 2020s and beyond. In order to support near term investment in renewables, there should be a smooth transition from current arrangements, for example through extending the ROC regime.

We set out the analysis underpinning these messages in six sections:

1. Progress reducing power sector emissions
2. Recap of our power sector indicator framework
3. Investment in renewable generation
4. Demonstration of CCS
5. Deployment of new nuclear
6. Electricity market reform

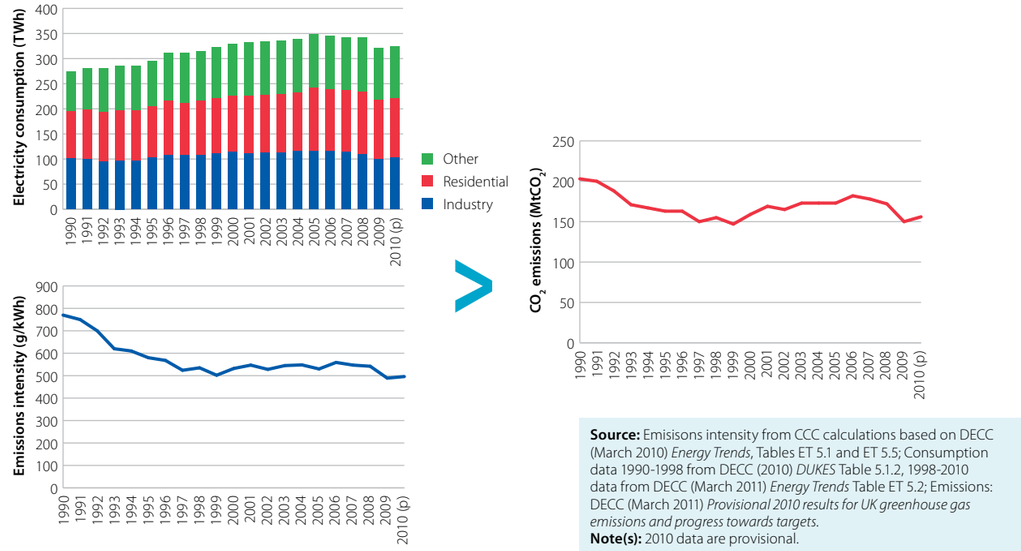
1. Progress reducing power sector emissions

Emissions in 2010

Power sector emissions account for around 27% of total UK greenhouse gas emissions (GHGs). Provisional data indicates that power sector emissions increased by 4% in 2010 to 156 $MtCO_2$, up from 150 $MtCO_2$ in 2009. This was driven by temporary increases in demand and in the carbon-intensity of generation in power stations (Figure 2.1).

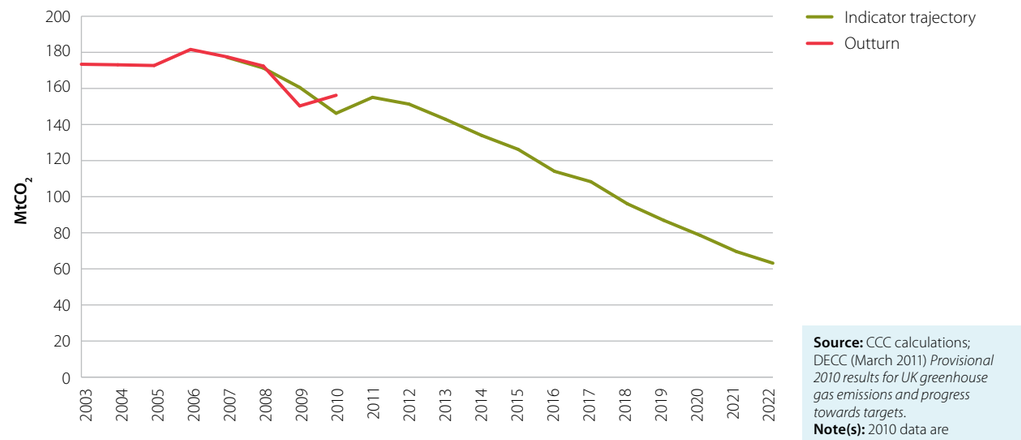
- Demand increased by 1% in 2010, having fallen by 6% in 2009. The increase in demand appears primarily to be the result of the recovery from the recession driving up industrial and commercial sector use, and the very cold winter months increasing demand for electric heating in the residential sector (more than offsetting reductions in demand in agriculture, transport and the public sector). Had the winter months of 2010 not been particularly cold, electricity demand may have fallen by up to 2% (See Box 1.1 in Chapter 1).
- Carbon-intensity of electricity supplied increased from 489 g/kWh in 2009 to 496 g/kWh in 2010. This reflects a temporary 10% reduction in nuclear generation due to outages and a compensating increase in coal generation of around 4% and in gas generation of around 7%. If nuclear output had not fallen, then emissions intensity would have stayed roughly constant or decreased.

Figure 2.1: Emissions intensity of electricity supply, electricity demand and carbon dioxide emissions from the power sector (1990-2010)



Source: Emisisons intensity from CCC calculations based on DECC (March 2010) *Energy Trends*, Tables ET 5.1 and ET 5.5; Consumption data 1990-1998 from DECC (2010) *DUKES* Table 5.1.2, 1998-2010 data from DECC (March 2011) *Energy Trends* Table ET 5.2; Emissions: DECC (March 2011) *Provisional 2010 results for UK greenhouse gas emissions and progress towards targets.*
Note(s): 2010 data are provisional.

Figure 2.2: Indicator trajectory versus outturn emissions (2003 to 2022)



Source: CCC calculations; DECC (March 2011) *Provisional 2010 results for UK greenhouse gas emissions and progress towards targets.*
Note(s): 2010 data are provisional.

The increase in emissions in 2010 took emissions above the trajectory set out in our indicator framework (Figure 2.2). However, this was due to short-term fluctuations in demand and supply. More important in the context of sector decarbonisation are longer-term changes due to investment in low-carbon capacity. This investment is reflected as changes in the level of *achievable emissions intensity*.

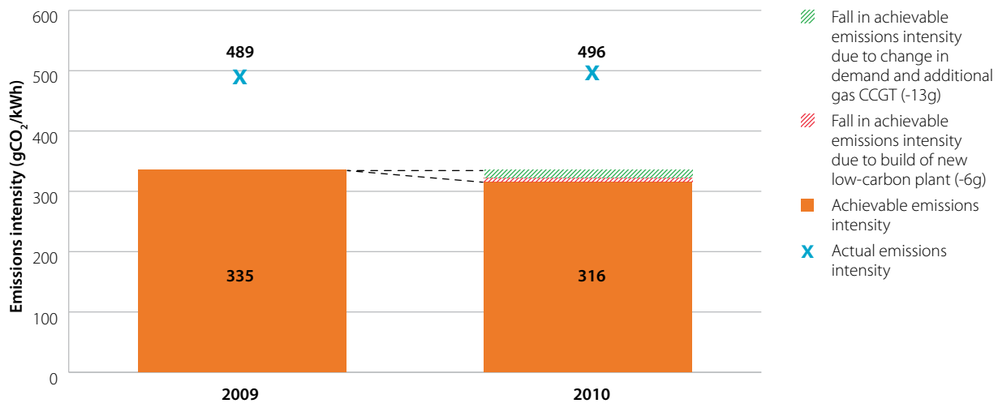
Achievable emissions intensity

Achievable emissions intensity is the carbon intensity of electricity supply that would be achievable if power plants were despatched to the grid in order of least emission rather than least cost, and if they were available to generate as often as in an average year. In practice this means meeting demand by running nuclear and renewables first, followed by gas and finally coal plant. Reductions in achievable emissions intensity therefore reflect investment in low-carbon generating capacity, and are not affected by changes in the short-term prices of carbon, coal and gas (which can determine whether coal generates before gas) or by load factors for nuclear and renewables varying between years.

Achievable emissions intensity in 2010 fell to 316 gCO_2/kWh, from 335 gCO_2/kWh in 2009. This reduction was due to investment in gas-fired and renewable power generation. The effect of new gas capacity on the system (which reduces the need to run coal-fired capacity) was greater than the effect of increased demand (which increases the need to use marginal – coal-fired – capacity), with these factors together reducing achievable emissions intensity by 13 g/kWh. The remaining 6 g/kWh fall in achievable emissions intensity was the result of new renewable capacity on the system in 2010 (Figure 2.3).

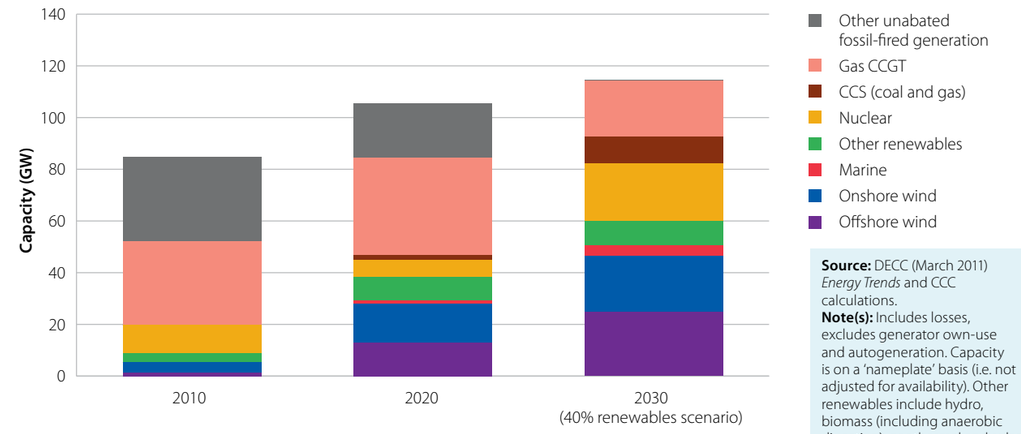
We show in section 3 that investment was broadly on track with our power sector indicators. However, a significant acceleration in the pace of low-carbon investment will be required in order to achieve sector decarbonisation over the next decades (Figure 2.4).

Figure 2.3: Achievable emissions intensity (2009-2010)



Source: CCC calculations based on various sources including DEFRA (2009) *GHG Conversion Factors*; DECC (March 2011) *Energy Trends*; DECC (June 2010) DUKES.
Note(s): Achievable emissions intensity is the minimum average annual emissions intensity that could be achieved in a year, given the installed capacity, demand and the profile of that demand. Emissions intensity is estimated on an end use basis (includes transmission and distribution losses).

Figure 2.4: Capacity by generation type (2010, 2020 and 2030)



Source: DECC (March 2011) *Energy Trends* and CCC calculations.
Note(s): Includes losses, excludes generator own-use and autogeneration. Capacity is on a 'nameplate' basis (i.e. not adjusted for availability). Other renewables include hydro, biomass (including anaerobic digestion), geothermal and solar PV. 2010 values based upon DECC energy model projection, plus outturn renewable energy data from DECC (March 2011) *Energy Trends* ET 7.1.

Emissions prior to 2010

Emissions fell significantly between 1990 and 1999 due to the 'dash for gas'. More recently, emissions rose from 2000 to 2008 as electricity demand increased and the rate of building new gas-fired capacity slowed. Emissions then decreased by 13% in 2009 due to demand falling during the recession and a short-term fall in carbon-intensity (as nuclear plants returned to operation).

These longer-term trends highlight the significant challenges in decarbonising the power sector:

- Whereas investment in the last two decades has been mainly in gas-fired power generation, the large majority of investment going forward should be in low-carbon capacity.
- On the demand-side, the challenge is to offset demand growth through energy efficiency improvement (e.g. through the use of more efficient appliances and lighting, see Chapter 3).

In the remainder of this chapter we focus on the first of these challenges, considering required low-carbon investment, progress against what is required, and electricity market arrangements to support investment over the next two decades.

2. Recap of our power sector indicator framework

Our indicators reflect a trajectory which puts the UK on a path to substantially decarbonising the power sector by 2030. It is designed both to reduce emissions over the next decade, and to develop a range of low-carbon options for sector decarbonisation in the 2020s and beyond. It is an indicative trajectory that is suitable for planning and monitoring purposes and should be kept under review.

The indicators are broadly consistent with the Government's plans for renewable energy deployment to 2020 as set out in its Renewable Energy Strategy[2]. We caveat this with the recommendation in our Renewable Energy Review[3], that a flexible approach is appropriate with scope for moderating offshore wind ambition if there are alternative and lower-cost options for meeting the 2020 renewable energy target. Such a moderation should only occur alongside setting a suitably stretching longer-term commitment for offshore wind to avoid stop-start investment cycles (e.g. we proposed around 25 GW installed capacity by 2030).

The indicators include investment in 23 GW of new onshore and offshore wind capacity between 2008 and 2020 (to reach a total capacity of around 27 GW by 2020), up to three new nuclear plants by 2022, and four CCS demonstration plants before 2020.

We also have indicators for key stages of the project cycle for these investments and policy milestones:

- **Renewables.** We monitor new wind projects entering the planning system and construction, new wind capacity coming onto the system, and progress in deploying the required transmission infrastructure. We also consider, at a high level, progress at deploying other renewables (biomass and marine) in the context of the 2020 renewables target.
- **CCS.** We monitor progress in the first competition under which one demonstration project will be funded, and a second in which a further three projects will be funded.
- **Nuclear.** Indicators for nuclear relate to the planning and regulatory framework, and to commencement and completion of construction for the first new plant.
- **Electricity market.** There is a need for early reform of current electricity market arrangements in order to strengthen incentives for low-carbon investment.

We now consider progress against indicators for these three classes of low-carbon technology, before summarising our assessment of the Government's consultation on Electricity Market Reform. The Committee's indicator framework and outturn data for 2010 are summarised in Table 2.1 at the end of the chapter.

3. Investment in renewable generation

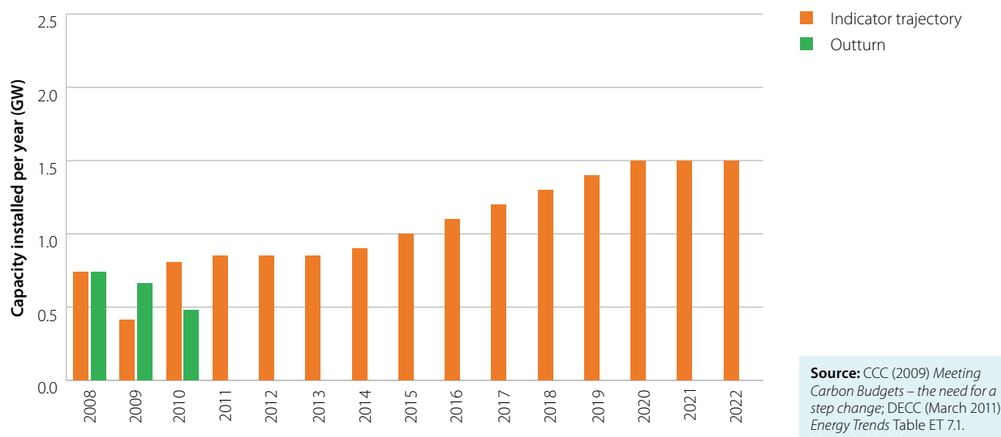
Adding new wind capacity

Our indicators focus on capacity added to the system, and forward indicators of capacity to be added to the system (i.e. capacity entering construction, capacity moving through the planning system, supply chain investment, and investment in transmission infrastructure to support increased wind generation).

2 HM Government (2009) *The UK Renewable Energy Strategy*
3 CCC (2011) *The Renewable Energy Review*

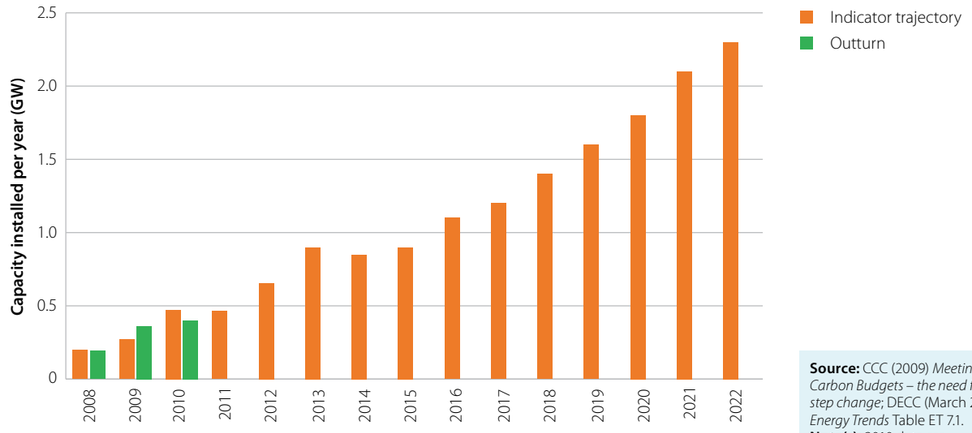
- **Capacity added to the system:** Fewer projects were added to the system in 2010 than envisaged in our indicator framework. However, cumulative additions in 2009 and 2010 were on track, given the relatively large amount of capacity added in 2009. Going forward, a significant acceleration in the pace of investment is required if renewables targets are to be achieved (Figures 2.5 and 2.6).
  - In 2010, 0.5 GW onshore wind and 0.4 GW offshore wind was added to the system. This fell short of our indicators for additional capacity of 0.8 GW onshore wind and 0.5 GW offshore wind for 2010.
  - However, due to outperformance in 2009, the total capacity in operation was on track in 2010 according to our cumulative indicators. Total installed capacity onshore was 4.0 GW in 2010 and total offshore capacity was 1.3 GW.
  - Generation in 2010 was lower than envisaged in our indicators (Figure 2.7). This was due to low wind speeds across the year reducing achieved load factors (Box 2.1).
  - In the coming decade, considerable increases in build rates are required for both onshore and offshore wind in order to achieve 27 GW of installed wind capacity in 2020 as set out in our indicator trajectory. Specifically, this build-out will require annual capacity additions of around 1.5 GW onshore and 1.7 GW offshore towards the end of the decade.

Figure 2.5: Additional operational onshore wind capacity per year (2008-2022)



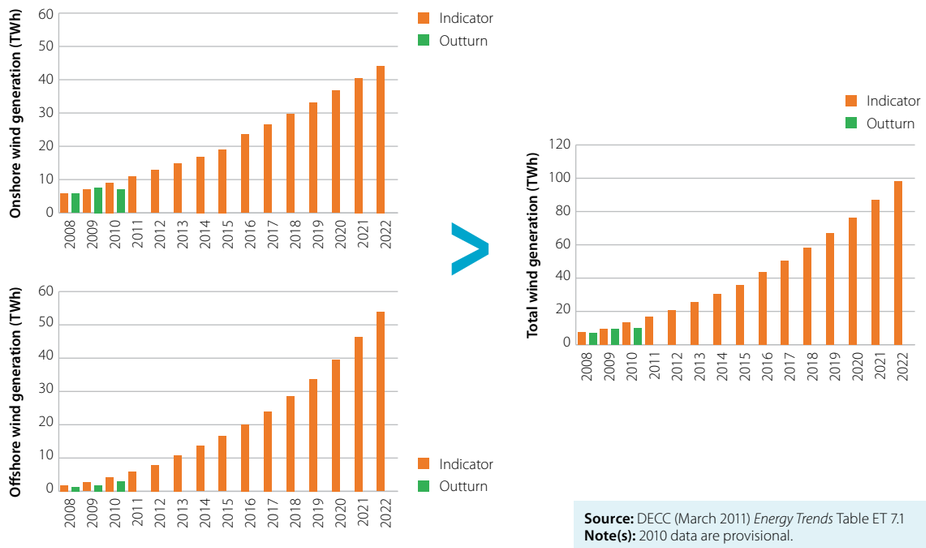
Source: CCC (2009) *Meeting Carbon Budgets – the need for a step change*; DECC (March 2011) *Energy Trends* Table ET 7.1.
Note(s): 2010 data are provisional.

Figure 2.6: Additional operational offshore wind capacity per year (2008-2022)



Source: CCC (2009) *Meeting Carbon Budgets – the need for a step change*; DECC (March 2011) *Energy Trends* Table ET 7.1.
Note(s): 2010 data are provisional.

Figure 2.7 : Onshore, offshore and total wind generation (2008-2022): Outturn against indicator trajectory



Source: DECC (March 2011) *Energy Trends* Table ET 7.1
Note(s): 2010 data are provisional.

Box 2.1: Low wind speeds and low wind power output in 2010

In 10 of the 12 months of 2010, wind speeds were lower than the 10-year average and lower than in 2009.[4]

Evidence on availability and achieved load factors suggests low levels of wind generation in 2010 relative to 2009 are more likely to reflect weather conditions than fundamental technical problems, with many generators reporting lower load factors for 2010, citing unfavourable weather conditions rather than availability. For example:

- The average load factor for Scottish and Southern turbines fell from 28% to 26%, 'due to the still weather conditions for much of the year', whilst availability was maintained at 97%.[5]
- Centrica reported that, whilst availability was high throughout the year, load factors were 29% for 2010, compared with 32% the previous year due to 'unfavourable weather patterns'.[6]
- Wind generation from E.ON turbines declined by 5.5%.[7]

Whilst load factors may well return towards the level assumed in our indicators (29% on average across onshore and offshore wind for 2010) after the recent dip, it will be important to monitor any longer-term changes in average load factors due to climate change:

- There is very little confidence in the ability of climate models to project future wind patterns.
- Based on current projections, research commissioned by the CCC suggests that the possible impacts of wind patterns on future levelised wind costs are similar in size to those from uncertainties in projected changes to capital costs[8]. For example a 3% reduction in load factor adds around 1 p/kWh to generation costs.
- Strategies that increase the flexibility of the current UK power sector to low wind periods such as 2010 will also improve resilience to climate change.

- **Projects in or awaiting construction.** The pipeline of projects in or awaiting construction should be sufficient to support required capacity additions over the next five years:
  - As of May 2011, there was 2.0 GW onshore wind and 3.1 GW offshore wind in construction.
  - In addition, there was 3.3 GW onshore and 0.9 GW offshore awaiting construction, having been granted planning approval.
  - The total stock of projects currently in or awaiting construction is consistent with required capacity additions over the next five years.
  - Data availability makes monitoring in this area difficult. Specifically, data on the timing of projects entering construction is not collected by DECC. This should be addressed in order to be better able to identify any bottlenecks in the project cycle.
- **Capacity moving through planning.** There remains a considerable stock of projects in the planning system. However, this reflects applications from previous years and low decision rates rather than large numbers of new applications in 2010.

4 2010 average wind speed was 1.2 knots lower than in 2009, and 1.3 knots lower than the 10-year average. DECC (2011) *UK Statistics Authority:* 26 May 2011, ET 6.2: http://www.decc.gov.uk/en/content/cms/statistics/uksa/sa20110526/sa20110526.aspx
5 Scottish and Southern Energy Plc (2011) *Financial report for the year to 31 March 2011* http://www.sse.com/uploadedFiles/Pages/14_Investors/SSE_2011_FullYearResultsStatement.pdf
6 Centrica (2011) A*nnual Review and Summary Financial Statements* 2010 http://www.centrica.com/files/reports/2010ar/files/pdf/centrica_annual_review_2010.pdf
7 E.ON (2011) *E.ON AG Financial Statements...for the 2010 Financial Year* http://www.eon.com/en/downloads/E.ON_2010_Jahresabschluss_en_.pdf
8 *Evaluation of the climate risks for meeting the UK's carbon budgets* (forthcoming – July 2011) Report for the CCC by AEA.

– There were 8.4 GW of onshore wind projects in the planning system on 31 December 2010, and 2.5 GW offshore projects.

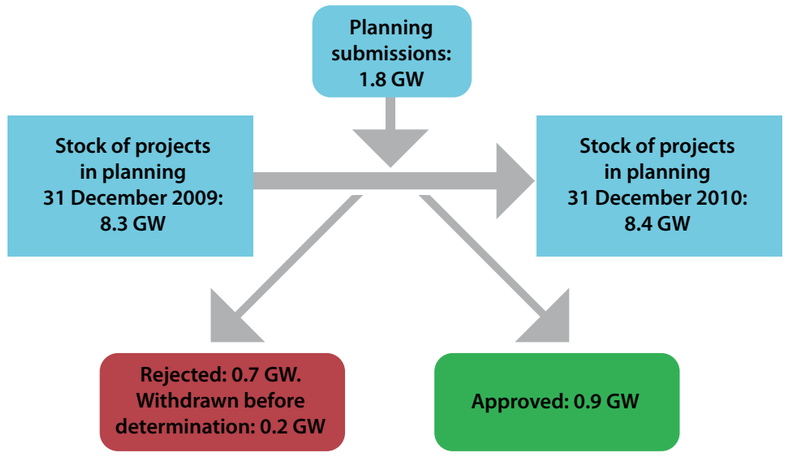
– The stock of onshore wind projects in planning increased marginally during 2010, as the flow in exceeded the flow out: 1.8 GW of onshore planning applications were received while just 0.9 GW of onshore wind projects received planning approval (Figure 2.8).

– No offshore projects were approved, and no new applications were made in 2010 (Figure 2.9). The lack of approvals is of concern since a pipeline of projects is needed in construction from 2015, and delays in planning may affect developer and supply chain confidence which is needed for delivering this. The lack of submissions reflects that projects licensed under Crown Estate Rounds 1 and 2 have largely progressed to construction, whilst projects in deeper waters – Round 3 and Scottish Territorial Waters – have not yet made applications. Planning applications are expected in 2012, and this is an area we will monitor closely in order that an adequate pipeline of projects moves through to construction from 2015.

- **Planning approval periods and approval rates.** Increased approval rates and shorter approval periods are required to support an increased flow of projects from planning.

  – Whilst total capacity determined stayed roughly constant, the approval rate for onshore wind farms fell from 67% to 56%, largely driven by a reduction in rate of approval for large-scale projects.[9] Total onshore wind capacity gaining approval consequently fell, from 1.1 GW to 0.9 GW in 2010.[10]

Figure 2.8: Planning flow chart for 2010 (Onshore wind)

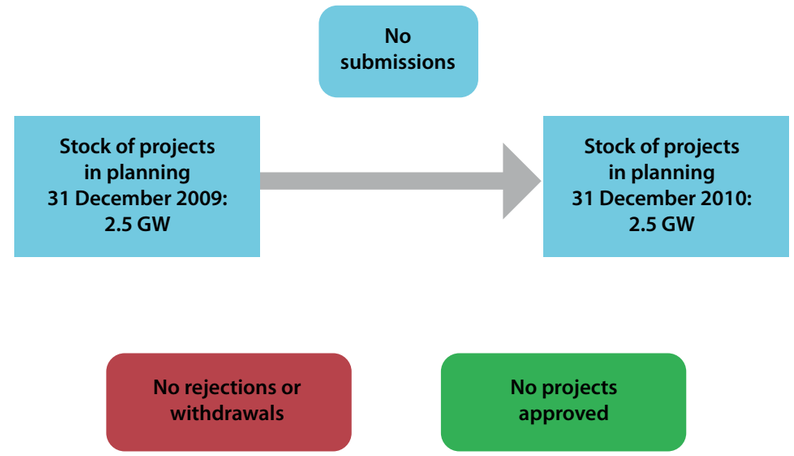


Source: CCC calculations based on DECC *Renewable Energy Planning Database.*
Note(s): Figures do not sum to end of year stock due to rounding.

9 CCC calculations based on DECC Renewable Energy Planning Database. The rate for small-scale (<50 MW scale) stayed roughly constant at around 57% and the large-scale (>50MW) approval rate fell from 100% to 54%, with 0.3 GW large-scale projects gaining approval compared with 0.4 GW last year.

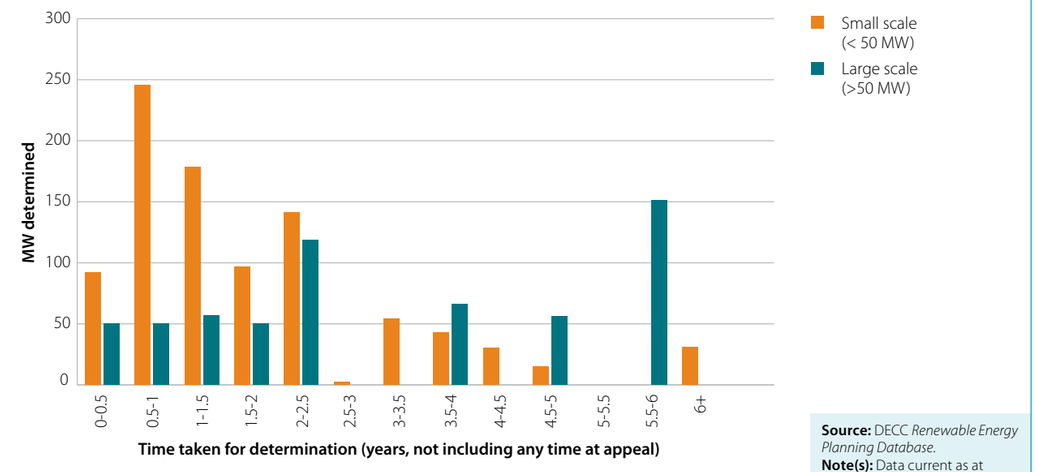
10 CCC calculations based on DECC Renewable Energy Planning Database.

Figure 2.9: Planning flow chart for 2010 (Offshore wind)



Source: CCC calculations based on DECC *Renewable Energy Planning Database.*

Figure 2.10: Decision time for onshore wind capacity determined in 2010



Source: DECC *Renewable Energy Planning Database.*
Note(s): Data current as at May 2011.

– The average planning decision period for onshore wind (not including time taken in subsequent appeals) was 18 months in 2010, a 3 month increase on 2009 and well above our indicator of 12 months. This reflects long decision periods for larger projects (projects above 50 MW had an average decision period of 36 months, with some projects determined in 2010 having been in the system for six years – Figure 2.10). Where shorter decision times were achieved these often went to appeal (e.g. nearly half of those projects determined in less than 18 months subsequently went to appeal).

  - Shorter decision times and higher approval rates are needed in order that there is a sufficient flow of projects out of planning consistent with increased rates of investment required from 2015.

- **Supply chain development.** Following supply chain bottlenecks in recent years, there have been various encouraging announcements relating to the offshore wind supply chain in 2010 and subsequently.

  - In 2010 and 2011 to date there have been announcements of intent to construct turbine factories in the UK by Siemens, Gamesa, General Electric and Vestas. In combination these projects, which remain at an early stage of development, could add around 4 GW/year of offshore wind supply chain capacity to the system, which together could form a large share of the European offshore wind supply chain (see Box 2.2).

  - Progress has also been made on the stock of installation vessels for offshore wind, with 12 new vessels placed on order in 2010. When completed this would increase the total number of vessels to 19, which may be sufficient to support UK offshore wind investment to 2020 and beyond.[11]

  - The 2010 Spending Review allocated £60 million to the development of ports for offshore wind, which has been supplemented by a Scottish announcement to commit a further £70 million for infrastructure development.

- **Transmission investment.** Increased renewable (and other low-carbon) capacity will require significant development of the transmission infrastructure. There are still important but unresolved issues around the approval and regulatory treatment of transmission investments by Ofgem, and the determination of charges for generators' access to the transmission system. Planning approvals are also required for important transmission investments in 2011.

  - **Regulatory approval of investments.** The Electricity Networks Strategy Group (ENSG) identified the need for £4.7 billion of transmission investment by 2020. Against this, Ofgem has approved £400 million in funding for feasibility studies and some funding for construction. Their approach will be to assess funding for Stage 1 of the investments in phases, with the next decisions in September 2011 and further approvals to be made in 2012/13. This is slower than envisaged in our indicator framework (i.e. this envisaged approval for Stage 1 of the investments in 2010), and is therefore an area for close monitoring.

  - **Transmission charging regime.** The charging system for use of the onshore transmission network is still under review with changes due to be implemented by April 2012. Lack of certainty is likely to undermine the investment climate. A timely decision on charging would enable project developers to fully assess project economics (which are sensitive to the charging regime) such that new projects enter construction on a schedule consistent with delivering required ambition to 2020.

11 According to http://www.4coffshore.com/offshorewind/ there are around 7 specialist installation vessels currently in operation in UK waters

  - **Planning approval of investments.** Our indicators set out that Stage 1 ENSG reinforcements should seek and gain planning approval in 2011 and 2013, to be operational in 2015 and 2017. There has been some progress against this indicator with Scottish Power and Scottish Hydroelectric Transmission (SHETL) already having obtained approval for most of their Stage 1 upgrades for 2015 and the remainder of these approvals expected later this year or in 2012. National Grid is expecting to have planning permission for its part of the Western 'bootstrap' this year, though planning for grid reinforcements to accommodate wind in central Wales will be delayed until 2012. National Grid still expects these projects to be completed by 2015, subject to timely Ofgem approval.

  - **Offshore transmission.** Our indicators set out that an enduring regime for governing investment in the offshore transmission network should be in place and the first connections tendered in 2010. Tendering for offshore connections is going ahead, but still under the transitional regime. DECC and Ofgem have agreed the form the enduring regime will take, with details over network integration still to be resolved (i.e. whether the offshore network should be developed as a set of point-to-point connections or as an integrated network). Finalisation of the enduring regime is required in order that projects further offshore proceed as planned.

On balance, there has been steady progress in wind deployment and supply chain development. A step change in capacity additions to the system will be required from the mid-2010s. Therefore shorter planning times and higher approval rates, and agreement on regulatory treatment and the charging regime for transmission assets, are required in order to ensure sustained progress to 2020 targets.

There are also issues around financial support for wind generation in the context of electricity market reform which we consider in section 6 below. These will be particularly important towards bringing forward the next round of major offshore projects, and represent a major risk to our indicator trajectories.

Box 2.2: Planned offshore wind deployment to 2020 at the EU level

Member States' Renewable Energy Action Plans set out a significant role for offshore wind towards meeting the EU target of 20% renewable energy by 2020:

- Around 43 GW of offshore wind capacity is planned by 2020 in total, compared with just over 2 GW at the end of 2010.
- UK plans would make up around 30% of this (13 GW).

Given these plans and assuming steady expansion, the rate of annual capacity additions across the EU by the end of the decade could be 5-8 GW per year, up from around 0.5 GW in 2010).

Progress on biomass generation

The Government's Renewable Energy Action Plan includes addition of 4.2 GW biomass power generation by 2020[12]. Our scenarios to 2020 assume that this is delivered.

In 2010, around 76 MW of dedicated biomass capacity was added to the system, and electricity generated by biomass co-firing with fossil fuels increased from 1.8 TWh to 2.5 TWh. This is broadly on track with the trajectory in the Government's Renewable Energy Action Plan.

We have questioned the longer-term availability of sustainable biomass for use in power generation and suggested that a cautious approach is therefore appropriate (e.g. making plant CCS ready, co-firing in existing plant, not planning for significant ramp up of investment in the 2020s).

We will consider approaches to investment in biomass generation in more detail in our bioenergy review to be published later this year.

Progress on marine generation

We highlighted in our May 2011 renewable energy review that marine technologies (both wave and tidal stream), whilst currently highly uncertain, are promising in terms of available resource, scope for becoming cost-competitive over the next decades and adding diversity to the generation mix.

In order to develop marine generation options, demonstration is required over the next decade. This is recognised in the Government's Renewable Energy Action Plan, which includes 1.3 GW of installed marine capacity in 2020.

There has been limited progress towards this ambitious target:

- 0.1 MW of marine capacity was added in 2010, taking the total figure for capacity receiving Renewable Obligation Certificates (ROCs) to 2.6 MW.
- A further 0.75 MW wave and 0.5 MW tidal stream capacity entered testing in Orkney during 2010.[13]
- Planning consents for 4 MW of prototype devices were obtained in 2010, taking the total consented to 11 MW.
- In 2010 an area which could support a total of 1.6 GW of capacity (600 MW wave and 1000 MW tidal stream) by 2020 was licensed by the Crown Estate in Orkney and in the Pentland Firth.

12 DECC (2010) *UK National Renewable Energy Action Plan*
13 Renewable UK (March 2011) *Wave and Tidal Energy in the UK: State of the Industry Report*

One key factor here will be financial support for marine development. In this respect, there may be an opportunity to use some of the £200 million of funding for low-carbon technologies announced in the 2010 Spending Review for marine research and development. This would complement support provided through the Renewable Obligation Certificate (ROC) regime and under new electricity market arrangements.

4. Demonstration of CCS

Our indicator framework for CCS is focused on progress demonstrating this potentially key technology, and progress developing an approach to CCS infrastructure:

- **Progress on the first demonstration project.** The allocation of up to £1 billion in capital expenditure for this project in the 2010 Spending Review is an important step forward. However, the process for awarding funding is yet to be concluded, with a need to reach final agreement quickly if the first demonstration plant is to become operational by 2016.
- **Progress on demonstration projects two to four.** The timetable for the second competition has slipped by a number of months, partly in order to align with the timetable for EU funding. It is important now to invite bids for demonstration funding as a matter of urgency in order that projects can be selected in 2012, enabling plant to be operational by 2017. In turn, early operation of the demonstration plant is necessary to inform the 2018 review[14] and if CCS is to make a major contribution to required sector decarbonisation in the 2020s.
  - The availability of European NER300 funding[15] for CCS projects can make a positive contribution to the overall funding of the UK demonstrations. Seven UK CCS projects have applied for this funding, representing the majority of the proposed CCS projects across the EU. The timetable for EU funding is slightly behind the original timetable for UK funding.
  - However, delays in commencing the competition for projects two to four, combined with the announcement that UK funding will come from general taxation rather than via the dedicated Levy mechanism, have had a negative impact on investor confidence.
  - It is important now that both the European process and the UK competition proceed according to the current NER300 schedule, leading to the selection of projects by the end of 2012. This requires an announcement of a firm start date for the UK competition, with a commitment to select all three projects in 2012.
  - There should be no further delay to CCS demonstration funding (e.g. funding should be awarded before new electricity market arrangements are legislated, expected in 2013).

14 The Energy Act 2010 requires the Government to undertake a rolling review of CCS development, culminating in a review in 2018 to consider the appropriate regulatory and financial framework for further CCS deployment.
15 The NER300 is a fund that is open to applications from CCS and renewables projects across the EU (up to 3 per Member State), to be paid for via the sale of 300 million allowances from the new entrant reserve of the EU emissions trading scheme.

- **Including gas CCS in the demonstration projects.** There continues to be a strong case for inclusion of gas CCS in the UK demonstrations:
  - Based on analysis suggesting that gas CCS could make a very useful contribution to required sector decarbonisation in the 2020s, and the fact that there is limited focus on this technology elsewhere, we recommended that gas CCS demonstration should be included in the second competition.
  - The Government announced that it was accepting this recommendation in November 2010.
  - Subsequently there have been several expressions of interest from gas CCS projects, which should be seriously considered for funding given the potential importance of this technology.
  - We note that one of the selection criteria for NER300 funding is the cost per tonne of CO_2 abated; as we outlined in our letter to Government in May 2010, this is a less meaningful measure than cost per kWh of low-carbon electricity generated and unfairly discriminates against gas CCS projects. The presence of this criterion at EU level should not affect the UK's selection decision.
- **Progress on developing an approach to CCS infrastructure.** A long-term strategy for CCS infrastructure is important, to ensure that demonstration projects can account for considerations relating to infrastructure, and to provide confidence for future industry development. Although DECC have committed to publishing a strategy, their CCS Roadmap has been delayed from spring to autumn 2011.

There have been positive high-level commitments to support for CCS demonstration. However, it is important that these translate to specific actions to take forward all four demonstration projects. The risk is that these projects slip further, such that demonstration is delayed and the contribution of CCS to sector decarbonisation in the 2020s limited. This would be mitigated through concluding the first project in the next several months, and inviting tenders for the second set of projects this year.

5. Deployment of new nuclear

Nuclear generation is potentially a key technology for decarbonisation of the power sector given its relatively low projected cost, and assuming any safety concerns are addressed. In this respect, we note that in the light of events in Fukushima, the Government announced a review of nuclear safety. The final report is due in September 2011 and it will be important to reflect any relevant conclusions in regulatory arrangements. The interim report was published in May 2011 and found that the UK had displayed a strong safety culture and current arrangements are adequate (Box 2.3).

In order that the first nuclear new build is added to the system in 2018 – in line with what is required to support power sector decarbonisation through the 2020s – we have identified policy and project milestones:

- **Regulatory justification.** In line with our indicators, the justification of two reactor designs (Westinghouse AP1000 and Areva's EPR) was approved by Parliament in November 2010.
- **Waste and decommissioning funding.** Regulations for the treatment of nuclear waste and funding for the decommissioning of new nuclear reactors entered force in April 2011.
- **National Policy Statement.** Final agreement on the nuclear National Policy Statement has been delayed to allow further consultation. Final scrutiny and approval by Parliament during 2011 would support required planning decisions.
- **Approval of reactor designs.** Our indicators set out that these should be issued in 2011. The outcome of the consideration of the two proposed reactor designs was expected in June 2011, but is now subject to the findings of the Weightman Review. Given that the final report of this review is due in September 2011, approval in 2011 would be possible and desirable to support required investment.
- **Planning application.** We originally envisaged that the first planning applications would be made at the end of 2010. However, despite continuing developer interest, no applications have yet been made. It will be important that planning approval is granted in 2011 or early 2012 in order to support civil works for the first new nuclear investment scheduled to start at the end of 2012.

The overall picture on nuclear is therefore one of some progress, but with some key challenges to address before the first project can proceed. In particular, there remains a pressing need for approval of the National Policy Statement, reactor designs, and planning applications, which may have been delayed on the original timeline by 6-12 months.

In addition, it will be important that risks under current market arrangements are addressed in a timely manner so that nuclear projects are bankable; we now turn to assess progress reforming the electricity market.

Box 2.3. Weightman Review – interim report conclusions

The Weightman Review interim report was published in May 2011. It drew 11 conclusions, of which the most relevant for future prospects for nuclear generation in the UK were as follows:

1. *In considering the direct causes of the Fukushima accident we [Dr Weightman and advisors] see no reason for curtailing the operation of nuclear power plants or other nuclear facilities in the UK. Once further work is completed any proposed improvements will be considered and implemented on a case by case basis, in line with our normal regulatory approach.*

4. *To date, the consideration of the known circumstances of the Fukushima accident has not revealed any gaps in scope or depth of the Safety Assessment Principles for nuclear facilities in the UK.*

5. *Our considerations of the events in Japan, and the possible lessons for the UK, has not revealed any significant weaknesses in the UK nuclear licensing regime.*

6. *Flooding risks are unlikely to prevent construction of new nuclear power stations at potential development sites in the UK over the next few years. For sites with a flooding risk, detailed consideration may require changes to plant layout and the provision of particular protection against flooding.*

7. *There is no need to change the present siting strategies for new nuclear power stations in the UK.*

8. *There is no reason to depart from a multi-plant site concept given the design measures in new reactors being considered for deployment in the UK and adequate demonstration in design and operational safety cases.*

Source: HM Chief Inspector of Nuclear Installations (May 2011) *Japanese earthquake and tsunami: Implications for the UK Nuclear Industry, Interim Report.*

6. Electricity market reform

We have previously suggested that existing market arrangements are unlikely to support required investment in low-carbon capacity and that new arrangements based on long-term contracts would best deliver a decarbonised system. We therefore included an indicator in our monitoring framework for review and introduction of new electricity market arrangements.

The Government's Electricity Market Reform

In December 2010 the Government opened a consultation on new electricity market arrangements that would be based on four pillars:

- **Long-term contracts for low-carbon generation.** New low-carbon capacity would be rewarded under long-term 'contracts for difference' (CfDs) or fixed feed-in tariffs. The CfD proposal is that generators will sell their output into the wholesale electricity market, and that there will be a mechanism to provide a top-up payment equal to the difference between the agreed tariff level and a market price index. An alternative model based on premium feed-in tariffs (additional payments on top of the market electricity price) was also consulted on.

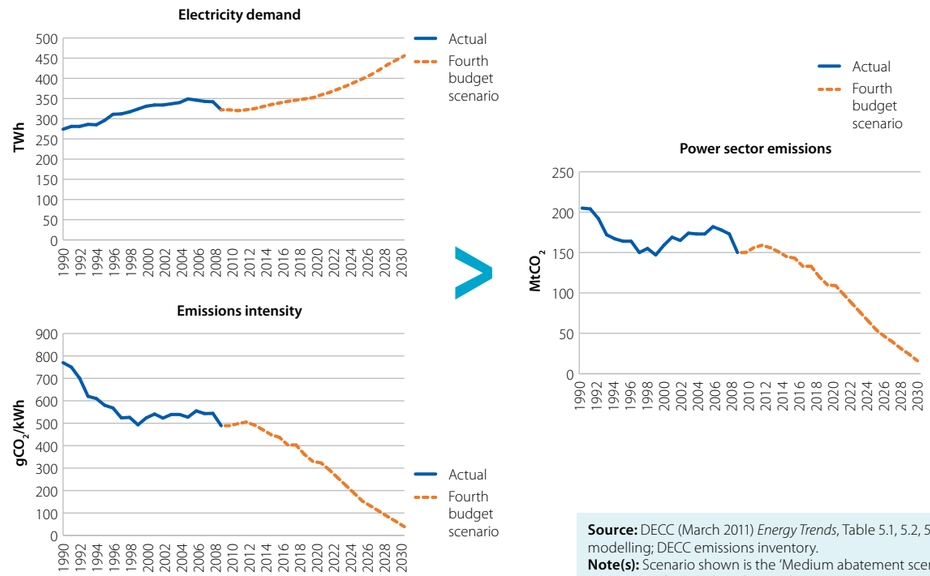
- **Carbon price underpin.** The December 2010 proposal to introduce a carbon price underpin was followed by an announcement in the Budget 2011 that the carbon price underpin would be implemented through reform of the Climate Change Levy. Rates will be set to achieve a target carbon price rising to £30/tCO_2 in 2020 and £70/tCO_2 in 2030 (in real terms).
- **Capacity mechanism.** Targeted capacity payments for flexible reserve plant and demand reduction measures were proposed to operate alongside the wholesale generation market.
- **Emissions Performance Standard (EPS).** An EPS of 600 gCO_2/kWh was proposed for new plant. This would allow investment in coal plant part-fitted with CCS, and gas-fired plant without CCS. An alternative of 450 gCO_2/kWh was also put forward.

Areas for further consideration

In our fourth budget report[16] we presented an illustrative least-cost investment path for the power sector over the next two decades, suggesting that the aim under new electricity market arrangements should be to reduce average emissions intensity to around 50 gCO_2/kWh by 2030 (Figure 2.11).

We recommended that new arrangements should be based on long-term contracts which would provide revenue security to investors, and would therefore bring forward required investments at least cost to consumers.

Figure 2.11: Electricity demand, emissions intensity and power sector emissions (1990-2030)



Source: DECC (March 2011) *Energy Trends*, Table 5.1, 5.2, 5.5; CCC modelling; DECC emissions inventory.
Note(s): Scenario shown is the 'Medium abatement scenario' from CCC (2010) *The Fourth Carbon Budget*.

16 CCC (2010) *The Fourth Carbon Budget, Reducing emissions through the 2020s*

The Government's proposals were broadly in line with recommendations in our advice on the fourth carbon budget. We therefore welcomed them in a letter to the Secretary of State in March 2011, highlighting four key areas for consideration as the proposals are developed into a White Paper:

- **Quantity-based approach.** This is preferred to a price-based approach, because it would provide more confidence over delivery of required investment, with limited risk of over-investment.
- **Contracts for Differences.** These would provide more confidence over delivery of required investment than the alternative option of premium feed-in tariffs. They would also reduce risks for investors, therefore reducing cost of capital and electricity price impacts of low-carbon investment.
- **Technology policy.** Ideally new arrangements would be technology neutral. However, given different stages of technology maturity there will be an important transitional role for technology policy to ensure that a portfolio of options for sector decarbonisation is available. The expectation is that ultimately all technologies would be able to compete directly for contracts without additional support.
- **Complementary levers.**
  - The carbon price underpin would be most effective if a means were found to make a clearer commitment to the targeted price trajectory, which is broadly appropriate.
  - A tighter emissions performance standard, alongside Contracts for Differences for CCS retrofit, would help to ensure that any investment in new coal is with the intention that this will be CCS retrofitted. There may also be a role for an EPS limiting investment in unabated gas beyond 2020.

There are also a number of detailed technical considerations for contract design that need to be addressed in the new arrangements; we do not recommend a specific way forward in these areas, but raise them for consideration (Box 2.4).

Box 2.4: Technical considerations for contract design in EMR

There are at least four specific areas of contract design that may need to be addressed in the new arrangements:

- **Sharing construction cost.** There is a high degree of uncertainty around construction costs for low-carbon technologies. Although part of this cost may be regarded as controllable, there is also likely to be a significant element of exogenous uncertainty (for example in material costs). Given large investments required, this could result in a prohibitively high cost of capital. One possibility to be explored here is partial risk-sharing between investors and consumers under CfDs. This could mobilise capital for required investment that might otherwise not be forthcoming at the scale required, and do so at lower consumer cost.
- **Sharing fuel price risk.** Generators exposed to significant fuel price risk – biomass and CCS plants – may require some sharing of this risk. For example, the index in the CfD for particular generators could be linked to a relevant agreed fuel price index.
- **Load factor uncertainty.** We project that from the mid-2020s a significant share of electricity demand will come from new markets for electric vehicles and heating. Development of these markets will be driven by Government policy, creating uncertainty about the precise level of demand from these sectors, and therefore of load factors for plant on the system in the 2020s. Contracts may have to build in a way to share this load factor risk (e.g. by guaranteeing a level of off-take or paying for capacity rather than generation for some low-carbon investments).
- **Index price.** In order to deliver revenue certainty (required to access finance) for intermittent renewable generators, arrangements will need to address the risk that they generate at times of low electricity prices. For example, intermittent generation could access a CfD based on a short-term (e.g. hourly) index of the wholesale market price.

Support for renewable generation under new market arrangements

More recently, in our renewable energy review, we suggested the need for specific technology policy commitments to support less mature but promising technologies – both those at the early deployment phase (e.g. offshore wind) and those at the demonstration phase (e.g. wave and tidal stream) – in the context of the new electricity market arrangements:

- There is currently a high degree of uncertainty about the market for less mature technologies in the 2020s. Given that these are likely not to be able to compete with more mature technologies, at least in the early 2020s, investments in less mature technologies would not be viable without additional financial support. However, the Government has yet to make any commitments going beyond 2020.
- Addressing this uncertainty now would improve the sector investment climate, and would strengthen incentives for required supply chain investment over the next five years.
- We therefore proposed that minimum commitments should be made for less mature but promising technologies (e.g. that there will be support to reach at least 25 GW of offshore wind installed capacity by 2030).
- We also suggested that, having set a firm and stretching 2030 commitment, current ambition for offshore wind in 2020 could be moderated if alternative and low-cost means become available for meeting the 2020 renewable energy target.

- Such commitments could be implemented through the new electricity market arrangements. For example, a proportion of the CfDs to be allocated each year could be reserved for less mature technologies, subject to certain conditions being met (e.g. on cost reduction).

We also highlighted the crucial need to manage the transition from current to new arrangements so as to avoid an investment hiatus. Given that it may be several years before new electricity market rules can be introduced and implemented, extension of the current ROC regime should be considered to support ongoing investment in renewable generation.

Next steps in market reform

The Government is due to publish its White Paper in July 2011. Key elements that we will focus on in our future progress monitoring are:

- The overall objective of the Electricity Market Reform (e.g. the rate of decarbonisation).
- The confidence that proposals provide over whether required investments will be forthcoming (i.e. that arrangements do not expose low-carbon investors to excessive risks).
- The technology policy aspects of new arrangements (i.e. whether additional support is provided for less mature technologies).

Key findings

Power sector **emissions increased by 4%** in 2010, mainly due to cold weather and temporary nuclear outages.

Carbon intensity of electricity supplied increased from 489 g/kWh in 2009 to **496 g/kWh** in 2010, largely due to temporary nuclear outages.

Achievable emissions intensity fell from 335 g/kWh in 2009 to **316 g/kWh** in 2010, reflecting investment in gas and renewables.

Wind capacity increased by 0.9 GW, bringing total installed capacity to 4 GW onshore and 1.3 GW offshore. This is **broadly on track** with our indicators, but a significant ramp up will be required to meet 2020 targets.

During **2011, funding** should be awarded for the first **CCS** demonstration project and **bids** should be invited for the second set of projects.

New **electricity market** arrangements should be based on **long-term contracts** rather than premium feed-in tariffs.

Table 2.1 The Committee's Power sector indicators

POWER		Budget 1	Budget 2	Budget 3	2010 trajectory	2010 outturn
Headline indicators						
Emissions intensity (g/kWh)		509	390	236	493	496
Total emissions (% change from 2007)		-15%	-39%	-64%	-17.5%	-12.0%
Generation (TWh)	Wind	21	50	98	13.4	10.0
	Nuclear	58	30	48	66.9	56.4
	CCS	0	5	11	0	0
Supporting indicators						
Transmission						
Agreement on incentives for anticipatory investment for Stage 1 reinforcements		2010			In place	£400m agreed, full agreement process could take until 2012 /2013
Implementation of enduring regime for accessing grid		2010			In place	In place
Transitional OFTO regime in place		2009			In place	In place
Enduring OFTO regime in place		2010			In place	In place, with implementation in 2011
Grid reinforcement planning approval		2011: Scotland Stage 1, Wales Stage 1 (Central), South East	2013: Wales Stage 1 (North), English East Coast Stage 1, South West 2014: Scotland Stage 2		n/a in 2010	
Grid reinforcemement construction begins		2012: Scotland Stage 1, Wales Stage 1 (Central), South East	2014: Wales Stage 1 (North), English East Coast Stage 1, South West 2015: Scotland Stage 2		n/a in 2010	

Table 2.1 The Committee's Power sector indicators

POWER		Budget 1	Budget 2	Budget 3	2010 trajectory	2010 outturn
Grid reinforcemements operational			2015: Scotland Stage 1, Wales Stage 1 (Central), South East 2017: Wales Stage 1 (North), English East Coast Stage 1, South West	2018: Scotland Stage 2	n/a in 2010	
Tendering for first offshore connections under enduring OFTO regime		2010			In place	Currently tendering under transitional regime. Enduring regime tenders expected later in 2011 or in 2012
Construction of first offshore connections under enduring OFTO regime begins		2011			n/a in 2010	
First offshore connections under enduring OFTO regime operational		2012			n/a in 2010	
Planning						
IPC set up and ready to receive applications		2010				In place. To be replaced by MIPU in 2012
Market						
Review of current market arrangements and interventions that will help deliver low-cost, low-carbon generation investment		To begin in first budget period			To begin in first budget period	Consultation completed, White paper due in July 2011
Wind						
Generation (TWh)	Onshore	13	26	44	9.0	7.0
	Offshore	8	24	54	4.3	3.0
Total capacity (GW)	Onshore	5.7	10.8	18.0	4.0	4.0
	Offshore	2.5	7.4	16.6	1.3	1.3
Capacity entering construction (GW)	Onshore	0.9	1.3	1.5	0.8	Data not yet available

Key: Headline indicators Implementation indicators Forward indicators Milestones Other drivers

Table 2.1 The Committee's Power sector indicators

POWER		Budget 1	Budget 2	Budget 3	2010 trajectory	2010 outturn
Capacity entering planning	Offshore	0.9	1.6	2.6	0.7	Data not yet available
	Onshore	New planning applications will be required from the end of the second budget period at the latest to maintain flow into construction			No trajectory	1.8
	Offshore	New planning applications will be expected in line with site leasing			No trajectory	0.0
Average planning period (months)		<12	<12	<12	<12	18
Nuclear						
Regulatory Justification process		2010			In place	In place
Generic Design Assessment		2011			n/a in 2010	
National Policy Statement for nuclear (including Strategic Siting Assessment)		2010			In place	Delayed by Weightman review – expected in 2011/12
Regulations for a Funded Decommissioning Programme in place		2010			In place	In place
Entering planning		First planning application in 2010	Subsequent applications at 18 month intervals		In place	Delayed by Weightman review – expected in 2011/12
Planning approval; site development and preliminary works begin		First approval and site development and preliminary works begin in 2011	Subsequent application approvals, site development and preliminary works at 18 month intervals		n/a for 2010	
Construction begins			First plant in 2013, subsequent plants at 18 month intervals		n/a for 2010	
Plant begins operation				first plant in 2018, with subsequent plants at 18 month intervals*	n/a for 2010	
CCS						
Front-End Engineering and Design (FEED) studies for competition contenders initiated		End 2009			Initiated	Initiated early 2010

Table 2.1 The Committee's Power sector indicators (continued)

POWER	Budget 1	Budget 2	Budget 3	2010 trajectory	2010 outturn
FEED studies for competition contenders completed	2010			Completed	FEED study ongoing
Announce competition winner	2010			Announced	Awaiting completion of FEED study
Second demonstration competition	Launch 2010, announce winners 2011			Initiated	Not yet launched – expected later in 2011
Quantification of saline aquifer CO2 storage potential		No later than 2015		n/a for 2010	
Review of technology and decision on framework for future support		No later than 2016**		n/a for 2010	
Strategic plan for infrastructure development		No later than 2016		n/a for 2010	
Planning and authorisation approval, land acquisition, and storage site testing completed, construction commences	First demo in 2011	Subsequent demos 2012/13		n/a for 2010	
Demonstrations operational		First demo in 2014, subsequent demos 2015/16***		n/a for 2010	
First new full CCS plants supported via the post-demonstration mechanism			2022	n/a for 2010	
Other drivers/wider monitoring					
Total demand (TWh), coal and gas prices, nuclear outages.					
Average wind load factors, availability of offshore installation vessels, access to turbines.					
Nuclear supply chain, availability of skilled staff.					
International progress on CCS demonstration and deployment.					
Planning approval rates and frequency of public inquiries to decisions of Infrastructure Planning Commission.					

*Up to 3 nuclear plants by 2022..
** The Energy Act 2010 requires a rolling review of CCS progress, to report on the appropriate regulatory and financial framework by 2018.
*** Total of 4 CCS demonstration plants by 2020.

Key: Headline indicators Implementation indicators Forward indicators Milestones Other drivers

Chapter 3: Progress reducing emissions from buildings and industry

Introduction and key messages

Buildings and industry emissions together account for more than two-thirds of total UK greenhouse gas emissions. In our 2010 progress report to Parliament, we documented a fall of 12% in buildings and industry emissions in 2009. We showed that this was largely driven by a 15% reduction in industry CO_2 emissions which was primarily a result of the recession. In addition, we observed a 10% emissions reduction in the residential sector, mainly due to a combination of rising energy prices and the recession.

In this chapter, we consider 2010 data on buildings and industry sector emissions and energy consumption, as well as the implementation of key abatement measures. We also discuss progress against policy milestones, given that we have previously highlighted the need for policy innovation to deliver the abatement measures in our indicator framework.

The key messages in the chapter are:

Buildings emissions

- Buildings CO_2 emissions increased by 7% in 2010, as a result of increased energy demand for heating due to cold winter weather both in early and late 2010.
- Implementation of some key measures in the residential sector fell in 2010. For example, the number of cavity wall and professional loft insulation installations fell by around 30%. This is of particular concern given the need for a significant acceleration in the delivery of insulation measures in moving from the first to the second carbon budget.
- This suggests the need for strong incentives if progress is to keep pace with our indicator framework. In this respect, we make suggestions for consideration in the context of the Green Deal and the Energy Bill. Our key recommendation is that the Green Deal and the new Energy Company Obligation should be aligned with the ambition to insulate all lofts and cavity walls by 2015, as well as 2.3 million solid walls by 2022. Where possible, mortgage rather than Green Deal finance should be used to limit funding costs, and associated energy bill/fuel poverty impacts.
- In the non-residential sector, a roll-out of Energy Performance Certificates (EPCs) and Display Energy Certificates (DECs) would strengthen incentives for energy efficiency improvement. Given the limitations of the current evidence base, it would also provide a better benchmark for future monitoring of progress reducing emissions.

Industry emissions

- Industry CO_2 emissions increased by 2% in 2010, as a result of recovery from the recession.
- In order to drive required industry emissions reduction going forward, the new round of Climate Change Agreements (CCAs) should encourage the uptake of the full range of abatement options, and require implementation of options which are cost effective with a carbon price of £30/tCO_2 in 2020 and rising through the 2020s. This includes measures both to reduce emissions in the near term and to prepare for longer term abatement options (e.g. through CCS).

We set out the analysis that underpins these conclusions in 6 sections:

1. Buildings and industry emission trends
2. The Committee's building and industry indicator framework
3. Residential buildings
4. Non-residential buildings
5. Renewable heat options
6. Emissions from industry

1. Buildings and industry emission trends

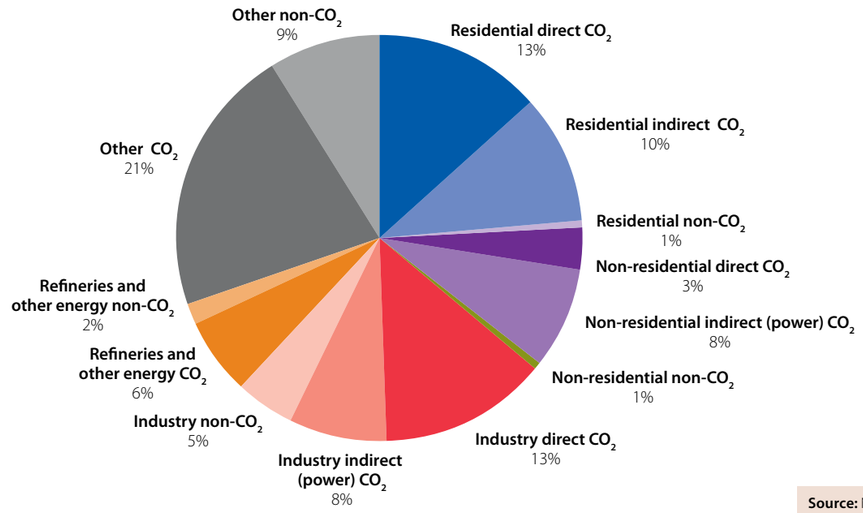
Overview of buildings and industry emissions

Emissions from buildings and industry accounted for 69% of total UK greenhouse gas emissions in 2009 (Figure 3.1). They comprise direct emissions (i.e. from burning fossil fuels for heat) and (electricity related) indirect emissions. On a sector basis, industry emissions accounted for the largest share of the total UK CO_2 emissions in 2009 (32%), followed by residential (28%), commercial sector (10%) and public sector emissions (4%).

In the five years prior to the recession (i.e. 2003-07), buildings and industry CO_2 emissions fell 1% annually. The recession changed this trend and in 2009 there were significant emissions reduction (12%) in the buildings and industry sectors:

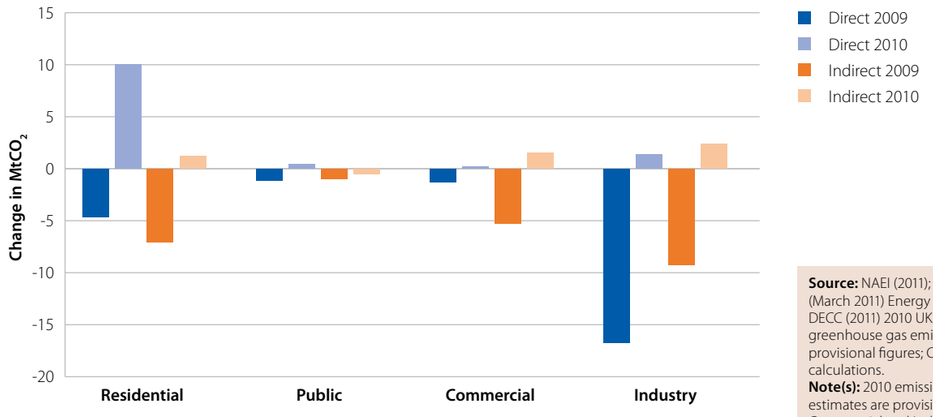
- The analysis in our 2010 progress report showed that the overall 10% reduction in direct buildings and industry emissions in 2009 was largely due to falling energy demand during the recession.
- The 15% reduction in electricity emissions was driven both by demand reduction during the recession and a reduction in the carbon intensity of electricity generation.

Figure 3.1: GHG emissions from buildings and industry in the context of total UK emissions (2009)



Source: NAEI (2011).

Figure 3.2: Change in buildings and industry direct and indirect CO_2 (2009 and 2010)



Source: NAEI (2011); DECC (March 2011) Energy Trends; DECC (2011) 2010 UK greenhouse gas emissions, provisional figures; CCC calculations.
Note(s): 2010 emissions estimates are provisional. Commercial and Industrial emissions are based on CCC estimates.

Preliminary data for 2010 suggests that buildings and industry emissions increased by 5% (Figure 3.2). The 2010 increase is primarily due to the cold winter months in 2010 and increased output in the industrial sector (see sections below):

- Overall residential emissions increased by 8%. The key driver was a 13% increase in direct emissions, which was a result of increased energy consumption for heating during the cold winter months in early and late 2010.

- Commercial emissions were up 4%, also primarily due to increased energy consumption due to cold weather in the heating months.
- Public sector emissions fell by 1%, due to a 7% fall in electricity consumption, resulting in a 6% fall in emissions. This was offset by a direct emissions increase of 5%.
- Industry emissions increased by 2%, primarily related to increases in output after deep reductions in 2009 due to the recession.

The combined effect of significant emissions reduction in 2009 and slightly increased emissions in 2010 is that emissions in 2010 were still 33 $MtCO_2$ below 2008 levels. This is below what we envisaged when we set out our progress indicators in 2009, but in line with what we would expect after allowing for the impacts of the recession and cold weather in 2010:

- We first set out indicators in our progress report to Parliament in October 2009. These include emissions trajectories which were broadly consistent with the legislated carbon budgets. They did not allow for a significant impact of the recession on emissions, especially in the non-residential and industrial sectors.
- In our 2010 progress report to Parliament and in our fourth budget report, we analysed the impact of the recession on emissions. This suggested that the emissions impact of the recession was greater than previously modelled. We reflected this greater impact in our revised 2010 Extended Ambition scenario in the Fourth Carbon Budget report.
- Buildings and industry emissions in 2010 were in line with our indicator framework (Figure 3.3). However, they were around 10 $MtCO_2$ above the level suggested in our 2010 Extended Ambition scenario (Figure 3.4). This reflects the fact that emissions in 2010 were relatively high given the cold winter. After adjusting for the cold weather, emissions levels in 2010 were broadly where we would expect them to be given the impact of the recession.

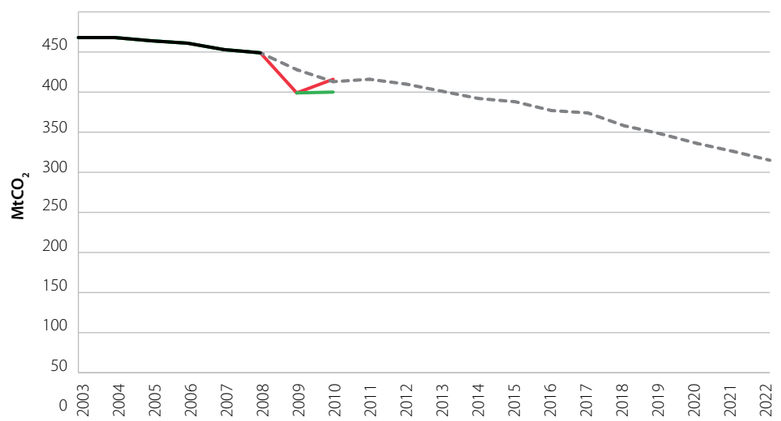
The fact that deviations from the indicator framework can be explained by the recession and the weather implies that the implementation of abatement measures is broadly on track. This is borne out by the detailed analysis set out below.

However, our indicator framework includes a relatively low ambition to 2012. This reflects the lead time for new policies before delivery can be ramped up. As shown in sections 3-6, and allowing for this lead time, a major increase in ambition and delivery is required if carbon budgets are to be achieved. In other words, a step change in the pace of emissions reduction is still required.

In the remainder of this section, the exhibits show the emissions in each sub-sector relative to emissions trajectories in our indicator framework. In the residential and industrial sectors, we also show the position relative to illustrative trajectories which reflect the impact of the recession.

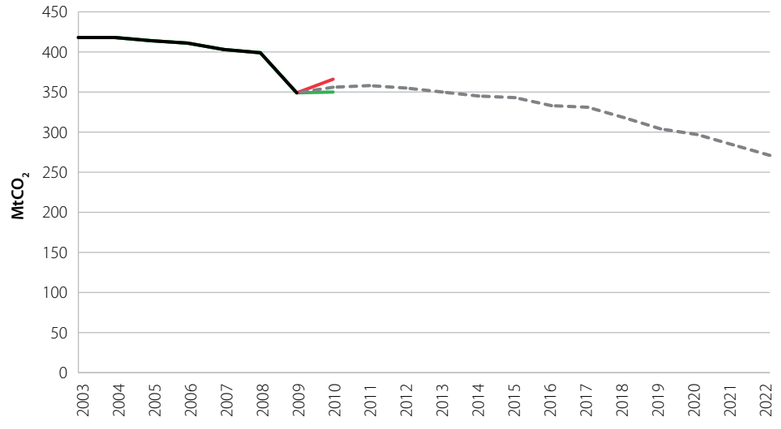
The aim is to illustrate that emissions are below what was previously envisaged. However, this should not be regarded as evidence of progress in line with what is required to meet carbon budgets. Rather, the fact that emissions for each sub-sector are at or above levels in illustrative trajectories reflecting the impact of the recession suggests that there has been no outperformance in the implementation of measures. In turn, it is important to place this in the context that the level of ambition for the implementation of measures in the period to 2012 was in many cases modest.

Figure 3.3: Buildings and industry – historic emissions vs original indicator trajectory (2003-2022)



Source: NAEI (2011); DECC (March 2011) Energy Trends; DECC (2011) 2010 UK greenhouse gas emissions, provisional figures; CCC calculations.
Note(s): 2010 emissions estimates are provisional. Adjusting emissions for weather is for illustration only and based on CCC estimates.

Figure 3.4: Buildings and industry – historic emissions vs 2010 Extended Ambition scenario (2003-2022)



Source: DECC (March 2011) Energy Trends; DECC (2011) 2010 UK greenhouse gas emissions, provisional figures; CCC calculations.
Note(s): 2010 emissions estimates are provisional. Adjusting emissions for weather is for illustration only and based on CCC estimates.

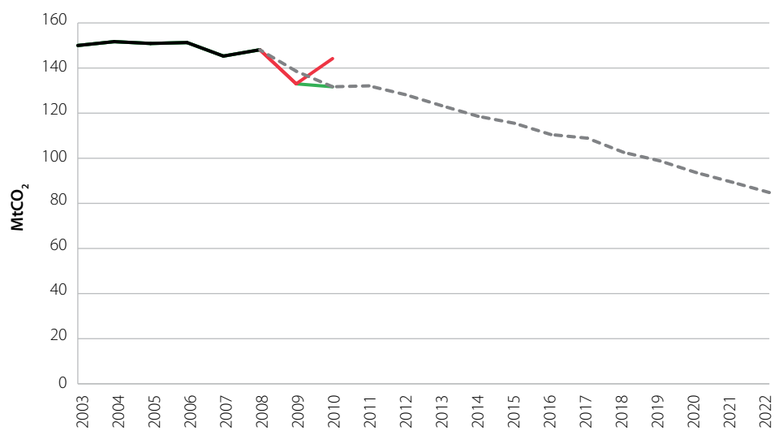
Emissions from residential buildings

Total residential CO_2 emissions increased by 8% in 2010, following a 10% reduction in 2009. Therefore emissions in 2010 were above the level set out in our indicator framework, and even further above an illustrative trajectory which reflects the impact of the recession (Figure 3.5 and 3.6).

However, the key driver of increased emissions in 2010 was the cold winter weather, with some increase attributable to falling energy prices, and with some small offsetting reductions due to implementation of measures:

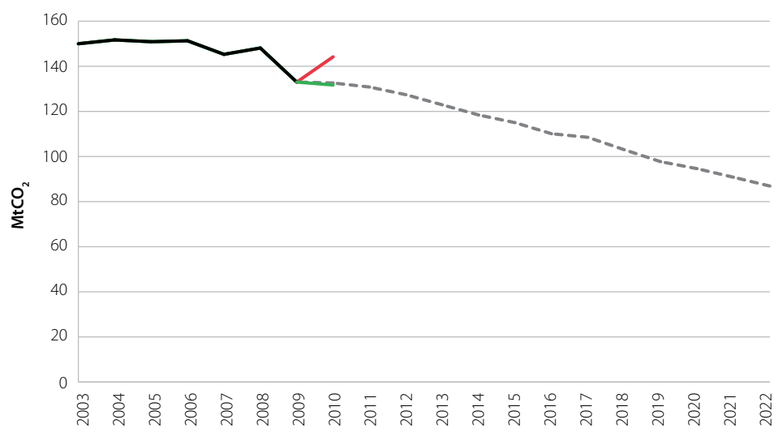
- Direct residential emissions account for 57% of total residential CO_2 emissions. They increased by 13% in 2010 after a 6% fall in 2009.
- The rise in direct emissions in 2010 can be attributed to a 15% rise in gas use in 2010 brought about by cold weather in the winter months of 2010.
- Adjusting energy consumption for changes in weather, total energy consumption in the residential sector would have fallen 1%, with direct emissions in 2009 also falling 1% (Figure 3.7 and Box 1.1 in Chapter 1 on weather).
- Real gas and electricity prices fell 9% and 5% respectively in 2010, which may have contributed to the increase in emissions.
- Implementation of measures slipped in 2010. There will be a need for a significant acceleration in the pace of emissions reduction if indicators and carbon budgets are to be achieved (see Section 3.3 below).

Figure 3.5: Residential – historic emissions vs original indicator trajectory (2003-2022)



Source: NAEI (2011); DECC (March 2011) Energy Trends; DECC (2011) 2010 UK greenhouse gas emissions, provisional figures; CCC calculations.
Note(s): 2010 emissions estimates are provisional. Adjusting emissions for weather is for illustration only and based on CCC estimates.

Figure 3.6: Residential – historic emissions vs 2010 extended ambition scenario (2003-2022)

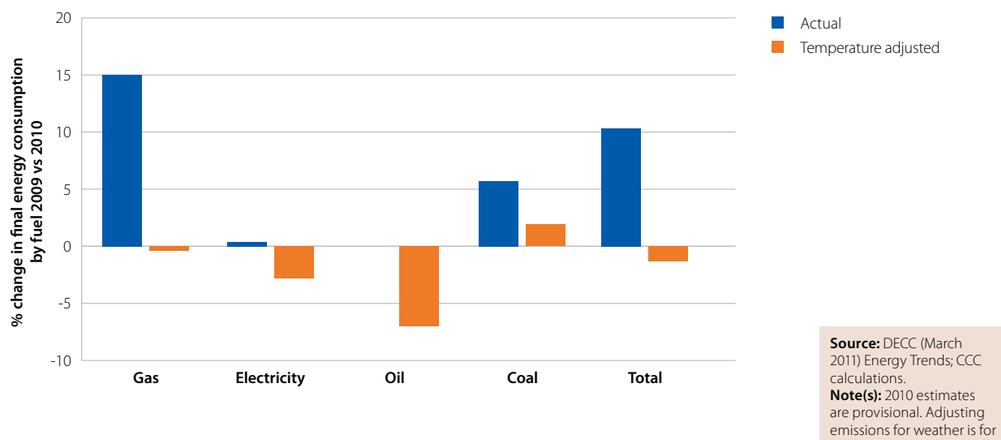


Source: NAEI (2011); DECC (March 2011) Energy Trends; DECC (2011) 2010 UK greenhouse gas emissions, provisional figures; CCC calculations.
Note(s): 2010 emissions estimates are provisional. Adjusting emissions for weather is for illustration only and based on CCC estimates.

After adjusting for the cold weather, residential emissions in 2010 were consistent with our illustrative trajectory which builds in the impact of the recession.

Indirect residential emissions increased by 2% in 2010, due to a 2% increase in carbon intensity of electricity generation whilst electricity consumption stayed flat. Flat electricity consumption is likely to reflect macroeconomic factors, rather than a significant change in consumer behaviour (see Section 3 below). The change in carbon intensity of power generation is discussed in Chapter 2.

Figure 3.7: Change in 2010 residential energy consumption – actual vs temperature adjusted



Source: DECC (March 2011) Energy Trends; CCC calculations.
Note(s): 2010 estimates are provisional. Adjusting emissions for weather is for illustration only and based on CCC estimates.

Emissions from commercial buildings

Following a five year period of broadly flat commercial sector emissions prior to the recession, and a 13% reduction in 2009, emissions increased by 4% in 2010.

- In 2010 direct commercial sector emissions, which account for around 20% of total commercial emissions, were up by 2%, driven by increased output and falling fuel prices.
- Indirect commercial sector emissions were up 4% caused by an increase in demand (3%) and carbon intensity of electricity generation (2%).

Emissions from the public sector

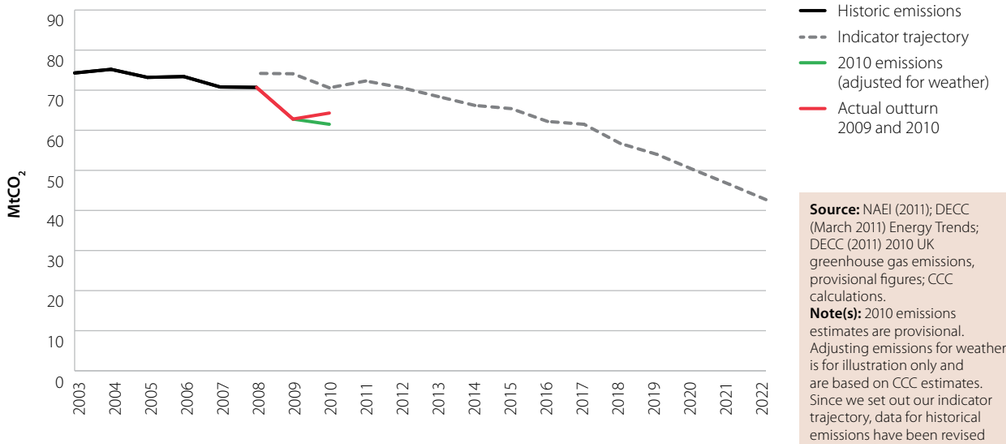
Public sector emissions fell by 1% in 2010. This is due to a 6% fall in indirect emissions, offset by an increase in direct emissions of 5%.

- Direct emissions were up 5% in 2010 due to an increased use of heating fuels in the first and fourth quarter of 2010, linked to the cold winter months.
- Indirect emissions fell by 6%, driven by a 7% reduction in electricity consumption.

Non–residential buildings indicator trajectories

According to the most recent data for emissions in both the commercial and public sector, 2010 emissions were still 9% below our indicator trajectories (Figure 3.8). This is partly because the scale of the recession impact in these sectors was deeper than the trajectories in our 2009 progress report predicted. However, 2010 emissions were broadly in line with our illustrative emissions trajectory incorporating impacts of the recession.

Figure 3.8: Non-residential – historic emissions vs original indicator trajectory (2003-2022)



Source: NAEI (2011); DECC (March 2011) Energy Trends; DECC (2011) 2010 UK greenhouse gas emissions, provisional figures; CCC calculations.
Note(s): 2010 emissions estimates are provisional. Adjusting emissions for weather is for illustration only and are based on CCC estimates. Since we set out our indicator trajectory, data for historical emissions have been revised downwards.

If the winter months of 2010 had not been unusually cold, we estimate that total non-residential buildings emissions could have fallen up to 2% .

Industry emissions

Industry emissions fell significantly between 1990 and 2007 (around 14%), primarily due to fuel switching and industry restructuring.

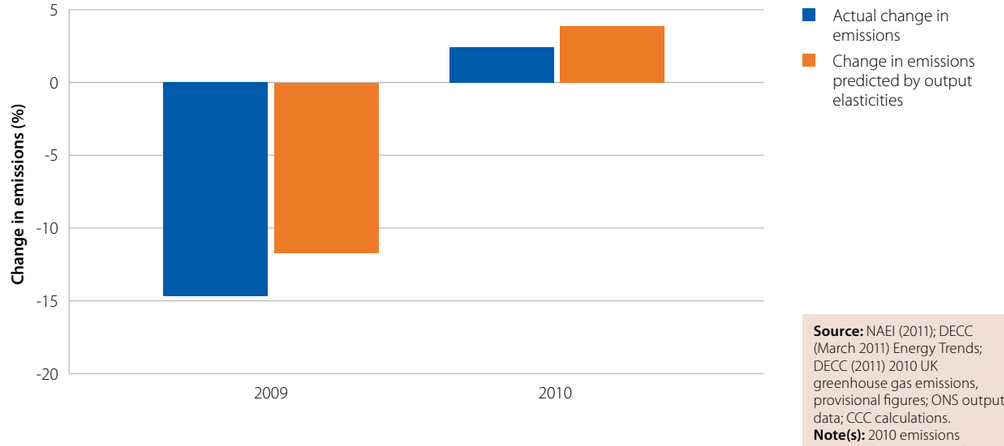
Further reductions occurred following the onset of the recession. In 2008 and 2009, overall emissions fell 18%, with direct and indirect emissions falling 16% and 22% respectively. Previously we suggested that the recession played a key role in driving these reductions, evidenced by the conjunction of reductions of output and emissions in key EU ETS sectors.

In 2010 however, overall emissions increased by 2%, with indirect emissions increasing 5% and direct emissions increasing 1%. The increase in emissions reflects increased output, suggesting that recovery from the recession was a key driver (Figure 3.9):

- For example, output from manufacturing of mineral products (including cement) increased by 5%, after a 14% decrease in 2009. Emissions from cement, clinker and lime were up 4% in 2010, after falling by nearly 30% in 2009.
- Increases in output and emissions also occurred across the EU in 2010, compared with falling output and emissions previously. Across the EU, output increased by 7% in 2010, after falling 14% in 2009, and emissions rose by 3% in 2010 after a reduction of 12.5% in 2009.

The fact that emissions did not rise directly in proportion to increased UK industrial energy demand in 2010 suggests that there was some fuel switching to less carbon-intensive fuels. This is consistent with an increase in the prices of carbon-intensive fuels (coal and oil), whereas those for lower carbon fuels (gas and electricity) fell.

Figure 3.9: Estimated change in industrial emissions due to output compared to actual change (2009-2010)



Source: NAEI (2011); DECC (March 2011) Energy Trends; DECC (2011) 2010 UK greenhouse gas emissions, provisional figures; ONS output data; CCC calculations.
Note(s): 2010 emissions estimates are provisional.

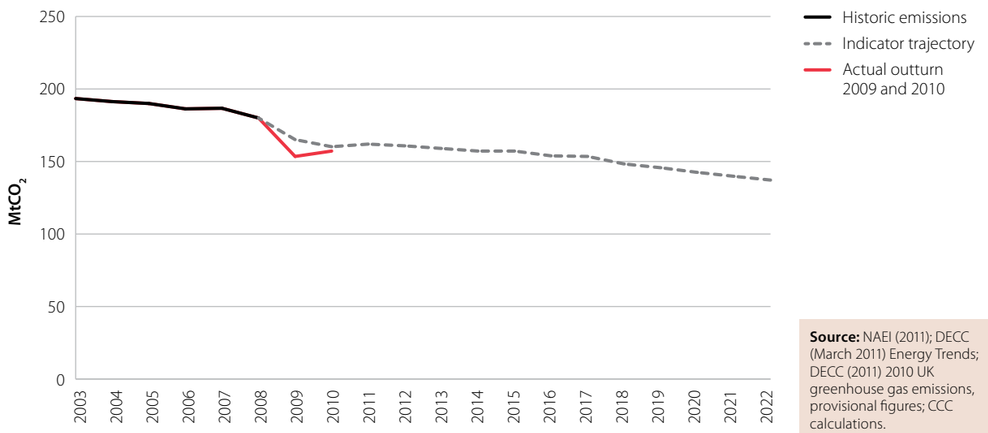
The potential for further bounce back depends on the extent to which there is a long-term income reduction, permanent closures of business, lasting fuel switching and investment in energy efficiency improvement. To date, evidence in key sectors does not provide a clear picture of the scope for further bounce back:

- In some sectors (e.g. steel), the mothballing of key plant has led to reductions. Whether they persist will depend upon whether the plants re-open in the long term. Rationalisation of the cement sector may also lead to persistent reductions that limit bounce back.
- Investment in energy-intensive industry fell in 2009 and 2010, which may indicate continued use of older plant. This is typically more energy-intensive compared to newer technologies and could exacerbate the emissions impact of the economic bounce back.

Industry emissions in 2010 were broadly similar to levels set out in our indicator framework (Figure 3.10). Although the recession in 2009 was more severe than we anticipated, the increase in emissions in 2010 brings emissions closer to our indicator framework, and in line with an illustrative scenario that fully allows for the impact of the recession (Figure 3.11).

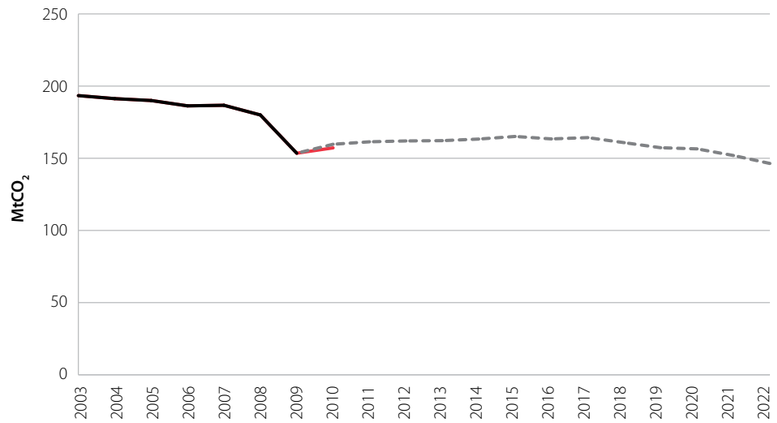
In industry, the links between weather and energy consumption are uncertain and we have not estimated weather corrected industry emissions.

Figure 3.10: Industry – historic emissions vs original indicator trajectory (2003-2022)



Source: NAEI (2011); DECC (March 2011) Energy Trends; DECC (2011) 2010 UK greenhouse gas emissions, provisional figures; CCC calculations.
Note(s): 2010 emissions estimates are provisional.

Figure 3.11: Industry – historic emissions vs 2010 Extended Ambition scenario (2003-2022)



Source: NAEI (2011); DECC (2011) Energy Trends March 2011; DECC (2011) UK Emissions Statistics 2010 Provisional UK figures; CCC calculations.
Note(s): 2010 emissions estimates are provisional.

2. The Committee's buildings and industry indicator framework

Our indicator framework – set out in the 2009 progress report to Parliament – includes a range of measures to reduce buildings and industry emissions:

Residential indicators

- Insulation of all lofts and cavity walls by 2015.
- Insulation of 2.3 million solid walls by 2022.
- Replacement of 12 million old inefficient boilers by 2022.
- 58% of the stock of wet appliances rated A+ or better and 45% of cold appliances rated A++ or better by 2022.

Non-residential indicators

- Implementation of all cost-effective measures to reduce emissions from lighting, appliances, heating and cooling in the public and commercial sector by 2018.

Industry indicators

- Emission reductions through investment in options such as energy efficient machinery and heat recovery to realise a 19% reduction by 2022 relative to 2007.

Renewable heat indicators

- Increasing investment in renewable heat to achieve a 12% penetration of total heat demand by 2020.

If these measures were implemented, we estimate that there would be emissions reduction across the whole of buildings and industry of 25% in the period to 2020 relative to 2007, with reductions of 29% in the residential sector, 33% in the non-residential sector, and 24% in industry.

The indicator framework also includes policy milestones to be met to help achieve targets. Key milestones are new policies to encourage the uptake of energy efficiency improvement in the residential sector, the extension of energy performance labelling to all buildings, new measures to encourage small and medium sized enterprises (SMEs) to reduce their emissions, and new incentives to support investment in renewable heat.

In assessing progress towards meeting carbon budgets in the buildings and industry sectors, we first consider progress towards implementing measures such as insulation. We then set out our assessment of key policy milestones, with a focus on policy innovation to deliver the measures in our indicator framework.

3. Residential buildings

Implementation of insulation measures

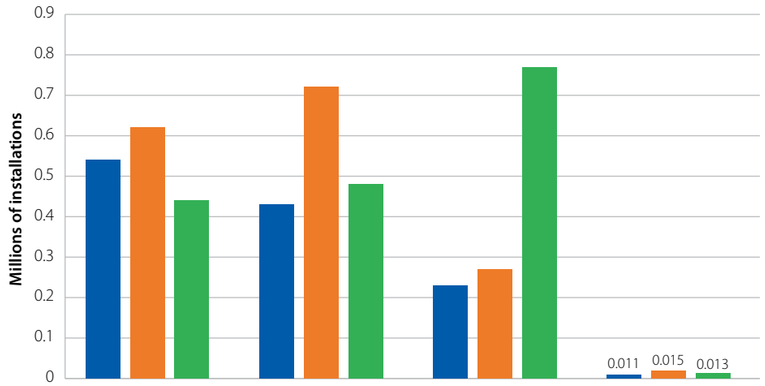
Insulation offers important opportunities for reducing emissions to meet carbon budgets, as well as allowing households to reduce their energy bills. In addition, a better insulated building stock is required to increase the number of properties suitable for renewable heat deployment required over the next two decades.

While delivery against our insulation indicators was good in 2009, in 2010 there was a significant slow-down in the numbers of professional loft and cavity insulation installations. In addition, rates of solid wall insulation remain low (Figure 3.12).

- Loft insulation. Professional loft insulation installations fell by around 30% in 2010, while DIY measures increased significantly (by a factor of 3). With DIY measures, loft insulation rates are above our indicator (Figure 3.13). However, there is uncertainty over the reported DIY figures. In the absence of any monitoring, it is not clear to what extent there is double counting (e.g. builders purchasing insulation material for work that falls under the building regulations) or whether DIY installations deliver the carbon savings claimed.
- Cavity wall insulation. There was a 30% decline in the number of cavity walls insulated in 2010. The installation rate is below our indicator for 2010, which is in turn at a low level relative to what is required beyond 2012 (Figure 3.14). Hard to fill cavity walls remain a particular challenge (see Box 3.1).
- Solid wall insulation. Rates of solid wall insulation remain low. In 2010, a total of only 13,200 solid walls were insulated under CERT (a drop of 15% compared to 2009), out of an available potential of around 8 million (Figure 3.15). Therefore, a significant acceleration in the pace of solid wall insulation is required, the driver for which will need to be the Green Deal and ECO (see below).

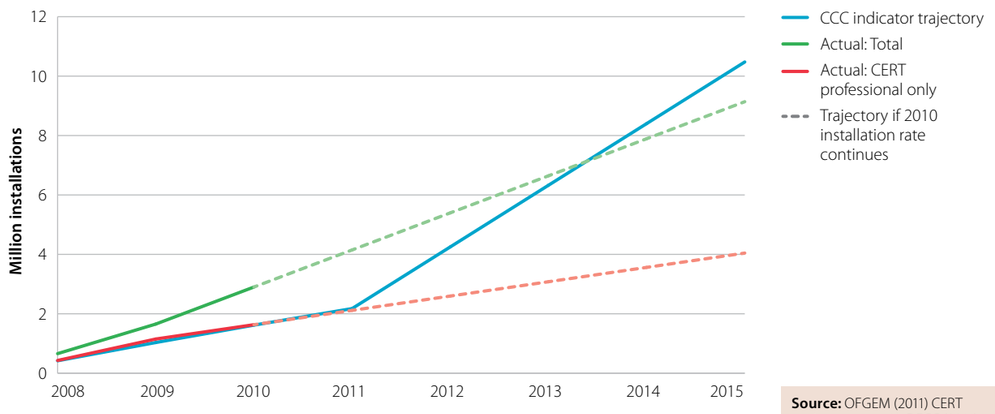
This underperformance against indicators highlights the crucial importance of ensuring that new policies provide sufficient incentives to improve energy efficiency in the large proportion of the housing stock that currently lacks adequate insulation.

Figure 3.12: Installation of residential insulation measures (2008-2010)



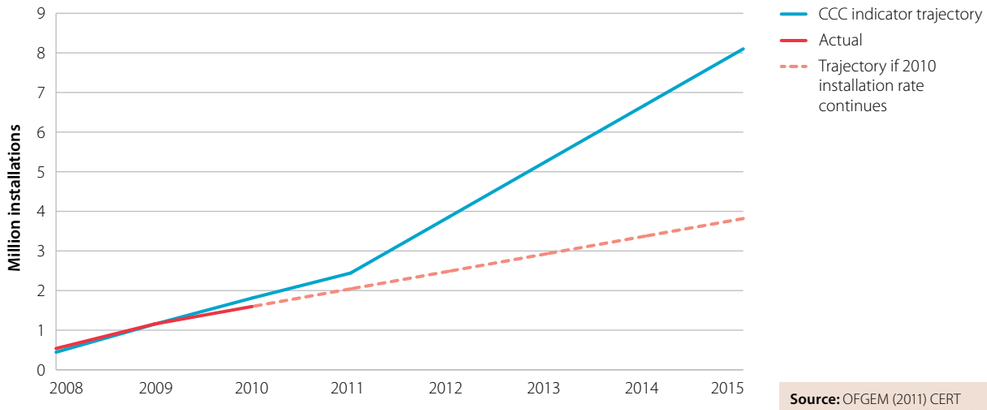
Source: OFGEM (2011) CERT update quarter 11; DECC (2011) Estimates of home insulation levels in Great Britain; CCC calculations.

Figure 3.13: Loft insulation cumulative installations (2008-2015)



Source: OFGEM (2011) CERT update quarter 11; DECC (2011) Estimates of home insulation levels in Great Britain; CCC calculations.

Figure 3.14: Cavity wall insulation cumulative installations (2008-2015)



Source: OFGEM (2011) CERT update quarter 11; DECC (2011) Estimates of home insulation levels in Great Britain; CCC calculations.

Box 3.1: Cavity walls

Cavity wall insulation is one of the cheapest CO_2 abatement options available at -£54/tCO_2. Out of a housing stock of 26 million, 19 million have cavity walls, and around 8 million remain uninsulated.

As discussed in our 2010 progress report, DECC assumes that a lower proportion of cavity walls are 'practical' to insulate than the Committee's indicator (75% versus 90%). DECC has since published new research to explore options for 'hard to fill' cavity walls[1] which suggests that:

- 65% of remaining cavities are hard to fill, with significant barriers to uptake.
- There is a saving potential of up 1 MtCO_2 from hard to fill cavity walls.

There are significant cost barriers in dealing with hard to fill cavities due to: associated building works, public disinterest, variability of costs of non-standard works, lack of funding mechanisms or subsidy for addressing non-standard cavities.

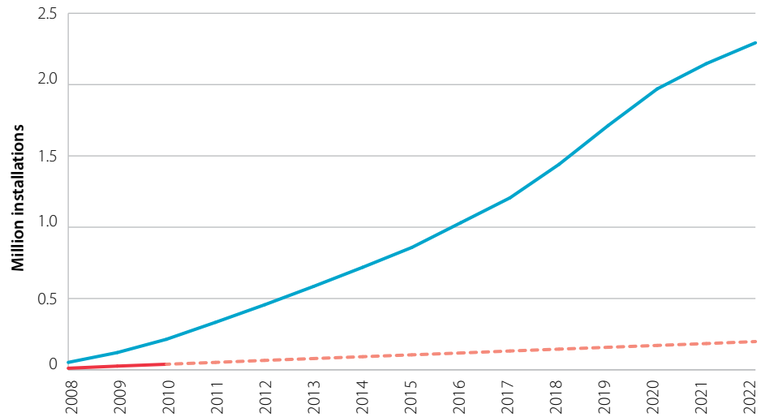
As the associated CO_2 savings are significant, it is important that barriers are addressed through policy. For example, the study proposes a new quality assurance mark for hard to fill cavity walls.

Boiler replacement

Replacement of old with energy efficient new boilers could result in a 6 MtCO_2 reduction over the next decade. In order to be on track to deliver this reduction, 1 million boilers would have to have been replaced in 2010. Performance was actually better than this, with around 1.3 million boilers replaced, partly due to the boiler scrappage schemes which operated in England, Scotland and Wales in 2010 (Figure 3.16).

1 http://www.decc.gov.uk/assets/decc/What%20we%20do/Supporting%20consumers/saving_energy/analysis/788-hard-to-fill-cavity-walls-domestic.pdf

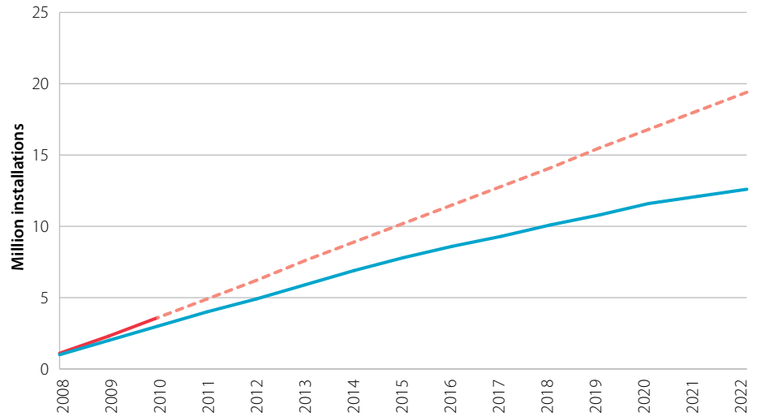
Figure 3.15: Solid wall insulation cumulative installations (2008-2022)



Source: OFGEM (2011) CERT update quarter 11; CCC calculations.

Going forward, we expect continued replacement to be broadly in line with our indicators, given that the boiler stock naturally turns over as boilers reach the end of their life. A slightly slower pace of replacement might now be expected, given that some of the boilers originally envisaged to be replaced in the next several years were replaced early under the scrappage schemes.

Figure 3.16: A-rated boilers cumulative installations (2008-2015)



Source: DCLG (2011) Housing statistics – Table 241; Heating and Hotwater Council (2011); CCC calculations.

Purchase of energy efficient appliances

The penetration of efficient cold and wet appliances in 2010 remained lower than the trajectories we set out in 2009:

- In 2010, the share of A++ (or better) cold appliances in the total stock remained very low (i.e. less than 1%). Given stock-flow considerations, the implication is that there is a need to quickly increase sales of A++ appliances to deliver the 45% share in 2022 in our indicator framework.
- Performance on wet appliances was better, with A+ appliances achieving a 8.3% share in the total stock. However, this was still lower than envisaged in our indicator trajectory, with a need to increase sales of A+ appliances to get on track to a 58% share in 2022.

In both cases, continued progress at 2010 rates would forego low-cost abatement opportunities. The result would be a need for increased investment in low-carbon generation or the need to offset power sector emissions from gas generation through the purchase of allowances in the European market. Given the benefits associated with efficient appliances, this raises questions about policy levers to encourage their uptake, both at EU and UK levels (e.g. fiscal incentives, raising minimum standards).

In December 2010, new A+, A++ and A+++ energy ratings for fridges, washing machines and dishwashers were introduced on a voluntary basis and will be made compulsory in late 2011. In the future, we will monitor against sales of A+ or better for wet appliances and A++ or better against cold appliances. In addition, we will consider energy efficiency data for other appliances if it becomes available. For example, energy labelling will become compulsory for televisions in 2011, and we may add a new indicator on this in the future.

Policy milestones

Current policy

The Carbon Emission Reduction Target (CERT) under which energy suppliers are required to deliver measures to reduce emissions, was extended in July 2010 to the end of 2012 (it was previously due to end in 2011). The overall CERT target was increased by 60%:

- We have previously suggested that CERT should focus on building fabric measures, and exclude giving out energy efficient light bulbs. This is now reflected in the design of the scheme, which from March 2011 no longer gives credit to energy efficient bulbs (although more than 300 million bulbs were distributed prior to this cut-off).
- The level of ambition for the remainder of the CERT period is consistent with our indicators. However, the slow progress in 2010 discussed above raises questions as to whether the CERT extension can now deliver its ambition to professionally insulate 2.1 million lofts, and 1.4 million cavity walls by December 2012. Even achieving these ambitious installation rates leaves a challenging path beyond 2012.

In addition to CERT, Warmfront, the Community Energy Saving Programme (CESP) and the devolved administrations own measures (see chapter 6) are delivering further energy efficiency measures:

- Warmfront, the Government's main fuel poverty programme for England, funds insulation and efficient boilers in low income households. In financial year 2009-10, Warmfront delivered over 21,000 cavity wall and 40,000 loft insulation measures, as well as 80,000 boiler replacements. Even though its budget was increased by £150 million to £345 million in financial year 2010-11, a high demand for measures resulted in the scheme running out of funds in December 2010. Furthermore, in the 2010 Spending Review, its funding was cut by more than two-thirds for 2011-12.
- CESP is an additional obligation on energy suppliers and focuses on whole house and area-based approaches in low income areas. CESP is effectively a pilot programme for the roll-out of solid wall insulation, with 81% of the proposed schemes offering this measure. The scheme has had a slow start – it commenced in October 2009 but by the end of 2010 only 7 schemes (out of 142 submitted) had been approved by the regulator OFGEM.

New proposals: the Green Deal and the ECO

Draft legislation brought forward in the Energy Bill would introduce new arrangements for financing and delivering energy efficiency improvements and fuel poverty measures from 2013:

- **Green Deal.** This will provide private sector finance for investments in energy efficiency without upfront costs to the householder, to be charged to the property and repaid through energy bill savings. Only those investments which result in savings over and above the amount to be repaid will qualify for finance (the Green Deal's "golden rule").
- **Energy Company Obligation (ECO).** This will replace CERT, CESP and Warmfront and require energy companies to deliver energy efficiency improvements for fuel poor households. It will also subsidise high cost measures under the Green Deal (e.g. solid wall insulation), with funding costs to be passed on to all consumers through energy bills.

Implementing arrangements include marketing, energy advice, accreditation, and regulation of the private rented sector:

- **Marketing and advice.** Green Deal providers will have access to EPC data to enable better targeting of the Green Deal. Accredited energy advisors will offer assessments on demand, recommending improvements from a list of approved measures.
- **Accreditation.** To build consumer confidence, energy advisors and installers will have to be certified and display a quality mark. There will also be insurance-based warranties for the work.

- **Regulation.** The Energy Bill contains a provision for minimum energy efficiency standards in the private rented sector to be introduced in 2018, making it illegal to rent out F and G rated properties.

We have previously highlighted the importance of non-financial (e.g. lack of information and hassle costs) and financial barriers (e.g. long payback periods for solid wall insulation) to energy efficiency improvement. We have suggested that these could be addressed through whole house and neighbourhood based approaches, underpinned by obligations, regulations and financial incentives, and with funding available for measures that have long pay-back periods:

- **Whole house approach.** This addresses non-financial barriers by providing a one stop shop, including an energy audit with follow up to implement a comprehensive range of measures.
- **Area-based approach.** This applies the whole house approach on a street by street basis. It strengthens incentives for uptake of measures, based on evidence that suggests people are likely to be more willing to act when they can see others acting. It also offers scope for cost reduction through scale economies.
- **Obligations and complementary incentives.** CERT and CESP have demonstrated that obligations on energy companies can deliver energy efficiency measures. Regulation of the private rented sector and fiscal incentives (e.g. stamp duty differentiation according to energy rating) would facilitate the delivery of any obligation.
- **Funding.** Although insulation of lofts and cavity walls offers scope for significant cost savings, solid wall insulation is unlikely to result in sufficient energy savings to fully offset up-front costs within a 20 – 25 year payback period; additional support will thus be needed.

Comparing our recommendations with the Government's proposals raises questions about how effectively the Green Deal and ECO will address barriers:

- **Delivery model.** The Green Deal does not preclude whole house or area-based approaches. However, the current proposals do not provide confidence that these approaches will be implemented, given uncertainty over the appetite of the private sector (e.g. of large retailers) for voluntary delivery of the Green Deal, and likely financial limits (see below) which will limit the opportunity for a whole house approach.
- **Regulation.** Possible regulation of 15% of the housing stock that is privately rented is positive. However, it is unclear why this should not be introduced earlier than 2018, given that the landlord-tenant split is currently preventing the widespread implementation of measures in this sector. This is evidenced by the fact that the private rented sector has a greater proportion of the least energy efficient properties. For example in England, 18% of privately rented homes have energy efficiency ratings of F and G and a high incidence of fuel poverty.

- **Funding and financing.**
  - Solid wall insulation is the main energy efficiency measure which could usefully be financed by the Green Deal. However, it is unlikely to meet the 'golden rule' (i.e. energy savings exceed up-front and financing costs). Therefore the ECO would have to subsidise solid wall insulation in order to reduce up-front costs to the point that these are less than energy savings (Box 3.2). We estimate that £0.7 to £17 billion of support will be required to insulate 2.3 million solid walls by 2022, under different assumptions about investment and financing costs (Box 3.2).
  - Combining this with mortgage financing where possible could reduce funding costs. For example, if 2 million solid walls were to be financed through mortgages rather than commercial rate Green Deal finance, this could reduce required ECO funding by £4 billion (Box 3.3). This would ease concerns over fuel poverty, given that ECO funding results in increased energy bills for those consumers not benefitting from energy efficiency improvement.
  - The proposed Green Deal finance cap is low relative to required investments, with the maximum of £10,000 (as envisaged by DECC) available per household for Green Deal measures unlikely to be sufficient. For many homes the cost of solid wall insulation alone could exceed this figure. In particular, if Green Deal and the Renewable Heat Incentive (RHI) measures were combined (as recommended in our Renewable Energy Review), financing packages of £20,000 or more will be needed in some cases. By contrast, the German CO_2 refurbishment programme offers subsidised loan packages of up to €50,000 per property.
  - Furthermore, ECO funding may be restricted under limits on DECC spending, given that this may be classed as tax and spend, limits for which were set to 2014 in the 2010 Spending Review.

Box 3.2: Solid wall programme costs

The net present cost for solid wall insulation is defined as the difference between the up-front investment cost of installing the measure and the discounted value of energy savings over an assumed lifetime of 20 years.

The programme funding cost can then be calculated as the net present cost (value, NPV) multiplied by the number of solid walls insulated.

The relevant variables in calculating programme cost are therefore the investment cost, the energy saving, the energy price, the discount rate, and the number of solid walls insulated.

The following examples illustrate the order of magnitude costs required to deliver the 2.3 million solid walls by 2022 in our indicator framework:

1 3.5% discount rate: Assuming an average upfront investment cost for solid wall insulation of £6200 based on the "average" 3 bedroom semi detached house; providing an annual energy saving of 8550 kWh per year; an average retail energy price for gas of 4.5p/kWh; a discount rate of 3.5% applied over a twenty year period results in a small net cost of around £0.7 billion.

2 7.5% discount rate: As 1, but assuming a 7.5% discount rate (e.g. to reflect the cost of unsecured finance) results in a cost of £4.5 billion.

3 High investment cost: As 2, but with an investment cost of £10,000, results in a cost of £13.2 billion.

4 15% discount rate: As 3, but with a high discount rate to reflect hidden costs, results in a cost of £17 billion.

Therefore the range for costs of funding a programme to insulate 2.3 million solid walls ranges from £0.7 – £17 billion. In order for such a programme to proceed, these costs would either have to be paid by the taxpayer, or added to energy bills as under the current CERT funding mechanism, and as proposed for the ECO.

Box 3.3: Green Deal financing costs

The cost of new mortgage finance is currently close to zero in real terms and rates offered on mortgages are considerably lower than those available for other types of finance (e.g. around 4 percentage points lower than rates for unsecured personal finance). The implication is that there could be a cost saving from financing solid wall insulation and other measures through mortgages rather than the Green Deal.

In order to unlock this cost saving, there would have to be scope for increasing mortgages. Evidence from the Financial Services Authority (FSA) suggests that such scope exists (e.g. at least 45% of households currently have loan to value ratios at or below 65%).

Table B3.3: Percentage of housing stock by mortgage loan to value ratio

<=10%	>10% <=20%	>20% <=30%	>30% <=40%	>40% <=50%	>50% <=60%	>60% <=65%
3%	5%	6%	8%	9%	10%	5%

Note: Based on unpublished FSA data, based on the Nationwide house price index (as at 2011, quarter 1) using a sample of 4 million residential mortgages. The ability to increase the value of a mortgage depends on more than the value of the house as the quality of the borrower will also be a consideration for mortgage lenders. There is some regional variation in these figures (e.g. loan to value ratios are relatively low in the South East).

If all those households with a favourable loan to value ratio were able and willing to finance energy efficiency improvement through mortgage finance, this could result in a significant cost saving relative to Green Deal finance (e.g. around £4 billion to 2020).

This suggests that energy efficiency policy should be designed to encourage use of mortgage finance where possible. For example, Green Deal assessors might offer homeowners with acceptable loan-to-value ratios a choice between mortgage and Green Deal finance, with additional incentives reflecting the cost savings associated with mortgage finance.

We make the following recommendations to provide confidence that the new approach will effectively address the full range of barriers and deliver required energy efficiency improvements in line with our indicator framework:

- **Comprehensive and ambitious obligation.** In order to provide confidence over the scale of delivery, the Government's energy efficiency programme and the ECO should cover the full range of measures at a level of ambition commensurate with that required to achieve carbon budgets.
  - The key measures to reduce emissions in the period to 2022 are loft, cavity wall and solid wall insulation.
  - Between 2012 and 2022, our analysis suggests that insulation of 8 million lofts, 6 million cavity walls and 2 million solid walls will be required to meet carbon budgets. The associated emissions saving would be around 8 $MtCO_2$, with up to an additional 20 $MtCO_2$ from the installation of renewable heat technologies.
  - Without such an obligation, it is unlikely that the required number of solid walls will be insulated and highly questionable whether lofts and cavity walls will be insulated. Other measures which could be financed by the Green Deal offer less in terms of their contribution to meeting carbon budgets.
  - In order to support such an ambitious obligation, it needs to be adequately funded (e.g. within any HMT spending limited related to DECC policies).
  - A comprehensive and ambitious obligation would not rule out participation of large retailers and other private sector participants, who could enter the market via partnerships with energy companies.
  - Such partnerships could work within a whole house and area-based approach, which would address barriers to uptake and bring economies of scale.
- **Use of mortgage finance.** Mortgage rates are likely to be lower than those for the Green Deal, and a significant proportion of mortgage holders have loan to value ratios that would in principle allow increased borrowing. Given that this is the case, financing of 2 million solid wall insulation through mortgage rather than Green Deal finance could result in cost savings of up to £4 billion to 2020.
- **Provision of additional fiscal incentives.** Given the potentially useful role of additional fiscal incentives (e.g. stamp duty rebates) in encouraging uptake of energy efficiency improvement, these should be seriously considered.
- **Provision of information to all households.** A commitment that all households will be provided with a free energy audit setting out opportunities for energy efficiency improvement would address non-financial barriers (e.g. lack of information, hassle costs) and therefore increase consumer demand. This need not be to the level of a fully-fledged Energy Performance Certificate. Rather, lower cost standardised products could be developed (e.g. setting out high level opportunities for generic house types) and rolled out together with the smart meter programme.

- **Clarity about the role of local authorities.** A coordinating and information provision role for local authorities should be considered (e.g. requiring local authorities to work with energy companies and commercial partners to develop local action plans).
- **Earlier introduction of regulation for the private rented sector.** Given the strong evidence on the landlord-tenant split, there is no reason to delay implementation of this aspect of the proposals. The regulation would only apply to F and G rated properties and improvements would be relatively low-cost in most cases (i.e. loft and cavity wall insulation, new boilers). More ambitious regulation would cover a higher proportion of the housing stock and should be considered.
- **Further assessment of fuel poverty implications.** The particular area of concern is the cost of subsidising solid wall insulation under the ECO which under current proposals would be passed through to all consumers, whether beneficiaries or not. If assessment suggests a significant risk of fuel poverty, mitigating measures that could be introduced include more targeting of the fuel poor under the ECO (e.g. to prioritise solid wall insulation in the 1.9 million fuel poor households that live in solid walled properties); adjusting energy suppliers' social tariffs or the Warm Homes Discount.

In our renewable energy review (published in May 2011) we highlighted the importance of integrating the approaches to energy efficiency and renewable heat. Specific recommendations included (see also section 5 below):

- Requiring the implementation of energy efficiency measures to qualify for the Renewable Heat Incentive (RHI).
- Marketing renewable heat options as part of a whole house approach.
- Offering finance for the up-front costs of renewable heat under the Green Deal.

We will monitor the detailed implementing arrangements for the Green Deal, the ECO and the RHI, and provide an assessment on the extent to which these address current deployment challenges in our report to Parliament in June 2012.

Zero carbon homes

The zero carbon homes policy (to be implemented in England by 2016) is important in the context of carbon budgets and the 2020 renewable energy target:

- Up to 7 million new homes will be required in the UK over the next two decades in order to accommodate growth in the number of households. For example, the government projects that the number of households will increase from the current 26 million to 33 million by 2030. Therefore the zero carbon homes policy could apply to a significant number of properties, and can thus help to meet carbon budgets.
- In addition, new homes are particularly suitable for the deployment of renewable heat and can thus make a significant contribution to the 2020 renewable energy target.

In the run-up to 2016, energy efficiency standards for new homes are being tightened progressively. In October 2010, revised building regulations were introduced that require a 25% improvement in energy efficiency over the 2006 building regulations. The exact details of the zero carbon policy are still under development but the definition of 'zero carbon' has recently been clarified (Box 3.4).

Box 3.4: Zero carbon homes

Whereas previously it was envisaged that homes would be zero carbon on a gross basis, the Government has announced that this will instead be defined on a net basis:

- As proposed by the Zero Carbon Hub, and announced in the March 2011 Budget, new homes will be required to make both on-site carbon reductions through low or zero carbon heat and the highest standards of energy efficiency, complemented by cost-effective options for off-site carbon reductions. The Government will be consulting with industry on how to take this forward.
  - According to Zero Carbon Hub, on-site CO_2 reductions of between 44 and 60% over 2006 building regulations (depending on dwelling type) are feasible.
- However, it is now proposed that the zero carbon requirement will only apply to emissions covered by the building regulations, i.e. heating, fixed lighting, hot water and building services. Electricity use for appliances and other lighting can still be met by grid electricity.

This change in definition has some potential implications for carbon budgets. In our fourth budget report, we had assumed no emissions or additional electricity capacity requirement from new homes. We now estimate that by 2030, new homes could require up to an additional 6 TWh of electricity which would have to be met by low carbon electricity generation capacity.

4. Non-residential buildings

Our framework of indicators for non-residential buildings includes high level emissions trajectories and policy milestones. For example, it includes emissions reduction of around 33% in 2020 relative to 2007, reflecting the take-up of cost-effective emissions reduction potential. In this respect, the flat emissions in the commercial sector and increased emissions in the public sector in 2010 suggest that there has been limited progress with the implementation of measures.

We do not include indicators for specific measures, as there is a lack of data on measures being installed in the non-residential sector. Our approach has been to focus on policies that incentivise the take-up of measures, on the basis that if incentives are in place then we can be more confident that cost-effective abatement will follow.

The main new policy covering the non-residential sector is the Carbon Reduction Commitment (CRC). As required under the Climate Change Act and requested by the Government, we published our recommendations for the capped phase of the CRC in September 2010. A key conclusion of the report was that there is scope, through a range of energy efficiency measures, to cut emissions in those sectors covered by the CRC by around 30% by 2017 relative to 2008 levels (Box 3.5).

Box 3.5: The Carbon Reduction Energy Efficiency Commitment (CRC)

The CRC covers large non energy-intensive companies and public sector organisation which together account for around 10% of UK greenhouse gas emissions.

In our 2010 report, we identified some aspects of the CRC design for further consideration:

- **Capping the number of allowances and auctioning.** We highlighted the complexities associated with setting a cap on the number of allowances in the CRC given uncertainty over abatement potential; and auctioning these to participants. We questioned whether this could be justified, given the absence of obvious benefits from introducing a cap and an auction.
- **Financial incentives.** We suggested that the mechanism for recycling revenues in the scheme was complex and unpredictable. We also questioned whether financial incentives in the scheme would continue to be necessary if a new carbon tax were to be introduced.
- **Reputational incentives.** We suggested that performance league tables would be more useful in strengthening reputational incentives if there were to be separate tables for public and private sector organisations. This would allow for the different opportunities and barriers that exist in each sector and concerns about transferring money from the public to the private sector.
- **Renewable heat.** We suggested that there should be no additional financial support for renewable heat under the CRC, given that the Renewable Heat Incentive is being introduced (see section 5 below).
- **Threshold for inclusion.** We suggested the need for further evidence on abatement opportunities in order to assess whether lowering the threshold for inclusion in the CRC would be justified.

In the 2010 Spending Review, the Government announced that it would drop revenue recycling from the CRC. Government is yet to respond on the range of issues that we raised; although we expect that these will be considered as part of the consultation to simplify the scheme due later this year.

Introducing more comprehensive information and incentives: roll out of EPCs and DECs

We have previously identified the lack of information as a barrier, both as regards the design of policy and the implementation of measures. Therefore we have proposed that Energy Performance Certificates (EPCs, assessing the theoretical energy performance of a building) and Display Energy Certificates (DECs, assessing the actual energy consumption in a building) should be fully rolled out across the non-residential sector.

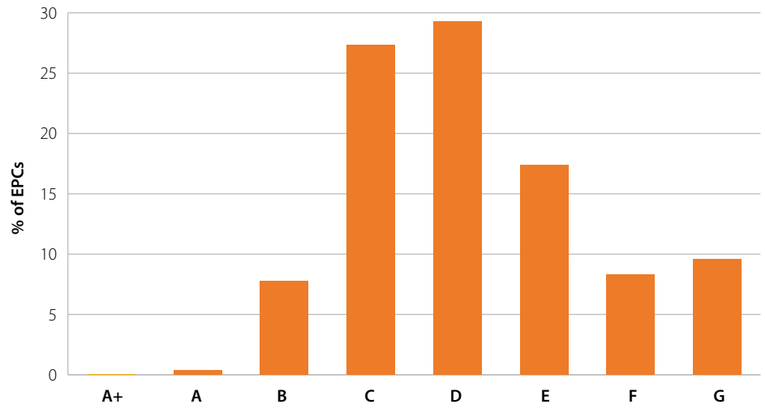
However, the current Government's position is that there should only be a partial roll-out on a mandatory basis:

- EPCs are mandatory on re-letting or sale of property, but voluntary for those properties currently let, or owner-occupied and not sold. Currently there is low compliance with this regulation. For example, indicative data suggests that up to 70% of properties are let or sold without an EPC. The intention is that this issue will be addressed through new legislation and increased powers for trading standards officers.
- DECs are mandatory for public buildings with a floor space over 1,000m^2, but voluntary for other buildings. The UK Green Building Council Task Group outlined in a recent report why a voluntary approach would not work. To date few firms have taken up DECs, and for competitive reasons those that have are frequently not displaying them due to the reputational risk of voluntarily showing certification of a poor rating. Notwithstanding the significant support for the mandatory roll-out of DECs demonstrated by respondents to the 2010 consultation by the Department of Communities and Local Government, the Government position is that a case has to be made as to why a voluntary approach could not work before it will consider a mandatory roll-out.

Given the importance of information, and limited roll-out to date, we recommend mandatory roll-out of EPCs and DECs to all non-residential buildings by 2017. Similar recommendations have been made by industry bodies including the Carbon Trust, the Aldersgate Group and, most recently, the CBI.

The latest data on the number of EPCs and DECs indicates that there are many buildings with the lowest ratings (F and G), where a large cost-effective abatement potential exists. For example, just under a fifth of non-residential buildings provided with an EPC by March 2011 achieved the two lowest energy rating bands (Figure 3.17). We have previously suggested that minimum standards should be introduced. As in the residential sector, the Energy Bill has a provision for regulating minimum standards in the non-residential sector (Box 3.6), which will be important for incentivising the take-up of the Green Deal.

Figure 3.17: Distribution of Energy Performance Certificates in the non-residential sector by rating as at March 2011



Source: Unpublished data received from DCLG (2011).

Box 3.6: The Green Deal and the Energy Bill – opportunities in the non-residential sector

Both the Green Deal and the Energy Bill cover the non-residential sectors, as well as the residential sector. It is envisaged that together these will encourage uptake of abatement potential in the SME sector in particular.

However, it is not clear whether the current proposals will successfully address the underlying opportunity:

- A recent study by construction and property consultants Cyril Sweett[2] suggests that the 'golden rule' will not work in many cases. In other words, key abatement measures will not pay back sufficiently, and will therefore not qualify for financing under the Green Deal.
- As with the residential sector, the Energy Bill includes a provision for the regulation of privately rented non-domestic properties by 2018. This is potentially important given that 60% of the non-residential building stock is privately rented, and strong evidence on landlord-tenant split incentives. However, it is not clear why introduction of regulation has been delayed.

The implication of these concerns is that current proposals should be changed in order to maximise incentives for uptake of measures. For example, the 'golden rule' under the Green Deal might be adapted in the case of non-residential buildings, and the introduction of regulations for the privately rented commercial properties could be accelerated.

In addition, it suggests the need for complementary policies to create demand for energy efficiency improvement which could then be financed through the Green Deal. These policies include the CRC and energy certification/related regulations (discussed above), and policies to support uptake of renewable heat (see below).

2

Public sector buildings

It is imperative for government credibility that the significant opportunity for reducing public sector emissions is addressed. This is recognised by the Government, which committed to reduce its emissions by 10% in 2010 on the central estate, and which preliminary data suggests has been achieved and exceeded in some instances. For example, DECC's Whitehall Place building in London has improved its energy consumption and associated emissions by 60% since 2008 and improved its DEC rating from a G to a D.

A new five year target to reduce all GHG emissions on the central Government estate will be announced during the summer. At the least this should be broadly commensurate with our assessment of cost-effective abatement potential (i.e. a 28% reduction by 2020), and could be achieved through a combination of demand side (e.g. more efficient lighting) and supply side (e.g. more efficient boilers) measures. We will monitor progress on further reducing central government emissions in our future progress reports.

At the local government level, the previous government's system of national indicators against which local government's performance was assessed (which included an indicator on local authorities' own carbon emissions) has been abolished. Instead, a Memorandum of Understanding signed between DECC and the Local Government Group earlier this year sets out how central and local government will work together to help and encourage English local councils to reduce their emissions. The approach is based on raising awareness and providing peer support, rather than setting top down targets for emissions reduction.

2 http://www.building.co.uk/5015871.article?origin=bldgsustainnewsletter

The majority of local authorities are also affected by the CRC. However it is not clear whether the new approach will sufficiently and comprehensively (i.e. across all local authorities) strengthen incentives for action to improve energy efficiency, particularly where available funds are limited in the context of budget cuts. Setting targets or standards (e.g. minimum EPC or DEC ratings) would bring the local authority approach in line with that of central government, and would provide more confidence that emissions reduction will follow.

Even if targets/minimum standards are introduced, it will be important to establish an evidence base on local authority emissions to facilitate effective monitoring and assessment of the extent to which these are being reduced.

5. Renewable heat options

Our indicator framework and the Government's Renewable Energy Strategy reflect an ambition to increase renewable heat penetration from current low levels of less than 2% to around 12% in 2020. This would lay the foundations for the deep cuts required in heat emissions through the 2020s, likely to come largely from deployment of renewable heat technologies.

There has been very limited progress to date in investing in renewable heat. This reflects the fact that there has historically been very little use of renewable heat in the UK and few incentives have been available. We recently set out a detailed assessment of the enabling framework for renewable heat in our Renewable Energy Review (May 2011), in which we made high-level recommendations on longer term ambition, funding and policies to address non-financial deployment barriers (Box 3.7).

Strengthened incentives will be required to achieve a major ramp-up to 12% renewable heat penetration by 2020. The RHI (Box 3.8), due to commence in 2011, is a first step but its success in tackling financial barriers will depend on the support that the scheme provides for specific technologies and the overall level of funding.

Box 3.7: CCC May 2011 Renewable Energy Review: renewable heat recommendations

Ambition

The Government should adopt an indicative target to achieve renewable heat penetration of 35% by 2030 as part of a broader strategy to prepare for meeting the fourth carbon budget.

Funding

The full range of technologies and applications should be funded under the RHI (e.g. it will be important to support deployment of electric heat pumps in the residential sector, given that this is the key option for required decarbonisation through the 2020s, see Box 3.8: RHI).

Early commitment on funding to 2020 and beyond will be required to provide confidence for investors and therefore support supply chain expansion.

Addressing non-financial barriers

There is a need to train and accredit sufficient numbers of suppliers of renewable heat technologies in order to enable supply chain expansion, which is a crucial determinant of uptake. Together with validation of equipment, this could also help to increase consumer confidence.

Interfacing energy efficiency and renewable heat policies would provide more suitable properties for renewable heat, could increase consumer information and confidence, and could – via the Green Deal – provide a means for financing investment in renewable heat technologies.

Box 3.8: Renewable Heat Incentive

Although there is scope for at least some renewable heat technologies to become cost-competitive over the next two decades, almost all renewable heat technologies are likely to be more expensive than conventional alternatives for at least the next decade.

Therefore if there is to be significant renewable heat deployment over the next decade, transitional financial support will be required before technology costs fall, and following which support can be reduced or removed.

The need for a financial support mechanism has been recognised by the current Government, which has committed to provide financial support through the Renewable Heat Incentive (RHI):

- Funding will start with a first phase in June 2011, and a second phase from October 2012.
  - In the first phase, long-term tariff support will be targeted in the non-residential sectors.
  - During the first phase, the residential sector will receive some 'premium tariffs' (up to 25,000 installations) and in return the householder will provide information on the performance of the technologies.
  - The second phase will begin with the launch of the Green Deal in October 2012 and will see households moved to the same form of long-term tariff support offered to the non-residential sector in the first phase. This timing offers the possibility for greater integration of renewable heat and energy efficiency policies than currently planned.
- Funding will be paid per unit of heat generated (e.g. rather than as an up-front contribution towards capital costs).
- In bioenergy applications, recipients of funding will be required to report on the sustainability of their biomass feedstock, with compulsory sustainability criteria to apply from 2013.

6. Emissions from industry

In considering progress reducing industry emissions, there are at least four complexities:

- Scope for reducing emissions is more uncertain than in other sectors (e.g. residential buildings).
- There is a multiplicity of measures for reducing emissions, which makes it difficult to set out a framework of progress indicators.
- There is limited data available on implementation of measures, which makes monitoring of progress difficult (as in the non-residential sector).

We have previously suggested that incentives for emission reduction may be stronger in industry than in other sectors, particularly where energy accounts for a significant share of total costs. However, there is limited evidence that measures are bringing emissions down in line with the high-level trajectories in our indicator framework (i.e. the observed reductions are primarily due to the recession).

In this report we therefore focus on incentives for uptake of abatement measures, both as regards cheaper near-term measures to improve energy efficiency, and more expensive longer-term measures identified in our report on the fourth carbon budget. Depending on the way that incentives are introduced, this could provide the basis for a more comprehensive monitoring framework in future.

We now consider in turn:

1. Opportunities for reducing emissions
2. Barriers to uptake: investment cycles and capital constraints
3. Current and future policies to address abatement opportunities
4. The Committee's future approach to industry: developing an indicator framework

Opportunities for reducing emissions

We have previously highlighted scope for emissions reduction in industry in the first three budget periods:

- **Energy efficiency improvement.** The ENUSIM model used by Government suggests scope for reducing industry emissions by around 7 $MtCO_2$ in the period to 2020 through energy efficiency measures. Although we have previously questioned how robust this model is, it is likely that there is a significant opportunity in this area.
- **Low carbon heat.** Modelling conducted by NERA for our 2009 progress report suggests the potential to reduce industry emissions by 9 $MtCO_2$ by 2020 primarily through biomass and biogas, with smaller contributions from heat pumps and CHP.

Going beyond 2020, our fourth carbon budget report highlighted opportunities for industry abatement through CCS, and various industry specific options:

- CCS could be feasible and cost-effective for deployment in the iron and steel sector and the chemicals industry from 2030. In 2050, CCS offers potential for cost effective emissions reduction of around 40 $MtCO_2$. Demonstration of CCS in industry, either here in the UK or elsewhere, is crucial to resolving current uncertainties about this potentially key technology (Box 3.9).
- Analysis that we commissioned from AEA Technology and presented in the fourth budget report identified cost-effective options for abatement in energy-intensive industries. These included increased recycling of steel, increased use of clinker substitutes in the cement sector and reduction of flaring in refineries. Taken together, these opportunities could provide an additional 12 $MtCO_2$ in 2030.
- Further abatement potential is likely in industry subject to strengthening of the evidence base, in particular, through product substitution options (such as the use biomass, e.g. wood in construction) and materials efficiency (e.g. light-weighting of steel products).

Box 3.9: International progress in industrial CCS

A feasibility study by ArcelorMittal into the use of industrial CCS is being conducted at its Florange site in France. The purpose of this study is to assess the suitability of the site for retrofitting a CO_2 capture and storage prototype project to an iron and steel manufacturing plant. The study and assessments aim to also identify the location for where the CO_2 will be injected into a saline formation. If the demonstration project proceeds, construction would commence 2012/2013 and injection would start by 2015.

Support for industrial CCS is offered under the New Entrants Reserve (NER 300), which will generate funds through selling 300 million allowances in the EU ETS. The NER 300 will support up to 12 CCS projects (including capturing and storing CO_2 from fossil fuel power generation and primary industry). Member states recently submitted grant proposals to the European Investment Bank, which is due to publish a list of recommended projects to the European Commission in February 2012.

Barriers to uptake: investment cycles and capital constraints

The existing set of policy measures is unlikely to encourage sufficient low-carbon investment in energy-intensive industry to meet future carbon budgets because of significant barriers to investment. The analysis by AEA demonstrated the importance of long lead times and high capital costs in constraining the uptake of measures:

- **Refurbishment cycles.** The abatement measures that we have identified for carbon-intensive industry in the 2020s typically have long lead times. Given the difficulty of retrofitting, and to avoid missing low carbon investment opportunities, it is important to prepare early for abatement in line with refurbishment cycles. For example, there is currently a risk that investments in the iron and steel industry will lock in to high carbon technologies. Policy should be designed to provide incentives for avoiding such lock-in, in order to preserve abatement opportunities in the 2020s.
- **Capital constraints.** Many of the cost-effective opportunities in energy-intensive industry have substantial upfront requirements for capital. For businesses making investment decisions in a capital constrained environment, low-carbon investments with longer paybacks will struggle to compete with investments in other parts of the supply chain. For example, in stakeholder consultations conducted by AEA in the chemicals sector, it was suggested that high capital cost measures and competition for capital could result in over 50% less abatement in 2030. This raises a question about whether some form of financing support may be appropriate for large investments with long payback periods.

Current and future policies to address abatement opportunities

In our 2010 progress report we outlined the current policy framework for industry, which includes CCAs, the EU ETS, the CRC and the RHI (for recent updates see Box 3.10). In this section we focus on the key policies for energy-intensive industry and their limitations.

Box 3.10 Industry sector policy updates

CCAs

As announced in the March 2011 Budget, CCAs will now run to 2023, with the first new CCAs to be signed in 2013 following consultation in 2011. The climate change levy discount on electricity for CCA participants will be increased from 65 to 80% from April 2013 to continue to support energy-intensive businesses exposed to international competition.

EUETS

Phase 3 of the scheme runs from 2013 to 2020, and includes changes to the design of the scheme including changes to the overall cap, a move toward auctioning and a limit on the use of project credits from outside the EU. For industry, the move towards benchmarking is important:

- Industrial sectors will be allocated allowances for free on the basis of product benchmarks. The benchmarks will be set on the basis of the average of the top 10% most greenhouse gas efficient installations in the EU.
- Sectors deemed at significant risk of relocating production outside of the EU due to the carbon price (i.e. carbon leakage) will receive 100% of the benchmarked allocation for free.
- Sectors not deemed at significant risk of carbon leakage will receive 80% of their benchmarked allocation for free in 2013, declining to 30% in 2020 and 0% in 2027.

In our Renewables Review we outlined that higher electricity prices could add to the impact of the EUETS and lead to impacts on competitiveness of a small number of energy-intensive UK industries which compete in global markets (e.g. iron and steel, aluminium). Options for addressing these impacts could include increasing the rebate on the Climate Change Levy, rebating tax as allowed under the EU ETS Directive, and possibly exempting energy-intensive industries from that part of the electricity price which relates to renewables support (e.g. as in some EU countries).

Climate Change Agreements

These agreements between the Government and energy-intensive companies provide an exemption on the Climate Change Levy in return for delivering agreed emissions reduction.

The majority of sectors met their annual carbon reduction targets under CCAs (36 of 52 sectors in the most recent review period). However, it is unclear whether targets were sufficiently stretching relative to underlying abatement potential (particularly in the early years of the scheme, as shown in a study by Martin, *et al.*[3]), and whether meeting of targets was due to CCAs or other factors (e.g. energy prices, demand). Furthermore, given the relatively short term nature of CCAs, these have not been able to address abatement opportunities with long lead times and longer pay-back periods.

Following consultation in 2011, new agreements will be signed in 2013. It has been announced that these will be extended to cover the period to 2023. Given evidence of limited emissions reduction in the past under CCAs, the challenge will be to define agreements, within this longer term framework, which are sufficiently tight and comprehensive to put sectors on track to meeting the carbon budgets.

3 http://cep.lse.ac.uk/pubs/download/dp0917.pdf.

New CCAs should therefore be agreed via a process which includes a rigorous assessment of the full range of options, and requires implementation of options which are cost-effective with a carbon price of £30/tCO_2 in 2020 and rising through the 2020s.

The new CCAs should include the full range of abatement measures, including energy efficiency improvement but also longer-term measures (preparing for CCS, recycling in iron and steel, product substitution etc). Long-term sector agreements could include industry plans and milestones around long-term investments to reduce emissions. Such agreements are already in place in the Netherlands, and appear to be performing well.

EU ETS

Verified emissions in the EU ETS have been consistently below the allocation of allowances. This has been exacerbated by the recession, which has further dampened the carbon price signal from the EU ETS.

Although there is a progressively tightening EU ETS cap to 2020, it is unlikely that this will result in significantly increased carbon prices over the next decade (see overview chapter).

Given the combination of limited carbon price signal, and uncertainty over the EU ETS in the 2020s, this weakens incentives for energy-intensive industries to prepare for and make long-term investments, particularly when capital is constrained.

Given the existence of capital constraints, it may be necessary to complement long term sector agreements with new instruments to provide long-term finance. As noted above, for example, our analysis has identified possible capital constraints in chemicals and refineries sectors which may prevent investments in low carbon technologies from proceeding. The Green Investment Bank (GIB) offers an opportunity to address such barriers through the provision of dedicated finance for low-carbon investments in energy-intensive industries. This is something that should be considered further as more detailed proposals for the GIB are developed.

The Committee's future approach to industry: developing an indicator framework

In the 2010 progress report we indicated the need to strengthen the evidence base on industrial abatement opportunities. Although progress has been made regarding energy-intensive industry, the evidence on abatement options and policy response for the remainder of industry (e.g. light manufacturing) requires further work. We will continue working with DECC to improve the evidence base and depending on progress, set out indicators on specific measures.

We are also currently assessing scope for product substitution (e.g. wood for construction in buildings) and materials efficiency (e.g. extension of the life of products). We will present the results of this analysis in our bioenergy review, to be published later in 2011.

Key findings

- Buildings CO_2 emissions **increased by 7%** in 2010, largely due to increased demand for heating as a result of the cold winter weather.
- The number of professional cavity wall and loft insulation installations **fell by 30%** over the year.
- Government should aim to **insulate all lofts and cavity walls** by 2015, along with **2 million solid walls** by 2020.
- The **Green Deal and Energy Company Obligation need to provide sufficient incentives** to improve energy efficiency in the large proportion of the housing stock that currently lacks adequate insulation.
- Energy Performance Certificates (EPCs) and Display Energy Certificates (DECs) should be **introduced into all non-residential buildings** to incentivise emissions reduction.
- Industry CO_2 emissions **increased by 2%** in 2010 as manufacturers recovered from the recession.
- The **new round of Climate Change Agreements (CCAs)** should encourage uptake of **the full range of abatement options**, including both measures to reduce emissions in the near term and preparations for longer term abatement options (e.g. through CCS).

Table 3.1 The Committee's buildings and industry indicators

BUILDINGS AND INDUSTRY		Budget 1	Budget 2	Budget 3	2010 trajectory	2010 outturn
All buildings and industry						
Headline indicators						
CO_2 emissions (% change on 2007)*	direct	-9%	-12%	-16%	-6%	6%
	indirect**	-11%	-28%	-58%	-13%	3%
Final energy consumption (% change on 2007)	non-electricity	-10%	-18%	-23%	-5%	10%
	electricity (autogen included)***	-8%	-7%	-5%	-8%	1%
	electricity (centrally produced)***	-4%	-9%	-13%	-5%	1%
Residential buildings						
Headline indicators						
CO_2 emissions (indicative minimum % change on 2007)*	direct	-6%	-18%	-20%	0%	13%
	indirect**	-11%	-23%	-53%	-13%	2%
Final energy consumption (indicative minimum % change on 2007)	non-electricity	-6%	-18%	-19%	0%	14%
	electricity (autogen included)***	-5%	-4%	-3%	-6%	0%
	electricity (centrally produced)***	-5%	-4%	-3%	-6%	0%
Supporting indicators						
Uptake of solid wall insulation (million homes, total additional installations compared to 2007 levels)		0.5	1.2	2.3	0.21	0.04
Uptake of loft insulation (up to and including 100mm) (million homes, total additional installations compared to 2007 levels)		2.3	5.6	5.6	1.6	2.9/1.6 (CERT professional)
Uptake of loft insulation (100mm +) (million homes, total additional installations compared to 2007 levels)		2.0	4.9	4.9		
Uptake of cavity wall insulation (million homes, total additional installations compared to 2007 levels)		3.9	8.1	8.1	1.8	1.6
Uptake of energy efficient boilers (million homes, total additional installations compared to 2007 levels)		4.9	9.3	12.6	3.0	3.6
Uptake of energy efficient appliances – cold A++ rated (% of stock)		3%	18%	45%	0.9%	0.1%

Table 3.1 The Committee's buildings and industry indicators

BUILDINGS AND INDUSTRY		Budget 1	Budget 2	Budget 3	2010 trajectory	2010 outturn
Uptake of energy efficient appliances – wet A+ rated (% of stock)		16%	40%	58%	9.5%	8.3%
Every house offered whole-house energy audit			By 2017			n/a
New energy efficiency financing mechanism budgeted and legislation in place		2011				Energy Bill going through Parliament to introduce Green Deal
Post CERT delivery framework legislation in place		2012				Energy Bill has provisions for new Energy Company Obligation
Accelerate the introduction of minimum standards for privately rented residential properties		by 2012				Energy Bill proposes introduction by 2018
Introduce additional financial incentives (e.g. stamp duty rebates)			By 2016			n/a
Other drivers						
Average SAP rating, population (by age), number of households (by type – building and occupants), household disposable income, electricity and gas prices, appliance ownership, weather.					See technical annex for these indicators	
Non-residential buildings						
Headline indicators						
CO_2 emissions (indicative minimum % change on 2007)*	direct	6%	2%	-3%	8%	4%
	indirect**	-9%	-22%	-51%	-10%	2%
Final energy consumption (indicative minimum % change on 2007)	non-electricity	-4%	-8%	-13%	-2%	6%
	electricity (autogen included)***	-1%	-1%	-1%	0%	0%
	electricity (centrally produced)***	-1%	-1%	-1%	0%	1%

*These indicators should be considered jointly. Reductions in total emissions from buildings and industry reflect savings from renewable heat. We do not however set out in advance the split of these savings across sectors. Therefore emissions changes for individual sectors do not assume any savings from renewable heat and reflect a minimum level of change.

**These changes are based on centrally produced electricity demand changes whose carbon intensity is assumed to be that of new build gas. Within our modelling of the power sector, emissions from electricity generation are lower than is represented here due to different assumptions about carbon intensity. The indirect emissions shown here are therefore conservative.

***Figures show percentage changes in total electricity consumption including auto generated electricity, and in centrally produced electricity only.

****The classification of industry has changed from previous CCC progress reports and these trajectories include this update. Industry energy consumption exludes energy consumption from refineries and other energy supply.

Note: Numbers indicate amount in last year of budget period i.e. 2012, 2017, 2022.

Key: Headline indicators Implementation indicators Milestones Other drivers

Table 3.1 The Committee's buildings and industry indicators

BUILDINGS AND INDUSTRY		Budget 1	Budget 2	Budget 3	2010 trajectory	2010 outturn
Supporting indicators						
Develop policy on SMEs		By October 2010				Green Deal aimed at SMEs but exact ambition unclear
Accelerate the introduction of minimum standards for privately rented non-residential properties			By October 2016			Energy Bill proposes introduction by 2018
Government decision on the following recommendations for EPCs and DECs:		By October 2010				
• All non-residential buildings to have an EPC			By 2017			No commitment to do this
• All non-residential buildings to have a minimum EPC rating of F or higher				By 2020		No commitment to do this
• Roll out of DECs to non-public buildings			By 2017			Government is developing options for extending DECs to commercial buildings
All public buildings covered by CRC to realise all cost-effective emissions change potential			By 2018	By 2018		On-going
Other drivers						
Emissions and fuel consumption by subsector, GVA vs. GDP for each sub-sector, electricity and gas prices.					See technical annex for these indicators	
Industry**						
Headline indicators						
CO_2 emissions (indicative minimum % change on 2007)*	direct	-13%	-7%	-1%	-12%	1%
	indirect**	-12%	-35%	-66%	-16%	5%
Final energy consumption (indicative minimum % change on 2007)	non-electricity	-20%	-21%	-19%	-17%	5%
	electricity (autogen included)***	-16%	-11%	-5%	-14%	3%
	electricity (centrally produced)***	-6%	-18%	-30%	-9%	4%

Table 3.1 The Committee's buildings and industry indicators

BUILDINGS AND INDUSTRY	Budget 1	Budget 2	Budget 3	2010 trajectory	2010 outturn
Other drivers/wider monitoring					
Emissions and fuel consumption by subsector, GVA vs. GVA for each sub-sector, electricty and gas prices.				See technical annex for these indicators	
Renewable heat					
Headline indicators					
Renewable heat penetration (% of heat demand from renewables)	1%	5%	12% in 2020	0%	n/a
Supporting indicators					
Renewable Heat Incentive in operation	From April 2011				The RHI policy document was released in March 2011. Aim to approve regulations in Parliament in summer 2011. The scheme will be introduced shortly thereafter.
Other drivers					
Uptake and costs of renewable heat technologies, Biomass boilers, Solar thermal, GSHP/ASHP, District heating.				See technical annex for these indicators	

*These indicators should be considered jointly. Reductions in total emissions from buildings and industry reflect savings from renewable heat. We do not however set out in advance the split of these savings across sectors. Therefore emissions changes for individual sectors do not assume any savings from renewable heat and reflect a minimum level of change.

**These changes are based on centrally produced electricity demand changes whose carbon intensity is assumed to be that of new build gas. Within our modelling of the power sector, emissions from electricity generation are lower than is represented here due to different assumptions about carbon intensity. The indirect emissions shown here are therefore conservative.

***Figures show percentage changes in total electricity consumption including auto generated electricity, and in centrally produced electricity only.

****The classification of industry has changed from previous CCC progress reports and these trajectories include this update. Industry energy consumption exludes energy consumption from refineries and other energy supply.

Note: Numbers indicate amount in last year of budget period i.e. 2012, 2017, 2022.

Key: Headline indicators Implementation indicators Milestones Other drivers

Chapter 4: Progress reducing transport emissions

Introduction and key messages

Domestic transport emissions (i.e. excluding emissions from international aviation and shipping) currently account for around 25% of total UK CO_2 emissions and 21% of total GHG emissions.

In our last progress report, we showed that surface transport emissions fell during the recession due to the purchase of more efficient vehicles and a reduction in distance travelled. This was against a longer-term trend of rising emissions, with increased distance travelled more than offsetting the impact of improved vehicle efficiency.

In this report we consider final emissions data for 2009 and preliminary data on key variables for 2010. We assess emissions trends and drivers, and consider progress in reducing underlying emissions. We focus, in particular, on new car and van emissions, progress in developing electric vehicle markets, and progress towards changed travel behaviour.

Our key messages are:

- Surface transport emissions fell by around 3.8% in 2009 as a result of car and HGV efficiency improvements, reduced distance travelled and increased penetration of biofuels, broadly in line with our emissions indicator. Preliminary data suggest further emissions reductions are likely in 2010, arising from car efficiency improvements, reduced car and HGV distance travelled, increased penetration of biofuels and weather effects. Indeed if the winter months of 2010 (January, February and December) had not been particularly cold, total transport emissions might have been up to 1% higher than actual outturn (See Chapter 1, Box 1.1). Our indicator in 2010 is a 0.1% reduction in surface transport emissions.
- New car emissions fell from 149.5 gCO_2/km in 2009 to 144.2 gCO_2/km in 2010. This significantly outperforms our indicator for new car emissions in 2010. Whether this is sustainable progress towards the 95 gCO_2/km target in 2020, or a transitory effect of the recession and rising oil prices, will need to be closely monitored.
- The Government has made major commitments to support electric vehicle market development, as regards both vehicle purchase and roll-out of charging infrastructure. This is crucial if longer term objectives to decarbonise surface transport are to be achieved.

In 2010 registrations were mostly limited to pilot schemes, with full electric cars only reaching dealers in late 2010.

- Behaviour change
  - The Local Sustainable Transport Fund could support roll-out of smarter choices initiatives.
  - However, there has been only the most limited progress on eco-driving training.
  - The current review of the planning policy framework offers a potential opportunity for transport emissions impacts to be more fully accounted for in land-use planning decisions.
  - There was an increase in speeding on motorways and dual carriageways in 2009, following several years of decreasing speeding. A sustained increase in speeds would significantly increase emissions (e.g. an 80mph speed limit could result in emissions up to 3.5 $MtCO_2$ higher than restricting speeds to the current limit).

The analysis that underpins these messages is set out in seven sections:

1. Transport emission trends
2. Recap of the indicator framework
3. Progress reducing car emissions
4. Progress reducing van emissions
5. Progress developing electric vehicle markets
6. Progress changing behaviour
7. Opportunities for longer term emissions reductions

1. Transport emission trends

In assessing transport emissions, we now consider:

(i) Total surface transport emissions

(ii) Car emissions

(iii) Van emissions

(iv) HGV emissions

(v) Motorbike emissions

(vi) Public transport emissions

(vii) Aviation emissions

(viii) Shipping emissions

(i) Total surface transport emissions

Preliminary data for 2010 relate to total transport emissions, and are not disaggregated (e.g. to surface transport emissions, car emissions). These data suggest that total transport CO_2 emissions fell by 0.2% in 2010. If the winter months of 2010 (January, February and December) had not been particularly cold, total transport emissions might have been up to 1% higher than actual outturn (See Chapter 1, Box 1.1). Transport emissions accounted for around 25% of total CO_2 emissions in 2010.

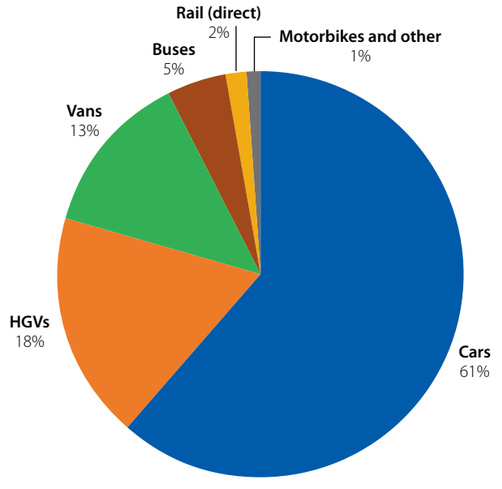
Given the lack of disaggregated data for 2010, our focus in this section is to consider final data for 2009. Where possible, we make inferences about 2010 emissions for each mode based on data for new vehicle emissions, distance travelled and biofuels penetration.

Final data for 2009 show that surface transport emissions accounted for 24% of total CO_2 emissions and 21% of total greenhouse gas emissions. They were dominated by emissions from cars (61% share of surface transport CO_2 emissions), vans (13% share) and HGVs (18% share), see Figure 4.1.

Surface transport emissions fell by around 4%, in line with what is required to meet carbon budgets (Figure 4.2):

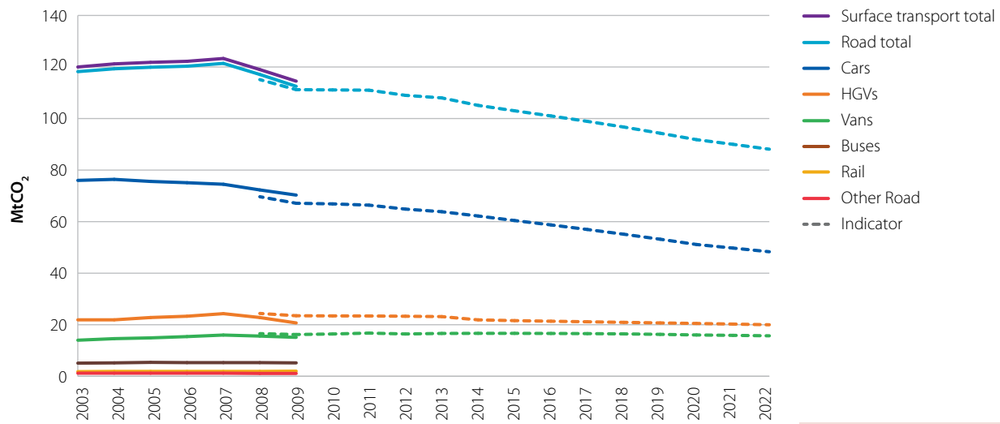
- Surface transport CO_2 emissions fell by around 3.8% in 2009, from 119.0 $MtCO_2$ in 2008 to 114.5 $MtCO_2$ in 2009.
- Emissions reductions were driven by more efficient vehicles, increased penetration of biofuels, and reduced distance travelled for cars, vans and HGVs (see below).

Figure 4.1: Breakdown of surface transport CO_2 emissions by mode in 2009



Source: DECC (2011) 2009 *UK greenhouse gas emissions, final figures.*

Figure 4.2: Surface transport emissions – historic and indicator trajectory



Source: DECC (2011) 2009 *UK greenhouse gas emissions, final figures*. CCC modelling.

- Emissions reductions in 2009 are consistent with the annual average 2.1% emissions reduction to 2020 in our indicator framework (i.e. are on track to deliver the surface transport contribution to meeting carbon budgets).

There was a 6.0% reduction in the five years to 2009. However, the longer-term trend since 1990 was rising emissions (e.g. between 1990 and 2009 emissions increased by 2.8%).

Given this longer-term trend, there is uncertainty over whether emissions will continue to fall at the rate observed in 2009 as the economy recovers. In particular, there is a risk that with stronger GDP growth distance travelled will increase, and that shifts in vehicle purchase behaviour may prove to be temporary.

(ii) Car emissions

Car emissions accounted for 61% of surface transport CO_2 emissions in 2009, almost 15% of total CO_2 emissions, and 13% of total greenhouse gas emissions.

Car CO_2 emissions fell by 2.7% in 2009, reflecting a combination of more efficient vehicles, increased penetration of biofuels, and reduced distance travelled (Figure 4.3). This compares with annual average emissions reductions of 2.9% required to 2020 in order to achieve carbon budgets (Figure 4.2).

- New car emissions fell from 158.0 gCO_2/km in 2008 to 149.5 gCO_2/km in 2009 (a 5.4% reduction).
- Combined bioethanol and biodiesel penetration increased to 2.1% in 2009 from 1.5% in 2008.
- Distance travelled fell by 0.2% in 2009, from 418.1 billion vehicle-km in 2008 to 417.0 billion vehicle-km in 2009.
- These figures imply that average fleet efficiency improved from 172.9 gCO_2/km in 2008 to 168.6 gCO_2/km in 2009.

In last year's progress report, we suggested that improvements in new car efficiency and reduced distance travelled were due at least in part to the recession. This raises questions about the need to use fiscal levers to ensure that progress is sustained as the economy recovers (see Section 4.3 below).

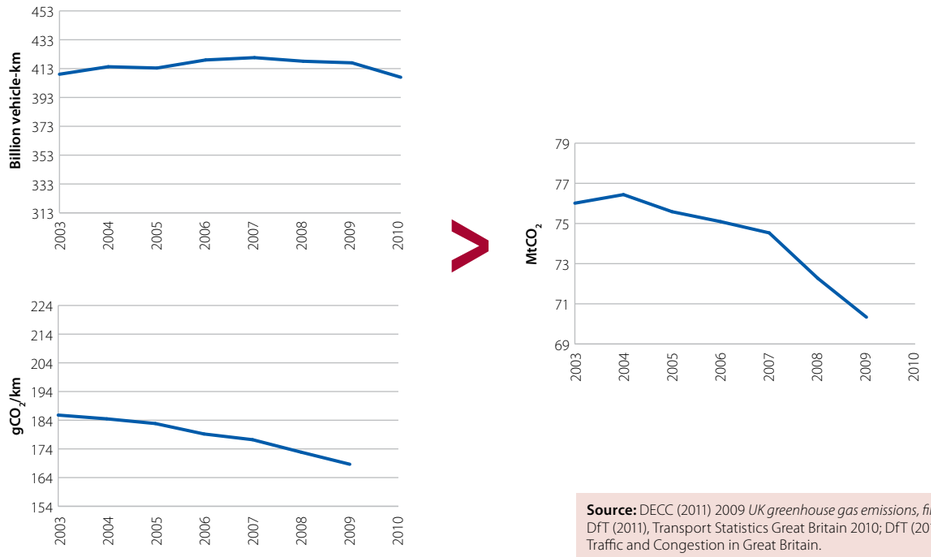
Although data are not available for car emissions in 2010, we have data for new car emissions, biofuels and distance travelled:

- New car emissions fell from 149.5 gCO_2/km in 2009 to 144.2 gCO_2/km in 2010 (a 3.5% reduction).
- Distance travelled fell by 2.4% in 2010, from 417.0 billion vehicle-km in 2009 to 407.0 billion vehicle-km in 2010; this is likely to be due to a combination of ongoing effects of the recession and a rise in fuel prices (Box 4.1), as well as temporary factors such as cold weather.
- Combined bioethanol and biodiesel penetration increased from 2.1% to 3.2% in 2010, driven by the Renewable Transport Fuels Obligation (RTFO – see Box 4.2).

The emissions impact of the combination of these measures is uncertain, but could result in a range of emissions reductions of the order of 3-3.5%, this would be consistent with our indicator trajectory.

However looking ahead there are risks that emissions reductions will not continue as the economy recovers, or if oil prices were to decrease significantly. Therefore it is important that the drivers of car emissions are closely monitored and appropriate policy implemented if the required rate of progress is not achieved.

Figure 4.3: Historic trends of vehicle km, $MtCO_2$ and gCO_2/km for cars (2003-2010)



Source: DECC (2011) 2009 *UK greenhouse gas emissions, final figures*; DfT (2011), Transport Statistics Great Britain 2010; DfT (2011) Road Traffic and Congestion in Great Britain.

Box 4.1: Economic drivers of transport trends 2008-2010

Figure B4.1 shows changes in economic drivers of transport activity between 2008 and 2010.

Prices are taken from the transport components of the Retail Prices Index. These relate to the use of motor vehicles (purchase of vehicle, maintenance, petrol & oil and tax & insurance) and public transport fares (rail fares and bus and coach fares).

Two measures of income are available: GDP and household disposable income. These are taken from Office of National Statistics (ONS) data. Activity in the freight sector is forecast using GDP as a determining factor, while activity in the passenger sector is forecast using household disposable income as a determining factor.

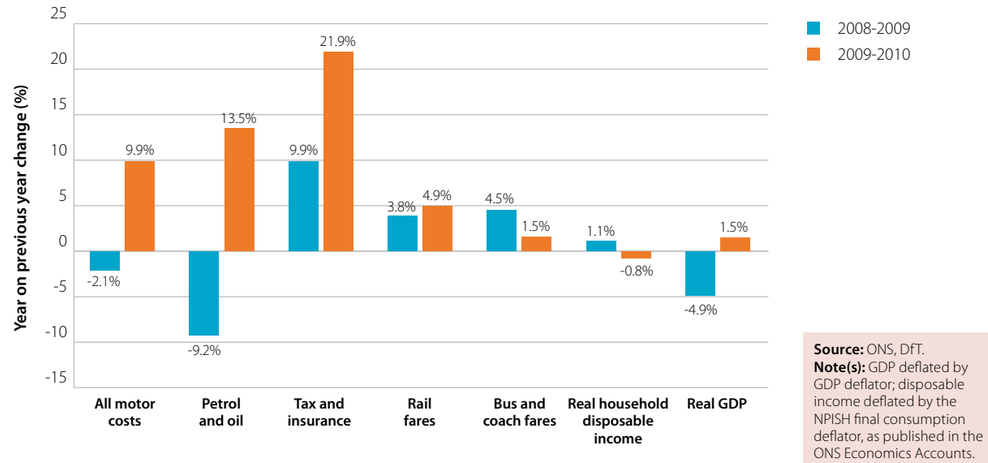
Petrol and oil prices decreased by 9.2% in 2009, accompanied by a decrease in vehicle purchase costs and an increase in vehicle maintenance and tax and insurance costs. The overall cost of motor vehicle use decreased by 2.1% in 2009, accompanied by a 3.8% increase in rail fares and a 4.5% increase in bus and coach fares, such that the overall cost of motor vehicle use therefore declined considerably relative to public transport fares.

Petrol and oil prices increased by 13.5% in 2010, accompanied by an increase in vehicle purchase, vehicle maintenance and tax and insurance costs. The overall cost of use of motor vehicles increased by 9.9% in 2010, accompanied by a 4.9% increase in rail fares and a 1.5% increase in bus and coach fares, such that the overall cost of motor vehicle use therefore increased relative to public transport fares.

Box 4.1: Economic drivers of transport trends 2008-2010

Real GDP decreased by 4.9% in 2009, though real household disposable income increased by 1.1%. In 2010, real GDP recovered slightly, increasing by 1.5%, though real household disposable income decreased by 0.8%.

Figure B4.1: Economic drivers of transport trends (2008-2010)



Source: ONS, DfT.
Note(s): GDP deflated by GDP deflator; disposable income deflated by the NPISH final consumption deflator, as published in the ONS Economics Accounts.

Source: DfT (2010) Transport Statistics Great Britain, ONS

Box 4.2: UK and EU biofuels policy

Current transport biofuels penetration in the UK is driven by the Renewable Transport Fuel Obligation, with longer-term options for meeting EU directives (the Renewable Energy Directive and the Fuel Quality Directive) still under review:

- **Renewable Transport Fuel Obligation (RTFO):** The RTFO came into effect on 15 April 2008, and requires fossil fuel suppliers (those who supply at least 450,000 litres per year) to ensure that a specified percentage of their fuels for road transport in the UK – rising from 3.5% by volume (2.8% by energy) in 2010/11 to 5% by volume (4% by energy) in 2013/14 – comes from renewable sources.
- **Renewable Energy Directive (RED):** In addition to the overall renewable energy target, the RED sets a binding UK target of 10% of energy from renewable sources in transport by 2020. The feasibility of reaching the 10% transport sub-target whilst ensuring sustainability will be subject to review by the European Commission by the end of 2014.
- **Fuel Quality Directive**: The transport sector also has to comply with the Fuel Quality Directive, which requires a 6% reduction in the greenhouse gas intensity of transport fuels by 2020.

(iii) Van emissions

Van emissions accounted for around 13% of surface transport CO_2 emissions in 2009, and around 3% of total CO_2 emissions.

Emissions from vans fell by 3.2% in 2009, mainly due to a reduction in distance travelled (Figure 4.4):

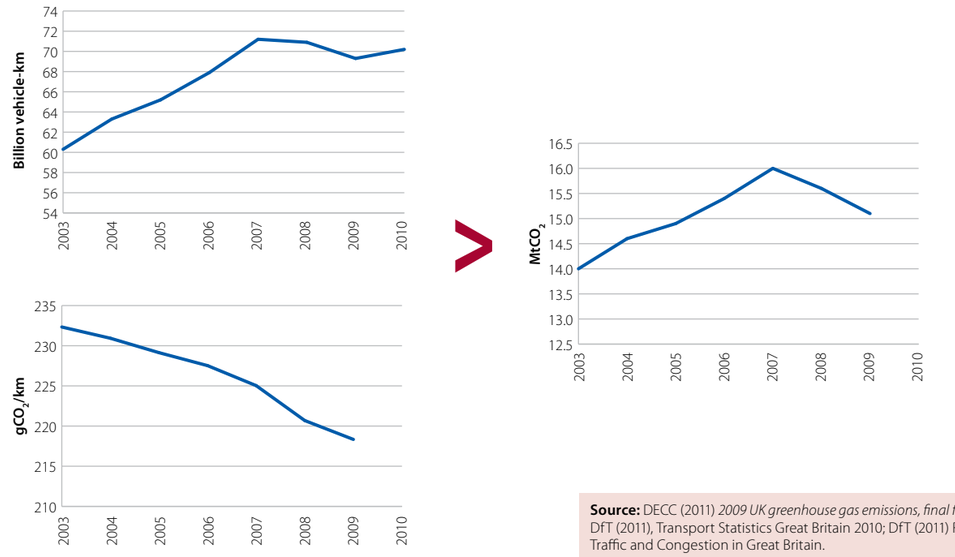
- Van distance travelled fell by around 2.2% in 2009, from 70.9 billion vehicle-km in 2008 to 69.3 billion vehicle-km in 2009, probably as a result of the recession.
- Combined bioethanol and biodiesel penetration for vans increased from 3.2% in 2008 to 3.9% in 2009, driven by the RTFO.
- Although we do not have good data on new van emissions, the implication of changes in emissions, distance travelled and biofuels penetration is that the efficiency of the van fleet improved by around 0.4%.

Data are not available for van emissions in 2010, but we have data for biofuels and distance travelled:

- New van emissions fell from 206 gCO_2/km in 2009 to 196 gCO_2/km in 2010 (a 4.9% reduction).
- Van distance travelled rose by 1.3% in 2010, from 69.3 billion vehicle-km in 2009 to 70.2 billion vehicle-km in 2010; it is likely that this reflects the economic recovery, which has more than offset the impact of rising oil prices (Box 4.1).
- Combined bioethanol and biodiesel penetration for vans was unchanged at 3.9% in 2010.
- For a given fleet efficiency, the combination of these effects would be a 1.3% increase in van emissions.

The combination of limited fleet efficiency improvement in 2009 and rising distance travelled in 2010 suggest a risk that emissions will not continue to fall in line with our indicator framework. This highlights the importance of introducing new levers such as CO_2 differentiated VED to deliver significant carbon efficiency improvement of new vans in line with EU targets (see Section 4 below).

Figure 4.4: Historic trends of vehicle km, $MtCO_2$ and gCO_2/km for vans (2003-2010)



Source: DECC (2011) *2009 UK greenhouse gas emissions, final figures*; DfT (2011), Transport Statistics Great Britain 2010; DfT (2011) Road Traffic and Congestion in Great Britain.

(iv) HGV emissions

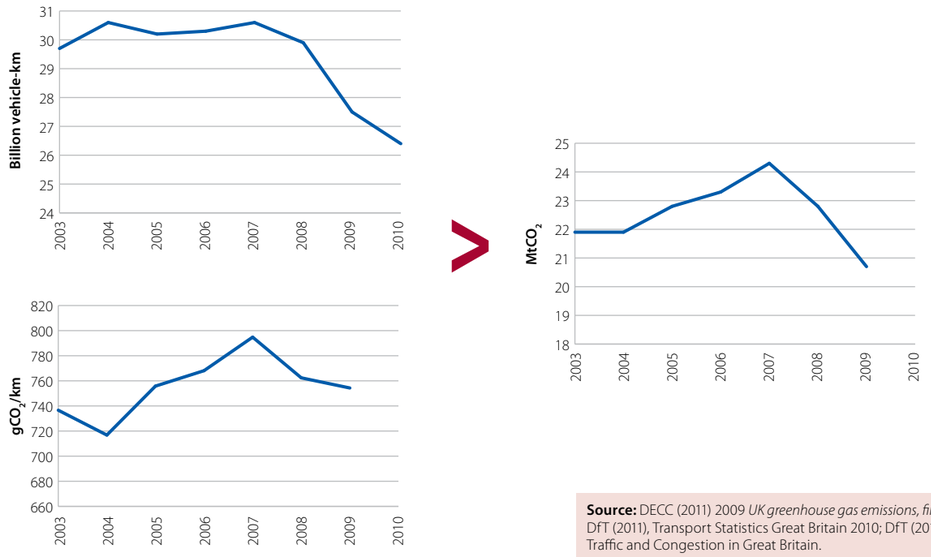
HGV emissions accounted for around 18% of surface transport emissions and almost 4% of total greenhouse gas emissions in 2009. They fell by around 9% in 2009, mainly due to reduced distance travelled as a result of the recession (Figure 4.5):

- HGV distance travelled in 2009 fell by around 8.0%, from 29.9 billion vehicle-km in 2008 to 27.5 billion vehicle-km in 2009, likely to be largely due to the recession.
- Biodiesel penetration for HGVs increased from 3.3% in 2008 to 4.0% in 2009, driven by the RTFO.
- The implied increase in HGV efficiency is around 0.4% in 2009.

Although data are not available for HGV emissions in 2010, we have data for biofuels and distance travelled:

- HGV distance travelled fell by a further 3.9% in 2010, from 27.5 billion vehicle-km in 2009 to 26.4 billion vehicle-km in 2010. This suggests that the impact of higher fuel prices, and possibly longer-term impacts of the recession, may have more than offset any immediate impacts of economic growth (Box 4.1).
- Biodiesel penetration decreased from 4.0% in 2009 to 3.9% in 2010.

Figure 4.5: Historic trends of vehicle km, $MtCO_2$ and gCO_2/km for HGVs (2003-2010)



Source: DECC (2011) 2009 *UK greenhouse gas emissions, final figures*; DfT (2011), Transport Statistics Great Britain 2010; DfT (2011) Road Traffic and Congestion in Great Britain.

Emission reductions in 2009, and likely reductions in 2010 based on further reductions in distance travelled, are consistent with what is required to meet carbon budgets (e.g. a 1.3% annual average emissions reduction to 2020). Underlying progress on HGV efficiency in 2009 is also consistent with what is required to meet carbon budgets (e.g. our analysis suggests scope for a 0.6% annual average efficiency improvement over the next decade).

(v) Motorbike emissions

The share of motorbike emissions in total surface transport emissions was around 0.5% in 2009. Motorbike emissions per passenger-km (106.9 gCO_2/pkm) are broadly comparable with those for cars (99.4 gCO_2/ pkm). This reflects lower emissions per vehicle-km but also lower passenger occupancy than cars.

The long term trend of motorbike CO_2 emissions is up 3.6% since 1990, and down 7.4% since 2003, with motorbike distance travelled decreasing by 7.1% since 1990, and by 3.7% in the five years to 2009.

However, motorbike distance and emissions increased in 2009:

- Motorbike distance travelled increased by around 2.0% in 2009, from 5.3 billion vehicle-km in 2008 to 5.4 billion vehicle-km in 2009.
- Emissions increased by slightly less (i.e. around 1.8%), from 0.61 $MtCO_2$ in 2008 to 0.63 $MtCO_2$ in 2009, largely due to increased biofuels penetration.

(vi) Public transport emissions

Public transport emissions increased in 2009, as reduced bus emissions were more than offset by increased rail emissions:

- Bus emissions
  - These account for around 73% of public transport emissions, and around 5% of surface transport emissions.
  - Final data on bus emissions in 2009 are not yet available. Provisional data suggest that bus emissions fell by around 1.1% in 2009, from 5.30 $MtCO_2$ in 2008 to 5.24 $MtCO_2$ in 2009.
  - Biodiesel penetration increased from 3.3% in 2008 to 4.0% in 2009 and vehicle-km remained unchanged, which imply an increase in bus efficiency of 0.4% in 2009 relative to 2008.
- Rail emissions (direct emissions; indirect emissions from electricity generation are accounted for in Chapter 2: Power)
  - These account for around 27% of public transport emissions, and around 2% of surface transport emissions.
  - Rail emissions increased by around 2.0% in 2009, from 1.92 $MtCO_2$ in 2008 to 1.96 $MtCO_2$ in 2009.
  - Increased emissions were due to an increase in train kilometres for passenger trains of 1.2%, in part offset by a 7.6% reduction in freight tonne-kilometres in 2009 compared to 2008.

(vii) Aviation emissions

Aviation CO_2 emissions (measured on a bunker fuels basis) fell by 5% in 2009. Both international and domestic emissions fell (Figure 4.6):

- International aviation CO_2 emissions fell by 4%, from 34.2 $MtCO_2$ to 32.7 $MtCO_2$
- Domestic aviation CO_2 emissions fell by 11%, from 2.2 $MtCO_2$ to 2.0 $MtCO_2$.

These falls reflect a response to the 7% reduction in passenger numbers in 2009, largely due to the recession.

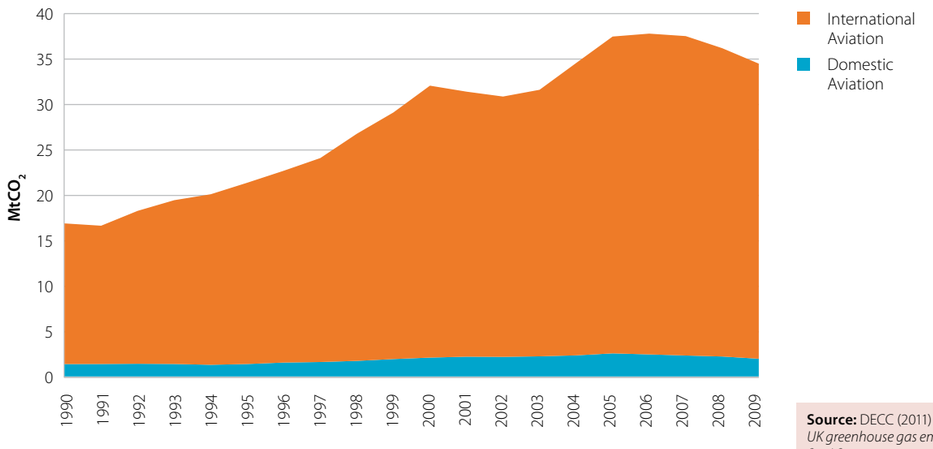
In 2010 passenger numbers fell over 3%, with reductions in short-haul passengers (5%) more than offsetting increases in long-haul passengers (1%). With higher average emissions on long-haul flights, this suggests aviation emissions could be broadly flat for 2010.

Aviation CO_2 emissions have doubled since 1990 to 34.7 $MtCO_2$, reflecting increasing demand for aviation driven by income growth and industry deregulation.

In future, net emissions will be constrained given that aviation will be included in the EU ETS from 2012 (see Box 4.3). However, the UK has a target to reduce gross aviation emissions to 2005 levels in 2050. Our aviation report suggested that this is achievable through a combination of efficiency improvement, use of biofuels, and demand management.

We will provide a detailed assessment of aviation emissions in our review of aviation and shipping, to be published in Spring 2012 (see Box 4.5).

Figure 4.6: UK aviation CO_2 emissions (1990-2009)



Source: DECC (2011) 2009 *UK greenhouse gas emissions, final figures.*

Box 4.3: Policy developments in aviation

At the EU level, and not withstanding current legal challenges from a group of non-EU airlines, progress continues to be made towards inclusion of aviation in the EU ETS from 2012. To underpin the cap for aviation, the European Commission has recently set EU-wide historic aviation emissions[1]. Further details on benchmarking for allocation of permits are expected in September 2011.

At the UK level, in 2011 the Government launched a process towards adopting a new policy framework for aviation. This is intended to set the high-level framework for future sustainable growth in aviation, consistent with UK climate change targets. The Government intends to consult on a draft policy framework by March 2012, and adopt the final framework by March 2013.

The Committee will consider these and any other relevant policy developments in more detail as part of advice required under the Climate Change Act in 2012 on inclusion of international aviation and shipping in carbon budgets (see Box 4.5).

1 EU-wide historic aviation emissions, defined as the 2004-06 average, were 219.5 $MtCO_2$. The cap will be set at 97% of EEA-wide historical aviation emissions, declining to 95% from 2013 onwards.

(viii) Shipping emissions

Shipping CO_2 emissions fell by 7% in 2009 to 12.0 $MtCO_2$, 1.2 $MtCO_2$ above 1990 levels (Figure 4.7). Emissions fell in both international and domestic shipping (see Box 4.4):

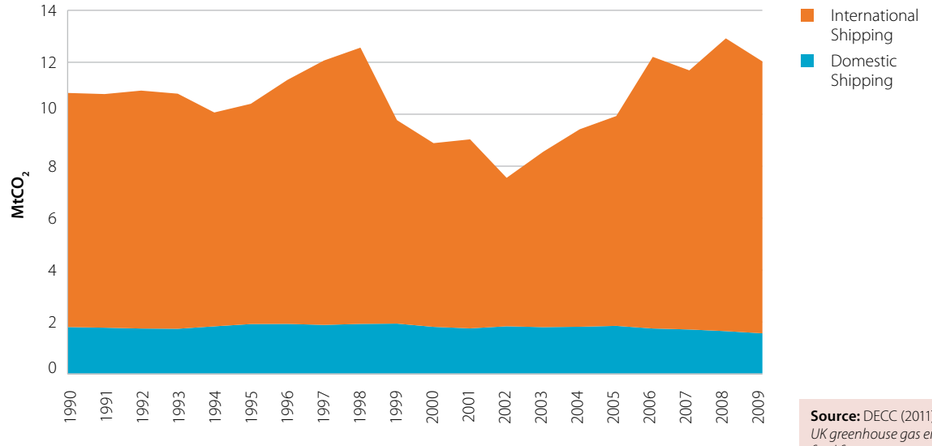
- International shipping CO_2 emissions fell by 7%, from 11.3 $MtCO_2$ to 10.5 $MtCO_2$
- Domestic shipping CO_2 emissions fell by 5%, from 1.6 $MtCO_2$ to 1.5 $MtCO_2$.

These falls largely reflect the effect of the recession; in 2009 international cargo volumes fell 13% and domestic cargo volumes fell 6%. However, reduced activity may not be fully captured in UK shipping emissions: total shipping emissions are based on a bunker fuel methodology, and it is not clear whether this accurately represents emissions from ships using UK ports.

We are currently undertaking a review of UK shipping emissions. This will include scenarios for shipping demand and emissions in the period to 2050. We will publish our shipping review in Autumn 2011.

The implications of including shipping emissions in carbon budgets will be included in our review of aviation and shipping, to be published in Spring 2012 (see Box 4.5).

Figure 4.7: UK shipping CO_2 emissions (1990-2009)



Source: DECC (2011) 2009 *UK greenhouse gas emissions, final figures.*

Box 4.4: UK shipping emissions inventory

From 2009 the UK has changed the way in which it reports shipping CO_2 emissions, and has revised the historic series on this new basis.

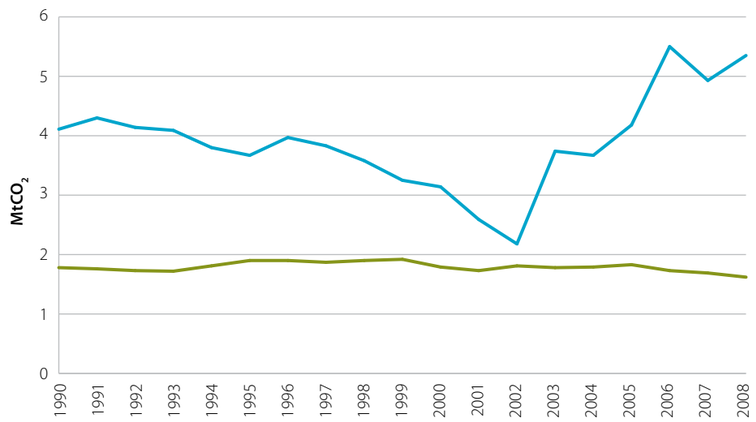
Previously, international and domestic shipping CO_2 emissions were reported in the national emissions inventory on the basis of fuel sales ('bunker fuels') and according to how the purchaser classified their use. However, there have been concerns around data uncertainty and in particular the accuracy of the domestic/international split.

Under the new methodology, total CO_2 emissions are still consistent with total bunker fuel sales, but the split between domestic and international has changed. International emissions are now based on the gap between total emissions (based on bunker fuels) and a new modelled estimate of domestic emissions (based on ship movements).

An implication of the new methodology is that domestic shipping emissions are lower and smoother across time than previously reported (Figure B4.4). The difference between the old and new methodologies (around 4 $MtCO_2$ in 2008) has been re-assigned from domestic to international shipping.

The Committee will comment in more detail on methodologies for measuring shipping emissions as part of its review of UK shipping emissions, to be published in Autumn 2011 (see Box 4.5).

Figure B4.4: UK domestic shipping emissions under new and old methodologies (1990-2008)



Source: DECC (2010) 2008 *UK greenhouse gas emissions, final figures.* DECC (2011) 2009 *UK greenhouse gas emissions, final figures.*

Box 4.5: Future work on aviation and shipping

Previous advice of the Committee clearly recommended inclusion of international aviation and shipping emissions in the 80% 2050 target, and the Climate Change Act requires the government to take these into account in setting carbon budgets. Under the Climate Change Act, by end-2012 the Government must decide whether to include international aviation and shipping in carbon budgets or explain why it has not done so. In relation to this decision, future work of the Committee will include:

- In Spring 2012, **advice on inclusion of international aviation and shipping in carbon budgets.** This advice will build on our previous high-level advice on inclusion of international aviation and shipping (see our fourth carbon budget report), and will include consideration of gross and net emission scenarios, implications of inclusion on other sectors, and any required revisions to the net carbon account or the first four carbon budgets.
- In Autumn 2011, a **review of UK shipping emissions** to underpin the 2012 advice on inclusion in carbon budgets. This will assess the range for future UK shipping emissions, taking into account different allocation methodologies, the range of abatement opportunities in shipping (including policy levers), and drivers of future demand for UK shipping.

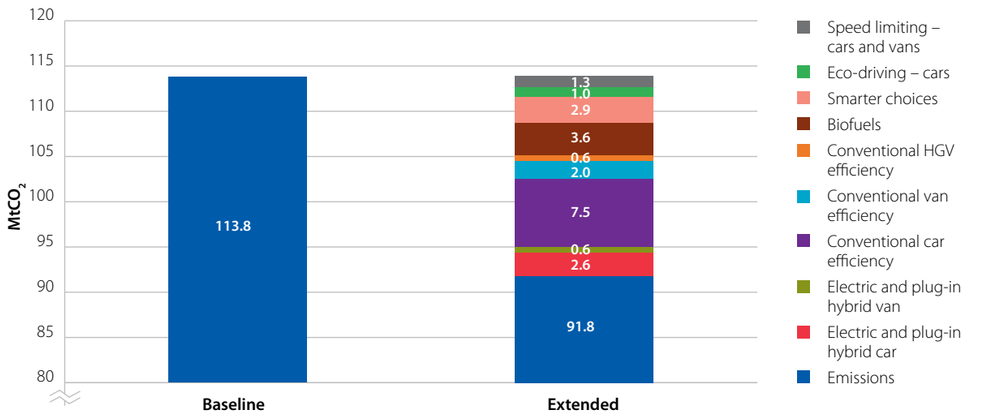
2. Recap of the indicator framework

We now recap our transport indicator framework before considering progress against indicators. The framework reflects measures that are either cost-effective, or required on the path to deeper decarbonisation in the 2020s:

Fuel/carbon efficiency of vehicles

- In our indicator framework, new car emissions fall to 95 gCO_2/km in 2020 in line with EU targets. We envisage that electric vehicles will contribute to meeting this limit. Excluding electric vehicles, conventional new car emissions fall to 110 gCO_2/km by 2020.
- In 2010 we tentatively adopted a provisional indicator for new van CO_2 of 135gCO_2/km consistent with the proposed EU new van CO_2 regulation. Following publication of the final Regulation in December 2010 we revise our indicator target upwards to the Regulation target of 147 gCO_2/km in 2020 (see Section 4 below). Again we envisage that electric vehicles contribute to meeting this target. Excluding these, conventional new van emissions fall to 169 gCO_2/km by 2020.
- Battery electric and plug-in hybrid car penetration reaches 1.7 million in 2020 (5% of all cars and 16% of new cars)
- Battery electric and plug-in hybrid van penetration reaches 135,000 in 2020 (4% of all vans and 16% of new vans)
- There is uptake of non-powertrain technologies in HGVs and introduction of hybrid rigid HGVs.
- Biofuels penetration increases to 8% by 2020, in line with recommendations in the Gallagher Review.

Figure 4.8: Extended Ambition Surface Transport emissions reductions in 2020



Source: CCC modelling.

Behaviour change

- Implementation of Smarter Choices initiatives results in a 5-7% reduction in car distance by 2020.
- There is wide-scale uptake of eco-driving through training, achieving levels of 10% of car and van drivers and 100% of HGV drivers by 2020.
- Speed limits are enforced at current levels. For example, if the existing 70 mph speed limit were strictly enforced, this could reduce emissions by 1.3 $MtCO_2$ in 2020.

If all indicators were to be achieved in practice, this would result in a 20% reduction in transport emissions by 2020 (Figure 4.8). Whether we are on track to deliver this emissions reduction depends on progress relative to indicators, which we now consider.

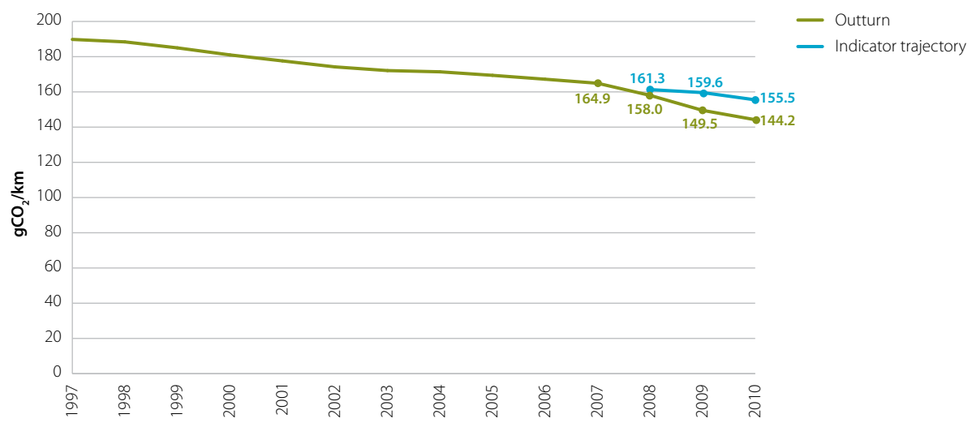
3. Progress reducing car emissions

Car emission reductions are primarily delivered through replacing inefficient old cars with increasingly efficient new cars. For a given turnover of the car stock, the key driver is therefore the increase in efficiency of new cars.

Building on progress in 2009, new car emissions continued to fall in 2010 (Figure 4.9):

- New car emissions fell from 158.0 gCO_2/km in 2008 to 149.5 gCO_2/km in 2009 and to 144.2 gCO_2/km in 2010.
- Our indicator for 2010 – consistent with progress towards a 95 gCO_2/km target in 2020 – is 156 gCO_2/km.

Figure 4.9: New Car CO_2 – indicator trajectory and outturn



Source: SMMT and CCC modelling.

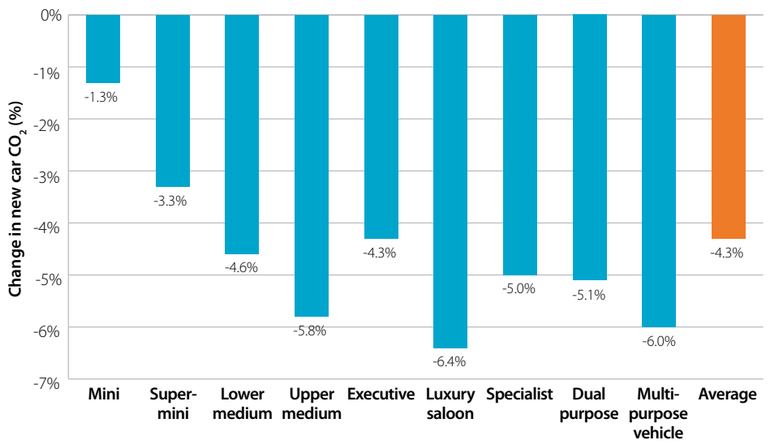
Therefore new car emissions are currently significantly out-performing our indicator, by around 7% in 2010.

Analysis in last year's report suggested that efficiency improvements in 2009 were due to a combination of technological improvements and consumer behaviour change relating to both the scrappage scheme and direct impacts of the recession:

- Average emissions for cars purchased under the scrappage scheme were around 133.3 gCO_2/km.
- However, these accounted for only around 14% of new cars purchased. The remaining 86% of new cars purchased outside the scrappage scheme, with average emissions of 152.2 gCO_2/km, also showed significant emission reductions.
- This efficiency improvement was due to both new models coming to market and consumer behaviour change (e.g. buying best in class cars, or switching between classes).
- Given limited changes in various drivers of consumer behaviour (e.g. VED, fuel duty), we concluded that these are likely to have had reinforcing effects, with the recession being the primary driver of consumer behaviour change.

Our assessment of efficiency improvements in 2010 is that these are likely to be due to a combination of consumer behaviour change and more efficient models coming to market (Box 4.6):

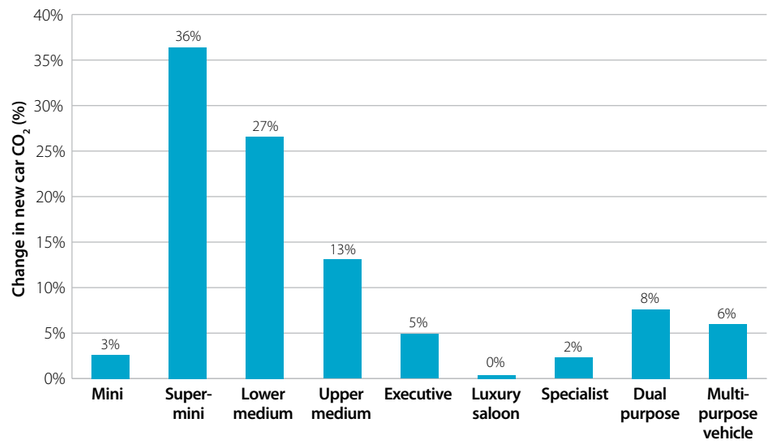
Figure 4.10: Change in gCO_2/km for each segment



Source: SMMT.

- The scrappage scheme closed for new orders in March 2010. While cars purchased under the scrappage scheme were lower CO_2 emitting (131.3g/km) than the average, these accounted for only a small percentage of new cars sold (around 5% of the total 2010 market).
- The average reduction in new car CO_2 across all market segments in 2010 was 4.3% (Figure 4.10). The reduction in each segment ranges from 1.3% for minis to 6.4% for luxury saloons. The market segments with the greatest sales volumes are the supermini (36% of sales) and lower medium (27% of sales) market segments (Figure 4.11). The reduction in new car CO_2 in these segments was 3.3% for superminis and 4.6% for lower medium cars.
- This reduction is likely to be due mainly to technological improvement (new, more efficient models coming to market), with consumer behaviour change playing a less important role in 2010 (Box 4.6).
- Following a shift in the market towards smaller cars in 2009, there has been some upsizing in 2010:
  - The market share of higher-emitting executive, dual- and multi-purpose vehicles increased 0.4%, 1.0% and 1.3% respectively, with a corresponding decrease in the share of lower-emitting mini, supermini and upper medium segments.
  - This upsizing only partially reversed the shift towards purchase of smaller cars in 2009, so the market share of smaller cars remains higher than in 2008.
  - The net effect of this shift in 2010 is to increase new car CO_2 by 0.7%, partially offsetting the 4.3% improvement in new car CO_2 for each class of car.

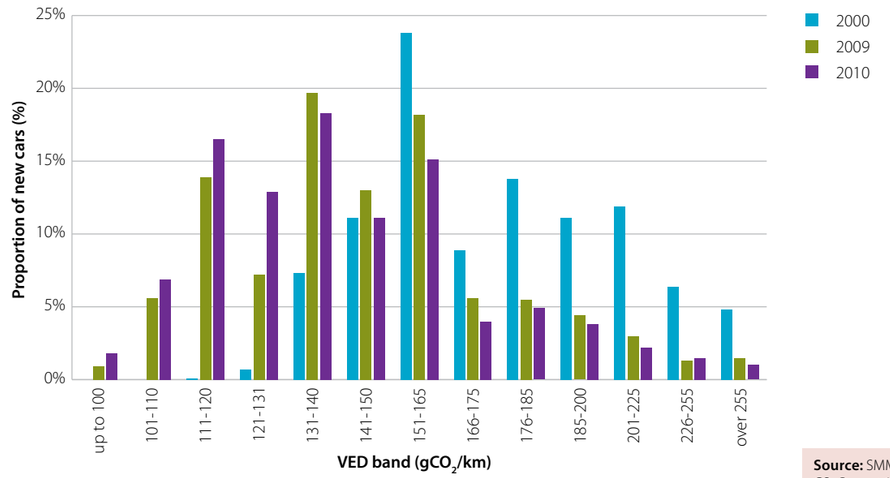
Figure 4.11: New car sales by market segment in 2010



Source: SMMT.

The combined effect of more efficient cars within each class, and the offsetting shift towards purchase of larger cars, is the observed 3.5% improvement in new car CO_2. The resulting distribution of new car efficiency is illustrated in Figure 4.12.

Figure 4.12: New car sales by VED band



Source: SMMT (2011), New Car CO_2 Report 2011.

Box 4.6: Drivers of new car CO_2

Average CO_2 emissions of new cars were 144.2g CO_2/km in 2010, a 3.5% reduction on the 2009 level of 149.5 g/km. The annual change in new car CO_2 is determined by two factors:

- Technological improvement: the degree to which new models on the market emit on average less CO_2 than comparable models on the market in the previous year.
- Consumer preferences: the degree to which consumers demand lower CO_2 emitting cars (e.g. due to their fuel efficiency or other characteristics). Consumers may demand cars that:
  - emit less CO_2 than other cars in a given market segment; or
  - are in market segments with lower average CO_2 emissions (i.e. downsizing).

Figure 4.10 shows that the average reduction in new car CO_2 across all market segments in 2010 was 4.3%.

The reduction in average new car CO_2 in each market segment is determined by technological improvement and consumer preferences for cars that emit less CO_2.

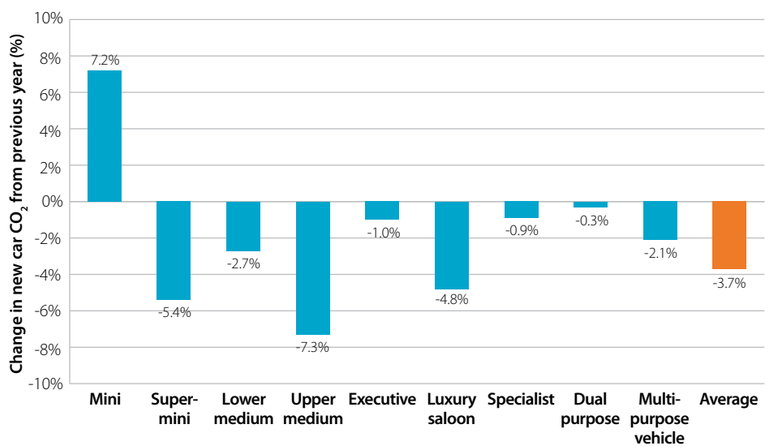
It is difficult to determine the relative contributions of technological improvement and consumer preferences to the reduction in average new car CO_2 in each market segment. We have looked at available evidence to develop a qualitative indication of trends in these two factors:

Technological improvement

Figure B4.6a shows the change in average new car CO_2 of **new models** in each market segment in 2010:

The product cycle of a car (the number of years a newly developed car model will remain on the market) is around 7 years. Reduction in average new car CO_2 due to technological improvement occurs when newer, lower emitting cars are released on the market and older, higher emitting models reach the end of their product cycle and are retired from the market.

Figure B4.6a: Change in gCO_2/km of new releases for each segment



Source: SMMT.

Figure B4.6b shows that there was a reduction in average CO_2 of new models in the majority of market segments in 2010, with an average reduction in CO_2 of new models across all market segments of 3.7%. While data on the technological improvement observed in new car models are not sufficient to estimate the level of technological improvement for the entire new car market with confidence, it does suggest that technological improvement is playing a substantial role in the reduction in average new car CO_2 in each market segment in 2010.

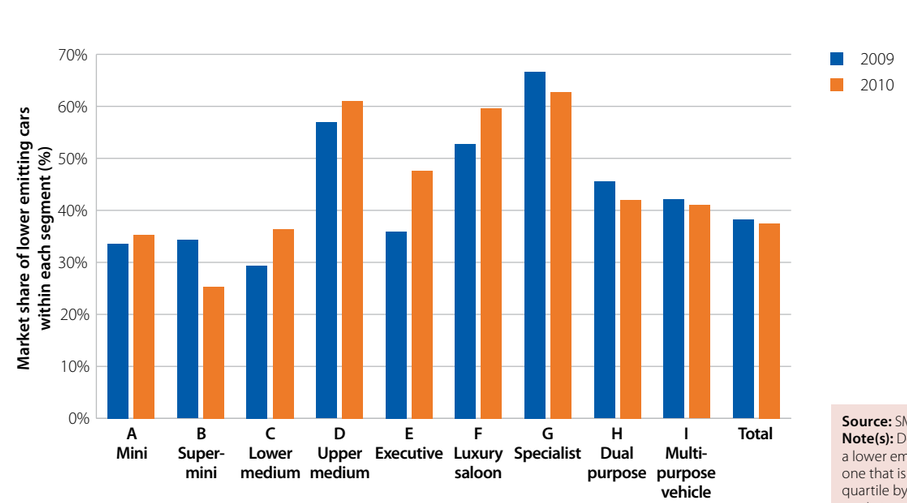
Consumer preferences within market segment

Figure B4.6b shows the proportion of new car sales falling within the lower quartile of new car CO_2 in each market segment in 2009 and 2010.

The proportion of new car sales falling within the lower quartile of new car CO_2 increased between 2009 and 2010 in the Mini, Lower Medium, Upper Medium, Executive and Luxury Saloon market segments, but decreased in the SuperMini, Specialist Sports, Dual Purpose and Multi Purpose market segments.

Overall, while 38.2% of new car sales fell within the lower quartile of new car CO_2 in each market segment in 2009, this proportion declined to 37.5% in 2010. While data on the proportion of new car sales falling within the lower quartile are not sufficient to estimate the level of behavioural change with confidence (for example, the position of the lower quartile may be skewed by the distribution of new models released on the market), it does suggest that behavioural change may have played a relatively minor role in the reduction in average new car CO_2 in each market segment in 2010.

Figure B4.6b: Market share of lower emitting cars for each segment



Source: SMMT.
Note(s): Definition of a lower emitting car is one that is in the lower quartile by CO_2 in its market segment.

Box 4.6: Drivers of new car CO_2

Consumer preferences across market segments

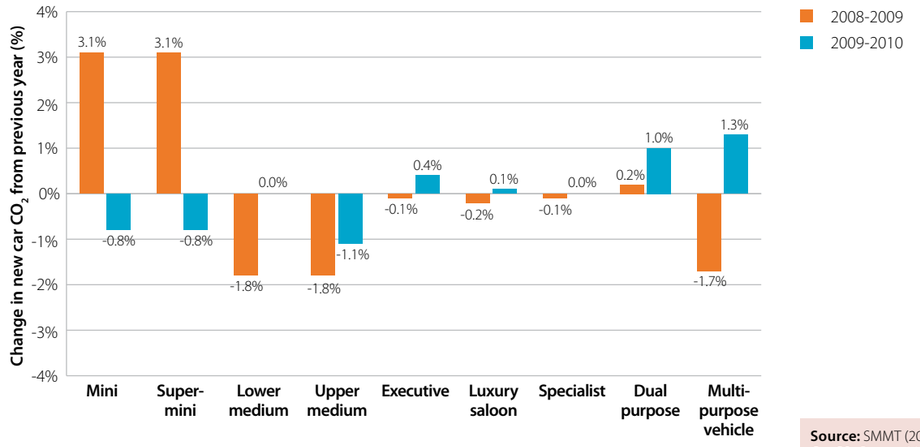
Figure B4.6c shows the change in the share of new car sales in each market segment between 2008-9 and 2009-10.

Figure B4.6c shows that there was an increase in the share of new car sales in the market segments of the smallest cars (minis and superminis) in 2009, offset by a decrease in the share of the new car sales in the market segments of larger cars. We previously judged that the scrappage scheme and the recession may have contributed to the observed shift towards smaller cars in 2009, and suggested that these effects may be temporary.

In 2010 this shift was partially reversed, with a decrease in the share of new car sales in the market segments of the smallest cars (minis and superminis), offset by an increase in the share of the new car sales in market segments of larger cars. The scrappage scheme closed for new orders in March 2010 and the observed shift towards larger cars in 2010 is consistent with our suggestion that the downsizing in 2009 may have been a temporary effect.

The upsizing in 2010 reduced the overall improvement in new car CO_2 by 0.7 percentage points, from an average reduction of 4.3% across all market segments, to an overall reduction of 3.5%.

Figure B4.6c: Change in market share for each category



Source: SMMT (2011), New Car CO_2 Report 2011.

Significant scope for further improvement in efficiency remains, both through a higher proportion of consumers buying best in class cars, through switching between classes, and through manufacturers bringing new more efficient models to market in line with EU targets.

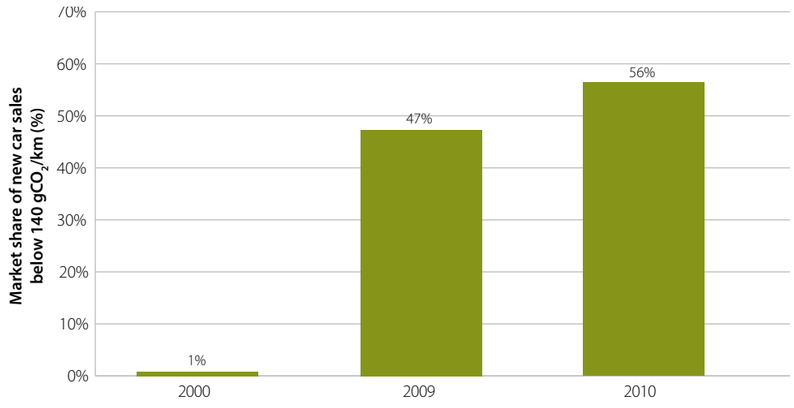
However, there is a risk that consumer behaviour change observed through the recession does not persist as the economy recovers, and in the event of a significant decrease in fuel prices. This suggests that the appropriate strategy is to monitor consumer behaviour closely, with a view to using fiscal levers if the rate of progress in the last two years is not sustained.

- **VED differentiation** (Box 4.7) is the most direct lever to encourage purchase of more efficient cars. Although differentiation is increasing over the period 2009-2012, further differentiation should not be ruled out. Options for consideration should include higher rates of first year VED for less efficient cars, which evidence suggests may be a particularly strong lever for encouraging behaviour change.
- **Fuel duty**. Fuel price reductions could undermine incentives for purchase of efficient cars, and increase distance travelled. Therefore significant reductions in fuel duty would increase risks of not achieving carbon budgets, as would significant reductions in fuel prices without offsetting increases in fuel duty.

Box 4.7: VED

- Incentives for purchase and manufacture of more efficient vehicles have been strengthened through recent increases in VED differentiation.
  - In the financial year 2009-10, VED was raised by £5 for CO_2 bands F or above (over 141g).
  - In 2010-11 VED was reduced by between £5-£30 for CO_2 bands E or below (under 140g), and increased (also by between £5-£30) for CO_2 bands G or above (over 151g). Over time there has been a significant increase in the proportion of cars emitting under 140 g/km (Figure B4.7).
  - In 2010-11 first year VED was also introduced. First year VED is between £20-£90 lower than annual VED for CO_2 bands A-D (under 131g) and rises from £110 for CO_2 band E (131-140g) to £950 for CO_2 band M (over 255g)
  - In the 2011-12 further differentiation will be introduced, with an increase of between £5-£30 for CO_2 bands D or above (over 121g).
  - Eftec analysis[2] suggests that these changes would be expected to shift purchase behaviour towards purchase of more efficient cars. However, given the limited change in differentiation in 2009 and 2010, this is likely to have been a reinforcing factor rather than a primary driver of consumer behaviour change.

Figure B4.7: Market share of new car sales below 140 gCO_2/km



Source: SMMT (2011), New Car CO_2 Report 2011.

2 Eftec (2008): Demand for Cars and their Attributes

We will continue to track new car efficiency and highlight appropriate actions to support continued progress, through encouraging demand for more efficient vehicles which in turn encourages suppliers to bring more efficient models to market.

4. Progress reducing van emissions

Data on new van CO_2 were not collected on a regular basis until 2009. New van emissions in the UK fell from 206 gCO_2/km in 2009 to 196 gCO_2/km in 2010 (a 4.9% reduction).

There is a significant scope for cost-effective efficiency improvement through a range of measures, particularly downsizing with turbo charging and/or hybridisation. This is recognised in the new EU framework – finally agreed in December 2010 – to support van emissions reduction in the period to 2020:

- A target of 175 gCO_2/km will apply to 70% of new vans from 2014, 75% from 2015, 80% from 2016 and 100% from 2017.
- A target of 147 gCO_2/km will apply to 100% of new vans by 2020

It is important to note that the 2020 target of 147 gCO_2/km is less ambitious than the 135 gCO_2/km initially proposed. This raises a question of what the appropriate target is for the UK (i.e. whether there is cost-effective potential to go further than this target).

Given that the van industry operates at the EU level, and that innovation will therefore be geared towards achieving the EU target rather than full cost-effective potential, it is not clear how much scope there is for the UK to go further than this target.

Therefore we recommend that the UK should aim at a minimum to meet the EU target. We reflect this in our indicator framework, which now includes new van emissions of 147 gCO_2/km in 2020, consistent with the EU target.

5. Progress developing electric vehicle markets

Electric vehicles are key to achieving deep cuts in transport emissions required beyond the 2020s. Given long lead times, it is crucially important that market development starts now, with the need for Government support of electric vehicle purchase and infrastructure investment, to allow deployment in the 2020s.

There has been good progress in both these respects:

- **Support for vehicle purchase**. The Plug-In Car Grant to support the purchase of electric cars was confirmed in the 2010 Spending Review. In January this year a consumer incentive scheme funded at around £300m was introduced, offering up to £5,000 per car to reduce the up-front cost of electric and plug-in hybrid cars.
- **Support for infrastructure investment.**
  - In 2010 the previous Government awarded funding to three pilot projects (London, Milton Keynes and the North East) to support infrastructure investment under its £30 million "Plugged-in Places" (PiP) programme.
  - In December 2010 the current Government confirmed provision for £30 million total funding and announced continuation of the three pilots for 2011/12 and 2012/13 as well as funding for five additional PiP projects in Northern Ireland, Scotland, Greater Manchester, the Midlands and the East of England.
  - The Coalition Government's Programme for Government has also committed to mandate a national recharging network for electric and plug-in hybrid vehicles, and to deliver a nationwide strategy to promote the installation of electric vehicle infrastructure by June 2011.

This Government support is timely given that various electric vehicles have arrived on the market, with more models due to come to market in the next two years (Box 4.8). Although initial take-up in 2010 of 167 new electric cars (138 full cars likely to be mostly part of pilot schemes, and 29 small electric cars formally classed as quadricycles) is lower than our indicator, this reflects the very limited availability of electric cars on the market in 2010.

Box 4.8: Current and near-term electric vehicle releases

As of June 2011, the following electric car models are currently available on the UK market:

Table B4.8.1: Electric car models currently available on the UK market

Brand	Model	Type
Mitsubishi	iMiEV	BEV
Tesla	Tesla	BEV
Citroën	C-Zero	BEV
Peugeot	iOn	BEV
Tata	Vista	BEV
Nissan	Leaf	BEV
Smart	ED	BEV

Notes: BEV = Battery Electric Vehicle. The Smart ED is available to lease in 2011 but will not be available to purchase until 2012.

In addition to these, options to purchase electric cars include:

- a number of small electric cars formally classed as quadricycles in the UK. These include the Aixam Mega, Reva G-Wiz, and THINK City.
- third party electric conversions, including the Peugeot Bipper, Expert and Partner Tepee conversions

Furthermore, a considerable range of new electric car models are currently under development and due to come to market in the near future:

Table B4.8.2: Electric car models currently under development

Brand	Model	Type	Estimated UK launch date
Hyundai	Ix-metro	BEV	2011
Westfield (race car)	iRacer	BEV	2011
Lightning Car Company	The Lightning GT	BEV	2012
Renault	Fluence Z.E.	BEV	2012
Vauxhall	Ampera	PHEV (RE)	2012
Renault	ZOE	BEV	2012
Audi	E-Tron	BEV	2012
Chevrolet	Volt	PHEV (RE)	2012
Ford	Focus	BEV	2012
Morgan	Lifecar2	BEV	2012
Smart	ED	BEV	2012
Tesla	Model S	BEV	2012
Westfield	Sport-E	BEV	2012
Axon	E-PHEV	PHEV	2012

Box 4.8: Current and near-term electric vehicle releases

Table B4.8.2: Electric car models currently under development

Brand	Model	Type	Estimated UK launch date
Toyota	Prius PHV	PHEV	2012
BMW (sub-brand)	Megacity Vehicle	BEV	2013
Ford	C-MAX	PHEV	2013
Westfield	GMT Electric	BEV	2013
Volkswagen	Up! blue-e-motion	BEV	2013
Volkswagen	Golf blue-e-motion	BEV	2013/2014
Fisker	Karma	PHEV	TBC
Ginetta	G50	BEV	TBC
Porsche	918 Spyder	PHEV	TBC
Th!nk	City EV	BEV	TBC
Th!nk	Ox	BEV	TBC

Notes: BEV = Battery Electric Vehicle; PHEV = Plug-in Hybrid Electric Vehicle. RE refers to "Range Extended", a type of plug-in hybrid that is powered exclusively by the electric motor, with a petrol or diesel internal combustion engine and on board generator to generate additional electricity when battery has been depleted.

As of June 2011, there are no full electric van models produced by auto manufacturers available on the UK market. However, a number of options to purchase electric vans are available:

- Aixam Mega van, a small electric van formally classed as a quadricycle
- Third party electric conversions, including the Citroën Berlingo, the Peugeot Bipper and Partner Tepee and Ford Transit Connect conversions
- Small electric HGVs such as the Smith Newton.

A number of new electric van models are also under development.

Source: SMMT

In building on this progress, there are three key challenges:

- To provide longer term certainty to the electric vehicle industry through indicating ambition to 2020 and beyond.
- To underpin this ambition with further funding to cover up front purchase costs, over and above funding already agreed, and to be phased out somewhere between 2015-2020.
- To implement the Government's new strategy (due for publication in June 2011) for roll-out of charging infrastructure (e.g. covering arrangements for people without off street parking, and funding of infrastructure investment).

6. Progress changing behaviour

Rollout of smarter choices

Smarter Choices refers to a range of measures promoting voluntary reductions in levels of car use, achieved either through the elimination of unnecessary trips, or through modal shift to public transport, walking and cycling.

We have previously set out the evidence suggesting that successful implementation of Smarter Choices reduces total distance travelled by car by 5-7%. This underpinned our recommendation that Smarter Choices should be rolled out nationwide by 2020.

There has been progress in this respect with the creation of a Local Sustainable Transport Fund:

- This will challenge local authorities outside London to develop schemes that promote economic growth and reduce carbon emissions.
- Authorities will propose initiatives and bid for some of the £560 million available over the period to 2014-15.

In principle, this fund could support roll-out of Smarter Choices to half the UK by 2015:

- The £560 million funding available translates to around £3 per capita per annum (with local authorities to make an additional contribution).
- This can be compared to £6 per capita per annum central government funding (with additional contribution from local authorities) required to support implementation of Smarter Choices in the Sustainable Travel Town pilot projects.

Therefore the challenge is to ensure that funding is allocated to schemes which deliver a significant total reduction in car travel. Depending on the success of this first phase, further funding would then be required to support full roll-out by 2020.

Eco-driving

Our indicator framework reflects carbon benefits of eco-driving, suggesting that extensive training of car, van and HGV drivers could result in emissions reductions of 1 $MtCO_2$ in 2020.

There has been very limited progress training car and bus drivers in 2010:

- Cars and vans: 10,085 drivers were trained under the Energy Saving Trust's Smarter Driving Programme in 2010, up from 5,311 in 2009.
- Buses: A total of 1,742 drivers undertook SAFED Bus and Coach training by the end of March 2010, of which 1,500 received funding from DfT to do so.

However, the number of drivers trained in 2010 is well below the 300,000 drivers to be trained each year if the potential for emissions reduction is to be realised, as set out in our indicator framework. Furthermore, the Government has not formally committed to the ongoing support of the Smarter Driving Programme, and the level of funding for the programme for 2011 onwards has not yet been confirmed.

Although there are opportunities for scaling up training, it is not clear that these are being developed under current policy approaches. For example, current policy on eco-driving in HGVs, buses and coaches is based on a voluntary approach, notwithstanding that DfT assessments have highlighted the benefits of mandatory implementation of eco-driving.

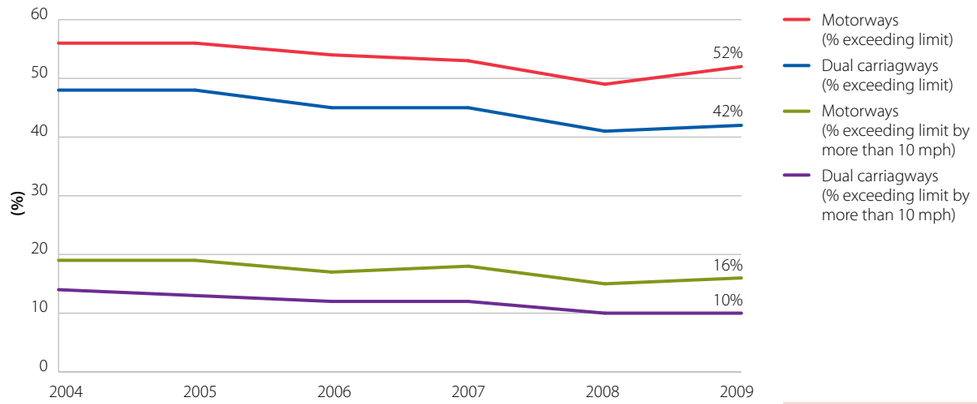
If potential for emissions reduction is to be unlocked, scope for including this training in driving tests should be carefully considered, and uptake in the HGV sector monitored with a mandatory approach introduced should the voluntary approach be shown not to deliver. Mandating of gear shift indicators currently being considered by the EU could make a useful contribution here, and should therefore be supported by the UK Government, given relatively low associated costs relative to carbon benefits.

Speed limiting

Department for Transport statistics indicate that speed limits are exceeded by the majority of drivers on motorways (52%), and a significant proportion on dual carriageways (42%). In 2009, following several years of decreasing speeding, there was an increase in speeding on motorways and dual carriageways (Figure 4.13). Although there are potential carbon benefits from enforcing the existing speed limit on motorways, the current policy approach includes reduced funding for speed cameras, and, according to commentators, a possible increase in the speed limit.

An increase in the speed limit on motorways and dual carriageways would fail to unlock potential emissions reduction from enforcement at the current level. It could also encourage an increase in speeds, both for drivers who currently drive within the speed limit, and drivers who currently break the speed limit. This could result in emissions up to 3.5 $MtCO_2$ higher than our indicator, which is based on enforcement of current speed limits.

Figure 4.13: Speeding on motorways and dual carriageways



Source: DfT (2010) – Road Statistics 2009: Traffic, Speeds and Congestion.

Transport and land-use planning

The approach to land-use planning for new development will help shape travel behaviour. For example, for new out of town residential or retail developments, there may be limited scope to encourage travel other than by car. In contrast, where developments are within existing areas that are well served by public transport, there may be an opportunity to encourage modal shift (e.g. through smarter choices policies, see above).

More generally, location within urban areas will shorten journeys relative to an approach based on out of town development, and therefore result in lower emissions for those journeys that continue to be made by car.

In last year's progress report, we highlighted risks under the current approach to land-use planning, suggesting that there was limited confidence that this fully accounted for transport emissions impacts. We noted a high degree of "out-of-town" development with high associated transport emissions. For example in 2006 58% of new retail development was located in out-of-town locations, where access by public transport or walking and cycling is more limited.

The Government is currently developing the National Planning Policy Framework to replace previous planning policy documents, and has committed to create a presumption in favour of sustainable development in the planning system. This presents an opportunity to ensure that the objective of reducing transport emissions is given adequate weight in determining the pattern of future residential and commercial development.

7. Opportunities for longer term emissions reductions

Our advice on the fourth carbon budget (2023-2027) included the need to plan for deep cuts in transport emissions through the 2020s, based on locking in consumer behaviour change and the deployment of more carbon-efficient technologies:

- We assumed significant progress on consumer behaviour change in the next decade through smarter choices and eco-driving. This should be locked in through the 2020s through ongoing policy incentives.
- There is scope for further improvement of car and van efficiency through the 2020s, to average emissions from new cars as low as 50 gCO_2/km in 2030, and 80 gCO_2/km for vans (including the contribution of electric vehicles).
- As set out in our advice on the fourth carbon budget, electric vehicles are likely to be cost-effective by 2030, with scope for the majority of new vehicles to be electric or plug-in hybrid by this time.
- There is a potentially important role for hydrogen vehicles, in niche markets (e.g. buses, HGVs) and potentially more widely.
- We adopted a cautious approach to the use of biofuels through the 2020s, assuming limited further penetration beyond 2020 given sustainability concerns.

Key aspects to develop these options which should be covered as part of Government's broader strategy for meeting the carbon budget are:

- The level of ambition for transport decarbonisation to 2030. This should be clarified, both in general and as regards potential contributions from different technologies (e.g. indicative trajectories for electric vehicle penetration over the next two decades.
- Implications of this ambition for action now on delivering current EU new vehicle CO_2 targets, developing electric vehicle markets and hydrogen technology, and agreeing new EU targets.
  - Achieving EU new vehicle CO_2 targets to 2020. This is key in the context of meeting the first three carbon budgets, but will also provide scope for further efficiency improvements required in the 2020s (i.e. if EU targets for 2020 are not achieved, progress through the 2020s will be at risk).

– Development of the electric vehicle market. Early development of the electric vehicle market is necessary to provide the option of wide-scale deployment in the 2020s. The Government is supporting market development, although further funding is likely to be required in the period to 2020 (see Section 5 above).

– Development of the hydrogen vehicle option. Analysis of technology priorities and UK capabilities – as undertaken for our review of low-carbon innovation in the UK – suggests that due to the UK's significant research capability and the potential to develop a leadership role, it should build UK research and development capabilities in hydrogen fuel cell vehicles.

– Gaining early agreement on new EU targets for 2030 new car and van emissions. Given the long investment cycle for the industry, emissions targets should be set well in advance. We suggested that appropriate targets might be 50 gCO_2/km for cars, and 80 gCO_2/km for vans.

These implications reinforce some of the indicators already in our framework (e.g. new vehicle emissions). They also suggest that a new indicator should be added relating to longer-term EU targets for new car emissions.

We will comment on the Government's strategy and the extent to which this is consistent with our indicators to prepare for meeting the fourth budget, in our next progress report to Parliament, to be published in June 2012.

Key findings

Surface transport **emissions fell by almost 4%** in 2009 as a result of the efficiency of new cars and HGVs improving, a reduction in distance travelled and increased penetration of biofuels.

New car emissions **outperformed** our indicator, **falling to 144.2 gCO_2/km** in 2010.

Government has made **major commitments** to support the development of electric vehicles particularly in supporting **new vehicle purchase** and the development of a **charging infrastructure**.

The Local Sustainable Transport Fund could support **wide scale roll out** of **'Smarter Choices'**, an initiative that encourages alternatives to car travel.

There has been **limited progress** on **eco-driving** training.

There was an **increase in speeding** offences in 2009; **enforcing the speed limit** could help to reduce emissions.

Table 4.1 The Committee's transport indicators

ROAD TRANSPORT		Budget 1	Budget 2	Budget 3	2010 trajectory	2010 outturn
Headline indicators						
Emissions (% change on 2007)	Road Transport	-10%	-18%	-27%	-8% (2009)	n/a (2009: -4%)
	Car	-13%	-23%	-35%	-10% (2009)	n/a (2009: -3%)
	Van	3%	4%	-2%	+1% (2009)	n/a (2009: -3%)
	HGV	-4%	-13%	-17%	-3% (2009)	n/a (2009: -9%)
gCO_2/km (carbon intensity of a vehicle kilometre)	Car	154	127	102	164 (2009)	n/a (2009: 169)
	Van	216	192	164	232 (2009)	n/a (2009: 218)
	HGV	761	678	619	777 (2009)	n/a (2009: 754)
Vehicle kilometres with impact of Smarter Choices (change on 2007, billion vehicle-km)	Car	420	450	478	409 (2009)	407.0
Supporting indicators						
Vehicle technology						
New car gCO_2/km	Car	146	116	95 (by 2020)	155.5	144.2
New electric cars registered each year (value at end of Budget period)		12,000	240,000	600,000	4,866	167
Stock of battery electric and plug-in hybrid cars in vehicle fleet		24,000	650,000 (240,000 delivered through pilot projects in 2015)	2.7 million	4,720	289
Biofuels						
Penetration of biofuels (by volume)		4.5%	7.7%	10.0%	3.5%	3.6%
Decision on whether RTFO target can be met sustainably		2011/12			n/a	n/a

Table 4.1 The Committee's transport indicators

ROAD TRANSPORT	Budget 1	Budget 2	Budget 3	2010 trajectory	2010 outturn
Demand side measures					
Proportion of drivers exceeding 70mph		0%*	0%*	n/a	n/a (2009: 51%)
Car drivers who have undergone eco driving training	1.2 million	2.8 million	4.5 million	590,000	15,396
Smarter Choices – demonstration in a city and development plan for roll out if successful, demonstration in rural areas and demonstration targeting longer journeys	2010			n/a	n/a
Smarter Choices – phased roll out to towns	2010		Complete	n/a	n/a
Development of integrated planning and transport strategy	2011			n/a	n/a
Other drivers					
Fuel pump prices, fuel duty, proportion of small/medium/large cars, Van and HGV kms (vehicle/tonne)**, Petrol/diesel consumption, surface transport modal split, average speed of car drivers exceeding 70mph.					
Agreement of modalities for reaching an EU target of 95 gCO_2/km target and strong enough penalties to deliver the target, new car CO_2 in EU, New Van and HGV gCO_2/km***, Number of EV car models on market, developments in battery and hydrogen fuel cell technogylogy, battery costs.					
Successful conclusion of EU work on Indirect Land Use Change/development of accounting system for ILUC and sustainability.					
Number of households and Car ownership by household, cost of car travel vs cost of public transport, funding allocated to and percentage of population covered by Smarter Choices initiatives*, Proportion of new retail floorspace in town centre/edge of centre locations, proportion of new dwellings in settlements >100,000 (% within boundary, on edge), ratio of parking spaces to new dwellings on annual basis.					

*These are the values implied by the estimated savings from speed limiting. CCC recognise that in practice it is impossible to achieve zero speeding. However, as close to zero as practicable is required to achieve the greatest carbon savings.

**We will include van and HGV km travelled in our headline indicators following new work on freight for our 2010 report.

***We aim to include new van and HGV gCO2/km in our indicator set as the available monitoring data improves.

Key: Headline indicators Implementation indicators Milestones Other drivers

Chapter 5: Progress reducing emissions from agriculture

Introduction and key messages

In our last progress report we presented new analysis of abatement potential in agriculture. This suggested that the previous Government's ambition for 2020 – set out in the Low Carbon Transition Plan – was low compared to the maximum technical potential. We highlighted uncertainties around emissions and abatement potential. We also started to scope out a framework of forward indicators, including both abatement measures and policy milestones.

In this chapter we do five things:

- We consider progress in reducing emissions based on new data for 2009.
- We attempt to assess the extent to which emission reductions have been driven through improvement in productivity and emissions intensity, rather than changes in output.
- We highlight limitations in the existing evidence base, and suggest key data that should be used to develop a comprehensive framework of forward indicators.
- We revisit our preliminary assessment of current policies and policy milestones. We consider incentives under EU policies, and the scope of the Government's proposed policy review in 2012, both of which could be crucial in determining the extent to which abatement measures are implemented in future.
- We summarise the advice in our fourth carbon budget report, focusing on implications for action in the near term, and any implied updates for our indicator framework.

Our key messages are:

- Agricultural emissions fell by around 1% in 2009. This is broadly consistent with average annual emission reductions of 1% required over the next decade, and on track for the 3% reduction (relative to 2007 levels) required by the end of the 1st budget period.
- There is some evidence of underlying progress towards improving emission intensities. However, the existing evidence base is incomplete, and should be extended to provide a more comprehensive overview of current and changing farming practice. Given further evidence, it will be possible to set out a framework of forward indicators as we have for other key emitting sectors.
- In order that the improvement in emissions intensity is sustained, new incentives may be required. There is scope for strengthening incentives at UK and EU levels. The Government's proposed policy review in 2012 is a key milestone in our indicator framework. This should cover the full range of policy options available, and should set clear performance triggers for the introduction of new policies.

- To prepare for emission reductions required in the 2020s, the Government should now consider options for further abatement over and above what is currently in the industry action plan. In addition, work should continue to identify further reduction opportunities through changes in consumer behaviour, both as regards reduction of waste and modification of diet.

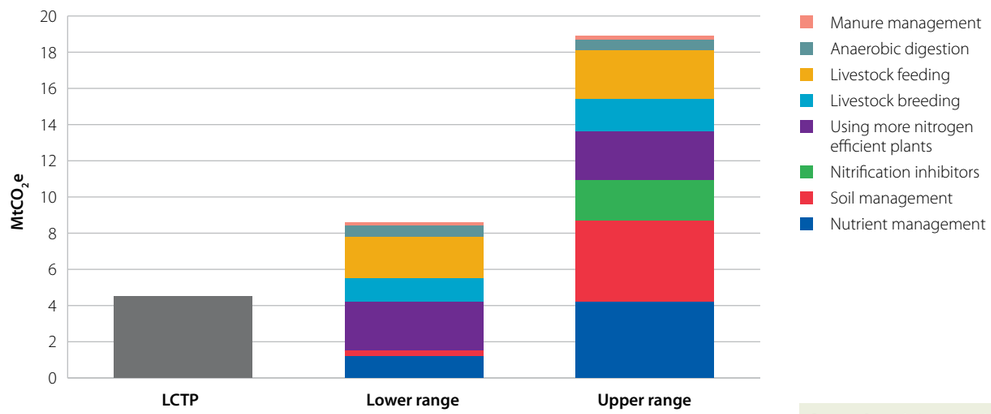
We set out the analysis that underpins these messages in five sections:

1. Agricultural emissions: trends and drivers
2. Developing the evidence base for emission indicators
3. Incentives for reducing agricultural emissions
4. Longer term potential for reducing agricultural emissions
5. Land use, land use change and forestry

1. Agricultural emissions: trends and drivers

The previous Government set out in its Low Carbon Transition Plan (LCTP)[1] an ambition to reduce agricultural emissions in England by 3 $MtCO_2e$ in 2020. This scales up to 4.5 $MtCO_2e$ for the UK as a whole. We have identified a range of measures which have the technical potential to reduce emissions by between 8 and 18 $MtCO_2e$, the majority of which are negative or zero cost. This suggests that the LCTP ambition is relatively modest compared to what could be achieved (Figure 5.1).

Figure 5.1: Technical abatement potential by 2022 compared to the Low Carbon Transition Plan ambition



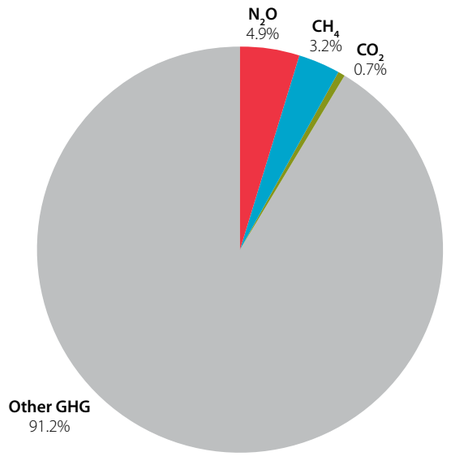
Source: Scottish Agricultural College (2010) and CCC modelling.

1 Published July 2009.

Emission trends

Agricultural emissions account for around 9% of total greenhouse gas emissions in the UK (Figure 5.2). Whereas in other sectors emissions fell significantly during the recession, this was not the case in agriculture. In 2009 agricultural GHG emissions fell by around 1%, following a 1% reduction in 2008. This relatively low emission reduction is consistent with food demand being relatively income inelastic (Box 5.1).

Figure 5.2: Agricultural emissions as a share of all UK emissions in 2009



Source: NAEI (2011).

Box 5.1: Income elasticity estimates for food products

In high income countries such as the UK the response of demand for food products to changes in income is very low:

- The magnitude of demand response among different food items does vary, with cereals exhibiting the lowest response to a change in income for the UK (table B5.1).
- As food makes up a smaller proportion of the total budget of consumers, a drop in income will impact other forms of expenditure.
- It is likely that a decline in income will have shifted consumption from higher to lowered priced items in the same food group. For example, switching to cheaper cuts of meat.

Therefore, the decline in incomes experienced during the recession is unlikely to have resulted in significant emission reductions.

Table B5.1: Income elasticity estimates for food (UK 2005)

Cereals	Meat	Dairy	Other food
-0.015	0.458	0.473	0.589

Source: USAD

Small agricultural emission reductions in 2009 occurred across the range of sources and gases:

- Emissions in 2009 declined for all the main sources: soils (-0.5%), enteric fermentation (-1.5%), wastes/manure management (-2.1%), and stationary/mobile combustion (-0.7%).
- The same trend was observed across the range of greenhouse gases: nitrous oxide (N_2O): -0.7%, methane (CH_4): -1.6% and carbon dioxide (CO_2): -1.1%.

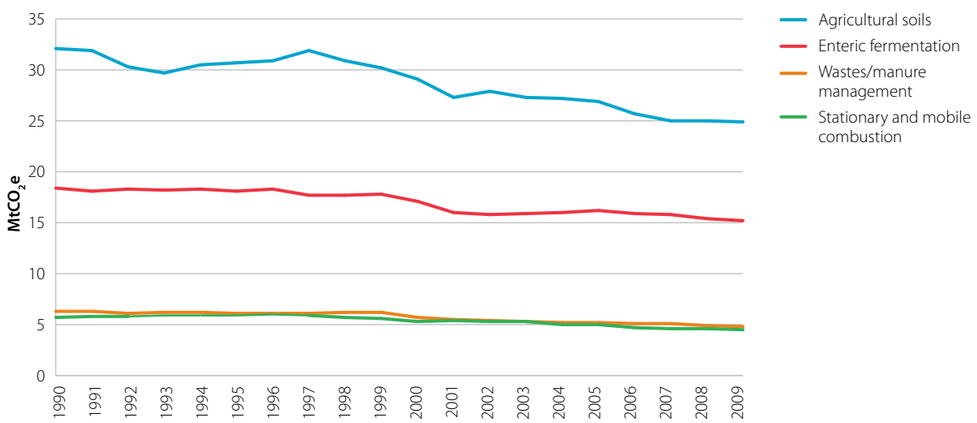
Resulting agricultural emissions were 49.5 $MtCO_2e$ in 2009:

- This is a slight increase on the inventory estimate of agricultural emissions in 2008 published last year (48 $MtCO_2e$). The reason is that inventory estimates from 1990 were revised upwards in 2011 in part due to the inclusion of emissions from the application of sewage sludge to land. The revised inventory estimate for 2008 was 50 $MtCO_2e$.
- In the period since 1990, agricultural emissions have fallen by around 21%, from 63 $MtCO_2e$ to 49.5 $MtCO_2e$. Emissions from all agriculture sources have fallen since 1990: soils (-22%), enteric fermentation (-17%), wastes/manure management (-24%), and stationary/mobile combustion (-21%) (Figures 5.3 and 5.4).
- Since 2003, agricultural emissions have fallen by 8% (i.e. 4.3 $MtCO_2e$), with just over half of the decrease attributed to a reduction in soil emissions. Between 2007 and 2009 emissions fell by 1 $MtCO_2e$.

The emission reductions in 2008 and 2009 are consistent with the ambition set out in the LCTP: emissions have fallen by 2% since 2007, and are on track for the 3% reduction (relative to 2007 levels) required by the end of the 1st budget period.

However, an assessment of emission drivers is required to understand the extent to which any emission reductions are due to reductions in emission intensities, which would suggest progress in implementing measures, or changes in output[2].

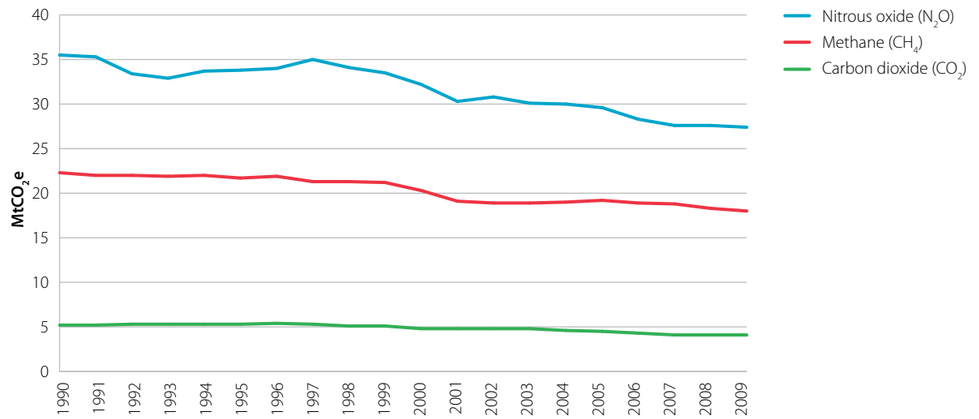
Figure 5.3: Agricultural CO_2e emissions by source (1990-2009)



Source: NAEI (2011).

2 Reduction in emission intensities may be due to changes in input use and shifts in composition of demand (e.g. away from carbon intensive red meat).

Figure 5.4: Agricultural CO_2e emissions by greenhouse gas (1990-2009)



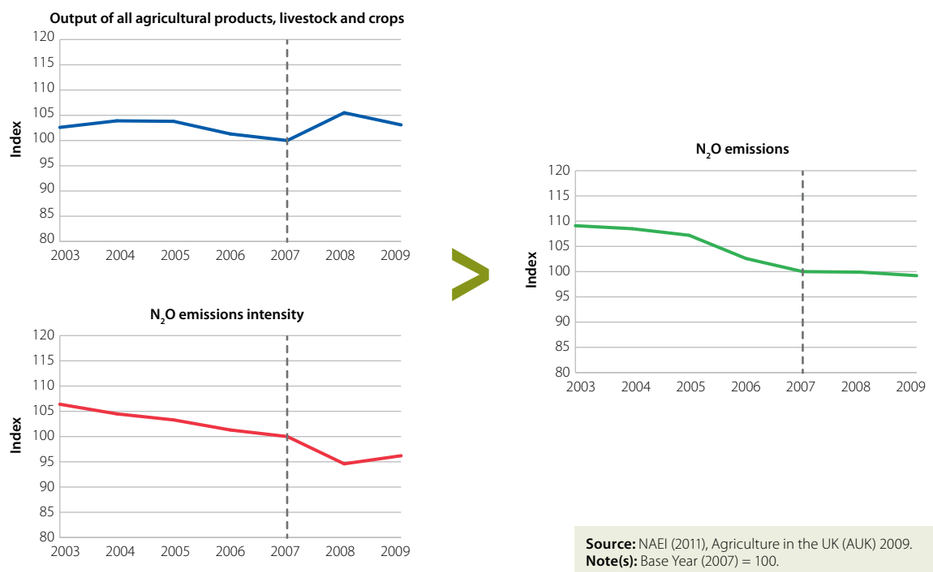
Source: NAEI (2011).

Emission drivers – nitrous oxide

Emissions from nitrous oxide (which account for over a half of all agricultural emissions) depend on the level and emissions intensity of UK production.

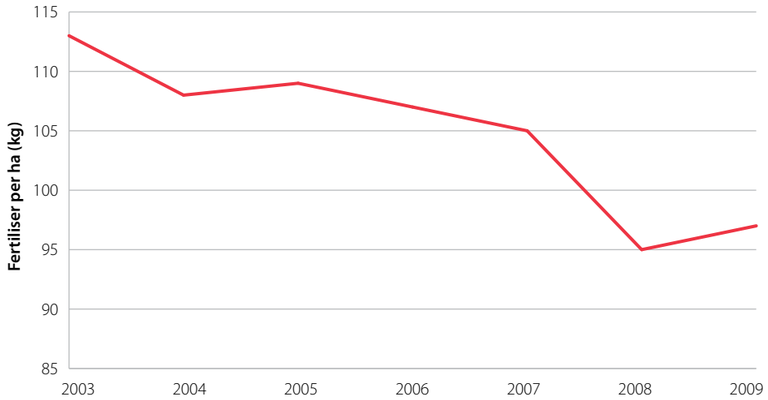
Emission reductions in 2009 were driven by a fall in output. However, longer-term emission reductions have been driven at least in part by reductions in emission intensity, due to reduced application of fertiliser to arable land and grassland (Figure 5.5):

Figure 5.5: Total agricultural output, N_2O emissions and N_2O emissions intensity of output (2003-2009)



Source: NAEI (2011), Agriculture in the UK (AUK) 2009.
Note(s): Base Year (2007) = 100.

Figure 5.6: Fertiliser efficiency on arable and grasslands (2003-2009)



Source: British Survey of Fertiliser Practice (2010).

- In 2009, total agricultural output fell by 2% and N_2O emissions fell by 1%. N_2O emission intensities therefore increased by nearly 2%. This was due to increased fertiliser application rates on pasture land.
- Total agricultural output in 2009 was 0.5% above 2003 levels and total emissions 9.1% below 2003 levels. Therefore emission intensities in 2009 were 9.6% below 2003 levels.
- These recent trends are consistent with longer term trends: since 1990 emissions have fallen at a faster rate than output (i.e. emissions fell by 23% compared to the 3% reduction in output).
- Reduced emission intensities are due to increased fertiliser efficiency. For example, fertiliser use per unit of land has improved significantly since 2003 (Figure 5.6):
  - On arable land, overall nitrogen use (kg/ha) from fertilisers in 2009 was 7% below 2003 levels. Between 1990 and 2009, use fell by 5%.
  - On grassland, overall nitrogen use (kg/ha) from fertilisers was 31% below 2003 levels in 2009. The longer term trend is a 56% reduction since 1990.

Therefore there is evidence of reduced emission intensities through soils measures in recent years, although not in 2009. Reductions will need to be sustained if agriculture is to achieve the emission reductions required to meet carbon budgets.

Emission drivers – methane

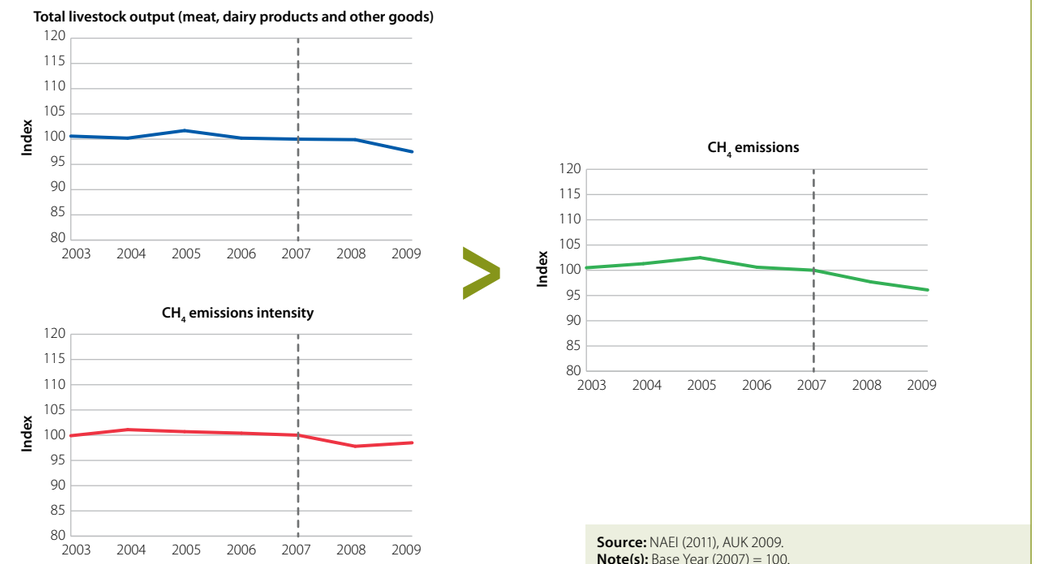
Methane emissions account for around 35% of total agricultural emissions. In terms of source, 84% of methane emissions arise from the digestive processes of ruminant livestock and 16% from wastes and manure management.

Emissions from livestock are a function of production (meat, dairy and other products) and the emission intensity of that production. In turn, emission intensity depends upon the emissions

factor of the animal (i.e. kg of GHG per cow), which depends upon the characteristics of livestock, what they are fed and how manures are managed; and the productivity of the animal, or its yield.

Since 2003 there has been a reduction in total meat consumption in the UK (Table 5.1). For much of this period total UK meat production remained broadly flat, while production of carbon intense red meat increased. Between 2007 and 2009 UK meat and milk production fell. Methane emission reductions of around 4% since 2007 reflect this as well as changes in emission intensity (Figure 5.7).

Figure 5.7: Total livestock output, CH_4 emissions and CH_4 emissions intensity of output (2003-2009)



Source: NAEI (2011), AUK 2009.
Note(s): Base Year (2007) = 100.

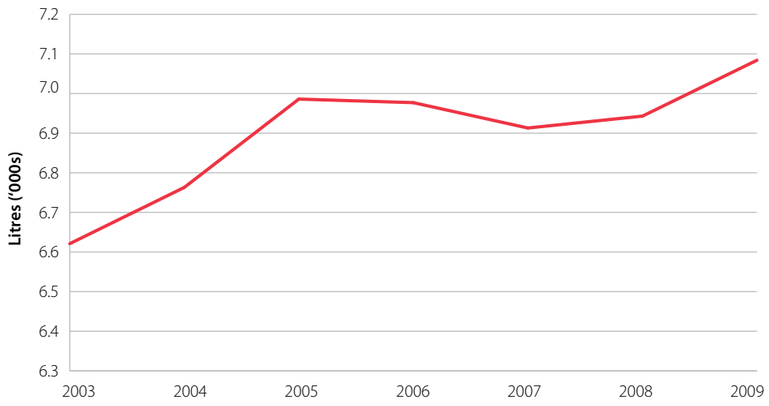
- Total UK meat *consumption* has fallen by around 3% since 2003 and 5% since 2007. The decline since 2007 coincided with big price increases for all food products. *Imports* of livestock fell by 4% between 2003 and 2009.
- Between 2007 and 2009 total UK milk production fell by 3%. Since 2003, milk production fell by 9%.
- Total UK meat production has remained broadly flat since 2003. Within this, production of beef increased by around 22%, and production of poultry fell by around 6%. UK meat production in 2009 was 2% lower than in 2007, which is explained by the 4% decline in red meat output, while white meat remained flat. Hence the share of white meat in total UK production rose between 2007 and 2009.
- Higher levels of productivity through increased yields enable a given demand for livestock products to be met with fewer animals and fewer emissions (Figures 5. 8 and 5.9). They therefore show up as an improvement in emission intensity. Overtime milk and some parts of livestock production have become more efficient:
  - Average milk yields have increased by 7% since 2003. The longer-term improvement is around 38% in the period since 1990.

– In 2009, beef and veal yields were 1% lower than 2007 levels, while clean pigs and poultry increased by 1%. Clean lamb/sheep yields were broadly flat during the period.

– The trends for beef and veal[3] show an 18% increase in the average dressed carcase weight between 1990 and 2009. A similar increase was also noted for clean pigs, while clean sheep and lamb experienced a smaller increase in the average dressed carcase weight of 6% over the same period.

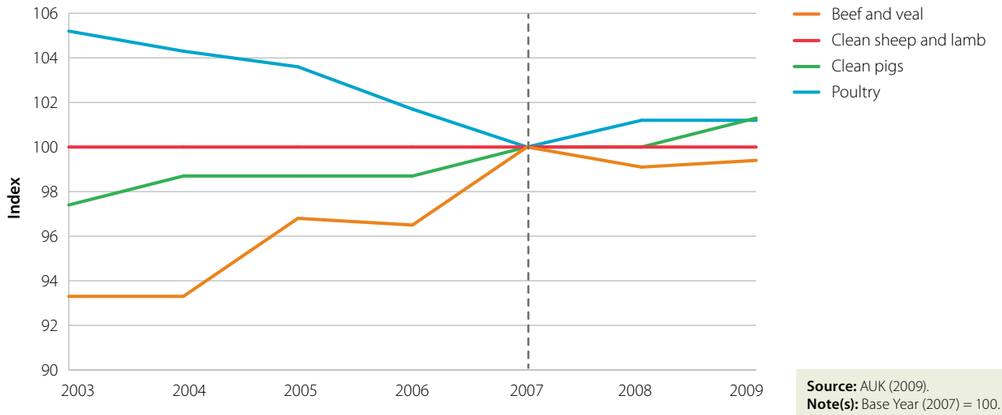
Overall, therefore, there has been progress towards reducing methane emissions. The reduction in emissions since 2007 reflects reductions in production and changes in its composition (e.g. increased share of white meat) and yields. As with soils measures, progress will need to be sustained if carbon budgets are to be met.

Figure 5.8: Milk output per dairy cow (2003-2009)



Source: AUK (2009).

Figure 5.9: Index of average dressed carcase weight per animal (2003-2009)



Source: AUK (2009).
Note(s): Base Year (2007) = 100.

3 Based on data for steers, heifers and young bulls.

Table 5.1: Trends in meat production, imports and consumption (2003-09)

	2003	2007	2008	2009	2009 change since 2003	2009 change since 2007
Home fed Production (kt), including exports						
Beef and veal	703	888	866	856	22%	-4%
Mutton and lamb	310	329	332	314	1%	-5%
Pigmeat	688	707	705	706	3%	0%
Poultry	1,557	1,467	1,464	1,459	-6%	-1%
Total	3,258	3,391	3367	3,335	2%	-2%
Exports (kt)						
Beef and veal	10	77	100	95	850%	23%
Mutton and lamb	85	77	95	98	15%	27%
Pigmeat	92	125	150	126	37%	1%
Poultry	260	293	279	254	-2%	-13%
Total	**447**	**572**	**624**	**573**	**28%**	**0%**
Imports (kt)						
Beef and veal	308	279	295	276	-10%	-1%
Mutton and lamb	136	137	135	141	4%	3%
Pigmeat	806	869	813	787	-2%	-9%
Poultry	412	461	406	393	-5%	-15%
Total	**1,662**	**1,746**	**1,649**	**1,597**	**-4%**	**-9%**
Total supply to UK market (kt)						
Beef and veal	1,001	1,090	1,061	1,037	4%	-5%
Mutton and lamb	361	389	372	357	-1%	-8%
Pigmeat	1,402	1,451	1368	1,367	-2%	-6%
Poultry	1,709	1,635	1,591	1,598	-6%	-2%
Total	**4,473**	**4,565**	**4,392**	**4,359**	**-3%**	**-5%**
Share of white meat (supply)	70%	68%	67%	68%		

Source: Agriculture in the UK (2009), Defra

Emission drivers – CO_2

Stationary and mobile combustion represent the largest source of CO_2 emissions in agriculture, accounting for around 9% of agricultural emissions, equivalent to 4.1 $MtCO_2$ in 2009. Almost 90% of CO_2 emissions were due to mobile machinery fuelled by gas oil, the vast majority being tractors.

- Emissions from mobile machinery fuelled by gas oil have declined by almost 20% in 2009 when compared to 1990, but its share of CO_2 emissions remains unchanged due to a similar long-term reduction in CO_2 emission over the period.
- More recently, the pace of emission reductions from mobile machinery fuelled by gas oil has slowed, declining by only 1% since 2007, compared to a 14% reduction between 2003 and 2009.

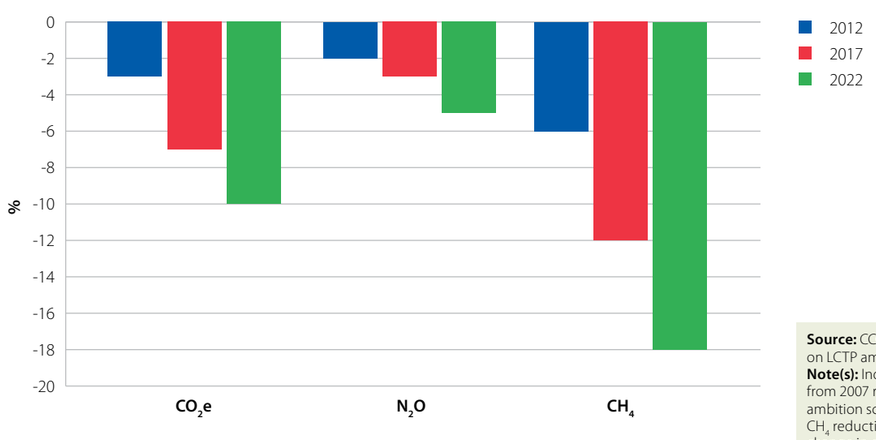
2. Developing the evidence base for emission indicators

A high-level assessment of emission trends and underlying productivity trends is useful in understanding progress reducing emissions, and the extent to which this is consistent with the required implementation of measures to achieve carbon budgets. For example, evidence of absolute emission reductions, or productivity improvements, would both suggest positive progress.

This is reflected in our preliminary set of indicators, set out in our 2009 report to Parliament. This includes (Figure 5.10):

- Average agriculture emission reductions of 10% by 2022 relative to 2007 levels.
- Average improvements in soils emissions intensity of 5% by 2022 relative to 2007 levels.
- Average improvement in livestock emissions intensity of 18% by 2022 relative to 2007 levels. Our indicator table sets out what this reduction would imply for different types of livestock.

Figure 5.10: Projections for emissions reduction by end of each budget



Source: CCC calculations based on LCTP ambition.
Note(s): Indicative % change from 2007 reflecting LCTP ambition scaled to UK; N_2O and CH_4 reduction equates to a change in emissions intensity if output is unchanged.

However, this approach alone is imperfect given uncertainties over emission factors and emissions reduction potential, which limit the ability of the current inventory to reflect emission intensity improvements, and the complexities associated with monitoring progress:

- **Uncertainty over emission factors and emissions reduction potential.** This relates to scientific uncertainties, and to uncertainties over current farming practice.
  - There are significant scientific uncertainties over the current level of agriculture emissions. For example, global or regional emission factors are unlikely to reflect soil or climatic conditions in the UK[4].
  - There are also uncertainties over current farming practice, which are unlikely to be reflected in standard emission factors or therefore in the emission intensity of UK production.
  - The combination of these uncertainties is that agricultural emissions could be 60% lower and up to 150% higher than currently recorded in the inventory (Table 5.2).
  - The potential emission reduction identified in our analysis is based on assumptions about current emissions and farming practice. The implication of these significant uncertainties is that emissions reduction potential is also highly uncertain (Box 5.2).

Table 5.2: Estimates of emissions factor uncertainty

GHG	Lower	Upper
Enteric Fermentation (CH_4)	-16%	16%
Manure Management (CH_4)	-25%	25%
All CH_4	-18%	43%
Manure Management & Soils (N_2O)	-93%	249%
Total	**-61%**	**152%**

Box 5.2: Uncertainties in the Agriculture MACCs

The SAC MACC analysis identifies technical potential ranging from 8.6-18.9 $MtCO_2e$ by 2022. The range indicates a pessimistic and optimistic set of assumptions, which reflect a number of uncertainties. These include:

- Baseline uncertainty as to the present state of farming practice. For example, the extent to which farmers are already implementing measures or the amount of additional land to which a measure can be applied.
- Technical uncertainty or the ability of measures to deliver identified potential given current evidence and/or timelines required to test and deploy options. For example, nitrification inhibitors, which slow the rate of conversion of fertiliser ammonium to nitrate, need to be adequately tested under UK conditions to establish their efficacy.
- Regulatory uncertainty. For example, the use of ionophores in livestock (which inhibit the production of methane from enteric fermentation) is at present illegal within the EU.

4 The current UK agriculture inventory uses generic emission factors based on IPCC Tier 1 methodologies to calculate emissions from agriculture.

- **Problems with the inventory and in measuring progress reducing emissions.** This relates to how changes in practice affect standard emission factors used to estimate the GHG inventory and the limits to what an assessment of productivity data can reveal.
  - As standard emission factors do not reflect current farming practices it follows that changes to UK farming practices will not affect the level of inventory emissions.
  - Given uncertainty over the scope for productivity improvement, an assessment of productivity cannot reveal the extent to which the underlying opportunity is being addressed.
  - There are some measures where productivity improvements result in increased emissions but these would not be reflected in inventory emissions. For example, measures to increase the weight gain in cattle would increase productivity but could also increase the emissions factor. The gain in weight would increase output – which would be recorded in statistics – but the emissions increase would not.

Therefore a monitoring approach based on the current inventory and productivity data must currently be based on an uncertain benchmark, and is not able to fully identify progress implementing measures.

In order to support more comprehensive assessment of progress implementing measures and reducing emissions, there are two key areas where the evidence base should and is being strengthened under Defra or industry initiatives:

- **Resolving scientific uncertainties.** The Government has commissioned several research projects to develop UK emission factors which when multiplied by the number of animals and crop area of each type will provide a more accurate inventory (Box 5.3). The inventory will also improve spatial and temporal resolutions allowing reporting of emissions for agricultural regions and seasons. Once complete, expected in 2015, this will allow more robust estimates of current emissions.

Box 5.3: Improving the agricultural emissions inventory

To reduce the uncertainty that exists with the method for calculating agricultural emissions in the inventory, the Government is funding work to develop a Smart Inventory which will better reflect the implementation of measures and emission reductions. Government and the DAs are to invest £12.6m to improve understanding of how UK agriculture contributes to climate change.

The research will take place over the next four and a half years in a series of projects that will focus on improving emissions data collection and providing a better understanding of the factors that have the biggest impact on CH_4 and N_2O emissions. For example, research may uncover that some livestock breeds produce less methane than other breeds under different farming systems or that N_2O emissions can be reduced by applying fertiliser at different times to certain crops. The investment is intended to develop a revised set of UK specific inventory emission factors for CH_4 and N_2O which when multiplied by the number of animals and crop area of each type will provide a more accurate inventory.

- **Better understanding of farming practice and ensuring changes are reflected in the inventory.** The revised inventory will estimate emission factors for a range of production systems, including the effect of specific mitigation methods and management practices. Given better understanding of farming practice, more robust estimates of emissions reduction potential and assessments of progress reducing emissions will be feasible (e.g. judgements about progress could then be based both on assessment of productivity improvement and evidence of changed farm practice).

In addition it will be important to draw upon, and strengthen, the existing evidence on farming practice:

- **Measures to reduce soils emissions:**
  - Existing data sources provide reasonable coverage of key indicators. Data on quantities of fertiliser applied, and when they are applied, are routinely collected in the British Survey of Fertiliser Practice; questions on soil testing have been included periodically in the Farm Practices Survey. Such sources do not, however, provide any information on the impact of measures (e.g. whether changes in timing of application lead to less fertiliser use).
- **Measures to reduce livestock emissions:**
  - Existing data sources provide data on the age distribution of cattle herds, survival rates for lamb and pig populations, livestock mortality rates and feed conversion rates. These can be used to make a judgement about changes in livestock productivity.
  - Data is collected periodically on manure storage facilities. This was last collected by the Farm Practices Survey in 2006 and will be collected again in 2011.
- **Installed on farm anaerobic digestion (AD) capacity and quantities of manure collected for use in AD:**
  - The Farm Practices Survey collected data on AD in 2008 although data on plant capacity, a key indicator, was not. The 2011 survey includes questions on farmer take up, actual and intended. As AD is anticipated to provide 20% of all abatement by 2020 this should be monitored on an annual basis.

There are several sources that collect data on measures, such as the annual Farm Practices Survey and the British Survey of Fertiliser Practice (Box 5.4). The challenge will therefore be to translate these into a useful monitoring framework, rather than to invent new data sources.

Box 5.4: Data sources for monitoring progress

- The annual Farm Practices Survey covers England and is sent to over 16,000 holdings. Response rates are around 65%. Currently, questions vary in each survey so key abatement measures might not be tracked each year. The 2011 survey will include questions related to AD, soil nutrient management, manure storage, the use of high sugar grasses on grassland and livestock breeding.
- The British survey of fertiliser practice is sent to 1500 farms with holdings of more than 20 hectares. It also includes a panel element which allows a subset of farms to be tracked every year. It provides data on nitrogen application rates and the application of organic manures.

It will be important that projects in these areas are implemented in a timely manner, in order to improve the effectiveness of monitoring in the context of carbon budgets. We will work with Defra and the industry to implement projects to improve the evidence base, with a particular focus on using these to further develop indicators of progress reducing emissions.

3. Incentives for reducing agricultural emissions

In addition to abatement measures, our indicator framework includes policy milestones: incentives to change farming practice will be required in order to deliver abatement measures.

In our previous progress report, we set out a preliminary assessment of the policy approach in agriculture, focusing on the current industry-led approach. We suggested that under this approach incentives may be weak, and therefore risks to delivering abatement measures may be high. However, we did not consider incentives under current EU policies, or the Government's proposed policy review in 2012.

We now build on last year's assessment, providing more details on the UK approach and incentives under current and possible future EU approaches. We also suggest key areas for focus in the Government's policy review.

If progress in reducing emissions is to be sustained, and abatement measures in our forward indicator framework are to be delivered, it will be important that policy milestones in this framework are achieved and incentives for delivery introduced.

We now consider:

- The current industry-led approach.
- Incentives under existing policies.
- Opportunities to promote mitigation under the CAP.
- Options and triggers for new national approaches.

The current industry-led approach

The current industry-led approach to delivering the LCTP ambition to reduce agricultural emissions by 3 $MtCO_2e$ in England by 2020 was set out in Agriculture Industry GHG Action Plan: Framework for Action, published on 10th February 2010[5].

At the aggregate level, the ambition in this plan is low relative to the abatement potential that we have identified. We have therefore suggested that this should be regarded as a minimum ambition, and that there should be flexibility to increase ambition if there is evidence to show that more is possible.

Regarding specific measures, the plan focuses on options which are more certain and cost effective. The key areas of focus in the plan and associated ambition are:

- Improvements to nutrient management plans to achieve a 0.6 $MtCO_2e$ reduction in 2020.
- Selection of different crop varieties which favour lower N_2O emissions to deliver a 0.2 $MtCO_2e$ reduction in 2020.
- Deployment of AD systems on farms reducing emissions by 0.6 $MtCO_2e$ in 2020.
- Increasing feed efficiency and dietary changes to deliver emission savings of 1.6 $MtCO_2e$ in 2020.
- The plan also includes ambitions to reduce CO_2 emissions, by improving energy efficiency and greater uptake of renewable energy sources, and to reduce land-use change emissions.

The plan does not cover less certain/more expensive measures identified in our analysis. These measures include, for example, dietary additives, soil drainage measures and nitrification inhibitors.

The plan will be delivered in three phases under a voluntary approach based on the provision of information and encouragement:

- Phase 1 (2010-2012) establishes the key activities required to deliver the planned 3 $MtCO_2e$ emissions reduction, including communications strategy, identifying key delivery routes and developing sector road maps (Table 5.3).
- Phase 2 (2012-2015) will promote improvements in farming practices in target sectors (i.e. crop nutrition improvements, promoting low-emission animal diets and improvements to animal health).
- Phase 3 (2015-2020), with the benefit of an improved inventory, will promote those measures where there is more cost-effective potential to reduce emissions.

5 The approach taken by the Devolved Administrations is set out in Chapter 6.

Table 5.3: Achievement measures for the first phase of the Industry GHG Action

Action	Description	Target date
1	AHDB feasibility study to assess need for i-Hub	End-April 11
2	Subject to need, pilot i-Hub	End-April 12
3	Liaison with farming organisations, service providers and their networks	Ongoing
4	Establish dialogue with retailers and other key supply chain organisations about advice and incentives	End-Feb 11
5	Identify sectors where biggest efficiency gains can be gained and map to existing networks	End-Apr 11
6	Develop key messages and updates	End-Apr 11
7	Develop information and case studies. Use farmer champions to communicate benefits of actions.	End-Oct 11
8	Develop concept of branding of advice	End-Oct 11
9	Industry Sector Training initiatives	End-Mar 12
10	Progress reports to Secretary of State	End July 11/End Apr 12
11	Working with GHG inventory data mining team to use industry data sources to help monitor emission reductions	Ongoing
12	Establishment of Steering group	End-Jan 11

A series of industry road maps will support implementation of the plan:

- The Dairy road map aims for a 20-30% emissions reduction by 2020 relative to a 1990 baseline. It includes performance indicators for the use of nutrient management plans, trialling of new technologies and uptake of carbon footprinting tools.
- The English Beef and Sheep production road map sets a baseline for beef and sheep emissions and energy use for 2008 and sets targets for an 11% reduction in lifecycle emissions by 2020. It also includes performance indicators for carcase weights, animal fertility and breeding values (Table 5.4).
- The Pork production road map sets out an ambition to reduce emissions per kg of pork by 17% by 2020. This will be achieved by using feed more efficiently; achieving a higher number of pigs per litter and managing slurry/waste in ways that reduce its environmental impact. The road map includes indicators relating to weight gain, meat production, animal mortality and feed efficiency (Table 5.5).

Our assessment is that the level of ambition in these road maps is consistent with the ambition in the Low Carbon Transition Plan to deliver 4.5 $MtCO_2e$ by 2020, when grossed up to the UK.

Table 5.4: Performance indicators included in the beef and sheep production road map

Indicator	2008 baseline	2020 target
Beef Global Warming Potential (GWP)	13.89 kg CO_2e/kg meat	12.37
Lamb GWP	14.64 kg CO_2e/kg meat	13.03
Beef efficiency	0.471 kg/d carcase wt	0.5
Beef fertility	88.27 calves per 100 cows	95
Lamb efficiency	17.31 kg lamb carcase per ewe	18
Ewe fertility	118.2%	125.7% (plus 7.5 lambs per 100 ewes)
Beef and sheep breeding progress	5 year average to 2008: – Suffolk 0.082 pts/yr – Texel 6.811 pts/yr – Limousin 0.91 BV/yr	5 year average to 2020: – Suffolk 0.12 – Texel 10.01 – Limousin 1.1

Source: EBLEX

Table 5.5: Performance indicators included in the Pork production road map

Indicator	2008 baseline	2014	2020
Weight of pigs at weaning (kg)	7.7	7.9	8.0
Pigs weaned per sow per year	22.1	25.3	26.0
Finishing mortality (%)	3.3	2.0	2.0
Rearing feed conversion ratio	1.73	1.5	1.5
Finishing feed conversion ratio	2.87	2.4	2.3
Daily gain (g)	478	530	n/a
Average live weight (kg)	103.05	105	110
Average dead weight (kg)	79.77	81.3	86.0
Killing out percentage	77	77.5	78
Sow feed (kg) per sow per year	1456	1560	1360
Tonnes pig meat per sow per year	1608	2000	2200

Source: Advancing together: A roadmap for the English Pig Industry, April 2011.

Incentives under existing policies

There are various EU and UK policies which provide, and if strengthened could increase, incentives for reducing agricultural emissions:

- **The EU Nitrates Directive.** This is aimed at limiting when, where and how fertilisers can be applied. It also requires farmers to have at least 6 months storage for manures and slurry. It covers some, but not all, of the UK. Emissions from manure management and fertiliser use account for up to 23% of the abatement potential identified in our analysis and 47% of the abatement potential identified in the plan. Our assessment is that if all the UK were covered by Nitrate Vulnerable Zones – it could provide significant incentives to reduce these emissions (Box 5.5).
- **The Gothenburg Protocol (1999).** The protocol, which is part of the Convention on Long-Range Trans Boundary Air Pollution[6], limits ammonia emissions – which mainly arise from agriculture – thus indirectly limiting soils emissions. In 2008 and 2009 the UK met the annual upper limit to be achieved by 2010 onwards due to reduced livestock numbers as a result of CAP reform. New limits to be achieved by 2020 are currently being negotiated. The existing limit on ammonia emissions is unlikely to constrain soils emissions. Tightening of ammonia limits such that these become a binding constraint would strengthen incentives to reduce soils emissions.
- **Regulation of animal health.** Incentives to promote animal health are currently limited, and uptake of animal health schemes is low. Strong incentives could improve livestock efficiency and reduce methane emissions. The scope for improvement in this area is currently uncertain, but will be assessed as part of an on-going Defra project.
- **Support for AD.** This is potentially provided by various renewable energy support mechanisms (e.g. ROCs, feed in tariffs, the Renewable Heat Incentives). However, analysis for our review of renewable energy[7] suggested that current support levels may be insufficient to make projects viable. Farmers face additional barriers to electricity grid connection. Addressing unnecessary barriers and the possibility of adjusting incentive regimes to increase the growth of AD were acknowledged by the Government in its recently published Anaerobic Digestion Strategy. This will include the provision of £10m of debt finance over four years to encourage new AD capacity. To deliver 20% of the abatement potential identified in the GHG Action Plan requires up to 100 MW of AD capacity using manures by 2022. With appropriate support, this level of ambition could be delivered.

6 The CLRTAP explicitly limits all trans-boundary pollutants, except GHGs
7 CCC(2011), Renewable Energy Review, May 2011

Box 5.5: The EU Nitrates Directive

The EU Nitrates Directive was adopted in 1991 and implemented in the UK by the Nitrates Action Programme. It aims to protect water quality across Europe by preventing nitrogen from agricultural sources polluting ground and surface waters and by promoting the use of good farming practices. The regulation identifies all surface and ground water which is polluted by nitrogen above a certain level and then designates the areas of land that drain into these waters as Nitrate Vulnerable Zones (NVZs).

The Nitrates Directive is implemented by separate regulations in England and Wales. Currently all of Northern Ireland, some parts of Wales and Scotland and around 60% of England, mainly in the east of the country, are designated to be NVZs. Farmers in these zones have to comply with certain conditions governing the use and storage of fertilisers and manures. For example:

- The spreading of fertilisers is prohibited at certain times during the year.
- By January 2012 farmers will be required to have up to six months worth of storage capacity for manures and slurry.

However the impact on English GHG emissions is less than it could be since large areas of the west, which experiences higher rainfall and where soil conditions make the release of N_2O more likely, are not covered by NVZs. A review will assess whether the designation of NVZs should be widened in 2013.

In summary, current policies provide incentives to implement some soils measures. Additional support could be provided through extending the coverage of Nitrate Vulnerable Zones, tightening ammonia limits and through increasing subsidy to AD. These should be considered by the Government to provide more confidence that the targets in the plan will be delivered, and possibly outperformed, in practice.

Opportunities to promote mitigation under the Common Agricultural Policy

UK farmers currently receive around £3.6 billion annually under the Common Agricultural Policy (CAP) of the European Union. This income is subject to certain conditions being met (Box 5.6).

Box 5.6: The Common Agricultural Policy

- Financial support to UK farmers under CAP was approximately £3.6 billion in 2009, of which just over £2 billion goes to English farmers.
- Compared to income from the sale of products, the level of support is substantial: in 2009 the value of subsidies was broadly equal to total farm profits and agricultural incomes (after depreciation).
- CAP support for UK farmers is currently provided in three ways:
  - The largest element is the single payments scheme ('Pillar one support'), which provided £2.9 billion in 2009.
  - Payments are based on historic production levels and are intended to secure availability of supply and provide farmers with stable incomes without leading to unmanageable surpluses.
  - The balance (over £600m in 2009) is used to support agri-environment schemes, animal disease compensation and less favoured areas support schemes. This form of support is funded under Pillar two.

Source: Agriculture in the UK, Defra (2009)

Although payment is not currently linked to measures which would reduce GHG emissions, scope for such linkage is being considered in the context of CAP reform.

This raises questions over the appropriate measures to be targeted under CAP, and the appropriate mechanism within CAP for channelling funding:

- **Measures to be targeted.** The current industry-led approach focuses on negative or zero cost abatement measures. CAP reform could reinforce incentives to take up these. In addition our analysis suggests significant abatement potential that costs less than the projected carbon price. There is therefore an opportunity for linking support under CAP to the introduction of more expensive measures whilst minimising impacts on competitiveness. The cost-effective measures that CAP could consider include:
  - Improved crop nutrient management practices to match the quantity, type and timing of organic and inorganic fertiliser to meet the needs of the crop.
  - Use of improved breeding practices in the beef, sheep and dairy industries.
  - Improved feeding practices, such as increased use of maize, instead of silage, or increased use of clover rich pastures and high sugar grasses.
  - Manure management measures, such as covers for slurry tanks and lagoons.
  - Take up of Anaerobic Digestion.
- **Mechanisms to be targeted.** There is an opportunity to support these measures either under a 'greener' pillar one or an expanded pillar two. In both cases the key point is whether conditionality is sufficiently tight so that changes in behaviour and the take up of measures are encouraged.

We have previously highlighted the need to design carbon policy for the agricultural sector in a way that does not result in leakage of production to other EU countries. Linking CAP to abatement measures offers an opportunity to reduce emissions without such leakage. It is therefore something which the Government should strongly support in order to mitigate delivery risks.

Options and triggers for new national approaches

The combination of the action plan and supporting roadmaps, together with EU and national policies discussed above, could provide sufficient incentives to address opportunities for reducing agricultural emissions over the next decade.

However, given current incomplete policy coverage, and uncertainties over how this will change in future, new policies may be needed in order that emission reductions are achieved. This is recognised by Defra, which is committed to a policy review in 2012.

In order to properly assess the extent to which the policy framework is fit for purpose, the review should:

- **Map incentives to measures.** There should be an assessment of the range of incentives for reducing emissions under policies in 2012. We have shown here that there are some incentives under current policies, with scope for strengthening these, for example, through CAP reform. The objective should be to provide an assessment of whether existing policies are sufficient, in terms of coverage, to realise required levels of abatement.
- **Consider scope for further policy innovation.** To the extent that there is still incomplete policy coverage in 2012, the review should examine the full range of policy options for incentivising emission reductions. This includes information based and voluntary approaches, but also approaches based on pricing of carbon, cap and trade, and regulation.
- **Set out triggers for the introduction of new policies.** The review should set triggers for the introduction of new policies. This could simply be a judgment that incentives under current policies are unlikely to deliver sufficiently, and therefore new policies should be introduced. Triggers could also relate to delivery of measures in the action plan. Given that this is not aimed at delivering changed farming practice until phase 2, these triggers would have to relate to performance in the first half of the second carbon budget period (e.g. 2013, 2014). Decisions to introduce new policies would need to be taken towards the end of phase 2 of the action plan (i.e. 2014-15), to take into account the long-lead times required to develop policies and the inevitable delay between policy implementation and incentivising changes in behaviour.

4. Longer term potential for reducing agricultural emissions

We set out our advice on the ambition and options for reducing agricultural emissions through the 2020s in the context of our advice on the fourth carbon budget (2023-27). This is relevant in the context of our progress reporting insofar as the 2020s may have implications for our framework of forward indicators, either in terms of reinforcing existing indicators or introducing new indicators. In this respect, we now highlight key areas which should be included in the Government's strategy on the fourth carbon budget, due later in 2011.

In the fourth budget report, we highlighted three key areas for consideration by the Government:

- **Options for supply side emission reductions up to 2020.** We highlighted scope for further emission reductions (e.g. up to around 15 $MtCO_2e$) from changed farming practice over and above those being targeted in the industry action plan to 2020. In addition, we suggested more radical options should be considered further, including the possible use of genetically modified organisms and alternative production systems (e.g. mixed farming). This is both in the context of the fourth carbon budget and emission reductions further out on the path to 2050.

- **Ambition for the 2020s.** Building on the minimum 4.5 $MtCO_2e$ emissions reduction to 2020 (i.e. 3 $MtCO_2e$ targeted for England scaled up to the UK level), we identified a further 5.4 $MtCO_2e$ of cost effective abatement in the 2020s as a contribution from agriculture towards meeting carbon budgets.
- **Options for reducing emissions through changing consumer behaviour.** Our assessment showed significant scope for emission reductions through reduced waste and diet rebalancing. Both should be seriously considered given the emission reductions required in the context of the 2050 target.
  - New policies to encourage reduced waste by households could result in annual emission reductions of up to 3 $MtCO_2e$ from reduced agricultural production[8] with a further reduction in land fill emissions of around 1 $MtCO_2e$.
  - Rebalancing of diets away from red meat and dairy produce (Box 5.7) offers significant potential for emission reductions (e.g. up to 15 $MtCO_2e$) whilst maintaining nutritional balance, improving health and freeing up land. Given the need for further deep cuts in agricultural emissions over the next decades, the full range of levers to encourage behaviour change (e.g. information provision through to taxation) should be considered.

Box 5.7: Emissions savings and health benefits from rebalancing diets

Two studies published earlier this year have highlighted the benefits of a low carbon diet.

A new WWF report[9] *Livewell – a balance of healthy and sustainable food choices'*, (2011) looked at whether a change from today's UK diet to one that has 25% less embedded GHG emissions by 2020 would meet the dietary recommendations for a healthy diet, and what that type of diet could look like. The study found that:

- The current UK diet is too high in fat, salt and sugar, and too low in fruit and vegetables and fibre. Protein intakes are higher than needed, with animal protein accounting for nine of the top ten sources in the average diet.
- A diet can be achieved which meets dietary recommendations for health and the GHG reduction targets for 2020, without eliminating all meat and dairy products. Average costs for the 'Livewell diet' in 2020 at £29 per person would be comparable to 2009 spend.
- The Livewell Plate diet broadly consists of eating more seasonal, regionally grown fruit and vegetables; less meat (red and white) and less highly processed foods which are more resource-intensive to produce. The diet would reduce annual consumption of meat per person from today's average of 79kg to 10kg by 2020.

A second report[10] by the Scientific Advisory Committee on Nutrition led the Department of Health to recommend that consumption of red or processed meat should not exceed more than 500g each week in order to reduce the risk of bowel cancer. The weekly amount would be reached by eating one large steak, a pork chop, two sausages and a small portion of beef bolognese sauce.

8 These savings would not be achieved if the industry exported the products that would otherwise have been wasted.
9 Research undertaken by the Rowett Institute of Nutrition and Health at the University of Aberdeen
10 *'Iron and health'* (2010)

We expect that the Government's response, and its strategy for delivering the fourth carbon budget, will include an indicative commitment to agricultural emission reductions through the 2020s, based on a preliminary assessment of supply side and demand side opportunities.

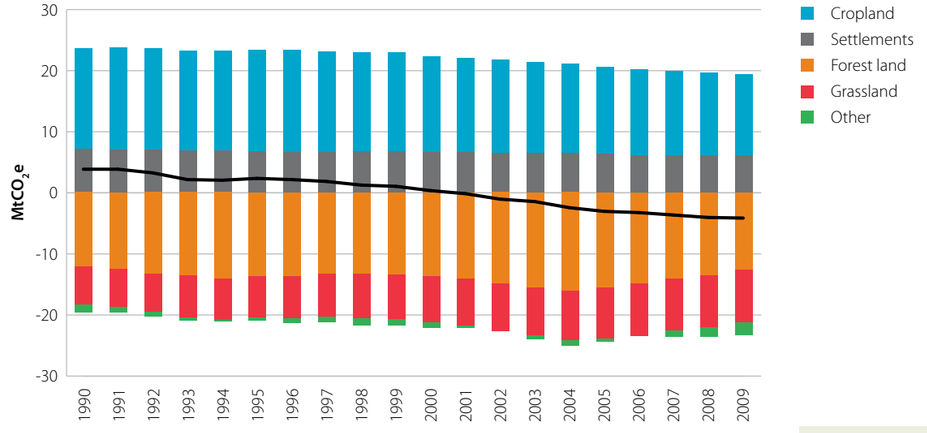
5. Land use, land use change and forestry

Emission trends

Emissions from LULUCF activities are mostly made up of emissions from the conversion of land to cropland and settlements. These are largely offset by carbon absorbed from land converted to forestry and grassland. On a net basis, the LULUCF sector absorbed 4.1 $MtCO_2e$ in 2009, up 3% on the previous year and consistent with the long-term declining trend of net emissions since 1990 (Figure 5.11):

- The conversion of land into cropland, which is the single largest source of emissions, saw a 1% annual decline in emissions in 2009. This represents a 19% reduction when compared to 1990 levels.
- The level of carbon removed from remaining forests land declined in 2009 by 6% year on year to around 12.7 $MtCO_2e$. This is part of a recent declining trend, since removals reached a high in 2004 of 16.1 $MtCO_2e$.

Figure 5.11: LULUCF emissions (1990-2009)



Source: NAEI (2011).

Opportunities to reduce land use emissions

In our fourth budget report, we included an assessment of options to reduce LULUCF emissions, not just in the fourth budget, but over the next decade. We revisit these options now, highlighting key actions required to reduce LULUCF emissions, progress made, and challenges/policy options to strengthen incentives for delivery of emission reductions.

We suggested that there is scope for reducing emissions in forestry, agriculture, and peat restoration:

- **Forestry:**
  - We identified planting more trees to increase sequestration and use of forestry biomass to displace the burning of fossil fuels in the energy sector as the two key options for abatement.
  - Latest data[11] reveal that the total area of woodland cover in Great Britain by end March 2010 totalled 2,982 thousand hectares, representing 13% of the total land area.
  - Work to increase woodland cover is already underway under the auspices of the Woodland Carbon Task Force. This is seeking to increase woodland planting rates in England, which have dropped by more than half in the last ten years to 2,000 ha per year.
  - Defra's independent panel of experts will provide an interim report[12] to the Government in autumn 2011 on the future direction of forestry and woodland policy. How to increase woodland cover will be one consideration of the panel.
  - In our 4th budget report we noted that by 2030, under our central scenario, a UK 10,000 hectare per year woodland creation programme could deliver annual savings of 1 $MtCO_2e$ by 2030.
  - However given long lead times we noted that planting would need to begin soon to deliver this abatement. For this reason we have included a forestry indicator in our indicator framework.

Notwithstanding the benefits of increasing carbon abatement from forestry, we also recognise that there could be potential trade-offs between increasing woodland cover and biodiversity that will need to be considered.

- **Agriculture and other land management practices:** various practices to sequester carbon such as biochar and reduced tillage might potentially reduce emissions. However, there are still uncertainties that need to be addressed as to whether these practices do result in additional abatement. Abatement potential depends upon the type of agricultural land and existing levels of soil carbon. For example:
  - Evidence[13] suggests that the level of carbon in **permanent pasture land** has reached saturation levels. However, there may be opportunities to enhance the soil carbon by converting arable land to permanent pasture land or forestry.
  - For **arable land**, practices such as reduced tillage appear to have little or no impact on soil carbon. The addition of biochar can increase soil carbon levels, although this may not be sufficient to offset soil carbon release due to climate change (Box 5.8).

Box 5.8: UK Climate Projections (UKCP09) and implications for soil carbon

The UK Climate Projections (UKCP09) provides projections of climate change for the UK up to the end of the century. The projections show three different scenarios representing high, medium and low GHG scenarios for the 2020s, 2050s and 2080s. The main climate change projections are of warmer wetter winters and warmer drier summers in almost all areas of the UK.

The impact of the changing climate will impact on carbon sinks. In the summer months, the soil moisture content is expected to decline due to reduced rainfall and warmer temperatures. In contrast, rainfall over the winter is expected to increase. The overall effect of this drying and rewetting cycle is to increase the release of CO_2 from the soil and therefore make soil a less reliable store of carbon.

Source: *Climate change scenarios for the United Kingdom: The UKCIP02 Scientific Report* (2002) Tyndall Centre for Climate Change Research

- **Peat restoration and reducing horticultural use:** There is an opportunity to reduce emissions from degraded peat. It is unclear that the light touch approach of the Soil Protection Review provides the level of protection required. Therefore stronger levers, at the UK or EU levels, are required if carbon release from peat is to be avoided. In addition, there is scope for preserving soil carbon by banning the use of peat in amateur horticulture from 2020 and all other horticultural use from 2030.

Therefore a range of policy options could result in reduced LULUCF emissions. These should be seriously considered by Government. In monitoring progress going forward, we will return to the success of Government polices in reducing LULUCF emissions.

11 'National Forest Inventory Woodland Area Statistics for Great Britain' (May 2011)
12 Full report due in 2012
13 For example, The Countryside Survey: England Results from 2007.

Key findings

Agriculture emissions **fell by 1%** in 2009. This reduction means that agriculture is **broadly on track** to meet the 1st carbon budget.

The existing **evidence base is incomplete** and more evidence about farming practices and an **improved inventory are needed** to effectively monitor performance.

There is **scope for strengthening policies** at both UK and EU level.

We recommend that:

- The **Government's policy review** in 2012 includes: an assessment of the full range of policy options available to reduce emissions in this sector; and performance triggers for the introduction of new policies.
- The Government supports proposals to link support under the **Common Agricultural Policy** to the take up of emissions reduction measures.

To prepare for emission reductions in the 2020s, the Government should consider **more ambitious policies** in the areas of consumer behaviour change, waste reduction and modification of diets.

Table 5.6 The Committee's agriculture indicators

AGRICULTURE	Budget 1	Budget 2	Budget 3	2009 trajectory	2009 outturn
Headline indicators					
Emissions (indicative % change from 2007 reflecting LCTP ambition scaled to UK)					
CO_2e emissions	-3%	-7%	-10%	-1.3%	-2.1%
GHG emissions (% change in tCO_2e against 2007) N_2O	-2%	-3%	-5%	-0.6%	-0.8%
GHG emissions (% change in tCO_2e against 2007) CH_4	-6%	-12%	-18%	-2.3%	-4.0%
GHG emissions (% change in tCO_2e against 2007) CO_2*	n/a	n/a	n/a	n/a	n/a
Source emissions (% change in tCO_2e against 2007) Soils	-2%	-3%	-5%	-0.6%	-0.4%
Source emissions (% change in tCO_2e against 2007) Enteric fermentation	-5%	-10%	-15%	-2.0%	-3.8%
Source emissions (% change in tCO_2e against 2007) Animal waste	-6%	-12%	-18%	-2.4%	-4.6%
Source emissions (% change in tCO_2e against 2007) Machinery/fuels*	n/a	n/a	n/a	n/a	n/a
Drivers (indicative % change from 2007 levels)**					
tN_2O emissions per thousand hectares of arable and managed pasture	2.02	1.99	1.95	2.04	2.03
tCH_4 emissions per tonne of cattle and calf meat, dressed carcase weight	8.95	8.53	8.10	9.21	9.43
tCH_4 emissions per thousand litres of milk	0.38	0.34	0.31	0.40	0.41
tCH_4 emissions per tonne of sheep and lamb meat, dressed carcase weight	10.16	9.81	9.47	10.37	10.28
tCH_4 emissions per tonne of pig meat, dressed carcase weight	1.09	0.96	0.82	1.18	1.20
tCH_4 emissions per tonne of poultry, dressed carcase weight	0.18	0.18	0.18	0.18	0.17
Supporting indicators					
Farming Practice					
Measures where greater confidence exists (e.g. proven technology, considered best practice, consistent abatement results) but uncertainty about baseline use.					

Key: Headline indicators | Implementation indicators | Milestones | Other drivers

Table 5.6 The Committee's agriculture indicators

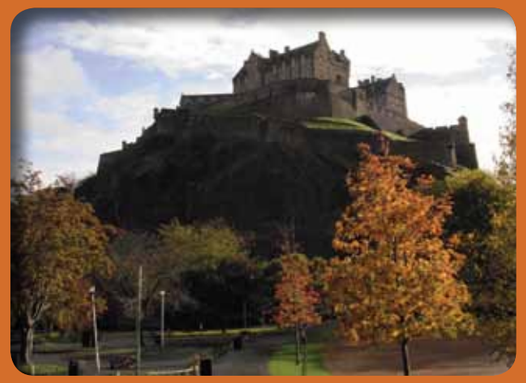
AGRICULTURE		Budget 1	Budget 2	Budget 3	2009 trajectory	2009 outturn
Nutrient management – including improved mineral and organic N timing, separating slurry and mineral N, using composts, and making full allowance for manure N	% of hectares where measures are in place	Better evidence about current farming practice is required to develop full trajectories.				
Livestock management – including breeding for fertility and productivity	% of livestock of different production/fertility efficiency	Better evidence about current farming practice is required to develop full trajectories.				
Manure management	% of manure/slurry stored in covered tanks or lagoons	Better evidence about current farming practice is required to develop full trajectories.				
Anaerobic Digestion	Installed AD capacity using manures (MW)***	31	68	102	Data on take up of AD will be next collected in the 2011 farm practices survey	
Measures that require further evidence to establish appropriateness and effectiveness in UK and in regional contexts						
Soil management (reduced tillage/ drainage), nitrification inhibitors, and using more N-efficient plants (species introduction and improved N-use plants)	% of hectares where measures are in place	Not suitable for all hectares. Requires development of evidence base to resolve possible conflicts with other goals and to determine applicability, GHG benefits and costs under different conditions.				
Livestock management (including maize silage and dietary additives in form of propionate precursors or ionophores)	% of livestock consuming different diets and feed additives	Not suitable for all animals/farms. We will monitor the development of the evidence base around these measures, including applicability, net GHG benefits and resolution of possible conflicts with other sector goals.				
Policy Milestones						
Development of delivery component of Industry Action Plan		Autumn 2010				Launched in March 2011
Completion of integrated advice pilot		Early 2012				Pilot launched in early 2011
Industry Action Plan implemented		Autumn 2010 to 2013				EBLEX, BPEX and Dairy road maps launched
Development of smart inventory			2014 (1st phase)			Projects underway
Full review of voluntary approach and development of policy options for intervention		End of 2012				
Establishment of baseline farming practice and monitoring framework for Industry Action Plan		To be completed by 2013				

Table 5.6 The Committee's agriculture indicators

AGRICULTURE	Budget 1	Budget 2	Budget 3	2009 trajectory	2009 outturn
Other drivers					
Crops/soils: Crop yields (e.g. cereals), cropping areas, N_2O emissions per hectare of cultivated land, N_2O emissions per unit of fertiliser use, output of product per unit of fertiliser use.					
Livestock: tCH_4/tonne dressed carcase weight (cattle & calves), weight of carcase produced per day of age, calves produced per cow per year.					
General: We will monitor development of the evidence base and R&D support for the various mitigation measures. We will also track upcoming CAP reform negotiations (to be complete by 2014) and implications for farming practice and emissions.					
LAND USE, LAND USE CHANGE AND FORESTRY			By 2030		
Headline indicator					
Emissions (annual savings from carbon sequestration by 2030)					
CO_2 sequestered			$1MtCO_2e$		
Supporting indicators					
UK woodland planting			At least 21,000 hectares/year from 2015		
Policy Milestones					
Development and implementation of a woodland creation programme			By 2014		

*CO_2 abatement potential not factored into first three budget periods.
**Broadly consistent with LCTP ambition and industry roadmaps. UK Inventory at present will not fully capture reductions in emissions as a result of uptake of particular measures. Intensity indicators for budget periods assume constant output. Should output exceed assumed levels then lower intensities would be needed to deliver absolute emissions reduction.
***Handling beef, dairy and pig manures and slurries.
****2007 baseline = 10.7 thousand hectares. Source: Forestry statistics 2010, figure 1.4.
Note: Numbers indicate amount in last year of budget period i.e. 2012, 2017, 2022.

Key: Headline indicators Implementation indicators Milestones Other drivers



Chapter 6: Progress reducing emissions in the devolved administrations

Introduction and key messages

Emissions in the devolved administrations account for around 20% of total UK greenhouse gas emissions. Our previous reports have identified significant abatement opportunities in the devolved administrations. Realising this potential will be required in the context of meeting UK carbon budgets, and ambitious national emission reduction targets.

In this chapter we assess the latest emissions, energy and macroeconomic data for the devolved administrations. We provide an overview of emission trends, both at the national level and, within this, at the sectoral level. We consider progress reducing emissions through the implementation of abatement measures, subject to data limitations. We also set out at a high level some of the policy interventions to drive emission reductions going forward, given the balance between reserved and devolved powers.

The evidence base for the devolved administrations is less well developed than for the UK as a whole. This is the case for emission data, abatement opportunities, implementation of measures, and policy incentives. However, based on a high level assessment of the available evidence, some clear messages emerge:

- Emissions fell in Scotland and Northern Ireland and increased in Wales in 2008, the last year for which economy-wide emission data is available. In 2009, data on energy consumption and production, as well as EU ETS data suggests that there was a significant reduction in emissions in each of the devolved administrations, mainly due to the impact of the recession. In 2010, temperature and macroeconomic data suggests that emissions are likely to have increased in each of the devolved administrations.
- The underlying trend is likely to be one of broadly flat or slightly falling emissions. This is less than will be required to achieve carbon budgets and national emission reduction targets. It reflects relatively low implementation of energy efficiency measures, investment in renewable heat, and measures to encourage transport consumer behaviour change. Therefore a step change in the pace of emission reduction is still required. Given the balance of reserved and devolved powers, there is an important role for the devolved administrations in driving this step change.
- Specific areas where there is scope for improved performance include:
  - Further implementation of area based approaches to encourage residential energy efficiency improvement.
  - Trialling of renewable heat technologies in the residential sector.
  - Roll out of Energy Performance Certificates and Display Energy Certificates, and possible regulation of minimum standards, to support energy efficiency improvement in the non-residential sector. In Scotland, energy based assessment (i.e. DECs) should be introduced.

– Roll out of Smarter Choices initiatives, and increased eco-driving training.

– Reducing planning approval times for renewables projects in Scotland.

– Ensuring policies fully address significant agriculture and land use abatement potential in the devolved administrations.

We set out the analysis that underpins these messages in 6 parts:

1. Emission trends
2. Progress reducing power sector emissions
3. Progress reducing emissions from buildings and industry
4. Progress reducing surface transport emissions
5. Progress reducing emissions from agriculture and land use
6. Future work of the Committee with the devolved administrations

1. Emission trends

Whereas there is data available for 2010 emissions at the UK level, the most recent emission data for the devolved administrations is for 2008. For 2009, energy consumption data is available, together with data for emissions from the EU ETS sectors. For 2010, preliminary data is available for EU ETS emissions, and inferences can be made based on UK level emission data and regional economic and temperature data.

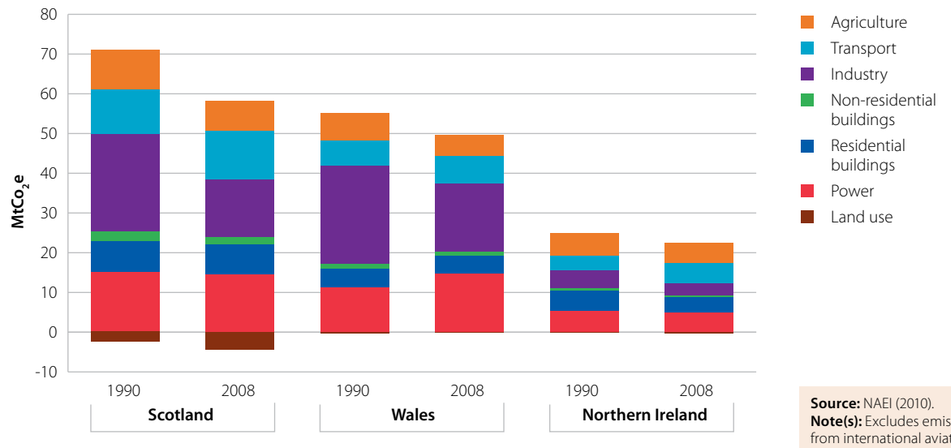
Final emission data for 2008 shows a fall in Scotland and Northern Ireland but an increase in Wales:

- Emissions fell 2.9% in Scotland in 2008 to 53.7 $MtCO_2e$, mainly from a fall in power sector emissions. Over the last five years to 2008, emissions fell by an average of 1.2% per year.
- Emissions fell 0.4% in Northern Ireland in 2008 to 22.2 $MtCO_2e$. On average, emissions have risen by 0.5% each year over the five years to 2008.
- Emissions rose 4.7% in Wales in 2008 to 49.5 $MtCO_2e$, primarily as a result of a coal-fired power station coming back on to the system. On average emissions fell 0.5% each year over the five years to 2008.

Over the longer period since 1990 emissions have fallen, though not in all sectors (Exhibit 6.1):

- In Scotland, emissions were 21% lower than 1990 levels in 2008. Emissions fell in all sectors except transport, which increased 7%.
- In Wales, emissions were 10% lower in 2008 than in 1990. Emissions in power and transport were above 1990 levels in 2008 (by 30% and 6% respectively).

Figure 6.1: Greenhouse gas emissions in devolved administrations by sector (1990 and 2008)



Source: NAEI (2010).
Note(s): Excludes emissions from international aviation and shipping.

- In Northern Ireland emissions were 11% lower than 1990 levels. Emissions fell in all sectors except transport, which rose almost 40%.

Energy data for 2009, together with EU ETS data, suggests that emissions fell significantly across the devolved administrations, mainly due to the recession (Figure 6.2 and 6.3):

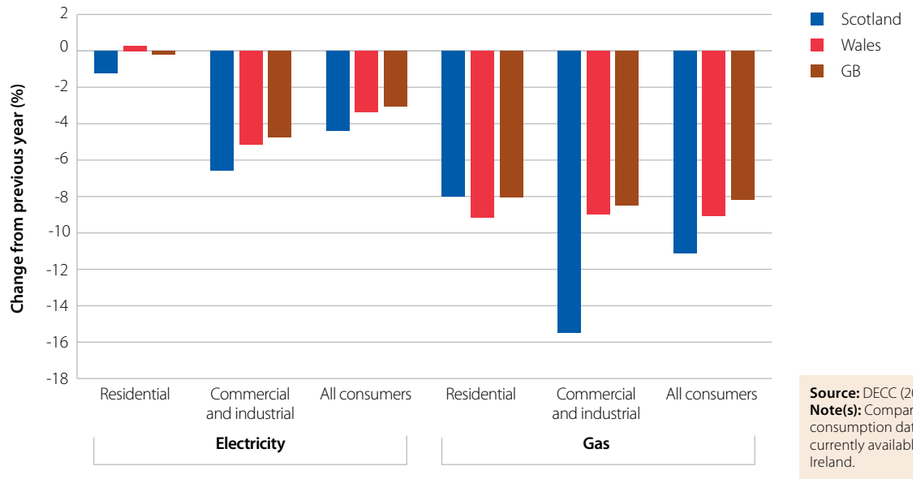
- In Scotland, GVA fell by 4.2% in 2009, compared to the 4.7% reduction for the UK. Output reductions were particularly marked in manufacturing (-8%) and construction (-10.5%). Energy consumption generally fell in line with output reductions 2009, as did EU ETS emissions.
  - Electricity consumption of residential and industrial and commercial users fell 1% and 7% respectively in 2009, more or less in line with the GB average (residential consumption was broadly flat and industrial and commercial users fell 5%).
  - Gas consumption of domestic consumers fell 8%; industrial and commercial consumption dropped 15%. The GB average was falls of 8% for both.
  - In the EU ETS gross verified emissions fell 8% overall, compared to a UK reduction of 12%.
- In Wales, manufacturing output fell by 16% and construction by 13%. This was reflected in reduced energy consumption for the non-residential and industry sectors, and in EU ETS emissions.
  - Electricity consumption in the residential sector remained broadly flat, whilst falling 5% across industrial and commercial customers.
  - Gas consumption fell by 9% in both the residential and industrial and commercial sectors.
  - EU ETS emissions were down 18% compared to 2008.

- In Northern Ireland, output fell significantly during the recession (e.g. by 12% in manufacturing), as did power generation and EU ETS emissions.
  - Electricity and gas consumption data for Northern Ireland are not available, but overall power generation fell 17% in 2009. Within this, renewable generation increased whilst generation from the two main sources (coal and gas) fell significantly (by 33% and 14% respectively);
  - EU ETS data shows a fall of 26% in emissions in 2009.

Preliminary EU ETS data (Figure 6.3) along with regional economic and temperature data (Figure 6.4) suggest that emissions are likely to have increased across the devolved administrations in 2010 due to the cold weather and economic recovery:

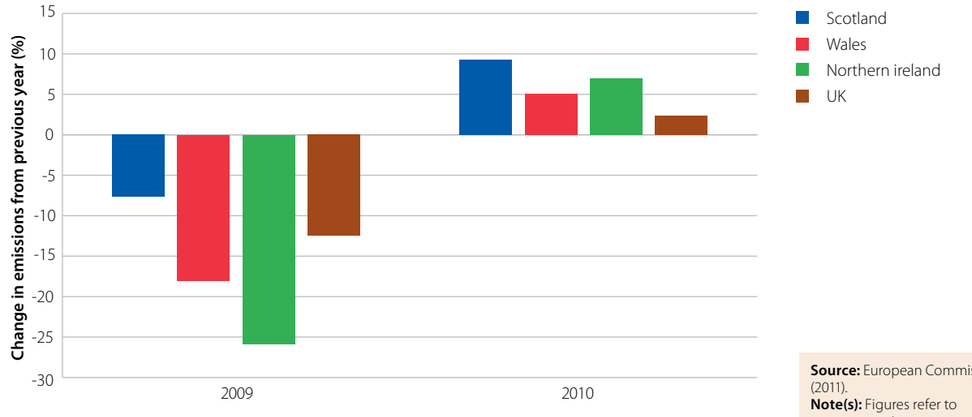
- The particularly cold weather in the winter months of 2010 was the main driver of increased residential emissions in the UK as a whole in 2010. The devolved administrations also experienced temperatures significantly below the long run average, particularly in Scotland and Northern Ireland. To the extent that householders responded by increasing heating use, this is likely to have caused a corresponding increase in residential emissions.
- Overall, positive growth returned to most sectors of the UK and devolved economies in 2010, though output levels remain much below pre-recession peaks in most cases.
- EU ETS data show that emissions in the traded sector rose 9%, 5% and 7% in Scotland, Wales and Northern Ireland respectively, compared to an increase of 2% across the UK as a whole.

Figure 6.2: Electricity and gas consumption – Scotland, Wales and GB: Percentage change in 2009 consumption from 2008



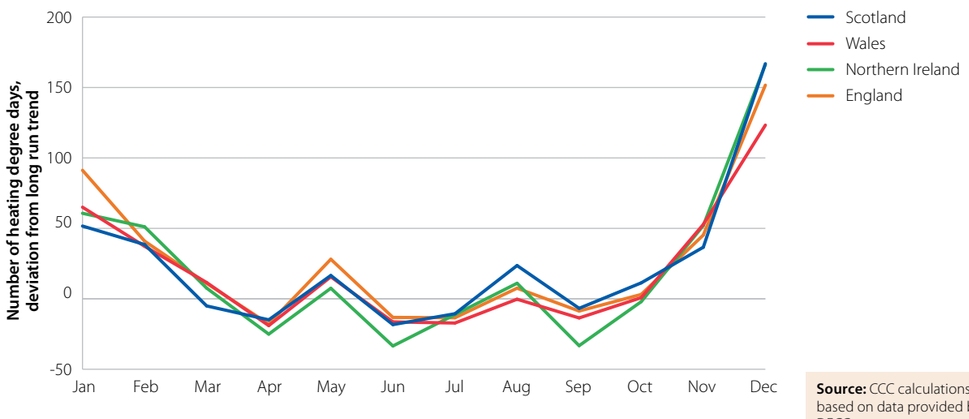
Source: DECC (2011).
Note(s): Comparable energy consumption data is not currently available for Northern Ireland.

Figure 6.3: Percentage change in emissions – EU ETS (2009 and 2010)



Source: European Commission (2011).
Note(s): Figures refer to percentage change in gross verified emissions from previous year.

Figure 6.4: Deviation from long run trend – number of heating degree days in 2010



Source: CCC calculations based on data provided by DECC.
Note(s): Long run trend is 1971-2000.

Given limited progress on the implementation of abatement measures (see below), the underlying trend in the devolved administrations in 2010 is likely to have been broadly flat emissions. This suggests that a step change in the implementation of abatement measures is still required to meet ambitious emission targets (Box 6.1) particularly as the economy recovers in 2011 and beyond.

Box 6.1: Devolved administration strategies and targets

In **Scotland,** legally binding targets for emission reductions over 2010-2022 were passed by the Scottish Parliament in October 2010. The levels of emissions allowed from 2010 represent annual reductions of 0.5% in 2011, 0.3% in 2012, 9.9% in 2013 (due to change in EU ETS cap) and between 2.1% and 3.0% each year thereafter. This amounts to a 42% reduction in 2020 relative to 1990. The Scottish Government's plans for how targets can be met suggest that current polices (at Scottish, UK and EU level) will deliver a 38% reduction on 1990 emissions by 2020.

If the EU moves to a 30% reduction target for 2020 and traded sector caps tighten accordingly, the Scottish Government estimate the 42% reduction could be met with current policies, although some new policies may be required to meet targets in individual years.

The **Welsh Government's** Climate Change Strategy (October 2010) sets emission reductions of 3% each year from 2011 to 2020, against a baseline of average emissions over 2006 – 2010. The target covers all direct emissions in Wales except those covered by the EU ETS. However it does include the 'indirect' emissions from electricity consumption by end-users in Wales, attributed with a UK-wide carbon intensity factor. Meeting the target requires an estimated 9 $MtCO_2e$ annual savings by 2020.

Of those savings, the strategy estimates that EU or UK Government policies will achieve 40% of the target reductions by 2020, and specific Welsh policies 30%. The remainder of the target is to be met by wider actions by business, the public sector and communities across Wales.

The strategy also outlines a target to reduce all emissions, including those from the traded sector, by 40% by 2020 from 1990 levels.

Over 2010, the **Northern Ireland Executive (NIE)** convened a cross-departmental working group on greenhouse gases and agreed an action plan setting out how all departments will contribute to the current non-statutory target to reduce greenhouse gases by 25% relative to 1990 by 2025.

The plan estimates that if all proposed policies are enacted and deliver expected reductions, emissions could be reduced by 33% by 2025, which would overachieve the 2025 target .

Meeting these targets would result in emissions in 2020 of:

Scotland: 40.7 $MtCO_2e$ (this includes emissions from IA&S, which is outside UK targets and carbon budgets).

Wales: 33 $MtCO_2e$

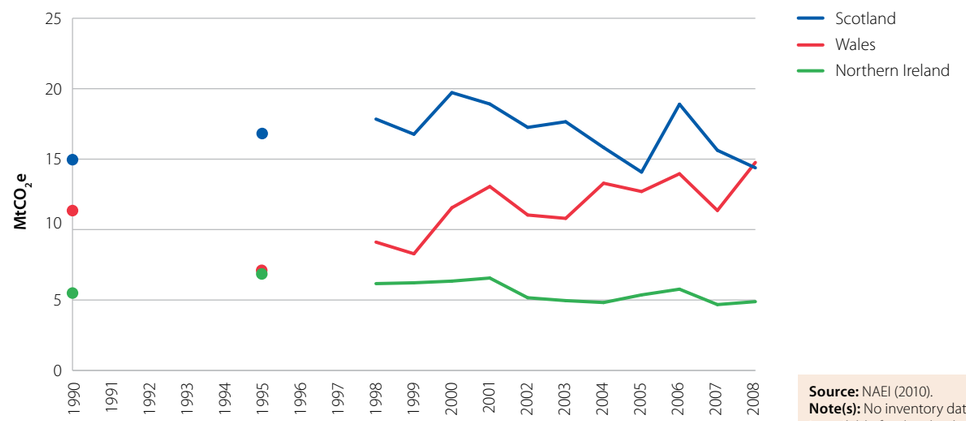
Northern Ireland: 20 $MtCO_2e$ (assuming an equal annual percentage path to the 2025 target).

2. Progress reducing power sector emissions

On a gross basis, trends in power sector emissions in the devolved administrations tend to be fairly sensitive to the operation of one or two individual power plants (Figure 6.5). As at 2008:

- In **Scotland**, emissions were 4% lower in 2008 than in 1990 and accounted for 27% of total emissions.
- In **Wales**, power sector emissions were 30% higher in 2008 than in 1990, and accounted for 30% of total emissions. This reflects, in the main, a rise in coal generation in 2008, though this fell sharply in 2009.
- In **Northern Ireland** emissions were 11% lower in 2008 than in 1990, and accounted for 22% of total emissions.

Figure 6.5: Power sector emissions in devolved administrations (1990-2008)

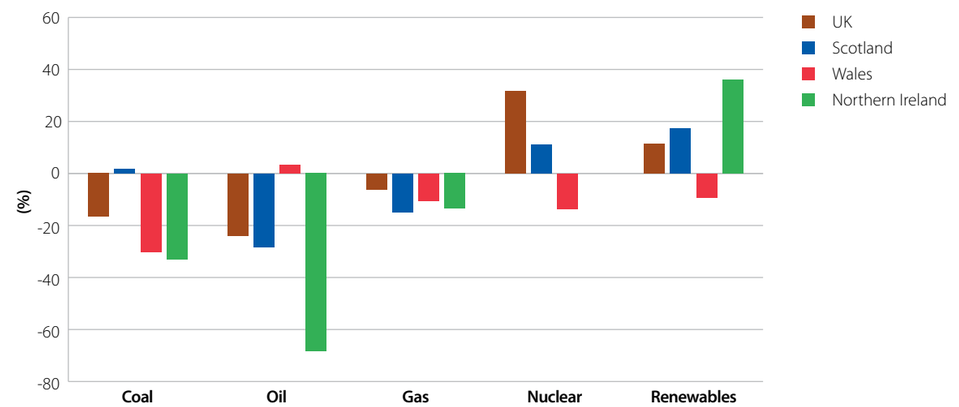


Source: NAEI (2010).
Note(s): No inventory data is available for devolved administrations in 1991-1994 or 1996-1997.

Power sector emissions are likely to have been broadly flat in Scotland in 2009, with reduced emissions in Northern Ireland and Wales (Figure 6.6):

- Although overall generation increased in **Scotland** (by 3% relative to 2008), the majority of additional generation was from nuclear and renewables. Generation from coal rose very slightly, while oil and gas fuelled generation fell (by 28% and 15% respectively). The overall impact is likely to have been broadly flat or slightly reduced emissions.
- In **Wales**, total generation fell 16%, including a particularly large fall in coal generation (30%). This is likely to have had a significant impact on Welsh emissions.

Figure 6.6: Electricity generation by source – percentage change from previous year (2008-2009)



Source: CCC calculations based on data from DECC (2011).

- In **Northern Ireland** total generation fell 17%, including falls of 33%, 68% and 14% from coal, oil and gas respectively. Renewable generation increased 36% in 2009. The overall impact is likely to have been a significant reduction in emissions.

There has been some progress in recent years moving towards a decarbonised power system through investment in renewable power generation (Figures 6.7, 6.8 and 6.9):

- In 2009, renewables accounted for 21% of generation in Scotland, and 27% of gross consumption. Between 2003 and 2009, renewables capacity increased over 130% from 1.7 GW to 3.8 GW, including 1.8 GW of wind. In 2009, Scotland accounted for half of the UK's wind generation and over 40% of total generation from renewables.
- The most recent data (from Scottish Renewables) show as at April 2011, installed capacity of 4.4 GW, including 2.6 GW of wind. A further 4.4 GW is in the planning system, with 15 GW, including 1.6 GW of wave and tidal, at the scoping stage.
- In 2009, renewable generation accounted for 5% of the electricity produced in Wales. Installed capacity of renewables increased over 75% from 0.4 GW in 2003 to 0.75 GW in 2009, most of which was wind power. Wales accounted for 6% of the UK's renewable generation in 2009 and 10% of wind.
- Renewables accounted for 10% of generation in Northern Ireland in 2009. Installed capacity increased almost 6-fold between 2003 and 2009 from 48 MW to 330 MW, again mostly wind. Northern Ireland generated 3% of UK renewable power in 2009 and 8% of wind power.

However, significant acceleration in the pace of investment will be required in order that stretching renewable generation targets are achieved (Box 6.2).

Box 6.2: Devolved administration targets on renewables

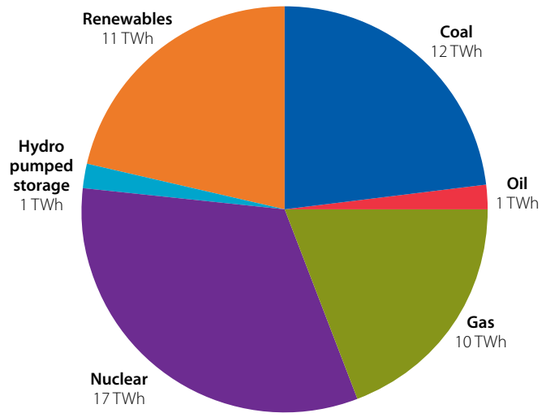
The Scottish Government has again revised upwards its renewable target, most recently to generate the equivalent of 100% of Scotland's gross electricity consumption from renewables by 2020. It is likely the majority of this will be wind (on and offshore), however, hydro, wave, tidal and biomass are also part of the potential resource. The renewable power target sits within the wider context of targets for 20% of total energy from renewables (11% heat and 10% transport) and to reduce total energy use by 12% by 2020.

The Welsh Government aims to realise estimates of the potential renewable resource in Wales (44TWh per year), which is more than twice Wales' current electricity demand. Offshore wind is the single biggest estimated potential resource (21TWh/year), though tidal range has been estimated at 18TWh.

Northern Ireland has recently agreed a target to generate the equivalent of 40% of power consumption from renewables by 2020. Onshore sources currently account for almost all NI's renewables but actions are underway to increase the contribution of offshore sources.

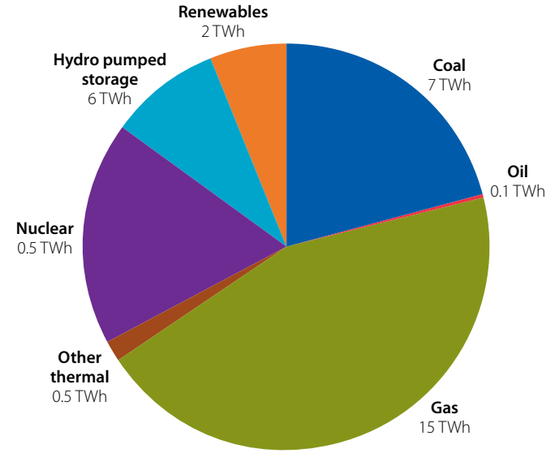
However, while these are stretching targets they are consumption based, and actual emissions, as well as emissions intensity of generation will reflect the full generation mix in each nation. If current levels of fossil fuel generation prevail through the 2020s unabated (though see Box 6.4 on CCS) it will have a significant implication for the level of gross emissions.

Figure 6.7: Electricity generation in Scotland by source (2009)



Source: CCC calculations based on data from DECC (2011).

Figure 6.8: Electricity generation in Wales by source (2009)

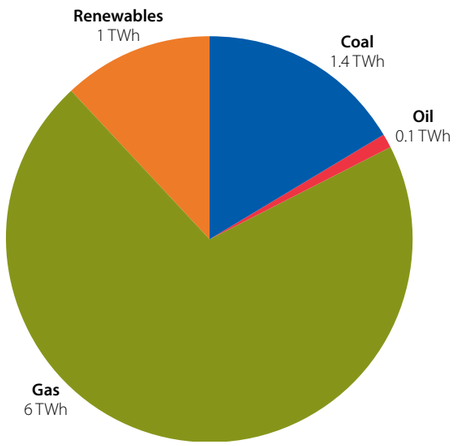


Source: CCC calculations based on data from DECC (2011).

Given the balance of reserved and devolved powers, devolved administrations have a key role to play in facilitating renewable generation investment:

- **Identifying resource.** For example
  - The additional ad hoc leasing round agreed between the Scottish Government and Crown Estate for offshore wind in Scottish Territorial Waters (STWs). Following a strategic environmental assessment (SEA) and consultation on the options, the final offshore wind plan for STWs sets out the 6 sites Scottish Ministers are recommending for short term development (2020) and a further 25 medium term (2030) sites.

Figure 6.9: Electricity generation in Northern Ireland by source (2009)



Source: CCC calculations based on data from DECC (2011).

  - The **Welsh Government's** Strategic Framework for marine renewable energy is the outcome of investigation of the potential marine energy resource and associated constraints to assist appropriate development of the resource. Building on this is further work to identify specific sites for development and work with the Crown Estate towards a leasing round for commercial wave and tidal developments.
  - Following the completion of an SEA of the **Northern Ireland Executive's** draft offshore renewable energy plan, the Crown Estate has set out the timetable for a programme of leasing and development for offshore wind and tidal energy in Northern Ireland's waters. The NIE is finalising its plan to exploit the 900MW of offshore wind potential and 300MW tidal potential outlined in the SEA.

- **Approving planning:** There is an important role for the devolved administrations approving both renewable generation and transmissions projects:
  - Scottish minsters are responsible for approving planning applications for energy infrastructure – whether that is power generation or transmission (see Box 6.3 for latest developments on the Beauly to Denny transmission line). Scotland tends to have higher approval rates than the UK average, although average decision times are longer. Reductions in the planning period would therefore help to ensure faster throughput of projects for the very significant investments required over the next decade.
  - Authorities within Wales can consent smaller developments (<50MW onshore and <1MW offshore), but consent for large power developments is reserved to Westminster.
  - Within the devolved energy market, Northern Ireland has powers of consent over energy infrastructure.

- **Supporting technology innovation.**
  - **The Scottish Government** continues to fund various research centres (e.g. European Marine Energy Centre where installation and testing of a number of wave and tidal projects has commenced) and innovation schemes (e.g. Saltire Prize)
  - **The Welsh Government** has outlined its commitment to assist with technology development and cost reduction for less developed technologies such as tidal stream and wave. The 1.2 MW tidal demonstration project being developed for deployment off the coast of Wales was recently supported with Welsh European funding.
  - The Welsh Government has committed to continue to support the study of the Severn estuary and consider the applicability of tidal range technologies elsewhere in Wales as appropriate.
  - **Northern Ireland's** innovation strategy outlines commitments to support renewable development policies with further funding from the innovation budget, including for example, the Department for Agriculture and Rural Development's plans to exploit renewable opportunities in the rural economy

Box 6.3: Beauly-Denny

In our 2010 progress report we noted that the Beauly to Denny transmission line upgrade was approved in January 2010, marking an important milestone in providing greater and more reliable capacity for the transmission of Scotland's renewable potential. The consent by Scottish ministers was subject to a range of conditions, including mitigation of the impact of the line on the surrounding areas.

In addition to the 5 rationalisation scheme areas recommended in the public inquiry, 3 mitigation schemes were required in the consent. For each area, the applicants are required to submit proposals to rationalise/mitigate the visual impact of the line. Neither the overhead transmission lines, nor the towers carrying the lines, can be installed or constructed until Scottish ministers, in consultation with the relevant local authority in the scheme area, have approved the proposals.

To date, 4 rationalisation schemes have been approved. However the proposals submitted for visual impact mitigation in the Stirling area have been deemed unsatisfactory. Scottish ministers have asked the applicant and the council to work jointly on further mitigation options, including possible undergrounding of the line, and submit revised proposals by the end of June 2011, after which Ministers will enter into a formal consultation with Stirling Council for at least 30 days.

In the case of Scotland, there is also an important role to support development of CCS technology in the context of the UK and EU level demonstration programme (Box 6.4).

Box 6.4: Carbon capture and storage

The Committee's Extended Ambition scenario for 2020 includes four demonstration CCS plants by 2020. Following the withdrawal of Kingsnorth from the UK CCS demonstration programme, the Longannet station in Fife remains the sole entrant. Longannet is also one of the three applicants within Scotland for the EU NER300 funding for CCS.

Consent for new thermal coal and gas stations lies with Scottish ministers. They have set out similar requirements for CCS as in the UK as a whole, meaning that no new unabated coal stations can be built and those that are proposed must demonstrate CCS on a minimum of 300 MWe from their first day of operation.

Following from the high level screening of potential CO_2 storage sites around Scotland (2009), the consortium of industry, academic institutions, Scottish Centre for Carbon Storage and the Scottish Government have published a second study investigating the potential of one of the 10 saline aquifer sandstones shortlisted in the 2009 study.

Due to its proximity to onshore CO_2 sources, existing offshore pipelines and availability of data for the entire sandstone, the potential of the Moray Firth site was assessed. Modelling the characteristics of the sandstone and the activity of 15 $MtCO_2$ injected each year for 30 years, the study found this likely to remain stable and contained under the sea bed 5,000 years forward.

The study concludes by setting out the next steps required towards proving there is a viable, large, long term source of CO_2 storage in the UK.

3. Progress reducing emissions from buildings and industry

Residential buildings

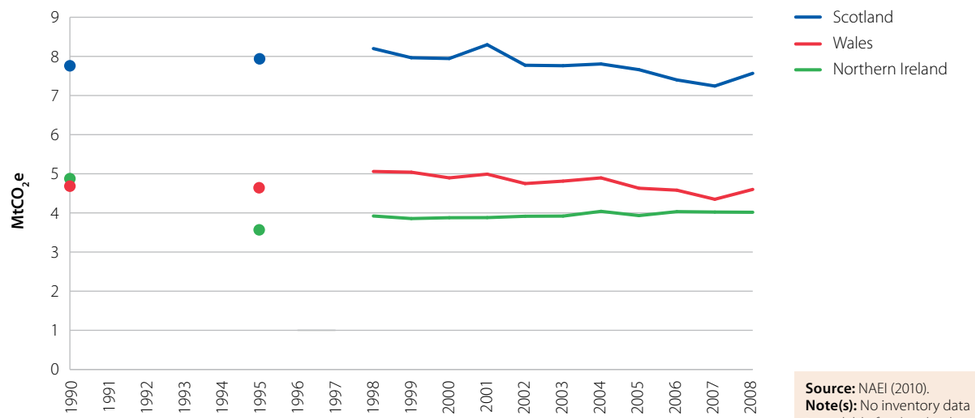
Since 1990, residential emissions have been broadly flat in the devolved administrations (Figure 6.10). The latest emission data for 2008 shows:

- In **Scotland** residential emissions account for 14% of total emissions and were 3% lower than 1990, despite a 14% increase in households over that time. A more than halving of coal use since 1990 in favour of gas for heating has helped to drive down emissions.
- In **Wales** residential emissions were 1% lower than 1990 and accounted for 9% of Wales' emissions. This is against a 15% rise in the number of households in Wales over the same period.
- **Northern Ireland's** residential sector emissions were 18% lower than 1990. This largely reflects a steep fall of 26% between 1990 and 1995; emissions have increased 11% since then and now account for almost a fifth of total GHG emissions. Although the introduction of gas in the 1990s helped drive down emissions, the network is currently only available to a small proportion of households and the relatively higher reliance on oil for heating means residential sector per capita emissions are higher than the UK average.

In 2009 there was little change in electricity consumption of residential customers in Scotland and Wales, but gas consumption fell substantially (see Figure 6.2. This information is currently not available for Northern Ireland).

In 2010, emissions from residential buildings are likely to have increased due to the particularly cold weather towards the end of the year (see Figure 6.4).

Figure 6.10: Residential sector emissions in devolved administrations (1990-2008)



Source: NAEI (2010).
Note(s): No inventory data is available for devolved administrations in 1991-1994 or 1996-1997.

To April 2010, CERT-funded loft and cavity wall insulations in Scotland and Wales were broadly in line with what has been achieved at the GB level (Table 6.1). This data is not as recent as available for GB[1] as a whole (Chapter 3) and therefore we cannot say whether the later slow down in the rate of measures observed in GB also occurred in Scotland and Wales.

Table 6.1: CERT measures years 1 and 2, GB, Scotland and Wales

	Cavity wall insulation			Loft Insulation		
	CERT Yr 1	**CERT Yr 2**	**Total**	**CERT Yr 1**	**CERT Yr 2**	**Total**
GB	523,702	485,696	1,009,398	672,745	553,240	1,225,985
Scotland: *2.5m households (9% UK total)*	39,231	44,277	83,508	38,689	48,764	87,453
% of total	*7%*	*9%*	*8%*	*6%*	*9%*	*7%*
Wales: *1.3m households (5% UK total)*	34,498	26,632	61,130	49,317	41,758	91,075
% of total	*7%*	*5%*	*6%*	*7%*	*8%*	*7%*

Source: Energy Saving Trust HEED database. **Note:** CERT year 1 runs from April 2008-March 2009; CERT year 2 runs from April 2009-March 2010. The HEED database currently contains a number of data gaps which are much larger for Year 2 than Year 1. These should be filled as the data is transferred to HEED (estimated date for revised data is July 2011), but in the meantime comparisons should not be drawn between the two years.

- In **Scotland** over 80,000 cavity wall insulations were carried out in the first two years of CERT, and almost 90,000 lofts were insulated. Further, the Scottish Government's residential energy efficiency schemes have funded a number of additional measures (see Box 6.6).

1 CERT does not apply in Northern Ireland.

- However, there remains a large number of households still to be treated. The latest Household Condition Survey in Scotland shows that in 2009 although only 5% of households that are suitable for loft insulation had no loft insulation, a further 46% of these households (833,000) had loft insulation but of less than 150mm thickness. The majority of solid walled properties had no insulation (530,000 properties), while over a million cavity walls remained uninsulated (though the survey found up to half of these were unsuitable for insulation).
- In **Wales** CERT delivered over 60,000 cavity wall insulations over years 1 and 2, and over 90,000 loft insulations. Additional Welsh Assembly Government programmes have delivered further measures (Box 6.6).
- **Northern Ireland** accounts for 3% of the UK building stock (730,000 households). As energy is devolved to NI, CERT does not apply, and instead a voluntary supplier scheme operates whereby energy suppliers bid for funding raised by a levy on energy customers (£7.35 per electricity customer in 2009-10). The scheme covers both residential and commercial energy efficiency schemes. In the residential sector in 2009-10 the scheme delivered: 3,400 insulation measures; almost 700 heating packages; over 600 whole house measures.
- However, the latest house condition survey (for 2009) finds that over 153,000 homes (21% of stock) have no wall insulation and although 96% of homes that are suitable for loft insulation have some installed (600,000), the latest fuel poverty report in Northern Ireland notes that over 400,000 dwellings could still benefit from loft insulation top ups.

Therefore further policy effort will be required to encourage the uptake of insulation measures (cavity and solid walls, lofts) if ambitious targets for residential emission reductions are to be achieved, (Box 6.5).

Box 6.5: Residential emission reductions

Each devolved administration has made residential emission reductions a key part of their overall emission reduction strategies:

The **Scottish Government** has estimated that the contribution to the 2020 42% reduction in emissions could be up to 0.7MtCO_2e from current policies. Further proposals (including post-2012 supplier obligations, Green Deal and ECO, and more stringent new-build domestic energy standards from 2013) could achieve abatement of up to 1.1 MtCO_2e in 2020, which is in line with the potential identified for Scotland in the Extended Ambition scenario for 2020.

The **Welsh Government** has estimated that the residential sector accounts for around a fifth of the emissions covered by the 3% annual reduction target. To deliver the emission reductions required by 2020, the climate change strategy outlines reductions of 1.5 MtCO_2e from the residential sector. This is slightly higher than the abatement potential identified in the Extended Ambition for Wales.

The main priority of **Northern Ireland's** residential sector policy is to tackle the high levels of fuel poverty, though this will have GHG benefits through reductions in household energy consumption.

Within the new Green Deal and ECO (see Chapter 3), there will be an important role for Scottish and Welsh governments in supporting uptake of measures. In particular, there is likely to be scope for national and local authority participation in scaling up the area based approach to home insulation recently trialled in both Scotland and Wales (Box 6.6).

There may also be opportunities for Scotland and Wales to lead on trialling renewable heat technologies in the residential sector, in conjunction with both the Green Deal and the Renewable Heat Incentive (see Chapter 3). Significantly increased investment in residential renewable heat is required, given current low levels of penetration, and the need for deep cuts in residential heat emissions through the 2020s.

Box 6.6: Area-based insulation/residential energy efficiency programmes

The Home Insulation Scheme is the Scottish Government's area based residential energy efficiency scheme. The first phase was launched in November 2009 with funding of £15m to support ten local authorities covering 100,000 households. In addition to providing extra funding, the scheme also aims to encourage greater uptake of CERT measures. The scheme was extended in April and September 2010 and now covers almost 400,000 households.

Collectively, 2009-10 provided 11,502 heating systems and 26,110 insulation measures.

The approach was noted (Home Energy Schemes Annual report 2009-10) to be particularly helpful in tackling 'hard to treat' (due to requirement for co-operation amongst occupiers) blocks of flats particularly prevalent in Glasgow and Edinburgh, with rates of referral and installations comparable to other housing types.

However, there was little uptake of more expensive measures (internal or external wall insulation and under-floor heating), mainly due to customer concerns about upheaval and disruption. Further, where both heating and these types of insulation were required, costs exceeded grant limits, so requiring a customer contribution.

Arbed is the Welsh Government's energy performance investment programme. This aims to take a whole house and community/street by street approach. The programme does not fund basic measures (such as gas boilers, loft and cavity wall insulation) as these are covered by Welsh Housing Quality Standard and CERT. These basic measures are integrated into arbed projects by the social housing providers delivering them from other sources of funding.

The measures and technologies that arbed funds include, solid wall insulation, solar photo voltaics, solar hot water, heat pumps, fuel switching and bespoke solutions.

Arbed opened in November 2009 with a budget of £30m. The first phase of projects was announced in May 2010 and due to complete by 31st March 2011.

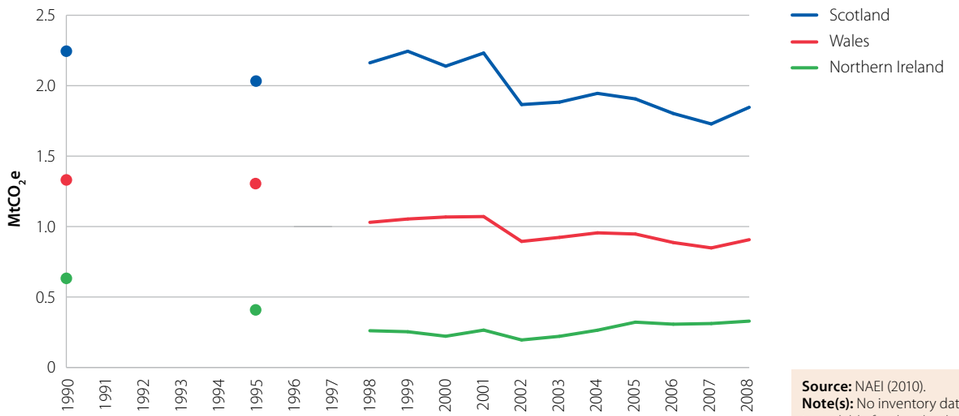
The Welsh Government is aiming to use £34m of European funding to continue the scheme for a second phase.

Non-residential buildings and industry

Emissions from non-residential buildings account for up to 3% of total emissions in the devolved administrations, compared to 4% in the UK as a whole (Figure 6.11):

- In **Scotland** non-residential emissions fell 18% between 1990 and 2008. In 2008 emissions of 1.8 MtCO_2e accounted for 3% of Scotland's total emissions
- In **Wales**, emissions fell 32% between 1990 and 2008. In 2008, emissions of 0.9 MtCO_2e accounted for 2% of Wales' total emissions
- In **Northern Ireland**, emissions in the non-residential sector fell 48% from 1990 to 2008. In 2008 emissions of 0.3 MtCO_2e accounted for 1% of total emissions.

Figure 6.11: Non-residential sector emissions in devolved administrations (1990-2008)

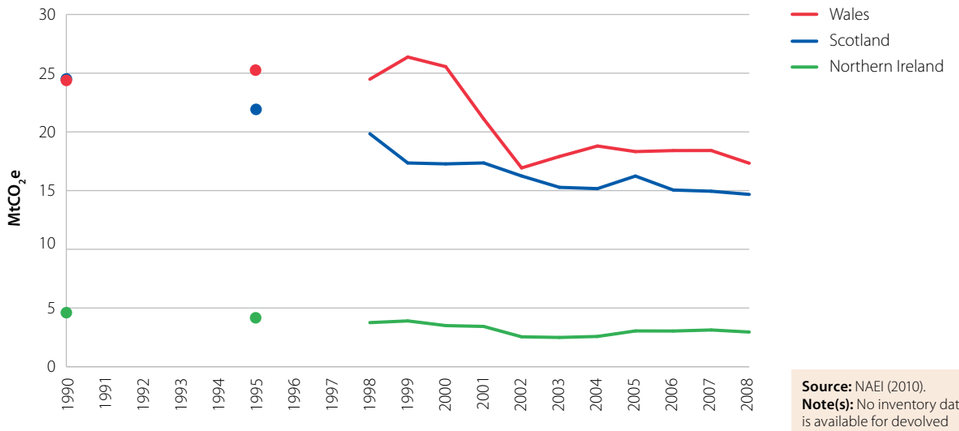


Source: NAEI (2010).
Note(s): No inventory data is available for devolved administrations in 1991-1994 or 1996-1997.

In 2008 industry emissions accounted for up to 35% of total emissions compared to 27% in the UK (Figure 6.12). As with the UK as a whole, emissions have fallen significantly since 1990, driven by similar factors, including a shift in economic activity away from 'heavy' industries towards a more service-sector based economy and fuel switching towards less carbon-intensive fuels.

- In **Scotland**, 15 $MtCO_2e$ accounted for 27% of Scotland's total emissions, having fallen 40% since 1990.
- In **Wales**, 17 $MtCO_2e$ accounted for 35% of total emissions, having fallen 29% since 1990.

Figure 6.12: Industry emissions in devolved adminstrations (1990-2008)



Source: NAEI (2010).
Note(s): No inventory data is available for devolved administrations in 1991-1994 or 1996-1997.

- In **Northern Ireland**, 3 $MtCO_2e$ accounted for 13% of Northern Ireland's total emissions, having fallen 36% since 1990.

The main policy levers to drive down emissions from non-residential buildings and industry are the Carbon Reduction Commitment, and the EU ETS, which operate at the UK level, and the Renewable Heat Incentive (which applies in GB only, given the devolved energy market in Northern Ireland). These are discussed in Chapter 3.

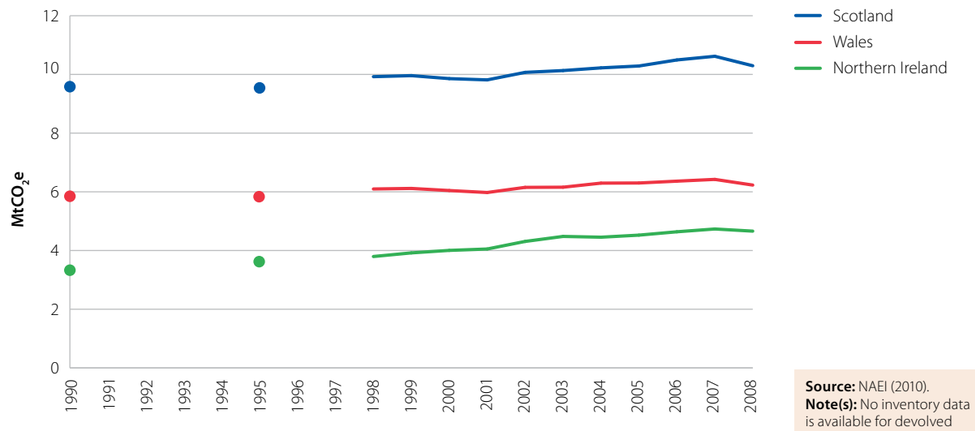
Given the devolved status of building regulations and certification to Northern Ireland and Scotland, our recommendation to roll out and mandate EPCs and DECs (see Chapter 3) is applicable here also. There is also a specific issue in Scotland, where DECs currently do not exist and EPCs are implemented in their place. The Scottish Government is currently undertaking work to scope options for possible introduction of operational ratings for non-domestic buildings, towards a public consultation later this year.

4. Progress reducing transport emissions

Surface transport emissions in the devolved administrations follow a similar rising trend to the UK as a whole (UK emissions increased 7% between 1990 and 2008): (Figure 6.13).

- In **Scotland**, surface transport emissions increased 8% between 1990 and 2008 reaching 10 $MtCO_2e$ (19% of total emissions), reflecting a significant increase in car ownership levels and a notable increase in road traffic vehicle km over that time.
- In **Wales,** surface transport emissions increased 7% between 1990 and 2008, reaching 6 $MtCO_2e$ (13% of total emissions), again reflecting increasing car ownership and increased vehicle km.

Figure 6.13: Surface transport emissions in devolved administrations (1990-2008)



Source: NAEI (2010).
Note(s): No inventory data is available for devolved administrations in 1991-1994 or 1996-1997.

- In **Northern Ireland**, surface transport emissions rose 40% between 1990 and 2008, reaching 5 $MtCO_2e$ (21% of total emissions). This relatively steeper increase is mainly due to a low emissions base in 1990, where car ownership rates were the much lower than elsewhere in the UK, but are now at parity.

In the UK as a whole, surface transport emissions fell in 2009 as a result of lower vehicle km travelled and improved fuel/carbon efficiency. For 2010, emission data is only available for transport as a whole (i.e. including domestic aviation and shipping), showing a decrease of 0.2% compared to a fall of 4.1% the previous year.

While we do not have 2009 or 2010 emissions or fuel consumption data for devolved administrations, information on new car efficiency for 2010 and traffic for 2009 suggests broadly level or falling emissions in devolved administrations relative to 2008:

- In **Scotland**, after rising steadily from 1999 to 2006, both car traffic and all road traffic has been broadly level across 2007-2009. There was no notable change in car vehicle km in 2009. As with the UK as a whole, all regions in Scotland outperformed our indicator level of new car CO_2/km in 2010 (155.5gCO_2/km).
- In **Wales**, total road traffic fell 1.4% in 2009 and car traffic by 1% compared to 2008. Again all of Wales outperformed the indicator on new car CO_2.
- In **Northern Ireland**, road traffic km increased slightly in 2009, though new car CO_2 was again below our indicator level in 2010.

We have previously identified opportunities at the national level for supporting development of electric vehicle markets and rolling out Smarter Choices Initiatives. These opportunities are reflected in national transport plans in each of the devolved administrations:

- **Scottish Government's** actions include:
  - **Supporting the procurement of low carbon vehicles and developing infrastructure**. The Low Carbon Vehicle Procurement Support Scheme has committed £4.3m to this in 2010/11
  - Central Scotland is one of the 5 UK Plugged in Places projects providing match funding to install up to 375 charging points across the central belt.
  - The Scottish Green Bus Fund for 2010-11 provides £4.4m to cover difference between low carbon vehicle and diesel equivalent aiming to add 50 low carbon buses to fleet.
  - **Encouraging people to switch to more sustainable forms of transport and encouraging increased levels of cycling and walking.** The Smarter Choices Programme ran projects in seven areas from March 2008-March 2011. Measures included public transport improvements, upgrades in walking and cycling infrastructure, and marketing and awareness campaigns. Monitoring results are due in a full evaluation shortly.

- The **Welsh Government's** climate change strategy sets out a range of measures aimed at reducing the carbon intensity of transport and securing behaviour change. These include Sustainable Travel Centres, Smarter Choices, eco-driving, rail and bus service investment, and freight efficiency measures.
- The **Northern Ireland Executive** has scoped out the trends in emissions from road transport over 1990 – 2007 and analysed key social, economic and environmental drivers in relation to sustainable transport and implications for future policy. The Regional Transport Strategy is under consultation and is to be followed by an Active Travel Strategy. Belfast was also a successful bidder for Plugged in Places.

Active participation of national authorities will be required – both on the supply side (i.e. electric vehicles) and demand side (i.e. consumer behaviour change) – if transport emissions are to be reduced and targets achieved (Box 6.7).

Box 6.7: Reducing emissions from transport

The Scottish Government's plans for meeting the 2020 target include a significant reduction in transport emissions This includes abatement of 1.4 $MtCO_2e$ from current policies and a further 1.1 $MtCO_2e$ from a range of proposals, not yet enacted but which collectively would deliver a reduction of 13% relative to 1990 levels by 2020.

Delivering the **Welsh Government's** climate change targets for 2020 also requires a substantial contribution from transport – a total of 1.4 $MtCO_2e$ emissions savings in 2020.

The Regional Transport Strategy currently under public consultation in **Northern Ireland** sets reducing emissions from transport as one of 12 strategic objectives, although a specific target for emission reduction from transport has not been set out.

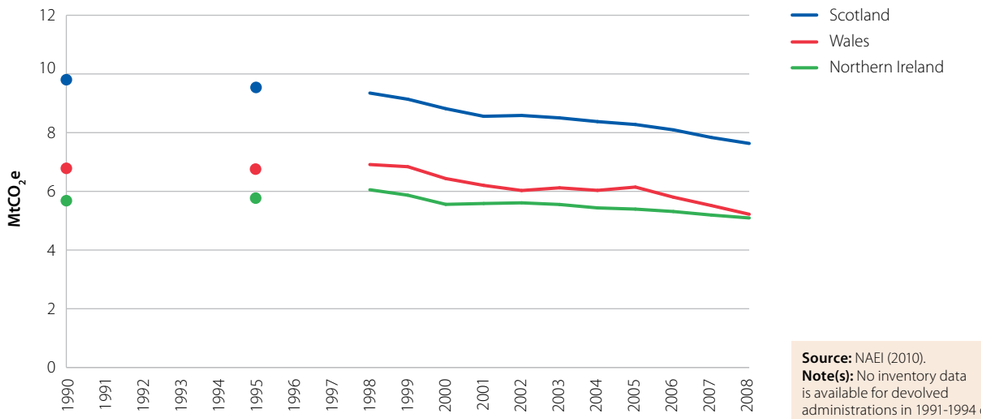
5. Progress reducing emissions from agriculture and land use

Emissions in agriculture have fallen by up to 23% in devolved administrations since 1990, compared to a fall of 21% in the UK as a whole (Figure 6.14):

- In **Scotland**, methane emissions decreased in line with a fall in livestock numbers, while N_2O emissions fell by almost a third from 1990 to 2008. Overall, GHG emissions were down 22%, to 7.6 $MtCO_2e$ (14% of Scotland's emissions).
- Similar trends are shown in **Wales**, with overall emissions down 23% on 1990, to 5.2 $MtCO_2e$ in 2008 (11% of emissions).
- Although N_2O emissions fell in **Northern Ireland** between 1990 and 2008, methane emissions increased slightly, with the overall effect being that agriculture sector emissions fell 10%, to 5 $MtCO_2e$ (around a quarter of emissions).

On a net basis LULUCF emissions are almost neutral in Wales and NI. In Scotland LULUCF is a net sink (Figure 6.15), the size of which has increased substantially since 1990 reflecting particularly high rates of tree planting in the 1970s and 80s.

Figure 6.14: Agriculture emissions in devolved administrations (1990-2008)



Source: NAEI (2010).
Note(s): No inventory data is available for devolved administrations in 1991-1994 or 1996-1997.

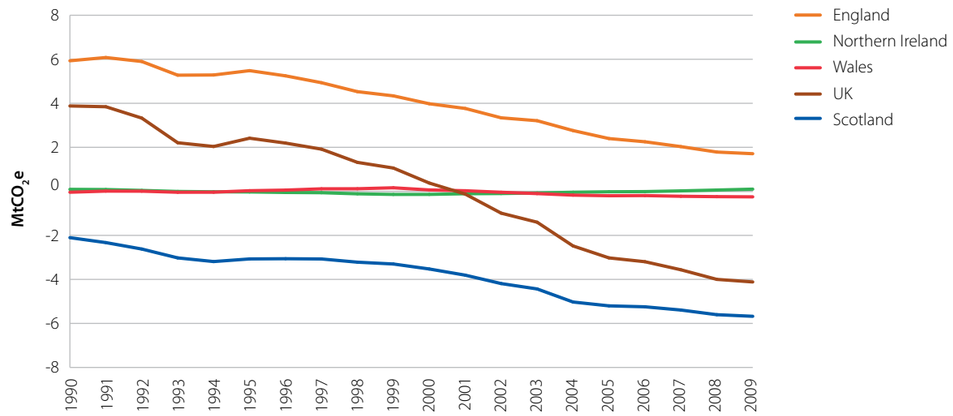
We have identified significant potential for emission reductions in each of the devolved administrations, which in part reflects the high share of agriculture in total emissions in devolved administrations:

- In **Scotland**, approximately 0.6 $MtCO_2e$ abatement potential in 2020;
- 0.46 $MtCO_2e$ in **Wales**;
- 0.46 $MtCO_2e$ in **Northern Ireland**.

A range of policies are in place to try to address these opportunities:

- The **Scottish Government's** 'Farming For a Better Climate' programme is aimed at encouraging farmers to adopt efficiency measures that reduce emissions, adapt to climate change while positively impacting business performance. Measures focus on using energy and fuels efficiently, developing renewable energy, locking carbon in soil, optimising use of fertilisers and optimising livestock management and storage of waste. The aim is to attain high uptake of Farming for a Better Climate voluntary measures; though regulation is not ruled out in the event of insufficient progress.
  - Together with support for AD through Scotland's Rural Development Programme (EU and SG funded) and increased woodland creation rates to 10,000 ha/year, the Scottish Government estimates 0.645 $MtCO_2e$ abatement could be achieved by 2020.
  - If further proposals were enacted (revisions to EU CAP and increased woodland by 15,000 ha/year) it is estimated this would provide an additional 0.7 $MtCO_2e$ taking the total to 1.3 $MtCO_2e$ by 2020.

Figure 6.15: Net emissions and removals, LULUCF (1990-2009)



Source: Centre for Ecology and Hydrology (2011).

- The **Welsh Government** is aiming to reduce emissions from agriculture and land use through: increased woodland creation and management of existing woodlands, the 'Glastir' programme which is targeted at supporting farmers to develop sustainable land management practices, provision of advice through the Farming Connect programme, and developing roadmaps for the dairy and red meat sectors. The Land Use and Climate Change group has recently reconvened with a new remit to monitor and report on progress against the 44 agreed recommendations (of the 49 their 2010 report recommended) which the Welsh Government has this year developed in to an implementation plan.
- **Northern Ireland's** Department of Agriculture and Rural Development (DARDNI) in partnership with key agri-food stakeholders in Northern Ireland agreed the themes of a GHG Reduction Framework in March this year. With the overarching theme that more efficient farming lowers emissions, voluntary mitigation measures spanning nutrient, livestock, renewable energy and carbon sequestration are being developed and will be communicated to primary producers later this year.

It will be important to review progress reducing agriculture emissions (Chapter 5), and to consider the full range of policy options in the event that current approaches do not sufficiently deliver.

6. Future work of the Committee with the devolved administrations

The Committee's indicator framework applies at the UK level and we have not disaggregated our trajectories to the devolved administrations. The GHG inventory is the basis for the legally binding targets in Scotland and non-statutory targets underpinning the climate change strategies in Wales and Northern Ireland. However, due to the time lag providing inventory figures it is important to measure progress through some key indicators.

In our future work with the devolved administrations we will develop our approach to measuring progress against emission reduction targets and consider the measures the devolved governments are putting in place to track progress:

- Scottish Ministers have asked the Committee for its first annual assessment of Scotland's progress in January 2012 as part of the reporting required under the Scottish Climate Change Act.
- The Welsh Government has commissioned the development of a set of policy indictors for each measure in the strategy. It has asked the Committee to review its progress against the commitments in the climate change strategy later this year.

Key findings

Emissions in the devolved administrations account for **20% of total UK GHG emissions**, and all 3 authorities now have **strategies in place** to reduce emissions.

Emissions **fell by 2.9%** in **Scotland**, and by **0.4%** in **Northern Ireland** in 2008.

Emissions **rose by 4.7%** in **Wales**, primarily as a result of a coal-fired power station coming back on to the system.

A step change in the pace of emission reductions **is required** in the devolved administrations in order to meet carbon budgets.

There is **scope to reduce emissions further** by improving residential energy efficiency, trialling renewable heat technologies in homes and rolling out Energy Performance Certificates and Display Energy Certificates in the non-residential sectors.

Transport emissions could be reduced by **rolling out Smarter Choices** and through **increased eco-driving training**.

Power emissions could be reduced by **shortening planning times** for renewable projects.

Agriculture emissions could be reduced by **ensuring policies** fully address the abatement potential in the devolved administrations.

Future work of the Committee

The Committee has a number of deliverables in 2011-2012, either required under the Climate Change Act or requested by Government:

2011

Mitigation

Advice to the Scottish Government on the second batch of Scottish targets (2023-27) and on limits to carbon unit use (2013-2017), to be published by July 2011.

Advice to the Welsh Government on their climate change strategy and progress reducing emissions, by October 2011.

Advice to the Northern Ireland Executive on the appropriateness of a NI Climate Change Act or other legislation to provide for legally binding GHG emission targets, by October 2011.

Review of international shipping emissions. The Committee has already provided a high-level assessment of international shipping emissions in the context of giving advice on the 2050 target. Further more detailed work is required to underpin advice on the inclusion of shipping and aviation in carbon budgets. This will be published in October 2011.

Bioenergy review. Various forms of bioenergy – biomass, biogas, biofuels – are potentially key to reducing emissions. However, there is uncertainty as regards the availability of bioenergy with rising food demand and other sustainability constraints (e.g. water, biodiversity). There is also a need for further work on the best use of bioenergy (e.g. between sectors and applications). The review will aim to provide an in-depth assessment of these issues and the role of bioenergy in delivering carbon budgets. It will be published by the end of 2011.

Adaptation

Second assessment of the UK's preparedness (July 2011): This will build on the ASC's first assessment by providing more quantitative information on the opportunities for the UK to adapt to current and future climate risks.

Advice on the preparation of the Climate Change Risk Assessment (CCRA) (July 2011): The ASC is required under the Climate Change Act to advise Government on the preparation of the UK's first CCRA. The ASC will continue to provide advice on how the assessment should inform the National Adaptation Programme and accompanying Economic Assessment of Climate Adaptation following the publication of the CCRA in January 2012.

Advice to the Scottish Government on Scotland's preparedness for climate change, by September 2011

The progress report to the Welsh Government in October 2011 will also include an assessment of progress on adaptation measures and advice on adaptation plans.

2012

Mitigation

Advice on inclusion of international aviation and shipping (IA&S) in carbon budgets. This advice will build on the considerations in the fourth carbon budget report and the review of international shipping emissions. It is required under the Climate Change Act to enable Government to make a formal decision on whether the net carbon account should be defined to include international aviation and shipping. It will be published in March 2012

Fourth annual report to Parliament. This will consider the latest emission trends and progress implementing measures against our indicator framework. It will be published in June 2012.

Advice to the Scottish Government on progress in reducing emissions in line with legislated targets, by January 2012.

Adaptation

Third assessment of UK's preparedness (July 2012): further quantitative assessment of progress and the ASC's advice to Government on the National Adaptation Programme.

Glossary

Achievable Emissions Intensity
The minimum average annual emissions intensity that could be achieved in a given year, given the installed capacity, projected demand and the projected profile of that demand.

Adaptation
Adjustment of behaviour to limit harm, or exploit beneficial opportunities, arising from climate change.

Anaerobic Digestion (AD)
A treatment process breaking down biodegradable, particularly waste, material in the absence of oxygen. Produces a methane-rich biogas that can substitute for fossil fuels.

Arbed
The Welsh Government's residential energy efficiency investment programme.

Availability
For an electricity generating station, this is the proportion of the time that the generator is physically able to supply electricity.

Battery Electric Vehicle (BEV)
A vehicle that recieves all motive power from a battery.

Biofuel
A fuel derived from recently dead biological material and used to power vehicles (can be liquid or gas). Biofuels are commonly derived from cereal crops but can also be derived from dead animals, trees and even algae. Biofuels can be blended with petrol and diesel and used in conventional vehicles.

Biomass
Biological material that can be used as fuel or for industrial production.

Bunker Fuels (international)
Fuels consumed for international marine and air transportation.

Capacity payment
Payment to energy supplier for providing a guaranteed level of capacity over a period of time

Carbon Capture and Storage (CCS)
Technology which involves capturing the carbon dioxide emitted from burning fossil fuels, transporting it and storing it in secure spaces such as geological formations, old oil and gas fields and aquifers under the seabed.

Carbon dioxide equivalent (CO_2e) concentration
The concentration of carbon dioxide that would give rise to the same level of radiative forcing as a given mixture of greenhouse gases.

Carbon dioxide equivalent (CO_2e) emission
The amount of carbon dioxide emission that would give rise to the same level of radiative forcing, integrated over a given time period, as a given amount of greenhouse gas emission. For an individual greenhouse gas species, carbon dioxide equivalent emission is calculated by multiplying the mass emitted by the Global Warming Potential over the given time period for that species. Standard international reporting processes use a time period of 100 years.

Carbon leakage
Carbon leakage occurs when there is an increase in emissions in one country/region as a result of emissions reduction by a second country/region with a strict climate policy.

Carbon price
The price at which 1 tCO_2e can be purchased. We use projections for the carbon price as a comparator for judging cost-effectiveness of potential emissions reduction measures.

Carbon price underpin
Policy to endure that carbon emitters pay a set minimum amount for every unit of carbon they emit.

Carbon Reduction Commitment (CRC)
A mandatory carbon reduction and energy efficiency scheme for large non-energy intensive public and private sector organisations. CRC will capture CO_2 emissions not already covered by Climate Change Agreements and the EU Emissions Trading System and started in April 2010.

Carbon sink
An absorber of carbon (usually in the form of carbon dioxide). Natural carbon sinks include forests and oceans.

CERT
CERT (Carbon Emissions Reduction Target) is an obligation placed by Government on gas and electricity suppliers to deliver a reduction in household carbon savings across England, Scotland and Wales.

Community Energy Saving Programme (CESP)
CESP targets households across Great Britain, in areas of low income, to improve energy efficiency standards, and reduce fuel bills. The programme is delivered through the development of community-based partnerships between Local Authorities, community groups and energy companies, via a house-by-house, street-by-street approach.

Co-firing
Combustion of two different materials at the same time.

Combined Cycle Gas Turbine (CCGT)
A gas turbine generator that generates electricity. Waste heat is used to make steam to generate additional electricity via a steam turbine, thereby increasing the efficiency of the plant.

Combined Heat and Power (CHP)
The simultaneous generation of heat and power, putting to use heat that would normally be wasted. This results in a highly efficient way to use both fossil and renewable fuels. Technologies range from small units similar to domestic gas boilers to large scale CCGT or biomass plants which supply heat for major industrial processes.

Contract for Difference
Form of hedging on the future price of a commodity in which a strike price is pre-specified. Payments are made between counterparties depending on the difference between the strike price and the market price at the time.

Copenhagen Accord
The document that delegates of the 15th Conference of Parties to the UNFCCC agreed to 'take note of' in December 2009. The text endorsed the continuation of the Kyoto Protocol, but is not legally binding.

Credits
Carbon credits purchased in international carbon markets, generally corresponding to 1 tCO_2e per credit. Also referred to as 'carbon units' in the Climate Change Act. It is not clear how carbon markets will develop by the 2020s. Therefore, where we refer to credits for the 2020s these could be allowances purchased in schemes such as the current EU ETS, or offset credits from project-based schemes (e.g. such as those generated under the Kyoto treaty's project-based flexibility mechanisms, Joint Implementation and Clean Development Mechanism).

Devolved powers
Policy areas governed by the relevant national authority, as defined by the relevant devolution agreement(s) and legislation.

Discount rate
The rate at which the valuation of future costs and benefits decline. It reflects a number of factors including a person's preference for consumption now over having to wait, the value of an extra £1 at different income levels (given future incomes are likely to be higher) and the risk of catastrophe which means that future benefits are never enjoyed. For example the Social Discount Rate (3.5%) suggests future consumption of £1.035 next year is equivalent in value to £1 today. Discount rates in the private sector generally reflect the real cost of raising capital, or the real interest rate at which consumers can borrow.

Display Energy Certificate (DEC)
The certificate shows the actual energy usage of a building and must be produced every year for public buildings larger than 1,000 square metres.

Energy Company Obligation (ECO)
A new Energy Company Obligation to take over from the existing obligations (the Carbon Emissions Reduction Target (CERT) and the Community Energy Saving Programme (CESP)) from 2012.

Eco-driving
Eco-driving involves driving in a more efficient way in order to improve fuel economy. Examples of eco-driving techniques include driving at an appropriate speed, not over-revving, ensuring tyres are correctly inflated, removing roof racks and reducing unnecessary weight.

Electric vehicle
A vehicle which is driven by an electric motor. These include battery electric (BEV), plug-in hybrid electric (PHEV) and hydrogen fuel-cell vehicles.

Electricity Networks Strategy Group (ENSG)
Joint government and industry group addressing key strategic issues affecting electricity networks in the shift to a low carbon economy.

Emissions Performance Standard (EPS)
Regulation setting a maximum level of allowable emissions from power plants.

Energy Performance Certificate (EPC)
The certificate provides a rating for residential and commercial buildings, showing their energy efficiency based on the performance of the building itself and its services (such as heating and lighting). EPCs are required whenever a building is built, sold or rented out.

Enteric fermentation
Fermentation process that takes place in the digestive systems of ruminant animals (e.g. cattle and sheep) to break down hard-to-digest grassy materials, leading to the release of methane.

European Commission
Executive arm of the European Union.

European Union Emissions Trading Scheme (EU ETS)
Cap and trade system covering the power sector and energy intensive industry in the EU.

Extended Ambition scenario
Emissions reduction scenario for measures to 2020, developed in our 2008 report and updated in our 2009 and 2010 progress reports. We recommended that the measures in this scenario should be implemented given the need to prepare for the 2050 target and the relative cost-effectiveness of many of the measures.

Feed-in-tariffs
A type of support scheme for electricity generators, whereby generators obtain a long term guaranteed price for the output they deliver to the grid.

Fluorinated Gases (F-gases)
Family of greenhouse gases containing fluorine. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF6) are used in industrial processes, refrigeration and air conditioning. They have a high global warming potential.

Fuel Duty
A tax on petrol and diesel. In June 2011, the UK tax was £0.58 per litre for petrol and diesel.

Fuel Poverty
A household is said to be in fuel poverty if it needs to spend more than 10 per cent of its income on fuel to maintain an adequate level of warmth.

Generic Design Assessment (GDA)
Generic Design Assessment (GDA), also known as pre-licensing, is the process of ensuring that the technical aspects of designs for nuclear power plants are safe ahead of site-specific license applications.

Green Deal
The Green deal is the Coalition Government's initiative to support the implementation of energy efficiency measures to households and businesses without needing to meet any upfront costs.

Green Investment Bank (GIB)
A bank to provide finance for investment in low-carbon technologies.

Greenhouse Gas (GHG)
Any atmospheric gas (either natural or anthropogenic in origin) which absorbs thermal radiation emitted by the Earth's surface. This traps heat in the atmosphere and keeps the surface at a warmer temperature than would otherwise be possible.

Gross disposable annual household income
The amount of money available to households after taxes, National Insurance, pension contributions and interest have been paid.

Gross Domestic Product (GDP)
A measure of the total economic activity occurring in the UK.

Gross Value Added (GVA)
The difference between output and intermediate consumption for any given sector/industry.

Gt
A gigatonne (1,000 million tonnes).

Heat pumps
Can be an air source or ground source heat pump to provide heating for buildings. Working like a 'fridge in reverse', heat pumps use compression and expansion of gases or liquid to draw heat from the natural energy stored in the ground or air.

Heating degree day
The number of degrees that a day's average temperature is below a baseline temperature (typically either 15.5°C or 18.3°C), below which buildings need to be heated.

Heavy Good Vehicle (HGV)
A truck over 3.5 tonnes (articulated or rigid).

Home Insulation Scheme
The Scottish Government's area based residential energy efficiency scheme.

Hybrid Vehicle
A vehicle powered by an internal combustion engine and electric motor that can provide drive train power individually or together. E.g. Toyota Prius.

Hydrocarbon
A chemical compound comprised of hydrogen and carbon atoms, often of fossil fuel origin. Examples include methane, crude oil and oil products (e.g. petroleum, diesel and kerosene). Hydrocarbons relase CO_2 upon combustion.

Infrastructure Planning Commission (IPC)
A new body established by the Planning Act (2008) to take decisions on planning applications for major infrastructure projects.

Intended budget
As proposed in our 2008 report, the Intended budget (2008-2022) corresponds to the UK share of an EU 30% 2020 target. We recommended it should be enacted in the context of a global deal to reduce emissions.

Intergovernmental Panel on Climate Change (IPCC)
The IPCC was formed in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). It is designed to assess the latest scientific, technical and socio-economic literature on climate change in an open and transparent way which is neutral with respect to policy. This is done through publishing a range of special reports and assessment reports, the most recent of which (the Fourth Assessment Report, or AR4) was produced in 2007.

Interim budget
As proposed in our 2008 report, the Interim budget corresponds to the UK share of an EU 20% 2020 target. This is the current set of legislated budgets.

Ionophores
Feed additives that can improve the performance of cattle. They are currently banned in the EU.

Joule
The standard international unit of energy. Related units are: Kilojoule (KJ) = 1000 Joules, Megajoule (MJ) = 1 million Joules, and Gigajoule (GJ) = 1 billion Joules.

Kilo-watt hour (kWh)
A unit of energy, equal to the total energy consumed at a rate of 1,000 watts for one hour. Related units are: Megawatt-hour (MWh) = 1,000 kWh, Gigawatt-hour (GWh) = 1,000 MWh and Terrawatt-hour (TWh) = 1,000 GWh. The kilowatt-hour is equal to 3.6 million joules.

Kyoto gas
A greenhouse gas covered by the Kyoto Protocol.

Kyoto Protocol
Adopted in 1997 as a protocol to the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol makes a legally binding commitment on participating countries to reduce their greenhouse gas emissions by 5% relative to 1990 levels, during the period 2008-2012. Gases covered by the Kyoto Protocol are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

Levelised cost
Lifetime costs and output of electricity generation technologies are discounted back to their present values to produce estimates of cost per unit of output (e.g. p/kWh).

Life-cycle assessment
Methodology used to quantitatively assess the environmental performance (e.g. emissions) of a product or service from its cradle to grave.

Load factor
A measure of the output of an electricity generator relative to the maximum output it could produce.

Low Carbon Transition Plan (LCTP)
White paper from the Department of Energy and Climate Change (DECC) published in 2009.

Major Infrastructure Planning Unit (MIPU)
Planning decision-making body for large scale projects, due to replace Infrastructure Planning Commission (IPC) in 2012.

Marginal Abatement Cost Curve (MACC)
Graph showing costs and potential for emissions reduction from different measures or technologies, ranking these from the cheapest to most expensive to represent the costs of achieving incremental levels of emissions reduction.

Methane (CH_4)
Greenhouse gas with a global warming potential of 20 (1 tonne of methane corresponds to 20 tonnes CO_2e). Arises in the agriculture sector as a result of enteric fermentation in the digestive systems of ruminant animals (e.g. cattle and sheep) as well as in manures.

Mitigation
Action to reduce the sources (or enhance the sinks) of factors causing climate change, such as greenhouse gases.

$MtCO_2$
Million tonnes of Carbon Dioxide (CO_2).

National Atmospheric Emissions Inventory (NAEI)
Data source compiling estimates of the UK's emissions to the atmosphere of various (particularly greenhouse) gases.

National Renewable Energy Action Plan (NREAP)
Document submitted to the Commission by each EU member outlining how they intend to meet their required contribution towards the target of 20% of EU energy to be supplied by renewable sources by 2020.

National Policy Statement (NPS)
National Policy Statements are produced by the Government and establish the national case for infrastructure development and set the policy framework for the Infrastructure Planning Commission (IPC) to take decisions.

New Entrant's Reserve of the EU-ETS 300m allowances
EU financing instrument consisting of 300 million allowances set aside from the New Entrant's Reserve of the EU-ETS for subsidising innovative renewable technologies and CCS.

Nitrification inhibitors
Chemical additives that slow the rate of conversion of fertiliser ammonium to nitrate and reduce the chances for nitrogen loss.

Nitrous oxide (N_2O)
Greenhouse gas with a global warming potential of 300 (1 tonne of nitrous oxide corresponds to 300 tonnes of CO_2e). Arises naturally in agricultural soils through biological processes and is influenced by a variety of soil and nutrient management practices and activities (e.g. synthetic fertiliser application).

NOx
Oxides of nitrogen, defined as the sum of the amounts of nitric oxide (NO) and nitrogen dioxide (NO_2).

Offset credits
See credits.

Ofgem (Office of Gas and Electricity Markets)
The regulator for electricity and gas markets in Great Britain.

Plug-in hybrid Electric Vehicle (PHEV)
A vehicle that recieves motive power from both a battery and a secondary source (e.g. an internal combustion engine). The battery will generally be charged in the same way as that in a BEV, but all electric range will be more limited (e.g. 40 rather than 100 miles).

Propionate precursors
Feed additives that reduce the production of methane in ruminants.

Regulatory Justification
Regulatory Justification is based on the internationally accepted principle of radiological protection that no practice involving exposure to ionising radiation should be adopted unless it produces sufficient net benefits to the exposed individuals, or society, to offset any radiation detriment it may cause. This principle is included in the European Council Directive 96/29/ Euratom 13 May 1996.

Renewable Energy Strategy (RES)
Government plan to meet the European target of 15% of energy (including electricity, heat and transport) from renewable sources by 2020.

Renewable Heat Incentive (RHI)
Will provide financial assistance to producers (householders and businesses) of renewable heat when implemented in April 2011.

Renewables
Energy resources, where energy is derived from natural processes that are replenished constantly. They include geothermal, solar, wind, tide, wave, hydropower, biomass and biofuels.

Renewables Obligation Certificate (ROC)
A certificate issued to an accredited electricity generator for eligible renewable electricity generated within the UK. One ROC is issued for each megawatt hour (MWh) of eligible renewable output generated.

Sequestration
The process of removing CO_2 from the atmosphere and capturing it, particularly in biomass and soils.

Smarter Choices
Measures that influence people's travel behaviour towards less carbon intensive alternatives to the car such as public transport, cycling and walking by providing targeted information and opportunities to consider alternative modes.

Social Tariffs
Discounted energy tariffs for those who find it difficult to heat and light their homes.

Solar photovoltaics (PV)
Panels that generate electricity from daylight.

Technical potential
The theoretical maximum amount of emissions reduction that is possible from a particular technology (e.g. What would be achieved if every cavity wall were filled). This measure ignores constraints on delivery and barriers to firms and consumers that may prevent up take.

Tidal stream
A form of renewable electricity generation which harnesses the energy contained in fast-flowing tidal currents.

Turbocharging
A type of forced induction system, which compresses the air flowing into a petrol or diesel combustion engine, squeezing more air into a cylinder, then allowing more fuel to be added. A turbocharged engine produces more power overall from each explosion in each cylinder, improving the power-to-weight ratio of the engine. One advantage is that it reduces fuel consumption without compromising engine performance.

Vehicle Excise Duty (VED)
Commonly known as road tax, an annual duty which has to be paid to acquire a vehicle licence for most types of motor vehicle. VED rates for private cars have been linked to emissions since 2001, with a zero charge for the least emitting vehicles (under 100 gCO_2/km).

Abbreviations

AD	Anaerobic Digestion
BEV	Battery Electric Vehicle
CAP	Common Agricultural Policy
CCA	Climate Change Agreement
CCC	Committee on Climate Change
CCGT	Combined-Cycle Gas Turbine
CCS	Carbon Capture and Storage
CERT	Carbon Emissions Reduction Target
CESP	Community Energy Saving Programme
CfD	Contract for Difference
CH_4	Methane
CHP	Combined Heat and Power
CLG	Department for Communities and Local Government
CRC	Carbon Reduction Commitment
DA	Devolved Administration
DARD	Department of Agriculture and Rural Development Northern Ireland
DEC	Display Energy Certificate
DECC	Department for Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DUKES	Digest of UK Energy Statistics
EC	European Commission
ECO	Energy Company Obligation
EMR	Electricity Market Reform
ENSG	Electricity Network Strategy Group
EPC	Energy Performance Certificate
EPS	Emissions Performance Standard
EU	European Union
EU ETS	European Union Emissions Trading Scheme
EUA	European Union Allowance
FIT	Feed-in Tariff
GHG	Greenhouse Gas
GHGAP	Agriculture Industry Greenhouse Gas Action Plan
GIB	Green Investment Bank

GVA	Gross value added
HDD	Heating Degree Days
HEED	Homes Energy Efficiency Database
HGV	Heavy goods vehicle
IEA	International Energy Agency
IPC	Infrastructure Planning Commission
LCA	Life-cycle assessment
LCTP	Low Carbon Transition Plan
LULUCF	Land use, land use change and forestry
MIPU	Major Infrastructure Planning Unit
N_2O	Nitrous oxide
NAEI	National Atmospheric Emissions Inventory
NER 300	New Entrant's Reserve % of the EU ETS 300 million allowances
NIE	Northern Ireland Executive
NPS	National Policy Statement
NREAP	National Renewable Energy Action Plan
NTS	Non-Traded Sector
NVZ	Nitrate Vulnerable Zone
OFGEM	Office of the Gas and Electricity Markets
ONS	Office for National Statistics
PHEV	Plug-In Hybrid Electric Vehicle
PiP	Plugged-in Places
RED	Renewable Energy Directive
RES	Renewable Energy Strategy
RHI	Renewable Heat Incentive
RO	Renewable Obligation
ROC	Renewable Obligations Certificate
RTFO	Renewable Transport Fuel Obligation
SAFED	Safe And Fuel Efficient Driving
SEA	Strategic Environment Assessment
SG	Scottish Government
SHETL	Scottish Hydroelectric Transmission
SMEs	Small & Medium Enterprises
SMMT	Society of Motor Manufacturers and Traders
STW	Scottish Territorial Waters
VED	Vehicle Excise Duty
WWF	World Wildlife Fund