Meeting Carbon Budgets – 2013 Progress Report to Parliament

Committee on Climate Change
June 2013

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Presented to Parliament
pursuant to section 36(1) of the
Climate Change Act 2008

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 May 2009. 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 fourth carbon budget was legislated in June 2011 at the level that we recommended. In April 2013 we published advice on reducing the UK's carbon footprint and managing competitiveness risks.

Progress meeting carbon budgets

The Climate Change Act requires that we report annually to Parliament on progress meeting carbon budgets. We have published four progress reports in October 2009, June 2010, June 2011 and June 2012.

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, renewable energy ambition, bioenergy, and the role of local authorities. In September 2010, July 2011 and July 2012, we published advice on adaptation, assessing how well prepared the UK is to deal with the impacts of climate change.

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, Ute Collier, Hanane Hafraoui, Jenny Hill, David Joffe, Alex Kazaglis, Ewa Kmietowicz, Sarah Leck, Eric Ling, Nina Meddings, Clare Pinder, Stephen Smith, Kavita Srinivasan, Indra Thillainathan and Mike Thompson.

Other members of the Secretariat that contributed to the report: Kristofer Davies, Delali Foli, Swati Khare-Zodgekar, Jo McMenamin and Joanna Ptak.

A number of organisations for their support, including Cambridge Econometrics, DECC, Defra, Department for Transport, Heating and Hot Water Industry Council, National Insulation Association, Northern Ireland Executive, Ofgem, RenewableUK, Scottish Government, Society of Motor Manufacturers and Traders, and the Welsh Government.

A wide range of stakeholders who engaged with us or met with the Committee bilaterally.

Images: Chapter 3 – National Insulation Association; Chapter 5 – Image by Ecotricity, reproduced with permission.

Contents

Foreword 6

The Committee 8

Executive Summary 10

Chapter 1: Overview 53

Chapter 2: Progress decarbonising the power sector 75

Chapter 3: Progress reducing emissions from buildings 109

Chapter 4: Progress reducing emissions from industry 139

Chapter 5: Progress reducing transport emissions 153

Chapter 6: Progress reducing emissions from agriculture 193

Chapter 7: Progress reducing emissions from waste management and other non-CO_2 sources 217

Future work of the Committee 241

Glossary 243

Abbreviations 250

Foreword

This is our fifth annual report to Parliament on progress in reducing greenhouse gas emissions to meet carbon budgets and my first as Chairman.

We consider the latest data on emissions and prospects for meeting future budgets based on our framework of indicators and policy development.

Economy-wide emissions rose by 3.5% in 2012. However, much of this increase was a reflection of temporary factors – the relatively cold winter months compared with 2011, which led to increased heating demand; and switching from use of gas to coal in power generation, which we can expect to be reversed as tighter environmental regulation to improve air quality takes effect. In the absence of these effects, emissions would have fallen by 1 – 1 ½ %.

Of fundamental importance is whether we are making sufficient progress to put us on track to future carbon budgets. Here the picture is mixed.

We have preliminary emissions data for 2012, the last year of the first carbon budget, and it seems clear that this budget has been met. However, a large part of the reason we are meeting the first carbon budget and look likely to achieve the second, is the economic downturn. To meet carbon budgets beyond this will require that the pace of emissions reduction increases markedly – we need annual emission reductions of 3% to meet the third and fourth budgets.

There has been good progress in a number of specific areas in 2012 – the amounts of new wind generation capacity added to the system, insulation of lofts and cavity walls in residential buildings, emissions of new cars, and reduction of emissions from waste.

Nevertheless, sustaining progress in areas where there has been some success in 2012 will require further development and implementation of policy. There are major challenges relating to design of the Electricity Market Reform, which is still to be finalised. In relation to the Green Deal, it is early days. We will return to this when it has had longer to run and we have more data to assess progress, but it is likely that further incentives to encourage uptake of insulation measures will be required.

In other areas, such as solid wall insulation, low-carbon heat and energy efficiency improvement in commercial and industrial sectors, there was much less progress in 2012. For the Government to deliver its commitments under the Climate Change Act it will have to provide more confidence to investors and strengthen incentives in these areas. Without this there is a risk that future emissions will rise as the economy returns to higher growth.

I would like to thank the members of the Committee for their substantial contributions to this report. We, in turn, are grateful for the support of our excellent Secretariat for this and other reports over a busy year. We now look forward to providing advice, at the end of 2013, for the fourth carbon budget review.

Lord Deben

Chairman, Committee on Climate Change

The Committee

The Rt. Hon John Gummer, Lord Deben, Chairman
The Rt. Hon John Gummer, Lord Deben established and chairs Sancroft, a Corporate Responsibility consultancy working with blue-chip companies around the world on environmental, social and ethical issues. He was the longest serving Secretary of State for the Environment the UK has ever had. His experience as an international negotiator has earned him worldwide respect both in the business community and among environmentalists. He has consistently championed an identity between environmental concerns and business sense.

David Kennedy (Chief Executive)
David Kennedy is the Chief Executive of the Committee on Climate Change. Previously he worked on energy strategy and investment 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 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. His research expertise is in weather and climate processes. He is a member of the scientific academies of the UK, USA, and China.

Paul Johnson

Paul is the director of the Institute for Fiscal Studies. He has worked on the economics of public policy throughout his career. Paul has been chief economist at the Department for Education and director of public spending in HM Treasury, where he had particular responsibility for environment (including climate change), transport and public sector pay and pensions. Between 2004 and 2007 Paul was deputy head of the Government Economic Service. He has also served on the council of the Economic and Social Research Council.

Professor Dame Julia King

Professor Dame Julia King DBE FREng 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, as well as holding senior posts in the marine and aerospace businesses. Julia is one of the UK's Business Ambassadors, supporting UK companies and inward investment in low-carbon technologies. She is an NED of the Green Investment Bank, and a member of the Airports Commission.

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, CBE, is Research Councils UK Energy Strategy Fellow and Professor of Sustainable Energy at Imperial College London. He was previously Research Director at the UK Energy Research Centre (UKERC) and 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 fifth statutory report to Parliament on progress towards meeting carbon budgets. In it we consider the latest data on emissions and their drivers, and we assess progress in development and implementation of new policies which are required in order to reduce emissions. The report includes assessment at a range of levels: the whole economy; the non-traded and traded sectors; the key emitting sectors; and the devolved administrations.

We conclude that there has been good progress in the implementation of some measures, notably loft and cavity wall insulation, boiler replacement, new car efficiency, investment in renewable power generation, and waste emissions reduction.

In order to ensure continued progress, incentives for uptake of insulation measures under the Green Deal should be strengthened. In the area of low-carbon power generation it is necessary to provide more confidence to investors that the Government is committed to sector decarbonisation.

Progress has been very limited in implementing other measures including solid wall insulation, low-carbon heat and energy efficiency improvement in non-residential and commercial sectors. New approaches are required in order to ensure increased uptake in these areas.

The UK has met the first carbon budget and our assessment is that we are likely to meet the second carbon budget. However, we are not currently on track to meet the third and fourth carbon budgets. Without a significant increase in the pace of emissions reduction, starting very soon, the costs and risks of moving to a low-carbon economy in the 2020s and beyond will be increased. To meet its statutory commitments, it will be necessary for the Government to develop and implement further policy measures over the next two years.

Our main conclusions, which lead us to specific recommendations summarised in Box 1, are:

- **Economy-wide emissions of greenhouse gases.** These increased by 3.5% in 2012 due to relatively cold winter months compared to 2011 and switching from gas to coal in power generation. After allowing for these temporary effects, emissions would have decreased by 1-1.5%. This highlights the significant challenge in meeting future carbon budgets, which will require annual emissions reductions of 3%. The challenge is more pronounced given that there was very limited GDP growth in 2012 and real increases in energy and fuel prices. The risk is that emissions may increase when the economy returns to higher growth, particularly if energy and fuel prices do not continue to increase at the rates in 2012.

- **Low-carbon investments and behaviour.** There was good progress in 2012 on adding new wind generation capacity to the system, insulating lofts and cavity walls in residential buildings, and improving the efficiency of new cars. However, there is a risk that progress will not be sustained, particularly as regards wind generation capacity and insulation. Progress was very limited in other areas, notably low-carbon heat, and energy efficiency improvement in commercial and industrial sectors.
  - **Power sector.** Record levels of wind generation capacity (both onshore and offshore) were added to the system in 2012. However, the slow movement of offshore wind projects into construction suggests that investments are now being delayed until implementing arrangements for the Electricity Market Reform are finalised. Challenges remain in moving forward with demonstrations of Carbon Capture and Storage (CCS) and investments in nuclear new build, and putting in place arrangements to support ongoing investment programmes for each of the low-carbon technologies.
  - **Buildings.** Loft and cavity wall insulation rates increased in 2012 as energy companies aimed to meet their targets in the final year of the supplier obligation schemes (CERT and CESP). There is a significant risk around future delivery of these measures given weaker incentives under the new Green Deal and Energy Company Obligation. Solid wall insulation rates increased but remained low. While central Government made good progress to meet emissions reduction targets for its own estate, there was very limited improvement in commercial sector energy efficiency. Low-carbon heat deployment remained very low, with inadequate levels of investment in heat pumps, which are an important option for meeting carbon budgets.
  - **Industry.** There was limited evidence of energy efficiency improvement in industry in 2012, and significant potential remains in this area. This should be addressed to reduce industry costs and emissions. An approach to developing industrial CCS compatible with deployment in the 2020s is also required.
  - **Transport.** Emissions of new cars and vans continued to improve, and are on track to meet EU targets for 2020. Take-up of electric vehicles is slow but the market is developing as new models become available. A stable framework of support must remain in place in this nascent market to boost consumer and producer confidence. The Local Sustainable Travel Fund is now fully committed and could reduce transport emissions through Smarter Choices programmes aimed at rationalising car travel. Further funding to support national roll-out should be provided if projects are successful in delivering emissions reductions at low cost. Uptake of eco-driving training remains very low; eco-driving should be actively encouraged through a combination of inclusion in the driving test, driver training, awareness raising and in-car information on fuel efficiency.
  - **Agriculture.** The evidence base on agriculture is highly uncertain. While estimated emissions were broadly flat, it is unclear what changes are occurring in farming practice and what impact these are having. In order to understand progress and develop policies accordingly, the evidence base needs to be improved through introduction of a smart emissions inventory, and systematic gathering and publication of information on farming practice.

  - **Waste emissions.** These emissions have been falling and are on track with our modelled trajectories to meet carbon budgets. However, further consideration should be given to banning specific types of biodegradable wastes, such as food waste, from landfill.
  - **F-gas emissions.** Emissions of F-gases arise primarily from leakage during their use as coolants in air conditioning and refrigeration, though they are also used in some industrial processes and other applications. Commercial companies are increasingly deploying low-carbon alternatives. Given significant scope for reduction of F-gas emissions, the Government should at a minimum fully support proposals from the EU to reduce emissions of F-gases by 70% in 2030, but should also consider pushing for a more ambitious agreement, with more rapid phase out of some uses of these gases.

- **Policy challenges.** There are major challenges relating to design and implementation of the Electricity Market Reform and the Green Deal. New policies are required to support uptake of low-carbon heat in the residential sector. Stronger incentives are required for uptake of measures in the commercial and industrial sectors.
  - **Electricity Market Reform (EMR).** There are a number of detailed issues relating to contract design and payments mechanisms which should be resolved as the Energy Bill passes through Parliament. The EMR Delivery Plan should be designed to provide clarity for investors over the Government's intentions as market-maker. This should include setting out the quantity of capacity that the Government intends to contract over the period 2014/15-18/19, and the prices that it intends to pay for wind generation. Clarifications and possible adjustments on funding under the levy control framework to 2020 are required in order to ensure that this is sufficient to support ambition. Longer-term certainty should be provided through setting out commercialisation strategies for less mature technologies, setting a carbon-intensity target for 2030, and also extending funding under the levy control framework out to this date.
  - **Green Deal/Energy Company Obligation.** Previously, energy companies had targets for insulation measures, and were subject to fines for under-delivery, resulting in subsidies being paid for loft and cavity wall insulation. Under the new Green Deal and Energy Company Obligation (ECO), incentives for delivery are weak, relying mainly on a market based approach to address significant non-financial barriers to uptake, and requiring that most households bear the full cost of these measures. Support is still available for some measures under the ECO but, with the exception of low-income households, this excludes lofts and most cavity walls (i.e. except those that are hard-to-treat). These policies should be closely monitored and options to increase flexibility, and strengthened financial/fiscal incentives for uptake should be considered.

  - **Low-carbon heat.** Very low uptake of low-carbon heat in the residential sector reflects significant financial and non-financial barriers, which are not adequately addressed by the small-scale grant programme currently in place. The Renewable Heat Incentive should be extended to cover the residential sector, funding committed beyond 2014/15, Green Deal finance allowed to pay for the up-front cost of low-carbon heat investment and approaches to address non-financial barriers introduced.
  - **Commercial and industrial sectors.** There is a need to rationalise the multiplicity of policies in these sectors and to strengthen incentives for uptake of measures. Proposed industry roadmaps are potentially important in increasing uptake of energy efficiency measures and new technologies in this sector.

- **Devolved administrations.** Similar emissions changes have occurred in the devolved administrations as in the UK overall. In some areas of policy and delivery the devolved administrations are leading within the UK, but significant challenges remain in the transition to low-carbon economies.
  - **Emissions.** Emissions in the devolved administrations have broadly followed the whole UK trend, with a decrease in emissions during the economic downturn, and year-on-year fluctuations largely due to variations in temperature. In 2011 (the latest year for which data is available), Scottish emissions fell faster than the UK average (by 10% compared to 7%), while emissions in Wales and Northern Ireland fell by 5%.
  - **Progress.** The devolved administrations continue to lead the UK in some areas. For example Scotland is making very good progress in increasing its renewable energy capacity, while both Scotland and Wales have more ambitious waste targets than required under the EU Landfill Directive. All three devolved administrations have additional, government-funded fuel poverty reduction programmes, focusing on energy efficiency.
  - **Challenges.** Significant challenges remain, and will need to be addressed, such as increasing the rate of renewable power capacity deployment (especially in Wales), increasing low-carbon heat penetration, increasing rates of woodland planting (especially in Wales and Northern Ireland), encouraging more uptake of electric vehicles, as well as reducing the very high rates of fuel poverty found in the devolved administrations.

Box 1: Summary of recommendations in 2013 progress report

Power

- Set out in the Delivery Plan for the Electricity Market Reform (EMR) the quantity of capacity to be contracted during the period 2014/15 to 2018/19, and the intended prices for wind generation.
- Resolve detailed implementing issues for EMR relating to contract design and payment mechanism as the Energy Bill is finalised, ready to sign contracts in 2014.
- Clarify that the funding under the levy control framework will be calculated relative to the cost of building and running a new unabated gas-fired plant rather than the wholesale electricity price and increase funding if contract lengths are shorter than expected project lifetimes.
- Agree the contract for the first new nuclear project.
- Provide clarity on power sector development through the 2020s: legislate a target for carbon intensity of power generation in 2030; set out commercialisation strategies for carbon capture and storage (CCS) and offshore wind; extend the levy control framework to 2030.
- Ensure the two selected CCS projects move forward such that contracts can be signed by early 2015, enabling plant to become operational by 2018/19. Set out the timing of further projects and approaches to de-risking and CO_2 infrastructure development.
- Set stretching sustainability standards for the use of biomass, and require that forest biomass comes from sustainably managed forests.

Buildings

- Carry out an early review of the Green Deal and ECO and consider further incentives to encourage uptake of measures (especially lofts and cavity wall insulation).
- Tighten building regulations in line with the previously announced schedule towards all new homes being zero carbon from 2016.
- Ensure measures are in place to adequately support fuel poor electrically heated households, either within the Energy Company Obligation, or otherwise. Ensure that the Energy Company Obligation continues to the point where all fuel poor households have benefitted from it, and address very high rates of fuel poverty found in the devolved administrations.
- Set ambitious minimum standards for energy efficiency in the residential and non-residential sector, as envisaged under the 2011 Energy Act. These standards should be announced now with a lead time so that landlords can optimise the timing of implementation, for example, as tenancy agreements come to an end.
- Make a comprehensive assessment of non-residential low-carbon policies to ensure they work effectively.
- Extend the Renewable Heat Incentive to the residential sector and ensure funding beyond 2015, allow Green Deal finance to cover the up-front cost of purchasing heat pumps, and consider options to address non-financial barriers.

Industry

- Include the full range of cost-effective abatement options in the industry sector roadmaps and align financial incentives for low-cost abatement.
- Set out an approach to demonstration and commercialisation of industry CCS compatible with deployment in the 2020s.
- Introduce a detailed implementing package for commitments to mitigate competitiveness risks for UK firms from low-carbon policies (e.g. the £250 million compensation package and exemptions from costs under EMR).

Box 1: Summary of recommendations in 2013 progress report

Transport

- Support the setting of challenging longer-term new Car and Van CO_2 intensity targets at EU level as soon as possible (e.g. following the Commission's proposed review to be completed by the end of 2014).
- Push for rapid progress in developing an EU framework for HGV emissions.
- Ensure a stable framework of support for electric vehicles (commit to continuation of funding of Plug-in Car and Van Grants beyond 2015 and reinstate tax incentives for company cars).
- Push for robust sustainability criteria for biofuels to be agreed at the EU level as soon as possible.
- Actively promote uptake of eco-driving through a combination of inclusion as a key element in the practical driving test, driver training, awareness raising and in-car information on fuel efficiency.

Agriculture

- Set targets in their roadmaps as to how the cereals and oil seeds sectors will contribute to emission reductions.
- Set out approach to assessing the effectiveness of the voluntary approach in the GHG Industry Action Plan.
- Any review on progress towards reducing emissions from agriculture should also consider a range of policy options, including policies that would provide stronger incentives for farmers.

Waste and other non-CO_2

- Consider stronger levers to reduce the amount of biodegradable waste that is sent to landfill, including further provision by local authorities for separate collection of food waste, and review landfill bans on major sources of biodegradable waste on a case-by-case basis.
- Support EC proposal to update the F-gas regulation and consider going further given the existence of cost-effective alternatives.

Actions for specific and national authorities

- **DECC** is the key department in ensuring that actions are taken in power, buildings and industry sectors.
- **CLG** has an important role to play ensuring that building regulations for new homes are tightened, minimum energy efficiency standards for non-residential buildings are set, and transport emissions fully accounted for as part of the planning process.
- **DfT** is responsible for actions to reduce surface transport emissions.
- **Defra** is responsible for actions to reduce agriculture and other non-CO_2 emissions, including our specific recommendations on waste and F-gases.
- **HM Treasury** is responsible for ensuring that there is sufficient funding, for example, in the levy control framework, the Renewable Heat Incentive, and to support Electric Vehicle Market Development; and to ensure that fiscal levers such as Vehicle Excise Duty and the tax regime for ultra low-carbon vehicles are designed to ensure carbon efficient choice and investments.
- **Devolved Administrations**. It is essential that national authorities take action across the range of measures in order to ensure that national and UK emissions targets are achieved, with a particularly important role supporting energy efficiency improvement, investment in renewable power generation and renewable heat, programmes to reduce car travel, and approaches to reduce emissions from agriculture and land use.

We set out the analysis that underpins these conclusions in ten parts:

1. Economy-wide emissions
2. Non-traded sector emissions
3. Traded sector emissions
4. Power sector emissions
5. Emissions from buildings
6. Emissions from industry
7. Emissions from surface transport
8. Agriculture
9. Waste and other non-CO_2 emissions
10. Emissions in the devolved administrations

1. Economy-wide emissions

The context for our assessment in this report is one of limited GDP growth in 2012, increased energy prices and colder winter months than 2011:

- GDP grew by 0.3% (in real terms) in 2012, following growth in 2011 of 0.7% (Figure 1). Within this, manufacturing output fell by 1.5%.
- Wholesale gas price increases in 2012 resulted in a 10% real terms increase in residential gas prices, and a 4% real terms increase in residential electricity prices (Figure 2).
- In the transport sector, petrol prices rose by 0.2% in real terms[1] and diesel prices rose by 0.8% in real terms (Figure 3).
- The winter months in 2012 (i.e. January, February and December) were around 0.5°C colder than in the previous year (though close to the long term average) and there were 20% more heating degree days (HDD)[2] over the year (Figure 4).

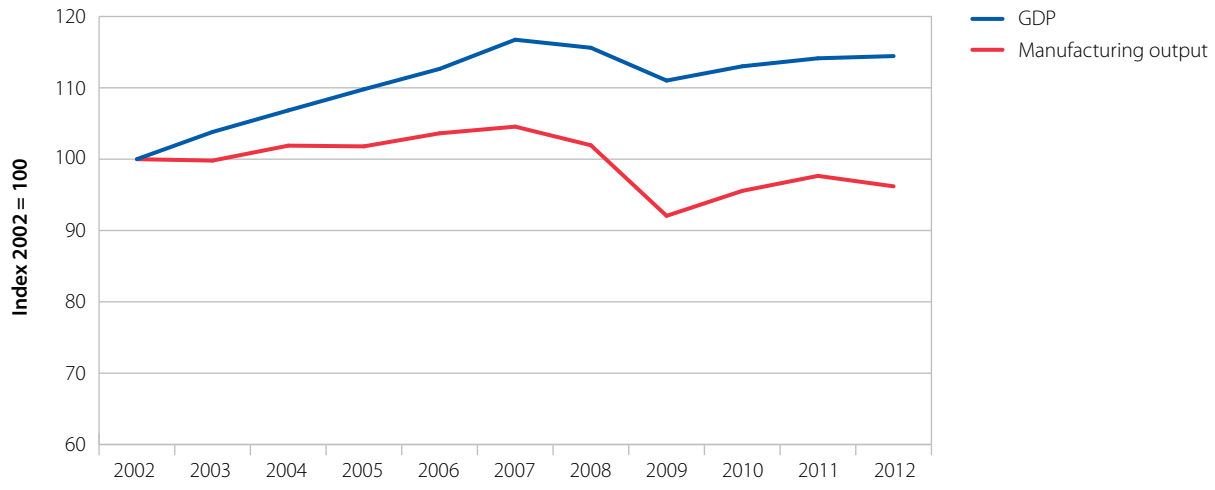
Economy-wide greenhouse gas emissions increased by 3.5% in 2012 (Figure 5). This reflected a 4.5% increase in CO_2 emissions, which account for 84% of total greenhouse gas emissions; and a 1.5% reduction in non-CO_2 emissions, which account for 16% of total greenhouse gas emissions.

The CO_2 emissions increase on 2011 was primarily due to an increase in heating demand due to lower winter temperatures and an increase in the share of coal use in power generation.

1 DECC publish gas and electricity prices in real terms using the Treasury's GDP deflator series. In order to maintain consistency with DECC's approach, we convert nominal petrol and diesel prices to real prices using the same GDP deflator. For 2012, the GDP deflator implies an inflation rate of 1.4%, considerably below the rates implied by the consumer price index (CPI) and retail price index (RPI) of over 4%.

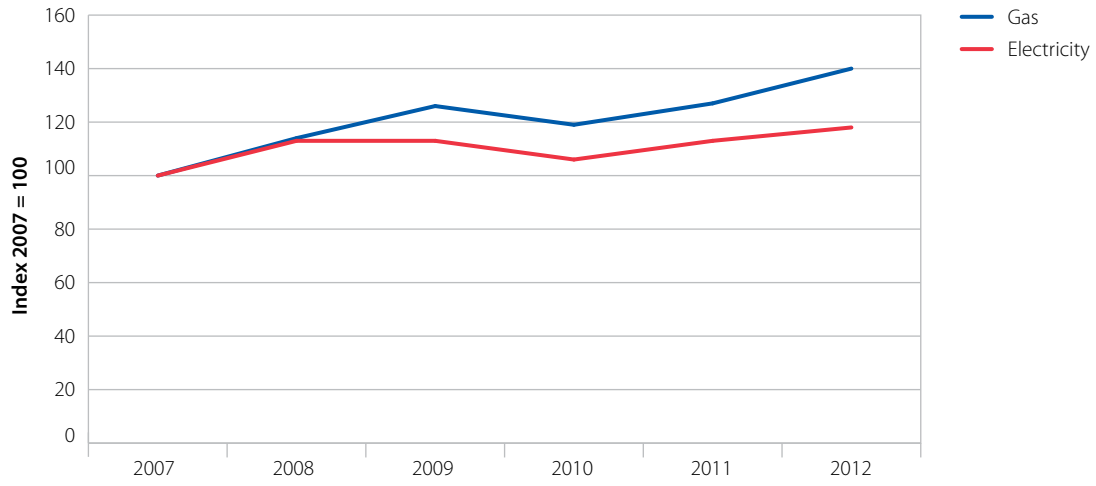
2 A Heating Degree Day (HDD) is defined as a decrease of one degree centigrade in the average temperature, below a baseline temperature of 15.5°C (below which a building typically needs heating) on a given day. For example, an average outside temperature of 10.5°C over two days would result in 10 HDDs.

Figure 1: UK economic indicators (2002-2012)



Source: ONS (March 2013) *Quarterly National Accounts.*

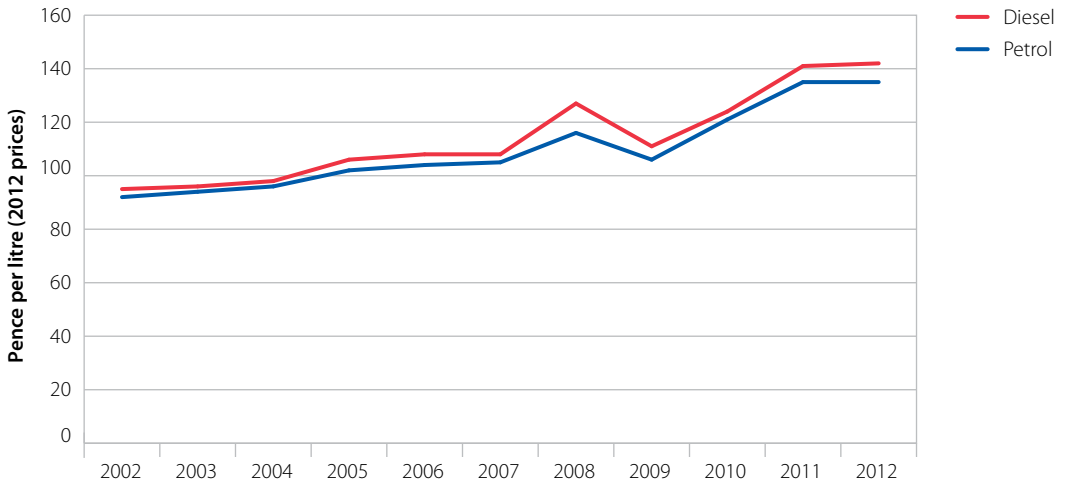
Figure 2: Residential fuel prices in the UK (2007-2012)



Source: DECC (March 2013) *Quarterly Energy Trends.*

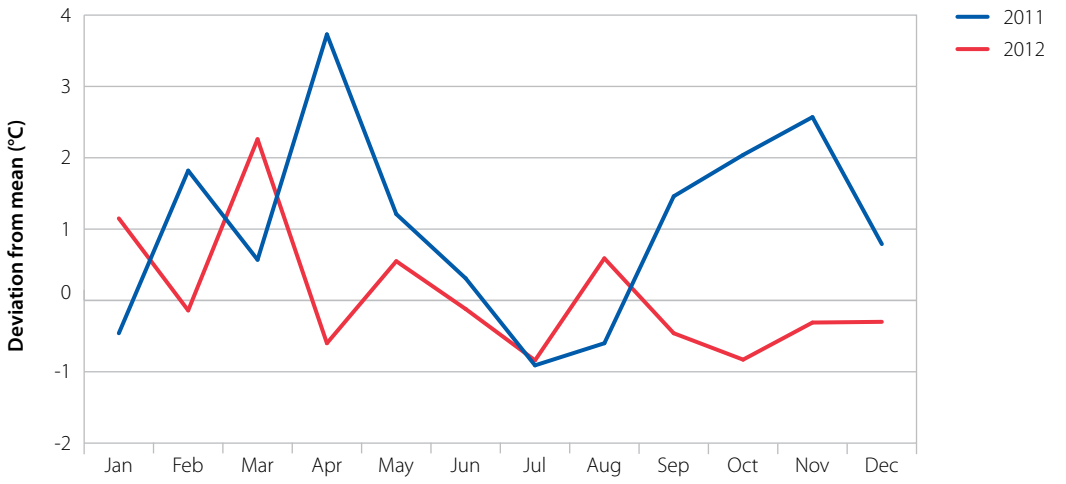
- Lower winter temperatures caused an increase in heating demand. This was met largely through burning of fossil fuels which resulted in increased direct emissions from buildings; these account for around a fifth of total CO_2 emissions, and increased by 10% in 2012. The majority of direct emissions from buildings come from the residential sector, where direct emissions increased by 12% in 2012.
- Emissions from power generation, which account for a third of CO_2 emissions, increased by 8% in 2012. The share of coal use in power generation increased from 30% of generation in 2011 to 39% in 2012, while the share of natural gas decreased from 40% in 2011 to 27% in 2012.

Figure 3: Road fuel prices in the UK (2002-2012)



Source: DECC (March 2013) *Quarterly Energy Trends.*

Figure 4: Average temperature deviation from the long term mean (2011-2012)



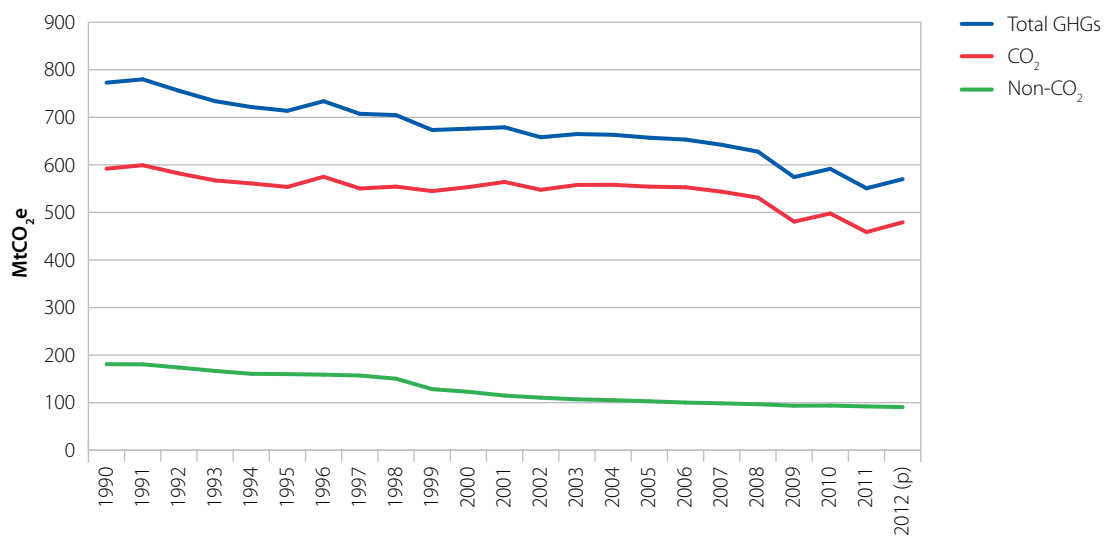
Source: DECC (March 2013) *Energy Trends.*
Note: The long term mean temperature is calculated for the years 1971-2000.

Adjusting for the impact of colder temperatures and also for the switch from gas to coal in power generation, both of which are transitory[3], greenhouse gas emissions fell by 1-1.5% in 2012. This compares with an annual emissions reduction of 3% required to meet the fourth carbon budget.

This limited reduction in the adjusted figures in 2012, a year characterised by low GDP growth and increases in energy and fuel prices, suggests it will be a major challenge to achieve a 3% a year reduction as the economy recovers, particularly if increases in energy and fuel prices were

3 We do not expect the gas to coal switch to continue in future as the majority of coal plant is set to retire driven by a combination of end-of-life closures, new EU legislation and coal becoming un-economic due to the rising carbon price floor (section 4).

Figure 5: UK greenhouse gas emissions (1990-2012)



Source: DECC (2013) *2012 UK Greenhouse gas emissions, provisional figures.*

to moderate. There is a risk that emissions increase as the economy returns to trend growth unless there is an increase in the pace of progress implementing measures to reduce emissions.

2. Non-traded sector emissions

Non-traded sector emissions are those not covered by the EU Emissions Trading Scheme (ETS). They include emissions due to burning of fossil fuels for heat in buildings, non-energy-intensive industry, surface transport, as well as almost all non-CO_2 emissions (e.g. from agriculture and waste). They account for 59% of economy-wide greenhouse gas emissions.

Non-traded sector emissions rose by 3.1% in 2012 (Figure 6). This increase was driven by an increase in emissions from buildings, which, as discussed above, was due to increased heating demand in response to colder winter temperatures. Without this impact, non-traded sector emissions would have increased by only 0.2%.

Our assessment of progress in implementing measures to reduce emissions shows that there was good progress on boiler replacement, loft and cavity wall insulation, and new car emissions. However, there was limited progress on solid wall insulation, low-carbon heat, non-residential and industrial energy efficiency improvement, electric vehicle market development and transport consumer behaviour change (see sections 5-7 below).

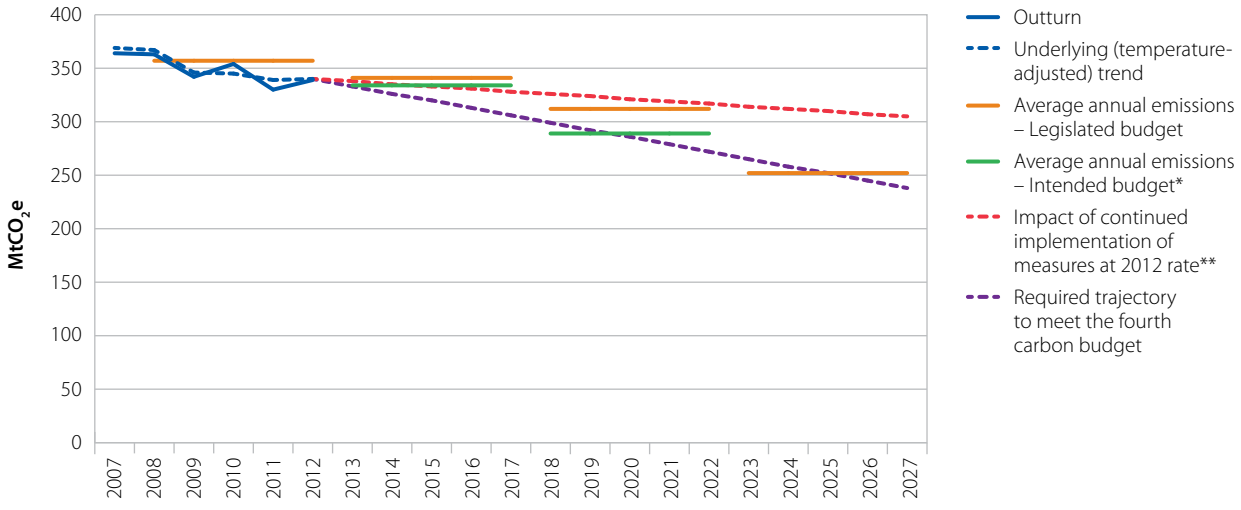
The first carbon budget was met, largely due to the impact of the recession, which would also allow achievement of the second budget with limited effort. However, if there were no improvement in the rate of progress achieved in 2012, the third and fourth carbon budgets would not be achieved (Figure 7).

This highlights the need first to continue progress in areas where this has been achieved to date, including where this may be more challenging in future, such as loft and cavity wall insulation under the new Green Deal and Energy Company Obligation (see Section 5 below).

Figure 6: Non-traded sector emissions vs. Carbon budgets (2007-2027)

Source: DECC (2013) *2012 UK Greenhouse gas emissions, provisional figures*; DECC (March 2013) *Energy Trends*; CCC calculations.
Notes: *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.

Figure 7: Non-traded sector emissions based on continued implementation of measures in 2012 (2007-2027)



Source: NAEI (2013); DECC (2013) *2012 UK Greenhouse gas emissions, provisional figures*; European Commission (2 April 2013) *Verified Emissions for 2008-2009-2010-2011-2012 and allocations 2008-2009-2010-2011-2012*; DECC (2012) *Updated Emissions Projections*; CCC calculations.
Notes: *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. **Based on the Baseline scenario from DECC (2012) UEP, net of estimated savings ensuing from continued uptake of measures at the rates seen in 2012, until 2027 or until full potential is realised (e.g. all lofts have been insulated), whichever is sooner. Trajectory has been smoothed.

In addition, it is necessary to accelerate the rate of progress in areas where this has been lacking to date, including low-carbon heat, non-residential and industrial energy efficiency improvement, new van emissions and electric vehicles. The need to accelerate progress is now urgent: lead times for policy development, and lags in market development, mean that action is required now if significant cuts are to be achieved by the time of the third and fourth carbon budgets.

3. Traded sector emissions

UK traded sector emissions

Traded sector emissions are those covered by the EU ETS. They comprise 67% emissions from the power sector and 33% emissions from energy-intensive sectors such as iron and steel and refining, and account for 41% of economy-wide emissions.

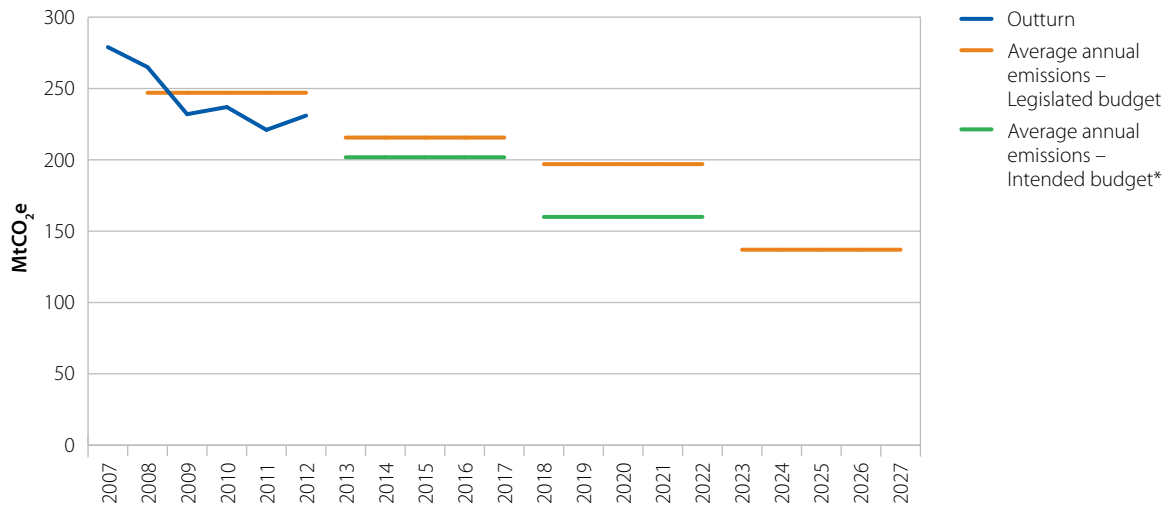
The carbon price underpin introduced in April 2013 applies to the power sector, but not to the rest of the traded sector; this started at a rate of £16/tCO_2 and will rise to £32/tCO_2 in 2020.

Given the accounting conventions under the Climate Change Act, the traded sector portion of the carbon budget will always be met. To the extent that gross emissions (i.e. actual emissions in the UK, before any trading of emissions allowances) in the traded sector are above budgeted levels, this will result in the purchase of allowances in the EU ETS, such that the budget is achieved on a net basis (i.e. after trading in emissions allowances).

However, it is important that gross emissions from the traded sector are reduced given the need to meet carbon budgets and targets further out in time largely through reductions in UK emissions.

Gross traded sector emissions rose by 5% in 2012, mainly as a result of increased emissions from power generation, but remained below the traded sector cap, mainly due to the ongoing impact of output reductions in 2009 (Figure 8).

Figure 8: Traded sector emissions vs. carbon budgets (2007-2027)



Source: European Commission (April 2013) *Verified emissions data for 2012.*
Notes: *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.

- Power sector emissions rose by 8% in 2012 driven by increased emissions intensity of power generation.
- Industry traded sector emissions fell by 4% in 2012[4].
- Traded sector emissions remained below the traded sector cap, reflecting the substantial decline in output in 2009 as a result of economic recession, which has not been made up since.

We consider whether there was progress implementing measures to reduce emissions in the power and energy-intensive sectors in sections 4 and 6 below.

EU traded sector emissions

EU traded sector emissions are important for the UK because the level of effort to reduce these emissions to the level of the cap determines the carbon price in the EU ETS. In turn, this is important because of the incentives it can provide to reduce emissions, and because a higher carbon price in the EU ETS would reduce electricity price differentials between the UK and other EU countries due to the carbon price underpin, therefore reducing competitiveness risks for electricity-intensive industries.

EU traded sector emissions fell 2% in 2012 and remained below the level of the EU ETS cap (Figure 9), resulting in a continued low carbon price (Figure 10).

- Emissions remained below the level of the EU ETS cap in 2012, largely reflecting the significant reduction in 2009 as a result of the EU and wider global economic downturn.
- Over Phase II as a whole (2008-12) emissions were around 10% below the level of the cap. The unused allowances from Phase II can be banked and will be available to meet the EU ETS cap in future years, putting a downward pressure on future as well as current carbon prices.
- The carbon price in 2012 averaged around €7/tCO_2 compared to €13/tCO_2 in 2011.

It is important to increase the carbon price, both to strengthen incentives for emissions reduction, and to improve credibility of one of the EU's key low-carbon policies.

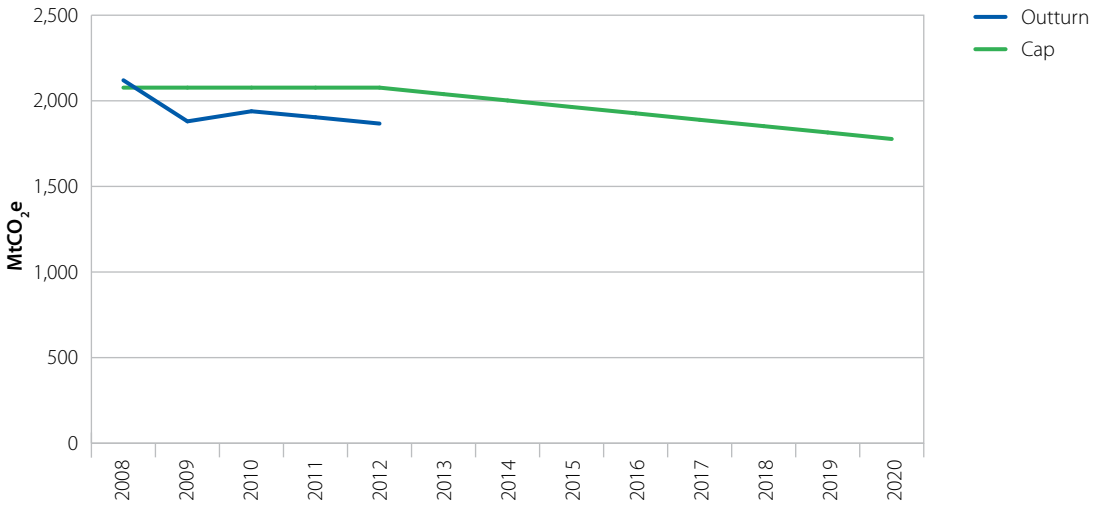
One option which could have increased the carbon price was to limit release of allowances to the market in the near term (called "back-loading"). However, this was voted against in the European Parliament in April 2013.

The European Commission (EC) is now considering proposals for structural reform of the EU ETS with a view to providing a more robust price signal, and which it will publish in 2014. The UK, alongside Energy and Environment Ministers from eight other member states, have called for substantive measures to strengthen the system.

The EC is also currently consulting on a range of issues relating to development of climate and energy targets for 2030, and intends to develop more concrete proposals for a 2030 framework

4 CITL data for 2011 and 2012.

Figure 9: Emissions within the EU ETS versus cap (2008-2020)



Source: European Commission (April 2013) *Verified emissions data for 2012*; European Commission (22 October 2010) *Commission Decision 2010/364/EU.*
Notes: Excludes International Aviation

Figure 10: Carbon price in the EU ETS

Source: Point Carbon.

by the end of 2013. The Green Paper, "A 2030 framework for climate and energy policies", which launches this consultation, states that the 2030 framework should take into account the longer term perspective laid out in the 2011 Roadmap for moving to a competitive low carbon economy in 2050. This Roadmap suggests a reduction in emissions of 40% on 1990 levels by 2030 on the path to an 80-95% reduction by 2050, reflecting the EC's analysis of scope for cost-effective emissions reductions.

A framework consistent with the ambition of the roadmap could strengthen the carbon price, put the EU on a cost effective path to meeting its target to reduce emissions by at least 80% in 2050 on 1990 levels, and make a positive contribution towards agreement on a global deal to reduce emissions.

In May 2013 the UK Government announced that it will support a 2030 target to reduce EU emissions by 40% on 1990 levels, rising to 50% through the purchase of credits in the context of a global deal, and depending on ambition committed by other countries.

This is broadly in line with the ambition (55% reduction including the purchase of credits) we suggested in our 2010 advice on the fourth carbon budget based on very high-level analysis.

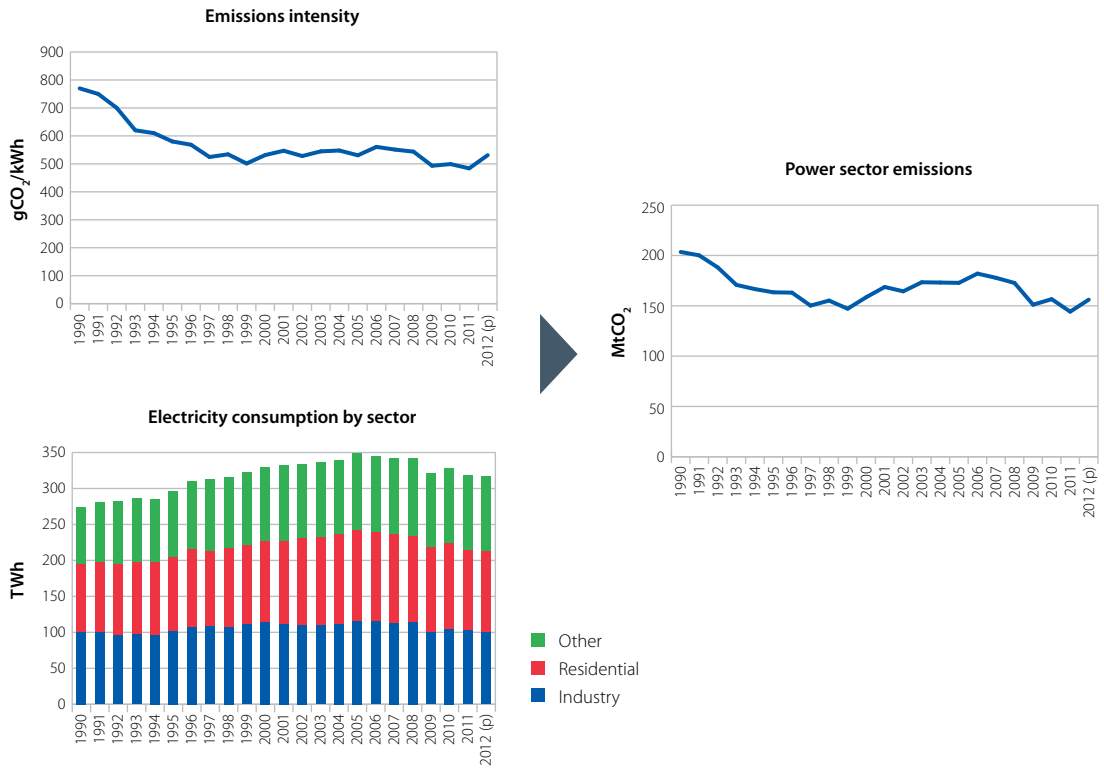
We therefore strongly support the UK Government position. We will consider consistency of UK carbon budgets with EU targets further in the context of the fourth carbon budget review.

4. Power sector emissions

Emission trends

Power sector emissions increased by 8% in 2012 due to increased carbon intensity of generation. This was the result of switching from gas to coal as the primary generation source. This more than offset the impact of increased renewable generation, while demand remained broadly constant (Figure 11).

Figure 11: Emissions intensity of electricity supply, electricity demand and CO_2 emissions from the power sector (1990-2012)



Source: DECC (March 2013) *Energy Trends*; DECC (2013) *UK Greenhouse Gas Emissions 1990-2012 (provisional)*, CCC calculations.
Notes: Emissions intensity is UK based useable generation, i.e. adjusted for losses. Electricity consumption includes imported power. 2012 data are provisional.

- **Carbon intensity.** In 2012, carbon intensity of generation increased by 10%, due to an increase of highly carbon-intensive coal-fired generation at the expense of gas-fired generation. This was driven by a low price of coal and a high price of gas in the global market and a low carbon price. The impact of increased coal generation on emissions was partially offset by the addition of renewable capacity to the system.
- **Consumption.** Total consumption remained broadly constant. A doubling of net imports of electricity led to a 4% reduction in the amount of electricity generated in the UK.

Achievable carbon intensity of power generation

While carbon intensity of generation increased by 10% to 531 gCO_2/kWh in 2012, achievable emissions intensity fell by 6% to 315 gCO_2/kWh. In other words, if plant on the system were dispatched so as to minimise emissions while still maintaining security of supply (i.e. if gas-fired plant were dispatched before coal-fired plant whenever technically possible), carbon intensity would fall by 41% from 531 to 315 gCO_2/ kWh, at minimal additional cost to the consumer.

This can be compared with carbon intensity levels around 200 gCO_2/kWh in 2020 and 50 gCO_2/ kWh in 2030 which we have identified as being on the cost-effective path to meeting the 2050 target set out in the Climate Change Act.

Over time we would expect actual carbon intensity to converge towards achievable intensity as coal plant currently on the system is retired in compliance with EU air quality legislation.

- **Age of coal plants.** The majority of coal plants in the UK were built in the 1960s and 1970s, and with a typical lifetime of 40-50 years, many of them are now nearing the end of their lifetime.
- **Environmental legislation.** European regulations relating to air quality will lead plants to retire or reduce their running hours earlier than suggested by expected retirement ages:
  - **Large Combustion Plant Directive (LCPD).** Around a quarter of UK coal-fired capacity (6 GW) face restricted running hours between now and end-2015 under the LCPD,[5] and will have to close when these hours are used up. The favourable economic conditions for coal in 2012 brought forward generation that would likely have occurred at a later date, therefore, the cumulative output and emissions from these plants is likely to be unaffected.
  - **Industrial Emissions Directive (IED).** The remainder of UK coal plant could also face further restrictions from 2015 and be forced to close by end-2023 under the IED.[6]
- **Economics of coal plant.** Even though the cost of coal generation has fallen over 2012, the profitability of coal plant is likely to decline in the future due to the UK's carbon price floor.

In order that carbon intensity is significantly reduced beyond this, investment across the portfolio of low-carbon technologies is required.

5 The LCPD regulates sulphur oxides, nitrogen oxides and particulate matter emissions. Plants were given a choice to opt in or out. Plants opting out were allocated 20,000 hours to run 2008-2015. Plants opting in must comply with Emissions Limit Values for the three pollutants. This could involve undergoing full biomass conversion.

6 In 2010 the LCPD was combined with six other existing directives to form the IED. LCPD plants which opt in to the IED must agree to stricter emissions limits. Plants which opted in to the LCPD but not to the IED will have their hours capped at 17,500 for 2016-2023. Plants are required to give notice of intent to comply with IED at the end of 2013; the final decision has to be taken by the end of 2014.

Progress in low-carbon investment

Wind generation

A record level of onshore and offshore wind capacity was added to the system in 2012 (1.2 GW of each). If these deployment levels can be sustained this would be enough to meet our 2020 indicators for both onshore and offshore wind (i.e. 15 GW and 12 GW respectively) (Figure 12).

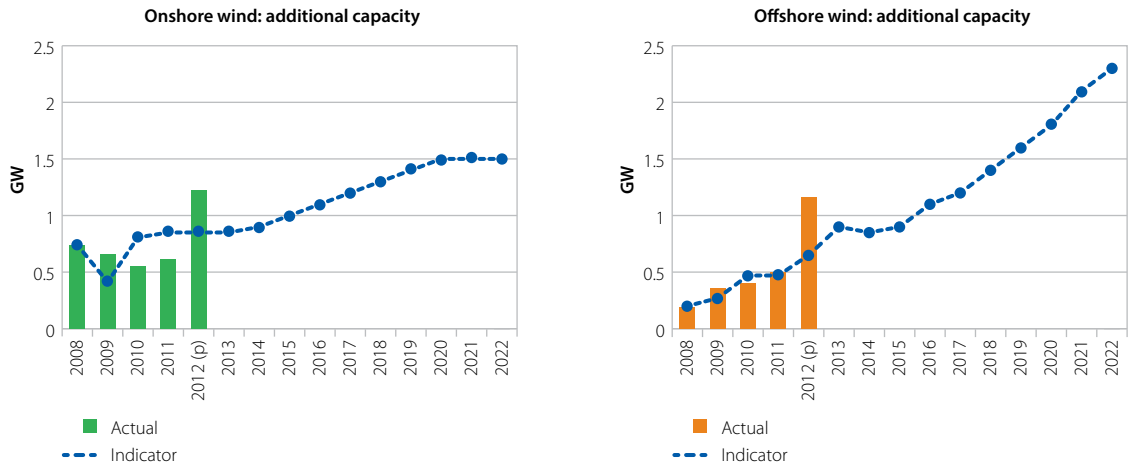
There is a healthy project pipeline to support further investment.

- 4.4 GW onshore wind and 2.3 GW offshore wind had planning approval and was awaiting construction at the end of 2012. If these projects move smoothly into construction and operation then this would be enough, along with those projects already under construction, to deliver required capacity additions for the next six years onshore and four years offshore.
- There was a substantial amount of new wind planning applications in 2012 (particularly offshore) and the number of determinations were in line with our indicators.

However, the rate at which projects are entering construction is slow, particularly for offshore wind, as investors wait for details on the design of the Electricity Market Reform before proceeding to the next stage of the project cycle.

- At the end of 2012, 1.9 GW of onshore wind and 1.3 GW of offshore wind were under construction (compared with 1.8 GW and 1.9 GW respectively at the end of 2011).
- During 2012, far less offshore capacity started construction than completed (0.6 GW compared with 1.2 GW), whilst a large amount of onshore capacity began construction (1.3 GW).

Figure 12: Onshore and offshore wind: annual additional capacity against our indicators (2008-2022)



Source: DECC (March 2013) *Energy Trends*.
Notes: 2012 data are provisional.

Whether and how quickly projects move forward will therefore depend on the Electricity Market Reform, both in terms of enabling legislation and implementing arrangements (see below).

Biomass

In 2012, only 30 MW (0.03 GW) of solid biomass was added to the system, compared with 830 MW (0.83 GW) in 2011 (largely due to the conversion of Tilbury coal power station).

A further 0.5 GW of coal plant has converted to biomass so far in 2013 (Ironbridge) and another 5.5 GW is publicly investigating conversion.

It is important that safeguards are in place to ensure that the use of biomass results in genuine emission reductions. We therefore repeat our recommendation that the threshold for the use of biomass under the Renewables Obligation should be reduced to 200 gCO_2/kWh compared to the current threshold of 285 gCO_2/kWh, and progressively tightened further. In achieving this, it is important that forest biomass comes from sustainably managed forests, meaning carbon stocks should be maintained and possibly increased over time.

Solar

Solar installations continued at a high level in 2012 (0.7 GW installed) although this was slightly down on 2011. Of the added capacity, over half (0.4 GW) came on line after a second round of tariff cuts came into force in April 2012, suggesting that solar generation is still profitable at these lower tariffs.

Progress investing in nuclear new build

Two important milestones were passed in the last year with generic design approval of the Areva reactor design and planning permission granted for the Hinkley site. Negotiations to agree contract terms for the first plant are underway.

- **Approval of reactor designs.** The pressurised water reactor designed by Areva (which will be used by EDF) received generic design approval by the regulator in December 2012. Horizon's planned boiling water reactor design was submitted for approval in January 2013, with a final decision expected by 2017/18.
- **Planning.** The EDF project at Hinkley Point C was granted planning permission in March 2013, two years later than initially expected following delays caused by the 2011 incident at Fukushima.
- **Contracting.** The Government is currently negotiating with EDF over the level and terms of support for a new nuclear plant at Hinkley. Following agreement the project can reach final investment decision and potentially begin construction this year.

Agreement on the contract for the first project at Hinkley Point C would allow focus on other contracts to be signed under the first EMR Delivery Plan period, with scope to sign for up to around 6 GW by 2018-19, as part of a major nuclear programme through the 2020s, with significant economic benefits for the UK.

Progress demonstrating carbon capture and storage (CCS)

Following limited progress over the last few years, the CCS Commercialisation Programme moved forward with selection of preferred bidders to undertake front-end engineering and design (FEED) studies for two projects:

- From the four projects shortlisted, two preferred bidders were selected to negotiate FEED studies: a gas post-combustion project at Peterhead in Scotland and a coal oxy-fuel project at Drax in Yorkshire.
- DECC has stated that it expects these studies to take around 18 months, with final investment decisions for the plants to occur in early 2015.

It is important that these projects move forward such that FEED studies are completed and contracts signed in early 2015, if not earlier, allowing for plant to become operational by 2018/19.

It is also important to set out the next steps for commercialisation of CCS, to capitalise on current investor interest, and noting that further investment will be required to drive down costs such that CCS can compete in the market:

- The Government should consider options for a further two demonstration projects to come on line by the early 2020s, in line with commitments in the Coalition agreement. This should include approaches to funding FEED studies and signing contracts, and opportunities to leverage UK funding with that from the EU.
- Going beyond the four demonstration projects, the Government should set out a commercialisation strategy for CCS covering investments envisaged through the 2020s and associated conditions, for example, related to required cost reductions in order that support is continued. This should include an assessment of different CCS applications within and between coal, gas, biomass and industry. It should take account of international efforts to develop CCS technology, complementing rather than duplicating what is happening in other countries.

The Government should also set out a strategy for the development of CO_2 infrastructure. This would encompass not only DECC's storage strategy, currently under development, but also what to build, how this would be funded and implications for locating new fossil and biomass power plants.

The combination of demonstration projects together with commercialisation and infrastructure strategies will provide a good basis for development of CCS technology in the UK to complement efforts in other countries, such that this can make a potentially important contribution to reduction of emissions in power and energy-intensive sectors in the 2020s and beyond.

Electricity market reform

The Electricity Market Reform (EMR) is essential in supporting investment across the portfolio of low-carbon technologies. The EMR offers the opportunity to bring forward investment in low-carbon technologies which has potential to deliver significant benefits to consumers in the long run. Without it, we would expect such investments to be limited in scale and to be more expensive.

The enabling legislation for the EMR – the Energy Bill – entered Parliament in the last year, and has now gone through the House of Commons and into the Lords.

There remain a number of detailed technical issues relating to contract design and payment mechanism which must be addressed as a matter of urgency in order that investments currently held up can enter construction.

There are also important issues related to uncertainty around the future project pipeline which should be addressed through the implementing arrangements for the EMR, to support further project development and supply chain investment:

- There is uncertainty over what investments will be supported in the first years of the delivery plan. This relates in part to the levy control framework which, while set at broadly the appropriate level, requires further clarification and possible adjustment to avoid a funding shortfall.
- There is more uncertainty over investments to be supported after 2020, where the Government has set out a wide range of possible investment pathways for the 2020s, some of which include no further investment in low-carbon technologies.
- The consequence of this uncertainty is that incentives for project development and for supply chain investment are undermined.

In order to address these uncertainties the Government should:

- Set out in the EMR Delivery Plan the quantity of contracts it intends to award for each technology over the first EMR Delivery Plan period (2014-18), and publish prices for onshore and offshore wind contracts for this period.
- Clarify that the levy control framework will be calculated relative to the cost of new gas-fired generation rather than the wholesale market price.

- Ensure that funding under the levy control framework is sufficient given decisions on contract length. Our analysis of required funding has assumed that contract length is commensurate with asset life. The Government has proposed shorter contracts, which would increase funding requirements to 2020 and beyond, and would reduce funding requirements in the 2030s. The Government should only proceed with shorter contracts if it can demonstrate that this is likely to result in a clear economic benefit. In this event, the levy control framework limit would have to be increased to avoid a funding shortfall.
- Provide more clarity for investors about the path for power sector development through the 2020s:
  - Commit in legislation to reduce the carbon intensity of power generation to 50 gCO_2/ kWh in 2030, with some flexibility to adjust this in the light of new information.
  - Publish commercialisation strategies for less mature technologies including offshore wind and CCS.
  - Extend funding under the levy control framework to 2030.

Noting that the current Government is not willing to commit to a carbon-intensity target, this will be a priority early in the next Parliament. For the interim period, the other measures above would help to improve the investment climate, and should be implemented in order to unlock the full economic benefit of the EMR.

5. Emissions from buildings

Emissions trends

Emissions from buildings account for 37% of total UK greenhouse gas emissions. They comprise 45% direct emissions due to the burning of fossil fuels for heat, and 55% indirect emissions related to electricity use. On a sector basis, residential emissions account for around 66% of total building emissions, commercial emissions for around 26% and public sector emissions for around 8%.

Buildings emissions increased by 10% in 2012. This was due to broadly similar increases across each of the residential, commercial and public sectors, mainly a result of an increase in indirect (electricity related) emissions due to higher electricity grid intensity, as well as a rise in direct emissions due to colder winter temperatures than in 2011.

- **Residential buildings.** Total residential CO_2 emissions increased by 12% in 2012, due in broadly equal part to the increase in winter temperatures and the increase in grid intensity due to the use of coal rather than gas in power generation.
- **Commercial buildings.** In 2012 total commercial emissions increased by 9%. This was largely due to the increase in grid intensity, given that the vast majority of commercial sector emissions are electricity-related.

- **Public buildings.** Public sector CO_2 emissions in 2012 increased by 8%. Part of this increase was weather related, but it largely reflects increased grid intensity, with most public sector emissions being electricity-related.

After allowing for the impact of the weather as compared with 2011 and the change in grid intensity, underlying emissions fell slightly in the residential sector, and were broadly flat in the non-residential sector. This conclusion is reinforced by the analysis summarised in the following sections, which also consider progress developing polices which will provide stronger incentives for energy efficiency improvements.

Progress against residential buildings indicators

There was a significant increase in loft and cavity wall insulation in 2012 as energy companies aimed to meet targets under the Carbon Emission Reduction Target (CERT) and the Community Energy Saving Programme (CESP), both of which were replaced with new policies at the beginning of 2013. Solid wall insulation was also increased, although from a very low base. The pace of boiler replacement was maintained, while progress on purchase of more efficient appliances is uncertain.

- **Loft insulation.** Professional installations increased by 50% in 2012 to almost 1.2 million, with DIY installations increasing by 35% to 0.4 million. Total installations were therefore 1.6 million, up from 1.1 million in 2011.
- **Cavity wall insulation.** Installations increased by 22% to over 0.6m.
- **Solid wall insulation.** Overall around 82,000 solid walls were insulated in 2012, up from around 19,000 in 2011.
- **Boiler replacement.** Installation of new boilers continued at a similar rate as in previous years. In 2012, 1.3m new efficient boilers were installed, up 2% from the level in 2011.
- **More efficient appliances.** As we reported in our 2012 progress report, the Government no longer monitors the sales of energy efficient appliances. We therefore have no new data to monitor progress. Considering the large savings expected from products policy, this is a gap which we recommend the Government should address promptly.

In future to meet carbon budgets, there is a need to maintain the pace of loft insulation and to increase the pace of cavity wall insulation, as well as significantly increase the rate of solid wall insulation.

However, there is a significant risk as to whether this is achievable under new policies, notably the Green Deal and the Energy Company Obligation, under which incentives for loft and cavity wall insulation are significantly weaker.

The Green Deal and the Energy Company Obligation

From early 2013, CERT and CESP have been replaced by the Green Deal and Energy Company Obligation (ECO):

- **Green Deal:** This is a new financing framework to facilitate energy efficiency improvements and low-carbon heat in homes and non-residential properties, funded by a charge on electricity bills that avoids the need for consumers to pay up-front costs.
- **ECO:** This creates a legal obligation on energy suppliers to improve the energy efficiency of households through the establishment of three distinct targets – the Carbon Emissions Reduction Obligation (20.9 million "lifetime"[7] tonnes of CO_2), the Carbon Saving Community Obligation (6.8 million lifetime tonnes of CO_2) and the Home Heating Cost Reduction Obligation (£4.2 billion of lifetime cost savings).

Whereas loft and cavity wall insulation were a major focus of efforts to meet targets under the previous policy, this has now shifted to solid wall insulation and hard-to-treat cavity walls under the ECO. The result is a greater reliance on a market based approach and for most measures a switch from subsidy to households bearing full cost. Therefore incentives for loft and cavity wall insulation are significantly weaker. This is reflected in the Government's own analysis, which projects that for example only around 10% of the remaining lofts will be insulated under the policies.

Data is available for accreditation of Green Deal Advisors and Green Deal Assessments that have been carried out in the first few months of the new policy.

- 152 Green Deal assessor organisations and the 1,274 Green Deal advisors they employ have been accredited
- 18,816 Green Deal assessments have been lodged
- £85.5 million of contracts have been let through the ECO brokerage system.

While official data on actual delivery of measures will not be available until after this report is published, there is evidence that this has slowed in early 2013. For example, registration figures for cavity wall and solid wall insulation under the official guarantee schemes suggest a drop of more than 60% compared to the same period in 2012.

This suggests the need for close monitoring, and consideration of ways to limit delivery risks including allowing the ECO to be met through loft and cavity wall insulation, and providing financial and fiscal incentives for uptake of these measures.

We will consider design and implementation of the Green Deal and the ECO in detail in our next progress report.

7 Savings during the lifetime of the measures installed.

Zero carbon homes

Our assessment above focuses on retrofit of measures to existing homes. It is also important to ensure that new homes are energy efficient and use electricity and heat generated from low-carbon sources.

The Government has previously committed to implementing a zero carbon homes policy in England by 2016. It is important that the Government should now tighten building regulations, as had been expected to be announced this May, in line with that commitment.

Fuel poverty

While low-carbon policies have to date had little effect on fuel bills and hence fuel poverty levels, by 2020 we expect average bills to rise by 10% compared to 2011 as a result of policies to support investment in low-carbon power generation technologies. Energy efficiency improvement is particularly important for addressing fuel poverty, to ensure price rises from low-carbon policies are offset.

In 2011 (the latest figures available), there were 4.5 million households in the UK in fuel poverty, down by 0.25 million from 2010:

- In England, there were 3.2 million fuel poor households, 0.3 million lower than in 2010.
- The devolved administrations had a much higher proportion of households in fuel poverty than England (15%) – in Northern Ireland fuel poverty levels reached 42% (mainly due to lower incomes and higher fuel prices, as most households rely on expensive heating oil). In Scotland fuel poverty stood at 25%, while fuel poverty levels in Wales were slightly higher at 29%.

It is unlikely that the fall in fuel poverty numbers in 2011 will have been maintained since then, due to fuel price rises and with fuel poverty policy (in particular in England) undergoing major changes. The main fuel poverty scheme for England (Warmfront) came to an end in early 2013 and the ECO is now the only scheme providing energy efficiency improvements in fuel poor households.

In future, the targeting of support under the ECO could offset the impact of rising electricity prices on the fuel poor as a group, although this should be closely monitored, and the level of targeting adjusted as required. In addition, ECO benefits will be unequally distributed, reaching only a proportion of fuel poor household over the next years. There are also particular issues for electrically heated households, where the impact of rising electricity prices will be felt disproportionately.

Therefore it will be necessary to put in place measures to support electrically heated homes, either within the ECO, or otherwise. Furthermore, it will be important to ensure that the ECO continues to the point where all fuel poor households have benefitted from it. In the meantime, there may be a need for other policies to support energy efficiency improvement, and possibly social tariffs or income transfers. All of these aspects should be considered in the Government's forthcoming fuel poverty strategy.

Emissions reduction in the non-residential sector

The CRC Energy Efficiency Scheme (formerly the Carbon Reduction Commitment) was simplified in 2013 through the abolition of the performance league table, the withdrawal of state funded schools from the scheme, and various administrative simplifications.

While simplification is generally to be welcomed, the abolition of the performance league table leaves incentives under the CRC much weakened. It is now little more than a (small) carbon tax and no longer tackles the non-price barriers it was originally set to address.

There are a number of retailers who have improved their energy efficiency significantly, for example through measures to improve the efficiency of heating, lighting and refrigeration.

However, for the non-residential sector as a whole there is limited evidence of energy efficiency improvement, as is manifest in emissions data, and there is a risk that significant energy efficiency potential is not addressed, for large and small energy users.

This risk could be limited through the setting of ambitious minimum standards for energy efficiency in the non-residential sector, as envisaged under the 2011 Energy Act. These standards should be announced now with a lead time so that landlords can optimise the timing of implementation, for example, as tenancy agreements come to an end.

In the public sector, there has been good performance against the 2014/15 target for the central Government to reduce emissions by 25%, with a 12% reduction achieved by the end of 2011/12. This highlights the effectiveness of setting targets for emissions reduction, reinforcing the experience under previous policies to improve energy efficiency in the residential sector. It suggests the potential benefits of setting targets in residential, non-residential and industrial sectors for energy efficiency improvement which would result in emissions reductions and cost savings.

Progress investing in low-carbon heat

Uptake of low-carbon heat in buildings remains very low, with 2% penetration in 2012 compared to 12% penetration envisaged by the Government in 2020 in its Renewable Energy Action Plan. Moreover, the vast majority of low-carbon heat in buildings is due to the use of biomass, with very limited investment in heat pumps. This is of concern, given the important role for heat pumps in meeting future carbon budgets.

The low level of heat pump penetration reflects limited incentives for a relatively unproven technology in the UK, particularly in the residential sector. Whereas policy should be aimed at addressing a range of financial and non-financial barriers, the current policy consists of small-scale programme of grants to households where uptake has been very low.

It is essential that the Renewable Heat Incentive is now extended to the residential sector, that this is funded beyond 2015, that Green Deal finance is allowed to cover the up-front cost of purchasing heat pumps, and that options to address non-financial barriers are considered. This set of measures together would provide more confidence that low-carbon heat markets will develop in a way that is consistent with the cost-effective path to meeting carbon budgets.

6. Emissions from industry

Industry emissions trends

Industry emissions account for a third of all greenhouse gas emissions in the UK. Around 80% of industry emissions are CO_2, of which 70% are direct due to the burning of fossil fuels and chemical processes, and 30% are indirect due to the use of electricity.

Industry CO_2 emissions increased by around 3% in 2012, reflecting increased carbon intensity of power generation, whilst electricity demand fell, and direct emissions were broadly flat.

- Indirect emissions increased by around 7%, as the 10% increase in the carbon intensity of the grid was partially offset by demand reduction of 2%.
- Direct emissions were broadly flat in a context where overall output fell, implying increased carbon-intensity of production. This can be largely explained through increased production in the iron and steel industry due to re-opening of the Teesside plant in 2012.

However, there is limited evidence of underlying reduction in industry emissions through energy efficiency improvement. In particular, energy intensity has not fallen in recent years. Furthermore, national accounts data shows low levels of investment in new plant and equipment required to unlock potential for energy efficiency improvement.

This should be addressed, given the significant opportunity to reduce industry emissions, which would reduce costs and contribute to meeting carbon budgets in a cost-effective way.

Policies to encourage energy efficiency improvement and low-carbon technology development

The key policy to encourage energy efficiency improvement is Climate Change Agreements (CCAs) for the energy-intensive industries. There has been mixed progress on CCAs, which have set ambitious targets to improve electricity related energy efficiency, but which no longer cover direct emissions. This is of concern because direct emissions comprise the majority of total industry emissions.

Going forward, it is very important to use the industry roadmaps proposed by the Government to set out milestones for energy efficiency improvement, and to ensure that policy incentives are aligned.

In addition, the road maps should set out an approach to the use of CCS in energy-intensive industries. This is a key abatement option for these industries, but at the moment the Government has not set out how it can be demonstrated and deployed, possibly in conjunction with programmes in other countries.

Limiting competitiveness risks for energy-intensive industries

We published a report in April 2013 which included an assessment of competitiveness risks for electricity-intensive industries. We concluded that these risks exist for electricity-intensive industries, but can be managed under current policies such as the proposed exemption for these industries from costs related to the Electricity Market Reform.

In designing and implementing this policy package, the relevant evidence to be considered includes:

- Electricity price increases for competitors to key UK electricity-intensive sectors
- Current and projected future industrial electricity UK consumption, at a detailed level (i.e. SIC 4)
- Scope passing through electricity price increases into higher product prices
- Materiality of electricity price impacts for firm location and investment decisions
- Whether surplus allowances have been generated for the sector under the EU ETS

The Government should now move from high level commitments to a detailed implementing package in order to provide clarity and support for electricity-intensive industries currently in the UK and those that might invest in the UK in future.

7. Emissions from surface transport

Emissions data for individual transport modes continue to be published with a time lag compared to UK-wide data, with the latest data currently available covering 2011. We report estimates of 2011 emissions by mode below; however we note that these should be treated with caution given uncertainties in the National Atmospheric Emissions Inventory (NAEI) methodology. We also make a provisional assessment for 2012 based on fuel sales, distance travelled, biofuel penetration and new vehicle efficiency.

Surface transport emissions account for around 20% of total UK greenhouse gas emissions, and fell by 1.3% in 2011. NAEI estimates suggest that within this, emissions from vans increased, while those from cars and HGVs fell. The 1.8% fall in emissions from cars was largely a result of improved fuel efficiency, which offset a slight increase in vehicle km. Van emissions rose by 1.6% as a result of both higher vehicle km and a worsening of the fuel efficiency of the fleet. HGV emissions fell by 0.8% as a fall in vehicle km and an increase in biofuels were partly offset by a worsening fleet efficiency.

A provisional assessment for 2012 suggests that CO_2 emissions may have fallen overall:

- Petrol sales fell by 4.8%, while diesel sales rose by 2.6% in 2012. Given the carbon intensity of petrol and diesel, this suggests road transport emissions may have fallen by 0.3%.

- Data on distance travelled, biofuels and new vehicle emissions suggest that within this, car and HGV emissions fell, while van emissions increased. Car travel fell by 0.2% in 2012 and new car CO_2 emissions improved by 3.6%, while biofuels penetration in cars remained constant. This suggests car emissions are likely to have decreased in 2012. Despite an improvement in efficiency of new vans of between 4.1 and 4.9%, van emissions are likely to have increased due to continued growth in vehicle km and a 1.1% fall in biofuel penetration. For HGVs, a continued decline in vehicle km is likely to offset the 1.2% fall in biofuel penetration suggesting emissions may have fallen last year.

Official estimates of emissions by mode in 2012 will be published early in 2014. We will report on these in our 2014 progress report.

Progress against indicators: new car and van emissions

Building on previous improvements, new car emissions continued to fall significantly in 2012, and outperform our indicator:

- Average new car CO_2 emissions fell from 138.1 gCO_2/km in 2011 to 133.1 gCO_2/km in 2012 – compared to our indicator of 145.8 gCO_2/km.
- New car emissions fell across all car classes in 2012. However, car purchase behaviour was more polarised than in 2011, with a smaller share of medium cars sold, but higher shares of both small and large cars (specifically dual-purpose vehicles)

Going forward, trends in purchase behaviour suggest there may be a need to reinforce EU standards with incentives for best-in-class purchase as well as switching between classes. Increased and further differentiated Vehicle Excise Duty may be required, with lower rates for more fuel efficient cars and without discontinuities such that there is a large change in VED for a small change in efficiency.

There was also good progress on new van emissions in 2012:

- Average new van CO_2 emissions fell by between 4.1 and 4.9%, to between 187 and 189 g/km in 2012 – compared to our indicator of 195.4 g/km
- However there was a continued trend towards purchase of heavier, higher-emitting vans (larger, heavier vans tend to offer greater flexibility of use and increased payload efficiency).

In future, if the trend towards heavier vans continues it will be important that purchasers choose best-in-class vehicles. The Government should consider scope for use of complementary policy levers to strengthen incentives for best-in-class purchase behaviour (e.g. fiscal levers).

We will continue to track the CO_2 intensity of new cars and vans and highlight appropriate actions to support continued progress.

The good progress on new car and van CO_2 intensity suggests that regulation is an effective means of achieving emissions reductions from vehicles. Given this, the Government should support the setting of longer term targets at EU level as soon as possible (e.g. following the

Commission's proposed review to completed by the end of 2014). These targets should be sufficiently challenging to have a strong effect on pulling new technology through into the market, with potential scope to go further than the indicative target ranges for 2025 proposed by the Commission (68-78 gCO_2/km for cars and 105-120 gCO_2/km for vans):

- Our scenario for meeting the fourth carbon budget envisaged 75 g/km in 2025 for cars and 112 g/km for vans[8]. New analysis on road transport technologies that we commissioned last year suggests g/km could be lower still e.g. through combined hybridisation and strong engine downsizing of non-EVs.
- Others have suggested that for cars a target of 60 g/km in 2025 would be achievable with an EV share of around 50% (of which half are pure battery electric) – and indeed required to accelerate the introduction of ultra-low emission vehicles[9] – while less than 100 g/km could be achievable for vans.

The Government should also push for rapid progress in developing an EU framework for HGV emissions. There is currently no agreed test cycle for measurement of new HGV emissions, although the Commission have been conducting work in this area. They are expected to publish a strategy for reducing HGV emissions in the coming months.

Progress against indicators: electric vehicle market development

Sales of electric cars in 2012 were around 2250 vehicles, more than double the volume in 2011. Despite the increase in sales, volumes were low compared to our indicator of 11,750. Factors affecting uptake are likely to include availability of models on the market, the cost of the vehicles, availability of infrastructure, and consumer caution towards a new technology.

Model availability

There has been good progress in development of new electric vehicle models. As of June 2013, there are ten electric car models available on the UK market, including one plug-in hybrid and two range-extended model in the medium car segment (which accounted for around half of total sales in 2012). Moreover, a considerable range of models is under development and due to come to market in the near future. A number of electric van models also reached the UK market in 2012, with seven models currently eligible for the plug-in van grant and further models expected on the market soon.

Price support

The cost of electric vehicles (EVs) remains high relative to conventional alternatives. Reflecting this, the Government offers price support for EVs through the Plug-in Car and Van Grants, which provide consumers and businesses with up to £5,000 towards the purchase of an eligible electric car and up to £8,000 for each eligible electric van. However, this funding is

8 Given a roughly 30% share of electric vehicles. Excluding electric vehicles, the values are 95 g/km for cars and 137 g/km for vans.

9 RAC Foundation (2013) Powering Ahead: the future of low-carbon cars and fuels; Greenpeace and Transport & Environment (2013) The case for 2025 targets for CO_2 emissions from cars and vans.

committed for the life of the current parliament only. The Government should commit to continuation of funding beyond 2015.

There are also a number of other financial incentives for businesses to purchase electric vehicles, including preferential company car tax rates, and first year capital allowances.

However recent Budget announcements confirm these incentives will be weakened from 2015:

- **Company car tax.** In our 2012 progress report, we recommended that the announcement in Budget 2012 to withdraw company car tax exemption for electric vehicles from 2015/16 should be reversed, as this would undermine incentives in a market niche with a potentially high share of early electric vehicle adopters, while raising limited tax revenue. In Budget 2013, a preferential 5% rate of tax for ultra-low emissions vehicles was re-instated from April 2015. Nevertheless, this will still add around £500 to the cost of a pure electric vehicle compared to the current zero rate.
- **Capital allowances.** In general, electric vehicles are eligible for 100% first year capital allowances. However, in Budget 2012, confirmed in Budget 2013, it was announced that this was to be withdrawn for leasing firms. There is a potentially key role for leased business cars in driving electric vehicle uptake (reflecting both their share in total sales and the opportunity they present in allowing the public to gain experience of EVs).

We therefore recommend that in relation to company car tax the Government should reconsider reinstating the zero rate for zero-emission vehicles and that the decision on capital allowances be reversed.

Infrastructure investment

The Government has previously provided funding for electric vehicle charging infrastructure through the Plugged-in Places initiative, which provided match-funding for chargepoint installation in eight Plugged-in Places. As at end March 2013, this had delivered a total of 4,000 chargepoints. There was also significant investment in privately funded chargepoints, with a total of around 5,000 delivered by this time. However there have been issues with interoperability of existing chargepoints.

In February 2013, the Government announced a further £37 million funding package to support installation of chargepoints. The requirement for chargepoints funded through this new national offer to have pay as you go functionality is a step towards improved interoperability.

These measures to support the development of the EV market are necessary. It is important that a stable framework addressing financial and non-financial barriers remains in place. We will continue to monitor this closely and recommend further approaches that may be needed to ensure this nascent market continues to grow and uptake moves towards levels needed to meet carbon budgets.

Progress against indicators: biofuels

Biofuels penetration decreased from 3.5% in 2011 to 3.1% in 2012, as the Renewable Transport Fuel Obligation (RTFO) was amended to allow biofuels produced from wastes, non-agricultural residues and second generation biofuels to be counted twice in meeting the biofuels target. This level of biofuels is 1% short of our indicator.

The RTFO is flat-lined from 2013/14, pending a decision from the EU on how indirect land use change (ILUC) will be taken into account. While it is important that robust sustainability criteria taking account of ILUC impacts are implemented, the Government should push for these to be agreed as soon as possible to guard against an unnecessary investment hiatus in this sector or to allow additional action to meet carbon budgets to be put in place if required.

Progress against indicators: consumer behaviour change

Behaviour change offers around a third the total abatement potential reflected in our indicator for surface transport emissions in 2020.

In 2012 there has been some progress towards roll-out of Smarter Choices (i.e. encouraging people to switch to public transport and other means to reduce car journeys), with limited progress on eco-driving training and speed limiting, and some uncertainty in land use planning:

- **Smarter Choices.** Funding for the Local Sustainable Transport Fund was increased from £560 million to £600 in 2012. The Fund is now fully committed, supporting 96 projects in 77 Local Authorities across England between 2011/12 and 2014/15 – almost all of which included Smarter Choices measures in their bids. As the projects progress, monitoring and evaluation of outcomes should be encouraged, to ensure emission reduction impacts are achieved. If successful, the Government should make a commitment to further funding post-2015 and develop a plan for nationwide roll-out of Smarter Choices over the next decade.
- **Eco-driving training.** The level of eco-driving training remained low in 2012, with much greater use reported for drivers of trucks than other vehicles. Given the benefits to both cost reductions and carbon savings, the Government should actively promote the uptake of eco-driving training, through a combination of inclusion in the driving test, driver training, awareness raising and in-car information on fuel efficiency.
- **Speed limits and their enforcement.** Speed limits are exceeded by a high proportion of drivers on motorways (49%) and dual carriageways (41%). Given the significant decline in fuel efficiency as car speed increases from 70 to 80 mph, enforcing current speed limits presents an opportunity for reducing emissions. In-car information from fuel consumption meters would also encourage driving within the speed limit by emphasising the excessive fuel consumption associated with driving at 80 rather than 70 mph.

- **Land use planning.** The Government has set out proposals for changes in the way local authorities take account of transport issues in local plans. Given the potential for these to increase car use and emissions, it is important that transport emissions are factored into planning decisions alongside other costs and benefits. An Impact Assessment setting out the potential effect on travel demand and emissions should be published as soon as possible.

The challenges are therefore to implement and then extend the current programme of Smarter Choices, to increase levels of eco-driving, to consider better enforcing the current speed limit, and to ensure that transport emissions are factored into planning decisions alongside other costs and benefits.

8. Agriculture

Greenhouse gas emission data for agriculture continue to be published with a time lag compared to UK-wide data, with the latest data currently available covering 2011.

Agriculture emissions are estimated to account for around 9% of total UK greenhouse gas emissions.

However, we note that the current level of emissions is highly uncertain due to the method used in calculating the inventory. In particular, this applies standard emissions factors to standard farming practice, and therefore does not allow for variation in biological processes and different farming practices. Given the need to be able to measure agriculture emissions accurately, it is of crucial importance that Defra delivers the new Smart Inventory on schedule in 2015.

Over half of estimated emissions (53%) are due to agricultural soils, while enteric emissions – arising from the digestive process of cattle and sheep – account for another 30% of emissions. The remaining emissions are split between stationary and combustion emissions (9%) and manure management (8%). By gas, nitrous oxide (N_2O) accounts for 57% of emissions in the sector, with a further 35% coming from methane and the remaining 8% from carbon dioxide (CO_2).

Agricultural emissions remained unchanged from 2010 at 51.2 MtCO_2e. However, there were marginal changes in emissions across the range of sources and gases. Emissions from enteric fermentation, waste and manure management and methane declined slightly, while emissions from agricultural soils, stationary and mobile combustion, N_2O and CO_2 increased marginally.

An increase in livestock output combined with a decline in the emissions associated with rearing livestock imply an improvement in carbon intensity of production in 2011. Improved intensity was driven by a 10% decrease in the use of inorganic fertiliser on grasslands, a 2% decline in cattle numbers and increased yields of milk and meat, particularly sheep and lamb. However, it is unclear whether these increased yields ensued from more carbon intense farming practice, for example, relating to feeding of livestock.

For crops, there was a 3% increase in output and a 5% increase in crop-related emissions. The implied increase in the carbon intensity of arable farming reflected higher emissions from crop residues. This was partially offset by a reduction in carbon intensity associated with the application of inorganic fertiliser to soils. Whether this represents an increase in efficiency, or a rebound in output following poor harvests related to weather conditions in 2010, is unclear.

Although overall emissions have not fallen since 2009, emissions reductions achieved in previous years mean that the level of emissions is still consistent with our indicator trajectory.

Defra has now published an indicator framework to monitor progress in reducing emissions. This is an important part of the evidence base to understand whether farming practice is becoming more carbon efficient, more so because it is difficult to make inferences about farming practice from emissions and productivity data.

If these indicators suggest that there is insufficient progress being made in improving carbon efficiency of agriculture, this should trigger a policy review. While the Government has set a date of 2016 to review progress, an earlier review may be appropriate depending on the evidence. Any review should include a range of policy options, including continuing the current voluntary approach, but going beyond this to policies which would provide stronger incentives for farmers.

9. Waste and other non-CO_2 emissions

Waste and other non-CO_2 emissions account for around 8% of UK greenhouse gas emissions. Greenhouse gas emission data for Waste and other non-CO_2 emissions continue to be published with a time lag compared to UK-wide data, with the latest data currently available covering 2011.

Progress reducing waste emissions

Waste emissions, mostly methane, account for around 3% of UK greenhouse gas emissions. In 2011, waste emissions fell by 3%, continuing a longer-term trend where emissions have fallen 64% since 1990. This is largely due to reductions in the amount of biodegradable waste sent to landfill in response to the landfill tax to meet targets under the EU landfill directive. There has also been good progress to reduce waste generated by households and businesses and to divert waste from landfill, through voluntary responsibility deals such as the Courtauld Commitment (in the grocery sector) and information awareness campaigns.

Further reductions in waste emissions could be supported through introduction of stronger levers, particularly targeting food waste, which is likely to continue to be a major contributor to future waste emissions. For example, local authorities should consider options for increasing separate collection of food waste, which can then be used to produce energy through anaerobic digestion and pyrolysis.

There is also an outstanding question of whether certain categories of waste should be banned from landfill, which is the approach in some EU countries and in Scotland. The Government considered a ban on sending wood to landfill but concluded that this was not

a cost-effective measure and that current policies such as the landfill tax are sufficient drivers for reducing the landfilling of wood waste . It then inferred that bans for other materials could not be economically justified at present. This is not an evidence based approach, and there may be cost-effective opportunities for banning of other types of waste from landfill. These should be considered on a case-by-case basis.

Progress reducing other non-CO_2 emissions

Other non-CO_2 emissions in the UK comprise emissions of methane from energy supply, nitrous oxide (N_2O) from industry, and fluorinated gases (F-gases). They accounted for 5% of all UK greenhouse gas (GHG) emissions in 2011. Emissions fell 2% in 2011 continuing the long term trend that has seen emissions fall 64% since 1990, due to:

- Falling N_2O emissions from industry due to abatement equipment being installed at plants
- Falling methane emissions due to the decline in coal production in the UK and reduced leakage from the gas supply network.

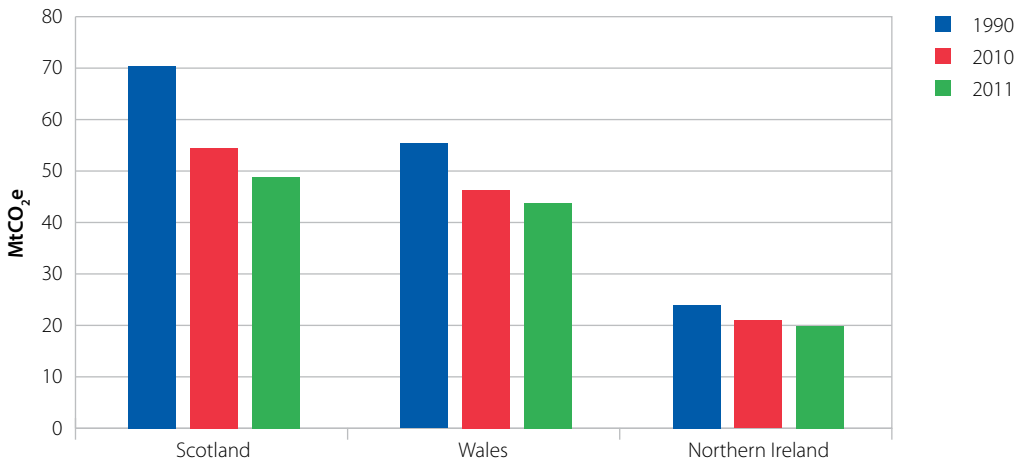
Emissions of these other non-CO_2 gases are projected to fall a further 50% by 2030 relative to 2011 levels. This primarily reflects expected reductions in energy supply and F-gas emissions, with emissions from industry expected to remain fairly flat:

- Energy supply emissions are projected to fall 45% due to further reductions in methane leakage and coal production
- Emissions of F-gases arise primarily from leakage during their use as coolants in air conditioning and refrigeration. Emissions are expected to fall 61% due to EC regulations that restrict their use in mobile air conditioning and other applications where low-GWP alternatives exist, and require reduced leakage rates across all uses.

In order to reduce F-gas emissions further the European Commission has proposed more stringent regulation which will phase down their supply to the market, with bans on their use in some applications. This proposal is expected to reduce F-gas emissions in the EU by around 70% in 2030 from today's levels.

However it should be noted that companies such as Coca-cola and Unilever have committed to the replacement of F-gases on a more ambitious timescale than the EC proposal (for example Coca-cola are committed to buying only HFC-free equipment by 2015). The US and China have also recently agreed a phase down in the use of HFCs. We therefore recommend that the Government should at a minimum fully support proposals from the EU to reduce emissions of F-gases by 70% in 2030, but should also consider pushing for a more ambitious agreement, for example, increasing the speed of phase out of some uses of these gases such that these emissions are zero or minimal by 2020.

Figure 13: GHG emissions Scotland, Wales and Northern Ireland (1990, 2010 and 2011))



Source: NAEI (2013).

10. Emissions in the devolved administrations

Greenhouse gas emission data for the devolved administrations continue to be published with a time lag compared to UK-wide data, with 2011 being the latest year for which data is currently available. In 2011, Scottish emissions fell faster than the UK average (by 9% compared to 7%), while emissions in Wales and Northern Ireland fell by 5% (Figure 13):

- Scottish emissions account for around 9% of the UK total. They fell by 10% in 2011, and were 31% lower than in 1990. The largest reduction in 2011 occurred in the energy supply sector[10] where emissions fell by 18% compared to 2010. This was due to a significant (27%) fall in coal-fired generation, combined with a large (43%) increase in renewable generation and a 10% increase in nuclear output. Residential sector emissions also fell by 21% in 2011. This can be attributed to the milder winter temperatures compared to 2010. Although Scotland missed its first annual emissions target and is likely to have missed its second target based on Scottish Government estimates, this is largely due to a combination of weather and revisions to the emissions inventory which have made achieving the targets more challenging. We note that Scottish emissions targets are more challenging than those of the UK to 2020, both because these have higher ambition, and because they include emissions from international aviation and shipping.
- Welsh emissions account for around 8% of the UK total. They were 5% lower in 2011 than 2010, and 21% lower than 1990. Emissions fell by 5% from 2010 to 2011, due mainly to the reduced energy demand during the warmer winter months. Reflecting this, residential emissions fell by 22%.
- Emissions in Northern Ireland account for around 4% of the UK total. They were 5% lower in 2011 than 2010 and 17% lower than in 1990. Residential sector emissions fell by 18% – slightly less than in Scotland and Wales but still significant, again reflecting a milder winter.

10 Around ¾ of emissions in energy supply are from the power sector.

As at the UK level, it is likely that emissions in the devolved administrations will have risen again in 2012 due to increased coal-fired generation and colder temperatures compared to 2011.

The devolved administrations continue to lead in the UK in some areas, for example:

- Scotland had 40% of the UK's renewable installed capacity in 2011, as well as a significant pipeline of potential capacity. The Scottish government has set an emissions intensity target for the power sector of 50gCO_2/kWh by 2030.
- All three devolved administrations have government-funded energy efficiency programmes targeted at fuel poor households, although fuel poverty levels remain high (particularly in Northern Ireland).
- Scotland and Wales have set themselves waste targets that go beyond the UK requirements under the EU Landfill Directive.
- Northern Ireland has sought views on the need for new climate change legislation, and recently introduced a charge on new plastic bags, which could have wider environmental benefits.

However, major challenges remain:

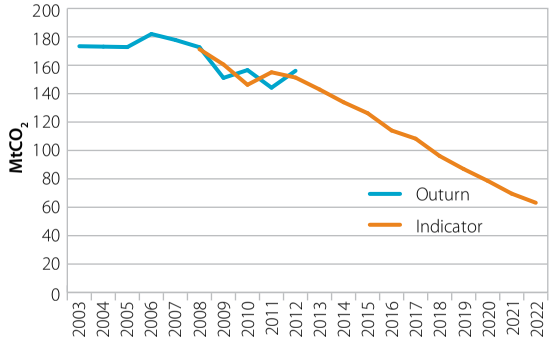
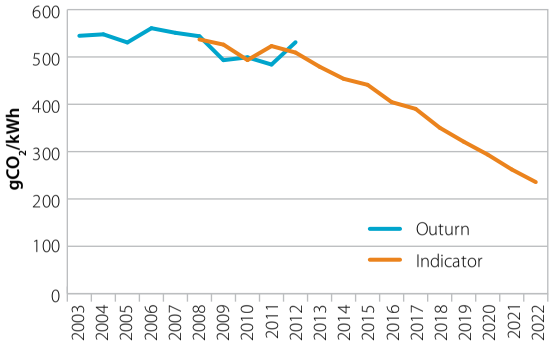
- Increasing the rate of renewable power capacity deployment, especially in Wales where deployment growth has been slower than in the rest of the UK.
- Increasing low-carbon heat penetration which remains low across the devolved administrations, even though they have particularly good opportunities with a higher than average number of off-gas grid properties.
- Encouraging a greater uptake of EVs, which currently have a low penetration across the whole of the UK.
- Increasing rates of woodland planting for which all three devolved administrations have ambitious targets, but for which only Scotland is currently on track.
- Reducing the very high rates of fuel poverty found in the devolved administrations and ensuring that low-carbon policies do not negatively impact on the most vulnerable households.

It is important to address these challenges so that the devolved administrations gain from the economic benefits, meet their own national emissions targets, and make an appropriate contribution to meeting the UK's carbon budgets.

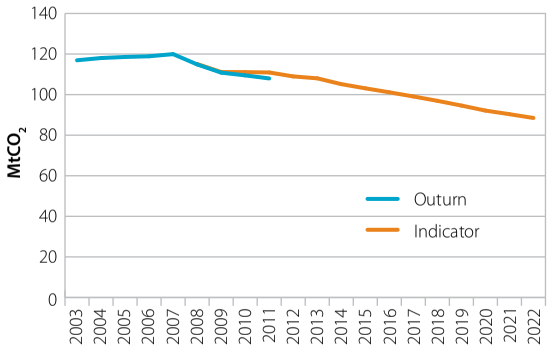
Summary of progress against indicators and future challenges

Economy-wide

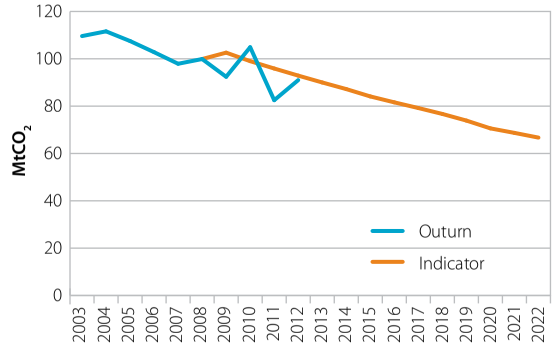
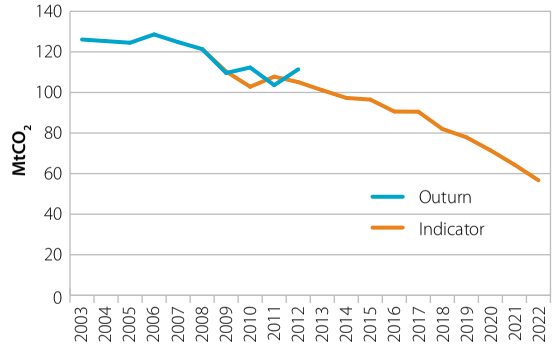
Increased emissions in 2012 largely reflect colder weather and a temporary switch from gas to coal in the power sector. Implementation of measures reduced emissions by around 1%. Implementation of measures was on track in some areas, however other areas continue to lag behind even the low ambition built into our indicators for the first budget period. Without a significant increase in the pace of emissions reduction, the costs and risks of moving to a low-carbon economy will be increased. There has been progress developing policies but a number of key policy challenges remain (e.g. around the design and implementation of flagship policies such as EMR and the Green Deal).

		Progress against indicators and milestones	Challenges
Power			
Emissions  **Emissions intensity**  	**Market**	Energy Bill introducing long-term contracts is progressing through Parliament.	Technical details need to be resolved and clarity needed for investors after 2020.
	Transmission	Revenue controls under RIIO were finalised by Ofgem (Dec 2012). There has been progress gaining planning approval and entering construction for some key investments. The review of charging system for transmission network is now finalised.	Still need planning approvals for some infrastructure, especially in Wales and Northern Scotland. Enduring regime for offshore transmission lines needs to begin implementation.
	Wind – planning	New planning applications continued onshore and reached record levels offshore. Average approval rate across the UK comparable to recent levels at 70% onshore, while offshore wind saw its first large-scale refusal. The average time taken for wind projects to be determined remains high (33 months), well above our indicator and guidance (12 months).	Slow determination rates could reduce competition for contracts under EMR and increase costs for consumers.
	Wind – installed capacity	Record levels added in 2012 both onshore and offshore. However, possible bottleneck for capacity progressing into construction for offshore wind.	Resolution of financial and non-financial uncertainties required in order to translate the strong project pipeline into generation. In particular, need to provide clarity over details in EMR.
	Nuclear	First reactor design (Areva's EPWR) received final approval under Generic Design Assessment (GDA) process (December 2012). Further design (Hitachi's ABWR) submitted for approval (January 2013). First new nuclear project (Hinkley C) received planning approval (March 2013) and entered negotiation for a contract under EMR.	Agreement of first contract will allow focus on other contracts to be signed under the first EMR Delivery Plan period.
	CCS	Second commercialisation programme has selected two projects to enter Front-End Engineering Design studies.	Momentum must be maintained so these two projects can become operational by 2018/19. Approach should be set out for further demonstration projects and longer-term commercialisation strategy.

Summary of progress against indicators and future challenges

		Progress against indicators and milestones	Challenges
Road transport			
Direct emissions  	**New car fuel efficiency**	Continued improvement n new car gCO_2/km, but more polarised purchase behaviour (fewer medium cars, more small and large ones).	Agreement of challenging longer term targets at EU level needed to ensure continued progress, potentially reinforced with use of fiscal levers if required.
	Reducing van emissions	Good progress on new van gCO_2/km, despite continued trend towards larger vans, as manufacturers respond to EU targets.	Agreement of challenging longer term targets at EU level needed to ensure continued progress, potentially reinforced with use of fiscal levers if required.
	Development of electric car market	Doubling of electric car sales as plug-in hybrid models became available. 9000 chargepoints installed as at March 2013. New funding package for further chargepoints announced in February 2013.	Uptake still low relative to indicator, and changes to tax incentives for company cars threaten progress. Stable framework of support needed (commitment to continuation of funding of Plug-in Car and Van Grants beyond 2015 and reinstatement of tax incentives for company cars).
	Increased use of biofuels	Fall in volumes supplied, due to amendments in the RTFO allowing double-counting of some feedstocks.	Agreement of robust EU framework for ILUC impacts needed as soon as possible.
	Smarter Choices	Local Sustainable Transport Fund fully allocated, with most successful projects including Smarter Choices measures.	Further funding required to support nationwide roll out by 2020.
	Eco-driving	Evidence of uptake in the freight sector but very low rates of training among car drivers.	Active promotion of eco-driving, through inclusion in the driving test, driver training, awareness raising and in-car information.
	Speed limiting	Violation of the speed limits on motorways by almost 50% of car drivers, resulting in increased emissions.	Consultation on increasing single carriageway speed limit for HGVs. Emissions impacts should be properly reflected in the final decision
	Land use/transport planning		Some elements of consultation on land use planning and the strategic road network could increase car trips and threaten carbon budgets.

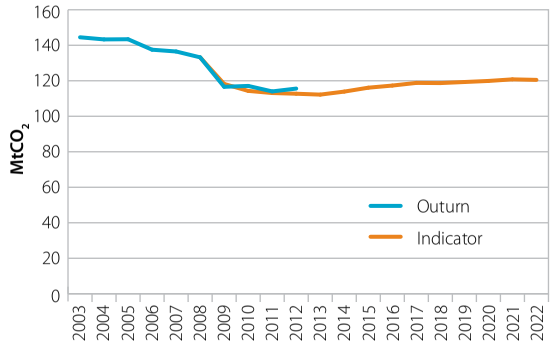
Summary of progress against indicators and future challenges

		Progress against indicators and milestones	Challenges
Buildings			
Direct emissions  **Indirect emissions**  	**Residential**	Delivery increased for cavity wall (+22%) and loft insulation (+45%) under the final year of CERT and CESP. Solid wall insulation rates increased fourfold but remains low (at 82,000).	Initial evidence from the operation of the Green Deal and ECO does not suggest that the delivery risks have subsided. Government should carry out an early review of the Green Deal and ECO and consider further incentives. Need to ensure measures are in place to adequately support fuel poor electrically heated households. ECO should continue to the point where all fuel poor households are covered.
		Currently on track for our indicator trajectories for loft insulation and boilers and off track for cavity wall and solid wall insulation.	
		Minimum energy efficiency standards for private rented properties to be introduced in 2018.	Standards need to be firmed up soon to ensure that landlords make relevant appropriate investment decisions.
	Non-residential	Green Deal for non-residential sector launched in 2013.	A comprehensive assessment of non-residential low-carbon policies is required to ensure they work effectively.
		CRC energy efficiency scheme weakened (e.g. by removing league table) further eroding the incentives to improve energy efficiency.	
		Minimum standards for rented premises proposed from 2018.	Standards need to be firmed up soon to ensure that landlords make relevant appropriate investment decisions.
		Public sector – good performance against the 2014-15 target for central Government to reduce emissions by 25%, with a 12% reduction in 2011/2 .	
	Renewable heat	Low-carbon heat deployment remains very low (<2%) and offtrack to reach the target of 12% penetration by 2020. RHI started for the non-residential sector in November 2011. Residential sector RHI has been delayed a further year until 2014, and the RHPP small grant scheme extended in the interim.	RHI funding must be committed beyond 2014/15, Green Deal finance allowed to pay for the up-front cost of low-carbon heat investment and approaches to address non-financial barriers introduced.

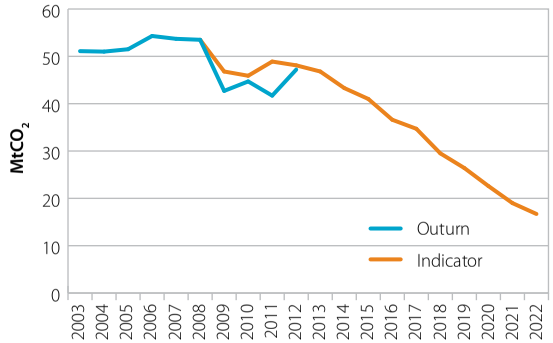
Summary of progress against indicators and future challenges

Industry

Direct emissions

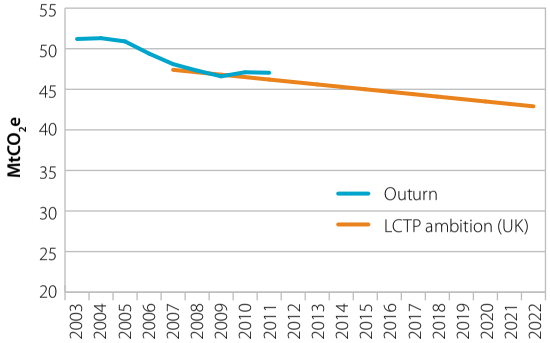


Indirect emissions

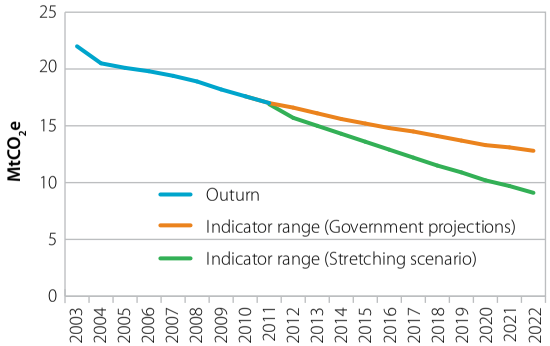
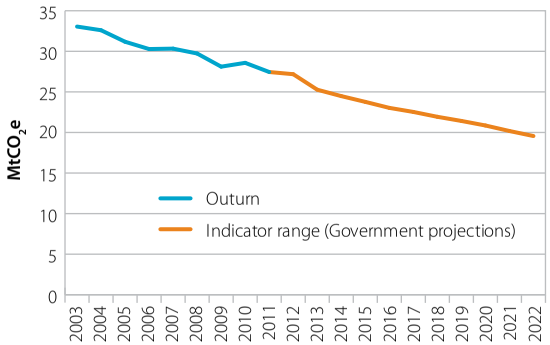


	Progress against indicators and milestones	Challenges
Energy intensity	No improvement in energy intensity of direct fuels (e.g. non-electricity) since 2007. Energy-intensive industry slightly improvement of 2%.	Significant barriers remain in industry, new policies are required to provide stronger incentives, particularly for investment in more expensive measures. Government should include the full range of cost-effective abatement options in the industry sector roadmaps currently being developed by DECC and BIS and align financial incentives for low-cost abatement
Renewable heat	Good progress, ahead of indicator trajectory.	Given that large biomass installations are likely to be a priority in future, Government should closely monitor uptake and set out an approach to large scale applications of biomass.
CCS	CCS in industry has not been funded under the current UK CCS competition and there has been a lack of progress internationally.	An approach to demonstration and commericalisation compatible with deployment in the 2020s is required.
Other milestones	New design of CCAs announced which reduce the scope of coverage to non-EUETS emissions only, and does not address barriers to uptake.	The Governments forthcoming industry roadmaps provides an opportunity to set out how gaps in the current policy framework can be filled.

Summary of progress against indicators and future challenges

		Progress against indicators and milestones	Challenges
Agriculture			
GHG emissions  	**Agriculture**	Phase 2 of the GHG Industry Action Plan on-going: • Roll-out of industry information hub 2013-2014 • Establish baseline farming practice and framework to monitor progress	Roll-out is dependent on satisfactory testing of the Hub by external advisors. This is required to assess the effectiveness of the GHG Action Plan in delivering the level of emissions reduction required to meet carbon budgets.
		On-going monitoring of voluntary approach: • Bring forward 2016 Review if progress off-track • Review should consider policy options for intervention	The 2012 GHG Review decided not to set triggers nor consider policy options. Therefore, we recommend that the scope of any future review should be widened to also consider a range of policy options, including continuing with the current voluntary approach and policies which would provide stronger incentives for farmers.
		Development of smart inventory	Projects are on-going and the revised inventory is on schedule for roll-out in 2015

Summary of progress against indicators and future challenges

		Progress against indicators and milestones	Challenges
Waste and other non-CO2			
Waste GHG emissions 	**Waste**	Emissions fell 3% in 2011 driven by historic reductions in the amount of biodegradable waste landfilled in line with our indicators. Key corporate voluntary responsibility deals to reduce waste/increase recycling were launched in 2012 (Courtauld Commitment Phase 3 and the Hospitality and Food Service Agreement); other existing deals continue to deliver against objectives. The number of AD plants handling municipal waste increased from 48 to 66, with an estimated capacity of handling 4 million tonnes.	Further reductions could be supported through stronger levers, particularly targeting household food waste; households can be further encouraged to reduce waste and increase recycling and local authorities can increase provision of separate food waste collection services, which can unlock potential for producing energy through anaerobic digestion. Landfill bans for specific waste materials should be considered on a case-by-case basis
Other non-CO_2 GHG emissions 	**Other non-CO_2**	The EC proposal to update the F-gas regulation by introducing a phase-down in F-gases represents a step forward in reducing future emissions of F-gases within the EU.	The proposed phase-down must be stretching enough to ensure that the chance to significantly reduce emissions of these gases, which have long atmospheric lifetimes and which already have market ready alternatives, is not missed.

Introduction and key messages
1. Economy-wide emissions trends and drivers
2. Non-traded sector emissions
3. Traded sector emissions
4. Government policy and strategy
5. Devolved administrations

Chapter 1: Overview

Introduction and key messages

In our previous progress reports, we showed that UK greenhouse gas emissions rose by 3% in 2010 as cold winter temperatures drove up energy demand, and then fell by 7% in 2011, in the context of warmer winter temperatures, low economic growth and rising fuel prices.

In this chapter we provide a high-level overview of emissions trends in 2012; we adjust emissions figures to allow for colder winter temperatures; we consider whether underlying progress is sufficient to meet carbon budgets; and we summarise key challenges in developing and implementing new policies. We first present analysis for the economy as a whole, then disaggregate to non-traded and traded sector emissions, and within this to specific sectors. Our key messages are:

- **Economy-wide emissions** increased by 3.5% to 570 $MtCO_2e$ in 2012, in the context of low economic growth and high oil and gas prices, but also cold winter temperatures and a gas-to-coal switch in the power sector driven by low coal prices. Without the cold winter temperatures the increase in greenhouse gas emissions would have been around 2%, and without the gas-to-coal switch greenhouse gas emissions would have decreased by 1-1.5%. Despite 2012 emissions remaining below the level of the first carbon budget (which was set before the full impact of the recession had occurred), such a rate of underlying progress would be insufficient to meet the third and fourth carbon budgets, which will require annual emissions reductions of around 3%.
- **Non-traded sector emissions** rose by 2.7% in 2012 to 339 $MtCO_2e$. Without the temporary impacts of the cold winter temperatures, emissions would have been broadly flat. Against a relatively low level of ambition, progress in delivering measures to reduce emissions was mixed, with good progress in insulation of lofts and cavity walls, and emissions intensity of new cars, but very limited progress in solid wall insulation, low-carbon heat and energy efficiency improvement in commercial and industrial sectors.
- **Traded sector emissions** increased 5% to 231 $MtCO_2e$, driven mainly by an increase in emissions from power, but remained 47 $MtCO_2e$ below the traded sector cap across the budget period. Emissions intensity of generation rose by 10% due to increased use of coal-fired generation in place of gas. The increase in emissions intensity of generation was partly mitigated by an increased share of renewable generation, from 9% in 2011 to 11% in 2012, reflecting good progress in adding new wind capacity. Without the gas-to-coal switch, emissions intensity would have fallen 2% due to the increased renewable generation.
- **Policy challenges.** There are major challenges relating to design and implementation of the Electricity Market Reform and the Green Deal. New policies are required to support uptake of low-carbon heat in the residential sector. Stronger incentives are required for uptake of measures in the commercial and industrial sectors.

- **Banking outperformance.** Given the importance of delivering measures to meet future carbon budgets, outperformance of the current budget due to the recession should not be carried forward to future budgets.

We set out our analysis in five sections:

1. Economy-wide emissions trends and drivers

2. Non-traded sector emissions

3. Traded sector emissions

4. Government policy and strategy

5. Devolved administrations

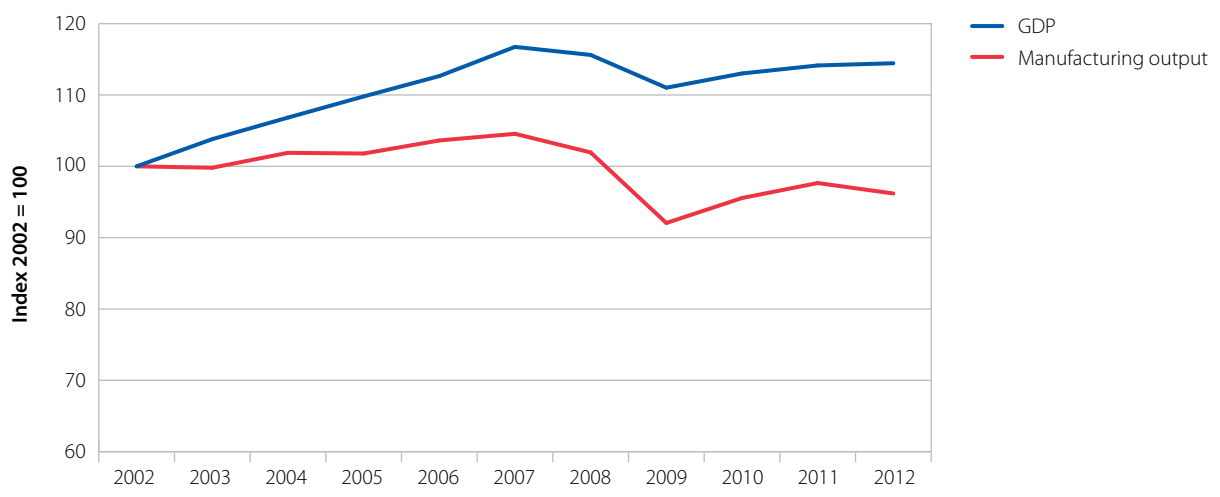
1. Economy-wide emissions trends and drivers

Our focus in this chapter is on emissions currently covered by carbon budgets. These are UK emissions of the six greenhouse gases in the Kyoto basket from all sectors of the economy except international aviation and shipping. Although not currently included in carbon budgets, international aviation and shipping emissions are important, and we consider them in Chapter 5.

The context for 2012 emissions is one of limited GDP growth, increasing energy prices, and colder winter months than 2011.

- **GDP.** Growth remained below the long-term trend at 0.3% (in real terms) in 2012, following growth in 2011 of 0.7% (Figure 1.1); within this, manufacturing output fell by 1.5%.

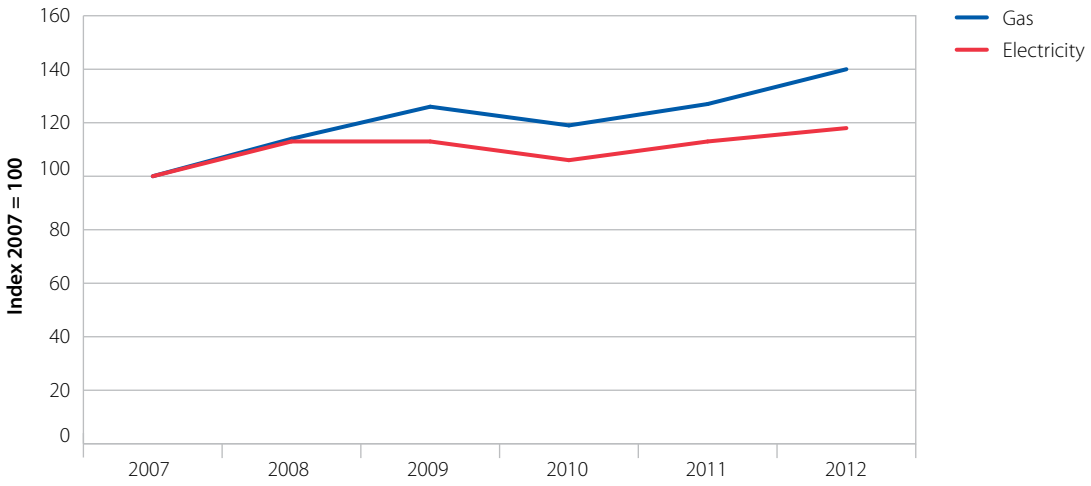
Figure 1.1: UK economic indicators (2002-2012)



Source: ONS (March 2013) *Quarterly National Accounts.*

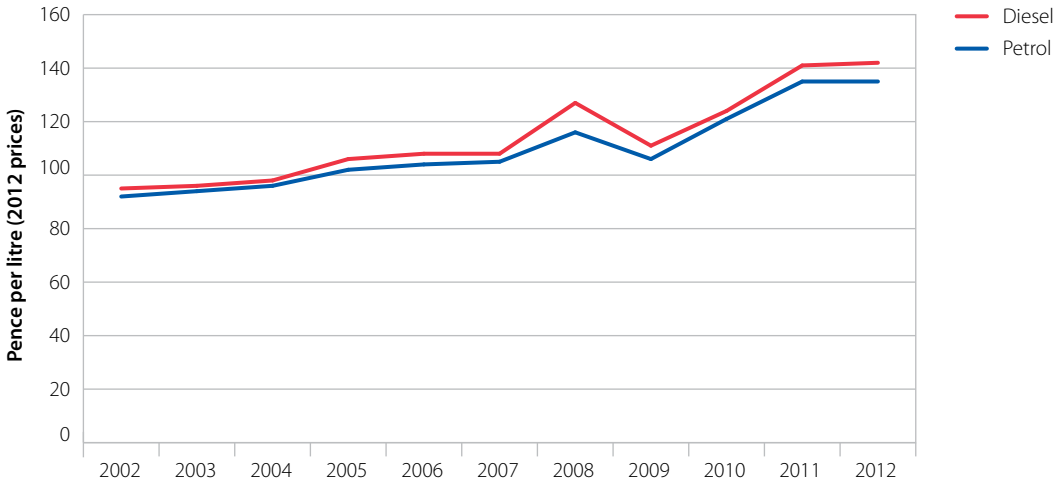
- **Prices.** Wholesale gas price increases in 2012 resulted in a 10% increase in residential gas prices, and a 4% increase in residential electricity prices, in real terms (Figure 1.2). In the transport sector, petrol prices rose by 0.2% and diesel prices rose by 0.8%, in real terms – see Figure 1.3[1].

Figure 1.2: Residential fuel prices in the UK (2007-2012)



Source: DECC (March 2013) *Quarterly Energy Trends.*

Figure 1.3: Road fuel prices in the UK (2002-2012)

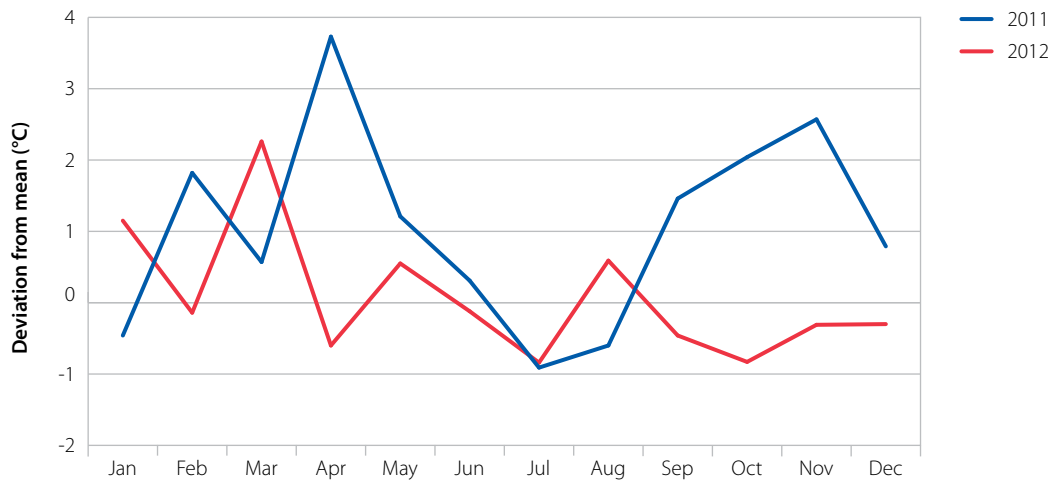


Source: DECC (March 2013) *Quarterly Energy Trends.*

1 Prices are expressed in real terms. DECC convert nominal gas and electricity prices to real prices using the Treasury's GDP deflator series. In order to maintain consistency with DECC's approach, we convert nominal petrol and diesel prices to real prices using the same GDP deflator. However, we note that for 2012, the GDP deflator implies an inflation rate of 1.4%, considerably below the rates of around 3% implied by the consumer price index (CPI) and retail price index (RPI).

- **Temperature.** The winter months in 2012 (i.e. January, February and December) were around 0.5°C colder than those in the previous year and there were 20% more heating degree days (HDDs)[2] over the year (Figure 1.4), leading to increased heating demand.

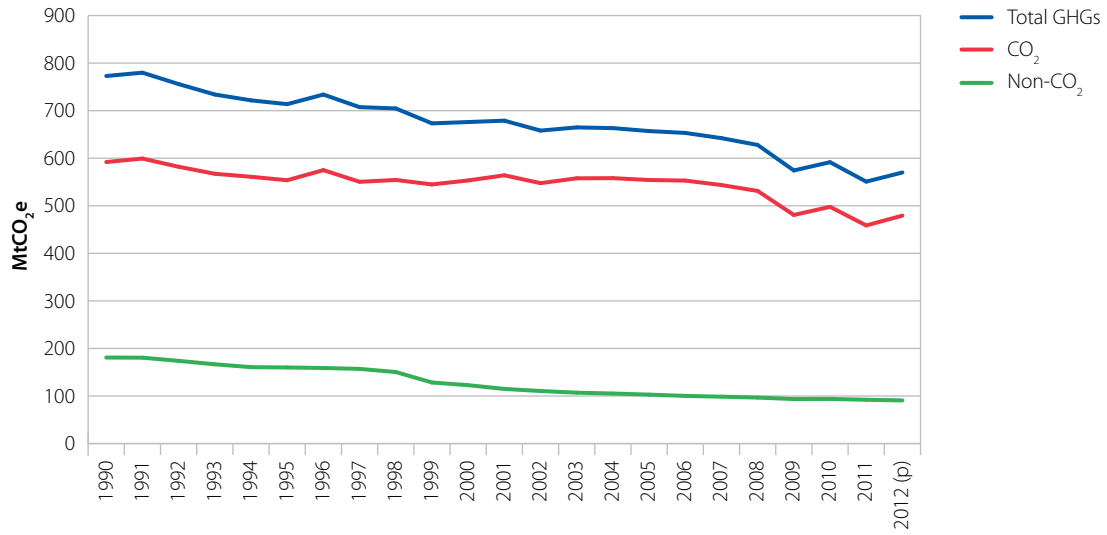
Figure 1.4: Average temperature deviation from the long term mean (2011-2012)



Source: DECC (March 2013) *Energy Trends*.

Within this context, UK greenhouse gas emissions rose from 551 $MtCO_2e$ in 2011 to 570 $MtCO_2e$ in 2012, a 3.5% increase (Figure 1.5). This reflected increased CO_2 emissions in all sectors, particularly in the residential sector (due to increased heating) and power sector (due to fuel switching).

Figure 1.5: UK greenhouse gas emissions (1990-2012)

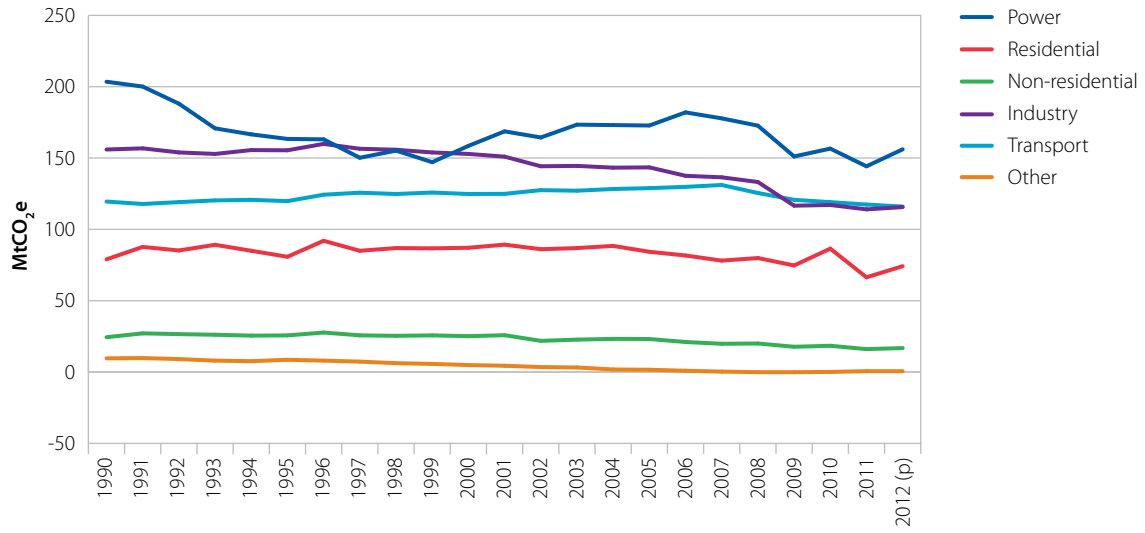


Source: DECC (2013) 2012 UK Greenhouse gas emissions, provisional figures.

2 A Heating Degree Day (HDD) is defined as a decrease of one degree centigrade in the average temperature, below a baseline temperature of 15.5°C (below which a building typically needs heating) on a given day. For example, an average outside temperature of 10.5°C over two days would result in 10 HDDs.

- CO_2 emissions accounted for 84% of total UK greenhouse gas emissions in 2012. They increased by 4.5% in 2012 to 479 $MtCO_2$, reflecting increased emissions from power generation, buildings and industry (Figure 1.6):

Figure 1.6: UK CO_2 emissions by sector (1990-2012)

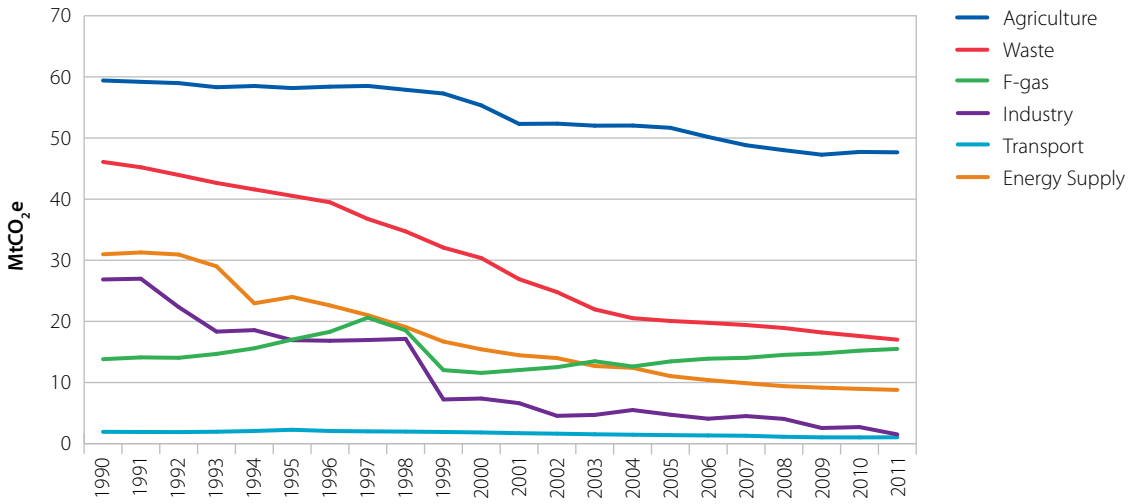


Source: DECC (2013) 2012 UK Greenhouse gas emissions, provisional figures.

  - Emissions from power generation, which account for 33% of CO_2 emissions, increased by 8% to 156 $MtCO_2$. This was due to an increase in coal use in power generation, from 30% of generation in 2011 to 39% in 2012, and a decrease in natural gas use, from 40% of generation in 2011 to 27% in 2012. The increase in emissions would have been even larger without the increased share of renewable generation, which rose from 9% in 2011 to 11% in 2012.
  - Direct emissions in buildings (e.g. from burning of fossil fuels for heat), which account for 19% of total CO_2 emissions, rose by 10% in 2012 to 91 $MtCO_2$. In particular, direct emissions from residential buildings rose by 12% to 74 $MtCO_2$, largely driven by an increase in heating demand due to lower winter temperatures. This reflected a 14% rise in average gas demand per household, such that residential gas bills rose by 26%, while residential electricity bills were 5% higher (Box 1.1).
  - Direct emissions from industry, which account for 24% of total CO_2 emissions, rose by around 1.4% in 2012 to 116 $MtCO_2$. Although total output fell in 2012, the impact of this in reducing emissions was more than offset by the reopening of the carbon-intensive Teesside plant in the iron and steel sector, and increasing gas consumption possibly related to lower temperatures.
  - Transport emissions, which account for 24% of total CO_2 emissions, fell by 1.2% in 2012 to 116 $MtCO_2$. Data on surface transport, and on the individual road transport modes, will not be released until early 2014.

- Non-CO_2 emissions account for 16% of total UK greenhouse gas emissions and largely comprise emissions from agriculture and waste. Provisional emissions statistics for 2012 assume non-CO_2 emissions continue long-term trends and decrease 1.5% to 91 $MtCO_2e$ (Figure 1.7). Actual estimates for 2012 non-CO_2 emissions will not be available until February 2014.

Figure 1.7: UK non-CO_2 emissions by sector (1990-2011)



Source: NAEI (2013) *Final emissions estimates*

Box 1.1: Fuel bills in 2012

2012 saw rising energy prices and a particularly cold winter, increasing demand for gas in the residential sector:

- **Prices.** In 2012 average domestic gas and electricity prices increased by 11% and 6% respectively (not adjusting for general inflation)[3]. Both these price rises were driven by:
  - an increase in the wholesale price of gas (which increased from 56 p/therm in 2011 to 60 p/therm in 2012)[4]; and
  - a small increase in support for development of low-carbon technologies and other energy policies[5].
- **Consumption.** At the same time, gas consumption increased by 14% and electricity consumption remained broadly constant.

As a result, the average annual gas bill increased by 26% to £637 and the electricity bill for those on standard tariff[6] increased by 5% to £422[7]. This compares to general inflation of around 3%[8].

Adjusting for the impact of the colder temperatures in the winter months (Box 1.2), the increase in greenhouse gas emissions would have been around 2%. Adjusting again for the impact of the temporary switch from gas to coal in the power sector, greenhouse gas emissions would have decreased by 1-1.5%.

This limited underlying reduction in 2012, a year characterised by low GDP growth and high energy prices, suggests it will be a major challenge to achieve the 3% reduction in GHG emissions per year required to meet the third and fourth carbon budgets, particularly as the economy recovers and if fuel prices do not continue to increase at the rates in 2012. We consider in more detail whether the UK is on track to meet future carbon budgets, and highlight specific challenges that may arise, with a detailed assessment of underlying progress in the rest of this chapter and throughout this report.

Box 1.2: The impact of temperature on energy demand and the Committee's approach to temperature adjusting

As noted in our previous progress reports, temperature can have a significant impact on energy consumption and therefore emissions. Winter temperatures in particular can affect demand for heating fuels (summer temperatures currently have a much smaller effect given that energy demand for cooling remains significantly lower than demand for heating in the UK).

The winter months of 2012 (January, February and December) were colder than those of 2011, resulting in higher emissions, particularly in the residential sector. We have used DECC estimates of the 'temperature-adjusted' change in energy consumption from 2011 to 2012, which can be interpreted as how energy consumption would have changed without the decrease in winter temperatures. We have then applied our own estimates of emissions intensity in 2012 to calculate the effect on emissions. This allows us better to assess underlying progress, abstracting from year-to-year variations in temperatures, which is useful in assessing future prospects for emissions.

Total CO_2 emissions in 2012 rose by 4.5%, but adjusting for temperature they would have risen 2.4%. The adjustment is primarily in energy use for heating buildings, with the largest impact in the residential sector.

DECC release their own estimates of temperature-adjusted emissions which suggest a larger impact, such that after adjusting for temperature total emissions in 2012 would have remained flat. DECC's methodology adjusts emissions directly (as opposed to energy consumption) and as such, may capture second-order impacts such as fuel switching. Our approach is to identify the impact of fuel switching separately and we therefore continue to temperature-adjust energy consumption rather than emissions.

2. Non-traded sector emissions

Non-traded sector emissions are those outside of the European Union Emissions Trading System (EU ETS) and include direct emissions from use of fossil fuels in buildings, non-energy intensive industry (primarily for heat) and transport, as well as almost all non-CO_2 emissions (e.g. from agriculture and waste). Non-traded sector emissions accounted for 59% of total UK greenhouse gas emissions in 2012.

Non-traded sector emissions rose by 2.7% in 2012 to 339 $MtCO_2e$. This increase was driven by an increase in emissions from buildings, due to increased heating demand in response to colder winter temperatures. Without the temporary impacts of the cold winter temperatures, emissions would have risen only 0.2%.

The slight increase in temperature-adjusted emissions in 2012 – particularly in the context of limited GDP growth and high energy and fuel prices – suggests there has been little, if any, underlying progress in the implementation of measures to reduce emissions (i.e. investments in energy-saving technologies, increased use of low-carbon technologies, etc). We now consider this further.

Underlying progress in the non-traded sectors

Our indicator framework for monitoring progress against carbon budgets includes not only emissions, but also implementation of measures to reduce emissions. In doing so, it provides an early signal of future emissions, to enable appropriate policy responses. The framework sets out trajectories for delivery based on our 'Extended Ambition' scenario, which is set out in our first (October 2009) progress report to Parliament and which we previously have shown to be broadly consistent with Government ambition.

Against this framework, there has been progress in some areas but with other areas falling behind:

- **Buildings.** In buildings, there was continued progress on boiler replacement with mixed progress on insulation measures.
  - Boiler replacement continued at a steady pace, with 1.3 million efficient boilers installed in 2012, up 2% from 2011 levels.
  - Uptake of loft insulation was above our indicator trajectory in 2012 when including DIY figures, reflecting the success of the CERT (Carbon Emissions Reduction Target) policy. However, it will be difficult to maintain these rates in future under the Green Deal and Energy Company Obligation (ECO) – see section 4.
  - Uptake of cavity wall insulation remained below our indicator trajectory in 2012.
  - Levels of solid wall insulation continued to be well below our indicator trajectory, despite increased rates of uptake in 2012 compared to 2011.
- **Heat.** Uptake of low-carbon heat across the range of technologies was very low, albeit broadly in line with expectations in 2010 and 2011.
- **Transport.** In road transport, emissions intensity of new cars outperformed our indicator for a fourth year, with some progress achieved in laying the foundations for electric vehicle market development, but limited progress on measures to encourage travel behaviour change.
  - New car emissions intensity fell by 3.6% in 2012, to 133 gCO_2/km – well ahead of our trajectory level of 146 gCO_2/km.
  - Following the launch of new electric car models and the plug-in car grant in 2011, around 2,250 electric cars were registered in 2012, more than double the volume in 2011. Although below levels assumed in our indicator trajectory, this is important progress in early market development.
  - Biofuels penetration decreased from 3.5% (by volume) in 2011 to 3.1% in 2012, as the Renewable Transport Fuel Obligation (RTFO) was amended to reduce the share of biofuels required by allowing biofuels produced from wastes, non-agricultural residues and second generation biofuels to be counted twice in meeting the RTFO target.

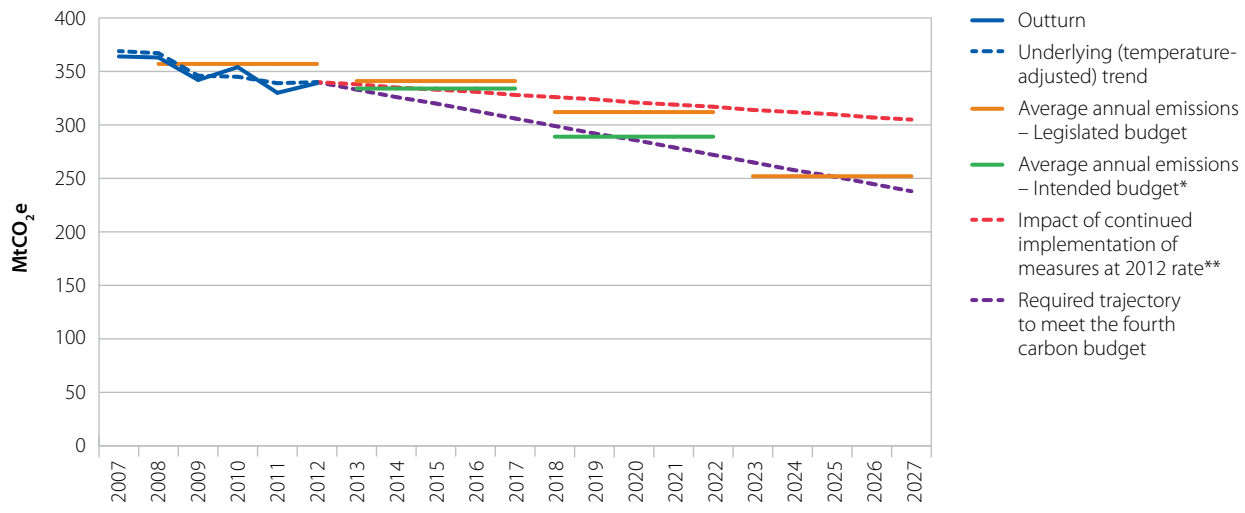
– Funding for the Local Sustainable Transport Fund was increased from £560 million to £600 million in 2012. The Fund is now fully committed, supporting 96 projects in 77 Local Authorities across England between 2011-2015. With local authority match funding, over £1 billion is now being invested in local sustainable travel. Almost all successful projects include Smarter Choices measures (workplace and school travel plans, public transport information and marketing, etc.).

– The number of car drivers trained in eco-driving fell from around 8,000 in 2011 to around 7,000 in 2012, well below the 300,000 assumed in our indicator trajectory.

The UK has met the first carbon budget and it is likely that we will meet the second. However, we are not currently on track to meet the third and fourth carbon budgets, for which a significant increase in the pace of emissions reduction is required (Figure 1.8). Achieving this will be challenging. Whilst there was good progress in 2012 in insulating lofts and cavity walls in residential buildings, and improving the efficiency of new cars, there are risks to sustaining that progress, particularly for insulation measures. In other areas, notably low-carbon heat, solid walls and energy efficiency improvement in commercial and industrial sectors, the challenge will be to ramp up progress. Development and implementation of new policies will be required to drive this acceleration; this is discussed in more detail in Chapters 2-7.

Despite the slow rate of implementation of measures in 2012, emissions in the first carbon budget period (2008-2012) were lower than the level of the budget; we now turn to the issue of outperformance.

Figure 1.8: Non-traded sector emissions based on continued implementation of measures at 2012 rate (2007-2027)



Source: NAEI (2013); DECC (2013) *2012 UK Greenhouse gas emissions, provisional figures*; European Commission (2013) *Verified Emissions for 2008-2009-2010-2011-2012 and allocations 2008-2009-2010-2011-2012*; DECC (2012) *Updated Emissions Projections*; CCC calculations.
Notes: *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. **Based on the Baseline scenario from DECC (2012) UEP, net of estimated savings ensuing from continued uptake of measures at the rates seen in 2012, until 2027 or until full potential is realised (e.g. all lofts have been insulated), whichever is sooner. Trajectory has been smoothed.

Outperformance of the first carbon budget

Total non-traded sector emissions were around 1,728 $MtCO_2e$ across the first carbon budget period (2008-2012). Net traded sector emissions (i.e. the UK's share of the EU ETS cap) were 1,233 Mt across the first carbon budget period. The UK net carbon account was therefore 2,961 Mt, indicating that the UK outperformed the first carbon budget (total 3,018 Mt) by around 57 Mt (2% of the total carbon budget, and 3% of the non-traded sector's share of the carbon budget) (Figure 1.9).

The Climate Change Act allows the UK to carry forward outperformance of a carbon budget to the next budgetary period, subject to advice from the Committee. There is a question over whether this outperformance should be carried forward to the next budgetary period. We have previously argued that outperformance should only be carried forward where it is due to implementation of policy to reduce GHG emissions.

Our analysis of underlying progress in the non-traded sectors does not suggest that this outperformance is due to implementation of policy to reduce GHG emissions. This outperformance should be seen in the context of the 9% reduction in GHG emissions during the recession in 2009. Therefore, there is no rationale to carry this outperformance forward to the next budgetary period, and to do so would risk reducing incentives to reduce emissions in future carbon budget periods. We will issue formal advice on carrying forward outperformance in early 2014 when final emissions statistics for 2012 are released.[3]

Figure 1.9: Non-traded sector emissions vs. carbon budgets (2007-2027)

Source: DECC (2013) 2012 UK Greenhouse gas emissions, provisional figures; DECC (March 2013) *Energy Trends*; CCC calculations.
Notes: *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.

3 2012 emissions data discussed in this report are provisional.

3. Traded sector emissions

Traded sector emissions in the UK

Our focus in this section is on emissions covered by both the EU ETS and carbon budgets. These include emissions from power generation and energy-intensive industries (e.g. refineries, production of cement, iron and steel), emissions from domestic aviation (but currently not international aviation) and non-CO_2 emissions from nitric and adipic acid and aluminium production. Traded sector emissions accounted for 41% of total UK greenhouse gas emissions in 2012.

Under the Climate Change Act, traded sector emissions are accounted for on a net basis (i.e. net of sales/purchases of allowances in the EU ETS or offset credits). Therefore, the net carbon account and the level of compliance with the carbon budget is not affected by the level of gross traded sector emissions (i.e. actual emissions, before any trading of allowances/credits).

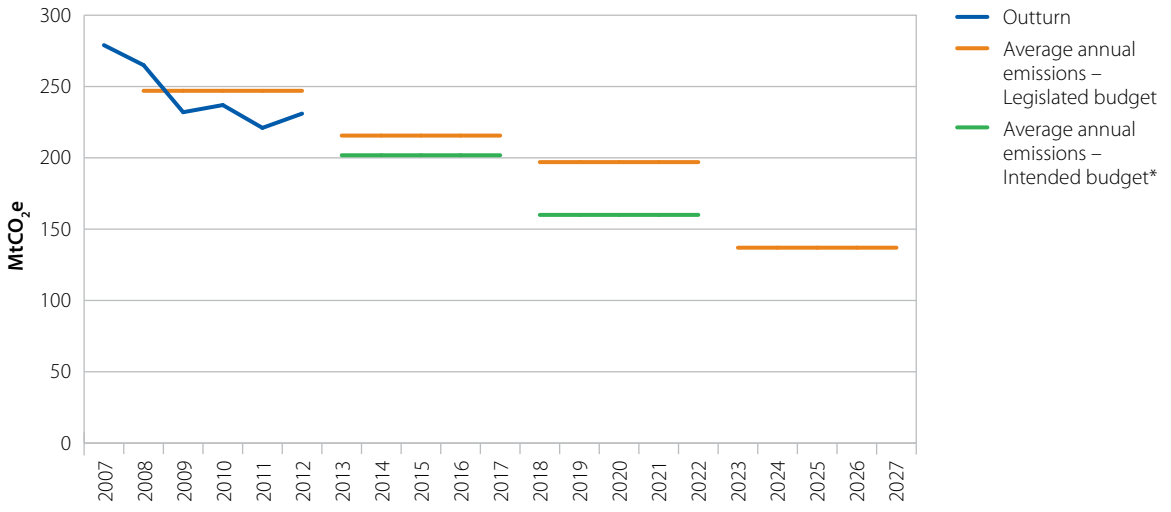
However, the importance of power sector decarbonisation for the economy-wide decarbonisation strategy means it is important to reduce gross (rather than only net) traded sector emissions. For example, in our previous work (e.g. our recent advice, *Next steps on Electricity Market Reform*) and again in this report (Chapter 2), we have suggested that an appropriate aim is largely to decarbonise the UK power sector over the next two decades (e.g. to around 50 gCO_2/kWh in 2030).

Gross traded sector emissions rose by 5% in 2012 to 231 $MtCO_2e$, driven mainly by an increase in emissions from power generation, but remained below the traded sector cap (Figure 1.10).

- Power sector emissions rose by 8% to 156 $MtCO_2$ driven by increased emissions intensity of generation:
  - Emissions intensity of generation rose by 10%, to 531 gCO_2/kWh, due to increased use of coal-fired generation in place of gas (because of low coal and carbon prices and high gas prices; see Chapter 2 for more details). Without the gas-to-coal switch, emissions intensity would have fallen 2% from 2011 to 472 gCO_2/kWh due to increased renewable generation.
  - Power sector emissions are now above our indicator trajectory of 151 $MtCO_2$, although without the coal to gas switch, emissions would have fallen 4% to 138 Mt and would therefore have been below the indicator trajectory.
  - The increase in emissions intensity of generation was mitigated by an increased share of renewable generation from 9% in 2011 to 11% in 2012, along with increased imports of electricity from 1.8% to 3.4% of total generation. Total electricity consumption was broadly unchanged in 2012, with increased use in buildings offset by a fall in use in industry.
- Industry traded sector emissions fell by 4% in 2012[4].

4 CITL data for 2011 and 2012.

Figure 1.10: Traded sector emissions vs. carbon budgets (2007-2027)



Source: European Commission (2013) Verified emissions data for 2012.
Notes: *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.

As discussed in Chapter 2, our assessment is that it is unlikely that the increase in coal burn will be sustained in the medium to long term, due to the age of existing plants, existing environmental legislation and the UK's carbon price floor. Under current policy it is likely that these factors will drive a shift from coal to gas over the near-term, reducing power sector emissions at low cost.

Over the first carbon budget period, gross traded sector emissions were 1,186 $MtCO_2e$, below the UK's cumulative ETS cap of 1,233 Mt for the period 2008-2012. This implies that the UK's ETS cap was loose over this period, so that the spare allowances to emit 47 $MtCO_2e$ could be either sold or used to meet the traded sector cap in future years. As for the non-traded sector, it is important to track not just current emissions but indicators of future emissions in the traded sector, particularly given long asset lifetimes. This is our focus in Chapter 2, where we consider progress in deploying new low-carbon capacity – renewables, nuclear and thermal plant fitted with carbon capture and storage technology (CCS).

EU ETS emissions and carbon prices

EU ETS emissions trends

UK traded sector emissions will in part be driven by the carbon price within the EU ETS. As the carbon price is determined by the level of effort required to limit gross EU traded sector emissions to the level of the EU ETS cap, these emissions are highly relevant for the UK.

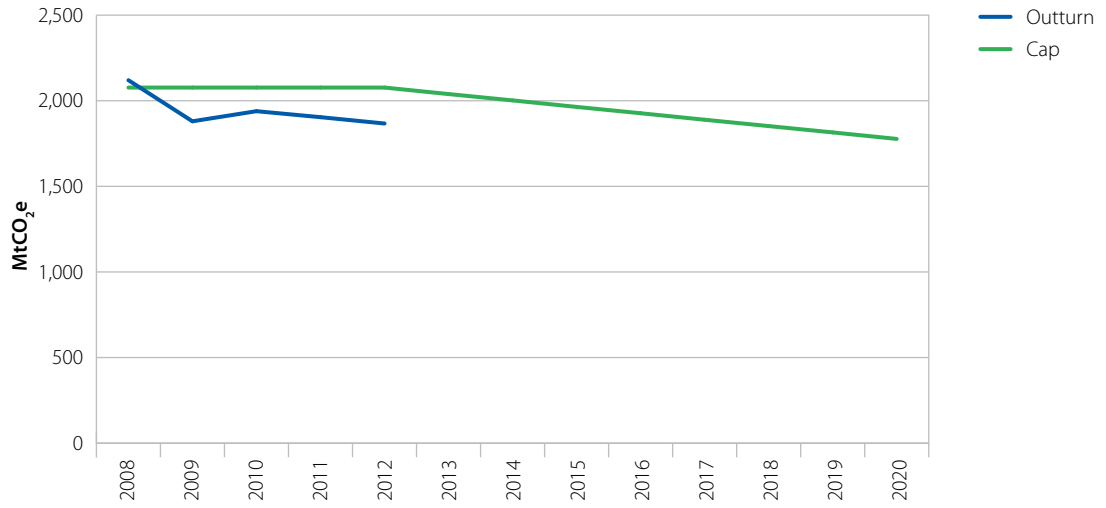
Gross EU traded sector emissions fell by 2% in 2012, continuing long-term trends.

- Key drivers of this decrease were lower emissions from Finland, Belgium, Italy, France and Spain. These decreases occurred in countries which had flat or negative GDP growth, however there was also increased renewable generation and decreased fossil fuel combustion.
- Offsetting these decreases were increased emissions from Germany and the UK due to increased coal-fired generation. As in the UK, increased coal use in Germany reflects low coal and carbon prices, and high gas prices, as well as reduced nuclear power.

Emissions remained below the EU ETS cap in 2012, largely reflecting the significant fall in 2009 as a result of the global economic downturn. In total over the whole of Phase II (2008-12), EU traded sector emissions were around 500 $MtCO_2e$ below the level of the cap. The unused allowances can be banked and will be available to meet the ETS cap in future years.

Current emissions are below the level of the Phase III (2013-20) cap out to around 2017, with the prospect that outperformance of the cap in the early years could mean that the entire cap could be met without any further reduction in emissions (given scope to bank outperformance towards meeting the cap in future years) – see Figure 1.11.

Figure 1.11: Emissions within the EU ETS versus cap (2008-2020)



Source: European Commission (2013) *Verified emissions data for 2012*; European Commission (2010) *Commission Decision 2010/364/EU.*
Notes: Excludes International Aviation

Figure 1.12: Carbon price in the EU ETS

Source: Point Carbon.

Carbon price trends

The low level of emissions in the EU ETS has seen the carbon price fall to very low levels (Figure 1.12), further compounded in 2013 by lack of an EU agreement on a temporary strategy to reduce the supply of emissions permits:

- The carbon price during 2012 was, on average, around €7/tCO_2 compared to €13/tCO_2 in 2011, with a peak of €9/tCO_2 in February and a minimum price of €4.5/tCO_2 in March.
- In the early months of 2013 the European Parliament voted against 'backloading' 900 million emissions allowances (i.e. removing them from auctions over the first half of Phase III before re-introducing them in the second half). In response the carbon price has fallen further with lows around €3/tCO_2.

Given the headroom in the cap, the carbon price is likely to remain low under the current scheme design, even if backloading were to go ahead. In fact, with projected emissions below the cap, it is likely that the price would be even lower (possibly zero) if there were not some uncertainty as to whether the cap might be tightened (either for the current Phase, or beyond 2020).

Only with structural reform of the EU ETS could we expect to see a significant increase in the price of EUAs. Structural reform is important to restore the credibility of the EU ETS, a key pillar of the current policy framework and a potentially important part of the 2030 package, to provide a clear signal for investment, and (from the UK perspective) to close the gap between the UK and EU electricity prices. It would also be desirable in emissions terms, given that fuel switching away from coal within existing capacity is a relatively low cost option for reducing emissions.

Structural reform of the EU ETS and proposed 2030 package

The European Commission has moved forward in implementing structural reform for Phase III and is running a consultation on how it can best be achieved. The current discussion includes six options for reform:

1. Raising the 2020 emission target from 20% to 30% below 1990 levels;
2. Retiring a number of allowances permanently;
3. Revising the 1.74% annual reduction in allowances to 2020;
4. Bringing more sectors into the EU ETS;
5. Limiting access to international credits;
6. Introducing 'discretionary price management mechanisms' such as a price floor.

The EC is also currently consulting on a range of issues relating to development of climate and energy targets for 2030, and intends to develop more concrete proposals for a 2030 framework by the end of 2013. The March 2013 Green Paper, 'A 2030 framework for climate and energy policies', which launched this consultation, states that the 2030 framework should take into account the longer-term perspective laid out in the 2011 Roadmap for moving to a competitive low-carbon economy in 2050.

The Roadmap identifies a cost-effective reduction in gross EU-wide emissions of 40% on 1990 levels by 2030 (on the path to an 80-95% reduction by 2050).

A framework consistent with the ambition of the roadmap could strengthen the carbon price, put the EU on a cost-effective path to meeting its target to reduce emissions by at least 80% in 2050 on 1990 levels, and make a positive contribution towards agreement on a global deal to reduce emissions.

In May 2013 the UK Government announced that it will support a 2030 target to reduce EU emissions by 40%, rising to 50% through the purchase of credits in the context of a global deal, and depending on ambition committed by other countries.

This is broadly in line with the ambition (55% reduction including the purchase of credits) we suggested in our 2010 advice on the fourth carbon budget, based on a high-level analysis.

We therefore strongly support the UK Government position. We will consider consistency of UK carbon budgets with the EU targets further in the context of the Review of the Fourth Carbon Budget to be published later this year.

4. Government policy and strategy

Recent policy developments

In order to achieve the significant ramp-up in ambition in our indicator framework over the second and third budget periods, and to prepare for meeting the fourth budget, new policies are required to overcome barriers and drive uptake.

Government has recently made a number of key policy announcements (on the Levy Control Framework, Carbon Capture and Storage commercialisation, the Green Deal and the Energy Company Obligation, and Climate Change Agreements).

- **Levy Control Framework.** The Levy Control Framework sets the total amount of subsidy that can be paid to new low-carbon generation, and provides a credible signal to investors by announcing in advance that the intention to sign contracts is underpinned by funding. In November 2012, the Government announced that it had agreed the level of support in 2020, at £7.6 billion (2012 prices), which is broadly comparable with our updated estimate of what is required to deliver a portfolio of low-carbon technologies, provided this is calculated appropriately (see Chapter 2).
- **Carbon Capture and Storage Commercialisation Programme.** DECC launched its Carbon Capture and Storage (CCS) Commercialisation Programme in Spring 2012. Under this programme, four (of eight) bids for support to develop a CCS installation were shortlisted: one gas post-combustion, one coal oxy-fuel and two pre-combustion coal projects, of which two (the 340 MW gas post-combustion project at Peterhead and the White Rose 304 MW oxy-fuel coal project at Drax) were selected as preferred bidders to negotiate front-end engineering and design (FEED) contracts, with a view to taking final investment decisions in early 2015. If these projects proceed as planned, they could be operational in 2018/19; however to deliver four CCS projects by 2020 (as set out in the Coalition Agreement in 2010) Government would need to proceed more quickly with other projects than currently planned.
- **Green Deal and Energy Company Obligation.** The Green Deal is a new financing framework, available from 2013, to facilitate energy efficiency improvements and low-carbon heat in homes and non-residential properties, funded by a charge on electricity bills. The Energy Company Obligation (ECO) creates a legal obligation on energy suppliers to improve the energy efficiency of households. In our 2012 progress report, we expressed concern that the estimated installation numbers under the Green Deal and ECO are substantially below our insulation indicator trajectories, which would have delivered a further reduction in emissions of at least 3 $MtCO_2$. It is too early to assess how initial activities will translate into actual measures. Registration figures for cavity wall and solid wall insulation under the official guarantee schemes suggest that uptake has been very slow in the first few months of 2013. We will provide a more comprehensive assessment of the operation of the Green Deal and the ECO in our 2014 progress report.

- **Climate Change Agreements.** In our 2012 progress report we noted that the scope of energy efficiency targets within Climate Change Agreements (CCAs) had been reduced substantially (by around 60%) to focus on only energy use not currently covered directly by the EU ETS (i.e. mostly electricity consumption), significantly weakening the incentives for reducing direct emissions. Energy efficiency targets have now been announced and are consistent with the level of ambition required for reductions in indirect emissions to 2020. The challenge remains to set out an approach that includes the full range of abatement options, including reduction of both direct and indirect emissions, and requires the implementation of options which are cost-effective compared with the carbon price.

However, a number of policy challenges remain:

- **Electricity Market Reform (EMR).** There are a number of detailed issues relating to contract design and payments mechanisms which should be resolved as the Energy Bill passes through Parliament. The EMR Delivery Plan should be designed to provide clarity for investors over the Government's intentions as market-maker. This should include setting out the quantity of capacity that the Government intends to contract over the period 2014-18, and the prices that it intends to pay for wind generation. Clarifications and possible adjustments on funding under the levy control framework to 2020 are required in order to ensure that this is sufficient to support ambition. Longer-term certainty should be provided through setting out commercialisation strategies for less mature technologies, setting a carbon-intensity target for 2030, and also extending funding under the levy control framework out to this date.
- **Green Deal/Energy Company Obligation.** Previously, energy companies had targets for insulation measures, and were subject to fines for under-delivery, resulting in subsidies being paid for loft and cavity wall insulation. Under the new Green Deal and Energy Company Obligation (ECO), incentives for delivery are weak, relying on a market based approach to address significant non-financial barriers to uptake, and requiring that most households bear the full cost of these measures. Support is still available for some measures under the ECO but, with the exception of low-income households, this excludes lofts and most cavity walls (i.e. except those that are hard-to-treat). These policies should be closely monitored and options to increase flexibility and strengthen financial/fiscal incentives for uptake should be further considered.
- **Low-carbon heat.** Very low uptake of low-carbon heat in the residential sector reflects significant financial and non-financial barriers, which are not adequately addressed by the small-scale grant programme currently in place. The Renewable Heat Incentive should be extended to cover the residential sector, funding should be committed beyond 2014/15, Green Deal finance allowed to pay for the up-front cost of low-carbon heat investment, and approaches to address non-financial barriers introduced.
- **Commercial and industrial sectors.** There is a need to rationalise the multiplicity of policies in these sectors and to strengthen incentives for uptake of measures. Proposed industry roadmaps are potentially important in increasing uptake of energy efficiency measures and new technologies in this sector.

Inclusion of international aviation and shipping emissions in carbon budgets

In 2012 we recommended that international aviation and shipping emissions should be included in carbon budgets and the 2050 target. A failure to do so would represent a departure from the approach taken by the Government in its Carbon Plan, and could result either in increased costs of meeting carbon budgets, or in accepting higher risks of dangerous climate change.

In December 2012, following the EC's decision to suspend inclusion of international aviation emissions in the EU ETS, the Government decided to postpone formal inclusion of international aviation and shipping (IAS) emissions in carbon budgets. However, it confirmed the status quo that IAS emissions are included in the 2050 target and that carbon budgets are set on this basis.

5. Devolved administrations

Data on greenhouse gas emissions in the devolved administrations are published with a time lag compared to UK-wide data, with the latest estimated emissions data currently available covering 2011[5]. Here we provide an overview of 2011 emissions trends in the three devolved administrations. For Scotland and Wales, our 2013 progress reports for the Scottish and Welsh governments provide a more detailed assessment and specific sector data.

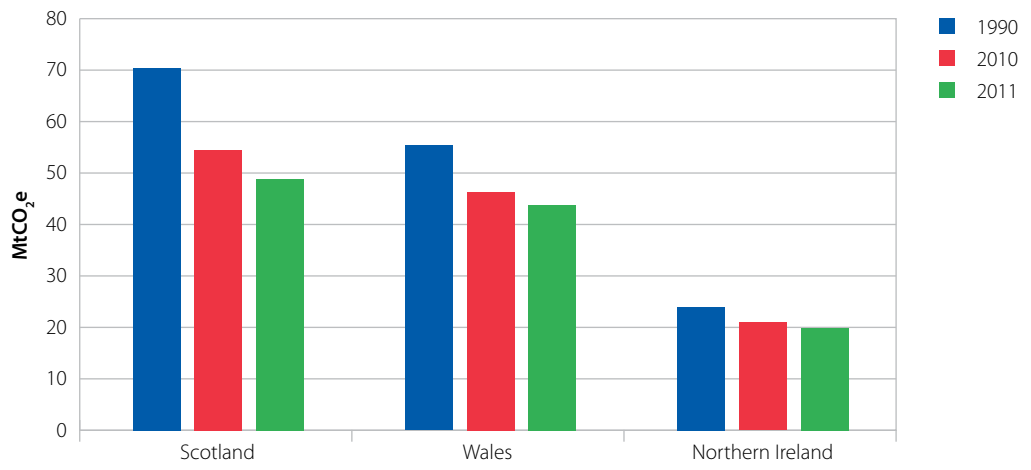
At the UK level in 2011, emissions fell by 7% in the context of warm winter temperatures, slow economic growth and rising fuel prices.

GHG data for the devolved administrations (Figure 1.13) show that in 2011, Scottish emissions fell more than the UK average (10%), while Welsh and Northern Irish emissions fell slightly less (5%):

- Scottish emissions account for around 9% of the UK total. They fell by 10% in 2011, and were 31% lower than in 1990. The largest reduction in 2011 occurred in the energy supply sector[6] where emissions fell by 18% compared to 2010. This was due to a significant (27%) fall in coal-fired generation, combined with a large (43%) increase in renewable generation and a 10% increase in nuclear output. Residential sector emissions also fell by 21% in 2011. This can be attributed to the milder winter temperatures compared to 2010. Although Scotland missed its first annual emissions target and is likely to have missed its second target based on Scottish Government estimates, this is largely due to a combination of weather and revisions to the emissions inventory which have made achieving the targets more challenging. We note that Scottish emissions targets are more challenging than those of the UK to 2020, both because these have higher ambition, and because they include emissions from international aviation and shipping.

5 Emissions data here are presented on a 'gross' basis – i.e. before trading in the EU ETS is accounted for.
6 Around three quarters of emissions in energy supply are from the power sector.

Figure 1.13: GHG emissions in Scotland, Wales and Northern Ireland (1990, 2010 and 2011)



Source: NAEI (2013).

- Welsh emissions account for around 8% of the UK total. They were 5% lower in 2011 than 2010, and 21% lower than 1990. Emissions fell by 5% from 2010 to 2011 (compared to a 7% UK-wide reduction), due mainly to the reduced energy demand during the warmer winter months. Reflecting this, residential emissions fell by 22%.
- Emissions in Northern Ireland account for around 4% of the UK total. They were 5% lower in 2011 than 2010 and 17% lower than in 1990. Residential sector emissions fell by 18% – slightly less than in Scotland and Wales but still significant, again reflecting a milder winter.

As at the UK level, it is likely that emissions in the devolved administrations will have risen again in 2012 due to increased coal-fired generation and colder temperatures compared to 2011.

The devolved administrations continue to lead the UK in some areas, for example:

- Scotland had 40% of the UK's installed renewable capacity in 2011, as well as a significant pipeline of potential capacity. The Scottish government has set an emissions intensity target for the power sector of 50g CO_2/kWh by 2030.
- All three devolved administrations have government-funded energy efficiency programmes targeted at fuel poor households, although fuel poverty levels remain high (particularly in Northern Ireland).
- Scotland and Wales have set themselves waste targets that go beyond the UK requirements under the EU Landfill Directive.

In terms of climate change strategy, the most important developments over the last year are:

- **Scotland** has published plans for meeting its future targets to 2027, setting out a range of policies and policy proposals. Significant revisions to both historical emissions data and projections suggest that there is a much greater challenge to meet emission targets than previously thought.
- **Wales** is currently considering the scope of an upcoming Environment Bill. This could be useful for providing a statutory underpinning to Wales' climate change targets, as well as considering longer-term targets (beyond 2020).
- **Northern Ireland** has run a pre-consultation seeking views on the need for a Northern Ireland Climate Change Bill. The aim of the proposed Bill would be to establish a long-term framework to drive greater efforts to reduce greenhouse gas emissions and to help ensure that Northern Ireland is better prepared to adapt to the impacts of unavoidable climate change.

We cover specific examples of policy developments in the devolved administrations in the sector chapters of this report. However, major challenges remain:

- Increasing the rate of renewable power capacity deployment, especially in Wales where deployment growth has been slower than in the rest of the UK.
- Increasing low-carbon heat penetration, which remains low across the devolved administrations.
- Encouraging a greater uptake of EVs, which currently have a low penetration across the whole of the UK.
- Increasing rates of woodland planting for which all three devolved administrations have ambitious targets but for which only Scotland is currently on-track.
- Reducing the very high rates of fuel poverty in the devolved administrations and ensuring that low-carbon policies do not negatively impact on the most vulnerable households.

It is important to address these challenges so that the devolved administrations gain from potential economic benefits, meet their own national emissions targets, and make an appropriate contribution to meeting the UK's carbon budgets.

Key findings

- Economy-wide **emissions rose by 3.5%** in 2012.
- The **colder winter temperatures** in 2012 (relative to very mild winter temperatures in 2011) increased emissions by around 1.5%. Without a switch from gas to coal in power generation emissions would have fallen by 1-1.5%.
- There has been **progress** in the delivery of low-carbon measures in some areas, but with others **falling behind**.
- A significant **ramp-up in the pace of delivery** will be required urgently in order to meet the currently legislated third budget, particularly for more challenging measures such as low-carbon heat and electric vehicles. An even greater acceleration will be needed to meet the fourth carbon budget.
- There are **major challenges** relating to design and implementation of the Electricity Market Reform and the Green Deal. **New policies are required** to support uptake of low-carbon heat in the residential sector. Stronger incentives are required for uptake of measures in the commercial and industrial sectors.
- The devolved administrations continue to **lead the UK** in some areas; however **major challenges remain**.

Introduction and key messages

1. Power sector emissions
2. The Committee's power sector indicator framework
3. Investment in renewable generation
4. Deployment of new nuclear
5. Commercialisation of CCS
6. Progress on Electricity Market Reform

Chapter 2: Progress decarbonising the power sector

Introduction and key messages

In our last progress report we showed that the fall in power sector emissions of 7% in 2011 was largely due to transitory factors, including favourable weather conditions for generation of renewables and nuclear plant returning to operation after outages.[1]

In this report we consider the latest data on emissions along with progress investing in new low-carbon capacity. We also outline priorities for taking forward the Electricity Market Reform given its crucial role in driving future low-carbon investments.

Our key messages are:

- **Emissions.** In 2012, CO_2 emissions in the power sector increased by 8% to 156 $MtCO_2$, due to an increase of highly carbon-intensive coal generation at the expense of gas. This was driven by a low price of coal in the global market and a low carbon price, and is likely to be a temporary effect. The impact of increased coal generation on emissions was partially offset by the addition of renewable capacity to the system.
- **Carbon intensity.** While actual carbon intensity increased by 10% to 531 gCO_2/kWh in 2012, achievable carbon intensity fell by 6% to 315 gCO_2/kWh. In other words, if plant on the system were dispatched so as to minimise emissions by substituting coal for gas, carbon intensity would fall by 41% from 531 to 315 gCO_2/kWh. This is consistent with achieving 200 gCO_2/kWh intensity in 2020 and 50 gCO_2/kWh in 2030, which we have identified as being on the cost-effective path to meeting the 2050 target set out in the Climate Change Act. The gap between actual and achievable carbon intensity will be closed as coal plant is retired as the relative cost of coal increases under the rising carbon price floor and given tightening EU legislation on air quality.
- **Low-carbon technologies.** Although a record amount of capacity was added in 2012 and the pipeline is strong, major challenges and risks remain in delivering the investment required across the portfolio of low-carbon technologies.
  - **Wind.** The rate of wind new build, if sustained through the rest of the decade, would meet the required level of capacity by 2020 for both onshore and offshore. The future pipeline remains strong, with sufficient projects awaiting construction or in planning to meet our indicators to 2020. Delivering these projects will require that current policy uncertainties relating to the Electricity Market Reform are resolved and financial barriers are addressed (e.g. the Green Investment Bank mobilising project finance for offshore wind).

1 CCC (2012) *Meeting Carbon Budgets – 2012 Progress Report to Parliament.*

  - **Nuclear.** Important milestones were passed in the last year, with the approval of the Areva (EDF) reactor design and planning approval for EDF's new plant at Hinkley Point C. Hitachi completed the purchase of the Horizon venture, and submitted their reactor design for approval. Agreeing the contract for the first project at Hinkley Point C would allow focus on other contracts to be signed under the first EMR Delivery Plan period, with scope to sign for up to 6 GW by 2018/19, as part of a major nuclear programme through the 2020s, with significant economic benefits for the UK.
  - **Carbon Capture and Storage (CCS).** DECC's Commercialisation Programme has selected two projects to enter negotiations for Front-End Engineering and Design (FEED) studies, with a view to making final investment decisions in early 2015. It is essential that the momentum is maintained, so that these two plants can enter operation by 2018/19. The Government should set out its approach to supporting further projects to become operational in the early 2020s at the latest, including approaches to funding FEED studies and signing contracts. It will also be crucial to set out a longer-term commercialisation strategy, in order to maintain interest from the supply chain beyond the initial projects and to ensure that future cost reductions can be achieved.

- **Electricity Market Reform (EMR).** Following pre-legislative scrutiny by the Energy and Climate Change Select Committee, the Energy Bill was introduced to Parliament in November 2012 and is currently progressing through Parliament. Challenges remain in finalising the Bill, developing the EMR Delivery Plan, ensuring sufficient funding and providing long-term certainty.
  - **Contracts.** There are a number of detailed issues relating to contract design and payment mechanisms which should be resolved as the Bill is finalised.
  - **Delivery Plan.** The Delivery Plan (due to be published for consultation in July) should be designed to provide clarity for investors over the Government's intentions as market-maker. This should include setting out the quantity of capacity that the Government intends to contract over the period 2014/15-2018/19, and the prices that it intends to pay for wind generation.
  - **Funding.** Clarifications and possible adjustments on funding under the levy control framework to 2020 are needed in order to ensure that it is sufficient to support the required investment in low-carbon technologies.
  - **Longer-term certainty** should be provided through setting out commercialisation strategies for less mature technologies, setting a carbon-intensity target for 2030, and also extending funding under the levy control framework out to this date.

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

1. Power sector emissions
2. The Committee's power sector indicator framework
3. Investment in renewable generation
4. Deployment of new nuclear
5. Commercialisation of CCS
6. Progress on Electricity Market Reform

1. Power sector emissions

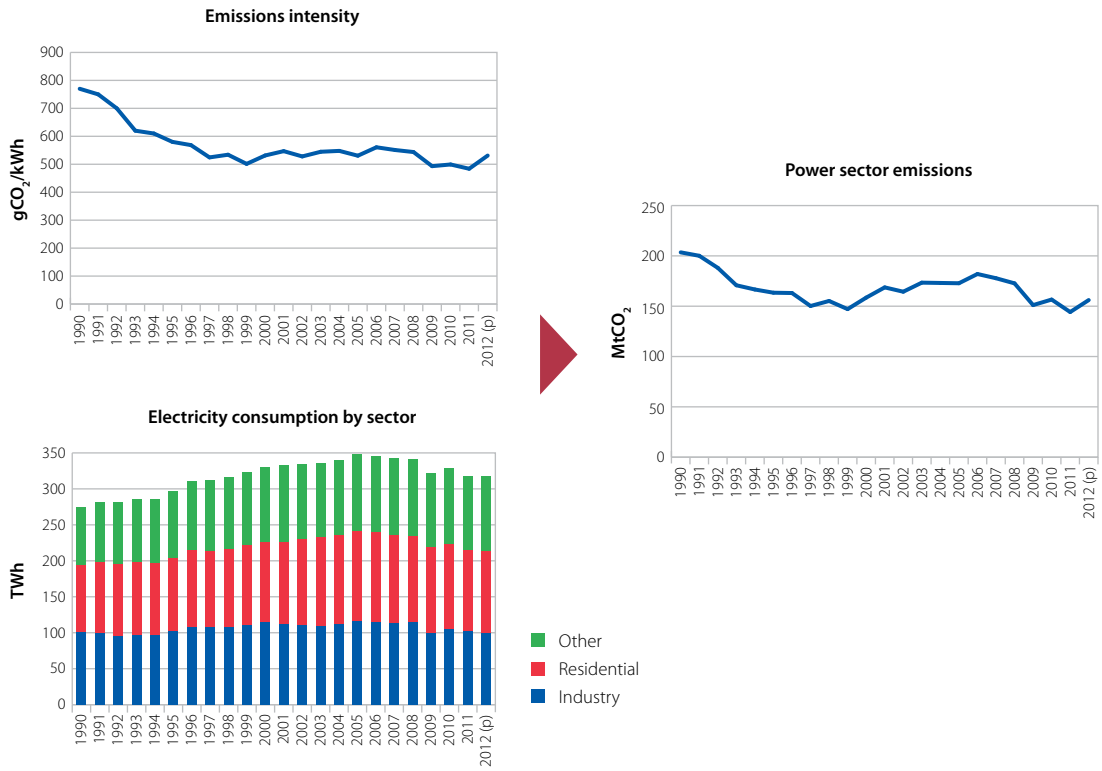
Emissions in 2012

In 2012, power sector emissions accounted for 27% of total UK greenhouse gas emissions. Provisional data suggest power sector emissions increased by 8%, from 144 $MtCO_2$ in 2011 to 156 $MtCO_2$ in 2012. This was driven by an increase in the carbon intensity of power generation (Figure 2.1).

- **Consumption** remained broadly constant across all sectors at 317 TWh. A doubling of net imports of electricity led to a 4% reduction in the amount of electricity generated in the UK.[2]
- **Carbon intensity.** The carbon intensity of electricity consumed increased by 10% from 484 gCO_2/kWh in 2011 to 531 gCO_2/kWh in 2012. This reflects an increase in generation from carbon-intensive coal at the expense of gas, although this was partly offset by generation from new renewables capacity added to the system.
  - Coal generation increased by a third from 105 TWh to 140 TWh, while gas fell by a third from 133 TWh to 86 TWh. This reflects commodity prices that were favourable for coal relative to gas – the wholesale coal price and carbon price fell throughout the year and the wholesale gas price increased (Box 2.1).
  - Generation from renewables continued to increase, rising by 20% from 34 TWh in 2011 to 41 TWh in 2012 and now accounts for 12% of total generation. This increase was due to a record amount of wind capacity having been added to the system in 2012, slightly offset by less favourable weather conditions (average wind speed fell by 8% and rainfall decreased by 25% causing generation from hydro to fall by 8% compared to 2011).[3] If coal had not replaced gas in 2012, this increase in generation from renewables would have reduced emissions intensity by 2%.
  - Nuclear generation remained broadly constant at 70 TWh.

2 Imported power has no emissions in the UK. In calculating achievable emissions intensity (below) we assume no net imports.
3 Full year in 2012 compared with full year in 2011, DECC (March 2013) Energy Trends. Data are not yet published on load factors for 2012, although higher wind speeds usually imply higher load factors, for example in 2011 average wind speed increased by 16% and average load factor for onshore wind increased by 18% and for offshore wind increased by 27%.

Figure 2.1: Emissions intensity of electricity supply, electricity demand and CO_2 emissions from the power sector (1990-2012)



Source: DECC (March 2013) *Energy Trends*; DECC (2013) *UK Greenhouse Gas Emissions 1990-2012 (provisional)*, CCC calculations.
Notes: Emissions intensity is UK based useable generation, i.e. adjusted for losses. Electricity consumption includes imported power. 2012 data are provisional.

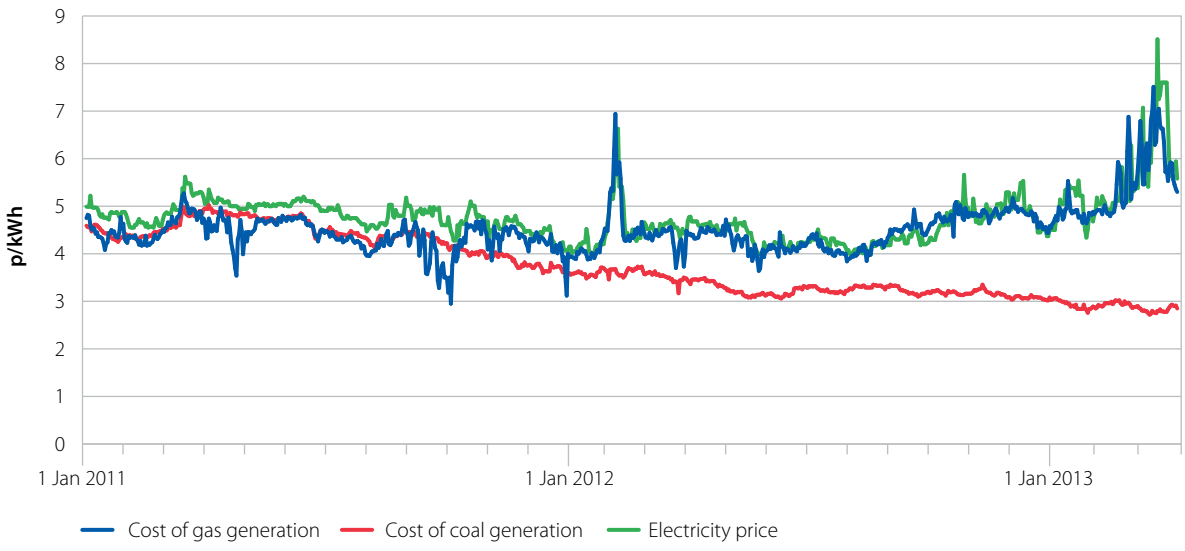
Box 2.1: Drivers of increased coal generation in 2012

The switch from gas to coal in 2012 was driven by a reduction in the cost of coal generation compared to gas. There were three key drivers for this:

- **The wholesale gas price increased** by 6% from 56 to 60 p/therm.[4] The price of gas in Europe rose, primarily as a result of increased demand from Japan, following the 2011 Fukushima nuclear disaster. This prompted closure of nuclear facilities, compensated with increased use of liquefied natural gas.
- **The wholesale coal price fell** by 11% from £89 to £79/tonne.[5] The exploitation of shale gas in North America pushed down US gas prices prompting a switch from coal to gas use in the US. Excess coal has therefore been supplied to European markets at low prices.
- **The carbon price in the EU Emissions Trading Scheme (EU ETS) remained at low levels** in 2012 following a dramatic fall of nearly 50% in 2011 from €14.1 to €7.4/tonne (£12 to £6.3/tonne).[6] It fell by a further 5% in 2012, averaging to €7.4 /tonne (£6/tonne) over the year. The carbon price drives a wedge between the cost of coal and gas generation as coal is more than twice as carbon-intensive as gas. As it has fallen, the relative cost of coal compared to gas generation has fallen.

Given these favourable conditions for coal compared with gas generation, the "clean dark spread" (i.e. the difference between the short-run cost of coal generation and the electricity price which is driven by the cost of gas generation) has been rising steadily since early 2012 (Figure B2.1).

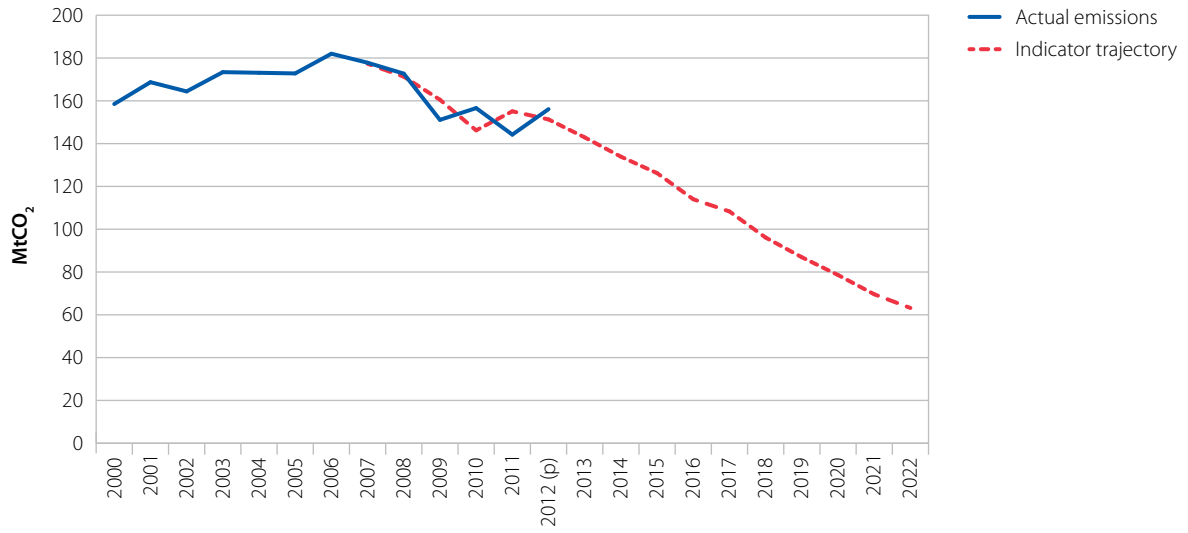
Figure B2.1: Short-run cost of gas and coal generation and electricity price (January 2011 to March 2013)



Source: *UK Power day-ahead data*, WMBA (accessed 9 May 2013); *System Average Price data*, National Grid (accessed 9 May 2013); *Coal ARA data*, ICIS, (accessed 12 May 2013); CCC calculations.
Notes: Assumes plant efficiency 49% for gas and 35% for coal (based on average for existing fleet). Carbon intensity 378 g/ CO_2kWh for gas and 1,000 g/ CO_2kWh for gas. Based on day-ahead electricity and gas prices, and coal monthly forward price.

4 Average gas wholesale price in 2012 compared to average price in 2011. Based on day-ahead gas price, National Grid (accessed 9 May 2013).
5 Average coal wholesale price in 2012 compared to average price in 2011. Based on month-ahead coal price, ICIS (accessed 12 May 2013). Conversion from $/tonne to £/tonne based on daily BID exchange rates, OANDA (accessed 27 May 2013).
6 Average December 2011 carbon price compared to average January 2011 price. Based on daily spot carbon price, ICE-ECX European Emissions (accessed 10 April 2013). Conversion based on daily BID exchange rates, OANDA (accessed 27 May 2013).

Figure 2.2: Actual power sector emissions compared with our indicator trajectory (2000-2022)



Source: DECC (March 2013) *Energy Trends*; DECC (March 2013) Provisional 2012 results for *UK greenhouse gas emissions and progress towards targets*; CCC calculations.

Emissions in 2012 were slightly above the trajectory set out in our indicators, despite the large fall during the recession (Figure 2.2). The large increase in 2012 driven by fuel switching from gas to coal raises a question as to whether the rise will persist in future. Our assessment is that it is unlikely that the increase in coal burn will be sustained in the medium-to-long term, due to the age of existing plants, existing environmental legislation and the UK's carbon price floor.

- **Age of coal plants.** The majority of coal plants in the UK were built in the 1960s and 1970s, and are now nearing the end of their typical lifetimes of 40-50 years. Therefore, most are expected to retire within the next decade, with little if any capacity on the system expected to remain in 2030 (the newest units at Drax power station started generating in the mid-1980s and will therefore be around 45 years old in 2030).
- **Environmental legislation.** European regulations relating to air quality will lead plants to retire or reduce their running hours earlier than suggested by expected retirement ages:
  - **Large Combustion Plant Directive (LCPD).** Around a quarter of UK coal-fired capacity (6 GW) faces restricted running hours between now and the end of 2015 under the LCPD,[7] and will have to close when these hours are used up. Many of these hours were used in 2012 (generating 35 TWh in 2012 compared with 4 TWh in 2011), with some plants subsequently shutting down. Only 15 TWh remain for 2013-2015.[8] This implies that most of the increase in generation in 2012 came from these plants (31 out of 35 TWh) and will necessarily fall again from 2012 to 2013 by at least 25 TWh (i.e. a reversal of two-thirds of the total increase in 2012). The favourable conditions for coal brought forward generation that is likely to have occurred at a later date, so the cumulative output and emissions from these plants is likely to be unaffected.

7 The LCPD regulates sulphur oxides, nitrogen oxides and particulate matter emissions. Plants were given a choice to opt in or out. Plants opting out were allocated 20,000 hours to run over the years 2008-2015. Plants opting in must comply with Emissions Limit Values for the three pollutants. This could involve undergoing full biomass conversion.

8 The coal plant at Kingsnorth (2 GW) closed in December 2012 having operated for 48 years, Cockenzie (1.2 GW) closed in March 2013 after 47 years and Didcot A (2 GW) closed March 2013 after 44 years.

  - **Industrial Emissions Directive (IED).** The remainder of UK coal plants could also face restrictions from 2015 and be forced to close by the end of 2023 under the IED.[9] To comply with the IED, plants have to fit expensive NO_X abatement equipment to keep running at 2012 levels beyond 2015. Incentives to fit equipment could be limited given that many plants will be reaching the end of their operational lives and given increasing costs under the rising carbon price floor.

- **Economics of coal plant.** Even though the cost of coal generation has fallen over 2012, the profitability of coal plants is likely to decline in the future. This particularly reflects the UK's carbon price floor, which was introduced in April 2013 at £4.94/tCO_2 on top of the EU ETS price (intended to deliver a minimum price of around £16 per tonne),[10] adding just under 30% to the cost of coal generation. The price floor will rise to deliver an overall target of £32 per tonne in 2020, by which time it will add an additional 30% to the cost of coal generation.

More generally, progress in decarbonising the power sector should not be judged solely on reducing emissions. Emissions will tend to fluctuate with fuel prices, availability of existing nuclear plant and weather conditions for renewables generation. Progress can also be measured through the *achievable emissions intensity*, discussed in the next section, and through adding low-carbon capacity, which we consider in sections 3-5. An assessment from this perspective confirms that there has been underlying progress, despite the increase in emissions in 2012.

Achievable Emissions Intensity

Achievable emissions intensity is the carbon intensity of electricity supply that would be achievable if power plants were dispatched in order of least emission rather than least cost, while still maintaining security of supply to keep the lights on.

In practice this means meeting demand with nuclear and renewables first, followed by gas, and finally coal plant. Reductions in achievable emissions intensity therefore mainly reflect investment in low-carbon generating capacity, and are not affected by short-term fluctuations in fuel and carbon prices (which can determine whether coal generates before gas) or by load factors for nuclear and renewables varying between years (for example due to weather conditions).

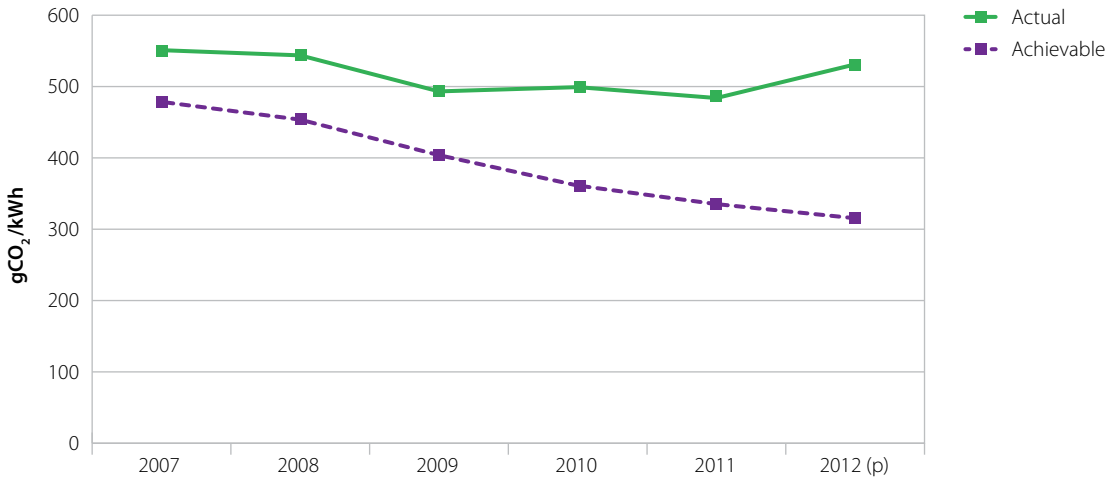
In 2012, achievable emissions intensity continued to improve, falling by 20 gCO_2/kWh (6%) compared to 2011, from 335 gCO_2/kWh to 315 gCO_2/kWh (Figure 2.3).[11] This reduction was due to renewables capacity added to the system in 2012, including 2.4 GW of wind and 0.7 GW of solar.

9 In 2010 the LCPD was combined with six other existing directives to form the IED. LCPD plants which opt in to the IED must agree to stricter emissions limits. Plants which opted in to the LCPD but choose not to opt in to the IED will have their hours capped at 17,500 for 2016-2023. Plants are required to give notice of intent to comply with IED at the end of 2013; the final decision has to be taken by the end of 2014.

10 The carbon price floor 'top up' was set in March 2011, on the expectation of an EU ETS price equivalent to around £11. HMT (2011) *Budget 2011*. However, so far in 2013, the price has turned out lower than expected (averaging under £5 so far in 2013), potentially reducing the actual floor price faced by generators to around £10.

11 Note that we have also recalculated previous year's figures based on revised outturn data for demand and capacity and a revised methodology.

Figure 2.3: Actual and achievable emissions intensity (2007-2012)



Source: CCC Calculations based on various sources including Defra *GHG Conversion factors*; DECC (March 2013) *Energy Trends*; DECC (June 2012) *DUKES*.
Notes: Achievable emissions intensity is the minimum average emissions intensity that could be achieved in a year, given the installed capacity, demand and the demand profile of that demand. Emissions intensity is UK based useable generation, i.e. adjusted for losses.

This indicator shows that there is scope to reduce current emissions intensity by over 200 gCO_2/kWh (41%) within existing capacity through fuel-switching, primarily from coal to gas. This is achievable while maintaining security of supply at minimal cost to the consumer, being available today without any requirement for new investment, and given that the market electricity price continues to be set largely by gas plant. It is likely to be achieved over time as old coal plant retires (as discussed above) and as relative economics change (for example as the carbon price rises).

2. The Committee's power sector indicator framework

The Committee's power sector indicator framework sets out a trajectory towards a largely decarbonised power sector by 2030, aimed at reducing emissions and developing a range of low-carbon options for future sector decarbonisation (Table 2.1).

The indicators set out timelines for key stages of investment, including policy milestones:

- **Renewables.** Our indicators cover capacity on the system and progression through the project cycle (i.e. in and entering construction, in planning, etc), generation, planning approval rates and progress in developing the transmission network (required reinforcements, access to the network, investment in the onshore and offshore grid) – see section 3.
- **Nuclear.** We monitor progress towards building a new generation of plants, including indicators on planning and regulation – see section 4.
- **CCS.** Our indicators for the first three budget periods focus on progress with the UK's programme of demonstration projects – see section 5.

- **Electricity Market Reform.** We have previously proposed that new market arrangements are required to support low-carbon investment and we monitor Government's progress in implementing these – see section 6.

The indicators therefore enable us to track not just the impact of investments on emissions in the latest year, but also the expected impacts in future years. They are designed to provide early warning of problems in the pipeline and to identify areas where action is required.

3. Investment in renewable generation

Progress adding new wind capacity

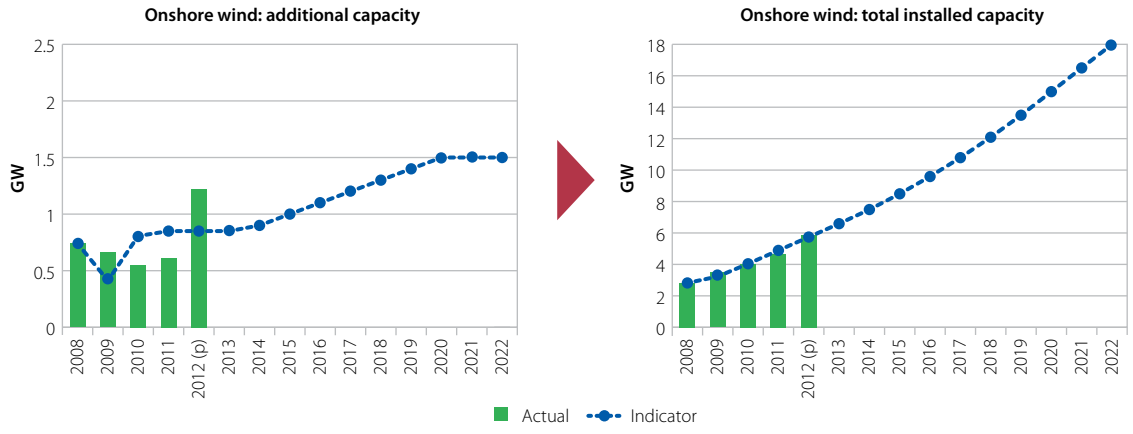
Our approach to monitoring progress in reducing underlying emissions focuses on how much wind capacity has been added to the system, and how much is likely to be added based on forward indicators (i.e. capacity entering construction, capacity moving through the planning system, supply chain investment and investment in transmission infrastructure to support the required increase in wind generation).

The overall picture for wind capacity is one of a significant ramp-up in the level of capacity deployed in 2012, a strong pipeline of potential projects, but questions over whether investment levels will be sustained.

Capacity added to the system

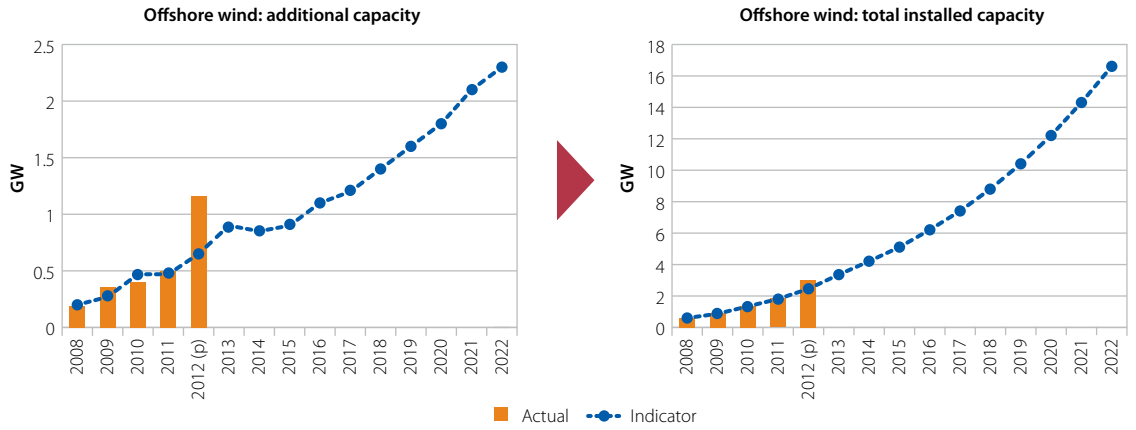
A record level of onshore and offshore capacity was added to the system in 2012 (1.2 GW of each), substantially exceeding our indicator for additional capacity (Figure 2.4 and Figure 2.5). If these deployment levels can be sustained this would be enough to meet our 2020 indicators for both onshore and offshore wind (i.e. 15 GW and 12 GW respectively).

Figure 2.4: Onshore wind: annual additional and cumulative capacity against our indicators (2008-2022)



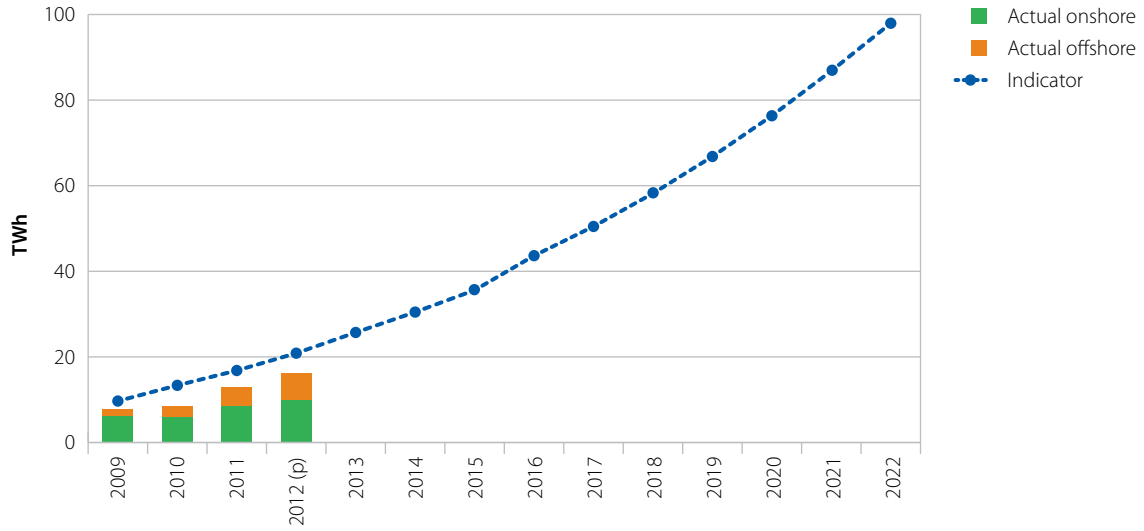
Source: DECC (March 2013) *Energy Trends*.
Notes: 2012 data are provisional.

Figure 2.5: Offshore wind: annual additional and cumulative capacity against our indicators (2008-2022)



Source: DECC (March 2013) *Energy Trends*.
Notes: 2012 data are provisional.

Figure 2.6: Onshore and offshore wind generation against our indicator (2008-2022)



Source: DECC (March 2013) *Energy Trends*.
Notes: 2012 data are provisional.

Wind performance in 2011 was in line with our assumed load factor (26% onshore and 37% offshore) when wind speed was at the long-term average (9 knots).[12] Load factors in 2012 are likely to have fallen (although data are not yet available), reflecting wind speeds that were 8% lower than average. Generation in 2012 is below the level envisaged in our indicators; this is not itself an indication of low load factors, but rather reflects that our indicators are based on an assumption that capacity is all available at the start of the year, whereas in reality it is commissioned throughout the year (Figure 2.6).

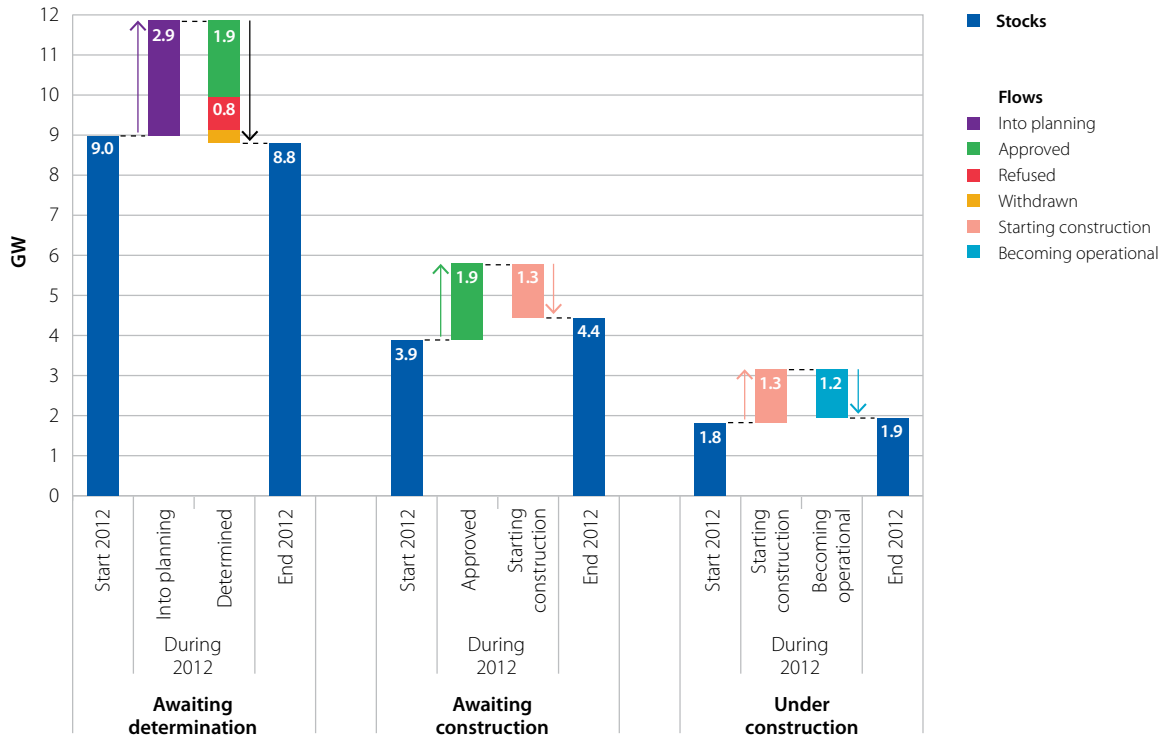
12 2011 is the most recent data available for load factors on an unchanged configuration basis (i.e. only including projects that had been on the system for the whole year). DECC (2012) *Regional load factors on an unchanged configuration basis, 2011.*

Wind project pipeline

There is a large amount of potential capacity in the project pipeline for both onshore and offshore wind, but offshore projects are moving slowly into construction (Figure 2.7 and 2.8).

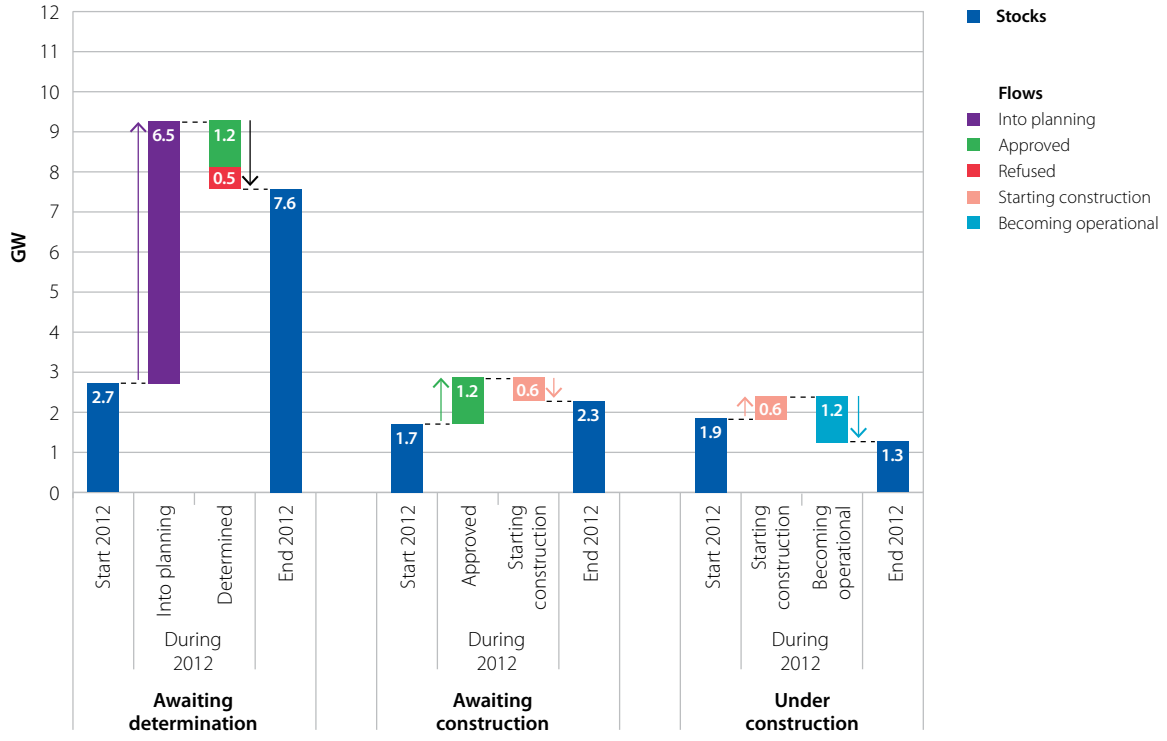
- **Capacity under construction.** At the end of 2012, 1.9 GW of onshore wind and 1.3 GW of offshore wind were under construction. This could potentially sustain the high level of added capacity from 2012 for onshore, given a construction time of 1-2 years, but is unlikely to do so for offshore, where construction periods are 2-3 years. This reflects that in 2012 far less offshore capacity started construction than completed it (0.6 GW compared with 1.2 GW), while a large amount of onshore capacity began construction (1.3 GW).
- **Capacity awaiting construction.** There was a further 4.4 GW onshore wind and 2.3 GW offshore wind with planning approval and awaiting construction at the end of 2012. If these projects move smoothly into construction and operation then, together with those projects already under construction, this would be enough to deliver required capacity additions for the next six years for onshore and four years for offshore. However, particularly for offshore, these projects do not appear to be progressing rapidly to construction. That may reflect the various uncertainties currently facing offshore wind developers (see below).
- **Capacity entering and moving through planning.** There was a substantial number of new wind planning applications in 2012 (particularly offshore) and the number of determinations was in line with our indicator. The average approval rate for onshore projects was strong overall, but fell for small-scale projects, whilst determination periods showed a slight improvement. However for offshore wind, the first large-scale planning refusal was seen and there was an increase in determination times.
  - **Onshore.** There was a continued flow of projects into the planning system, with 2.9 GW of new projects submitted for approval in 2012. Of the capacity awaiting approval, 3.0 GW were determined, with 1.9 GW approved, 0.8 GW refused and 0.3 GW withdrawn, leaving around 9 GW still awaiting approval at the end of 2012. The majority of this capacity is in Scotland (63%). This pipeline of onshore projects awaiting determination along with those already deployed or in the construction pipeline would be sufficient to deliver 2020 capacity in our indicator trajectory (i.e. 15 GW) assuming historic approval rates continue (Figure 2.9).
  - **Offshore.** In 2012, applications submitted for planning approval reached a record 6.5 GW for new offshore capacity with significant applications from the Round 3 and Scottish Territorial Waters leasing rounds. Of the capacity awaiting approval, 1.7 GW were determined. As a result there was a large amount of capacity (7.6 GW) awaiting determination at the end of 2012. Of this, 4.0 GW is in Scottish waters and the remaining 3.6 GW is in English waters. As with onshore wind, the offshore pipeline, if added to that already deployed or in the construction pipeline, would be sufficient to deliver our 2020 indicator (i.e. 12 GW) if approved and constructed (Figure 2.9). However as we note below, significant challenges remain.

Figure 2.7: Capacity moving through planning and construction – onshore wind (2012)



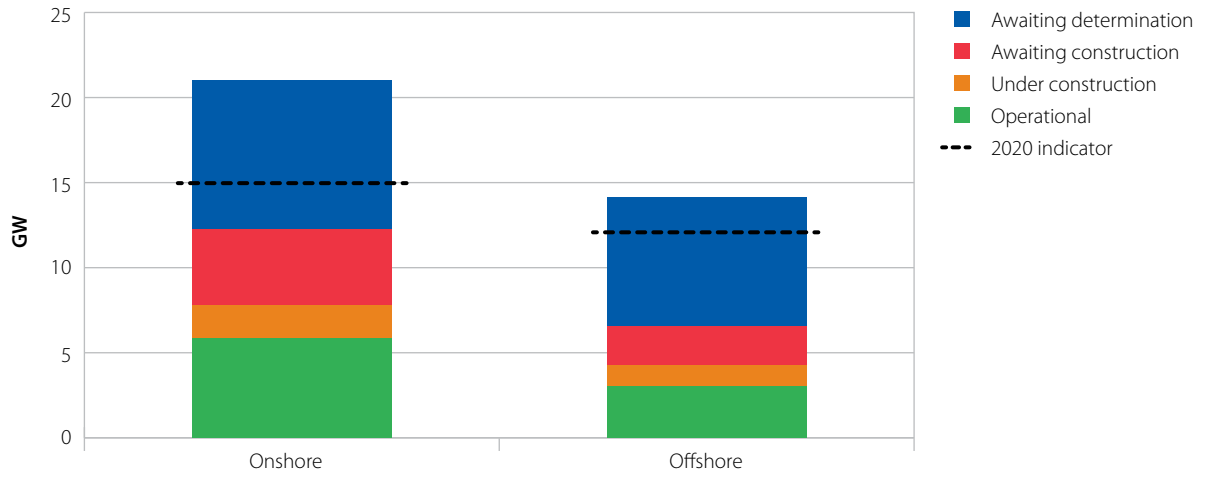
Source: DECC (March 2013) *Renewable Energy Planning Database.*
Notes: Numbers may not sum due to rounding. For the three pre-operational stages (awaiting determination; awaiting construction; and under construction), chart shows capacity at the beginning of 2012; capacity moving through each stage; and capacity at the end of 2012.

Figure 2.8: Capacity moving through planning and construction – offshore wind (2012)



Source: DECC (March 2013) *Renewable Energy Planning Database.*
Notes: Numbers may not sum due to rounding. For the three pre-operational stages (awaiting determination; awaiting construction; and under construction), chart shows capacity at the beginning of 2012; capacity moving through each stage; and capacity at the end of 2012.

Figure 2.9: Stock in planning and construction (end-2012) compared with the CCC's 2020 capacity indicator



Source: DECC (March 2012) *Renewable Energy Planning Database* and DECC (March 2013) *Energy Trends*.

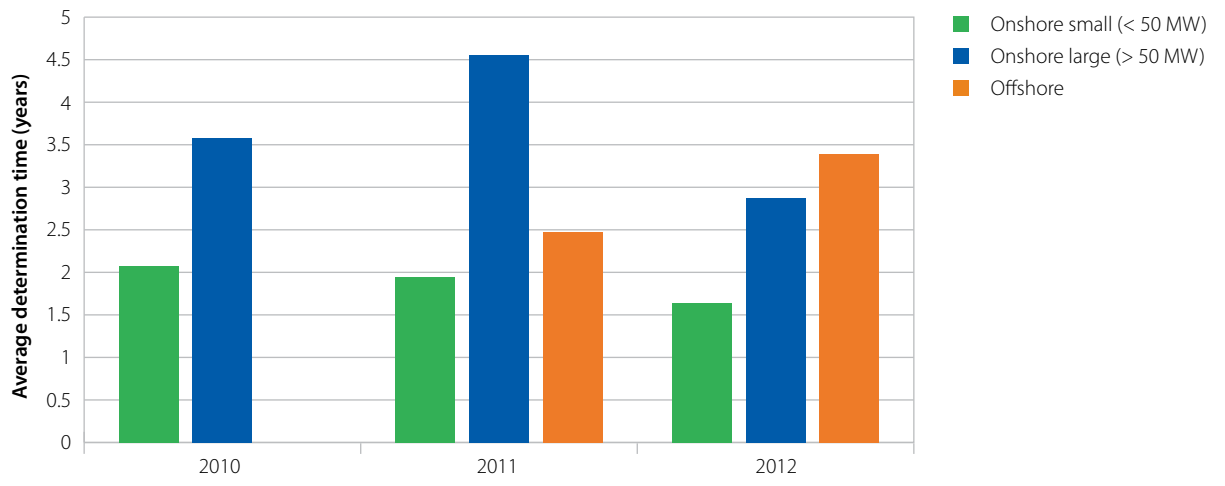
– **Planning approval rates.** The UK-wide approval rate for onshore projects was 70% in 2012, comparable to recent levels, which have fluctuated between 50% and 80%. This reflects a high approval rate for large projects (i.e. >50 MW) but falling approval rates for small projects, especially in Wales and Scotland (Box 2.3). Decisions regarding offshore wind applications are infrequent and lumpy; one 0.5 GW project was refused in 2012 in England over wildlife concerns. This pushed the overall approval rate down to 70% in 2012 whereas historically 100% of projects have been approved.

– **Determination periods.** This is the time taken from entering planning to approval or refusal, excluding projects that go to appeal. Determination periods fell for onshore wind; however they still remain substantially greater than our indicator of 12 months. For small-scale onshore projects, the average time fell from 19 to 16 months and for larger-scale projects (determined by the Secretary of State) the average time fell from 46 to 29 months. Offshore wind determination periods increased to 41 months in 2012 from 34 months in 2011 (Figure 2.10). Long determination periods reduce the amount of capacity ready to enter construction and could limit competition for contracts under the Electricity Market Reform.

The slow movement of projects into construction could be a result of uncertainties over returns of current and future projects and a tight supply chain resulting from a lack of clarity over direction for the power sector beyond 2020. Although the Government has set funding for 2020 in the levy control framework and made some progress with the design of contracts, there is still a lack of clarity over these contracts and objectives beyond 2020.

- **Support mechanisms and finance constraints.** Uncertainties over project returns may have held back projects from proceeding.

Figure 2.10: Determination time for wind capacity determined in 2012



Source: DECC (March 2013) *Renewable Energy Planning Database.*
Notes: Chart shows average determination time weighted by capacity. Determination time refers to the period between an application being submitted to the relevant planning body and an initial planning decision. It includes projects that later went to appeal, but excludes the time taken during the appeal process.

- **Renewables Obligation (RO).** The RO Banding Review was published in July 2012, setting out support levels for projects commissioning between 2013/2014 and 2016/2017. It is likely that projects were delayed from proceeding into construction until this announcement. Resolution of uncertainty about the RO, however, would only provide a temporary reprieve, given that projects entering construction next year are likely to commission under the Electricity Market Reform (assuming a three-year lead time).
- **Electricity Market Reform (EMR).** After March 2017, projects will be supported under the EMR rather than the RO. Projects may also choose to receive support under the EMR from 2014 onwards. However, the final arrangements for contracts and the levels of support under the EMR are not yet known (see section 6). This could be especially problematic for new projects that might not complete construction in time to be eligible for support under the RO. For offshore projects, further complications may arise for investments where the first phase of a larger project commissions under the RO, but where later phases proceed under the EMR.
- **Electricity price uncertainty.** Revenue under the RO is dependent on the wholesale electricity price at which generators can sell their electricity. Uncertainty over support under the RO is compounded by concerns over the availability of Power Purchase Agreements for independent renewable generators and uncertainty of the electricity price that will ensue under the EMR.
- **Finance.** There may be limited appetite to finance projects, given revenue uncertainties and the further uncertainties over details of support under the EMR, limited balance sheet strength of vertically integrated companies and conditions in capital markets. This would prevent projects moving into construction, given that projects need to secure finance before construction commences.

  - **Onshore transmission charging.** After a lengthy review process, the preferred option for charging arrangements for onshore generators was published by Ofgem in May 2012 ('Project TransmiT'). This may have affected projects considering moving into construction early in 2012. Onshore wind developers now have some clarity over transmission charging (up to around 10% of costs for onshore wind), although the detailed methodology for calculating transmission charges is currently being developed by industry.

- **Supply chain.** Offshore installation vessels do not appear to be causing problems, with six delivered in 2012 and two already entering into service so far this year (enough to install several GWs per year). However, there could be issues with other parts of the supply chain – although we have noted significant developer interest in constructing UK manufacturing facilities in our previous progress reports, these have not progressed into construction and operation. Given the limited pre-existing supply chain for offshore wind, the importance of the UK market in the wider European market, the need for specialist parts (e.g. high voltage undersea cables) and the benefits of local sourcing given high transport costs, this could be preventing developers contracting required parts. Supply firms have indicated that the current lack of visibility for the UK market beyond 2020 is preventing them from investing in the UK supply chain.[13]
- **Radar.** Last year we acknowledged that radar interference posed a significant barrier for capacity seeking planning approval. The Government is making good progress with respect to radar in some areas, for example £2 million has been committed for a technology demonstration intended to release a large amount of offshore capacity facing refusal due to radar interference with air traffic control. Further research and development is being carried out looking for solutions for other radar interferences. Despite these steps, radar still presents an important potential barrier for both onshore and offshore wind projects.

The risk is that projects currently developed do not proceed to construction, that new projects are not developed, and that supply chain investments are not made. These risks should be mitigated through urgent resolution of the various uncertainties associated with the Electricity Market Reform (see section 6).

13 See for example, letter to The Times (October 2012) '*Go green or we quit*'.

Box 2.2: Onshore wind: trend in approval rate by UK country

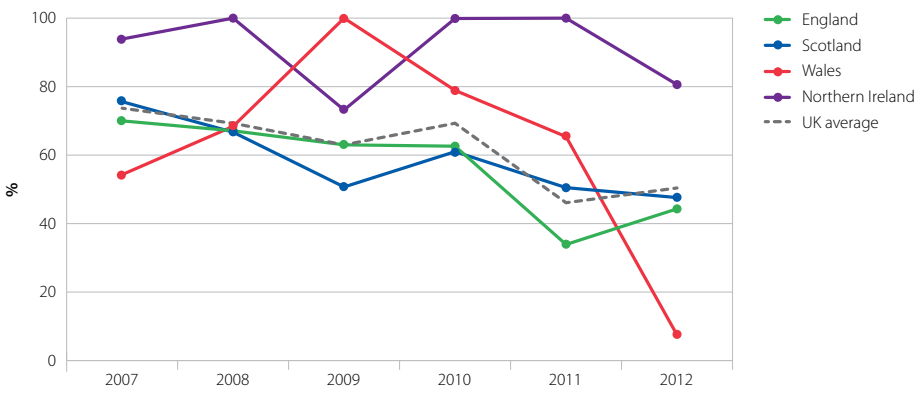
Just under half of the 8.8 GW of onshore capacity awaiting planning approval at the end of 2012 is considered 'large scale' (larger than 50 MW), with the remainder being 'small scale' (less than 50 MW). In 2012, approval rates were high for large projects, and relatively low for small projects.

- **Large projects.** Large onshore wind projects are determined at the national level by the Secretary of State, with advice from the Ministerial Infrastructure Planning Unit (MIPU). There are relatively few large-scale projects and determinations; therefore approval rates can vary markedly. In 2012, 100% of large-scale projects determined in England and Wales were approved (based on two projects), 92% of capacity of the six large Scottish projects were approved, and there were no large-scale determinations in Northern Ireland.[14]
- **Small projects.** Small onshore wind projects are determined at the local authority level. The UK-wide approval rate for these small projects has fallen from 69% in 2010 to 50% in 2012, with only England seeing an increase in the approval rate from 2011 to 2012 (Figure B.2.2).
  - **England.** 1.2 GW (25%) of UK small-scale capacity awaiting approval at the end of 2012 are projects in England. There has been a downward trend in the approval rate since 2007, with a substantial drop in 2011 only partly offset in 2012 (just 34% of capacity of projects determined received approval in 2011 and 44% in 2012, compared with 63% in 2010).
  - **Scotland.** 2.2 GW (48%) of small-scale capacity awaiting determination at the end of 2012 is in Scotland. The approval rates for Scotland fell slightly in 2012, from 51% in 2011 to 48% in 2012.
  - **Wales.** 0.6 GW (13%) of small-scale capacity awaiting determination is in Wales. The approval rate fell from 65% in 2011 to 8% in 2012. In 2012, Wales had the lowest approval rate for small-scale projects out of the devolved administrations and England.
  - **Northern Ireland.** 0.7 GW (14%) of capacity awaiting determination is in Northern Ireland. In contrast to the other devolved administrations, Northern Ireland has had relatively high approval rates for the period since 2007, with 100% of small scale projects approved in 2008, 2010 and 2011, although this fell to 81% in 2012.

The approval rate remains higher in Scotland than England where the Scottish Government has created a more explicit guidance for developers. The fall in small-scale approval rates throughout the UK could be due to a number of factors. It could be indicative of more appropriate sites being used up, local opposition, an increase in the number of applications (the *number* of onshore applications doubled in 2012 compared to 2011 although remained broadly unchanged in *capacity* terms), and/or reductions in planning board capacity at the local level.

The National Planning Policy Framework was published in March 2012, aimed at making the planning system less complex for England. This was followed in June this year by new guidance on local community engagement and benefit funds which increases the recommended community benefit package (from £1,000 to £5,000 per MW per year). There will also be an update to planning guidance in July 2013, which could affect future approval rates and development choices.

Figure B2.2: Approval rate for small-scale wind capacity by UK country



Source: CCC calculations using DECC (March 2013) *Renewable Energy Planning Database.*
Notes: Chart shows average approval rate weighted by capacity for projects determined in that year. Excludes projects that were withdrawn before determination.

Progress with other renewables

Biomass generation

Our indicator trajectory includes around 4 GW of solid biomass power generation, largely from converted coal plant, by 2020, in line with the Government's 2010 National Renewable Energy Action Plan, and within the Government's range in the 2011 Renewable Energy Roadmap.

In 2012, only 30 MW (0.03 GW) of solid biomass was added to the system compared with 830 MW (0.83 GW) in 2011 (largely due to the conversion of Tilbury coal power station). However, a further 0.5 GW has converted so far in 2013 (Ironbridge) and another 5.5 GW is publicly investigating converting.

While there has been progress adding biomass capacity it is important to put in place safeguards to ensure that the use of biomass results in genuine reductions in emissions. We therefore repeat our recommendation that the threshold for the use of biomass under the RO should be tightened to 200 gCO_2/kWh from the current threshold of 285 gCO_2/kWh, and should be progressively tightened over time. In achieving this, it is important that forest biomass comes from sustainably managed forests, meaning that carbon stocks should be maintained and possibly increased over time.

We will continue to monitor the addition of all types of biomass capacity and the development of sustainability criteria as part of our annual progress reporting.

Solar

Last year we highlighted a large increase in installed solar capacity driven by declining solar costs and over-generous support under the Feed-in Tariff (FiT) where 0.9 GW was added in 2011 compared with 0.1 GW in 2010. However, tariffs were cut by 40-70% for large-scale solar (over 50 kW) in August 2011 and further cuts for all new solar installations were introduced in April 2012 with ongoing reviews scheduled thereafter. Tariffs are now at a level that provides support similar to the subsidy for offshore wind under the RO.

Solar installations continued at a high level in 2012 (0.7 GW installed) although this was slightly down on 2011. Of this, over half (0.4 GW) came on line since the further tariff cuts came into force in April 2012, suggesting that solar generation is still profitable at these lower tariffs. This level of deployment is capable of generating around 0.6 TWh, equivalent to the output of around 0.25 GW of onshore wind, or 0.2 GW of offshore wind.

Last year we identified a risk that higher than intended deployment of solar could divert resources from more cost-effective low-carbon technologies under the levy control framework. This is less of a risk as tariffs fall, and if costs continue to decline there could be a greater role for solar PV than envisaged in our scenarios.

14 Approval rates refer to capacity-weighted average approval rates (as opposed to a simple average based on the number of projects).

Marine generation

Wave and tidal stream technologies remain at a very early stage, despite reaching record levels of deployment in 2012. 3 MW was added to the system, taking the total figure for installed capacity to 6 MW (0.006 GW).

The Government has increased support under the RO from 2 to 5 ROCs from April 2012 to March 2017 in line with that in Scotland and Wales, albeit subject to a 0.03 GW size limit.[15] However, so far this appears to be insufficient to bring forward new capacity without additional capital funding.

To date in 2013, two tidal stream projects, MeyGen Ltd in Scotland (0.4 GW) and Sea Generation Wales Ltd (0.01 GW), have won funding under the government's Marine Energy Array Demonstrator scheme (MEAD). MEAD was launched in April last year to support the development and testing of pre-commercial marine devices in array formations out at sea. These projects plan to become operational by 2015 (Sea Generation) and 2020 (MeyGen).

Looking forward, Siemens have opened a large testing and assembly facility for tidal installations in Bristol. Falmouth-based engineers Mojo have secured £3 million from the Technology Strategy Board for research into the HiFlo-4 project.

Transmission investment

Our indicator framework includes development of the UK's transmission network to support increased low-carbon capacity. These are based on the reinforcements identified by the Electricity Networks Strategy Group (ENSG).

In line with our indicator, the Allowed Revenue, the regulatory agreement of investment in new onshore transmission infrastructure, was announced in December 2012.[16] There has also been some progress with both onshore and offshore transmission investment, although in some cases this has been slower than we envisaged.

- **Onshore.** In December 2012, Ofgem provided final regulatory approval for up to £14.5 billion capital expenditure for transmission lines in England and Wales.[17] There has been some progress in the planning approval of new investments; the Western HVDC link (bootstrap, 2 GW) and Beauly-Denny (0.9 GW) lines are now under construction and on track to begin transmitting power respectively by 2016.[18] However, major delays of 2 to 4 years were announced late in 2012 for many projects in Northern Scotland and the reinforcements required in mid and north Wales remain behind schedule.[19] Our indicators envisaged that construction would begin in 2012 (mid-Wales) and this year (north Wales), but there have been continued delays in planning, largely due to local public opposition.

15 For larger projects, support remains at 2 ROCs for additional capacity in excess of 0.03 GW. This is designed to prevent unexpectedly large projects putting pressure on the RO budget, not to incentivise smaller projects.
16 This was under a new regime of price controls (RIIO T1). Ofgem (2012) *RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas*
17 Ofgem (2012) *Final Proposals for National Grid Electricity Transmission and National Grid Gas.* Figures are from accompanying press release, £ 2009/10 prices.
18 The 'bootstraps' are planned to connect onshore generation in Scotland with end-use in England.
19 National Grid (2012) *Summary of the Impact of the SHE Transmission programme changes – 20 December 2012.*

- **Offshore.** There is now 1 GW of capacity fully operational under the 'transitional' OFTO regime, with a further 3 GW in the process of competitive tendering. Although not yet operational, Ofgem expects a number of projects to qualify under the 'enduring' regime, delivering up to 30 GW of additional capacity over the next decade (Box 2.3). Although implementation of the new regulatory regime governing the offshore network has progressed more slowly than envisaged in our indicators, this does not appear to have affected the deployment of offshore wind to date.

Despite progress in transmission investment continuing to be slower than envisaged in our indicators, delivery of infrastructure when required remains feasible.

Box 2.3: Offshore transmission – progress implementing the transitional and enduring regimes

Ofgem estimate that up to £15 billion of investment in offshore transmission will be needed to connect new offshore wind to mainland substations over the next decade.[20] This will be brought forward under a new regulatory regime involving 'OFTOs' (Offshore Transmission Owners), whereby there will be competitive tendering (managed by Ofgem) for the right to build, own and operate offshore transmission networks. National Grid (as System Operator) will provide strategic oversight to ensure these networks are developed in a coherent manner. These will be tendered in two phases:

- **Transitional regime.** In earlier rounds (July 2009 – March 2012), offshore developers built the transmission assets but are then required to sell these assets to an OFTO under a competitive tendering process. To date, around £0.5 billion has been attracted through this round and Ofgem expect a further £2 billion of investment once all transitional projects reach financial close.[21]
- **Enduring regime.** Later projects (from March 2012) have the choice over whether to follow the OFTO model (where OFTOs design and build transmission assets), or whether to undertake construction themselves and transfer responsibility to an OFTO once construction is complete. Tendering for projects under this phase is expected to commence in the second half of 2013, but Ofgem have not published any expectations of when the first projects are likely to be operational.

There has been a slight delay in implementation of the OFTO regime, as our indicators envisaged that the first offshore connections under the enduring regime would become operational in 2012. However, this does not appear to have been a barrier to the deployment of offshore wind to date, as the level of total installed capacity in 2012 slightly exceeded our indicators (Figure 2.5).

4. Deployment of new nuclear

Nuclear generation accounted for one fifth of all generation in the UK in 2012; however 9.3 out of 10.6 GW will retire by the end of the next decade. Nuclear power can play an important role in the decarbonisation of the power sector providing sufficient capacity comes on line throughout the 2020s.

There are currently eight sites in the UK approved for new nuclear plants with a combined capacity potential of around 23 GW. EDF, Horizon and the NuGen consortium are at various stages of development in projects on a number of these sites. Last year we reported that the Horizon venture was up for sale; this has now been bought by Hitachi, continuing the intention to build around 6 GW of new nuclear capacity.

20 Ofgem website (accessed 20 May 2013). http://www.ofgem.gov.uk/
21 Ofgem website (accessed 20 May 2013). http://www.ofgem.gov.uk/

Our indicators track progress against development and deployment of the new nuclear power stations, based on a number of policy and project milestones. Two important milestones were passed in the last year with generic design approval of the Areva reactor design (for use by EDF) and planning permission granted for the Hinkley site, while a third key step of agreeing contract terms for the first plant is underway.

- **Approval of reactor designs.** Progress was delayed following the Fukushima incident and awaiting the outcome of the Weightman report (2011), which concluded that the UK displayed a strong safety culture with adequate existing procedures. The pressurised water reactor designed by Areva, which will be used by EDF and NuGen, received generic design approval by the regulator in December 2012. Horizon's planned boiling water reactor design was submitted for approval in January 2013, with a final decision expected by 2017/18.
- **Planning.** The EDF project at Hinkley Point C was also delayed and gained planning permission in March 2013, two years later than we initially expected.
- **Contracting.** The Government is currently negotiating with EDF over the level and terms of support for a new nuclear plant at Hinkley. Following agreement the project can reach final investment decision and potentially begin construction this year.

In March 2013, the Government published a strategy to support the development of the nuclear industry in the long term. The strategy sets out the key actions and approach needed to provide industry with the confidence to invest in new nuclear in the UK and to ensure the UK's role as a centre of excellence in the international market.[22]

In addition to the progress with new nuclear, EDF announced in December 2012 that it will extend the operating life of two of its existing plants by seven years (equivalent to around 1.7 GW), allowing them to generate until 2023. This will help manage the transition to new nuclear and will mean existing plants continue to play an important role in the UK generation mix.

The priorities now are to finalise the Electricity Market Reform, ensuring that contracts provide revenue certainty for investors and to agree an effective contract for the first new nuclear project. Agreement on the first project is needed in order for future projects to proceed and to unlock the benefits of a major nuclear programme for the UK.

5. Commercialisation of CCS

Carbon capture and storage (CCS) is a crucial set of technological options for reducing emissions in the medium to long term, as it can perform several key roles.

- It is a relatively flexible form of low-carbon electricity generation (when used with fossil fuels).
- It is an essential option to reduce emissions from carbon-intensive industry.
- It can maximise the emissions reduction potential of scarce bioenergy, generating negative emissions.

22 HMG (March 2013) *The UK's Nuclear Future.*

The near-term priority is to move ahead quickly with projects that demonstrate the viability of CCS at scale. DECC launched its CCS Commercialisation Programme in Spring 2012, which has since made progress towards funding two initial projects that could be operational in 2018/19 if they proceed as planned.

Two projects are being taken forward, with the intention to take final investment decisions (FIDs) in early 2015:

- Eight bids for support were received by the July 2012 deadline. In October 2012, DECC announced that four of these projects had been shortlisted: one gas post-combustion, one coal oxy-fuel and two pre-combustion coal projects.
- In March 2013, DECC announced that two of the four projects (the 340 MW gas post-combustion project at Peterhead and the White Rose 304 MW oxy-fuel coal project at Drax) had been selected as preferred bidders to negotiate Front-End Engineering and Design (FEED) contracts, with a view to taking FIDs in early 2015. This would allow them to complete construction and begin operation by 2018/19.
- The two other shortlisted projects, Captain Clean and Teesside (both pre-combustion coal), remain in reserve in case agreement cannot be reached with the preferred bidders.
- It will be important that the Government continues to learn the lessons of the earlier failed CCS Competition, including the need for rapid progress and avoiding traditional procurement processes unsuited to a complex first-of-a-kind project. If the FID date can be brought forward to the second half of 2014, this would be highly desirable.
- Scope for leveraging UK funding with that from the EU should be fully explored, particularly given the failure to access this funding in the context of the first phase of the NER300 (Box 2.4).

Given the slow progress to date, it is now questionable whether four CCS projects can be delivered by 2020, as set out in the Coalition Agreement in 2010. This could still be possible in principle, but would require the Government to proceed more quickly with other projects than currently planned.

- If the new timeline is kept to then the first two projects (either the preferred bidders or the reserve projects) should be operational by 2018/19.
- However, given that no further funding for FEED studies has been announced, it is not clear that further projects could follow soon afterwards, before 2020.
- Given the urgency to develop CCS and the benefits of keeping supply chain interest following the selection of the two preferred bidders, the Government should set out its approach to supporting a further two projects. This should include approaches to funding FEED studies and signing contracts, such that these further projects become operational in the early 2020s at the latest, noting the Coalition Agreement commitment to support four CCS demonstration projects.

– Should the two preferred bidder projects proceed, the two pre-combustion coal reserve projects would be candidates for subsequent support. It will be important to signal the next steps sufficiently early to avoid these potential projects disappearing due to a lack of clarity over future opportunities.

– The Don Valley project (also pre-combustion coal), which was top-ranked within the European NER300 process, was not shortlisted in the UK competition. However, it has previously undertaken a FEED study and has declared an intention to compete for a Contract for Difference, with FID possible in 2015.

Despite progress being slower than planned, the UK remains one of the leading countries in developing and demonstrating CCS given limited progress elsewhere (Box 2.4). Therefore, UK action towards CCS commercialisation is expected to make an important contribution to its development as a crucial option to reduce emissions globally.

Box 2.4: International progress in CCS demonstration

CCS has not been demonstrated on power generation at scale to date anywhere in the world. There remain only two large-scale CCS power generation projects under construction globally, although several smaller non-power projects using high-CO_2 gas streams have also emerged:

- The two power projects under construction are both driven by enhanced oil recovery opportunities in North America, and are both due to enter operation in 2014. The Saskpower project in Canada is a post-combustion retrofit to an existing coal plant, while the Kemper County project is a new-build pre-combustion coal plant.
- There are several other projects in North America outside the power sector, either now operational or due to be later in 2013, based on carbon capture from plants producing ethanol, hydrogen and fertiliser, as well as natural gas processing (all sources of flue gas with high CO_2 concentrations).

Within Europe, the first phase of the 'NER300', the mechanism to disperse funds from the sales of 300 million EU ETS permits from the New Entrant Reserve, awarded €1.2 billion for renewables but did not fund any CCS projects, although it remains possible that it may do so in the second phase.

- The only CCS project for which its national government was able to provide the necessary financial guarantees was at the Florange steelworks in France. However, this project failed to go ahead after the company withdrew.
- A second phase of the NER300 was launched in April 2013. This phase will disperse funds from the sale of the remaining 100 million permits, plus the €288 million funds remaining from the first phase (i.e. those allocated to the Florange CCS project).

The lack of progress on CCS demonstration within Europe was acknowledged in a communication in March 2013 from the European Commission[23], which described the extent of the shortfall in policy and funding to date, as well as the challenges still to be overcome. One of the policy options outlined to accelerate matters was for a Europe-wide 'CCS Obligation', requiring large emitters to deploy a certain quantity of CCS, or to buy certificates from those that have done so. Such a mechanism could raise considerable funds for the deployment of CCS, much of which could occur in the UK, given the UK's high proportion (around 50%) of candidate projects within the NER300 process.

We conclude that the UK remains one of the leading countries in developing CCS and that it will be important to ensure that the UK programme interfaces effectively with international action.

23 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the Future of Carbon Capture and Storage in Europe. Available at http://ec.europa.eu/energy/coal/doc/com_2013_0180_ccs_en.pdf

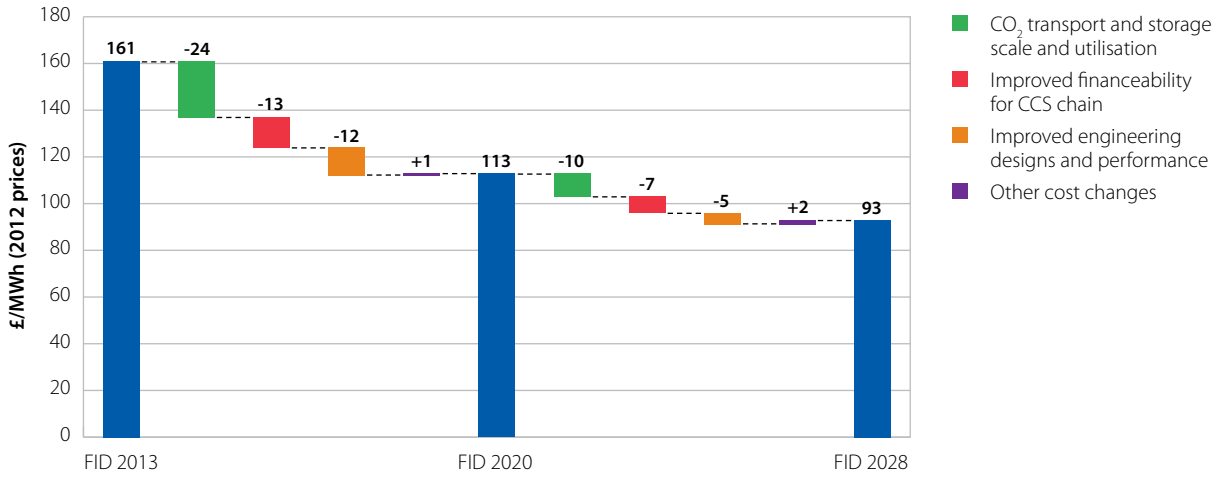
Another important development was the report by the CCS Cost Reduction Task Force, which set out the steps necessary for CCS to become a cost-competitive form of low-carbon generation. This analysis highlighted that only around 25% of the reduction in levelised cost of CCS power generation over the next 15 years will derive from reductions in the cost of component technologies. The remaining 75% would result from reducing the cost of capital by reducing the riskiness of investments and from increasing the scale and utilisation of CO_2 transport and storage infrastructure (Box 2.5).

Box 2.5: Findings of the CCS Cost Reduction Taskforce

The CCS Cost Reduction Taskforce was set up by DECC to advise Government and industry on the potential for reducing costs so that CCS generation projects are financeable and competitive with other low-carbon technologies in the early 2020s. The Taskforce's interim report was published in November 2012, focusing on the quantitative analysis, with the final report following in May 2013.

The report sets out the steps that would take the levelised cost of CCS power generation from around £160/MWh for projects with a final investment decision (FID) in 2013, to below £100/MWh for FID in 2028. These steps can be separated into three broad categories: improvements in the cost/performance of component technologies (around 25% of the cost reduction); increasing the scale/utilisation of CO_2 infrastructure (50%) and reductions in projects' cost of capital (25%) (Figure B2.5).

Figure B2.5: CCS cost reduction trajectory



Source: CCS Cost Reduction Taskforce (2013).
Notes: Chart shows average costs across technologies. Calculations assume DECC's central fossil fuel prices and carbon values (applied to residual CO_2 emissions). FID = Final Investment Decision.

Box 2.5: Findings of the CCS Cost Reduction Taskforce

The report sets out key next steps to support the large-scale development of power and industrial CCS in the UK, including:

- **Ensure optimal UK CCS transport and storage network configuration:** Conduct industry-led but government supported studies to identify options for developing configurations for the UK CCS transport and storage system for both early CCS projects and future CCS projects, in order to minimise long-run costs.
- **Create a vision for development of CCS Projects in the UK from follow-on projects through to widespread adoption:** Create an industry-led and government-supported vision of how subsequent phases of CCS projects in the UK can be developed and financed.
- **Promote characterisation of CO_2 storage locations to create maximum benefit from the UK storage resource:** Examine the options for characterisation of both storage areas and also specific sites for CO_2 storage in the UK Continental Shelf, and recommend a way forward to Government and industry.
- **Create policy and financing regimes for CCS from industrial CO_2:** Create proposed policy and financing regimes for the CCS of industrial CO_2.

The Taskforce's assessment highlighted the need – as we set out in last year's report, and reinforced in our recent report on Electricity Market Reform (see section 6) – for a longer-term Government strategy to commercialise CCS, beyond the initial plants being funded by the Commercialisation Programme.

Having begun moving forward with the first demonstration projects, it is important now that the Government has a clear strategy for moving beyond these to full commercialisation of the technology. Such a strategy should include:

- Scenarios for future investment in CCS, including minimum levels of investment and associated expectations of cost reductions. This would reduce the perceived riskiness (and therefore cost of capital) in this sector while enabling supply-chain investment and appropriate investment strategies (e.g. in CO_2 infrastructure).
- A strategy for the development of CO_2 infrastructure. This would encompass not only DECC's storage strategy, currently under development, but also what to build, how this would be funded and implications for locating new fossil and biomass power plants.
- How bioenergy and industry CCS projects will be brought into future phases of deployment, in a manner consistent with meeting our long-term emissions targets.

With a sense of urgency in taking forward the Commercialisation Programme, together with the development of a longer-term strategy beyond these initial projects, the Government would be well placed to deliver on its stated goal to make CCS competitive with other low-carbon technologies in the 2020s.

6. Progress on Electricity Market Reform

Electricity Market Reform (EMR) introduces long-term contracts for low-carbon generators to support power sector decarbonisation. Our report published in May this year, *Next Steps on Electricity Market Reform – securing the benefits of low-carbon investment,* showed this offers significant economic benefits.[24]

Decarbonisation involves paying a relatively small premium on energy bills in the near to medium-term, which we estimate to be around £100 on the typical annual household bill by 2020. Our estimate is broadly comparable with DECC's recent estimate (Box 2.6).

There has been important progress in EMR during the last year. Specifically the enabling legislation in the draft Energy Bill was introduced to Parliament on 29 November 2012. The Bill completed the Report stage in the House of Commons on 4 June before passing to the House of Lords the following day.

There are a number of outstanding technical issues which should be addressed as a matter of urgency, relating to contract design and the payment mechanism. These must be resolved as the Bill is finalised and in negotiations of specific contracts if investments that are currently being held up are to proceed.

Although the Energy Bill sets the right framework for EMR by introducing long-term contracts, it does not sufficiently resolve uncertainties to allow investments to proceed at lowest cost. That requires clarity in the Delivery Plan and allocation of sufficient funding under the levy control framework:

- **Delivery Plan.** The Government will publish its first draft Delivery Plan for EMR in July for consultation, to be finalised by the end of 2013. In order to support project development, the Delivery Plan should set out the quantity of capacity to be contracted (rather than commissioned) during the delivery plan period of 2014/15 to 2018/19, and the prices that will be offered for onshore and offshore wind generation. These prices, and possibly the quantities, should be subject to periodic review of new evidence based on transparent criteria, with a move to auctioning if practical.
- **Levy control framework.**[25] The level of funding confirmed for 2020 (£7.6 billion) is broadly sufficient to support required investments in renewables, nuclear and CCS, provided that it is calculated on an appropriate basis and that contracts can be signed at prices in line with costs over project lifetimes. These provisions should be clarified, otherwise there is a risk that there will be a funding shortfall of around £1.2 billion under our central assumptions:

24 In that report we set out analysis showing savings £25-45 billion, in present value terms under central case assumptions about gas and carbon prices, rising to over £100 billion with high gas and carbon prices.

25 The levy control framework sets a limit on the funding for support for certain DECC policies to be paid by consumers via energy bills. Here, it refers to the support for low-carbon generation under the Renewables Obligation, Feed-in Tariffs and Contracts for Differences under the EMR. It does not include required funding for other policies e.g. Warm Homes or ECO.

- **How spending is calculated.** The cost to consumers is best represented by the cost of low-carbon generation calculated against the full cost of gas-fired generation rather than the wholesale price of electricity. This reflects that investments in low-carbon generation with low marginal costs will tend to reduce the wholesale price (the so-called "merit order effect") to the advantage of consumers, as may the introduction of the capacity market. This will also give investors more certainty over what can be funded given uncertainties in predicting the wholesale price. If spending is instead calculated based on the wholesale price, then we estimate a funding shortfall of around £0.7 billion.
- **How contracts are defined.** The final details of the contracts under EMR could require accelerated depreciation of assets. Specifically, required prices could be higher if shortened contract lengths are offered, particularly for offshore wind.[26] It is not clear that these would offer better long-term value for consumers than the alternative of contracts which are commensurate with asset life. Full-length contracts should be seriously considered, but if shorter contracts are preferred, we estimate a further £0.5 billion of funding would be needed in 2020 under the levy control framework, with the expectation that the identified future benefits would more than offset this in later years.

There is also currently a significant risk that supply chain investment, which has long payback periods, and project development, which has long lead times, will not proceed due to uncertainty over the path for the power sector beyond 2020, with potentially serious adverse consequences:

- The Government has not yet set out its intentions for the direction for the power sector beyond 2020. There is therefore a high degree of uncertainty for low-carbon projects commissioning after this date. This uncertainty was compounded by the publication of the Gas Generation Strategy (and later in the CfD Impact Assessment published earlier this year) which included a scenario with almost no low-carbon investment in the 2020s such that carbon intensity remains at 200 gCO_2/kWh throughout the 2020s.[27]
- This uncertainty is problematic as regards supply chain investment required to drive innovation and cost reduction, and project development for investments to come on the system after 2020 (and possibly before). If not addressed it would risk failing to prepare sufficiently for meeting the 2050 target in the Climate Change Act to reduce economy-wide emissions by 80% relative to 1990 levels.

It is therefore essential to address this uncertainty in order that the EMR can be implemented in a way that gives value for money for consumers.

26 Some of the detailed technical issues to be resolved as the Bill is finalised (e.g. relating to change in law protection) could also increase required prices and therefore funding.
27 DECC (2012) *Gas Generation Strategy*; DECC (2013) *Electricity Market Reform – ensuring electricity security of supply and promoting investment in low-carbon generation [update: January 2013].*

In our May 2013 report, we identified a number of actions by which the Government could address the issue of uncertainty over the long-term direction:

- **Carbon-intensity target.** Set a target in legislation during this Parliament to reduce the carbon intensity of power generation to 50g CO_2/kWh by 2030. There should be some flexibility to adjust this in light of new information – for example, if costs fall less quickly than currently envisaged, or if achievable build rates are lower than expected.
- **Commercialisation strategies.** Publish strategies for the further development of offshore wind and commercialisation of carbon capture and storage, setting out the amount of intended investment to 2030 and cost reductions required to sustain this ambition.
- **Funding after 2020.** Extend the levy control framework beyond 2020 to 2030 with flexibility to adjust this in light of new information, for example about gas prices and technology costs. Our analysis suggests it would need to be £1-2 billion higher in 2030 than in 2020, with the range depending on the size of the CCS commercialisation programme in terms of deployment and scope of technologies supported.

The Government has recognised the value of setting a carbon-intensity target by including a provision to do so in the draft Bill. However, it does not intend to do this until 2016, by which time this will be a key priority.[28] For the interim period, the other measures above would help to improve the investment climate, and should be implemented in order to unlock the full economic benefit of the EMR and the move to a low-carbon economy.

28 A target has been set in Scotland at 50 gCO_2/kWh under Scotland's revised Offshore Wind Route Map, and the Scottish Government's draft second report on proposals and polices (RPP2).

Box 2.6: Impact of support for low-carbon generation on household energy bills – CCC and DECC analysis

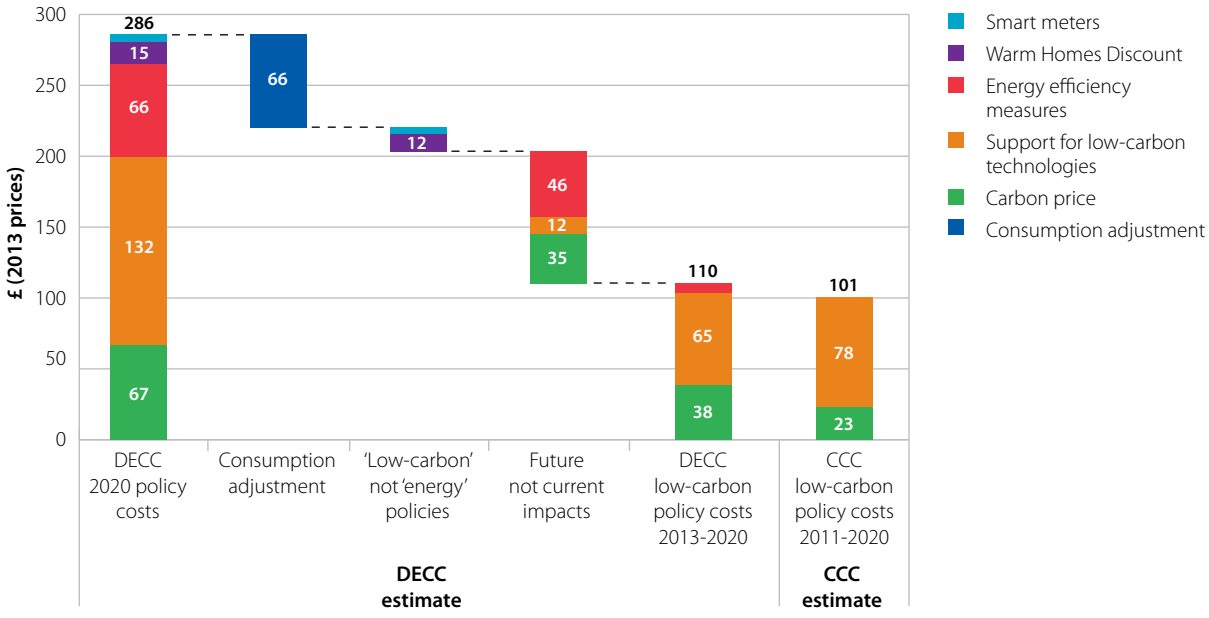
In our December 2012 report *Energy Prices and Bills – Impacts of meeting carbon budgets* we concluded that the impact of support for low-carbon generation would add around £100 to the typical annual household energy bill in 2020.

In March 2013, DECC published their assessment of the impact of energy policy on prices and bills, and also found that household bills will be higher in 2020 due to policy. To compare our analysis with DECC's, some adjustments are required (Figure B2.7):

- **Consumption adjustment.**
  - **Average versus 'dual-fuel' bill.** DECC considers the impact on the 'average' energy bill, based on electricity consumption including electrically-heated households. We focus on the dual-fuel bill (around 85% of households) and assess the impact on electrically heated households separately. As electrically heated households have very high annual electricity consumption (i.e. around 12,000 kWh compared to 4,000 kWh for a dual fuel household) our level of consumption (and therefore bill) for a household is lower than DECC's.
  - **Consumption baseline.** DECC also calculate costs against a hypothetical consumption baseline which reflects a world 'if there had been no past energy efficiency'. In contrast, we compare consumption against what it was in 2011.
- **Policy.** DECC include a wider set of policies that do not directly support the reduction of CO_2 emissions, such as the Warm Homes Discount (which provides a rebate for the fuel poor), and smart meters (which help customers monitor their energy use and bring down their bill).
- **Current versus future impacts.** DECC include the 'current' impact of policies in their headline figure, while our figure is an estimate the future cost and so does not include this.

After adjusting for these factors, we estimate that the comparable figure in DECC's analysis is an increase of around £110 (Figure B2.6). Furthermore, both we and DECC conclude that there is scope to more than offset the impact of higher prices due to support for low-carbon technologies with further energy efficiency measures.

Figure B2.7: DECC and CCC estimates of the cost of climate change policies on the household energy bill



Source: DECC (2013) *Policy impacts on prices and bills*; CCC (2012) *Energy prices and bills – impacts of meeting carbon budgets*; CCC calculations.
Notes: The first adjustment compares DECC's consumption on a consistent basis to CCC – i.e. reflects consumption based on a 'typical' dual-fuel household bill (using gas for heating and electricity for lights and appliances) rather than an 'average bill' (including electrically heated). It also reflects using today's consumption as a baseline rather than DECC's hypothetical consumption baseline of no past energy efficiency. The second adjustment reflects the impact of only assessing low-carbon policies rather than all energy policies e.g. removing Warm Homes Discount which assists low-income households. Finally we remove the costs of these policies to date; and only present the future impacts on the bill out to 2020.

Source: DECC (2013) *Policy impacts on prices and bills*; CCC (2012) *Energy prices and bills – impacts of meeting carbon budgets*; CCC calculations.

Key findings

- Power sector **emissions increased by 8%** to 156 $MtCO_2$ in 2012, driven by an increase in carbon intensity of electricity, as demand stayed constant.
- **Carbon intensity increased** by 10% to 531 gCO_2/kWh, reflecting the increase in highly carbon-intensive **coal generation** at the expense of gas. We expect this to be **temporary**, as EU legislation, end-of-life retirements and the carbon price floor, force coal off the system.
- **Achievable emissions intensity**, which measures underlying progress, **improved by 6%** to 315 gCO_2/kWh as more renewables were added to the system.
- A **record level of wind** capacity was added to the system in 2012 (2.4 GW), which if continued would be sufficient to reach our 2020 indicator. This is challenging given an apparent **bottleneck** for offshore wind projects moving into construction.
- Some key **milestones** were achieved for **nuclear**. The first site gained **planning approval** and **Generic Design Assessment** (GDA) approval and a further design was submitted for GDA. Agreeing the contract for the first project would open up the option of a larger nuclear programme.
- The second **CCS commercialisation programme** has selected two projects to enter Front-End Engineering Design studies. It is vital now to maintain **momentum**, with the Government setting out the approach for further demonstration projects and a longer-term **commercialisation strategy**.
- The **Energy Bill** introducing **long-term contracts** for low-carbon capacity is progressing through Parliament. Details of EMR are still to be **finalised** which are crucial to bringing forward **investment** in low-carbon power generation.
- The **Delivery Plan** should set out **capacity** to be contracted over 2014/15-18/19 and **prices** to be paid for wind. Funding under the levy control framework (LCF) should be clarified and adjusted if necessary. **Longer-term clarity** should be provided beyond 2020 through a 2030 target for carbon intensity, **commercialisation strategies** for less mature technologies, and **extending funding** under the LCF to 2030.

Table 2.1: The Committee's Power sector indicators

POWER		Budget 1	Budget 2	Budget 3	2012 trajectory	2012 outturn
Headline indicators						
Emissions intensity (g/kWh)		509	390	236	509	531
Total emissions (% change from 2007)		-15%	-39%	-64%	-15%	-12%
Generation (TWh/year)	Wind	21	50	98	20.9	19.4
	Nuclear	58	30	48	58.2	70.4
	CCS	0	5	11	0	0
Supporting indicators						
Transmission						
Agreement on incentives for anticipatory investment for Stage 1 reinforcements		2010			In place	Scottish TO's business plans agreed, National Grid (NGET) revenue controls finalised Dec 2012
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, but yet to be implemented
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		Major delays of 2-4 years for many SHE projects, Wales Stage 1 (Central) a serious concern	
Grid reinforcement 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		Scotland Stage 1 in construction, but delays in planning for Wales Stage 1 (Central) and London	

Table 2.1: The Committee's Power sector indicators

POWER		Budget 1	Budget 2	Budget 3	2012 trajectory	2012 outturn
Grid reinforcements 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 2012	
Tendering for first offshore connections under enduring OFTO regime		2010	2017: Wales Stage 1 (North), English East Coast Stage 1,		In place	Continuing to tender under transitional regime. Enduring regime tenders now expected later in 2013.
Construction of first offshore connections under enduring OFTO regime begins		2011	South West	2018: Scotland Stage 2	Still under transitional regime	
First offshore connections under enduring OFTO regime operational		2012			Delayed	
Planning						
IPC set up and ready to receive applications		2010				Replaced by MIPU in April 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				Energy Bill introduced long-term contracts, technical details need to be resolved and clarity needed for investors after 2020
Wind						
Generation (TWh/year)	Onshore	13	26	44	12.9	11.9
	Offshore	8	24	54	8.0	7.5
Total capacity (GW)	Onshore	5.7	10.8	18.0	5.7	5.9
	Offshore	2.5	7.4	16.6	2.5	3.0

Table 2.1: The Committee's Power sector indicators

POWER		Budget 1	Budget 2	Budget 3	2012 trajectory	2012 outturn
Wind (continued)						
Capacity entering construction (GW)	Onshore	0.9	1.3	1.5	0.9	1.3
	Offshore	0.9	1.6	2.6	0.9	0.6
Capacity entering planning	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	2.9
	Offshore	New planning applications will be expected in line with site leasing			No trajectory	6.5
Average planning period (months)		<12	<12	<12	<12	33
Nuclear						
Regulatory Justification process		2010			In place	In place
Generic Design Assessment		2011			In place	Final approval December 2012
National Policy Statement for nuclear (including Strategic Siting Assessment)		2010			In place	Approved July 2011
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	In place
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		In place	Approved March 2013
Construction begins			First plant in 2013, subsequent plants at 18 month intervals		n/a for 2012	
Plant begins operation				First plant in 2018, with subsequent plants at 18 month intervals*	n/a for 2012	

Table 2.1: The Committee's Power sector indicators

POWER	Budget 1	Budget 2	Budget 3	2012 trajectory	2012 outturn
CCS					
Front-End Engineering and Design (FEED) studies for competition contenders initiated	End 2009			Initiated	Initiated early 2010
FEED studies for competition contenders completed	2010			Completed 2010	Completed 2011
Announce competition winner	2010			Announced 2010	Funding not awarded, 2011
Second demonstration competition	Launch 2010, announce winners 2011			Initiated 2010	Initiated 2012
Quantification of saline aquifer CO2 storage potential		No later than 2015		Research initiated/ongoing	
Review of technology and decision on framework for future support		No later than 2016**		n/a for 2012	
Strategic plan for infrastructure development		No later than 2016		n/a for 2012	
Planning and authorisation approval, land acquisition, and storage site testing completed, construction commences	First demo in 2011	Subsequent demos 2012/13		First demo not yet commissioned	
Demonstrations operational		First demo in 2014, subsequent demos 2015/16***		n/a for 2012	
First new full CCS plants supported via the post-demonstration mechanism			2022	n/a for 2012	
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.					

Notes: Budget numbers indicate the number in the last year of budget period e.g. 2012, 2017, 2022

* 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

Introduction and key messages

1. Building emissions trends
2. The Committee's buildings indicator framework
3. Residential buildings
4. Non-residential buildings
5. Low-carbon heat options

Chapter 3: Progress reducing emissions from buildings

Introduction and key messages

In this chapter we look at emissions from buildings, which account for 37% of total UK greenhouse gas emissions. As a significant part of buildings emissions are related to space heating, they can fluctuate significantly year-on-year depending on winter temperatures. For example, in our 2012 progress report to Parliament, we documented a 12% fall in buildings emissions in 2011. We showed that this was mainly a result of reduced gas use due to milder winter temperatures compared to the unusually cold winter months of 2010.

Here we consider 2012 data on buildings emissions and energy consumption (with and without temperature adjustment), as well as data on the implementation of key abatement measures, with a focus on energy efficiency improvement and investment in low-carbon heat. We also discuss progress against policy milestones, given that we have previously highlighted the need for policy innovation to deliver the required abatement measures.

The key messages in the chapter are:

- Buildings CO_2 emissions increased by 10% in 2012. This reflects an increase in indirect (electricity) emissions due to higher electricity grid intensity (see chapter 2), as well as a rise in direct emissions due to lower winter temperatures than in 2011.
- In terms of the implementation of energy efficiency measures, there was good progress on cavity wall and loft insulation, as energy suppliers increased their activities to ensure they would meet their targets under the previous supplier obligations which came to an end in December 2012. However, we have previously pointed to the delivery risks (e.g. due to insufficient incentives for loft and cavity wall insulation) associated with the new policy approach – the Green Deal and the Energy Company Obligation. There is no evidence from the schemes' first few months of operation that these risks have subsided. Therefore, concerns remain about potentially low levels of delivery and the Government should consider further incentives.
- In the non-residential sector, simplification of the CRC energy efficiency scheme beyond our original recommendations has further eroded the incentives to improve energy efficiency it set out to provide. The abolition of the performance league table means that there is now no reputational incentive, while the financial incentive provided by the scheme remains weak. The non-residential Green Deal has been launched but uncertainty remains over minimum energy performance standards for the private rented sector, which will provide a crucial incentive for commercial landlords to engage in the Green Deal. The Government should conduct a comprehensive assessment of non-residential low-carbon policies to ensure they work effectively.

- Low-carbon heat uptake continues to be slow. In order to remain on track to deliver a 12% uptake in 2020, revisions to the non-residential scheme, the introduction of the residential renewable heat incentive, certainty of tariffs after 2015 and a range of supporting measures to overcome non-financial barriers are required.
- Overall, there is a need for policy strengthening and consistency across all buildings sectors and policies.

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

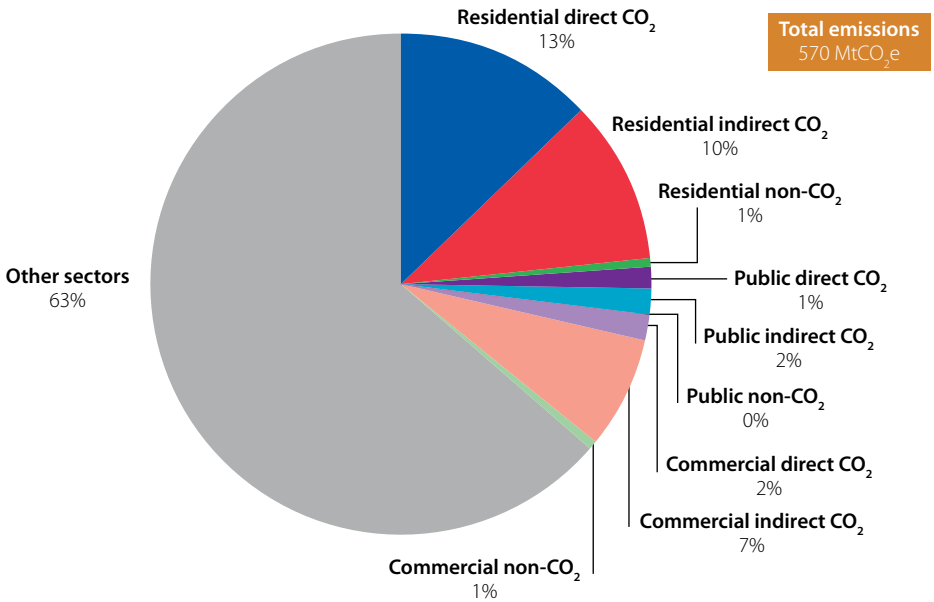
1. Buildings emission trends
2. The Committee's buildings indicator framework
3. Residential buildings
4. Non-residential buildings
5. Low-carbon heat options

1. Building emissions trends

Overview

Emissions from buildings accounted for 37% of total UK greenhouse gas emissions in 2012 (Figure 3.1). Residential emissions account for 66% of buildings emissions, with commercial and public sector emissions accounting for 26% and 8% respectively. They comprise 45% direct CO_2 emissions (i.e. from burning fossil fuels) and 55% indirect (grid electricity-related) emissions.

Figure 3.1: GHG Emissions from buildings in the context of total UK emissions (2012)



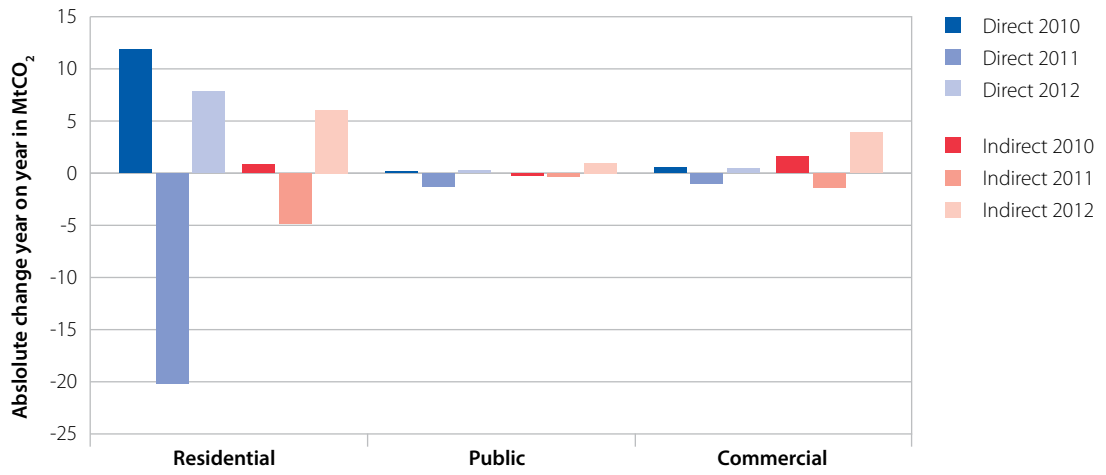
Source: NAEI (2013), DECC (2013), *Energy Trends*, March 2013, DECC (2012) DUKES; CCC calculations.
Notes: 2012 emission estimates are provisional. Commercial sector and non-CO_2 are based on CCC estimates.

Between 2003 and 2008, buildings CO_2 emissions fell by 3%, mainly due to improved energy efficiency. Since 2008, buildings emissions have fallen by 8% but have shown year-to-year fluctuations due to economic and temperature effects, i.e. while in 2009, emissions dropped 10% due to rising fuel prices and the recession, they increased by 7% in 2010 due to cold weather, but fell again (by 14%) in 2011 due to warmer winter months and rising fuel prices.

In 2012, preliminary data suggests that both direct and indirect emissions rose across all three buildings sectors by 11% to 202 $MtCO_2$ (Figure 3.2). Indirect emissions rose by 11 $MtCO_2$ (11%), largely due to an increase of highly carbon-intensive coal generation at the expense of gas in the power sector (see chapter 2). This was driven by a low global wholesale price of coal and a low carbon price, which increased the carbon intensity of electricity by 10%.

Although temperatures in 2012 were not colder than the long-term average, direct emissions nonetheless rose by 10% due to the colder temperatures compared to 2011, which had particularly mild winter temperatures.

Figure 3.2: Change in direct and indirect buildings CO_2 emissions



Source: NAEI (2013), DECC (2013), *Energy Trends*, March 2013, DECC (2012) DUKES; CCC calculations.
Notes: 2012 emission estimates are provisional. Commercial sector and non-CO_2 are based on CCC estimates.

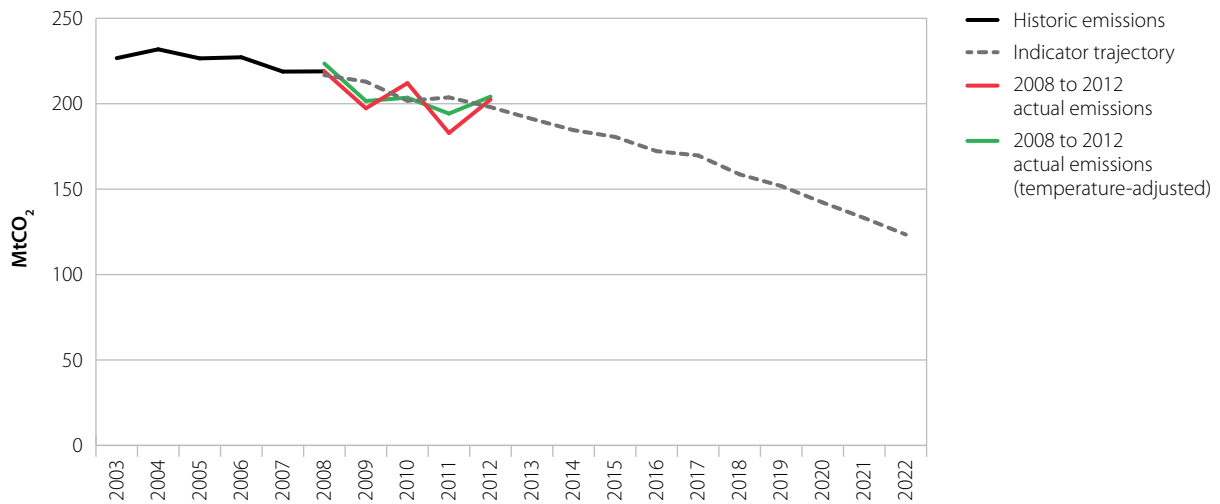
Overall, emissions were 2% above the level we envisaged when we set out our progress indicators in 2009:

- 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 the impact of the prolonged economic downturn on emissions, which was particularly pronounced in the non-residential sector. They assumed temperatures as in a typical year (i.e. based on the average of the period 1971-2000), and therefore did not allow for fluctuations due to lower than average winter temperatures in 2010 and higher than average temperatures in 2011 (Figure 3.3).

- Emissions from buildings were 4 Mt CO_2 above our trajectory in 2012 despite the continued effects of the sluggish economy. Adjusting for temperature, emissions from buildings were 6Mt CO_2 above our trajectory, as temperatures in 2012 were just above average.
- Without the increase in emissions intensity from the electricity grid, emissions from buildings in 2012 would have been 3% below the 2009 trajectory (or 2% when also adjusting for temperature).

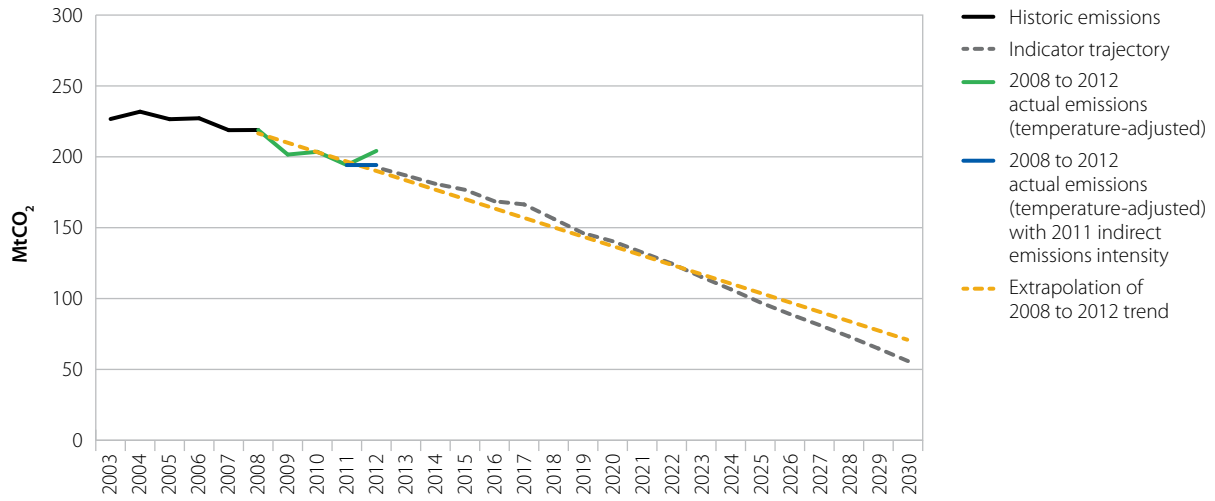
Our assessment (see chapter 2) is that it is unlikely that the increase in coal burn will be sustained in the medium-to-long term, due to the age of existing plants, existing environmental legislation and the UK's carbon price floor. However, even if the higher grid intensity is a temporary effect, it remains the case that the implementation of measures at current rates is not sufficient to meet the fourth carbon budget, notwithstanding the impacts of the economic downturn (Figure 3.4). Furthermore, there are significant risks that the new policy framework (especially in the residential sector) will result in an even lower implementation rate for key measures.

Figure 3.3: All buildings – historical emissions vs original indicator trajectory (2003-2022)



Source: NAEI (2013), DECC (2013), *Energy Trends*, March 2013, DECC (2012) DUKES; CCC calculations.
Notes: 2012 emission estimates are provisional. Temperature adjustment is based on CCC calculations.

Figure 3.4: All buildings – fourth carbon budget trajectory vs underlying trend (2003-2030)



Source: NAEI (2013), DECC (2013), *Energy Trends*, March 2013, DECC (2012) DUKES; CCC calculations.
Notes: 2012 emission estimates are provisional. Temperature adjustment is based on CCC calculations.

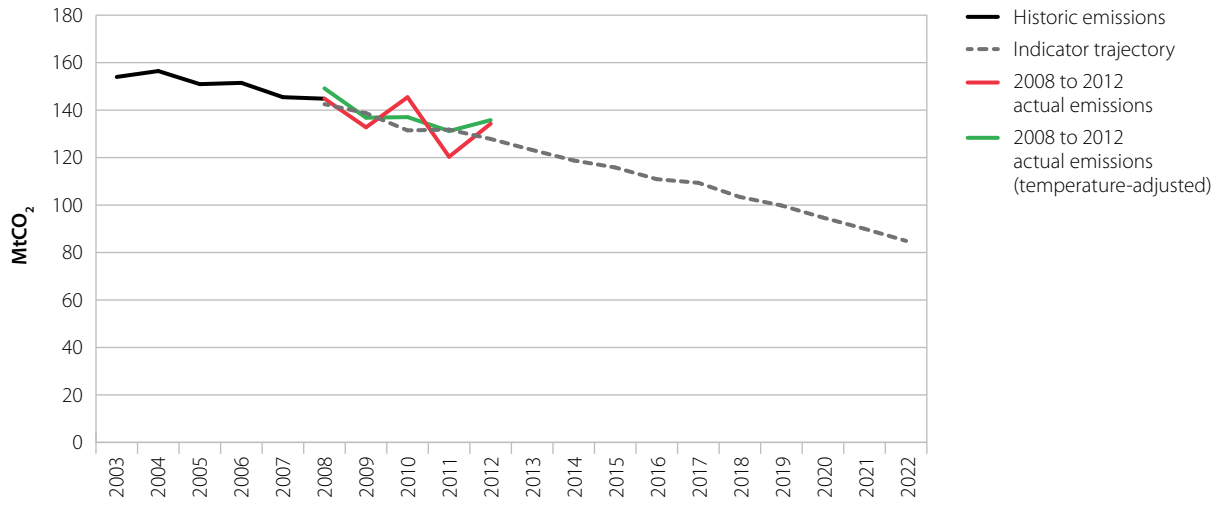
Residential buildings

Total residential emissions increased by 12% to 134 $MtCO_2$, largely due to the 10% rise in the grid emissions intensity and the reduction in temperatures between 2011 and 2012:

- Direct residential emissions account for 55% of total residential emissions and increased by 12% in 2012. Gas consumption increased despite a sustained increase in gas prices in 2012. Adjusting for the colder temperatures in 2012 accounts for nearly all the increase in direct emissions. This suggests that taken together the implementation of measures and the increase in gas prices did not have a significant impact on emissions.
- Indirect residential emissions account for 45% of residential emissions and increased by 11% in 2012. Electricity consumption increased despite an increase in electricity prices of 4%. The increase in emissions is mainly (10%) due to the higher carbon intensity of power generation, with the remainder due to the colder temperatures compared to 2011.

Overall, residential emissions were above our indicator trajectory (Figure 3.5). This is of concern, in particular in relation to the recent transition in energy efficiency policy, which creates a high degree of delivery risk (see section 3). This means that from 2013 onwards it is likely that there will be a much slower delivery of measures than is implied by our trajectories.

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



Source: NAEI (2013), DECC (2013), *Energy Trends*, March 2013, DECC (2012) DUKES; CCC calculations.
Notes: 2012 emission estimates are provisional. Temperature adjustment is based on CCC calculations.

Commercial buildings

After a 5% fall in emissions in 2011, total commercial emissions increased by 9% in 2012.

- Direct commercial emissions account for 18% of total commercial emissions and increased by 5% in 2012.
- Indirect commercial emissions account for 82% of commercial emissions and increased by 10% in 2012, reflecting the 10% increase in electricity grid carbon intensity.

Stripping out grid-related and temperature factors, commercial sector emissions have stayed broadly flat in the last two years, continuing a trend observed in the five years before the economic crisis.

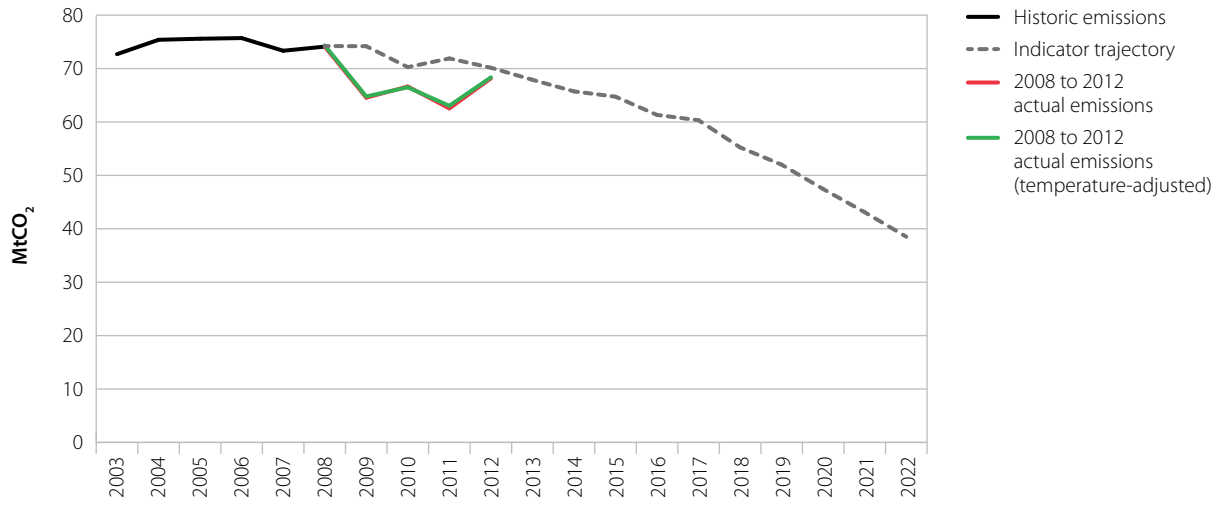
Public sector

Public sector CO_2 emissions in 2012 increased by 8% due to the higher grid intensity and the lower temperatures in 2011:

- Direct public sector emissions account for 43% of total public sector emissions and increased by 4% in 2012.
- Indirect public sector emissions account for 57% of public sector emissions and increased by 11% in 2012, mostly due to the rise in the electricity grid emissions intensity.

Despite the increases in 2012 in both public and commercial emissions, the emissions from the non-residential sector are still below our indicator trajectory for 2012 (Figure 3.6), following on from the sustained year-on-year decreases in emissions between 2008 and 2011. This is likely to be due to a mix of factors, including the recession. When accounting for temperatures and the increase in emissions intensity of electricity, non-residential emissions have been fairly flat since 2011. This reinforces the fact that further efforts are required in order to unlock the significant abatement potential in the sector.

Figure 3.6: Non-residential sector – historical emissions vs original indicator trajectory (2003-2022)



Source: NAEI (2013), DECC (2013), *Energy Trends*, March 2013, DECC (2012) DUKES; CCC calculations.
Notes: 2012 emission estimates are provisional. Temperature adjustment is based on CCC calculations.

2. The Committee's buildings indicator framework

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

Residential indicators

- Insulation of all lofts (10.5 million) and cavity walls (8.1 million) by 2015.
- Insulation of 2.3 million solid walls by 2022.
- Replacement of 12.6 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.

Low-carbon heat indicators

- Increasing investment in low-carbon heat to achieve a 12% penetration of total heat.

The indicator framework also includes policy milestones to support the implementation of measures, including the extension of energy performance labelling to all buildings and accelerating the introduction of minimum standards for privately rented residential properties.

In assessing progress towards meeting carbon budget in the buildings sector, we first consider the residential sector, where we consider implementation rates for measures such as energy efficiency improvement and look at key policy milestones. We then turn to developments in the non-residential sector, and finish by assessing progress towards ramping up levels of low-carbon heat.

3. Residential buildings

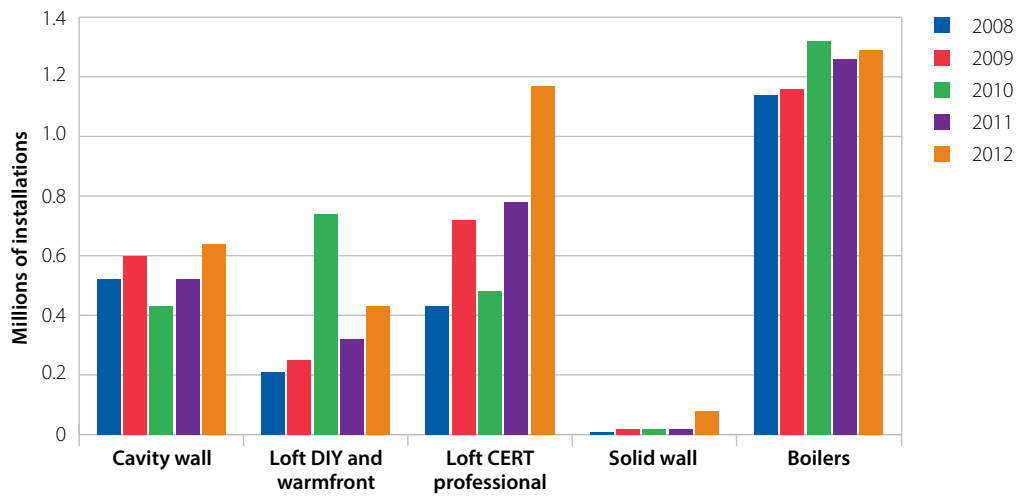
Implementation of insulation measures

Improving energy efficiency through home insulation is important both for reducing emissions and for reducing energy bills.

2012 was the final year of operation for the Carbon Emission Reduction Target (CERT) and the Community Energy Saving Programme (CESP). Energy companies had to deliver large numbers of installations to ensure they met their targets. This meant that installation numbers were up on 2011:

- **Lofts.** Rates for professionally installed loft insulation increased by 50% in 2012 to 1.17 million. DIY loft installations also increased by 35% to 433,000, together giving an installations figure of 1.6 million, up from 1.1 million in 2011 (Figure 3.7). This was despite a 95% drop off in loft installations under the Warm Front programme which came to an end in early 2013 (see below). As noted in our previous report, professional installations give greater confidence in the associated levels of carbon savings being achieved, whereas DIY installations numbers might be subject to some double counting and lower carbon savings.
- **Cavity walls.** Installations of cavity wall insulation measures were also up in 2012 by 22%, with a total of 637,000 installations, almost exclusively under CERT.

Figure 3.7: Installation of residential insulation measures (2008-2012)



Source: Ofgem (2012 and 2013), DECC (2012) Estimates of home insulation levels in Great Britain; CESP data; CCC Calculations.
Notes: 2012 CERT professional includes 0.02 million lofts insulated under CESP.

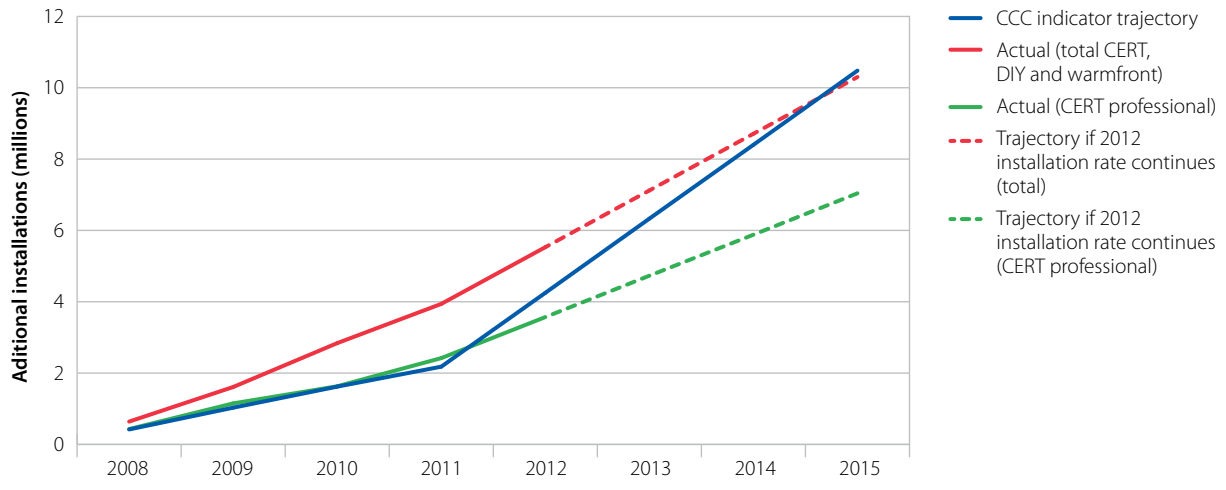
- **Solid walls.** Overall, around 68,000 solid walls were insulated under CESP, compared to just 14,000 under CERT. Although the levels remain low, this represents a fourfold increase from installation rates in 2011.

While 2012 saw a ramp-up in activity, this is likely to have slowed considerably in 2013 as the new market-based policy framework (see below) became operational, which has ended the large subsidies previously provided for loft and cavity wall insulation. For example, industry figures suggest that in the first three months of 2013, less than 44,000 cavity walls were insulated compared to more than 140,000 in the first three months of 2013.

- The rate of loft insulation is above our indicator trajectory when including DIY figures (Figure 3.8), reflecting the success of the CERT policy. Whilst installations increased under the final year of CERT and CESP with suppliers expending efforts to meet CERT targets, it is will be difficult to maintain these rates under the Green Deal and the Energy Company Obligation (ECO), particularly as no clear targets are in place for the Green Deal and the ECO has less focus on lofts and cavities than CERT and CESP.
- Cavity wall insulation figures remain below the trajectory (Figure 3.9). This is in part due to an increase in uptake rates envisaged in our indicator trajectory from 2011 which has not occurred in practice. When we developed the indicators in 2009, the trajectory was based on forecast uptake under CERT and CESP, with an increase in rates from 2012 in order to meet the previous government's policy commitment of insulating all lofts and cavities by 2015.

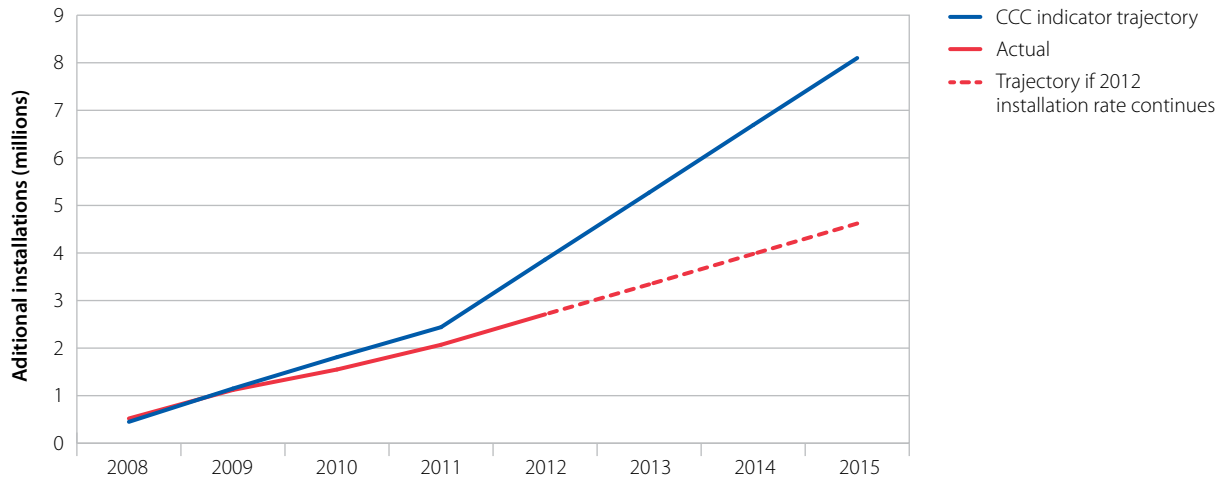
There is some uncertainty about the number of uninsulated lofts and cavity walls that remain. DECC has recently undertaken research under the National Energy Efficiency Database (NEED) framework which has led to revised Government estimates of the number of remaining lofts and cavity walls that can practicably be insulated. We will review this evidence and our indicator trajectory as part of the fourth carbon budget review later this year and next year's progress report, where we will undertake a full evaluation of the first carbon budget.

Figure 3.8: Loft insulation cumulative installations (2008-2015)



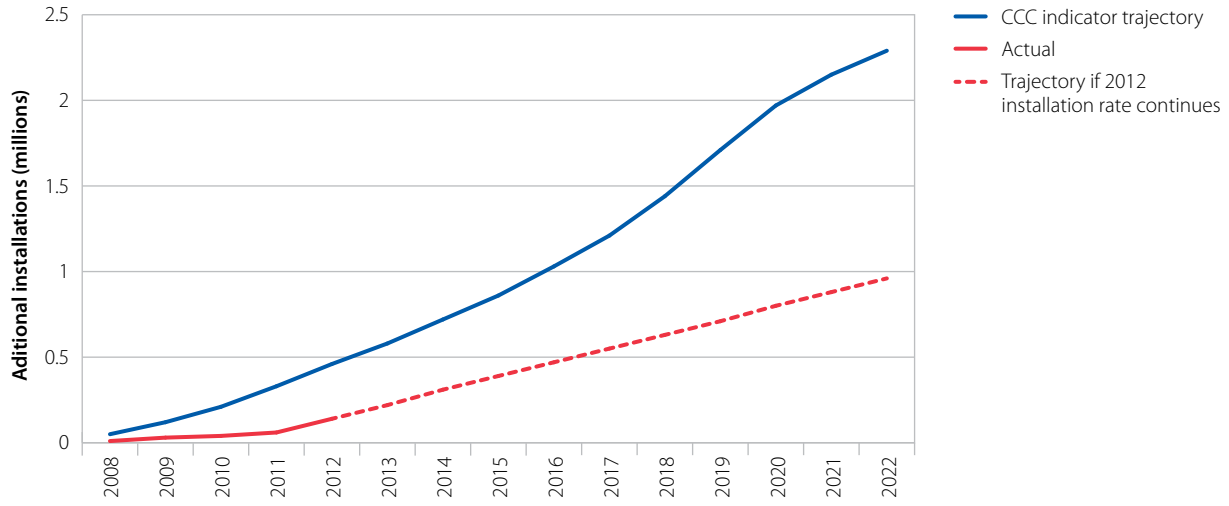
Source: Ofgem (2012 and 2013), DECC (2012) Estimates of home insulation levels in Great Britain; CESP data; CCC Calculations.

Figure 3.9: Cavity wall insulation cumulative installations (2008-2015)



Source: Ofgem (2012 and 2013), DECC (2012) Estimates of home insulation levels in Great Britain; CESP data; CCC Calculations.

Figure 3.10: Solid wall insulation cumulative installations (2008-2022)



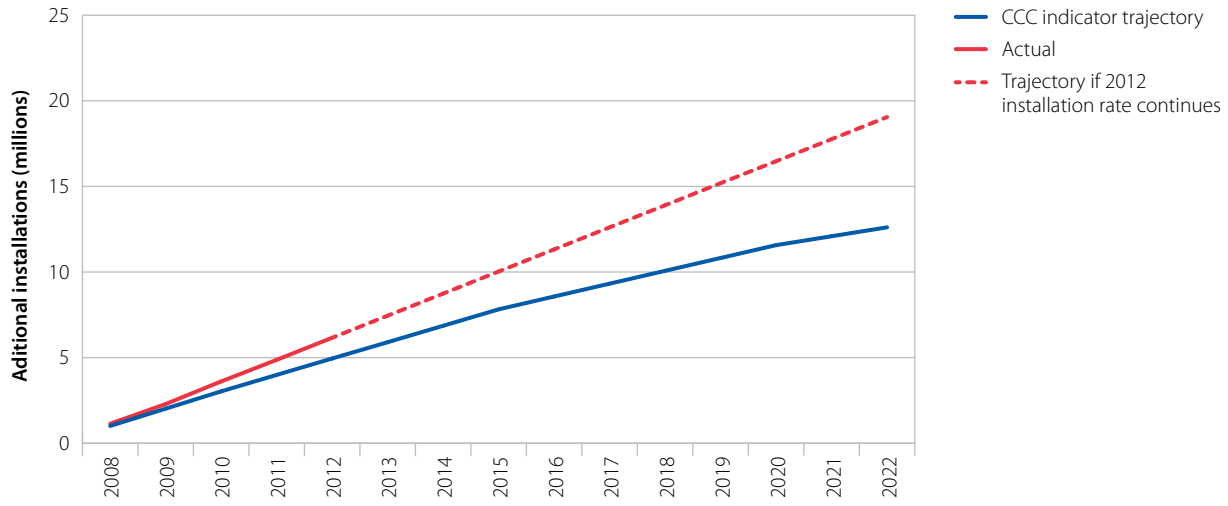
Source: Ofgem (2012 and 2013), DECC (2012) Estimates of home insulation levels in Great Britain; CESP data; CCC Calculations.

Solid wall insulation continues to be well below the trajectory (Figure 3.10), despite the increase in rates of uptake. The new policy framework of the Green Deal and ECO is expected to deliver increased numbers of solid wall installation, although still significantly below our trajectory.

Boiler replacement

As in previous years, boiler replacement continued at a steady pace. In 2012, 1.3 million efficient boilers were installed, up 2% from 2011 levels (Figure 3.11).

Figure 3.11: A-rated boilers cumulative installations (2008-2022)



Source: DCLG (2012) Housing statistics – Table 241, Heating and Hot Water Industry Council (2013); CCC calculations.

In future, we would expect the pace of boiler replacement to be maintained, or possibly to increase, given that it is a qualifying measure under the Green Deal. This may encourage homeowners to replace their inefficient boilers before the end of their life.

Energy efficient appliances

As we noted in our 2012 progress report, the Government no longer monitors the sale of energy efficient appliances. It has therefore not been possible to access appliance data to monitor progress against our indicators.

Considering the large savings expected from products policy (e.g. the Government expects energy savings of 20% from more efficient appliances and lighting in the residential sector by 2020), we strongly recommend that the Government establishes a monitoring programme to ensure product policy meets its objectives.

Policy milestones

Final year of delivery under CERT & CESP

From 2008 to 2012, the main policy instrument for delivery of residential energy efficiency measures in Great Britain[1] was the Carbon Emission Reduction Commitment (CERT), requiring energy suppliers to deliver a range of carbon saving measures, with specific targets for insulation measures and assisting fuel poor and vulnerable households. In addition, the Community Energy Saving Programme (CESP), required suppliers and generators to deliver area-based energy efficiency programmes. Both programmes finished at the end of 2012 and broadly were successful:

1 Northern Ireland has a separate scheme (Box 3.1).

- 99% of CERT and CESP targets were achieved, with some companies overachieving some of their targets by up to 20%. However, six energy companies will be investigated by Ofgem for failing one or more of their targets.
- While in the early years, lighting was a particular focus of CERT (with almost 304 million compact fluorescent lamps delivered to Britain's 25 million households), since 2010 the focus has been on insulation.
- Since 2008, CERT and CESP resulted in more than 4 million lofts being insulated professionally (and many more on a DIY basis through subsidised loft insulation material), as well as 2.5 million cavity walls and almost 150,000 solid walls.

However, at the end of the CERT and CESP period, there were still an estimated 5-7 million lofts with insufficient levels of insulation, as well as 4-5 million unfilled cavity walls. While the programmes made a start in insulating the UK's 7-8 million inefficient solid walls, much larger installation numbers will need to be delivered to help meet carbon budgets.

Green Deal and ECO

As of early 2013, CERT and CESP have been replaced by the Green Deal and the Energy Company Obligation (ECO):

- **Green Deal:** This is a new financing framework to facilitate energy efficiency improvements and low-carbon heat in homes and non-residential properties, funded by a charge on electricity bills that avoids the need for consumers to pay upfront costs.
- **Energy Company Obligation (ECO):** ECO creates a legal obligation on energy suppliers to improve the energy efficiency of households through the establishment of three distinct targets – the Carbon Emissions Reduction Obligation (20.9 million 'lifetime' tonnes of CO_2, i.e. savings over the lifetime of the measures installed), the Carbon Saving Community Obligation (6.8 million lifetime tonnes of CO_2), and the Home Heating Cost Reduction Obligation (£4.2 billion of lifetime cost savings, focused on fuel poor households).

The two mechanisms are expected to work hand in hand, with the Green Deal for example helping to finance solid wall measures which also receive support under the ECO.

Finance

Financing for the Green Deal is being provided through the Green Deal Finance Company, which initially has £244 million available, provided by:

- Committed funding of £69 million from 16 members of the Green Deal Finance company and other stakeholders (including energy suppliers, potential Green Deal installers and DECC)
- An additional Junior Capital Facility of £20m and a Contingent Capital Facility of up to £30 million provided by DECC
- A senior debt facility of £125 million provided by the UK Green Investment Bank.

However, interest rates charged for Green Deal plans are close to 7%, which earlier consumer research had suggested would be unattractive to householders. It is also a major change from CERT and CESP where measures were given away for free or a very low fee.

To provide incentives for early adopters, the Green Deal has also received a £200 million support package from the Treasury which is being used for cashback incentives and to support local authorities. The Government has also run an advertising to promote the Green Deal.

Local authority involvement

In our 2012 local authorities report, we highlighted the importance of local authorities in delivering the Green Deal and the need for some Government funding to support local authorities in becoming engaged in the Green Deal. DECC has since provided £13 million for eight Green Deal Low Carbon Cities (Birmingham, Bristol, Leeds, Liverpool, Manchester, Newcastle, Nottingham and Sheffield) to test elements of the Green Deal framework such as assessment and installation between October 2012 and May 2013.

In addition, in late 2012, DECC established a Green Deal Pioneer Places Fund of £10 million for additional local authorities to demonstrate ambitious approaches to kickstart local activity in the residential and non-residential sector, including:

- Promoting Green Deal-ready plans through creating a portfolio of households willing to enter Green Deal plans
- Adopting a street-by-street/area-based approach to projects
- Establishing the basis and developing innovative approaches for driving future Green Deal demand
- Developing strong local Green Deal delivery networks and partnerships.

Forty local authorities/consortia were allocated funding. However, the funding had to be spent in a very short time period (January to May 2013) and no further funding has been made available.

Several local authorities have announced major Green Deal plans, for example:

- Birmingham City Council has partnered with Carillion to launch Birmingham Energy Savers, potentially worth £600 million over eight years and aiming to retrofit 60,000 homes.
- Leeds City Region (11 local authorities) are looking to work with one provider to deliver Green Deals for 12,000 homes over three to four years, estimated to be worth £100 million.
- West Sussex Council is currently procuring for a £750 million contract. The Council will directly provide £75 million, with the rest to be leveraged through the Green Deal and ECO.

To encourage local authority involvement in energy efficiency delivery, DECC published revised Home Energy Conservation Act (HECA) guidance in July 2012 outlining new responsibilities and reporting requirements for local authorities. Local authorities were required to submit new reports by the end of March 2013 setting out practical and cost-effective energy efficiency

measures in residential buildings. Subsequent progress reports must be published at two-year intervals.

To date, around 75% of local authorities have submitted reports outlining current trends in emissions, energy use, and demographics, uptake of energy efficiency measures, energy efficiency ambitions and priorities, and action plans to deliver measures (including summary of local and regional schemes such as ECO and Green Deal). DECC will publish a full analysis of these reports by the end of June.

These are encouraging developments and we will monitor in future progress reports how local authority schemes deliver.

Initial take-up

In our 2012 progress report, we pointed out that there is a set of risks around the new market-based policy and that the estimated installation numbers under the Green Deal and ECO are substantially below our insulation indicator trajectories, thus resulting in a potential carbon gap of at least 3 $MtCO_2$. This is due to insufficient incentives under the Green Deal and ECO, especially for lofts and cavity wall insulation (e.g. high interest rates under the Green Deal and much more restrictive criteria for cavity wall insulation support under the ECO compared to CERT).

DECC is planning to publish the first actual take-up figures for the Green Deal and ECO at the end of June 2013. In the absence of this, only limited data is available on the first few months (until April 2013) of the Green Deal/ECO operation:

- 152 Green Deal Assessor Organisations and the 1,274 Green Deal Advisors they employ had been accredited
- 18,816 Green Deal Assessments had been lodged
- £85.5 million worth of contracts had been let through the ECO brokerage system.

It is too early to assess how these initial activities will translate into actual measures. However, there are signs that compared to 2012 the implementation of measures in early 2013 has proceeded at a slow pace. For example, registration figures for cavity wall and solid wall insulation under the official guarantee schemes suggest that uptake has been very low in the first few months of 2013, with a drop of more than 60% compared to the same period in 2012. According to industry sources, a similar drop has been seen in loft insulation when comparing sales in the period March to May 2013 to the last quarter of CERT.

Overall, despite some positive signs such as local authority involvement, the initial evidence from the operation of the Green Deal and ECO does not suggest that the delivery risks have subsided. Additional incentives are likely to be needed. The Government should therefore carry out an early review of the policies.

Supporting measures

We suggested in our 2012 progress report that incentives need to be strengthened to ensure the remaining potential for loft and cavity wall insulation is exploited. Wales and Scotland have additional energy efficiency policies, while Northern Ireland operates a totally separate scheme (Box 3.1). As yet, it is too early to assess how successfully the Scottish and Welsh schemes will interact with the Green Deal and ECO. In England, no further incentives have been introduced.

- One future driver for the Green Deal could be minimum energy performance standards for private rented sector homes, which account for around 15% of the UK's housing stock and have a higher than average incidence of low energy efficiency performance (e.g. in England in 2011, 11% of privately rented homes had the lowest F and G ratings compared to 8% on average and 2% in social housing). Minimum standards from 2018 were provided for in the 2011 Energy Act and DECC has set up a working group with the aim to develop proposals for publications later in 2013. We urge the Government to come forward with ambitious standards to send a clear signal to private landlords about the need to make energy efficiency improvements.
- Smart meters may play a role in improving energy efficiency but their roll-out has been delayed by one year and will now begin in 2015 rather than 2014.
- We have previously recommended additional incentives such as provisions for consequential improvements through the buildings regulations and/or stamp duty relief but none of these have so far been implemented.

Overall, additional incentives that could drive Green Deal and ECO uptake remain weak and Government needs to address the emerging gap between what is needed to achieve carbon budgets and what is being implemented.

Box 3.1: Devolved administration energy efficiency and fuel poverty programmes

Scotland

In April 2013, the Scottish Government launched the new Home Energy Efficiency Programmes for Scotland (HEEPS). £60 million have been made available in 2013/14 for area-based energy efficiency schemes, £46 million of which have been allocated to all Scottish local authorities. Another £16 million will be available for energy efficiency grants to vulnerable households under the Energy Assistance Scheme, as well as £4 million for gas grid infill and extension projects. The Scottish government also aims to leverage £125 million per year from the ECO, thus achieving a total spend of £200 million.

Wales

The Welsh government is providing £30 million in 2012/13 to support two programmes, Nest and Arbed. Nest provides funding for a range of energy efficiency improvements in low-income households. Arbed is an area-based scheme (focused on deprived areas) and its second phase (2013-2015) will see £45 million investment over three years (£35 million of which is funded by the European Regional Development Fund) to improve energy efficiency and develop renewable energy in a further 5,000 homes in Wales. The aims of the scheme cut across carbon reduction, regeneration of the local economy and reduction of fuel poverty.

Box 3.1: Devolved administration energy efficiency and fuel poverty programmes

Northern Ireland

The Green Deal and ECO do not operate in Northern Ireland. Instead, the Northern Ireland Sustainable Energy Scheme is funded through a levy on all electricity customers, and totalled just under £8 million in 2011/12. 80% of the scheme is aimed at low-income households. These are also the focus of the government-funded Warm Homes scheme, which improves the energy efficiency of at least 9,000 homes a year. Additional measures include targets for energy efficiency standards in new social homes, and a £1,000 boiler scrappage scheme available to households earning less than £40,000 (over 6,000 applications have been approved). There is also a Heating Replacement Scheme which since 2001, this has seen the number of homes using coal reduced from 56,000 to 6,900 and the number using electric heating from 21,560 to 9,280.

Fuel poverty

Fuel poverty affects a large number of households in the UK and is particularly extensive in the devolved administrations. Current levels of fuel poverty are the result of a combination of low household incomes and a relatively inefficient housing stock, with fuel bills accounting for a significant proportion (10%+) of fuel poor households' costs. While low-carbon policies have to date had little effect on fuel bills (and hence fuel poverty levels), by 2020 we expect low-carbon measures to increase average bills by 10% (compared to 2011), in addition to a 6% increase due to fuel price rises. We have previously highlighted the importance of addressing fuel poverty through energy efficiency improvement, to ensure price rises from low-carbon policies are offset.

The Government has yet to publish its response to the consultation on a new measure for fuel poverty, in light of the Hills Fuel Poverty Review which was published in 2012. The latest fuel poverty statistics report both on the current 10% definition[2] and the Hills Low Income High Cost (LIHC) measure[3]:

- **10% definition.** In 2011, there were 4.5 million households in the UK in fuel poverty, down by 0.25 million from 2010. In England, there were 3.2 million fuel poor households, 0.3 million lower than in 2010. The devolved administrations had a much higher proportion of households in fuel poverty than England (15%) – in Northern Ireland fuel poverty levels reached 42% (mainly due to lower incomes and higher fuel prices, as most households rely on expensive heating oil). In Scotland fuel poverty stood at 25%, with fuel poverty levels in Wales slightly higher at 29%.
- **LIHC.** Under the low income high cost measure, 2.6 million households were fuel poor in England[4] in 2011, a decrease of 0.1 million from 2010.

The 10 per cent indicator shows a larger drop in the number of fuel poor households than the LIHC measure. This is mainly because the 10 per cent measure is absolute, whereas the LIHC is relative. Neither measure reflects year-to-year changes in temperature (and any associated rises in energy bills), as they calculate required fuel costs based on a long-term temperature average.

2 Under the 10 per cent definition, a household is said to be fuel poor if it needs to spend more than 10 per cent of its income on fuel to maintain an adequate level of warmth.
3 Under the **Low Income High Cost** definition a household is considered to be fuel poor where (i) they have required fuel costs that are above average (the national median level), and (b) were they to spend that amount, they would be left with a residual income below the official poverty line.
4 The devolved administrations have not used this measure to produce fuel poverty estimates.

The Government's analysis suggests that the decrease in fuel poverty in England between 2010 and 2011 was the result of a rise in income, and a reduction in energy use through improvements in the energy efficiency of housing. These combined to offset the price increases seen in 2011. The aggregate fuel poverty gap[5] however, increased in real terms from 2010 by £22 million to £1.15 billion, and the average gap increased by £26 to £448, largely reflecting the increase in energy prices.

However, it is unlikely that this fall in fuel poverty numbers will have been maintained since 2011, due to fuel price rises and with fuel poverty policy (in particular in England) undergoing major changes:

- In addition to the completion of CERT in 2012, the Warm Front budget was cut by more than two-thirds in financial year 2011/12 (from £345 million to £110 million). There was an even larger reduction in the number of insulation measures delivered under the scheme (in particular lofts) – just over 1,300 lofts were insulated under the scheme (compared to around 20,000 in the previous year).
- Warm Front funding was further cut in 2012/13 (to £100 million) and the scheme was closed at the end of March 2013, with ECO now being the sole policy for fuel poverty measures in England.

While the devolved administrations still operate separate government-funded fuel poverty schemes (Box 3.1), these policy changes mean a significant cut in support for the fuel poor in England. In future, the targeting of support under the ECO could offset the impact of rising electricity prices on the fuel poor as a group. However, ECO benefits will be unequally distributed, reaching only a proportion of fuel poor household over the next years. There are also particular issues for electrically heated households, where the impact of rising electricity prices will be felt disproportionately.

With household energy bills expected to increase further, additional intervention may be required, especially for electrically-heated households, either within the ECO, or otherwise. Furthermore, it will be important to ensure that the ECO continues to the point where all fuel poor households have benefitted from it. In the meantime, there may be a need for other policies to support energy efficiency improvement, and possible social tariffs or income transfers. All of these aspects should be considered in the Government's forthcoming fuel poverty strategy. We will continue to monitor the Government's approach to fuel poverty, in accordance with the Climate Change Act.

Zero carbon homes

In the context of the 2050 target, it is important that new homes are built with high levels of energy efficiency. In addition, new homes are particularly suitable for the deployment of low-carbon heat. The Government has previously committed to implement a Zero Carbon Homes policy in England by 2016. It is important that the Government holds to this timetable and the

5 The amount by which the assessed energy needs of fuel poor households exceed the median level.

milestones in between (e.g. the tightening of the building regulations which was supposed to be announced by May 2013).

4. Non-residential buildings

Our framework of indicators for non-residential buildings includes high-level trajectories and policy milestones (e.g. emission reductions of around 36% in 2020 relative to 2008). We do not include indicators for specific measures, as there is a lack of data on the installation of measures in the non-residential sector. Our approach has been to focus on policies that incentivise the uptake of measures.

A number of different policies impact on non-residential buildings, including the CRC Energy Efficiency Scheme, the Climate Change Levy, Energy Performance Certificates, the Green Deal, mandatory carbon reporting and (in the future) energy audits under the EU Energy Efficiency Directive. However, these policies do not necessarily apply consistently across the sector and it is not clear that they provide sufficient incentives for driving the uptake of measures.

CRC Energy Efficiency Scheme

The CRC Energy Efficiency Scheme (formerly known as Carbon Reduction Commitment) is the main policy instrument covering the non-residential sector, focused on large commercial and public sector energy users. In our 2012 progress report, we described the Government's simplification proposals for the scheme and warned against the abolition of the scheme.

The Government has since finalised its simplification proposals. Changes include:

- The abolition of the performance league table, although the aggregated participants' energy use and emissions data will still be published.
- The withdrawal of all state-funded schools from the scheme.
- A reduction in the number of fuels covered from 29 to 2.
- Reducing the overlap with other schemes.

The Government expects that these changes will reduce the administrative costs of participants by more than half, which equates to around £272 million in administrative cost savings for CRC participants up to 2030.

While most of these changes are welcome, the abolition of the performance league table further erodes the potential effectiveness of the scheme. We have previously advised that the reputational aspects of the scheme are potentially useful. These are now missing without a benchmarking of participants against each other.

A final league table was published in February 2013, covering the financial year 2011/12. The table ranks participants on the basis of three weighted metrics (Early Action Metric, Absolute Metric, and Growth Metric), with the following results:

- Two construction companies are ranked at the top of the performance table (BAM group[6] and Skanska), with seven local authorities in the top 20 (13 in the top 30).
- Total CRC emissions were 56 $MtCO_2$, 8% less than in 2010/11.
- Tesco recorded the highest overall level of emissions, followed by the Ministry of Defence and BT. Another four supermarket chains were amongst the top 10 largest emitters.

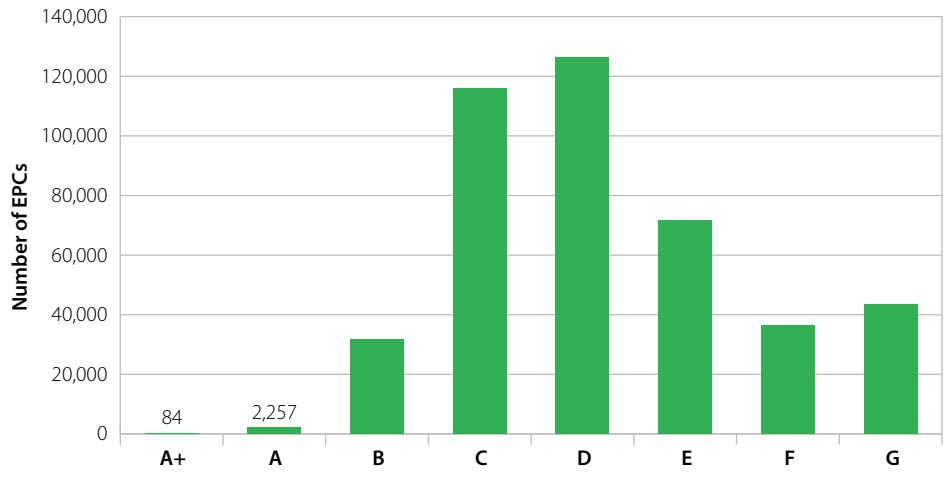
Without the league table and with other major changes (e.g. dropping revenue recycling after a previous review), the CRC is now essentially a modest carbon tax which is unlikely to provide major additional energy efficiency incentives in this sector beyond the price measures already in place (i.e. the climate change levy and the carbon floor price passed through in electricity bills). It no longer tackles the non-price barriers it was originally set up to address. We found in our 2010 CRC report that complementary levers and approaches will be required to ensure that the full abatement potential for the sector is unlocked. However, these are still lacking and energy performance in the sector has not improved in recent years (see below).

Energy performance data

Recent data on Energy Performance Certificates (EPCs) and Display Energy Certificates (DECs) shows that there has been little progress on energy performance in the sector:

- Of the 427,814 EPCs that had been issued by mid-June 2013, more than 18% received the lowest (F and G) energy performance ratings. Only 8% of EPCs received a rating of B or above. Overall, there has been no improvement since 2012. While there is a large cost-effective potential for energy efficiency improvement, this appears not to be taken up.

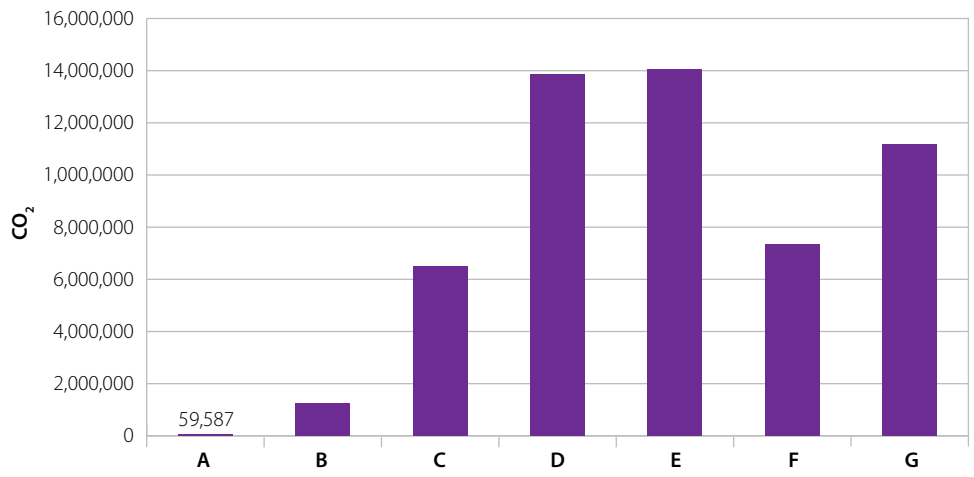
Figure 3.12: Number of non-domestic EPCs per rating



Source: Landmark.
Notes: Number of lodgements at mid June 2013.

6 BAM has suggested that its ranking (and 65% emission reductions) is partially due to changes in the CRC which means it now only has to report gas and electricity use, rather than other fuels such as fuel oil. Clearly, there have been some issues with the way performance was calculated.

Figure 3.13: CO_2 emissions per DEC rating



Source: Landmark.
Notes: Number of lodgements at mid June 2013.

- DECs have to be displayed by public authorities in all their buildings over 500 m^2. 154,515 DECs have been lodged to date. F and G-rated DECs still account for 20% of all DECs lodged, as well as for around one-third of CO_2 emissions. A recent Freedom of Information request by the Property and Energy Professionals Association (PEPA) suggests that 30% of councils in England and Wales were not even compliant with the requirement to display DECs.

This energy performance data suggests little progress in the non-residential sector. There are a number of retailers who have improved their energy efficiency significantly, for example through measures to improve the efficiency of heating, lighting and refrigeration. However, more generally complementary levers may be needed, such as minimum standards (see below).

Non-residential Green Deal, minimum standards and energy audits

The Green Deal also covers the non-residential sector, with a range of eligible measures including lighting systems, heat pumps and mechanical ventilation with heat recovery systems. DECC has estimated that annual savings of 1.3 $MtCO_2$ will be delivered through the non-residential Green Deal and supporting policy.

In our 2012 advice to local authorities on reducing emissions, we raised concerns about the lack of information and financial incentives which is likely to limit uptake of Green Deal financing in the non-residential sector. Some limited funding has been made available through the Pioneer Places Fund, with some local authorities using this funding to raise awareness of Green Deal opportunities in businesses and pay for surveys.

To date, there is no available data on Green Deal uptake in the non-residential sector but it is likely to be low until minimum energy efficiency standards are introduced in 2018, as provided for in the 2011 Energy Act. DECC has set up a working group with key stakeholders and it is expected that proposals will be published later in 2013. As in the residential sector,

the Government should ensure that ambitious standards are announced that send a signal to commercial landlords about the need to make energy efficiency improvements.

A further development is the requirement for energy audits for large enterprises under the new EU Energy Efficiency Directive. The Government will be consulting on the implementation of the Directive later this year. Public transparency will be important to ensure that the audits provide reputational incentives, especially in light of the CRC changes.

Overall, the non-residential sector is subject to a variety of energy efficiency and low-carbon policies but there is limited evidence of energy efficiency improvement and a risk that significant energy efficiency potential is not addressed. Therefore, the Government should consider a comprehensive review of non-residential low-carbon policies to ensure they work effectively.

Public sector buildings

In 2011, central government set itself a target to reduce GHG emissions from its estate and transport conducted on central government business within the UK by 25% by 2014/15 (from a 2009/10 baseline). The Government produced the first annual report on this (and other 'greening government' commitments) in December 2012:

- A 12% reduction in GHGs was achieved across Government in 2011/12 against a 2009/10 baseline.
- Emission reductions were made by 20 departments, while 8 out of 21 departments met or exceeded the 2015 target.
- The Ministry of Defence, the largest public sector emitter covered by the CRC, achieved savings of 11%.
- Carbon reductions represent estimated energy and transport fuel cost savings of over £40 million across Government against 2009/10 figures.
- While reductions in the size of Government departments and spending restrictions have clearly played a part in departments' emissions reductions, the Government reports that behaviour change, better use of building management and capital investment have been important.

We have previously noted the importance of government setting an example and these reductions are very welcome. They also illustrate the effectiveness of simple and clear targets, with potential implications for approaches in the commercial and industrial sectors, as well as other public sector entities (e.g. local authorities).

Local authorities have been requested by DECC to measure and publish annual emissions data from their own estate and operations with the expectation that central government will further consider how the data can be used to help local authorities reduce their emissions. However, not all local authorities report (around 200 out of 353 local authorities reported on own emissions data in 2010/11). The reporting methodology also allows for significant variation

as to what emissions should be included, making it difficult to assess progress and compare between local authorities.

We suggested in our 2012 local authorities report that Government should consider a statutory duty on local authorities to develop an area-wide low-carbon plan (including their own estate, with a consistent approach for reporting emissions). However, there has been no response from Government.

5. Low-carbon 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 around 2% to around 12% in 2020. Schemes have been put in place to drive uptake in both the residential and non-residential sectors. However, uptake is currently low and incentives weak, with potential implications for carbon budgets:

- **Residential sector.** A further delay in the introduction of the Renewable Heat Incentive (RHI) to 2014 has increased the need for faster uptake in the remainder of the 2010s.
- **Non-residential sector.** Tariffs in their first year of operation appear to not to be driving the levels of uptake expected. However, recently published proposals to increase tariffs for the non-residential scheme could provide the necessary incentives to deliver the required uptake.

In order to remain on track to deliver 12% uptake in 2020, revisions to the non-residential scheme, the introduction of the residential RHI, certainty of tariffs pre- and post 2015 and a range of supporting measures to overcome non-financial barriers are required.

Renewable Heat Premium Payment (RHPP) and Renewable Heat Incentive (RHI)

The RHPP covering the residential sector in Great Britain began in August 2011, with a separate Northern Ireland scheme starting in 2012 (Box 3.2). It provides grants (in the form of vouchers) on installations in off-grid homes (except for solar thermal which is available in all homes) and funding for projects delivered by registered social landlords. Phase 1 (August 2011 to March 2012) delivered 7,253 projects, and Phase 2 (May 2012 to March 2013) delivered 5,758 projects. In phase 2, projects were 49% heat pumps, 39% solar thermal and 12% biomass. Both Scotland and Wales have an above average share of projects (compared to their share of the housing stock).

The first phase of the scheme (August 2011 to March 2012) was undersubscribed (£15 million was available but only £7.7 million was spent). Reasons for the underspend include the relatively low levels of grants available and the lack of certainty about future RHI payments for installations supported under the RHPP. The second phase of the scheme (May 2012 to March 2013) saw improved uptake, particularly in the household voucher scheme and social landlord competitions, with around £17 million of the £25 million available expected to be spent.

The Government announced an extension to the second phase in May 2013, comprised of another household voucher scheme to run during 2013/14 and two further social landlord competitions. The levels of the grants were also increased (Table 3.1).

Table 3.1: RHPP voucher value

	Old	New
Air-to-water heat pump	£850	£1,300
Biomass boiler	£950	£2,000
Ground or water-source heat pump	£1250	£2,300
Solar thermal hot water	£300	£600

Source: DECC, 2013

There remains a major challenge to support investment in residential sector renewable heat. Around 2.6 million installations are required by 2025 in our medium abatement scenario for the fourth carbon budget. In order to address this future challenge, the RHI will replace the RHPP in spring 2014, offering tariffs for residential installations. The RHI will be open to all households but offering the best deal for installations off the gas grid (Table 3.2).

Table 3.2: Residential RHI proposed tariffs

	Indicative tariff range (p/kWh)
Air source heat pump	6.9-11.5
Ground source heat pump	12.5-17.3
Biomass boiler	5.2-8.7

Source: DECC, 2013

In our 2011 Renewable Energy Review, we assessed the level of the tariffs required. The announced tariffs for heat pumps appear adequate compared with our existing analysis. However, the evidence base regarding costs, performance and barriers to uptake has progressed since this work, and we are currently reviewing our scenarios and costs as part of our fourth carbon budget review, to be published later this year.

Even with the implementation of the RHI, there remain barriers to uptake:

- High upfront costs are a barrier to uptake and Green Deal finance should be made available in conjunction with the RHI to cover at least the additional costs of renewable heat investment compared to conventional alternatives.
- There are other non-financial barriers to uptake of low-carbon heat, such as lack of trust in technologies and installers, and lack of consumer information. The requirement that RHI installations must be accredited under the Microgeneration Certification Scheme addresses the lack of trust issue to some extent; however Government should continue to develop approaches to address these barriers.

We will examine potential measures to overcome these barriers in our fourth carbon budget review.

Box 3.2: Low-carbon heat in the devolved administrations

Scotland

- In Scotland, low-carbon deployment has continued to progress above the targeted level. The latest survey of heat capacity (EST, 2012[7]) found Scotland had around 2.3 TWh of low-carbon heat (around 3.8% of Scotland's total forecast heat demand in 2020) which is above the interim milestone set for 2011 (2%).
- In the non-residential sector, uptake under the RHI totalled 18% of the total (364 installations) to April 2013.
- In the residential sector, there is likely to be a greater opportunity for renewable heat than the UK as a whole, given there is a higher proportion of properties that do not have access to mains gas for heating. The RHPP uptake was above Scotland's share of the GB housing stock (9%), with 13% of the total (1391 installations) to April 2013.
- The Scottish Government has committed to developing a long-term renewable heat strategy in order to support the delivery of the RHI and RHPP in Scotland. It will be crucial that the renewable heat strategy sets out a framework for accelerating investment and addressing the barriers to uptake to achieve the target of 11% of heat demand by 2020. A Draft Heat Generation Policy Statement will be published by the end of 2013, which will set out the scenarios for how the low-carbon heat uptake targets will be achieved.
- In May 2013, the Scottish Government published a District Heating Action Plan to address the barriers and improve the uptake of district heating. Targets for district heating uptake in the public sector will be developed, and where viable the conversion of all multi-storey social housing to district heating will be explored. The action plan also identified areas for improvement of the evidence base, including heat mapping, and development of standards and regulation. Furthermore, a £5m District Heating Loan Fund was announced.

Wales

- In Wales, uptake under the RHI in the non-residential sector totalled 6% of the total (124 installations) to April 2013.
- Low-carbon heat uptake in households under the RHPP was above Wales' share in the GB housing stock (5%), at 8% of the total (816 installations). As grants are only available for off-grid properties, it is expected that the opportunity for Wales is above the GB total given the relatively higher proportion of off-gas grid properties (21% versus 16% in GB).
- We recommended in our 2013 Welsh progress report that the Welsh Government should develop a renewable heat strategy to ensure that uptake of incentives is maximised and to help overcome barriers to uptake.

Northern Ireland

- Northern Ireland has good opportunities for low-carbon heat as most of the country is off the gas grid.
- Northern Ireland introduced its own RHI in late 2012, also initially focused on the non-residential sector.
- For the residential sector, Northern Ireland is currently running a RHPP scheme, with higher grants for most technologies than in the GB scheme (e.g. £1,700 vs £1,300 for air-source heat pumps, £2,500 vs £2,000 for biomass boilers). To date over 950 applications have been received, and grants awarded worth over £1.4 million.

7 Energy Saving Trust (2012) 'Renewable Heat in Scotland' available at http://www.energysavingtrust.org.uk/scotland/Take-action/Get-business-funding/Renewable-Heat-in-Scotland-2011

Heat strategy

In our 2012 progress report, we noted that the Government's heat strategy was broadly consistent with our emphasis on the importance of heat pumps and district heating based on low-carbon sources, but that the challenge was to move from the high-level strategy to detailed implementing arrangements for low-carbon heat.

Subsequently, the Government has launched a set of actions relating to low-carbon heat in buildings and district heating:

- **Buildings.** £250,000 for heating installers to subsidise the cost of renewable heating kit installation training and 100 green apprenticeships in small-scale renewable heat technologies
- **District heating.** A £9 million district heating package and an expert advisory Heat Networks Delivery Unit. £1 million has been awarded to help specific cities (Manchester, Leeds, Newcastle, Sheffield and Nottingham) develop heat networks.

Further detail is still required to address the challenges to uptake, particularly in the residential sector, where introduction of a RHI with adequate tariffs and further measures are needed to address the barriers to renewable heat uptake.

District heating should be based on sources from low-carbon fuels such as biomass. Further work is required to identify the potential for such sources. For example, in the London heat map produced by the Greater London Authority, the primary source was identified as waste heat from nuclear power, but further work is required to determine whether this is viable and the costs and barriers associated with this approach.

We noted last year that given the lack of a carbon price for heat, and the higher costs of low-carbon heat options, further funding will be required to support investment in low-carbon heat options in the period beyond 2015. Funding post-2015 need to be confirmed as early as possible.

Key findings

- Buildings CO_2 emissions **rose by 10% in 2012**, in equal parts due to the higher electricity grid intensity and lower winter temperatures than in 2011.
- There was an increase in insulation rates in the final year of the supplier obligation schemes (CERT and CESP), with **a total of 2.3 million** lofts, cavities and solid walls insulated.
- However, there is a significant risk around future delivery of these measures given weaker incentives under the new Green Deal and Energy Company Obligation. The Government should undertake an **early review of the Green Deal and ECO and consider further incentives** to encourage uptake of measures (especially lofts and cavity wall insulation).
- There was very limited improvement in commercial sector energy efficiency. The Government should make **a comprehensive assessment of non-residential low-carbon policies** to ensure they work effectively.
- There was some progress on fuel poverty in 2011, although it is unlikely that this will have been maintained since due to fuel price rises and given changes in fuel poverty policy. The Government needs to ensure measures are in place to adequately **support fuel poor electrically-heated households and ensure ECO continues to the point where all fuel poor households are covered**.
- The **Renewable Heat Incentive** should be extended to cover the residential sector as soon as possible, funding committed beyond 2014/15, Green Deal finance allowed to pay for the upfront cost of low-carbon heat investment and approaches to address non-financial barriers introduced.

Table 3.1: The Committee's buildings indicators

BUILDINGS		Budget 1	Budget 2	Budget 3	2012 trajectory	2012 outturn
All buildings						
Headline indicators						
CO_2 emissions (% change on 2007)	direct	-5%	-19%	-32%	-5%	-7%
	indirect	-10%	-25%	-53%	-13%	-8%
Final energy consumption (% change on 2007)	non-electricity	-8%	-20%	-25%	-8%	-10%
	electricity	-3%	-2%	-1%	-3%	-5%
Residential buildings						
Headline indicators						
CO_2 emissions (indicative minimum % change on 2007)**	direct	-8%	-22%	-29%	-8%	-5%
	indirect*	-17%	-28%	-56%	-17%	-11%
Final energy consumption (indicative minimum % change on 2007)	non-electricity	-6%	-18%	-19%	-6%	-4%
	electricity	-5%	-4%	-3%	-5%	-8%
Supporting indicators						
Uptake of solid wall insulation (million homes, total additional installations compared to 2007 levels)		0.5	1.2	2.3	0.5	0.14
Uptake of loft insulation (up to and including 100 mm) (million homes, total additional installations compared to 2007 levels)		2.3	5.6	5.6	4.3	5.5/3.6 (CERT professional)
Uptake of loft insulation (100 mm +) (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	3.9	2.7
Uptake of energy efficient boilers (million homes, total additional installations compared to 2007 levels)		4.9	9.3	12.6	4.9	6.2
Uptake of energy efficient appliances – cold A++ rated (% of stock)		3%	18%	45%	3%	no data
Uptake of energy efficient appliances – wet A+ rated (% of stock)		16%	40%	58%	16%	no data
Every house offered whole-house energy audit			By 2017			Audits will be carried out for homes taking up the Green Deal.

Table 3.1: The Committee's buildings indicators

BUILDINGS		Budget 1	Budget 2	Budget 3	2012 trajectory	2012 outturn
New energy efficiency financing mechanism budgeted and legislation in place		2011				Green Deal scheme in place from January 2013
Post CERT delivery framework legislation in place		2011				ECO scheme in place from January 2013
Accelerate the introduction of minimum standards for privately rented residential properties		by 2012				Energy Act proposes introduction by 2018
Introduce additional financial incentives (e.g. stamp duty rebates)			by 2016			n/a
Other drivers						
Average SAP rating, implementation of behavioural measures, population (by age), number of households (by type – building and occupants), household disposable income, electricity and gas prices, appliance ownership, weather.						
Non-residential buildings						
Headline indicators						
CO_2 emissions (indicative minimum % change on 2007)*	direct	6%	-9%	-43%	6%	-15%
	indirect**	-8%	-21%	-49%	-8%	-4%
Final energy consumption (indicative minimum % change on 2007)	non-electricity	-4%	-8%	-13%	-4%	-16%
	electricity	-1%	-1%	-1%	-1%	4%
Supporting indicators						
Develop policy on SMEs		by October 2010				Green Deal scheme in place from January 2013
Accelerate the introduction of minimum standards for privately rented non-residential properties			By 2016			Energy Act 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

Table 3.1: The Committee's buildings indicators

BUILDINGS	Budget 1	Budget 2	Budget 3	2012 trajectory	2012 outturn
– Roll out of DECs to non-public buildings		by 2017			No commitment to do this
All public buildings covered by CRC to realise all cost-effective emissions change potential			by 2018		Ongoing
Other drivers					
Emissions and fuel consumption by subsector, electricity and gas prices.					
Renewable heat					
Headline indicators					
Renewable heat penetration (% of heat demand from renewables) – total buildings and industry**	1%	5%	12% in 2020	1%	1.1%
Buildings renewable heat penetration (% of heat demand)**	1%	4%	11% in 2020	1%	0.5%
Renewable Heat Incentive in operation	From April 2011				Non-residential RHI introduced November 2011. Residential sector RHI due to commence 2013.
Other drivers					
Renewable heat penetration (% of heat demand from renewables) – buildings.					
Uptake and costs of renewable heat technologies in buildings, Biomass boilers, Solar thermal, GSHP/ASHP, District heating.					

* These figures do not include renewable heat, which is included separately below.
** CCC estimates for 2012 outturn based on DECC (2012) Energy Trends and BSRIA (2013) Heat pumps United Kingdom World Renewables 2013.

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

Key: Headline indicators Implementation indicators Milestones Other drivers

Introduction and key messages

1. Industry emissions trends
2. Opportunities and challenges in reducing industry emissions
3. Managing competitiveness risks

Chapter 4: Progress reducing emissions from industry

Introduction and key messages

Emissions from industry accounted for around a third of UK greenhouse gas emissions in 2012 (around 200 $MtCO_2e$), of which around 80% are CO_2. Industry CO_2 emissions are around 70% direct emissions (of which 92% are from the combustion of fossil fuels and 8% are from chemical processes) and 30% indirect emissions (i.e. electricity-related).

In our 2012 progress report, we reported that industry emissions fell 43% between 1990 and 2011:

- Between 1990 and 2007, CO_2 emissions fell by 15%, primarily due to improvements in energy efficiency and fuel switching (Box 4.1). A further 16% reduction in 2008 and 2009 occurred as a result of the recession, reflecting a fall in output of around 12%.
- In 2010 emissions rose by 2% due to a recovery in output of 4%. In 2011, emissions were 3% lower, despite rising output (of 2%), possibly due to slight improvements in energy efficiency and running plant more efficiently (e.g. iron and steel plant running at higher load factors with better energy performance).
- Non-CO_2 emissions have fallen by around 70% between 1990 and 2011 reflecting the introduction of technologies to abate N_2O emissions in industrial processes and reduced fugitive emissions from the gas distribution network and coal mines.

In this chapter we assess preliminary 2012 data on industry emissions and energy consumption as well as policy milestones.

The key messages of this chapter are:

- Total CO_2 emissions from industry increased by 3% (to 163 $MtCO_2$) in 2012, reflecting increased carbon intensity of the electricity grid (due to switching from gas to coal, set out in Chapter 2).
- Direct emissions increased by 1% in 2012 (to 116 $MtCO_2$), with little evidence that energy efficiency has improved.
- There is unlikely to be adequate progress regarding energy efficiency for direct fuels (i.e. non-electricity), despite higher fossil fuel prices, due to high barriers and weak policy incentives. Without structural reform the EU ETS prices to 2020 will remain low, and Climate Change Agreements do not focus on reducing fossil fuel consumption. In order to improve progress, Government should include the full range of cost-effective abatement options in the industry sector roadmaps currently being developed by DECC and BIS and align financial incentives for low-cost abatement.

- CCS in industry is a key option to meet the 2050 target. Given that industrial CCS projects have not been funded under the current UK CCS competition and a lack of progress internationally, an approach to demonstration and commercialisation compatible with deployment in the 2020s is required.
- In order to ensure that carbon policies do not result in risks to UK competitiveness (e.g. drive existing industry abroad, or stop new industry locating here) it is important to move from high level commitments (e.g. the £250 million compensation package, and exemptions for costs arising under Electricity Market Reform) to a detailed implementing framework.

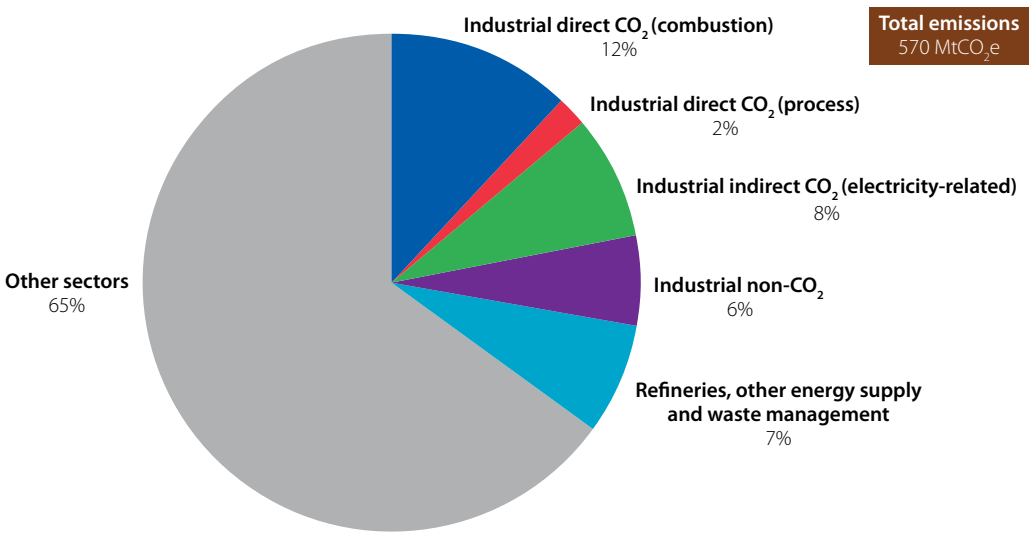
We set out the analysis that underpins these conclusions in three sections.

1. Industry emissions trends
2. Opportunities and challenges in reducing industry emissions
3. Managing competitiveness risks

1. Industry emissions trends

Emissions from industry accounted for around a third of UK greenhouse gas emissions in 2012 (Figure 4.1). Around 80% of industry emissions are CO_2, of which around 70% are direct due to the burning of fossil fuels and chemical processes, and 30% are indirect due to the use of electricity.

Figure 4.1: GHG emissions from industry in the context of total UK emissions (2012)



Source: NAEI (2013)
Notes: 2012 emission estimates are provisional. Emissions from waste are shown here, but are discussed and accounted for in Chapter 7.

Total industry emissions increased by 2% in 2012. Within this overall increase, CO_2 emissions increased by 3% (to 163 $MtCO_2$), and non-CO_2 emissions were flat (36 $MtCO_2$).

Emissions rose despite a fall in output of around 2%. The rise in CO_2 emissions was mainly due to indirect emissions which rose by 7%, reflecting a rise in the carbon intensity of the electricity grid (this is detailed in chapter 2), which more than offset a reduction in electricity consumption of 2%.

Direct emissions increased by 1% in 2012. Although output fell by 2%, consumption of fossil fuels increased by 4% last year. Fuel consumption increases are likely to have been due to a combination of the steel sector reopening plant at Teesside and possibly also a response to low coal prices, and slightly cooler temperatures.

- Production across the manufacturing sector fell by 2%, with greater decreases in some energy-intensive industries (e.g. cement, lime and plaster fell by 15%, linked to continued Eurozone uncertainty and a slump in the construction sector).
- Use of fossil fuels increased by 4% in 2012, and electricity consumption reduced by 2%.
  - Fossil fuel consumption increased in the steel sector due to reopening plant at Teesside (using coal and manufactured fuels).
  - There may have been some switching from electricity to coal in response to relative price changes: the electricity price increased by 4%, the coal price went down by 4% (both in real terms).
  - Gas consumption increased by 4%. This is also possibly a result of colder weather impacting the weather-dependent parts of industry, however, evidence is limited.

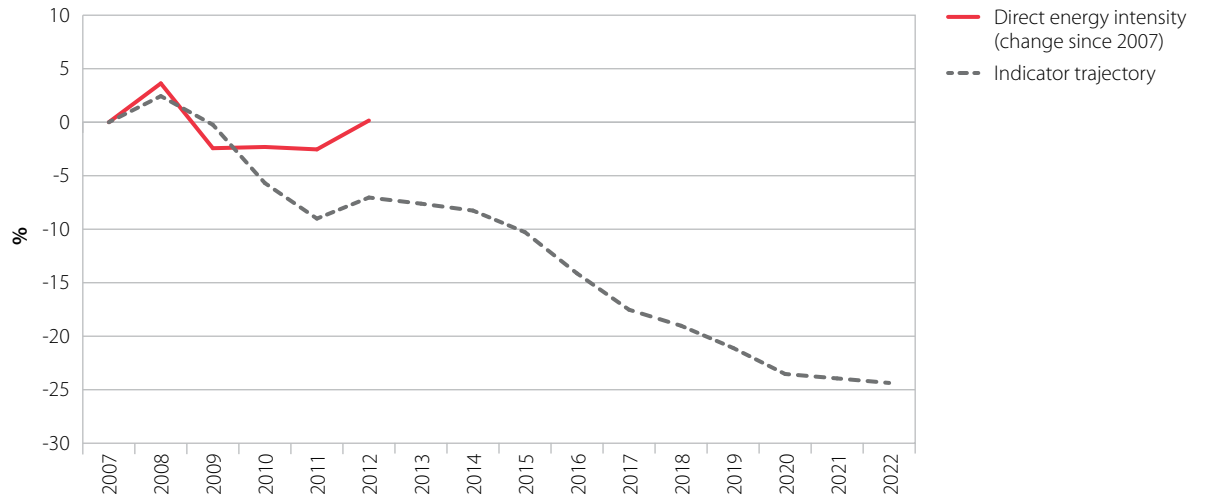
Emissions in 2012 (163 $MtCO_2$) are broadly in line with indicators (160 $MtCO_2$). However, the level we envisaged when we set out our progress indicators in 2009 did not fully account for the recession, and as a result we would have expected emissions to fall below the level of indicators if implementation of abatement measures was on track.

Despite improvements in energy efficiency of around 2% per annum between 1990 and 2007 (as detailed in box 4.1), there is a lack of evidence to substantiate energy efficiency improvement in the first budget period (2007 to 2012).

- Direct energy intensity increased 3% in 2012 due to increases in fossil fuel consumption, despite falling production, and was broadly flat since 2007 (Figure 4.2).
- Falling investment in new plant and equipment[1] may also suggest continued use of older, less efficient plant (investment fell by 1% in 2012, and an average annual fall of 2% in the five years since the recession, compared with average annual increases of 3% in the five years prior to the recession).

1 ONS (2012) National Accounts available at http://www.ons.gov.uk

Figure 4.2: Direct energy-intensity and indicator trajectory (2007-2022)



Source: DECC (2013) *Energy Trends*, March 2013; DECC (2012) DUKES 2012; ONS (2012) *Index of Production*; CCC calculations.
Notes: This chart shows energy-intensity for direct fuels only (i.e. non-electricity).

Box 4.1: Emissions drivers in the industrial sector

CO_2 emissions from UK manufacturing between 1990 and 2012 fell by around 30%.

Falls in industrial emissions could be caused by changes in output (e.g. recession-related emission reductions), fuel switching to lower carbon fuels (e.g. coal to gas), changes in the industrial structure (e.g. energy intensive manufacturing moving abroad) and energy efficiency.

Hammond and Norman (2012) conducted an analysis of emissions drivers in the industrial sector between 1990 and 2007 (i.e. before the current recession), attempting to explain the relative reductions in energy-related industrial emissions.

The primary reasons for the fall in emissions over the period was found to be reductions in energy-intensity (which includes installation of energy efficient technologies and running plant more efficiently), rather than changes in output or industrial restructuring (Table 4.1).

Table 4.1: Emissions drivers in the industrial sector 1990-2007

Driver	Contribution to annual change in energy-related emissions
Production/output	0.46%
Industrial structure (e.g. energy-intensive industry moving abroad)	-0.27%
Energy-intensity improvements (e.g. more efficient equipment, running plant more efficiently)	-1.92%
Fuel switching (e.g. coal to gas or electricity)	0.49%
Emissions factor of the grid	-0.77%
Total (average annual % change in emissions)	-2.01%

Source: Hammond, G. P. and Norman, J. B. (2012) Decomposition analysis of energy-related carbon emissions from UK manufacturing. Energy, 41 (1). pp. 220-227.

Box 4.1: Emissions drivers in the industrial sector

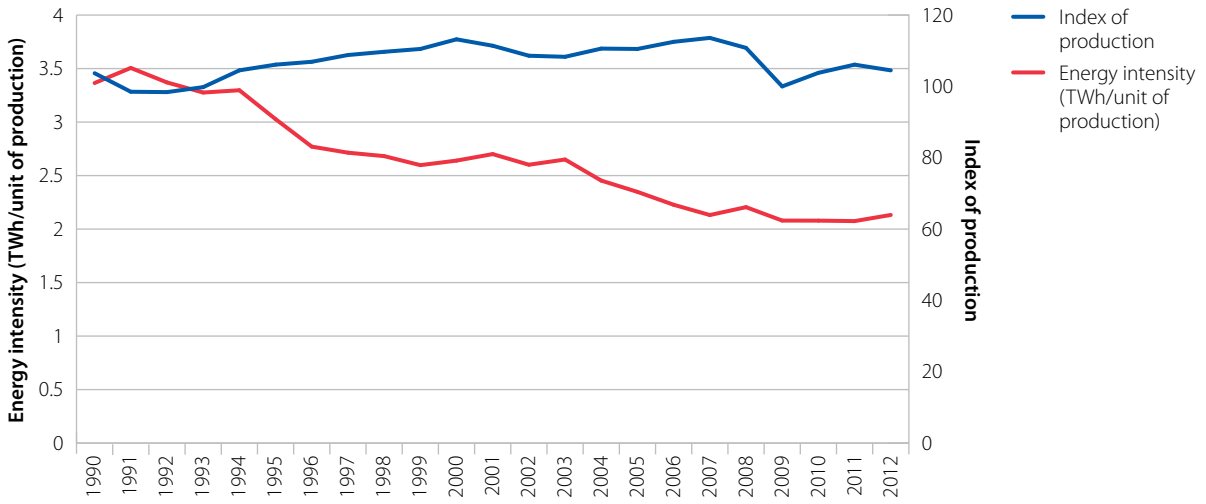
Similar trends are exhibited in other analyses. For example the Department for Trade and Industry (1994, cited in Hammond and Norman, 2012) examined the period prior to 1990, concluding that the main contributor to reductions was falling energy intensity, with structural change having a relatively small impact.

Improvements in energy efficiency are coupled with periods of growth, due to the associated investment in new and often more energy efficient plant and equipment (Jenne and Cattell, 1983 and Greening et al., 1998 cited in Hammond and Norman, 2012).

Trends in output, investment and energy efficiency appear to be consistent with this, although further work is required to establish the extent of these relationships (Figure B4.1).

- In the five years since the start of the recession (2007-2012) there has been depressed industrial production, and investment in new plant and equipment has been below the long term average (2% decrease per year on average 2007-2012, compared with increases of 3% per annum in the five years prior to the recession).
- Energy intensity decreased relatively consistently since 1990, except during recessions, where there is a flattening of the energy intensity trend.

Figure B4.1: Production and energy intensity (1990-2012)



Source: DECC (2013) *Energy Trends*, March 2013; DECC (2012) DUKES 2012; ONS (2012) *Index of Production*; CCC calculations.
Notes: Energy intensity is for directly-combusted fuels only (i.e. non-electricity).

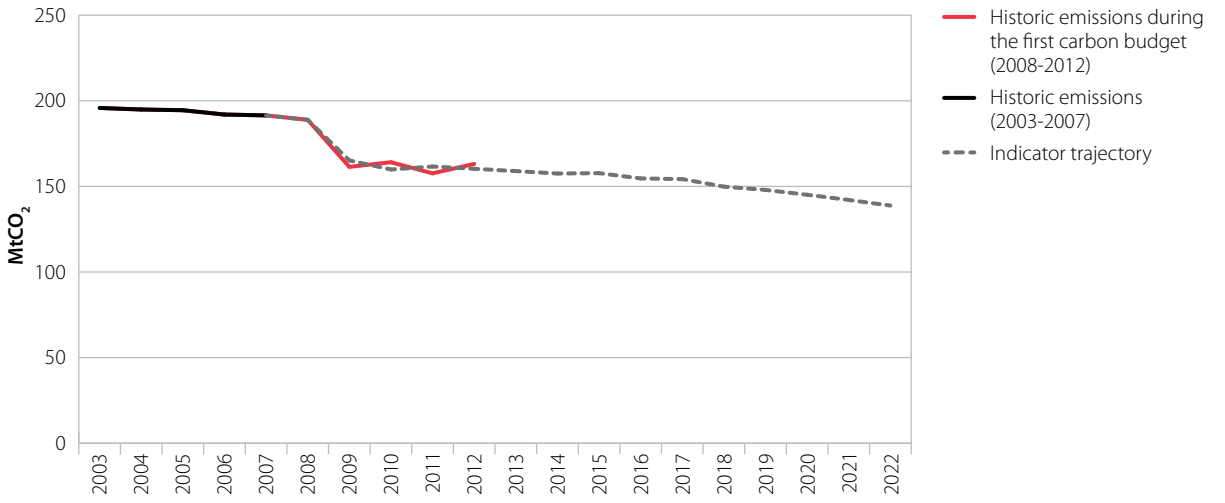
We are improving the level of detail of this assessment (including ways of measuring progress in energy efficiency) as part of our 2014 Progress Report.

Source: Hammond, G. P. and Norman, J. B. (2012) Decomposition analysis of energy-related carbon emissions from UK manufacturing. Energy, 41 (1). pp. 220-227. Available at http://opus.bath.ac.uk/25342/1/Norman_energy_2011.pdf

As a result, industry emissions in 2012 were 3 $MtCO_2$ above the level (160 $MtCO_2$) envisaged when we set out our progress indicators in 2009 (Figure 4.3).

- In 2012, emissions increased due to the rising carbon intensity of power generation. This is a short-term increase resulting from switching from gas to coal in the power sector.
- Direct emissions have not fallen in line with indicators. Given that fossil fuel consumption has not fallen relative to output, this indicates that the pace of energy efficiency improvement will need to increase in order to meet future carbon budgets (e.g. around 15% reduction on current levels is required by the beginning of the fourth carbon budget in 2023).

Figure 4.3: Historic emissions vs indicator trajectory (2003-2022)



Source: NAEI (2013); DECC (2013) *Energy Trends*, March 2013; DECC (2012) DUKES 2012; DECC (2013) *UK Emissions Statistics 2012 Provisional UK figures*; CCC calculations.
Notes: 2012 emission estimates are provisional.

There is an opportunity to reduce emissions further in industry at low cost if barriers can be overcome, as we set out below.

2. Opportunities and challenges in reducing industry emissions

We have previously highlighted scope for reducing emissions in industry in the first four budget periods from around 180 $MtCO_2$ in 2008 to around 120 $MtCO_2$ in 2030[2].

- **Energy efficiency improvement.** The ENUSIM model used by Government suggests scope for reducing industry emissions by around 6 $MtCO_2$ in the period to 2020 through energy efficiency measures.
- **Low-carbon heat and use of bioenergy.** Modelling conducted by NERA suggests the potential to reduce industry emissions by 20 $MtCO_2$ by 2030. This is primarily through use of biomass and biogas, with smaller contributions from heat pumps and CHP.
- **CCS.** CCS could be feasible and cost-effective for deployment in the iron and steel sector and the chemicals industry during the 2020s, and by 2050 could contribute to cost-effective reductions of around 40 $MtCO_2$.
- **Options in energy-intensive industry.** Further cost-effective options for energy-intensive industry include recycling of steel, increased use of clinker substitutes in the cement sector and reduction of flaring in refineries, which taken together provide around 12 $MtCO_2$ abatement by 2030.

2 There are further options for the decarbonisation of industry on the path to 2050 but not embedded in our evidence underpinning the fourth carbon budget. These include extending low-carbon electricity to the production of heat in industry (i.e. as set out in our 2012 International Aviation and Shipping report), and the use of wood in the construction sector as a substitute for energy-intensive materials (detailed in our 2011 Bioenergy Review).

In our 2012 progress report, we noted that it is important to plan for investment in low-carbon measures given long project lead times, and the need to synchronise investment with the refurbishment cycles of the capital stock.

- **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, blast furnaces have around 15-20 years between refurbishments, which involve significant disruption (the recent rebuilding of a blast furnace at Port Talbot involved a 130 day construction time). This leads to a risk that these infrequent opportunities for major improvements are missed, and high-carbon infrastructure is locked in.
- **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 consultation with stakeholders from the chemicals sector, it was suggested that high capital cost measures and competition for capital could result in over 50% less abatement in 2030.

In order for firms to plan and finance abatement opportunities, policies will have to be put in place that offer a premium to low-carbon investment, and ensure that this is prioritised in a capital-constrained world. Progress in 2012 in key policy areas was slow:

- **EU ETS.** We previously noted that the price signal from the EU ETS had been weakened from excess allocation of allowances and the recession (surplus allowances in the EU ETS are also covered in Box 4.3). In 2012 this continued, with the carbon price dropping further (from €13/tCO_2 in 2011 to €7/tCO_2 in 2012).
- **Climate Change Agreements (CCAs).** In 2012, the Government announced new simplified CCAs for 2013 to 2023.
  - These reduce the scope of emissions covered by the CCAs to non-EU ETS emissions only (previously they covered both EU ETS and non EU ETS), resulting in around a 60% reduction in emissions covered compared with the previous design. However, energy used across the entire site (i.e. traded and non-traded) will remain eligible for the CCL discount. This implies weakened incentives for reduction of direct emissions in industry[3].
  - However, for indirect emissions, energy efficiency targets have now been announced and, for many sectors, are consistent with or even higher than the level of ambition implied when we published our analysis of carbon budgets in 2008 (e.g. CCAs have agreed a 11% target with the chemicals sector, compared with 2% reduction implied by previous CCC analysis).

3 Indirect emissions are still covered by CCAs however, even though the power sector is within the EU ETS, industry is not required to surrender allowances for their indirect emissions.

- **The Renewable Heat Incentive (RHI).** While the absolute economy-wide level of uptake of renewable heat technologies was on track with our indicators in 2010 and 2011 (Figure 4.4), the rate of increase is unlikely to meet the 12% target of total heat output given current incentives. The RHI commenced in November 2011, and data suggest uptake across the range of technologies is low. Given the limited availability of sustainable biomass, we have identified the use of biomass in large industrial installations as a priority because of the lack of low-carbon alternatives, and recommended that the Government sets out an approach to encourage uptake in this market segment. In May 2013, Government announced increased tariffs (from 1.0 to 2.0 p/kWh) for large biomass in industry. Close monitoring is now required to ensure that this additional incentive improves uptake for large biomass projects. Additionally, uncertainty about RHI funding beyond 2015 needs to be resolved as soon as possible in order to achieve supply chain growth to deliver the increased uptake consistent with meeting carbon budgets.
- **CCS demonstration.** CCS in industry is a key option to meet the 2050 target. Given that industrial CCS projects have not been funded under the current UK CCS competition and that there has been limited progress internationally (Box 4.2), an approach to developing industrial CCS demonstrations compatible with required deployment in the 2020s is required. CCS is also likely to be a key abatement option globally, with significant spillovers from the UK contribution to commercialisation to international action to reduce emissions. The development of CCS infrastructure in the power sector provides an opportunity for co-located industrial plant (e.g. in the chemicals sector) to be included in a CCS commercialisation strategy across both the power and industrial sectors.

Box 4.2: International progress on industrial CCS

The IEA 2012 CCS roadmap forecasts that around half the mitigation potential from CCS could be from industrial applications in 2050. In the UK, the Committee's 2010 advice on the fourth carbon budget report identified CCS applications in industry as feasible and cost-effective from 2030, with potential to abate up to around 40 $MtCO_2$ by 2050.

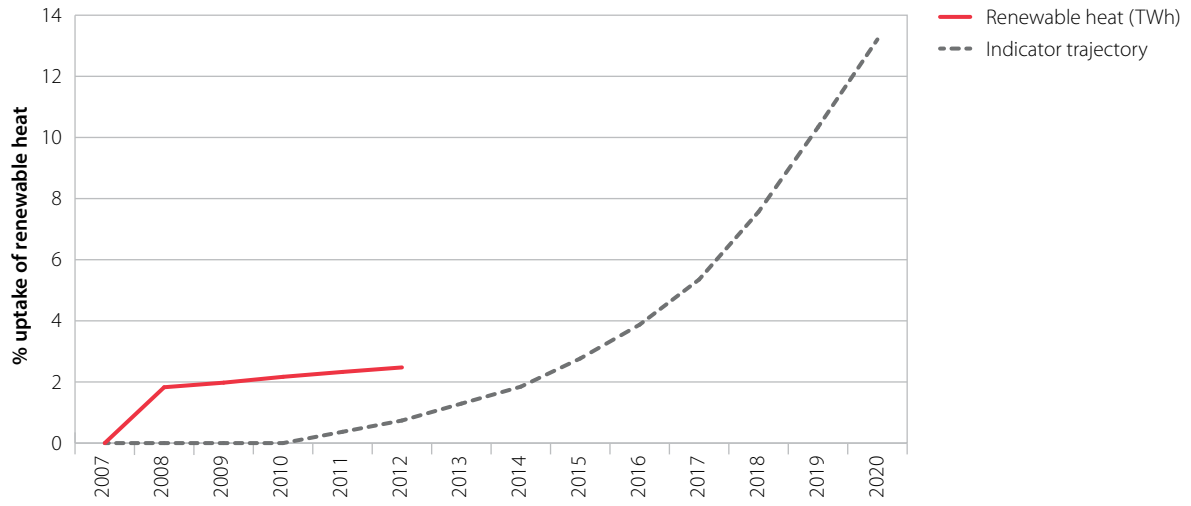
Demonstration of CCS in industry, either in the UK or elsewhere, is crucial to resolving current uncertainties. However, there has been limited progress on industrial CCS at scale:

- Florange steelworks, France was in line for funding under the NER300 fund. However in December 2012 the ArcelorMittal plant withdrew from this round of funding due to technical difficulties.
- Air Liquide hydrogen, Netherlands: 0.5 $MtCO_2$ on a hydrogen plant, with the potential to expand CCS further in the region in future to commence construction in 2014.
- Masdar steelworks, Abu Dhabi: 0.8 $MtCO_2$ on direct reduced iron plants.

Given limited progress on CCS internationally, domestic demonstration of CCS will be important to meet the timetable of 2027-2030, set out in the Carbon Plan to start CCS roll-out in industry.

In the 2013 heat strategy, DECC and BIS committed to developing long-term decarbonisation roadmaps with energy-intensive sectors. This provides an opportunity to set out how gaps in the current policy framework can be filled, and gives more confidence over the implementation of the measures required to meet carbon budgets.

Figure 4.4: Industry renewable heat uptake and trajectory (2007-2020)



Source: DECC (2013) *Energy Trends*, March 2013; DECC (2012) DUKES 2012; BSRIA (2013); CCC calculations.

In the context of the 2014 Progress Report we will develop analysis to input into the development of these roadmaps, including:

- An update on assumptions underpinning fourth carbon budget analysis of abatement options.
- Indicative trajectories showing the opportunities for abatement in key energy-intensive industries consistent with the fourth carbon budget, including technology changes and timelines.
- Competitiveness impacts of rising energy costs (both direct and indirect) and costs of abatement.

It will be necessary to complement roadmaps with long-term financial instruments that align incentives for abatement and overcome barriers to uptake of measures in the industrial sector[4]. Financial support may be most appropriate for projects that have large capital cost requirements and long payback periods but for which the abatement costs are below the expected carbon price. Candidates for this could be those options set out in analysis conducted in 2010 by AEA, underpinning our 2010 fourth carbon budget report (e.g. optimisation of refineries, improved distillation and bio-processing in the chemicals sector). These could potentially be explored by linking opportunities set out in roadmaps to financing under the Green Investment Bank and the Green Deal.

We will explore potential opportunities for financing in more detail as part of our 2014 progress report.

4 CCC (2012) Fourth Progress report. Available at www.theccc.org.uk

3. Managing competitiveness risks

In our 2013 report on competitiveness risks of carbon budgets, we noted that there are potential competitiveness risks for electro-intensive industries that are also subject to international competition and facing higher relative energy costs. These firms could see a squeeze on profits which could potentially drive output and jobs overseas.

The UK Government has recognised these risks and put in place support arrangements:

- In the 2011 Autumn Statement the Government committed £250 million for the period 2013-15 to offset the impact of rising electricity prices for electro-intense industries. Government has consulted on eligibility and design of the scheme, and will announce the final design in late 2013.
- In November 2012, exemptions were announced to offset the additional costs arising under Electricity Market Reform as part of the 2012-13 Energy Bill. Although the value of these exemptions has not currently been specified by Government, we estimated in our 2013 Carbon Footprint and Competitiveness report that they would amount to around £350 million in 2020 if extended to the electro-intensive industries we identified as at-risk[5].
- In the 2013 Budget, further exemptions from the Climate Change Levy were announced to the metallurgical and mineralogical process sectors to be introduced in 2014.

The value of these measures, if continued to 2020, is up to £475 million annually.

We assessed the extent of competitiveness risks to electro–intensive sectors, and found that profit impacts were between £150-400 million in 2020, and therefore manageable under existing policies.

In order to appropriately target support, the Government will have to develop the evidence base on:

- Electricity price increases arising from climate change policy for competitors
- Current and projected future electricity UK consumption, at a detailed level (i.e. Standard Industrial Classification level 4)
- Scope for cost pass-through
- Materiality of electricity price impacts for firm location and investment decisions
- Surplus allowances arising from EU ETS allocations (Box 4.3).

It is important to move from high level commitments to a detailed implementing framework to ensure carbon policies do not drive existing industry abroad, stop new industry from locating here, or make it more difficult for UK firms to compete effectively.

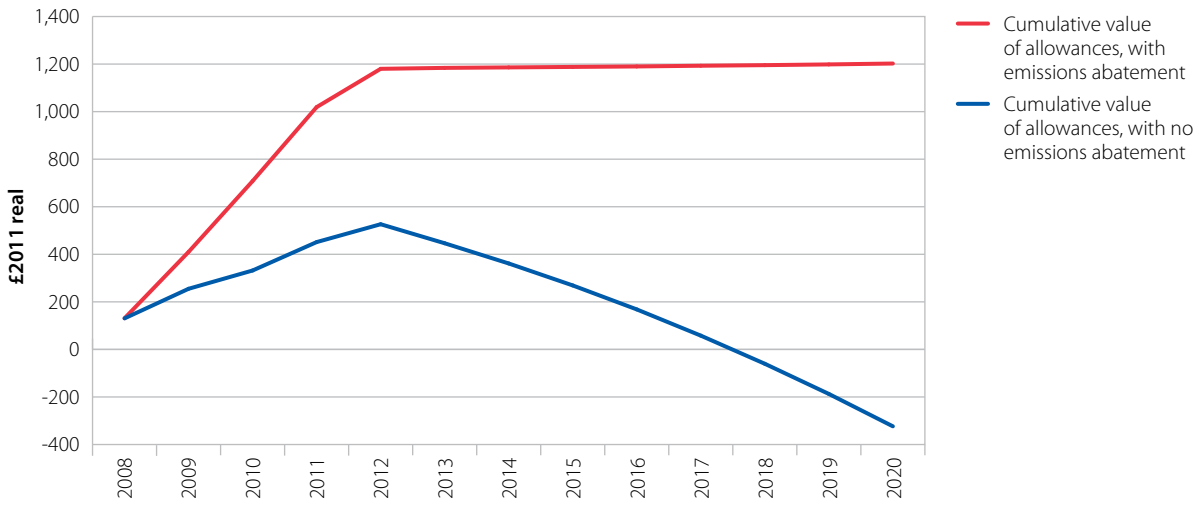
5 These included paper, cement, glass, basic inorganic chemicals, fertilizer and nitrogen, iron and steel, rubber and plastics.

Box 4.3: Surplus EU ETS allocation and weakened carbon price signal

Surplus allocation of allowances in the EU ETS can reduce incentives for reducing emissions by lowering the carbon price. Also, in some sectors, excess allocation may imply windfall profits and this may reduce the incentive to reduce emissions.

Analysis conducted in the context of our 2013 Carbon Footprint and Competitiveness report showed that Energy-intensive industry has surplus allocation by around £530 million in Phase II. Given banking between phases, surplus allowances are expected to continue in Phase III (Figure B4.3).

Figure B4.3: Estimated cumulative value of EU ETS allowances in UK energy-intensive industry (2008-2020)



Source: ICF and Cambridge Econometrics (2013); CCC calculations.
Notes: Based on a carbon price of £6/tCO_2 in 2008, rising to £8/tCO_2 in 2020.

Some specific sectors have substantial surplus in 2020. For example, basic metals (including iron and steel) has surplus allowances of £450 million in 2020. The implication is that some businesses may be more than fully compensated under the current regime.

If it is the case that the same firms requiring support for indirect impacts have received surplus free allowances, the Government could also consider if these should be taken into account in judgements regarding the appropriate level of compensation.

Source: ICF and Cambridge Econometrics (2012).

Key findings

- Total CO_2 emissions from industry **increased by 3% in 2012**. The majority of this increase reflects higher carbon intensity of the electricity grid.
- **There is little evidence that energy efficiency has improved** in 2012 or over the first carbon budget period (2008-2012).
- Given weak incentives for abatement, particularly on direct emissions, **Government should include the full range of cost-effective abatement options in the industry sector roadmaps** currently being developed by DECC and BIS and align financial incentives for low-cost abatement.
- **An approach to demonstration and commercialisation of CCS** compatible with deployment in the 2020s is required.
- To mitigate competitiveness impacts, it is now important to **move from high level commitments to a detailed implementing framework**.

Table 4.1: The Committee's industry indicators

INDUSTRY		Budget 1	Budget 2	Budget 3	2011 trajectory	2011 outturn
Headline indicators						
CO_2 emissions (indicative minimum % change on 2007)	direct	-14%	-9%	-7%	-14%	-15%
	indirect	-12%	-35%	-66%	-12%	-14%
Final energy consumption (indicative minimum % change on 2007)	non-electricity	-19%	-20%	-18%	-19%	-8%
	electricity (autogeneration included)	-16%	-11%	-5%	-16%	-12%
	electricity (centrally produced)	-6%	-19%	-30%	-6%	-11%
Supporting indicators						
Renewable heat						
Buildings and industry renewable heat penetration (% of heat demand)*		1%	5%	12% in 2020	<1%	1.2%**
Industry renewable heat penetration (% of heat demand)		1%	5%	13% in 2020	<1%	2.4%
CCS						
In light of outcome of CCS competition, set out an approach for industrial demonstrations compatible with deployment in the late 2020s			No later than 2013		No project in competition, commercialisation strategy required.	
Energy intensity						
Energy intensity (% change compared with 2007)		-7%	-18%	-24%	0%	
Energy intensity for energy-intensive sectors					-2%**	
Other milestones/drivers/wider monitoring						
Publish industry strategy including detail and milestones for meeting carbon budgets, incentives and mechanisms for overcoming barriers			No later than 2013		DECC/BIS industry roadmaps announced. Will report review of evidence in summer 2013.	

* Reflects incremental penetration of renewable heat above a baseline penetration in 2007 of 1.2%.
** Reported for 2011 (data is not available for 2012).

Key: Headline indicators Implementation indicators Milestones Other drivers

Introduction and key messages
1. Transport emission trends
2. Opportunities for reducing emissions – the indicator framework
3. Progress in reducing car emissions
4. Progress in reducing van emissions
5. Progress in reducing HGV emissions
6. Progress in developing electric vehicle markets
7. Progress on biofuels in surface transport
8. Progress in changing travel behaviour
9. Other policy developments

Chapter 5: Progress reducing transport emissions

Introduction and key messages

Domestic transport emissions were 117 $MtCO_2$ in 2011, accounting for 26% of UK CO_2 emissions. Emissions from international aviation and shipping were 42.5 $MtCO_2$ but are not currently formally included in carbon budgets.

The focus of this chapter is on domestic transport emissions covering emissions from surface transport and domestic aviation and shipping.

Our analysis is based on final emissions and other data for 2011 and preliminary data on emission drivers for 2012 which enables us to make an estimate of emissions last year. Our focus is on trends in new car and van emissions, HGV emissions, the use of biofuels, recent developments in the market for electric vehicles and progress towards sustainable transport choices.

Our key messages are:

- Domestic transport CO_2 emissions fell 1.2% in 2011, having been unchanged the previous year. An initial assessment suggests that surface transport emissions may have fallen slightly in 2012, with reduced emissions from cars and HGVs outweighing an increase from vans.
  - Surface transport emissions fell 1.3% in 2011, largely due to falls among cars and buses. Improved vehicle efficiency for car and vans and lower kms travelled for HGVs offset lower penetration of biofuels and a rise in distance travelled for cars and vans.
  - Our initial assessment for 2012 suggests that emissions may have decreased again, with continued improvement in vehicle efficiency driven by EU regulations, and lower distance travelled by cars and HGVs, offsetting reduced biofuels and the continuing rise in kms travelled by vans.
  - Domestic aviation emissions fell by 4.5% in 2011, to 1.7 $MtCO_2$, while domestic shipping emissions fell by 3.2%, to 2.5 $MtCO_2$.

- Carbon intensity of vehicles. There has been continued good progress in reducing new car and van emissions, leading to improvements in the overall fleet intensity. Monitoring of emissions intensity for HGVs is problematic as new HGV emissions are not currently measured, and monitoring of trends in the overall fleet is affected by the methodology adopted by the National Atmospheric Emissions Inventory (NAEI). While emissions are currently on track to meet our indicators, progress will need to be maintained to meet future carbon budgets.
  - CO_2 intensity of new cars fell from 138.1 gCO_2/km in 2011 to 133.1 gCO_2/km in 2012, a 3.6% reduction. While there was a reduction in CO_2 intensity of new cars across all car classes, the purchase of cars in different classes was more polarised than in 2011, with a move towards both smaller and larger models at the expense of the medium car segment. Continued growth in higher-emitting vehicles suggests a need to reinforce EU standards with incentives for best-in-class purchase as well as switching between classes. On the supply side, the Government should push for agreement of an ambitious EU target for 2025 in order to drive continued technological progress.
  - Average CO_2 intensity of new vans is estimated to have fallen by between 4.1 and 4.9% in 2012, to between 187 and 189 gCO_2/km, as industry responds to the target of 175g/km in 2014-17. However, the market shift to larger, higher emitting vehicles may limit progress in reducing emissions. The Government should push for a challenging EU target for 2025, with a possible need to reinforce EU standards with incentives around purchase behaviour.
  - Uptake of electric cars doubled in 2012 as Plug-in Hybrid Electric Vehicles (PHEVs) became available. A number of new Battery Electric Vehicles (BEVs) and PHEV models are expected in 2013/14. There was also progress in developing charging infrastructure with around 9,000 chargepoints installed to date, and the launch of a new national funding offer in February 2013. However, levels of uptake are still low and the market remains in its infancy. It is important that a stable framework of support remains in place to boost consumer and producer confidence, including continuation of current grants, as well as incentives for leasing firms who have the potential to play a key role in driving uptake.
  - Biofuels penetration decreased from 3.5% in 2011 to 3.1% (by volume) in 2012, as the Renewable Transport Fuel Obligation (RTFO) was amended to allow biofuels produced from wastes, non-agricultural residues and second generation biofuels to be counted twice in meeting the biofuels target. This level of biofuels is 1.4% short of our indicator. It is important that a robust framework for taking account of Indirect Land Use Change (ILUC) impacts is agreed as soon as possible to guard against an investment hiatus in this sector, or to allow additional action to meet carbon budgets to be put in place if required.
- Progress on changing behaviour. There has been some progress towards roll-out of Smarter Choices, with limited progress on eco-driving training and speed limiting, and some uncertainty in land use planning:

- Funding for the Local Sustainable Transport Fund (LSTF) was increased from £560 million to £600 million in 2012. The Fund is now fully committed, supporting 96 projects in 77 Local Authorities across England between 2011/12 and 2014/15 – almost all of which included Smarter Choices measures in their bids. As the projects progress, monitoring and evaluation of outcomes should be encouraged, to ensure emission reductions are achieved. If successful, the Government should make a commitment to further funding post-2015 and develop a plan for nationwide roll-out of Smarter Choices over the next decade.
- The level of eco-driving training remained low in 2012, with much greater use reported for truck drivers than for other vehicles. Given the benefits to both cost reductions and carbon savings, we recommend the Government should actively promote the uptake of eco-training, through a combination of inclusion as a key element in the practical driving test, driver training, awareness raising and in-car information on fuel efficiency.
- Speed limits are exceeded by a high proportion of drivers on motorways (49%) and dual carriageways (41%). Given the significant decline in fuel efficiency as car speed increases from 70 to 80 mph, enforcing current speed limits presents an opportunity for reducing emissions. In-car information from fuel consumption meters would also encourage driving within the speed limit by emphasising the excessive fuel consumption associated with driving at 80 rather than 70 mph.
- Government has set out proposals for changes in the way local authorities take account of transport issues in local plans. Given the potential for these to increase car use and emissions, it is important that transport emissions are factored into planning decisions alongside other costs and benefits. An Impact Assessment setting out the potential effect on travel demand and emissions should be published as soon as possible

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

1. Transport emission trends
2. Opportunities for reducing emissions – the indicator framework
3. Progress in reducing car emissions
4. Progress in reducing van emissions
5. Progress in reducing HGV emissions
6. Progress in developing electric vehicle markets
7. Progress on biofuels in surface transport
8. Progress in changing travel behaviour
9. Other policy developments

1. Transport emission trends

In 2011, domestic transport emissions were around 117 $MtCO_2$. These are dominated by surface transport (96%), with domestic aviation and shipping accounting for the remaining 4% of emissions. Provisional data suggest domestic transport emissions fell 1.2% in 2012, to 116 $MtCO_2$. A breakdown by mode is not yet available.

Since the financial crisis in 2008, surface transport emissions as well as those from aviation and shipping have been falling. The key drivers have been reduced economic activity, high fuel prices and EU emissions standards for new cars and vans, as well as tax and other incentives for the purchase of cleaner vehicles.

In this section we assess 2011 emissions data (the latest year for which final data by mode are available) and data on emission drivers for 2012. We consider in turn:

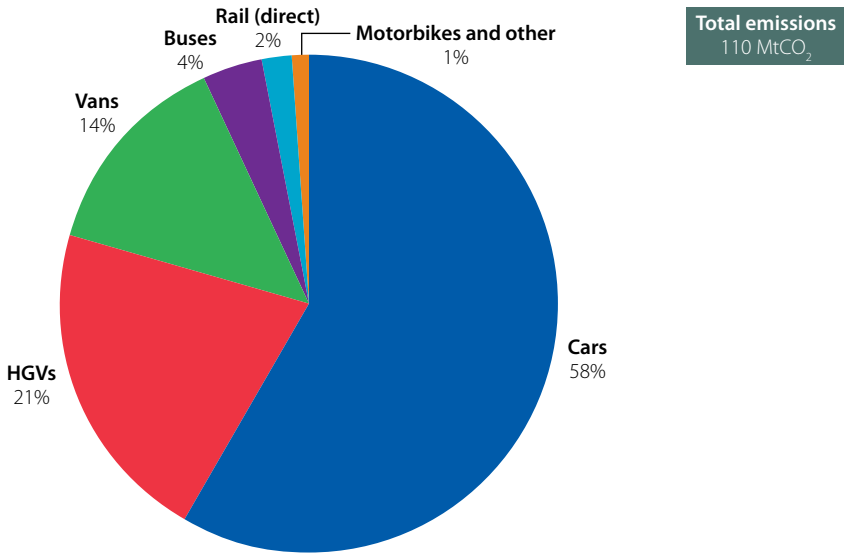
(i) Emissions from surface transport

(ii) Emissions from aviation and shipping

(i) Emissions from surface transport

Official estimates from the National Atmospheric Emissions Inventory (NAEI) suggest that surface transport (road and rail) CO_2 emissions in 2011 were dominated by cars (accounting for 59% of emissions), followed by HGVs (21%), vans (14%), buses (4%), mopeds and motorcycles (1%); rail accounted for the remaining 2% of surface transport emissions (Figure 5.1).

Figure 5.1: Breakdown of surface transport CO_2 emissions by mode (2011)



Source: NAEI (2013).
Notes: 'Other' includes motorcycles and mopeds, liquefied petroleum gas emissions (all vehicles), and other road vehicle engines.

According to these estimates, surface transport emissions fell by 1.3% in 2011, to 110 $MtCO_2$, with a 1.4% fall in road transport, which was partly offset by a 4.6% increase in rail emissions. Within road transport, emissions from vans increased, while those from other modes fell. The biggest falls were in emissions from cars and buses.

While road transport emissions data for 2012 are not yet available, petrol and diesel sales in 2012 suggest that emissions may have fallen by 0.3%

- Petrol and diesel currently account for the vast majority of road transport emissions (99.7% in 2011).
- Petrol sales fell by 4.8% in 2012, while diesel sales rose by 2.6%.
- Given the carbon intensity of petrol and diesel, this suggests road transport emissions may have fallen by 0.3%.
- For comparison, in 2011, petrol sales fell by 4.8% and diesel sales rose by 1.2%, suggesting a 1.3% fall in emissions, compared to the 1.4% fall based on NAEI estimates.

Overall road transport emissions have fallen by 10% since 2007, in line with our indicator trajectory (Figure 5.2). Most of this fall has been among passenger cars, driven by EU limits on new car CO_2, together with subdued economic activity and high fuel prices which have affected travel demand (Box 5.1). As economic conditions improve, policies will become increasingly important in driving emissions reductions in order to meet carbon budgets.

Box 5.1: Drivers of travel demand

While emissions from surface transport fell in 2011, this was against the background of subdued economic activity and high fuel prices. Going forward, it is important to monitor these drivers and their implications for travel demand. The key economic drivers we consider are prices, incomes, population and car efficiency. Figure B5.1 shows recent trends in the transport components of the RPI, and key income measures: GDP, manufacturing output as well as population changes.

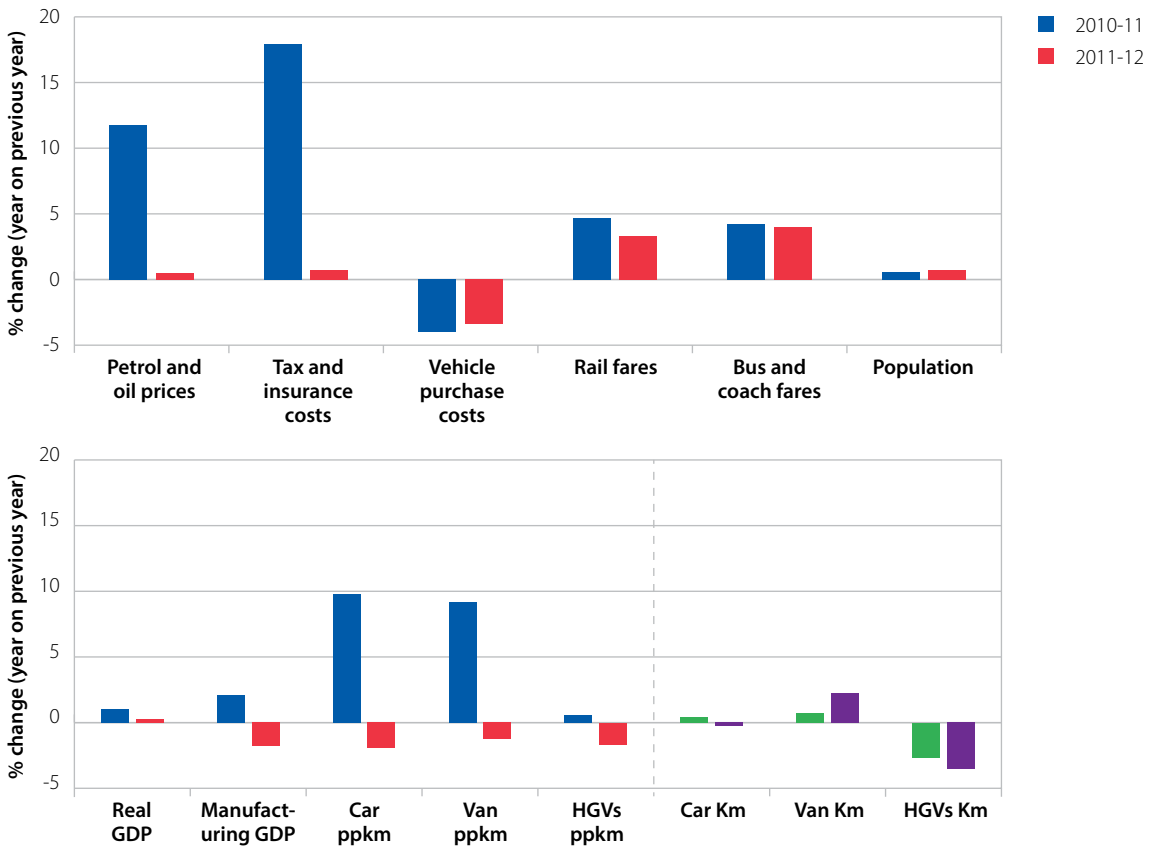
In the passenger car market, real GDP and population grew slightly in 2012. Last year also saw a rise in motoring costs, particularly running costs – petrol and tax and insurance. However improvements in car efficiency meant that the overall cost of driving per km fell. The balance of these factors resulted in a slight fall in car-km. This goes against evidence on elasticities which suggest that the net effect of these factors would be to increase demand over the last year. However, year-on-year changes are subject to other fluctuations (e.g. depending on weather) and over a longer period these remain useful indicators. Going forward, we would expect demand to be less responsive to prices as improvements in efficiency and rises in incomes reduce the importance of prices in determining demand.

In 2012, van-km rose much faster than would have been expected given indicators on prices and incomes. The rise in population and fall in cost of van travel per distance would have broadly been expected to offset the fall in GDP per capita, but in fact travel demand by vans grew by 2.3%. This reflects a continuation of longer term trends, where over the last decade van travel has risen by nearly 10 times as fast as would have been predicted by historical indicators. This may reflect a stronger relationship of van travel to income indicators such as GDP and retail sales than has previously been estimated. We will return to this in future reports.

HGV-kms fell by 3.5% in 2012, broadly in line with expectations given the fall in manufacturing output was larger than the fall in motoring costs. Over the last decade or so the fall in distance travelled by HGVs has been faster than would have been expected given the fall in manufacturing output and rise in travel costs. As with van travel, this may be because demand to transport goods and services rather than the cost of motoring are more important considerations for companies servicing that demand.

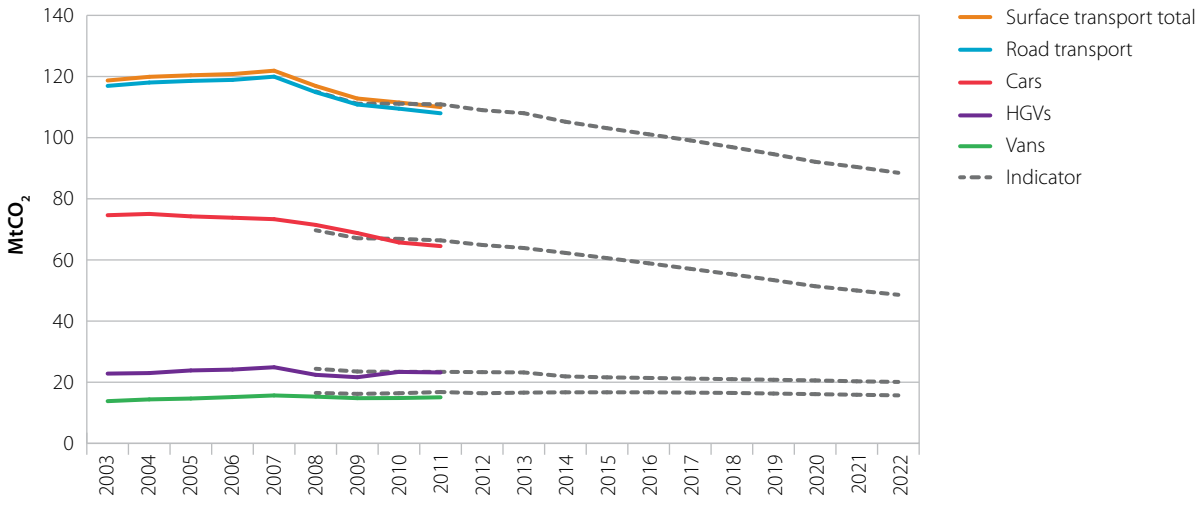
Box 5.1: Drivers of travel demand

Figure B5.1: Drivers of travel demand (2010-2012)



Source: CCC calculations based on Office of National Statistics and Department of Transport data.
Notes: ppkm refers to pence per kilometre

Figure 5.2: Surface transport emissions: historic and indicator trajectory (2003-2022)



Source: NAEI (2013), CCC modelling.

Uncertainty around emissions estimates

In our 2012 progress report, we highlighted issues with the methodology used in the NAEI to estimate emissions by mode. We demonstrated that, given data on distance travelled and penetration of biofuels, these estimates implied implausible changes in the fuel efficiency of vehicle fleets, particularly HGVs. Our recommendation was that the NAEI move to a more rigorous estimation methodology based on bottom-up modelling of the vehicle fleet.

In this chapter we continue to report NAEI estimates of emissions by mode. While we still have concerns over these estimates, more recent data have helped to explain some of the changes seen historically (Box 5.2). However, it remains the case that improvements in the methodology and data used to estimate emissions are needed to allow an accurate assessment of trends by mode. It is likely this will entail additional resources; the Government should consider what steps could be taken to provide better estimates at reasonable cost.

Box 5.2: Estimating emissions by mode

The National Atmospheric Emissions Inventory (NAEI) includes estimates of road transport CO_2 emissions by mode. CO_2 emissions from each mode are estimated with the following steps:

- Fuel consumption factors are defined for petrol and diesel vehicles, for each type of road.
- Total petrol and diesel consumption is estimated based on fuel consumption factors and vehicle km travelled on each type of road.
- Estimated petrol and diesel consumption is adjusted so that total consumption matches official statistics on total petrol and diesel sales in the UK.

In our 2012 progress report, we highlighted two problems with this methodology:

- While bus and HGV fuel consumption factors reflect real-world survey data, car and van factors are assumptions based on speed-emissions curves which do not reflect reductions in gCO_2/km arising from the latest EU new car and van CO_2 regulations. Car and van emissions are therefore likely to be overestimated.
- For petrol, any discrepancy between estimated consumption and total sales is allocated proportionally across petrol consuming modes, but for diesel it is allocated entirely to HGVs. This can lead to large year-on-year changes in implied HGV fleet efficiency, raising questions over the robustness of the estimates.

We highlighted last year that the scaled estimates imply HGV fleet intensity (gCO_2/v-km) worsened by over 10% between 2009 and 2010. However, recently available road freight statistics suggest that loads lifted in 2009 were particularly light, with a significant fall in goods moved by the heaviest HGVs. In 2010, there was a bounce back, with tonne km undertaken by the heaviest HGVs increasing by 14%. Given heavier vehicles tend to have higher tailpipe emissions, this is likely to have led to the apparent worsening of emissions on a vehicle km basis. On a tonne km basis however, emissions fell by 2.6%.

A number of actions could be taken to improve emissions estimates by mode, including:

- Speed emissions curves for cars and vans could be updated to reflect improvements in new vehicle CO_2 intensity arising from the latest EU legislation.
- Updating of HGV fuel consumption factors to reflect real-world survey data could be done on a regular basis to reflect the most up-to-date information available and better capture variations in loads lifted over time.
- Estimates of fuel used in the UK but purchased elsewhere (and vice versa) could be improved (e.g. using HGV Road User Levy data, following its introduction in April 2014), to reduce the discrepancy between estimated consumption and total sales data (which must then be allocated to particular modes)[1].

These actions would require additional resources. However, accurate monitoring of emissions by mode is important to allow the appropriate action to meet carbon budgets to be put in place if required.

1 Not all fuel used in the UK is sold in the UK and vice versa, as vehicles (especially HGVs) may enter or leave the country with full tanks.

Car emissions

Car emissions in 2011

The NAEI estimate of car emissions in 2011 is 64.5 $MtCO_2$, a 1.8% decrease on the estimate for 2010 of 65.7 $MtCO_2$. The change in emissions can be accounted for by changes in total car travel, penetration of biofuels, and the fuel efficiency of the car fleet:

- Total car travel in 2011 was 403.2 billion vehicle km, a 0.4% increase on 2010 levels of 401.6 billion vehicle km.
- Combined bioethanol and biodiesel penetration for cars fell from 2.7% (by energy) in 2010 to 2.6% in 2011.
- The implication of data on car emissions, total car travel and biofuels penetration is that the fuel efficiency of the fleet may have improved by 2.2% between 2010 and 2011.

The age profile of the fleet and historical time series of the CO_2 intensity of new cars (which fell by 4.2% in 2011) also suggests that the fuel efficiency of the fleet may have improved by 2.2% between 2010 and 2011.

Car emissions in 2012

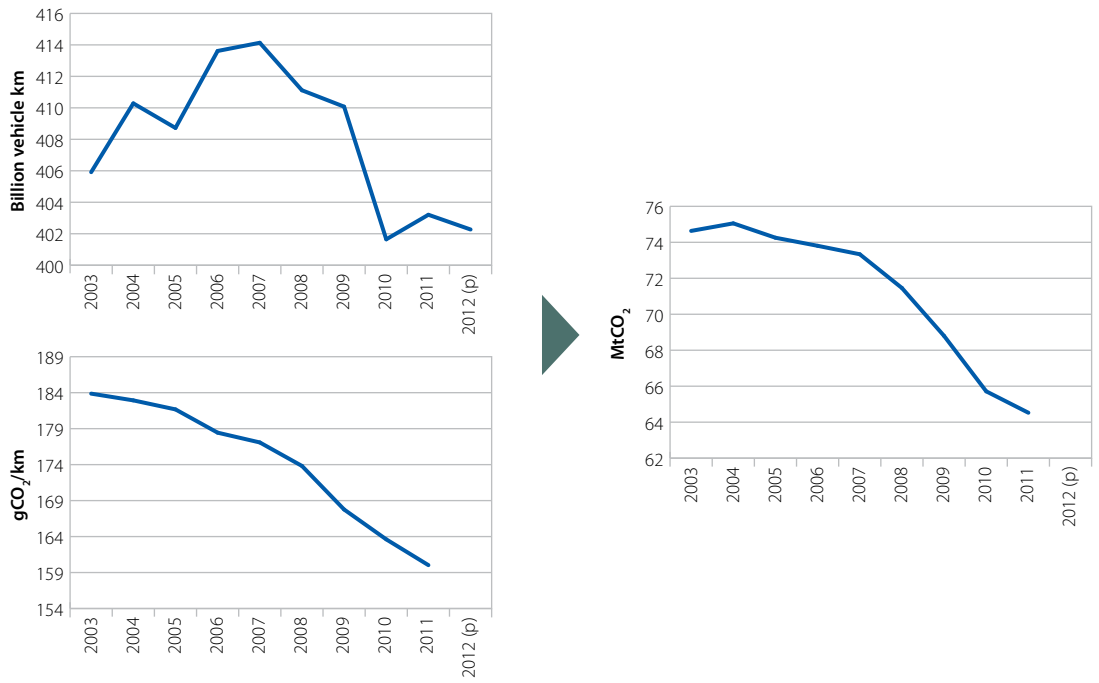
We do not have estimates of car CO_2 emissions in 2012. However, there are provisional data on total car travel, biofuels penetration and new car CO_2:

- Total car travel in 2012 was 402.3 billion vehicle km, a 0.2% decrease on 2011 levels of 403.2 billion vehicle km.
- Combined bioethanol and biodiesel penetration for cars remained constant at 2.6% (by energy) in 2012.
- The CO_2 intensity of new cars fell by 3.6% in 2012 (see section 3 below). The age profile of the fleet and historical time series of new car CO_2 intensity suggests that the fuel efficiency of the fleet may have improved by 2.4% between 2011 and 2012.

The implication is that car CO_2 emissions in 2012 are likely to have fallen between 2011 and 2012, though this should be treated with caution given uncertainties in the data.

With this caveat in mind, Figure 5.3 sets out the historical data on total car travel, CO_2 emissions and the resulting CO_2 intensity of the fleet.

Figure 5.3: Historical trends of vehicle km, $MtCO_2$ and gCO_2/km for cars (2003-2012)



Source: NAEI (2013), DfT (2013) Transport Statistics Great Britain 2012.

Van emissions

Van emissions in 2011

The NAEI estimate of van emissions in 2011 is 15.1 $MtCO_2$, a 1.6% increase on the 2011 estimate of 14.8 $MtCO_2$. The change in emissions can be accounted for by changes in total van travel, penetration of biofuels, and the fuel efficiency of the van fleet:

- Total van travel in 2011 was 69.3 billion vehicle km, a 0.8% increase on 2010 levels of 68.8 billion vehicle km.
- Combined bioethanol and biodiesel penetration for vans decreased from 3.8% (by energy) in 2010 to 3.4% in 2011.
- The implication of data on van emissions, total van travel and biofuels penetration is that the fuel efficiency of the fleet may have worsened by 0.4% between 2010 and 2011.

Looking at the age profile of the fleet and historical time series of the CO_2 intensity of new vans suggests that the fuel efficiency of the fleet should have improved by around 0.3 – 0.5% between 2010 and 2011. Given the level of accuracy of the figures, this is consistent with the change in fuel efficiency implied by the NAEI estimate of van emissions.

Van emissions in 2012

We do not have estimates of van CO_2 emissions in 2012. However, there are provisional data on total van travel, biofuels penetration and CO_2 intensity of new vans:

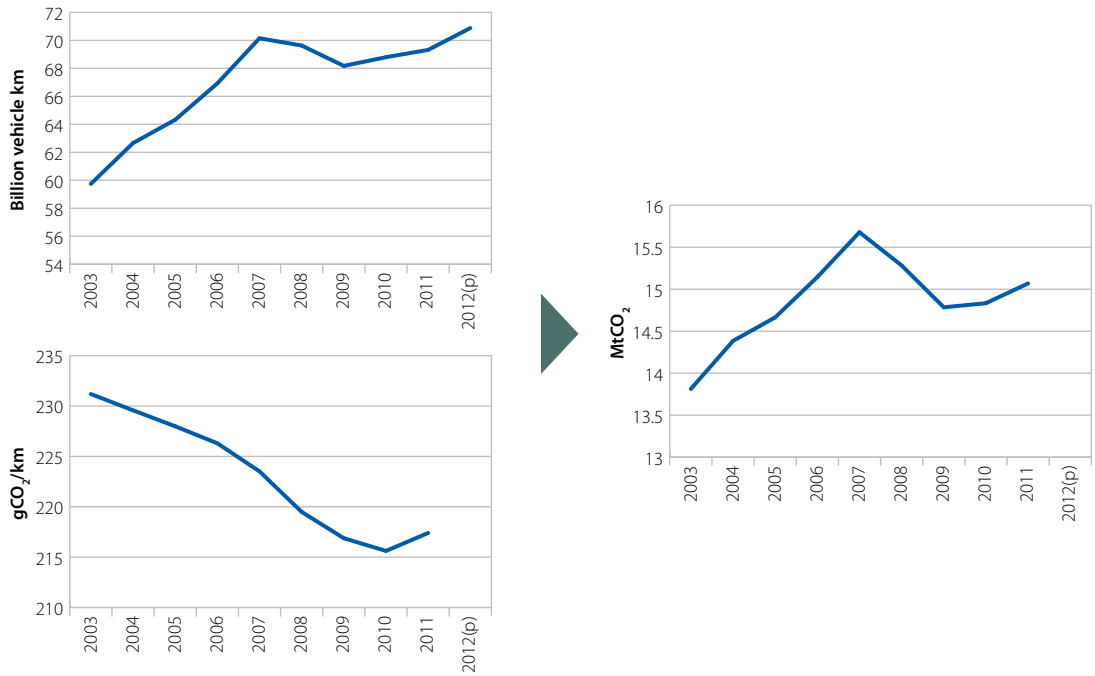
- Total van travel in 2012 was 70.9 billion vehicle km, a 2.3% increase on 2011 levels of 69.3 billion vehicle km.
- Combined bioethanol and biodiesel penetration for vans decreased from 3.4% (by energy) in 2011 to 2.3% in 2012.
- Estimates from the Driver and Vehicle Licensing Agency (DVLA) and Society of Motor Manufacturers and Traders (SMMT) suggest that the CO_2 intensity of new vans improved by 4.1 – 4.9% in 2012 (see section 4 below). The age profile of the fleet and limited historical time series of CO_2 intensity of new vans suggests that the fuel efficiency of the fleet is likely to have improved by at least 0.8% between 2011 and 2012.

Together, these factors imply that van emissions may have increased between 2011 and 2012.

Figure 5.4 sets out the historical data on total van travel, CO_2 emissions and the CO_2 intensity of the fleet.

In order to ensure that van emissions are reduced in future, the key driver will be lower CO_2 intensity of new vans; we consider approaches to reducing new van emissions in Section 4 below.

Figure 5.4: Historical trends of vehicle km, $MtCO_2$ and gCO_2/km for vans (2003-2012)



Source: NAEI (2013), DfT (2013) Transport Statistics Great Britain 2012.

HGV emissions

HGV emissions in 2011

The NAEI estimate of HGV emissions in 2011 is 23.2MtCO_2, a 0.8% decrease on the 2011 estimate of 23.4 MtCO_2. The change in emissions can be accounted for by changes in total HGV travel, penetration of biofuels, and the fuel efficiency of the HGV fleet:

- Total HGV travel in 2011 was 26.6 billion vehicle km, a 2.7% fall on 2010 levels of 27.4 billion vehicle km.
- Biodiesel penetration for HGVs increased from 2.0% (by energy) in 2010 to 3.4% in 2011.
- The implication of data on HGV emissions, total HGV travel and biofuels penetration is that the fuel efficiency of the fleet (gCO_2/v-km) may have worsened by 3.4% between 2010 and 2011.
  - This apparent worsening may be due to data issues related to how NAEI allocates emissions to HGVs (see Box 5.2 for a discussion of the methodology).
  - It may also reflect increased activity by larger vehicles: the share of vehicle km travelled by articulated HGVs with 6 or more axles increased from 23% to 27% in 2012. This would be expected to increase emissions per vehicle km.

Data on the fuel efficiency of the fleet in 2011 (collected via the survey of haulage companies reported in Department for Transport (DfT) Road Freight Statistics) is not yet available.

HGV emissions in 2012

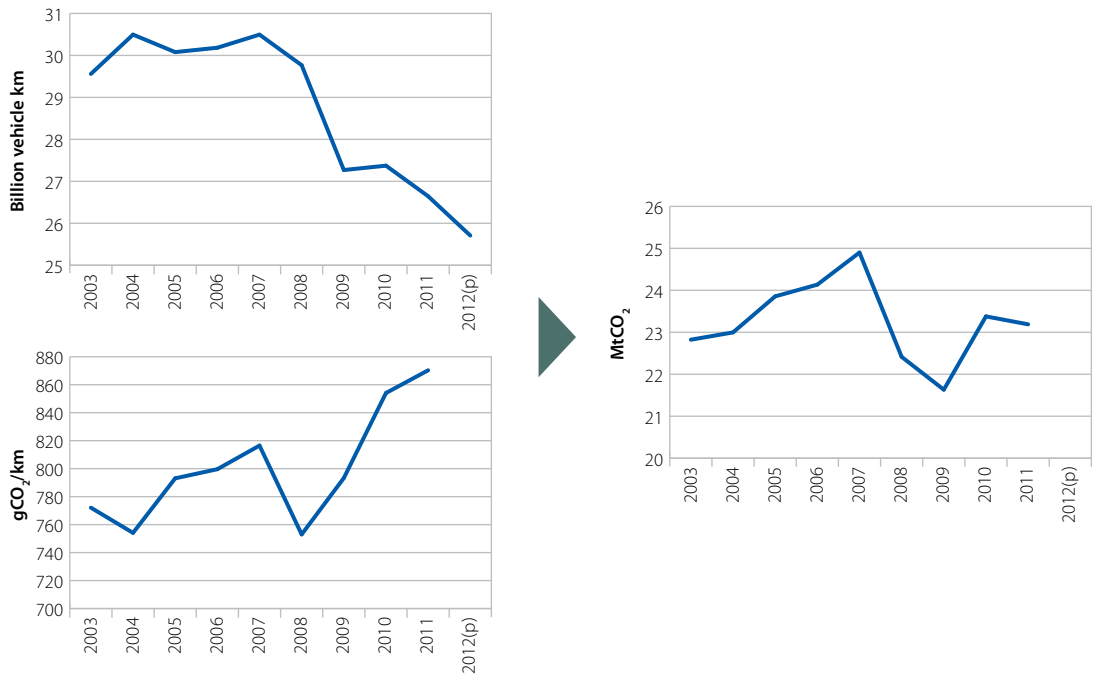
We do not have estimates of HGV CO_2 emissions in 2012. However, there are provisional data on total HGV travel and biofuels penetration:

- Total HGV travel in 2012 was 25.7 billion vehicle km, a 3.5% fall on 2011 levels of 26.6 billion vehicle km, and coincides with a 2% drop in manufacturing output.
- Biodiesel penetration for HGVs decreased from 3.4% (by energy) in 2011 to 2.3% in 2012.
- We do not have data on the CO_2 intensity of the HGV fleet in 2012.

If there was no change in CO_2 intensity between 2011 and 2012, a small reduction in HGV emissions between 2011 and 2012 seems likely.

Figure 5.5 sets out the historical data on total HGV travel, CO_2 emissions and the implied CO_2 intensity of the fleet.

Figure 5.5: Historical trends of vehicle km, $MtCO_2$ and gCO_2/km for HGVs (2003-2012)



Source: NAEI (2013), DfT (2013) Transport Statistics Great Britain 2012.

Motorcycle emissions

In 2011 motorcycle emissions comprised around 0.5% of all surface transport emissions.

The NAEI estimate of motorcycle CO_2 emissions is 0.5 $MtCO_2$ in 2011, a 0.2% increase on the 2010 level.

Motorcycle CO_2 emissions increased by over 20% between 2000 and 2007, but have decreased by around 18% between 2007 and 2011, with motorcycle distance travelled also decreasing by 16% over the same period.

Public transport emissions

Public transport emissions as a whole decreased in 2011, as the fall in bus emissions more than offset the increase in rail (direct) emissions.

- The NAEI estimate of bus emissions in 2011 is 4.2 $MtCO_2$, a 7.1% decrease on the 2010 estimate of 4.6 $MtCO_2$.
- Direct emissions from rail increased by around 4.6% in 2011, from 2.0 $MtCO_2$ in 2010 to 2.1 $MtCO_2$ in 2011, driven largely by an increase in passenger demand (passenger km increased by 5.3%). Indirect emissions from electricity generation used in transport (currently mainly rail) are accounted for in Chapter 2, however indirect emissions from rail increased by 5%, with the increase in demand only partly offset by a 3% fall in the carbon intensity of electricity.

(ii) Emissions from aviation and shipping

Aviation emissions

UK aviation CO_2 emissions grew by 3.8% in 2011. Domestic emissions fell while international emissions grew (Figure 5.6):

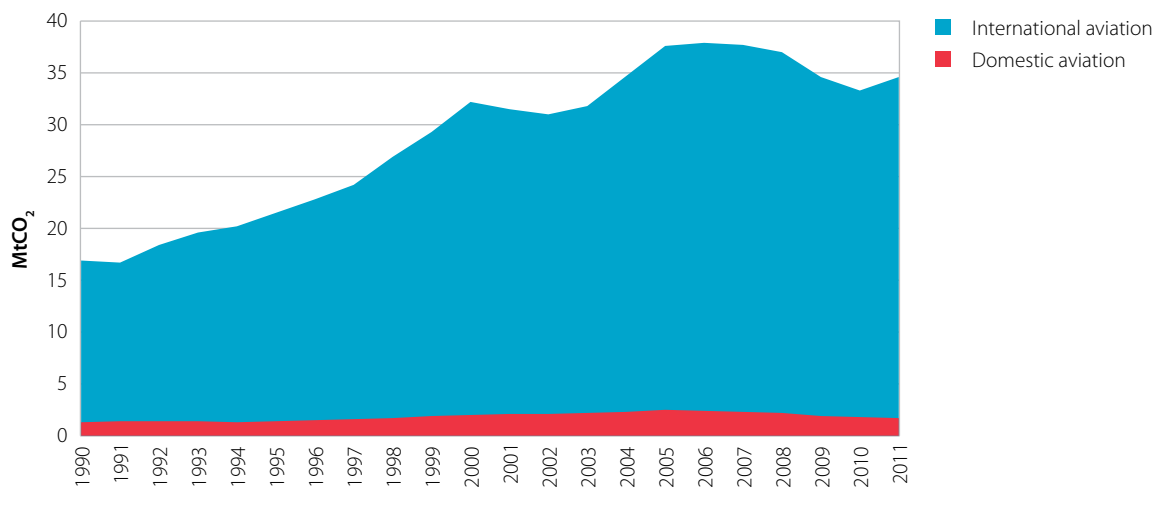
- Domestic aviation CO_2 emissions fell by 4.5%, from 1.8 $MtCO_2$ to 1.7 $MtCO_2$
- International aviation CO_2 emissions[2] grew by 4.3%, from 31.5 $MtCO_2$ to 32.9 $MtCO_2$.

The increase in aviation emissions reflects a 4.1% rise in passenger numbers in 2011. Growth in international passengers (5.1%) outweighed a fall in domestic trips (0.5%).

In 2012 passenger numbers rose by 0.6%, suggesting that aviation emissions may also have risen.

In future, emissions are projected to continue rising but can be reduced through a combination of improvements in fuel efficiency, use of biofuels, and moderations to demand growth. In our 2012 advice on the inclusion of international aviation and shipping in carbon budgets[3], we suggested an appropriate planning assumption was for UK aviation emissions in 2050 to be around 2005 levels. Our analysis, and that of government and industry, suggests this is feasible and broadly cost-effective. In January 2013 DfT updated their forecast of aviation emissions to provide a baseline for discussion in relation to the new Airports Commission (Box 5.3). Given weaker forecast demand growth due to the recession, these suggest emissions in 2050 could be around 4% lower than previously forecast. We will assess the implications of this in our review of the fourth carbon budget later this year.

Figure 5.6: UK aviation CO_2 emissions (1990-2011)



Source: NAEI (2013).

2 Based on bunker fuel sales. International emissions occur on journeys where one of the departure/destination points is outside the UK.
3 http://www.theccc.org.uk/publication/international-aviation-shipping-review/

Shipping emissions

UK shipping CO_2 emissions grew by 8.7% in 2011. Domestic emissions fell while international emissions grew (Figure 5.7):

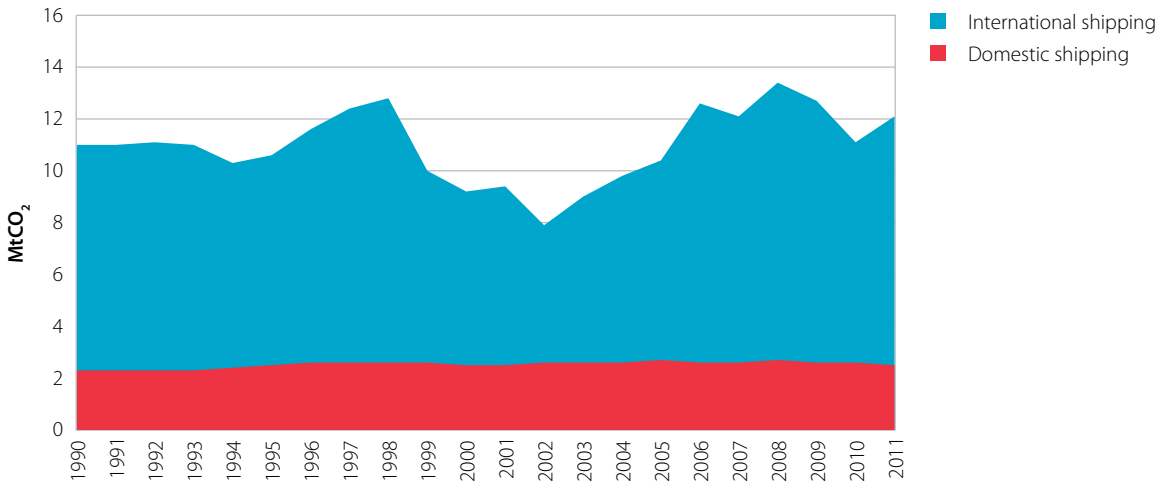
- Domestic shipping CO_2 emissions fell by 3.2%, from 2.6 $MtCO_2$ to 2.5 $MtCO_2$
- International shipping CO_2 emissions[4] grew by 12.2%, from 8.5 $MtCO_2$ to 9.6 $MtCO_2$.

The increase in shipping emissions is likely to reflect a 5% increase in UK cargo demand in 2011.

In 2012 UK cargo demand fell by 2.7%, suggesting that emissions may have fallen in 2012.

In future, there is scope to significantly reduce UK shipping emissions (e.g. by up to around 65% below current levels by 2050). More ambitious international policies beyond those already agreed (i.e. the IMO's Energy Efficiency Design Index, Box 5.3) will be needed to unlock the full range of abatement potential.

Figure 5.7: UK shipping CO_2 emissions (1990-2011)



Source: NAEI (2013).

4 Based on bunker fuel sales. International emissions occur on journeys where one of the departure/destination points is outside the UK.

Box 5.3: Recent climate change policy developments in aviation and shipping

International policy

- **Aviation.** In November 2012 the International Civil Aviation Organisation (ICAO) agreed to form a High-level Group on environmental policy. This will provide recommendations on global market based measures to the ICAO Assembly in late 2013.
- **Shipping.** In January 2013 the International Maritime Organisation's regulation to improve energy efficiency of new ships – by up to 30% by 2025 – came into force (the Energy Efficiency Design Index). The IMO has also agreed to undertake a study to update its 2009 estimate of greenhouse gas emissions from international shipping.

EU policy

- **Aviation.** In November 2012 the European Commission (EC) decided to suspend inclusion of non-EU aviation emissions in the EU ETS for one year. This is designed to allow space for ICAO to develop a proposal for global market based measures by its Assembly in late 2013. If ICAO is not able to agree, then aviation will revert back to inclusion in the EU ETS.
- **Shipping.** In October 2012 the EC announced their intention to introduce a system for monitoring, reporting and verification of EU shipping emissions in 2013. This will help provide more accurate data on shipping emissions.

UK policy

- **Carbon budgets.** In December 2012, following the EC's decision to suspend inclusion of non-EU aviation emissions in the EU ETS, the Government decided to postpone formal inclusion of international aviation and shipping (IAS) emissions in carbon budgets. However, it confirmed the status quo that IAS emissions are included in the 2050 target and that carbon budgets are set on this basis.
- **Airport capacity.** In September 2012 the Government established the Airports Commission to advise on future need for airport capacity. The Commission will release interim advice by the end of 2013, and final advice by Summer 2015. The Commission membership includes Julia King who is a member of the Committee on Climate Change.
- **Aviation strategy.** In March 2013 the Government published a new policy framework for aviation. This set out the Government's policy objectives for aviation, including their climate change strategy. It emphasised the importance of international and EU action on aviation emissions, together with the national actions which could support this.

2. Opportunities for reducing emissions – the indicator framework

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

Surface transport emissions

- By 2020, emissions from road transport fall by 23% relative to 2007 levels, with reductions of 30% in car emissions, and 15% in HGV emissions, while a rise in van emissions is limited to 1%.
- The CO_2 intensity of the fleet falls to 121 gCO_2/km for cars, 176 gCO_2/km for vans and 648 gCO_2/km for HGVs

Fuel/carbon efficiency of vehicles

- New vehicle CO_2 intensity falls in line with EU regulations, reaching an average of 95 gCO_2/km in 2020 for new cars, and 147 gCO_2/km for new vans. We envisage that electric vehicles contribute to meeting these targets. Excluding electric vehicles, CO_2 intensity of conventional new cars falls to 110 gCO_2/km by 2020, while CO_2 intensity of conventional new vans falls to 169 gCO_2/km.
- The market share of electric (battery and plug-in hybrid) vehicles reaches 16% of new sales for both cars and vans. This translates to a fleet penetration of 5% (1.7 million vehicles) for cars and 4% (135,000 vehicles) for vans.
- CO_2 intensity of new HGVs decreases by 6-9% between 2008 and 2020.
- Sustainable biofuels penetration increases to 8% by energy (10% by volume) by 2020, in line with recommendations in the Gallagher Review.

Behaviour change

- Implementation of Smarter Choices initiatives nationwide results in a 5% reduction in car travel by 2020 relative to a business as usual scenario.
- There is wide-scale uptake of eco-driving through training, with 3.8 million drivers trained by 2020 (10% of car and van drivers and 100% of HGV drivers).
- Speed limits on motorways are enforced at current levels, cutting the additional emissions generated at higher speeds.

If all indicators were to be achieved in practice, this would result in a 20% reduction in transport emissions in 2020 relative to a business as usual scenario. Whether we are on track to deliver this emissions reduction depends on progress relative to indicators, which we now consider.

3. Progress in reducing car emissions

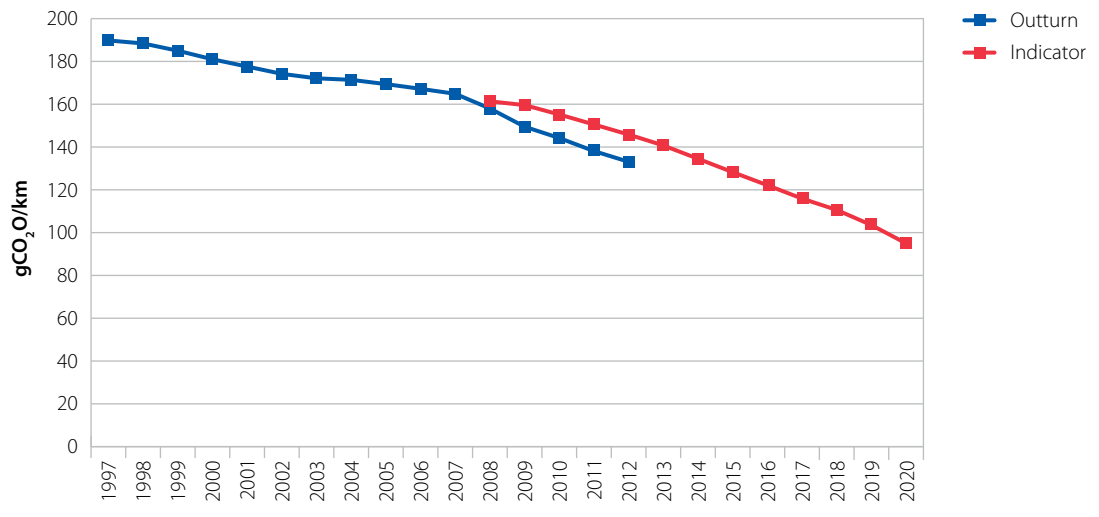
A reduction in car emissions is primarily achieved through the renewal in the car fleet; our analysis suggests that replacement of old inefficient cars with increasingly efficient new cars offers scope for a 2.5% annual improvement in the carbon intensity of the car fleet between 2010 and 2020.

Strong progress in recent years on new car efficiency improvement continued in 2012 (Figure 5.8):

- CO_2 intensity of new cars fell from 144.2 gCO_2/km in 2010 to 138.1 gCO_2/km in 2011 (a 4.2% reduction), and to 133.1 gCO_2/km in 2012 (a further 3.6% reduction).
- Our indicator for 2012 – consistent with progress towards a 95 gCO_2/km target in 2020 – is 145.8 gCO_2/km.
- Therefore CO_2 intensity of new cars is currently out-performing our indicator, by around 9% in 2012.

There is, however, evidence that efficiencies under real world driving conditions can be significantly lower than measured under the current test cycle. Our indicator trajectories account for this difference to the extent that historic data suggests; however if the gap were to widen in future, for example the difference between the test cycle data and real driving were to be proportionately greater for highly efficient, low emissions vehicles, this could pose a risk to meeting carbon budgets. The European Commission's proposed move to an alternative test cycle – part of a wider set of proposals relating to the EU new vehicle CO_2 regulations (Box 5.4) – could help to mitigate this risk.

Figure 5.8: New car CO_2 – indicator trajectory and outturn (1997-2020)



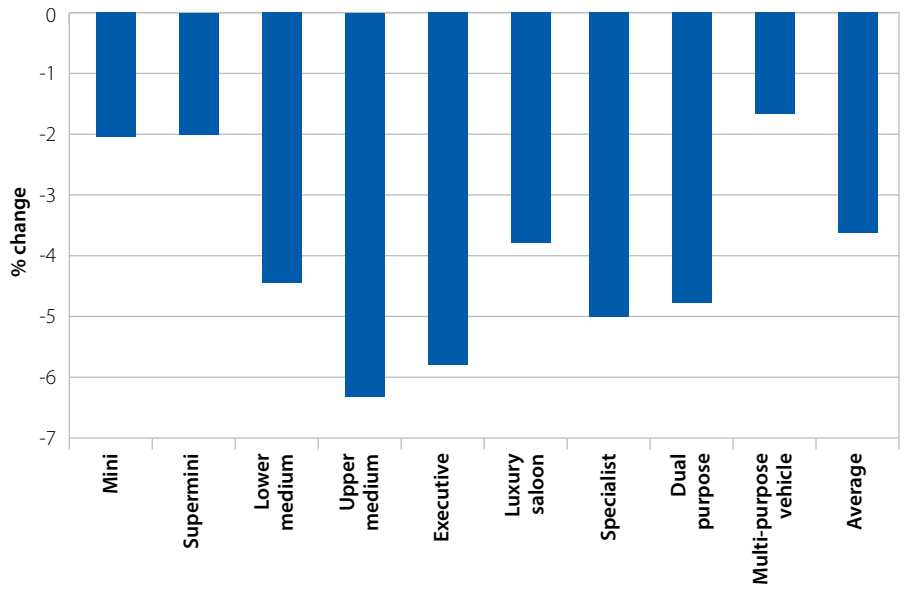
Source: Society of Motor Manufacturers and Traders (SMMT) (2013) *New Car CO_2 Report 2013*, CCC modelling.

There was a reduction in CO_2 intensity of new cars across all car classes, while purchase of cars in different classes was more polarised than in 2011, with a smaller share of medium cars sold, but higher shares of both small and large cars:

- CO_2 intensity of new cars fell across all car classes in 2012, with the reduction ranging from 1.7% for multi-purpose vehicles to 6.3% for upper medium saloons (Figure 5.9). The significant improvement in executive saloon efficiency was influenced by an increase in the share of diesel vehicles in this market segment.
- There was a slightly lower share of medium-sized new cars in 2012, with increases in the shares of both smaller, lower-emitting and larger, higher-emitting cars:
  - There was a small decrease (1.9 percentage points) in the market share of cars in the lower medium and upper medium segments (despite an increase in the number of models available). Meanwhile, the share of cars in the mini and supermini segments rose by around 1%, returning to almost their 2009 shares (Figure 5.10). However, the share of higher-emitting 'dual-purpose' vehicles also rose by 1.2 percentage points, reaching their highest level (almost 10%) since 2008, and corresponding to a 25% increase in models available.
  - Overall, the impacts of these changes were broadly offsetting: had the share of car sales in each class remained at their 2011 levels, average new car CO_2 intensity would have been 133.0 gCO_2/km, rather than the actual value of 133.1 gCO_2/km).

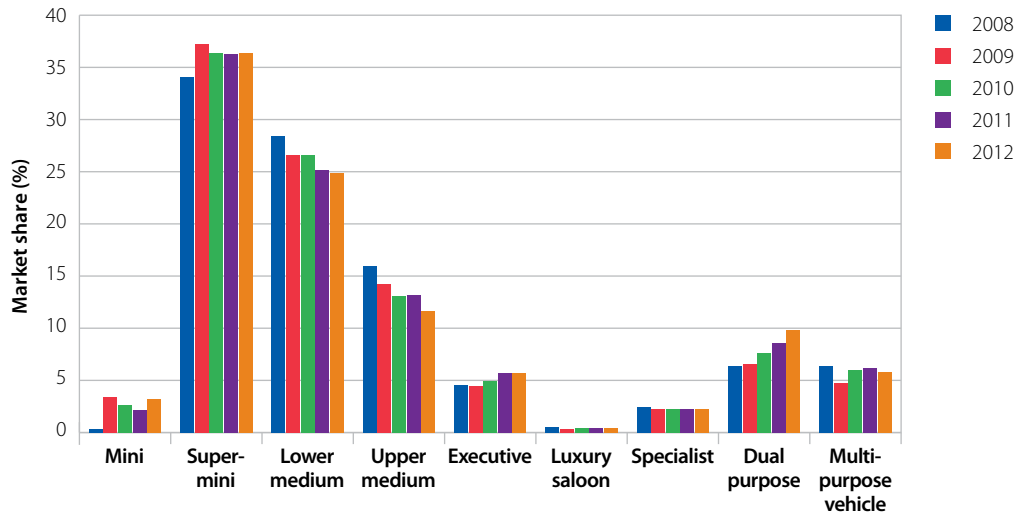
The changes in car purchase behaviour in 2012 appear to form part of a longer term trend, with a high and stable share of mini and supermini segments (following a sharp increase in 2009), declining shares of medium sized cars and increasing shares of executive and dual-purpose vehicles.

Figure 5.9: Change in gCO_2/km for each car segment (2011-2012)



Source: SMMT.

Figure 5.10: Market share of new car segments (2012)



Source: SMMT.

Going forward, there remains scope for CO_2 intensity of new cars to be reduced both due to within-class efficiency improvements and switching between classes. There are signs that the market share of mini and supermini segments may continue to grow at the expense of medium sized cars, even as the economy recovers. However, the continued growth in the share of higher-emitting dual purpose vehicles suggests a need to reinforce EU standards with incentives for best-in-class purchase as well as switching between classes. If progress in reducing car emissions is to be sustained in future, increased and further differentiated Vehicle Excise Duty may be required, with lower rates for more fuel efficient cars and without discontinuities such that there is a large change in VED for a small change in efficiency.

We will continue to track the CO_2 intensity of new cars and highlight appropriate actions to support continued progress by encouraging demand for more efficient vehicles, thereby encouraging suppliers to bring more efficient models to market. This is especially relevant in light of the recent draft agreement on use of "supercredits" for meeting the 2020 target (Box 5.4). While encouraging manufacturers to produce higher volumes of ultra-low emissions vehicles, supercredits also mean that actual g/km (even on a test-cycle basis) may be higher than 95 g/km.

Notwithstanding this, it is clear that the EU new car CO_2 regulations have been very effective in driving emissions reductions. In order to provide certainty for vehicle manufacturers and sustain progress, there is a need for longer-term targets to be set. The European Commission recognises this, and has proposed an indicative target range for 2025 of 68-78 gCO_2/km (Box 5.4). However, evidence suggests there may be scope to go further than these proposals:

- Our scenario for meeting the fourth carbon budget envisaged 75 g/km in 2025 given a 30% share of plug-in electric vehicles (95 g/km excluding plug-in EVs)[5]. New analysis of road transport technologies we commissioned last year[6] suggests g/km could be lower still, for example with combined hybridisation and strong engine downsizing.
- Others[7] have suggested a target of 60 g/km in 2025 would be achievable with an EV share of around 50% (of which half are BEVs) – and indeed required to accelerate the introduction of ultra-low emission vehicles.

To ensure continued progress, particularly given current outperformance, and to further encourage the availability of ultra-low emission vehicles, the Government should push for agreement of ambitious longer term targets as soon as possible (e.g. after the Commission's proposed review in 2014). These should be sufficiently challenging to have a strong effect on pulling new technology through to market.

Box 5.4: Update on EU new vehicle CO_2 regulations

In April 2013, the European Parliament's Environment Committee approved a draft law setting out the rules for meeting the 95 gCO_2/km new car CO_2 target for 2020. They also added an indicative target for post-2020 CO_2 emissions. Key features of the draft law include:

- Use of supercredits to provide an incentive to manufacturers to bring forward ultra-low emission vehicles. When calculating manufacturers' fleet-average emissions, each car emitting less than 50 gCO_2/km would count as 3.5 cars in 2013 (falling to 1.3 from 2020 to 2023 and 1 from 2024 for cars emitting less than 35 gCO_2/km), making their target easier to meet. However, the draft law states that any effective increase in manufacturers' emissions targets deriving from the "super-credits" calculation would be capped at 2.5 gCO_2/km. It also states that it should not be possible to transfer any unused super-credits from one year to another.
- An indicative 2025 target range from 68 – 78 gCO_2/km, to further incentivise manufacturers to maintain investment in ultra-low carbon vehicles. A review and impact assessment should be carried out by the end of 2014 at the latest.
- A move to the new UN-defined World Light Duty Test Procedure (WLTP) "as a matter of urgency", and if possible by 2017. Currently new car CO_2 is measured using the New European Driving Cycle (NEDC). However, a number of studies suggest significant discrepancy between test-cycle fuel consumption and emission figures and those achieved in everyday driving conditions. The WLTP has been designed with the aim to better reflect real-world driving conditions.

The draft is due to be considered by the full European Parliament in July 2013, and will also need to be approved by the European Council before it can enter into force.

In May 2013, the Environment Committee also approved a draft law setting out rules for meeting the new van CO_2 target of 147 gCO_2/km by 2020, and proposed an indicative target range of 105 – 120 gCO_2/km from 2025. However, they rejected tightening the 2020 target.

5 Around 50 g/km in 2030 with a 60% share of EVs (80 g/km excluding EVs).
6 AEA (2012) *A review of the efficiency and cost assumptions for road transport vehicles to 2050.*
7 RAC Foundation (2013) *Powering Ahead: The future of low-carbon cars and fuels*, Greenpeace and Transport & Environment (2013) *The case for 2025 targets for CO_2 emissions from cars and vans.*

4. Progress in reducing van emissions

There is scope, under our indicators, to reduce total van[8] emissions in 2020 by around 2% from 2010 levels (in the context of an expected 28% increase in van km), mainly due to fleet efficiency improvement as old inefficient vans are replaced with increasingly efficient new vans.

The context for new van emissions reductions is the EU new van CO_2 target: in May 2011, the EU agreed a target to reduce the average CO_2 intensity of new vans to 175 gCO_2/km by 2017, and to 147 gCO_2/km by 2020.

We have previously reported estimates of new van CO_2 intensity from the Driver and Vehicle Licensing Agency (DVLA). DVLA estimate that the new van CO_2 intensity fell 4.1% to 187 gCO_2/ km in 2012, having fallen by 0.6% the previous year. An alternative estimate is available from the Society of Motor Manufacturers and Traders (SMMT), who recently established a database for light commercial vehicles. SMMT estimate that new van CO_2 intensity fell 4.9% to 188.7 gCO_2/km in 2012. Our indicator value for 2012 is 195.4 gCO_2/km.

According to SMMT data, the reduction in average gCO_2/km comes despite a continued shift in van sales towards heavier, higher-emitting vans, which offer greater flexibility of use and increased payload efficiency. The market share of vans[9] weighing 3.5 tonnes grew from 28% to 30% in 2012, with reductions across all lower van weight classes[10].

This implies that the shift towards heavier vehicles was outweighed by improvements in average CO_2 intensity within-class, driven by a shift in purchase behaviour towards best-in-class vehicles and/or technology-driven improvements in CO_2 intensity within each class.

In future, if the trend towards heavier vans continues, it will be important that purchasers choose the least carbon-intense options within-class. Further levers to encourage uptake of more efficient vans, and the emissions reductions that these offer, may be needed.

It will also be important that technology improvements continue to be delivered and to this end, MEPs recently proposed an indicative target range for van emissions in 2025 of 105 –120 gCO_2/km (Box 5.4). However evidence suggests there may be scope to go further than the Commission's proposals:

- Our scenario for meeting the fourth carbon budget envisaged 112 g/km in 2025 given a 29% share of electric vehicles (137 g/km excluding EVs)[11]. With lower emissions from non-plug in vehicles (e.g. with combined hybridisation and strong engine downsizing), these values could be lower.
- Others have suggested that a target of 85 – 100 g/km in 2025 would be with an EV share of 50%, depending on the mix of pure battery and plug-in hybrid vehicles[12].

As for cars, the Government should push for rapid agreement of challenging longer term targets that will have strong effect on pulling new technology through into the market.

8 Including 4x4s and pick-up vehicles.
9 Excluding 4x4s and pick-up vehicles.
10 The share of 4x4 and pick-up vehicles remained broadly constant.
11 around 80 g/km in 2030 with a 60% share of EVs (120 g/km excluding EVs).
12 Greenpeace and Transport & Environment (2013) *The case for 2025 targets for CO_2 emissions from cars and vans.*

5. Progress in reducing HGV emissions

As for cars and vans, there is scope to reduce total HGV emissions, notwithstanding an increase in HGV km, mainly through fleet efficiency improvement as old inefficient HGVs are replaced with increasingly efficient new ones.

However, there is no official test cycle for measuring new HGV CO_2 intensity and no regulatory framework for reducing new HGV emissions. This is more challenging than for cars and vans given the heterogeneity of the HGV fleet and the impact of loads on emissions.

Nevertheless, the European Commission recognises the need to address this issue and has been conducting work on measurement of new HGV CO_2 intensity, together with abatement opportunities and costs.

- Working with industry and academia, the Commission is developing a simulation methodology and tool (VECTO) for measuring whole-vehicle tailpipe emissions. The tool is expected to be available in 2014.
- Research for the Commission[13] suggested a range of cost-effective technology measures, with emissions savings of around 30% available at zero or negative cost over the vehicle lifetime.

It is anticipated that the Commission will publish a strategy for HGV emissions in summer 2013, which is expected to consider regulating whole emissions over the vehicle lifetime after 2020. This is expected to be accompanied by an Impact Assessment considering the likely costs and benefits of introducing limits for HGV CO_2 emissions (akin to the new car and van CO_2 legislation).

In April 2013, the Commission also proposed updates to existing rules on HGV weights and dimensions, to permit manufacturers to develop more aerodynamic HGVs with rounded cabins and aerodynamic flaps at the back of the trailer. This is expected to lead to a cut of up to 15% in GHG emissions per year as well as reducing fatal accidents with vulnerable road users (pedestrians or cyclists)[14].

There have also been a number of initiatives aimed at reducing HGV emissions within the UK (Box 5.5). While these initiatives are welcome, given the effectiveness of the EU new car and van CO_2 targets, the Government should push for an EU framework for HGVs as quickly as possible.

13 CE Delft (2012) *Marginal abatement cost curves for Heavy Duty Vehicles.*

14 See http://ec.europa.eu/commission_2010-2014/kallas/headlines/news/2013/04/doc/com(2013)195-impact-assessment.pdf

Box 5.5: UK action on reducing emissions from HGVs

- Research commissioned by the UK Task Force on Fuel Efficient, Low Emission HGV Technologies, a joint industry/government initiative[15], suggested three key areas for emissions reduction: substituting diesel with natural gas, improving aerodynamic efficiency, and supporting uptake of electric vehicles for urban and municipal delivery. It also identified uncertainty over the business case as a key barrier to uptake, with a need for government-led demonstration programmes to provide evidence for operators.
- The Low Carbon Truck Demonstration Trial will run for two years and supports delivery of low-emission HGV fleets and supporting infrastructure. Since the competition closed in June 2012, 13 awards have been made to a range of partners including fleet operators, vehicle convertors, gas hub providers and universities. For example, the John Lewis Partnership is seeking to reduce carbon emissions by 70% across its articulated vehicles, through a range of interventions including improved aerodynamics and use of biomethane.
- The Logistics Carbon Reduction Scheme (LCRS) is a voluntary, industry-led scheme, covering around 9% of all licensed HGVs. Members reported a 2.8% reduction in the carbon intensity of their operations in 2011, on track to the scheme's target reduction of 8% between 2010 and 2015, through a combination of behavioural and technology measures (most commonly fuel performance monitoring, use of automated transmission vehicles, eco-driving, and reduced engine idling).
- In May 2013, DfT published the Freight Carbon Review of industry-led efforts, including results of an online survey which allowed operators who are not part of the LCRS to provide information on uptake of carbon saving interventions. The Review concluded that efforts by some operators to reduce HGV fuel consumption (mainly through eco-driving training) are evident, but that evidence on the sector as a whole is limited. It also concluded that no regulatory action should be pursued at this stage, letting industry lead the way in adopting low-carbon measures more widely, while keeping the issue under review.

6. Progress in developing electric vehicle markets

In previous reports we have identified deployment of ultra-low emission vehicle (ULEV) technologies (battery electric, plug-in hybrid electric or hydrogen fuel cell vehicles) as key to achieving the deep emission cuts required to meet the 2050 emissions reduction target.

We have presented analysis suggesting that it is technically feasible and economically desirable for all light duty vehicles to be ULEVs by 2050, and have recommended this as the current planning assumption. Achieving a fully ULEV fleet by 2050 requires that 100% of new cars and vans purchased will need to be ULEVs by the mid 2030s, and that progress in developing ULEV markets must be made now in order to prepare for this. The relative technical maturity of battery electric and plug-in hybrid electric vehicles implies that support for an early-stage electric vehicle market is now critical.

The Government has accepted this advice, and is supporting electric vehicle market development both through providing subsidy for purchase of electric vehicles, and through funding investment in recharging networks:

15 Ricardo-AEA (2012) *Opportunities to overcome the barriers to uptake of low emission technologies for each commercial vehicle duty cycle.*

- **Price support.** The Plug-in Car Grant (PiCG) came into effect in January 2011 and provides consumers and businesses with up to £5,000 towards the purchase of an eligible electric car. It was extended in January 2012 to vans, providing up to £8,000 for each eligible electric van. In 2012, 2,129 claims were made through the plug-in car grant (up from 892 in 2011) and 215 through the Plug-in Van Grant. However, this funding is only committed for the remainder of the current parliament. Given the low sales of EVs, and high costs relative to conventional alternatives (see below), the Government should extend availability of the grants beyond 2015.
- **Infrastructure investment. The Government is providing a range of support:**
  - **Plugged-In Places.** Through the PiP scheme, designed to kick-start a national recharging infrastructure, the Government offered match-funding to private and public sector consortia for the installation of EV charging points in eight regional schemes (East of England, Greater Manchester, London, the Midlands, Milton Keynes, the North East, Northern Ireland and Scotland). Data gathered through the PiP scheme will be used to help inform business models for future investment.
  - **National Offer.** In February 2013, the Government announced a further £37 million funding package, including £13.5 million available to homeowners, £11 million to local authorities (for rapid or on-street residential chargepoints), £9 million to train companies (for chargepoints at stations) and £3 million to public sector bodies (for chargepoints on their estate). Funding will cover 75% of the cost of installation and be available until April 2015. Meanwhile, in February 2013, the Scottish Government announced a new policy for charging infrastructure, including a £2.6 million scheme for free installation of home chargepoints, plus chargepoints at leisure facilities, local authority public carparks and (in contrast to the UK offer) private workplaces.
  - **Infrastructure strategy.** *Making the Connection* (June 2011) set out the Government's vision for recharging infrastructure and identified actions being taken to "remove barriers for those wishing to invest in, provide or benefit from" it. An updated strategy is expected in the summer this year. It is important that consistency is provided between this and a number of other Government strategies expected this year (roads, industrial, automotive and transport), in order to provide clear signals to investors.

Sales of electric cars were around 2,250 vehicles in 2012, more than double the volume in 2011 but still only 0.1% of total new car sales. Despite their higher up-front costs, the increase largely corresponds to the appearance on the market of plug-in hybrid and range-extended models in the medium car segments:

- Of the electric cars sold in 2012, around 1,260 were pure EVs, while around 520 were range extended EVs, and 470 were PHEVs. This compares with sales of around 1,100 in 2011, which were almost all pure EVs.
- The price of a PHEV is currently around £30,000 (including grant) compared to around £18,000 for the best-selling conventional car in the same segment. The price of 2012's best-selling BEV is around £23,000 (including grant), compared to around £17,000 for the best-selling conventional car in the same segment.

While full penetration of BEVs (or other zero-emission vehicles) is likely to be needed in the longer term to meet the UK's emissions reduction targets, our indicator trajectories to 2020 assume a higher share of PHEV sales, reflecting the likely range constraints of BEVs over this period. The relatively high uptake of PHEVs in 2012 is therefore not a matter of concern, provided it drives development in battery technology, allowing increased electric range and paving the way for a high penetration of BEVs later on. PHEVs are currently eligible for the PiCG provided they have an electric range of just 10 miles. Ideally, however, the electric range of PHEVs should be consistent with typical driving patterns. Our indicator trajectories assume PHEVs with an electric range of 40 miles (65 km), which given trip patterns, have the potential to cover over 70% of total car km in electric mode, so that miles travelled in non-electric mode are limited to occasional long trips. In future, the Government should take account of this in incentives offered for PHEVs.

We will return to pathways for high electric vehicle uptake in our review of the fourth carbon budget.

We noted in our last progress report that low sales of EVs in 2011 relative to volumes required over the next decade (e.g. a total of around 1.7 million electric vehicles by 2020), could be explained by the higher up-front cost of the vehicles (notwithstanding the PiCG), the limited range of models on the market, limited investment in public charging infrastructure, and initial consumer caution towards what may be perceived as a new and radically different technology.

There has been good progress in the development of new electric vehicle models, including, as noted above, availability of plug-in hybrid and range-extended models, although the cost of electric vehicles remains higher relative to conventional alternatives (Box 5.6):

- As of June 2013, there are ten electric car models available on the UK market, including one plug-in hybrid and two range-extended models in the medium car segment. Moreover, a considerable range of models is currently under development and due to come to market in the near future, with all of the current top-ten best-selling vehicle brands represented.
- In addition, a number of electric van models reached the UK market in 2012, with seven models currently eligible for the plug-in van grant available and further models expected soon.
- It is important to set a sufficiently challenging 2025 target to encourage further availability of models on the market (see section 5).

There has also been progress in development of public charging infrastructure:

- Plugged-In Places delivered a total of around 4,000 chargepoints in the period to the end of March 2012. This period has also seen significant investment in privately delivered chargepoints, with a total of around 5,000 delivered to the end of March 2013. It is likely that the Plugged-In Places programme has facilitated investment in privately delivered chargepoints by providing the private sector with confidence in the existence of a market for electric vehicles and the viability of battery-charging business models.
- However, interoperability of chargepoints is an issue, with access to some available on a pay-as-you-go (PAYG) basis and others through subscription to a membership schemes. The requirement that chargepoints funded through the new National Offer have PAYG functionality is a step towards improved access.

In terms of consumer awareness, a joint Government and industry communications campaign is planned for autumn this year. Meanwhile the Government is supporting the Plugged-In Fleets Initiatives (PIFIs).

- PIFI (2012–13) was funded by DfT and Transport for London, and delivered by the Energy Saving Trust (EST) in partnership with EDF Energy and Route Monkey. Twenty companies received free guidance and a strategic plan for the introduction of plug-in vehicles into their fleets. Findings and case studies from the initiative were published in a report to offer wider practical advice for all business fleets.
- Through PIFI 100, EST – with funding from the Office for Low Emissions Vehicles– is offering 100 further organisations free analysis and a tailored review of where and how plug-in vehicles could work in their business. In return, live fleet lists, vehicle usage and fuel data will be shared with EST to help inform policy development.

Box 5.6: Current and near-term electric vehicle releases

As of June 2013, the following electric car models are currently available on the UK market (Table B5.6.1):

Table B5.6.1: Electric car models currently available on the UK market

BEV	PHEV	PHEV (RE)
Citroen Czero (2011)	Toyota Prius Plug-in (2012)	Chevrolet Volt (2012)
Mitsubishi i-MiEV (2011)		Vauxhall Ampera (2012)
Nissan Leaf (2011)		
Peugeot iOn (2011)		
smart Electric Drive (2011)		
Renault Fluence ZE (2012)		
Renault Zoe (2013)		

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.

In addition to these, options to purchase electric cars include a number of small cars formally classed as quadricycles, and third party electric 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 B5.6.2):

Table B5.6.2: Electric car models expected on the UK market

BEV	PHEV	PHEV (RE)
Mercedes-Benz SLS AMG E-Cell (2013)	Misubishi Outlander PHEV (Q2 2013)	BMW i3 EREV (2013)
Tesla Model S (2013)	Porsche 918 Spyder (Q4 2013)	Fisker Karma (2013)
Ford Focus Electric (2013)	Volvo V60 PHEV (Q3/Q4 2013)	Fisker Surf (2013)
BMW i3 (2013)	Ford Mondeo Energi (2013)	
VW Golf (2013)	Ford C-Max Energi (2013)	
VW e-Up (2013)	VW Golf PHEV (2013)	
Audi E-Tron (2014)	BMW i8 (2013/14)	
Lightning GT (tbc)	Land Rover Range Rover PHEV (2014)	
Westfield Sport-E (tbc)	Honda Accord PHEV (2014)	
Ginetta G50 electric (tbc)	Porsche Cayenne E-hybrid (2014)	
	Porsche Panamera E-hybrid (tbc)	

Notes: BEV = Battery Electric Vehicle; PHEV = Plug-in Hybrid Electric Vehicle. RE refers to "Range Extended".

As of June 2013, there are a number of electric van models available on the UK market. DfT's list of vans eligible for the Plug-in Van Grant comprises the BD Otomotiv Veicoli eTrafic, Daimler Mercedes-Benz Vito E-Cell, Faam ECOMILE, Faam JOLLY 2000, Mia U, Renault Kangoo and Smith Edison electric vans.

As with cars, options to purchase electric vans include a number of small electric vans formally classed as quadricycles, and third party electric conversions.

Source: Manufacturer websites.

Budget 2012 announced that from 2015/16 ultra-low emission cars will no longer be exempt from Company Car Tax (CCT), or attract 100% first year capital allowances (FYA) for leasing firms. We noted in our progress report last year that this could have a significant impact on purchases (e.g. removal of the CCT exemption could add around £2,000 to the cost of a BEV compared to conventional alternatives). Given the promise of this sector, the need for early take-up of electric vehicles, and the very limited revenue generated by the proposed changes, we strongly recommended that the Government should reverse this decision.

In the 2013 Budget, the Chancellor announced two new company car tax bands to be introduced from April 2015:

- Cars emitting 0-50 g/km will be taxed at 5% in 2015/16, rising to 7% in 2016/17
- Cars emitting 51-75 g/km will be taxed at 9% in 2015/16, rising to 11% in 2016/17

The 4% differential between bands will fall to 3% in 2017/18 and to 2% in 2018/19 and 2019/20. The Government will review this in light of market developments at Budget 2016, to inform decisions on CCT from 2020-21 onwards.

The reinstatement of preferential rates for ULEVs is welcome, but compared to the existing zero rate, the 5% rate for zero-emission vehicles will still add around £500 to the cost of a BEV. We recommend that the zero rate for zero-emission vehicles is reinstated.

On FYA, it was announced that 100% FYA for non-leasing businesses purchasing low-emission vehicles will be extended to 31st March 2018; the qualifying threshold will be reduced from 110 g/km to 95 g/km in April 2013 and to 75 g/km in April 2015. These changes could be positive in encouraging uptake of BEVs and PHEVs, as it is unlikely that a wide range of internal combustion engine cars with similarly low emission levels will be available by 2015.

However, the removal of 100% FYA for leasing firms was confirmed in Budget 2013. A recent report by the Institute of Public Policy Research[16] suggested this could add 3-5% to the cost of car lease. Given the potentially key role for leased business cars in driving EV uptake (reflecting both their share in total sales and the opportunity they present in allowing the public to gain experience of ULEVs), we recommend that this decision be reversed.

In addition to support for plug-in vehicles, the Government is working with industry on the H2Mobility project, which was established to evaluate the benefits of fuel cell electric vehicles (FCEVs) to the UK and to develop a roadmap for the introduction of vehicles and hydrogen refuelling infrastructure.

- Phase 1 of the project reported in February 2013. The findings suggest around 10% of new car buyers could be potential early adopters of FCEVs, with vehicle costs and access to refuelling infrastructure being the key barriers to uptake. Annual sales of around 10,000 could be achievable by 2020, rising to around 300,000 by 2030, as vehicle costs become more competitive and the refuelling infrastructure develops from around 65 stations initially (in major population centres and connecting roads) to full national coverage.

16 IPPR (2013) *Leading the charge: Can Britain develop a global advantage in ultra-low emission vehicles?*

- Phase 2 of the project will build on these findings to develop a detailed business case for deployment. Measures will be identified for overcoming the barriers identified, including the commercial model for the initial network of refuelling stations as well as the early consumer proposition. Phase 3 will then commit partners to specific actions to accelerate roll-out.

Progress on hydrogen fuel cell vehicles and infrastructure is important to provide a long-term alternative to plug-in electric vehicles, especially where the latter may not be suitable (e.g. for larger, high-mileage vehicles including HGVs). Availability of hydrogen produced via low-carbon routes (steam methane reforming with carbon capture and storage or electrolysis using low-carbon electricity) will be critical in order that FCEVs deliver emissions reductions. This reinforces the need for demonstration of carbon capture and storage and decarbonisation of electricity supply (see Chapter 2). Without hydrogen from low-carbon sources, FCEVs can have significantly higher emissions than conventional vehicles.

7. Progress on biofuels in surface transport

The use of biofuels in the transport sector is important in meeting our carbon budgets in the medium term. Our indicator for road transport biofuels penetration is for 8% (by volume) to be supplied by 2020. In 2012 the volume of biofuels supplied to the transport sector was 3.1%, down from 3.5% in 2011. This was due to amendments to the Renewable Transport Fuel Obligation (RTFO) from April 2012, allowing biofuels produced from wastes, non-agricultural residues and second generation biofuels to be counted twice in meeting the 10% biofuels target, in line with the EU directive. This led to a reduction in the volume of biodiesel supplied in the UK due to the high proportion of used cooking oil and tallow used in this sector. The proportion of bioethanol supplied continued to rise, from 3.3% in 2011 to 4.1% in 2012 (by volume).

While incentivising biofuels with high carbon savings is to be encouraged, the current penetration of biofuels in this sector falls short of our indicator trajectory by around 1.4% by volume (1% by energy).

A key issue on biofuels is to ensure that this supply is sustainable. Mandatory sustainability criteria for direct GHG impacts of using biofuels are already in place, and are due to become more stringent over time. Biofuels supplied currently are exceeding the minimum standards of at least 35% GHG savings. Of biofuels supplied in 2012/13, 80% had direct GHG savings of at least 50% relative to the fossil fuel comparator, and almost 70% achieved savings of 60% or above. These savings are net of emissions from direct land use change associated with biofuel production, but exclude emissions from indirect land use change (ILUC).

The framework for ILUC impacts is still under discussion at the EU level. The EU published its proposals in Autumn 2012 (Box 5.7), but these are unlikely to be resolved in the near term.

Until this issue is resolved, there remains uncertainty as to the direction of government policy in this area. The RTFO target is flat-lined from 2013/14 onwards and there are as yet no plans for how to deliver the Fuel Quality Directive (FQD) beyond 2014. The FQD requires the suppliers of fuel for use in road vehicles and non-road mobile machinery (NRMM) to reduce the life-cycle GHG emissions per unit of energy ('GHG intensity') of the fuel they supply by 6% in 2020 relative to an EU-wide 2010 fossil fuel baseline.

While it is important that robust sustainability criteria that take account of ILUC impacts are implemented, the Government should push for these to be agreed as soon as possible to provide certainty to investors and to allow additional action to meet carbon budgets to be put in place if required.

Box 5.7: Biofuel sustainability standards

Mandatory sustainability standards for the direct impacts of using biofuels in the transport sector were introduced in the Renewable Energy Directive in December 2010. These were transposed into the RTFO in December 2011. The Directive requires a GHG saving of 35% (rising to 50% in January 2017, and 60% in January 2018 for installations in which production started from 2017 onwards). It contains a methodology for calculating this saving as well as default values that can be used in certain cases to show compliance with the requirement. The criteria also ensure that biofuels are not produced from areas of high carbon stock or high biodiversity.

DfT are responsible for administering compliance with the sustainability criteria, which includes chain of custody evidence and independent verification of supplier evidence. It is important that this procedure is clear and transparent in order to retain confidence in ensuring GHG emissions reductions are being achieved.

In October 2012 the EC published proposals to take account of indirect land use change when calculating GHG savings. They suggested the inclusion of ILUC factors in reporting by fuel suppliers and Member States of savings from biofuels and bioliquids counted under the RED and the FQD.

The ILUC factors represent the estimated land use change emissions that are taking place globally as a result of the crops being used for biofuels in the EU, rather than for food. Feedstocks that do not require agricultural land for their production (e.g. wastes, residues, algae), and those that cause direct land use change (in which case operators need to calculate their actual emissions) are exempt from the factors.

The EC proposals also:

- Increase the minimum GHG savings requirements for new installations to 60% compared with fossil fuels, in order to improve the efficiency of biofuel production processes and discourage those with low GHG performance.
- Limit the amount of food and crop-based biofuels and bioliquids that can be counted towards the EU's 10% target for renewable energy in the transport sector by 2020, to 5% (around the current level). This means the remainder will have to come from mainly second generation biofuels.

For the new rules to take effect, the European Parliament and the Council must first adopt the proposals in a co-decision procedure (after which Member States must transpose the provisions into national law within one year); the timescale for a decision is uncertain.

8. Progress in changing travel behaviour

Smarter Choices

Smarter Choices corresponds to a set of measures addressing psychological motivation for travel choice with the objective of reducing levels of car use (in contrast to alternative measures such as development of transport infrastructure or services, enforcement of travel behaviour or changes to economic incentives).

Smarter choices measures include:

- Travel plans (e.g. workplace, school, residential, and station travel plans)
- Personalised travel planning
- Public transport information and marketing
- Travel awareness campaigns
- Car clubs
- Car sharing schemes
- Teleworking, teleconferencing, and home shopping
- Cycling and walking information, marketing, training and events.

The Local Sustainable Travel Fund (LSTF) was created by DfT in 2011 with the dual objective of supporting the local economy and reducing carbon emissions. The initial fund of £560 million (£350 million resource plus £320 million capital funding) was topped up to £600 million in 2012 to accommodate approval for a greater number of bids.

The LSTF bidding rounds are now closed and the fund is fully committed. In total, the fund is supporting 96 projects in 77 Local Authorities across England between 2011/12 and 2014/15. Along with local contributions provided by funded project teams, over £1 billion is now being invested in local sustainable travel.

As part of the bidding process, Local Authorities (LAs) were asked to provide evidence for the carbon benefits of proposed schemes, and show that the benefits identified clearly relate to the package proposals. However, under the monitoring and evaluation framework published by DfT, measurement of carbon benefits is not required for all LAs:

- All projects are required to report annually on outputs (e.g. delivery of cycle training), but only larger schemes are required to report on outcomes metrics (e.g. increased number of cycle trips).
- Some projects (both large and small) are asked to submit case studies for a few key priority questions, where evidence is weakest. There will be a case study looking at carbon impacts, which is expected to carry out in-depth research to understand the carbon savings from a select number of LSTF projects. The intention is that this case study will serve as a proxy for all projects.

- The first LSTF annual report was published in May 2013, covering progress to date in the 39 projects allocated funding in Tranche 1. Every project team reported providing community engagement activities during 2011/12, mainly consisting of travel planning for workplaces, schools, residents and/or visitors and tourists. However, as the Tranche 1 projects are all small schemes, the impact of these activities is not reported.

Going forward, monitoring of impacts on travel behaviour should be encouraged across all projects where possible, to allow estimates of emissions reductions to be made. Monitoring will also be important in the context of DfT's Door to Door Strategy, published in March 2013 (Box 5.8).

Almost all successful projects receiving LSTF funding include Smarter Choices measures – most commonly workplace engagement initiatives to promote sustainable travel choices.

It is important that progress continues. If monitoring and evaluation confirms success in achieving emission reductions, the Government should make a commitment to further funding post-2015 and develop a plan for nationwide roll-out of Smarter Choices over the next decade.

Box 5.8: DfT's Door to Door Strategy

The Door to Door Strategy establishes what the Government wants from transport providers and what DfT is doing to support door-to-door journeys using sustainable modes. It addresses four core areas that influence people in choosing sustainable transport:

- Access to reliable information on transport options
- Providing convenient and affordable tickets, for an entire journey
- Making sure there are regular and straightforward connections at all stages of the journey and between different modes of transport
- Ensuring safe, comfortable transport facilities

The LSTF is cited as one of the existing programmes supporting this agenda, though the focus is mainly on infrastructure investments rather than softer measures. DfT has established a cross-industry group, the Door to Door Roundtable, to act as a delivery mechanism for taking forward the initiatives outlined in the strategy, and will publish an action plan later this year. Going forward, it will be important to monitor progress against actions and evaluate the resulting impacts, particularly in terms of modal shift and emissions reductions.

Eco-driving

Eco-driving (i.e. adoption of more efficient driving techniques such as smooth acceleration and braking, driving at optimal speeds, use of cruise control, engine braking) could make an important contribution to reducing the CO_2 intensity of vehicles.

Progress on eco-driving appears to be mixed, with the freight sector embracing it as an effective cost and emissions reduction measure, but uptake among car drivers has been limited:

- Evidence from the LCRS and Freight Carbon Review suggest that eco-driving is the most common emissions reduction measure employed by freight operators (see section 5 above), although we do not have data on actual numbers of drivers trained. Our indicator framework assumes 100% of HGV drivers are trained in eco-driving, delivering emissions reductions of 0.9 $MtCO_2$ in 2020.
- Only 6,962 drivers (around 75% of which are car drivers, and 25% van drivers) were trained under the Energy Saving Trust's Smarter Driving Programme in 2012[17], down from 7,892 in 2011. The Energy Saving Trust's target is 8,500 per year. The pace of roll-out is therefore still very low relative to the 300,000 car and van drivers to be trained annually if an emissions reduction of 0.3 $MtCO_2$ for eco-driving is to be achieved by 2020

In our 2012 progress report we recommended that eco-driving become a formal part of the driving test. This recommendation was not accepted by the Driving Standards Agency (DSA), although some action has been taken:

- In April 2013 DSA revised the National Driving Standards for categories B, C and D[18], extending the content of the sections on "driving in an ecologically responsible way" and "choosing a suitable mode of transport". They now include a requirement to turn off the engine when one is likely to be stationary for some time, and to understand the environmental implications of tyre choice.
- DSA also commissioned research[19] looking at how eco-driving training can be provided and promoted in a more engaging way, how take-up can be increased amongst existing car drivers, and how the use of the techniques can be sustained over time (Box 5.9).

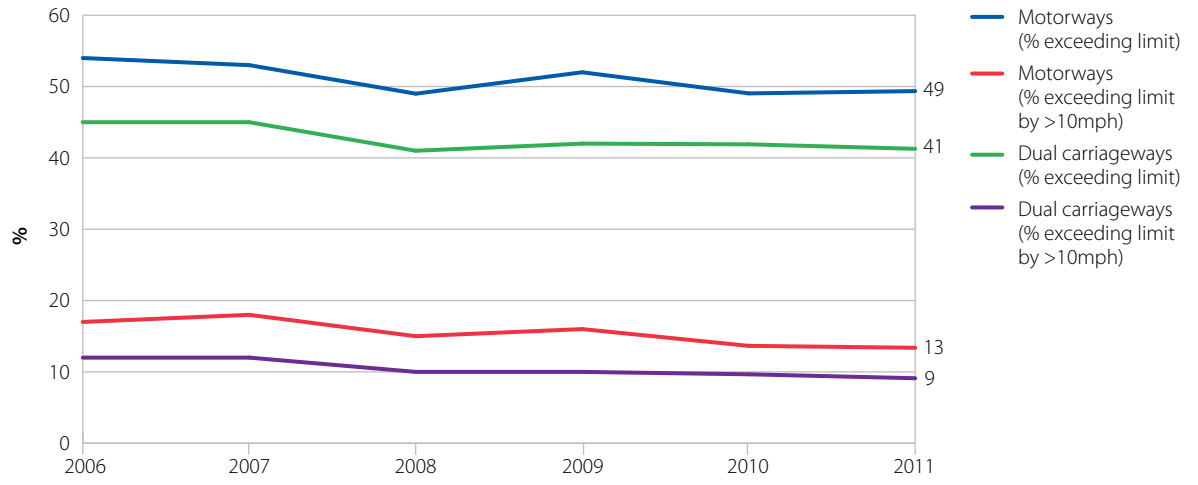
In future, drivers will be assisted in driving more efficiently by technology solutions within the vehicle:

- Gear shift indicators (GSI) inform the driver when to change gear to minimise fuel consumption. Under EU regulations, GSI are mandatory, as of 1 November 2012, for all new passenger vehicles which undergo type approval, and mandatory for all new vehicles sold in the EU from 2014.
- Fuel consumption meters (FCM) can provide information on fuel consumption in real-time or as an average over a specified period. Many new cars are already fitted with an FCM, although display is often optional. Following a consultation in 2011, the European Commission is expected to include mandatory fitting of FCM to new cars and vans in a package of proposals due in summer 2013.

We continue to believe that eco-driving is an effective emissions reduction measure for both private drivers and employers, as well as helping to save fuel costs. The Government should actively promote uptake of eco-driving, through a combination of inclusion as a key element in the practical driving test, driver training, awareness raising and in-car information on fuel efficiency.

17 Please note that the Smarter Driving Programme is only open to organisations.
18 B: cars, C: lorries, and D: buses and coaches.
19 TNS-BMRB (2011) *Eco-driving: Factors that determine take-up of post-test training research.*

Figure 5.11: Speeding on motorways and dual carriageways (2006-2011)



Source: DfT (2012) Free flow vehicle speeds in Great Britain 2011.

Box 5.9: Promoting eco-driving

A recent report for the DSA looked at how eco-driving training can be provided and promoted in a more engaging way, how take-up can be increased amongst existing car drivers, and how the use of the techniques can be sustained over time. The report included a number of recommendations:

- Emphasising wider benefits
  - Cost savings from lower fuel consumption and reduced maintenance costs need to be made explicit to employers and ordinary drivers through carbon calculators, websites, and information campaigns (e.g. changing the term to "fuel efficient driving").
  - Providing tangible financial incentives through a reduction in insurance or road tax could also help increase take up in the current climate
  - Stressing the full range of savings (e.g. lower maintenance costs) and other benefits such as increased road safety, and – for employers – corporate image, is crucial
- Promoting eco-driving as a social norm
  - Policies targeting behaviour change in this area should be easy to adopt, stressing the "fun" element of in-vehicle training (e.g. where colleagues/friends could compete with each other on their eco performance).
  - Behaviour change policies should also aim at presenting driving in an ecologically friendly way as a characteristic of skilled drivers.
  - Initiatives to increase take-up should target appropriately the "messengers" within a community or a workplace.
- Timing
  - To increase specifically post-test interventions, eco-driving training should be offered in conjunction with popular course such as Pass Plus and Advanced Driver Skills trainings.
- The report also recommends trying to provide information on eco-driving at different stages of driving/buying a car (e.g. when hiring a car, when purchasing a vehicle, and when renewing car tax).

DSA have stated that they "expect the lessons identified in the report will be taken forward by training providers".

Speed limits and their enforcement

DfT statistics indicate that speed limits are exceeded by a high proportion of car drivers on motorways (49%) and dual carriageways (41%) (Figure 5.11). This offers an opportunity for reducing emissions through enforcing the current speed limit, given the significant decline in fuel efficiency as car speed increases from 70 to 80 mph. Our indicator framework includes full enforcement of the speed limit from 2012.

Conversely, if the speed limit were to be increased, fuel efficiency would further decline, increasing emissions. The Government recently consulted on increasing the speed limit for HGVs on single carriageway roads (Box 5.10). It is important that emissions impacts are properly reflected in the final decision, alongside other costs and benefits. Any increase in the speed limit leading to an increase in emissions (other things equal) will reinforce the need for progress in reducing the emissions intensity of HGVs, and agreement of an EU framework to drive this as soon as possible (see section 5).

In future, car drivers may be encouraged to observe the speed limit by in-vehicle technology. Fuel consumption meters, which are expected to become mandatory for new cars and vans under European regulations (see above), could allow drivers to observe the impact of speed on fuel economy.

Box 5.10: Government consultation on the speed limit for HGVs on single carriageway roads

Currently the maximum speed limit for HGVs over 7.5t on single carriageway roads is 40 mph and 50 mph for smaller HGVs (between 3.5t and 7.5t).

Stakeholders have voiced concerns that the 40 mph speed limit leads to additional costs to vehicle operators, congestion, overtaking accidents, and an uneven playing field given 70% of observed vehicles currently exceed this speed limit.

Consequently, DfT consulted on increasing the speed limit for HGVs over 7.5t on single carriageway roads to 45 mph or 50 mph.

The preliminary impact assessment published alongside the consultation[20] suggested that benefits from time savings and non-fuel operating cost savings, would outweigh fuel, carbon and local environmental costs associated with a speed limit increase. Carbon emissions were estimated to increase by 12 – 31 $ktCO_2$ per year over the years modelled (2013-2030).

The consultation closed on 1 February 2013, and Ministers are currently considering the responses.

Transport and land-use planning

In our last report we highlighted the need to ensure that the new National Planning Policy Framework (NPPF), published in March 2012, encourages appropriate land-use planning decision making and ensure that the impact for transport emissions are taken into account.

Since then the Government has issued a consultation[21] on revising policy on the way the Highways Agency engages with the new planning system.

20 See https://www.gov.uk/government/consultations/examining-the-speed-limit-for-heavy-goods-vehicles-over-7-5-tonnes-on-single-carriageway-roads
21 See https://www.gov.uk/government/consultations/consultation-on-the-strategic-road-network-and-the-delivery-of-sustainable-development

- The consultation document sets out the role of the Strategic Road Network (SRN) and the support function that the Highways Agency can provide in delivering a reliable road network, supporting productivity and growth.
- The proposals reflect the changes brought about by the NPPF, removing regulation and devolving decisions to local authorities, while placing more emphasis on the Highways Agency's role as a delivery partner and enabler. A key plank of the proposals is for planning authorities to deliver Local Plans setting out the scale and pattern of local development. It is envisaged that the Highways Agency will work with local authorities to provide information and expertise in helping to understand the transport implications of new developments.
- However elements of the proposals such as easing of restrictions of access to motorways and removal of restriction on retail space at motorway service areas could increase car trips and mileage.

Going forward it is important that transport emissions are factored into planning decisions alongside other costs and benefits. An Impact Assessment setting out the potential effect on travel demand and emissions of the current proposals should be published as soon as possible. To the extent that travel demand is projected to increase beyond levels incorporated in our indicator framework, this could pose a risk to meeting carbon budgets.

9. Other policy developments

In November 2011, Alan Cook published a report[22], commissioned by the Government, which set out the challenges in managing the SRN and outlined a package of reforms to the current operating model for the network. In response to this report, the Government has committed to delivering a long term roads strategy, and has taken several measures to achieve this:

- The first performance specification for the SRN was published in April 2013, setting out five outcomes and key performance indicators for the network up to 2015, including economic growth, safety on roads, an efficient network and one that minimises negative impacts on the environment.
- A programme of route-based strategies which set out investment and delivery plans for the network on key routes, with the aim of informing decisions on policy and funding requirements. Three routes were published earlier this year.
- Government plans to publish a consultation paper on a roads reform feasibility study looking at new ownership and financing models for the national roads system later this year. The study will explore a number of options for running and financing roads, including how investment in roads can be paid for and the interaction with existing motoring taxation.

It is important that, in considering alternative financing models for roads, government places due weight on the environmental damage of car use, and on incentives to move towards cleaner forms of travel consistent with meeting carbon budgets.

22 Alan Cook (2011) *A Fresh Start for the Strategic Road Network.*

Key findings

- Surface transport **emissions fell in 2011** after staying flat the previous year…
- … car and HGV emissions fell but van emissions increased
- Road transport emissions **likely to have fallen slightly in 2012**
- EU **new car and van CO_2** regulations continue to drive improvements in efficiency, which **outperformed** our indicators…
- … important that **challenging targets** agreed for 2025 and introduced for HGVs as soon as possible
- The market for new electric vehicle models is expanding, with **plug-in hybrid models available** for the first time in 2012…
- … however take-up remains limited and purchase **incentives need to continue**, including reinstatement of tax incentives for company cars
- **Progress on behaviour change was mixed**. Some progress towards roll-out of Smarter Choices, limited uptake of eco-driving and uncertainty over land-use planning.

Table 5.1 The Committee's transport indicators

ROAD TRANSPORT		Budget 1	Budget 2	Budget 3	2012 trajectory	2012 outturn
Headline indicators						
Emissions (% change on 2007)	Road Transport	-9%	-17%	-26%	-8% (2011)	-10% (2011)
	Car	-11%	-22%	-34%	-9% (2011)	-12% (2011)
	Van	5%	8%	4%	+7% (2011)	-4% (2011)
	HGV	-6%	-15%	-19%	-6% (2011)	-7% (2011)
gCO_2/km (carbon intensity of a vehicle kilometre)	Car	158	136	113	162 (2011)	160 (2011)
	Van	217	196	171	227 (2011)	217 (2011)
	HGV	761	678	635	768 (2011)	870 (2011)
Vehicle kilometres with impact of Smarter Choices	Car	412	419	431	412	402 (2012p)
Supporting indicators						
Vehicle technology						
New car gCO_2/km	Car	146	116	95 (by 2020)	146	133
New electric cars registered each year (at end of Budget period)		12,000	240,000	600,000	12,000	2,254
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	24,000	3,566
Biofuels						
Penetration of biofuels (by volume)		4.5%	7.7%	10.0%	4.5%	3.1%
Decision on whether RTFO target can be met sustainably		2011/12			n/a	n/a

Table 5.1 The Committee's transport indicators

ROAD TRANSPORT	Budget 1	Budget 2	Budget 3	2012 trajectory	2012 outturn
Demand side measures					
Proportion of drivers exceeding 70mph		0%*	0%*	n/a	49% (2011)
Car drivers who have undergone eco driving training	1.2 million	2.8 million	4.5 million	1.2 million	30,000
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	LSTF funding Smarter Choices projects in 77 Local Authorities
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 technology, 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.					

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

* 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 aim to include new van and HGV gCO_2/km in our indicator set as the available monitoring data improves.

Key: Headline indicators Implementation indicators Milestones Other drivers

Introduction and key messages

1. Agricultural emissions: trends and drivers
2. Progress against indicators
3. Incentives to reduce agricultural emissions – the policy framework
4. Land use, land use change and forestry

Chapter 6: Progress reducing emissions from agriculture

Introduction and key messages

In this chapter we present the latest evidence on emissions in agriculture, which accounted for around 9% (51.2 $MtCO_2e$) of UK greenhouse gas (GHG) emissions in 2011. We also consider the Land use, land use change and forestry (LULUCF) sector, which is a net carbon sink, absorbing 3.3 $MtCO_2e$ in 2011.

Our key messages are:

- In 2011 agriculture emissions remained unchanged from 2010 at 51.2 $MtCO_2e$. This is the second year in a row that emissions did not follow the trend in recent years of declining agricultural emissions, which have fallen by 8% since 2003.
- Agricultural output increased by 2.5% in 2011 implying an improvement in carbon intensity. Within this, carbon intensity of livestock output improved due to increased milk yields and reduced use of fertiliser on pastureland. Crop output also increased but this was accompanied by a larger rise in nitrous oxide emissions from higher fertiliser use on arable land and soil incorporation of crop residues. This suggests the carbon intensity of crops worsened.
- Defra has now published an indicator framework to monitor progress in reducing emissions. It will be important to continue to monitor progress and develop the evidence base, and if the indicators suggest progress is not being achieved then a review should be implemented before the planned 2016 date.
- It is important to put in place measures to monitor the effectiveness of the industry-led GHG Action Plan in influencing the uptake of less carbon-intensive farming practices. In addition, the cereals and oilseeds roadmap should set targets as to how the sectors will contribute to emission reductions.
- Any review on progress towards reducing emissions from agriculture should also consider a range of policy options, including continuing with the current voluntary approach, and policies that would provide stronger incentives for farmers.

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

1. Agricultural emissions: trends and drivers
2. Progress against indicators
3. Incentives to reduce agricultural emissions – the policy framework
4. Land use, land-use change and forestry

1. Agricultural emissions: trends and drivers

Emissions data for agriculture lag that of other sectors due to the high proportion of non-CO_2 emissions which take longer to collate. This chapter therefore reports on trends and drivers for 2011.

A complete assessment of progress in reducing emissions in the sector cannot currently be made due to the uncertainties over measuring emissions and current framing practices. Until these uncertainties are resolved we will continue to assess high-level progress in reducing emissions, as set out in section 2.

Emissions trends

At 51.2 $MtCO_2e$ in 2011, emissions in the agriculture sector accounted for 9.3% of total greenhouse gas emissions in the UK (Figure 6.1).

- Over half of agriculture emissions (53%) are due to agricultural soils, while enteric emissions – arising from the digestive process of cattle and sheep – account for another 30% of emissions. The remaining emissions are split between stationary and mobile combustion emissions (9%) and waste and manure management (8%) (Figure 6.2).
- Nitrous oxide (N_2O) accounts for 57% of emissions in the sector, with a further 35% coming from methane and the remaining 8% from carbon dioxide (CO_2).

Data in this year's inventory has been revised upwards for the entire time series so 2010 emissions are now 1% higher than quoted in last year's inventory (50.7 $MtCO_2e$). One of the main reasons for the change was the upward revision in the land area of cultivated histosols (organic soils). Based on the revised series, overall agricultural emissions in 2011 remained unchanged from the previous year. However, there were marginal changes in emissions across the range of sources and gases:

- While emissions from enteric fermentation and waste and manure management declined slightly, emissions from agricultural soils and stationary and mobile combustion increased marginally.
- A breakdown by gas shows that while N_2O and CO_2 emissions increased, methane emissions declined. All of these changes were very small.

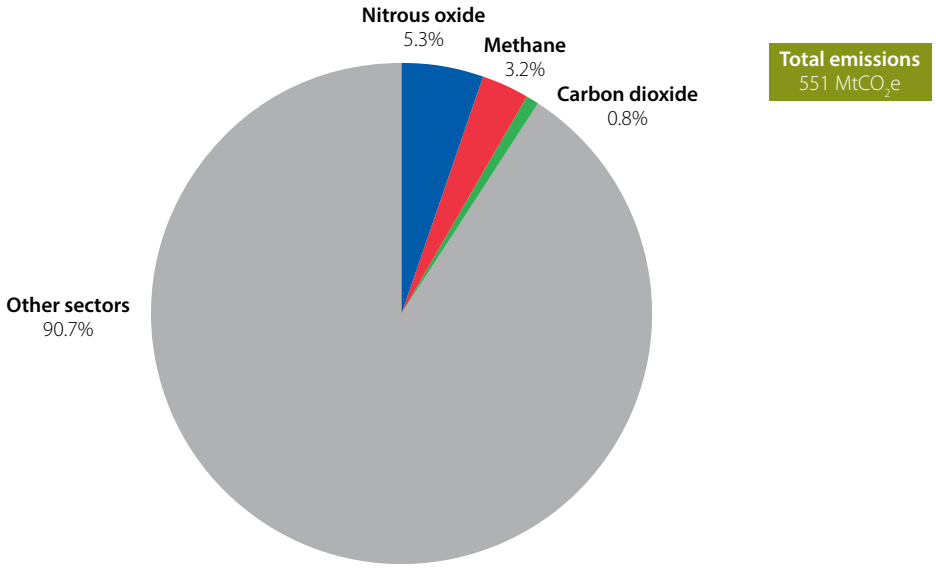
2011 is the second year in a row that overall emissions did not follow the longer-term trend of declining emissions (Figure 6.3):

- Since 1990, agricultural emissions have fallen by 20% from 63 $MtCO_2e$, with reductions across all sources: agricultural soils (19%), enteric fermentation (18%), wastes and manure management (23%) and stationary and mobile combustion (19%).
- In the period since 2003, emissions for the sector have fallen by 8.5% (from 55.9 $MtCO_2e$), with the reduction in soil emissions accounting for over half of the decline.

Due to reductions that occurred before 2010, emissions are on track to meet our emissions indicator for a 10% decline (compared to 2007) by the end of the first budget period in 2022.

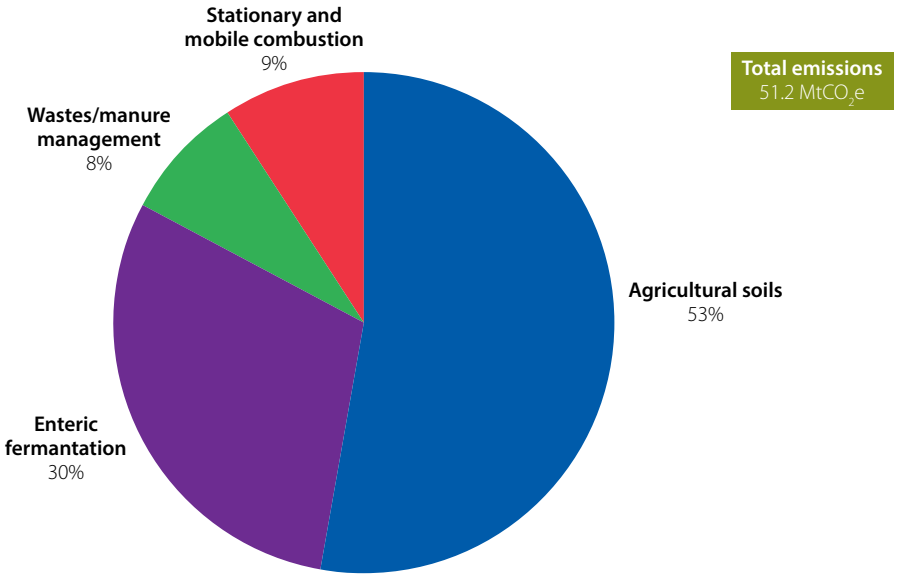
Given the lack of progress in reducing emissions in the past two years, it is important to understand emissions drivers to assess whether any progress has been made in implementing measures to reduce emissions intensity.

Figure 6.1: GHG emissions from agriculture in the context of total UK emissions (2011)



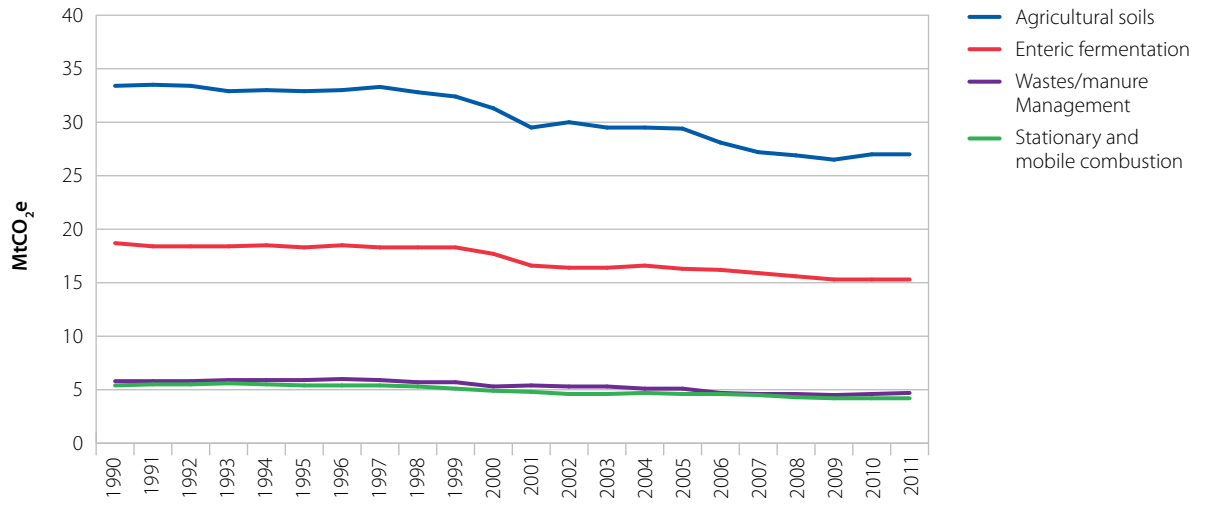
Source: NAEI (2013).
Notes: Emissions from other sectors excludes international aviation and shipping sectors.

Figure 6.2: Agriculture emissions by source (2011)



Source: NAEI (2013).

Figure 6.3: Agriculture CO_2e emissions by source (1990-2011)



Source: NAEI (2013).

Emission drivers – nitrous oxide

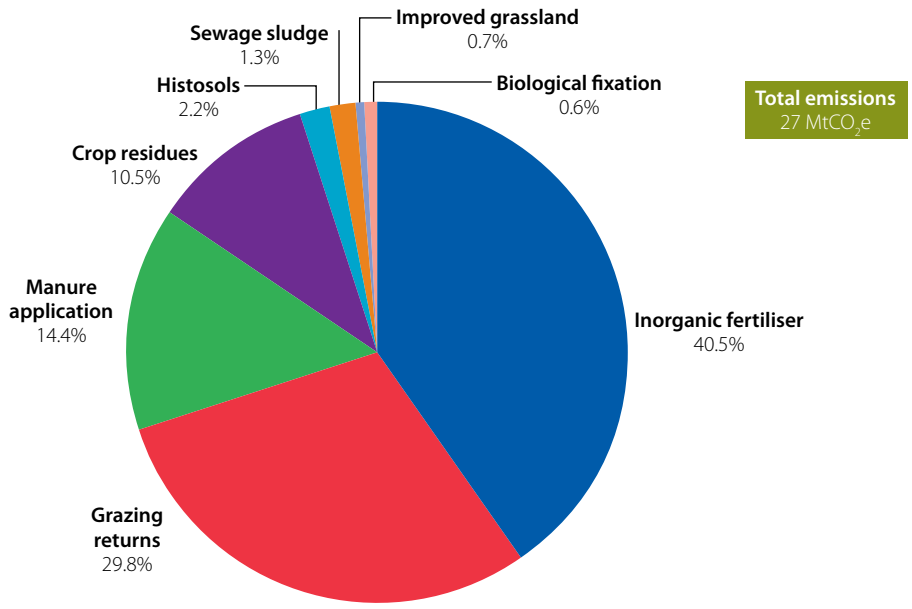
N_2O emissions in agriculture occur from two main sources – soils and manure management, with the former accounting for over 90% of the emissions. N_2O from agricultural soils comprise many sources, and within these, there have been year-on-year changes that help explain the overall marginal increase in N_2O emissions in 2011 (Figure 6.4):

- The application of inorganic fertiliser on cropland and pastureland is the single largest source of N_2O emissions from soils (40.5%) and fertiliser-related emissions declined by 1% in 2011.
- Manure deposited by grazing livestock on pastureland (i.e. grazing returns) accounted for over a quarter of N_2O emissions. Emissions from this source declined 1% on the previous year.
- These reductions were offset by increased emissions from the ploughing in of crop residues (e.g. cereal straw and stubble) left over from arable harvests and the application of sewage sludge.

The impact of a slight increase in N_2O emissions combined with a much higher growth (2.5%) of overall agricultural output implies a reduction in the N_2O emissions intensity of agricultural output by 2.3%.

It is also useful to disaggregate the data between crops and livestock to assess whether improving emissions intensity was observed for both types of farming activities:

Figure 6.4: Source of N_2O emissions from agricultural soils (2011)

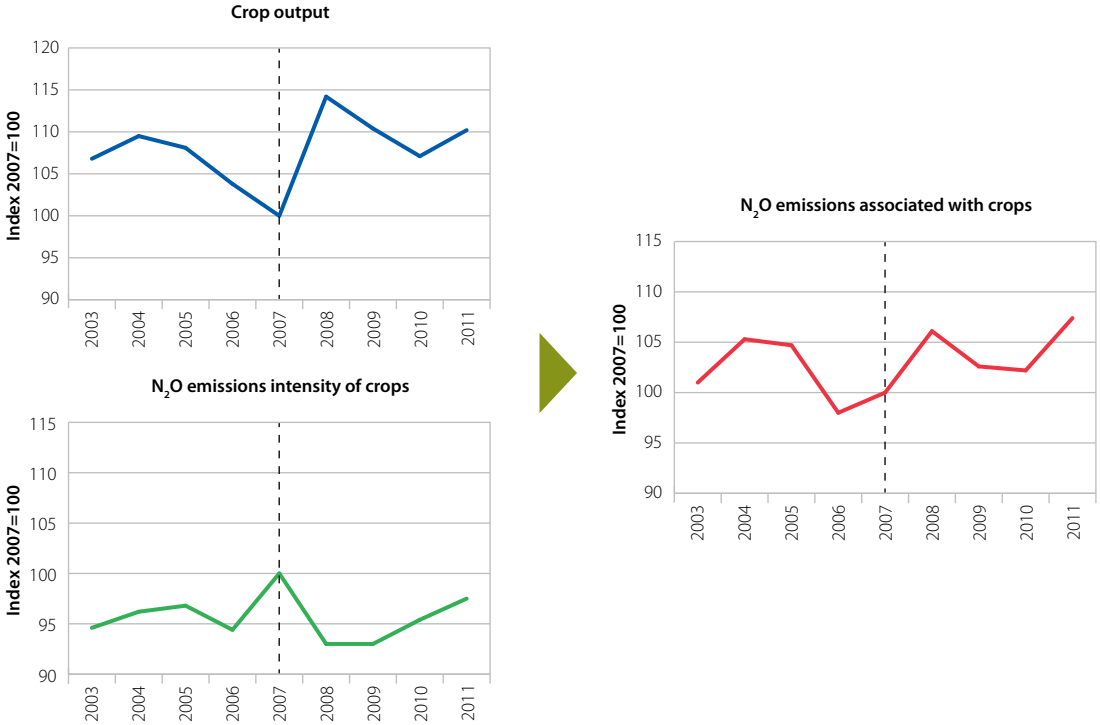


Source: NAEI (2013).

- Following the adverse weather that reduced crop output in 2010, more favourable conditions in 2011 saw output growing by 2.8%. In tonnage terms, barley growth was particularly strong at 4.6%, while wheat grew by 2.5%. However, growth in crop-related emissions of 5% was faster than growth in output, implying an increase in N_2O emissions intensity of crops. This is the second successive year this has occurred (Figure 6.5). This was due to a number of factors, including a 1% increase in the intensity of inorganic fertiliser use on cropland, and higher emissions arising from crop residues. The increase in total crop dry matter production resulted in a larger amount of crop residues available for incorporation into soils.
- For livestock, N_2O emissions from grasslands declined by 6.2% while output increased by 2.7%, implying an improvement in emissions intensity in 2011. The decrease in emissions was driven by a 10% decrease in the application of inorganic fertiliser per hectare of grasslands. With the price of inorganic fertiliser rising in 2011, farmers switched from grass to less fertiliser intensive feeds such as maize silage. Another contributory factor was the 2% decline in cattle numbers which supported a 1% reduction in N_2O emissions from both grazing returns and manure management. These factors led to a 9% improvement in N_2O emissions intensity for livestock (Figure 6.6).

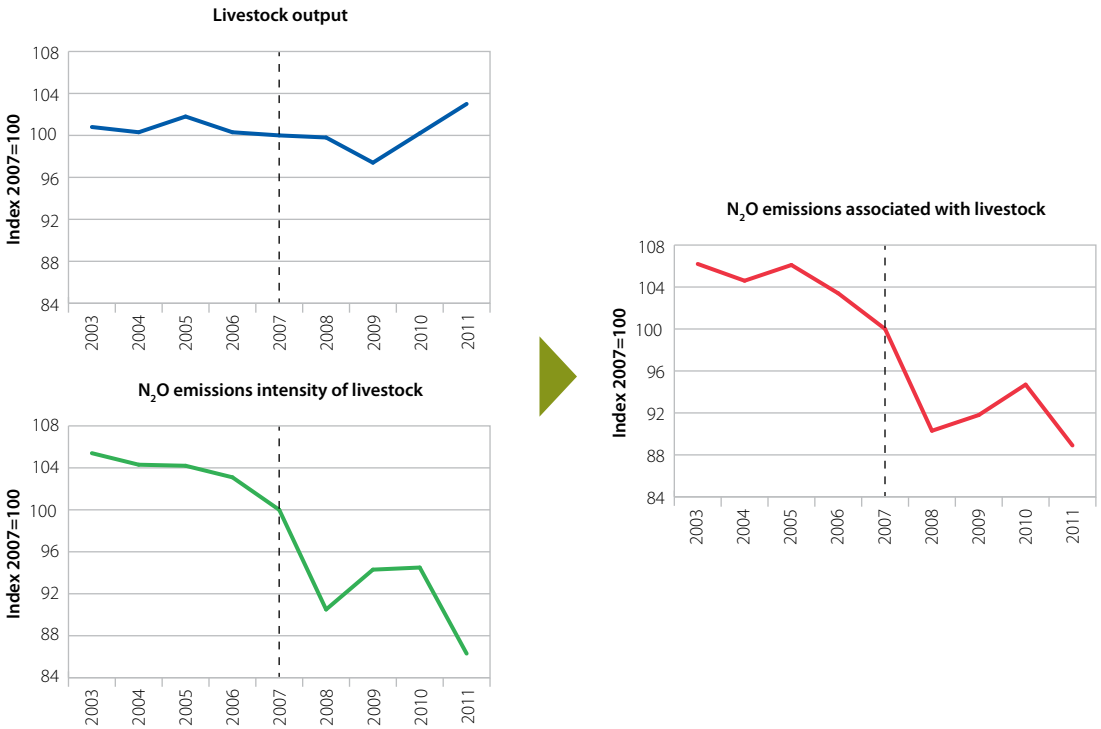
The annual changes in inorganic fertiliser use on grasslands and arable land in 2011 reflects the long-term trend: an overall decline in the application rate on grasslands due to declining cattle and sheep numbers. Meanwhile rates for arable use in 2011 returned to levels previously observed before the historic high fertiliser price in 2008 and 2009 (Figure 6.7).

Figure 6.5: Crop output, N_2O emissions associated with crops and emissions intensity of crops (2003-2011)



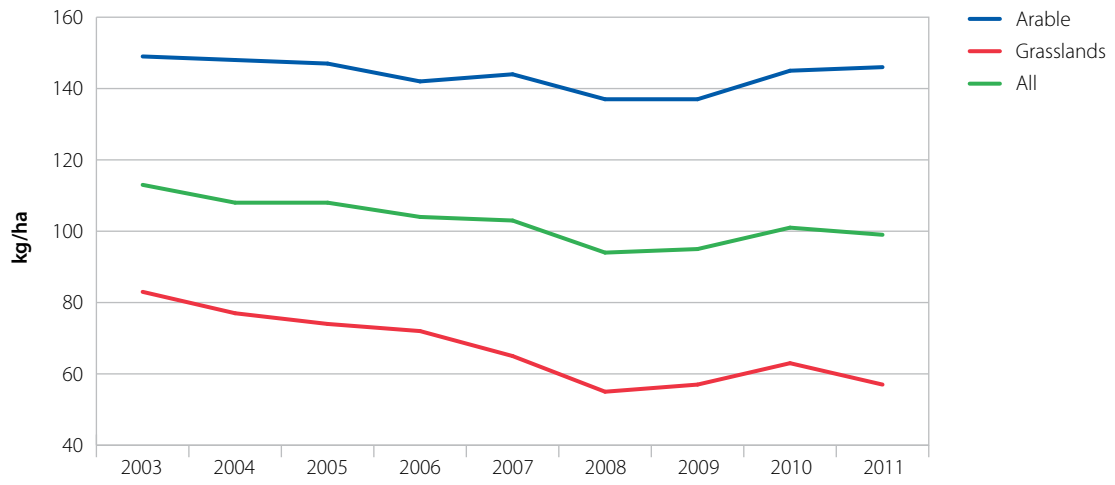
Source: NAEI (2013), Agriculture in the UK (AUK) 2011, CCC calculations.
Notes: Base Year (2007) = 100.

Figure 6.6: Livestock output, N_2O emissions associated with livestock and emissions intensity of livestock (2003-2011)



Source: NAEI (2013), AUK 2011, CCC calculations.
Notes: Base Year (2007) = 100.

Figure 6.7: Fertiliser use (2003-2011)

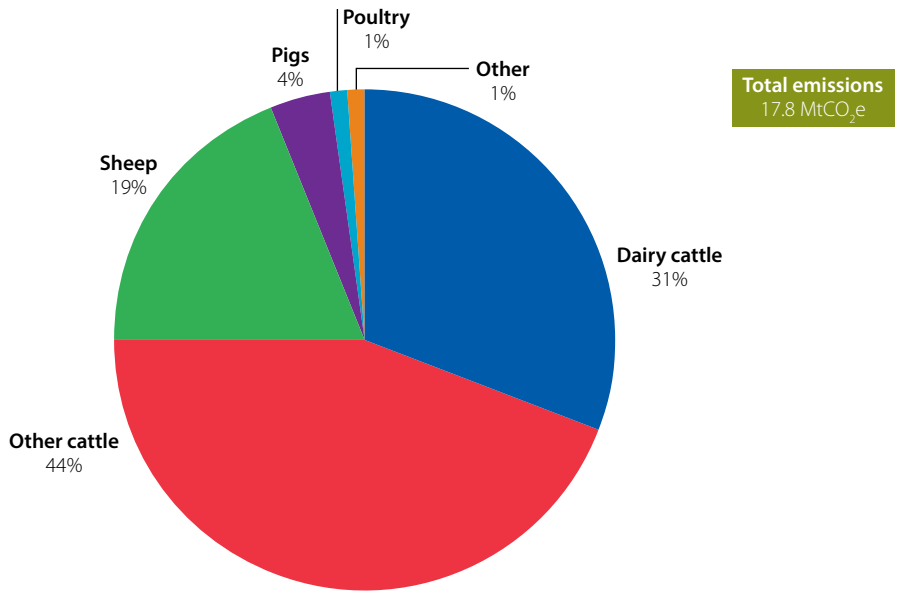


Source: British Survey of Fertiliser Practice (2012).

Emission drivers – methane

Over 90% of methane emissions are accounted for by cattle and sheep with enteric fermentation being the main source. Pigs and poultry account for 5% of emissions, which mainly arise from waste and manure management (Figure 6.8).

Figure 6.8: Source of methane emissions by animal (2011)



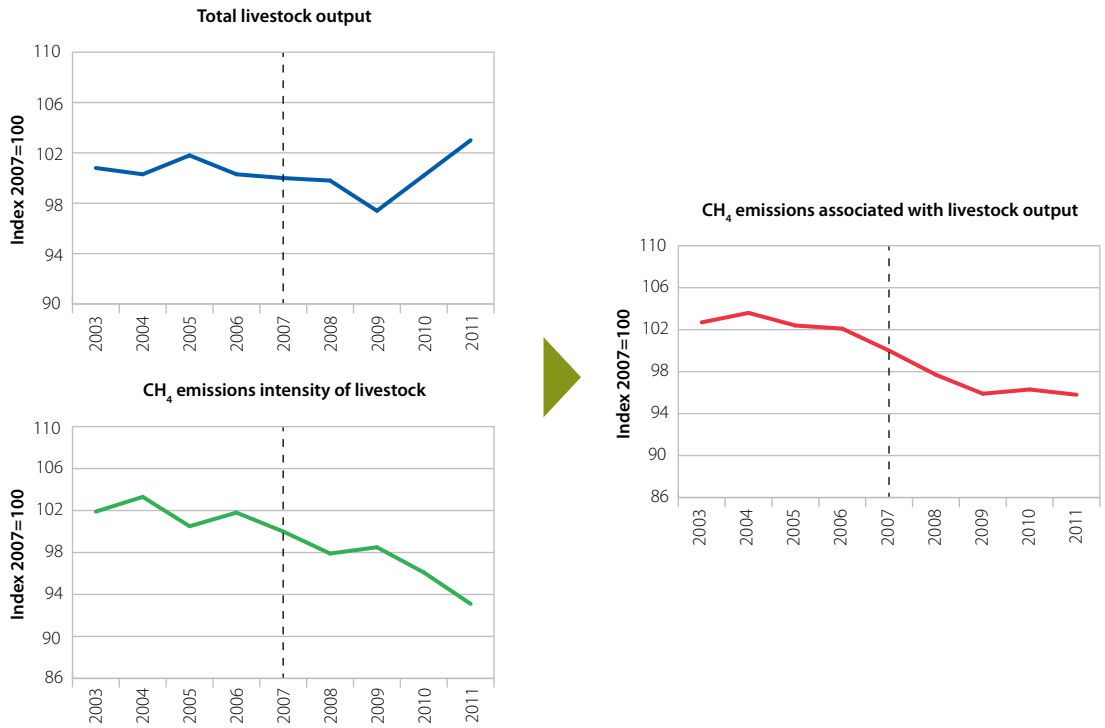
Source: NAEI (2013).

In 2011, methane emissions declined by 0.5% driven by a 2% reduction in cattle numbers. Despite the reduction in the number of animals, livestock output increased in 2011 by 2.7%, with beef up 3.4%, milk up 1.7% and sheep and lamb meat up 6%. These two factors imply a reduction in methane intensity of 3.2% (Figure 6.9).

Improving methane emissions intensity can be partly explained by improving livestock productivity:

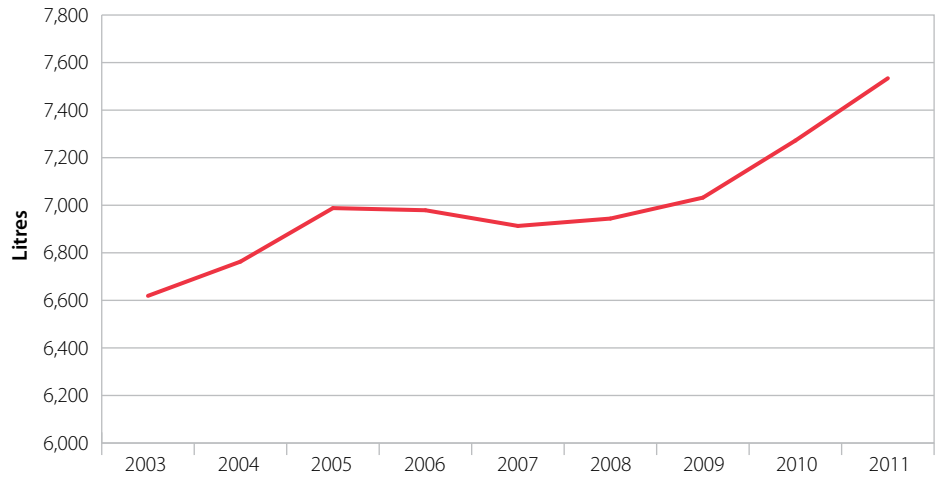
- Average milk yields increased by 3.5% in 2011, with the average dairy cow producing in excess of 7,500 litres for the year. The longer-term improvement is 14% since 2003 (Figure 6.10).
- Average dressed carcase weights for clean sheep and lamb increased by 0.5% in 2011 due to good grazing conditions. Although the average dressed carcase weight of beef and veal fell slightly (down 0.6%), high feed prices saw cattle sent to slaughter early which could indicate a fall in methane emissions per unit of output. Over the longer-term weights for beef and veal have increased by 8% since 2003 (Figure 6.11).

Figure 6.9: Total livestock output, methane emissions and methane emissions intensity of output (2003-2011)



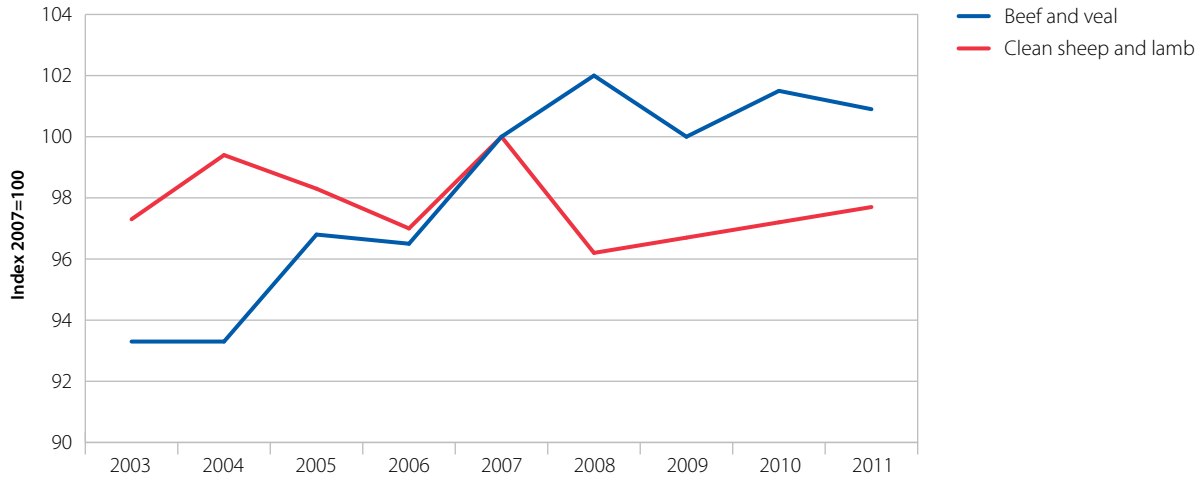
Source: NAEI (2013), AUK 2011, CCC calculations.
Notes: Base Year (2007) = 100.

Figure 6.10: Milk output per dairy cow (2003-2011)



Source: AUK (2011), NAEI (2013).

Figure 6.11: Index of average dressed carcase weight per animal (2003-2011)



Source: AUK (2011).
Notes: Base Year (2007) = 100.

However, yield alone is not a perfect indicator of changes in emissions intensity. It is important also to consider the feed conversion ratio (FCR)[1], and, where applicable, other measures (e.g. fertility rates and on-farm mortality) for a more accurate assessment of emissions intensity:

1 FCR measures the amount of feed required to produce an extra kg of meat or litre of milk. An increase in the FCR could imply greater methane emissions if the increase in feed is lost as carbon via enteric emissions if not properly digested and used for growth.

- In the dairy sector, the ratio of dairy cow compound and blend feed to milk production has been on an upward trend since 2005 indicating that the rate of increase in feed has risen more than the rate of increase in average milk yields. This would imply reduced feed efficiency and increasing emission intensity. However in 2011, there was an improvement of 3% for dairy cattle. (Figure 6.12).
- Measuring the FCR for grazing livestock (beef cattle and sheep) is more complicated due to the difficulty in measuring the consumption of grass that make up a substantial volume of the diet. Therefore, alternative measures are required. The new indicator framework established by Defra to track progress in reducing emissions uses beef and sheep breeding regimes to assess changes in emissions intensity of grazing livestock (see Section 3).

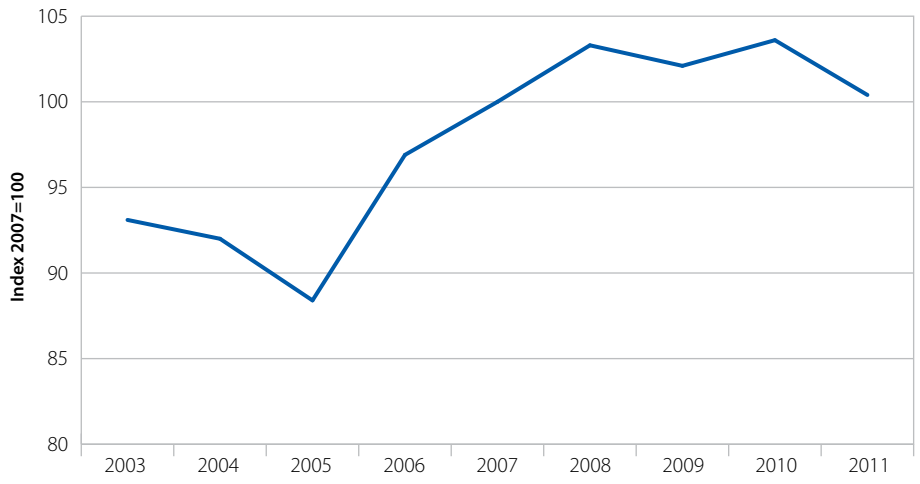
We note, however, that given the current uncertainty attached to calculating non-CO_2 emissions in the sector, it is unclear whether the required carbon intensity improvements are actually occurring. On-going work of the GHG R & D Platform (see Section 2) will eventually allow for an improved evidence base in which changes in emissions intensity can be calculated more accurately.

Emission drivers – CO_2

Machinery used in agriculture makes up the bulk of CO_2 emissions in agriculture and accounts for 8% of GHG emissions in this sector. In 2011 CO_2 emissions rose for the second successive year:

- All of this increase comes from stationary and mobile machinery, which accounts for almost all of the CO_2 emissions.
- Emissions from machinery are still 13% lower compared to 2003.

Figure 6.12: Ratio of compound and blend feed production to milk production per annum – GB (2003-2011)



Source: AUK (2011).
Notes: Base Year (2007) = 100.

In line with reductions elsewhere in the economy, there is a potential for further CO_2 savings in agriculture by improving energy efficiency and more use of renewable fuel. From April this year, the Renewable Transport Fuels Obligation was extended to cover fuels used for non-road mobile machinery. Suppliers are now obliged to supply a proportion of sustainable biofuels for each litre of fuel used by tractors and other mobile farming machinery.

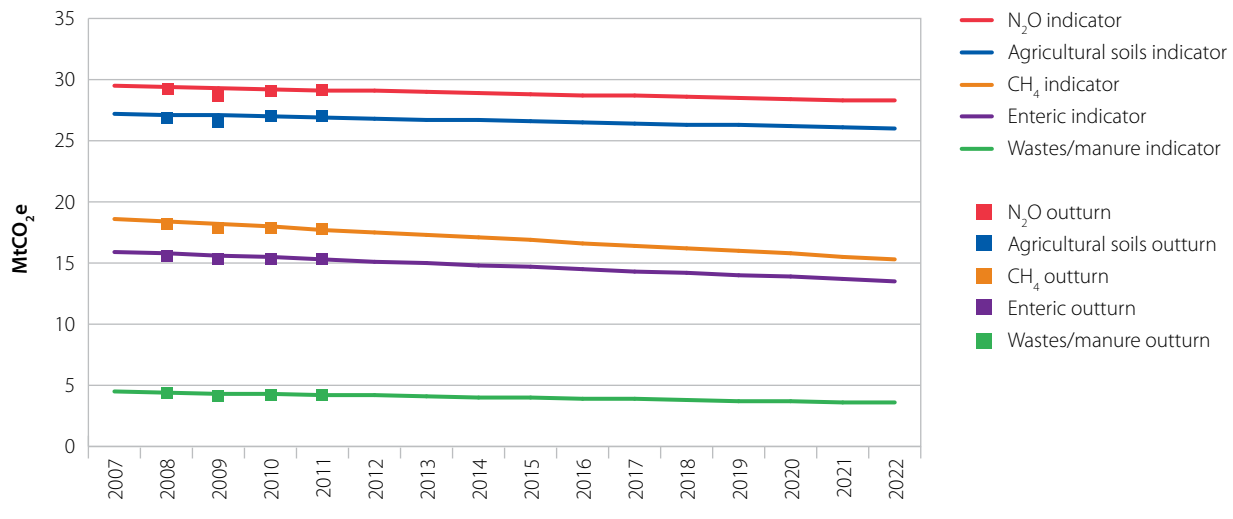
2. Progress against indicators

In our 2009 Progress Report we set out our preliminary indicators to track progress in reducing non-CO_2 emissions in the agriculture sector, consistent with the Government's ambition of 3 $MtCO_2e$ of savings by 2020 (scaled up to 4.5 $MtCO_2e$ for the UK) compared to 2007. The set of indicators comprise trajectories for reductions in emissions (by gas and source) and for changes in carbon intensity and productivity improvement:

- Average agricultural non-CO_2 reductions of 10% by 2022 relative to 2007 levels.
- Average improvements in soil emissions intensity of 5% by 2022 relative to 2007 levels through improvements in fertiliser efficiency in arable and pasture.
- Average improvement in livestock emissions intensity of 18% by 2022 relative to 2007 levels, through improvements in productivity (e.g. meat yields).

Although overall emissions have been flat since 2009, emissions reductions achieved in previous years mean that the level of emissions is still consistent with our indicator trajectory (Figure 6.13). Going forward, a reduction of 0.7% is required each year to achieve the 4.5 $MtCO_2e$ of savings by 2022. Given the lack of progress in the past two years it is important that an effective monitoring framework is in place and appropriate action is taken to get back on track should this be required.

Figure 6.13: Progress against indicators for agriculture to end of the third budget period (2007-2022)



Source: NAEI (2013), CCC calculations based on LCTP ambition.

Since last year's Progress Report, Defra published its own framework of indicators for monitoring progress in reducing emissions by 2022 (see Section 3). In light of this it remains to be seen whether our own indicators continue to be appropriate, especially with regard to measuring changes to the carbon intensity of livestock given that looking at meat yields alone may not be sufficient. We will return to this for next year's progress report.

An accurate assessment of progress is not possible given the significant uncertainties in the way agricultural emissions are currently calculated. This is because the current inventory uses standard, rather than UK-specific, emissions factors that do not reflect regional differences in soil and climate, for example. The inventory also fails to take account fully of current farming practices that could already be reducing emissions. This means that both the current level of emissions and emissions reduction potential is highly uncertain.

On-going work funded by Defra and the devolved administration governments will establish an improved method for calculating the agriculture inventory that will be based on UK-specific emissions factors. The revised inventory will also reflect the adoption of mitigation practices by UK farmers. Roll-out of the new inventory is scheduled for 2015.

3. Incentives to reduce agricultural emissions – the policy framework

In November 2012, Defra published its review[2] on progress towards reducing emissions from agriculture in England. The review represented the Government's long standing commitment to assess the current voluntary approach to reduce agricultural emissions in England. The main points from the review relate to:

i. An assessment of the ambition to reduce emissions by 2022

ii. The establishment of an indicator framework to monitor progress

iii. Future review of progress

We now look at each of these in turn.

i. An assessment of the ambition to reduce emissions by 2022

Government analysis looked at the 3 $MtCO_2e$ level of ambition in England by 2022 and concluded that it continues to remain credible. Furthermore, in response to a CCC recommendation for an assessment of whether existing policies and incentives were sufficient to realise the level of ambition, Defra undertook a mapping exercise of seven policies and concluded that the existing policy landscape is encouraging the adoption of farming practices to deliver abatement (Box 6.1).

2 *'2012 Review of Progress in Reducing Greenhouse Gas Emissions from English Agriculture'*, (2012), Defra.

Box 6.1: New analysis and mapping of policies

Analysis of abatement potential in agriculture

In its analysis of the abatement potential in England, Defra found:

- A maximum technical abatement potential of 3.9 $MtCO_2e$ using measures that represent cost savings to farmers.
- Using survey data and expert judgement on implementation rates, the review found that of the 3.9 $MtCO_2e$ of potential abatement, 0.6-0.8 $MtCO_2e$ had already been saved by 2010.
- Using the Farmscoper[3] tool and the Scottish Agricultural College (SAC) Marginal Abatement Cost Curve (MACC) an additional 3.1-3.3 $MtCO_2e$ of emissions savings were available at zero or negative cost in 2010.
- Defra noted that the maximum potential of 3.9 $MtCO_2e$ represents an overestimate of the actual potential due to a number of factors, including the failure of the Farmscoper model to consider overlaps between different methods and the assumption that all farmers implement all cost saving measures fully. Based on these uncertainties, Defra considered that 3 $MtCO_2e$ remained a more plausible level of ambition.

Mapping of policies against farm practices

The exercise mapped seven policies deemed to have most relevance to agricultural production, against farming practices able to deliver reductions in emissions:

- The strength of each policy in driving a particular mitigation method was assessed, and the analysis found that the strongest drivers overall were Catchment Sensitive Farming (CSF), Soils for Profits[4], the environmental stewardship schemes under the Common Agricultural Policy and the Nitrate Vulnerable Zones (NVZs). The remaining policies were found to be less successful in incentivising the type of farming practices that would reduce emissions (e.g. Soil Protection Review, Silage, Slurry and Agricultural Fuel Oil (SSAFO) Regulations).
- Collectively, these policies were found to be important in supporting the adoption of farming practices and technologies that had delivered 0.6-0.8 $MtCO_2e$ worth of cost savings by 2010.
- Looking ahead, Defra also concluded that the existing policy landscape was well placed to support Industry in its efforts to deliver savings of 3 $MtCO_2e$ by 2022.

An assessment of the voluntary approach to deliver emissions savings by 2022

In its review of the voluntary approach (GHG Action Plan) to deliver 3 $MtCO_2e$, Government reiterated its support for industry to take the lead, and for the progress it had achieved to date (Box 6.2). However, Government also stressed that there were certain areas in which Industry could do more:

- Seek more engagement from the rest of the supply chain (e.g. processors and supermarkets) to increase their support for on-farm reduction.
- *'... set out the specific success criteria for how its novel approaches will encourage change and where appropriate, link the selected delivery approach to its key on farm actions'.*

Industry has plans in place take on board these recommendations. They have already established good links with the Waste & Resources Action Programme's (WRAP) supply chain Product Sustainability Forum, which will be used as a mechanism for sharing the messages of the GHG Action Plan to supply chain organisations. With regards to setting out success

3 The Farm Scale Optimisation of Pollutant Emission Reduction (Farmscoper) decision support tool evaluates the impact of specific mitigation methods on a wide range of environmental pollutants.

4 The Soils for Profit (S4P) project works with farmers to help them improve their management of soils, nutrients, and manures.

criteria, Industry plan to work with the Campaign for the Farmed Environment's Evidence and Monitoring group and Defra to identify the most suitable indicators of on-farm practice. However, Industry and Defra[5] have noted the difficulty of attributing changes in on-farm practices directly to the GHG Action Plan due to the wide variety of existing factors (both voluntary and regulatory) that exert influence on farmers. On this basis, while Industry considers the Plan will help support emissions reduction, it is less sure how it can gauge its performance. We consider, however, that it is important for Industry to put in place measures to monitor the effectiveness of the Plan in influencing the uptake of less carbon-intensive farming practices.

Further to the above recommendations, we recommend that consistent with the livestock road maps, targets should be set as to how the cereals and oilseeds sector will contribute to emissions reductions.

Box 6.2: The second phase (2012-15) of the GHG Action Plan

The main highlights from the first year of the second phase of the GHG Action Plan include:

- The GHG Action Plan joined other industry voluntary initiatives under the umbrella organisation of the Campaign for the Farmed Environment (CFE)[6]. This will enable the GHG Action Plan to benefit from the CFE's extensive communications links and access to the technical expertise of the Evidence and Monitoring group, which will be used to support work to evaluate and agree key indicators of activity and progress for the GHG Action Plan.
- The move has also enabled the GHG Action Plan to secure the services of a part-time co-ordinator to take its work forward. This will include the testing of the Farm-Efficiency Hub with external advisors, which if all goes well, is expected to be launched within the year. The hub is intended to be main source of approved guidance and information for farmers and their advisors.
- The Home Grown Cereals Authority (HGCA) published an environmental road map that sets out how the cereals and oilseeds sector could contribute to the GHG Action Plan. The road map identified four main areas for reducing emissions through improving efficiency of nitrogen use, increasing crop yields, using alternative sources of nitrogen and reducing on-farm energy use and fossil fuel dependency. We recommend that the sector follows the approach of the livestock roadmaps by setting out how it intends to achieve emissions reductions with the setting of targets against each of the main areas identified.
- Industry's 'Tried and Tested' nutrient management team launched a new guide and tool[7] to support improved feed efficiency of cattle and sheep. In addition to supporting emissions reductions, improving the efficiency of feed can deliver additional benefits of improved animal health and profitability. In the first instance, it is planned to distribute the Tried and Tested feeding plan to around 10,000 farmers on request, and promote the plan through the supply chain for beef and lamb products.
- In the absence of any standard for advisors of animal feed nutrition, the Feed Adviser Register (FAR) was launched last month and will enable advisors to demonstrate professional competence. To be registered, advisors with less than a year of experience will have to undertake 12 months of supervised work, while continued membership will require verification of core competencies. FAR is the feed industry's contribution to the GHG Action Plan and advice will deliver benefits in terms of production efficiencies and reduced emissions.

5 Defra (2013), *'Review of Partnership Approaches for Farming and the Environment Policy Delivery'*.
6 The Campaign is supported by a wide partnership of organisations that recognise the importance of voluntarily managing the farmed environment.
7 *'Feed planning for cattle and sheep'* (2013).

ii. The establishment of an indicator framework to monitor progress

In our 2012 Progress Report, we noted that the evidence base for assessing progress in reducing emissions remained incomplete, and as such a framework of indicators and supporting data on farming practice should be established as a matter of urgency.

Defra has now established a framework that that will capture ten indicators, against which progress to reduce emissions will be measured. The indicators cover three broad themes: farmers' attitudes, the adoption of mitigation measures and indicators to measure the GHG emission intensity of production (Table 6.1). According to Defra, the uptake of mitigation methods set out in the indicator framework had produced savings of 1.2 $MtCO_2e$ by early 2012. Progress will be monitored annually, and the first year of data will be published this July. We will look at the results for next year's progress report.

Table 6.1: Defra Indicators to monitor progress in reducing agricultural emissions

Overarching Indicators	**Description**
1. Attitudes and knowledge	This indicator aims to measure awareness of the sources of emissions and intentions to change practice. Seven attitudinal questions were asked in this year's Farm Practice Survey, which included the following: • How important do you feel it is to consider GHGs when taking decisions about your farm? • To what extent do you agree that reducing your farm's GHG emissions will contribute to your overall profitability? • Where on your farm do you think GHGs come from?
2. Uptake of mitigation measures	Uptake of mitigation measures across five activity groups is being monitored: • Nutrition management • Livestock nutrition • Livestock breeding • Land and soil management • Plants with improved nitrogen use efficiency
3. Soil nitrogen balance	The soil nitrogen balance provides a measure of the total loading of nitrogen (inorganic and organic) on agricultural soils. A surplus implies pollutant losses to the environment.
Sector specific Indicators	**Description**
4. Feed conversion ratio for pigs	A reduction in the feed conversion ratio (FCR) implies improving carbon intensity through feed efficiency. In the last 10 years Defra note that the FCR has increased.
5. Beef and sheep breeding regimes	This indicator will track the percentage of farms using bulls or rams with a high Estimated Breeding Value (EBV). The EBV is an estimate of the genetic merit an animal has for a measured trait or characteristic. A selection of useful traits can improve productivity and efficiency thereby implying improving carbon intensity.

Table 6.1: Defra Indicators to monitor progress in reducing agricultural emissions	
6. Dairy cow feed production to milk production	Increasing milk yields by a larger rate than an increase in feed input (dry matter) implies an improvement in feed efficiency and therefore a reduction in carbon intensity. However, as Defra points out the indicator requires further improvement as the quantity of dry matter feed produced will be determined by changes in the availability of other feeds such as on-farm feed and forage grass.
7. Feed conversion ratio for poultry	The quantity of poultry feed produced per kg of poultry meat (dressed carcase weight) is a proxy for carbon intensity. In the last ten years, the FCR has increased slightly implying a worsening of carbon intensity.
8. Cereals and other crops – manufactured fertiliser application	Increased use of nitrogen fertiliser (as measured here by the ratio of the weight of crops produced to the weight of the manufactured fertiliser applied) implies a reduction in carbon intensity. To avoid year-on-year fluctuations arising from random events (e.g. bad weather), the indicator will be based on a five-year moving average. The indicator will track five cereal crops (wheat, winter barley, spring barley, winter oil seed rape and sugar beet).
9. Slurry and manure	This indicator will track up-take of five measures that can minimise emissions through improving the handling and storage of manure and slurry. These include the installation of covers to slurry stores and the use of liquid/solid manure separation techniques.
10. Organic fertiliser application	This indicator will track up-take of five practices that can minimise emission from the use of organic fertiliser. These include the use of slurry injection application techniques and use of a manure spreader calibration.
Source: Defra.	

iii. Future review of progress and new policy options

Defra has stated that it will not commit to a further review of progress until 2016 at the earliest, by which time it will be able to take stock of the new agricultural inventory and the completion of the second phase (2012-2015) of the GHG Action Plan. However, we support the intention to bring forward a review in the event that its indicators suggest that there is insufficient progress being made. On the basis of an improved evidence base, we also suggest that Defra widen the scope of any review to consider a range of policy options, including continuing with the current voluntary approach and policies which would provide stronger incentives for farmers. To date Defra has stated that it will not specify targets or trigger points for policy intervention.

4. Land use, land use change and forestry

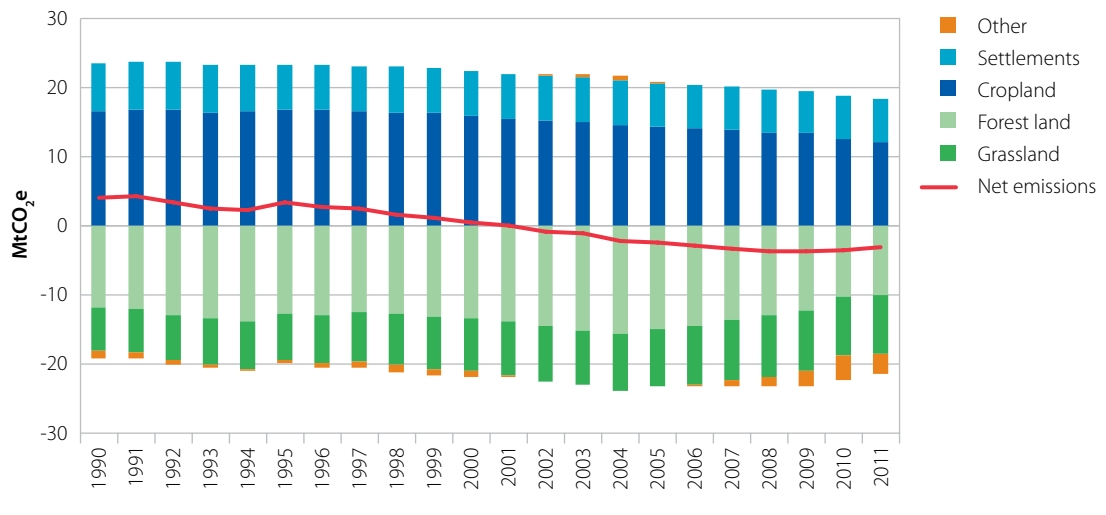
Emissions trends

The Land use, land use change and forestry (LULUCF) sector continued to be a net carbon sink, absorbing 3.3 $MtCO_2e$ more than was emitted in 2011 (Figure 6.14). However, a 3% decline in the amount of carbon sequestrated meant that for the second successive year net emissions increased, up 10% in 2011:

- Forestry is the single largest source of sequestration, accounting for just under half of the carbon absorbed in 2011. Grasslands accounted for a further 39% of sequestration. For both land types, net carbon absorbed declined in 2011 compared to the previous year.
- Over 60% of LULUCF emissions arise from cropland, but in 2011 levels declined by 4.1% driven by the reduction in emissions from land converted to cropland. The other significant source of net emissions is settlements, which produced a 1% increase in emissions due to the conversion of more land to settlements.

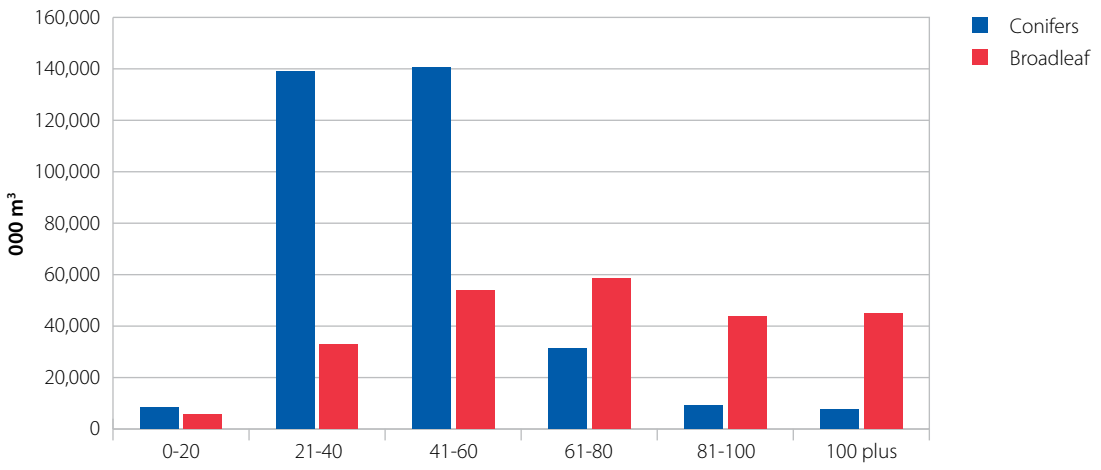
The increase in net emissions is due to the declining ability of existing forestry to absorb carbon due to the sharp fall in tree planting rates at the beginning of the 1990s. This is reflected in the age distribution of the standing volume of conifers and broadleaves, with only around 2% of the total volume less than 20 years of age (Figure 6.15). According to projections by DECC and the Centre for Ecology and Hydrology, under the worst case scenario, the LULUCF sector could become a net carbon emitter as early as 2013.

Figure 6.14: LULUCF emissions/removals (1990-2011)



Source: NAEI ((2013).

Figure 6.15: Age profile of GB woodland



Source: National Forest Inventory (Forestry Commission).
Notes: As measured by the standing volume of conifer and broadleaf trees (000 m^3).

Opportunities to reduce land use emissions

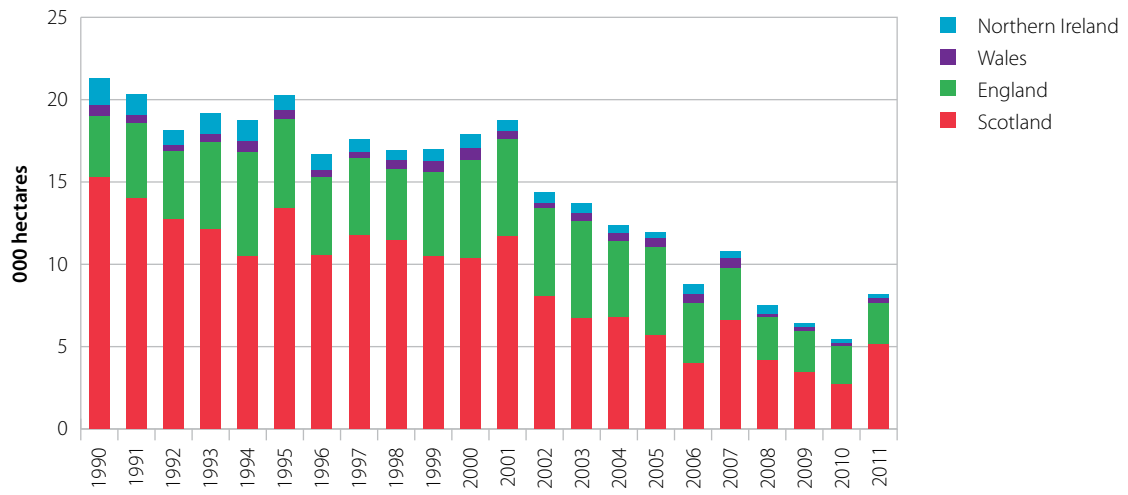
There is a range of options that can be employed to increase carbon sequestration and reduce the release of emissions in the LULUCF sector. This includes the expansion of woodland cover.

Forestry

Woodland accounts for only 13% of the total UK land area, well below the EU average of 44%. On this basis, we reiterated in last year's progress report our recommendation first made in the Fourth Carbon Budget report, for an increase in UK tree-planting rates, equivalent to 10,000 hectares a year by 2030. Since then:

- In July 2012, the Independent Panel on Forestry, which was set up by Defra to look at the future direction of forestry and woodland policy in England, published its recommendations. With regards to expanding woodland area, the panel recommended Government commit to an ambition to increase woodland cover from 10% to 15% by 2060. This would entail a planting rate of 15,000 hectares a year.
- The panel's recommendation was based on a limited economic assessment and was deemed unsustainable by Defra and the Forestry Commission. Defra subsequently set a lower level of ambition of 12% by 2060, which equates to an annual average of 5,000 hectares. The ambition is contingent on private investment taking the lead and Government assuming an enabling role (e.g. developing new ways of encouraging growth and removing barriers).

Figure 6.16: New planting in the UK (1990-2011)



Source: Forestry Commission, Forest Service, grant schemes.
Notes: 1. Non-FC/FS figures are based on areas for which grants were paid during the year. Estimate of areas planted without grant aid are also included (where possible), although non-grant aided planting may be under-represented in the figures. Figures for grant-aided planting under Rural Development Contracts in Scotland relate to calendar years. 2. The planting season lies both sides of 31 March, and the weather can cause planting to be advanced or delayed. 3. Includes natural colonisation.

- Forestry is a devolved matter, and elsewhere targets have also been set to increase woodland area, although results to date have been mixed:
  - **Scotland:** a rural development scheme[8] to fund the ambition for an additional 100,000 hectares between 2012 and 2022 has already delivered positive results with planting rates nearly doubling in 2011 compared to the previous year. This accounted for most of the 50% increase in UK planting in the same year (Figure 6.16).
  - **Wales:** in our 2013 report on progress in reducing emissions in Wales[9], we noted that Wales was still some way off from the 3,000 ha/year (2010-30) target, with levels reaching only 300 hectares in 2011.
  - **Northern Ireland:** with a target to double woodland cover to 12% by 2056, planting rates will have to increase to 1,700 ha/year, which is well above current rates of around 300 hectares.

If all these targets are met, they would be close to meeting the CCC recommendation for 2030. Therefore England, Wales and Northern Ireland should look to mirror the achievements made in Scotland by progressing plans to meet their own targets. We will continue to monitor progress in next year's progress report.

8 The Woodland Creation Grant.
9 CCC (2013) *'Progress on reducing emissions and preparing for climate change in Wales'.*

Key findings

- Agriculture emissions **remained unchanged** from 2010 at 51.2 $MtCO_2e$, but given reductions in previous years, agriculture remains **on track** to broadly meet its contribution to meeting the first carbon budget.
- While an increase in inorganic fertiliser use on arable land contributed to a **worsening carbon intensity** of crops, a reduction in fertiliser use on grasslands supported an **improvement** in the carbon intensity of livestock products.
- We welcome the publication of Defra's indicator framework to monitor progress in reducing emissions. The indicators should be kept under review to ensure they remain **comprehensive and relevant**.
- Consistent with the livestock road maps, **targets should be set** as to how the cereals and oilseeds sector will contribute to emissions reductions.
- Industry should set out plans to assess the effectiveness of the Industry Action Plan to **provide confidence** that the voluntary approach is influencing farming practices and achieving emissions reductions.
- If needed, a review should be implemented before the planned 2016 date, and the Government should consider a range of policies that would provide **stronger incentives** for farmers.

Table 6.1: The Committee's agriculture indicators						
AGRICULTURE		**Budget 1**	**Budget 2**	**Budget 3**	**2011 trajectory**	**2011 outturn**
Headline indicators						
Emissions (indicative % change from 2007 reflecting LCTP ambition scaled to UK)						
CO_2e emissions		-3%	-6%	-9%	-2.5%	-2.2%
GHG emissions (% change in tCO_2e against 2007)	N_2O	-1%	-3%	-4%	-1.1%	-1.0%
	CH4	-6%	-12%	-18%	-4.7%	-4.1%
	CO_2*	n/a	n/a	n/a	n/a	n/a
Source emissions (% change in tCO_2e against 2007)	Soils	-1%	-3%	-4%	-1.2%	-0.8%
	Enteric fermentation	-5%	-10%	-15%	-4.0%	-4.2%
	Animal waste	-7%	-13%	-20%	-5.4%	-5.5%
	Machinery/fuels*	n/a	n/a	n/a	n/a	n/a
Drivers**						
tN_2O emissions per thousand hectares of arable and managed pasture	2007 = 2.23	2.20	2.17	2.14	2.21	2.22
tCH4 emissions per tonne of cattle and calf meat, dressed carcase weight	2007 = 9.06	8.60	8.14	7.69	9.06	8.84
tCH4 emissions per thousand litres of milk	2007 = 0.41	0.40	0.39	0.36	0.34	0.40
tCH4 emissions per tonne of sheep and lamb meat, dressed carcase weight	2007 = 11.23	10.42	9.62	8.81	10.75	10.41
tCH4 emissions per tonne of pig meat, dressed carcase weight	2007 = 1.12	1.06	1.00	0.95	1.08	0.92
tCH4 emissions per tonne of poultry, dressed carcase weight	2007 = 0.18	0.17	0.16	0.15	0.18	0.17

Table 6.1: The Committee's agriculture indicators

AGRICULTURE		Budget 1	Budget 2	Budget 3	2011 trajectory	2011 outturn
Supporting indicators						
Farming Practice **Measures where greater confidence exists (e.g. proven technology, considered best practice, consistent abatement results) but uncertainty about baseline use.**						
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	Less than 1% of holdings have AD (2011)	
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						
Phase 2 delivery of GHG AP: • Roll-out of Industry information hub • Establish baseline farming practice and framework to monitor progress			2013-14			Hub to be tested by external advisors 2013 On-going
Government policy review on voluntary approach (2012): • Development of policy options for intervention • Set triggers for intervention		End 2012 End 2012				Review decided not to set triggers nor consider policy options
On-going monitoring of voluntary approach: • Bring forward 2016 Review if progress off-track • Review should consider policy options for intervention			2013-2015			On-going

Table 6.1: The Committee's agriculture indicators

AGRICULTURE	Budget 1	Budget 2	Budget 3	2011 trajectory	2011 outturn
Development of smart inventory	Set milestones for delivery	2014 (1st phase)			Projects underway
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	1 $MtCO_2e$				
Supporting indicators					
UK woodland planting	At least 21,000 hectares/year from 2015				
Policy Milestones					
Development and implementation of a woodland creation programme	Government has set ambition for England of average rate of 5,000ha/year by 2060				

* 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

Introduction and key messages

1. Waste emissions: trends and drivers
2. Progress against waste indicators
3. Other non-CO_2 emissions: trends and drivers
4. Other non-CO_2 emissions: projections and abatement potential
5. Other non-CO_2 emissions: indicators of progress

Chapter 7: Progress reducing emissions from waste management and other non-CO_2 sources

Introduction and key messages

Outside of the agriculture sector, non-CO_2 emissions in the UK arise from a wide range of sources including waste, industry, transport, buildings and energy supply. These include methane (CH_4), predominantly arising from waste management, nitrous oxide (N_2O) and certain fluorinated gases (F-gases) including HFCs, PFCs, and SF_6.

Emissions data in the waste and other non-CO_2 sectors lag that for CO_2 by a year due to the longer time required to collate non-CO_2 emissions data. In this chapter, we focus on the latest data which show that in 2011, waste and other non-CO_2 emissions totalled 45 $MtCO_2e$, accounting for approximately 8% of total UK greenhouse gas emissions.

We have previously set out high-level assessments of abatement potential for waste and other non-CO_2 emissions (e.g. in our advice on the fourth carbon budget and on the 2050 target).

In our 2012 progress report we included an analysis of waste emissions and set out indicators against which future progress can be monitored. We also suggested that there was scope for emissions reductions beyond the Government's existing ambition, given further opportunities for waste prevention and recycling and other disposal methods such as anaerobic digestion and composting. We recommended that introduction of stronger levers to address the full potential for reducing waste emissions should be kept under review.

In this chapter we present latest evidence on emissions from waste, which accounted for 3% of total emissions in 2011, and consider policy developments to further reduce emissions.

We also bring together latest emissions data for other non-CO_2 emissions, arising in industry, transport, buildings and energy supply. Using the usual CO_2 equivalent metric based on the Global Warming Potential (GWP) over 100 years, other non-CO_2 emissions accounted for 5% of total greenhouse gas emissions in 2011. These non-CO_2 emissions have been continually monitored in our progress reports (e.g. in the overview and relevant sector chapters such as buildings and industry) but for the first time this year we set out indicators against which future progress can be monitored, with a focus on F-gases arising from industrial processes and buildings.

Our key messages are:

Waste emissions

- Waste emissions decreased by 3% in 2011, continuing a longer-term trend where emissions have fallen by 64% since 1990, largely due to reduced methane emissions arising from landfill sites.
- Landfill emissions have fallen due to reductions in the amount of biodegradable waste landfilled, driven by the landfill tax imposed to meet EU Landfill Directive targets. There has also been good progress to reduce waste generated by households and businesses and divert waste from landfill, through voluntary responsibility deals, information awareness campaigns and strategies to support anaerobic digestion.
- Further reductions in waste emissions could be supported through introduction of stronger levers, particularly targeting household food waste, which is likely to continue to be a major contributor to future landfill emissions. For example, households can be further encouraged to reduce waste arisings and increase recycling efforts. Local authorities can increase provision of separate food waste collection services, which can further unlock potential for producing energy through anaerobic digestion. The Government should also consider bans on major sources of biodegradable waste (e.g. food and textiles) from landfill on a case-by-case basis.

Other non-CO_2 emissions

- Other non-CO_2 emissions (from industry, energy supply, transport and buildings) fell by 4% in 2011, in line with the long-term trend which has seen emissions fall by 64% since 1990. This is mainly due to reduced emissions from industry and energy supply, caused by EU legislation to reduce emissions from industrial processes and reduced coal mining.
- Current policies are expected to lead to other non-CO_2 emissions falling by 50% by 2030 on current levels.
- There is potential to go further in reducing F-gas emissions than is currently being achieved under existing legislation.

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

1. Waste emissions: trends and drivers
2. Progress against waste indicators
3. Other non-CO_2 emissions: trends and drivers
4. Other non-CO_2 emissions: projections and abatement potential
5. Other non-CO_2 emissions: indicators of progress

1. Waste emissions: trends and drivers

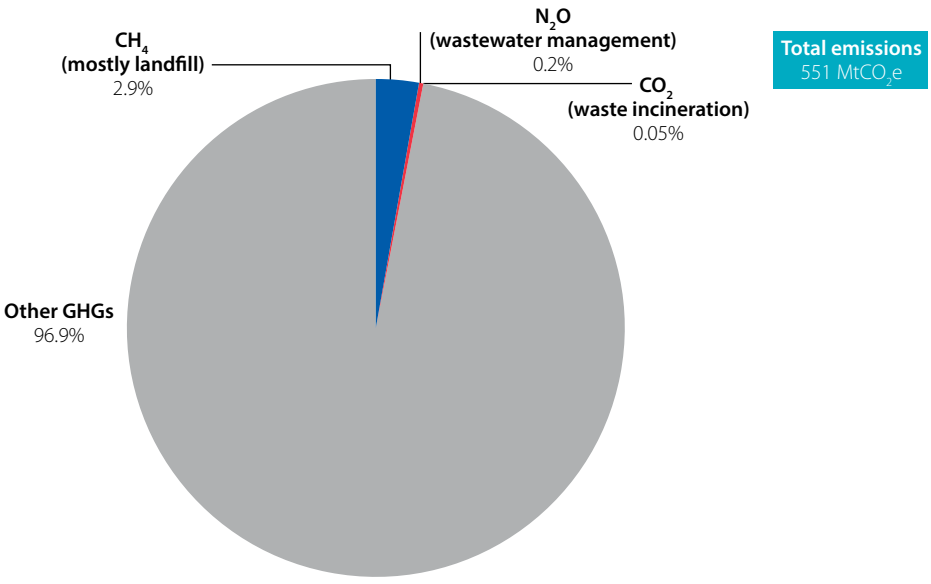
Emissions trends – methane, nitrous oxide, and CO_2

The waste emissions inventory was revised in 2012 to include a new separate time series of methane emissions arising from industrial wastewater treatment between 1990 and 2011.[1] Estimates for other sources of waste emissions remain unchanged. Due to the additional emission source, historic waste emissions reported in 2013 are slightly higher than previous estimates (e.g. 17.9 $MtCO_2e$ in 2010 versus previous estimate of 16.5 $MtCO_2e$). Therefore overall waste emission trends described below will differ slightly from those reported in our 2012 progress report.

Waste emissions were estimated to total 17.3 $MtCO_2e$ in 2011, accounting for just over 3% of total greenhouse gases in the UK (Figure 7.1). They are predominantly methane emissions which arise as biodegradable waste in landfill sites decomposes in the absence of oxygen.

- Methane emissions arising from landfill, accounted for 82% of waste emissions and fell 4% in 2011 (from 14.7 $MtCO_2e$ to 14.1 $MtCO_2e$). Overall landfill methane emissions have decreased by 67% since 1990.
- Methane and nitrous oxide (N_2O) emissions arising from wastewater treatment were 2.8 $MtCO_2e$ and increased very slightly in 2011.
- CO_2 emissions arising from incineration of wastes *without* energy recovery (e.g. clinical and sewage sludge) are small (0.3 $MtCO_2$ or 2% of total waste emissions) and fell 3% in 2011.

Figure 7.1: Waste emissions as a share of all UK greenhouse gas emissions (2011)



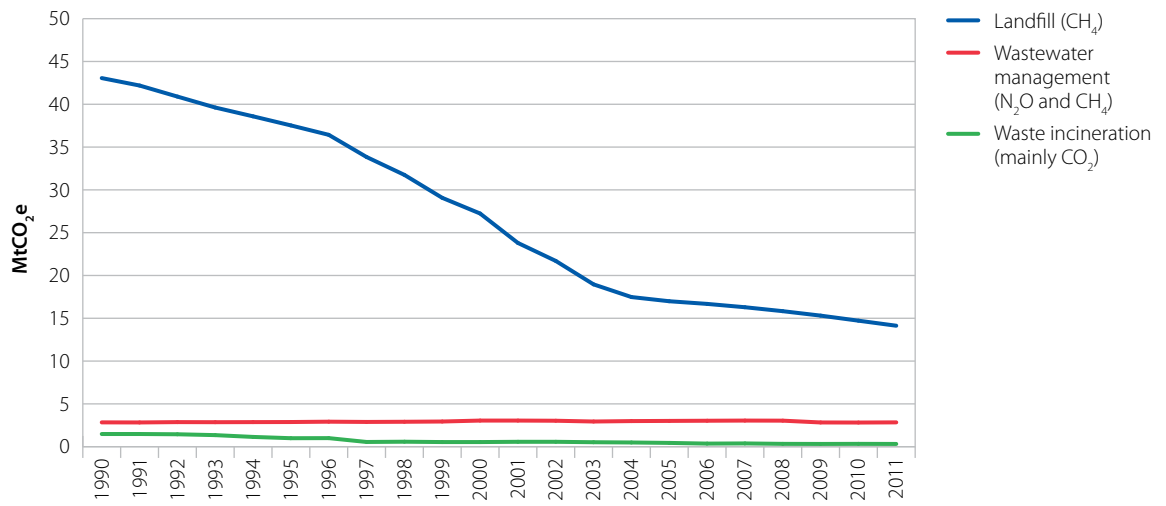
Source: NAEI (2013).
Notes: CH_4 = methane.

1 As recommend by the UNFCCC in its 2012 review of the UK inventory.

- There were also 1.8 $MtCO_2$ emissions arising from incineration of wastes *with* energy recovery, up 9% from 2010. These CO_2 emissions are allocated to the power rather than waste sector.

Overall waste emissions decreased by 3% in 2011, continuing a longer-term trend where emissions have fallen by 64% since 1990 (Figure 7.2).

Figure 7.2: Waste emissions by source (1990-2011)



Source: NAEI (2013).
Notes: CH_4 = methane.

Emissions drivers – methane

Methane arising from landfill sites, as food, paper and other biodegradable rubbish decomposes without oxygen, accounted for 90% of methane from the waste sector in 2011. The remaining 10% came primarily from wastewater treatment, as methane is produced from anaerobic decomposition of organic matter by bacteria in sewage facilities.

Landfill methane emissions are not directly measured but calculated based on data on: the quantity and composition of waste sent to landfill sites; assumptions on the properties of waste streams such as methane yield and decay rates (e.g. how much and over how many years methane is emitted as different types of waste degrade); as well as the properties of landfill sites (e.g. how much methane is captured and flared or used for energy generation rather than emitted into the atmosphere). There is imperfect understanding of methane yields and decay rates, which are affected by real landfill conditions and will therefore differ between and within sites. Given these uncertainties, the Government has estimated that landfill emissions could be 50% greater or lower than currently recorded in the inventory.[2]

Waste landfill emissions are in part determined by waste that was landfilled many years ago. For example, paper takes 12 to 17 years to emit half of its eventual total methane emissions. It is therefore important to consider longer-term as well as year-on-year changes in drivers of landfill methane emissions.

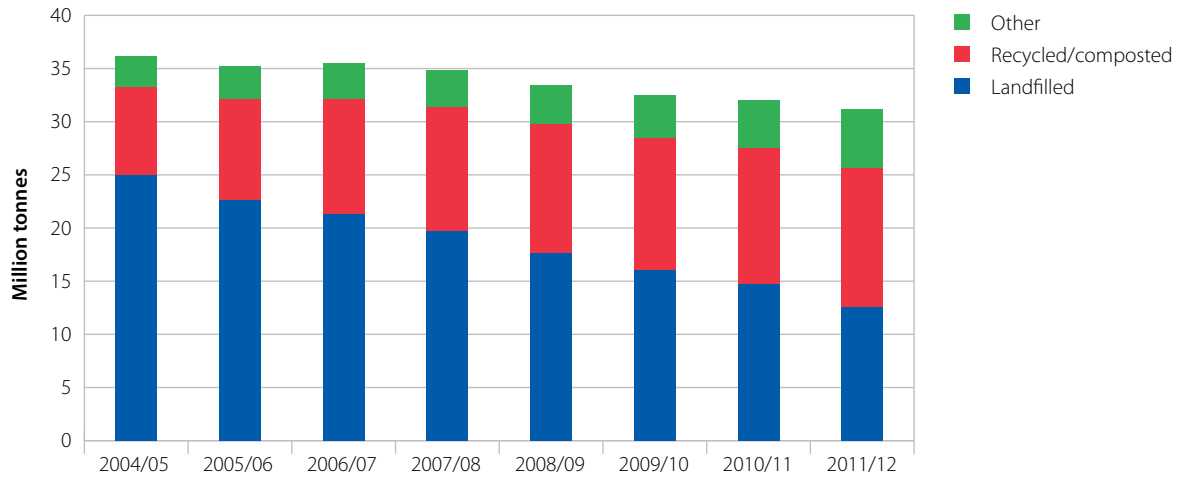
2 Ricardo-AEA (2013) *UK Greenhouse Gas National Inventory, 1990-2011, Annex 7.*

The three key drivers of methane emissions arising from landfill sites are: the amount of biodegradable waste generated in the UK; the amount of biodegradable waste that is landfilled; and the proportion of methane emitted by landfill sites that is captured or flared.

- **Waste arisings.** The latest Defra data on total waste arisings in the UK is for 2008 and shows an 11% decrease from 2004 levels. More recent Defra data suggest that municipal solid waste collected by local authorities fell by 3% in 2011/12, continuing a trend where waste collected by local authorities has decreased by 14% between 2004/05 and 2011/12 (Figure 7.3). Data on trends in biodegradable waste arisings are limited but Waste Reduction Action Programme (WRAP) data suggests that household food and drink waste has fallen by 13% since 2006, from 8.3 to 7.2 million tonnes (Mt). Reductions in waste have been driven by waste prevention and resource efficiency campaigns, voluntary responsibility deals and more recently the recession (Box 7.1).
- **Biodegradable waste sent to landfill.** This was reduced by an estimated 6% in 2011, continuing a longer-term trend where the amount of biodegradable waste landfilled has decreased by over 60% since 1990. These reductions have been driven by the UK landfill tax in place to meet EU Landfill Directive targets (Box 7.1). Limited data are available on how biodegradable waste is managed (e.g. proportion sent to landfill versus other treatments) but overall waste management statistics show an increasing trend towards treatment via recycling, composting, and other treatments including incineration, anaerobic digestion, and mechanical and biological treatment (Figure 7.3).
- **Methane captured at landfill sites.** Lifetime methane capture rates at landfill sites (or the proportion of methane that is captured rather than emitted) are assumed to average 75% (unchanged since 2005).

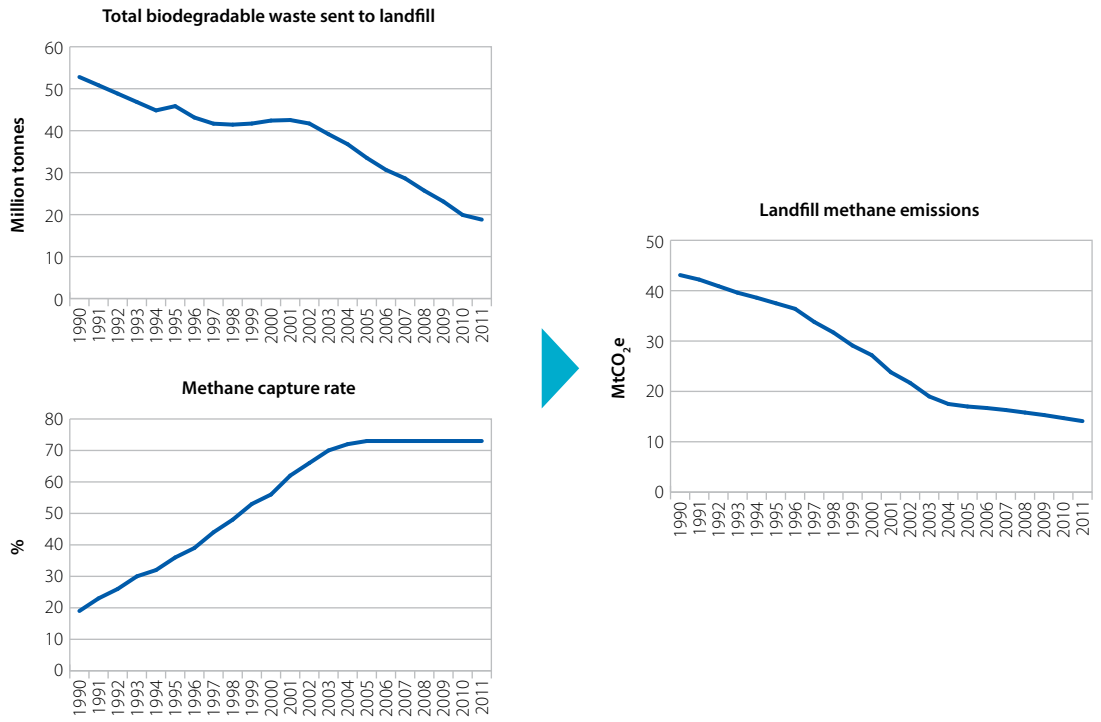
As a result, landfill methane emissions have decreased by 67% between 1990 and 2011 (Figure 7.4).

Figure 7.3: Local authority collected waste management in the UK (2004/05-2011/12)



Source: England: Defra (2013); Wales: StatsWales (2012); Scotland: SEPA (2012); Northern Ireland: DOENI (2012).
Notes: Compiled from various waste statistics databases; 'Other' includes incineration with/without energy recovery, mechanical and biological treatment and other treatments.

Figure 7.4: Total biodegradable waste sent to landfill, proportion of methane captured at landfill sites and methane emissions ($MtCO_2e$) from landfill (1990-2011)



Source: NAEI (2013).
Notes: These charts provide high-level overview of the key drivers accounting for reductions in landfill methane, which arises as various biodegradable waste streams decompose in landfills in the absence of oxygen. Emissions are a function of 1 minus the methane capture rate, and depend on the precise composition and historical timing of landfilled materials (e.g. each waste stream decays at a different rate and emits different levels of methane over time).

Success in reducing landfill emissions therefore reflects a combination of financial incentives introduced through the landfill tax, local authority and commercial/industrial actions in response to the landfill tax and other objectives, information and voluntary programmes for waste reduction and regulations to improve landfill management practices (Box 7.1).

As noted above and in greater detail in our 2012 progress report, considerable scientific and analytical uncertainty remains regarding the modelling of methane emissions (e.g. due to uncertain estimates of waste arisings, assumptions regarding methane yield and decay rates of waste streams, and the methane capture rate). We will continue to monitor any developments in the evidence base to improve the accuracy of waste emission estimates, including the Government working with the waste management sector to improve estimates of commercial and industrial waste and improving estimates of methane captured at UK landfill sites.

Box 7.1: Policy framework to reduce waste generation and landfill methane emissions

The UK landfill tax is currently the key policy driver to achieve targets under the 1999 EU Landfill Directive, which requires a 50% reduction in biodegradable municipal waste landfilled in the UK by 2013 relative to 1995 levels and a 65% reduction by 2020.

The landfill tax imposes a charge on landfill operators for each tonne of waste landfilled. Operators in turn pass on the costs as gate fees to local authorities and businesses, creating an incentive to reduce the waste they send to landfill either through waste prevention or diverting waste to other treatments (recycling, composting, recovery, and reuse). The tax has been increased from its initial rate of £7 per tonne to £72/t, and will rise to £80/t in 2014/15.

There are also a number of complementary approaches to encourage waste reduction, to increase recycling rates and to increase diversion of waste from landfill.

- **Waste reduction**
  - WRAP's **Love Food Hate Waste Programme** encourages voluntary reductions in food waste. It was introduced in 2007 and has had some success, with food waste generated by households falling by over 1 Mt (a 13% reduction) between 2006 and 2010.
  - The **Courtauld Commitment**, a voluntary responsibility deal to improve resource efficiency in the grocery retail sector, prevented 0.7 Mt of food waste between 2005 and 2009. The second phase (2009-2012) aimed to further reduce household food and drink waste by 4%, packaging waste by 10%, and supply chain product and packaging waste by 5% relative to 2009 levels. Much of this was achieved in the first year and a final evaluation of Phase 2 will be published in autumn of 2013. The third phase covers 2013-2015 and aims to reduce household food and drink waste by a further 5% from 2012 levels.
- **Diversion of waste** towards recycling and other treatments
  - **Household waste.** Partly incentivised by the landfill tax and until recently, the Landfill Allowance Trading Scheme (which set limits on the amount of biodegradable municipal waste that local authorities could send to landfill), local authorities have supported the sorting of waste through providing for recycling collection (and in some cases for separate food waste collection), encouraged composting and invested in waste treatment facilities.
  - **Commercial and industrial waste.** The UK has a statutory producer responsibility regime to reduce packaging and recently set new targets requiring producers to increase recovery rates of materials (e.g. paper/card, glass, aluminium, steel) from 74% in 2012 to 79% in 2017.
- **Methane capture and anaerobic digestion (AD).** A combination of permit conditions and financial incentives for capturing methane from landfill and anaerobic digestion (e.g. under the Renewables Obligation, Feed-in-Tariffs, and Renewable Heat Incentive) has driven investment to significantly increase capture of methane at landfill sites. The Government's 2011 AD Strategy and Action Plan aims to reduce barriers to uptake of AD in England.

Emissions drivers – nitrous oxide and CO_2

Nitrous oxide (N_2O) emissions in the waste sector arise primarily from wastewater treatment and are estimated based on the quantity of sewage sludge disposed, population levels, and protein consumption.

Overall N_2O emissions allocated to the waste sector decreased very slightly in 2011 (by -0.4%):

- The amount of sewage sludge treated increased 5% (mainly reflecting increasing population levels);
- In the absence of new information, per capita protein consumption has been assumed to be unchanged from 2010;

- However more sewage sludge was applied to agricultural lands in 2011 with associated emissions allocated to the agricultural sector, such that the share allocated to waste management has fallen.

CO_2 emissions from incineration of wastes *without* energy recovery are included in the waste sector inventory emissions and decreased 3% due to reductions in the amount of waste incinerated.

CO_2 emissions from incineration of waste *with* energy recovery are captured in the power sector (e.g. combustion of municipal solid waste). This has accounted for most waste incineration emissions since 1997 and is related to burning waste products that are produced from fossil fuels (e.g. plastics). Estimates of these emissions were revised upwards in 2012 using updated and improved emissions factors. The revised estimate for CO_2 emissions from incineration of wastes with energy recovery is 1.8 $MtCO_2$ in 2011, a 9% increase from 2010 which is likely to have been due to increased combustion of wastes with fossil fuel content.

Given the small magnitude of these emissions, our focus in monitoring progress in reducing waste emissions is on methane released from landfill sites.

2. Progress against waste indicators

Our indicator framework – set out last year in our 2012 progress report to Parliament – includes trajectories for emissions, biodegradable waste sent to landfill, the amount of methane captured at landfill sites and policies to drive progress.

Outcome indicators

Recognising opportunities to go further than the Government's ambition, we present our indicators as a range, reflecting scenarios where biodegradable waste sent to landfill is reduced at least in line with the Government's projections and potentially reduced close to zero by 2020. Our indicators were developed as a set of trajectories from 2007 (the last year before the first carbon budget) through to 2020, requiring the following:

- Landfill methane emissions fall by 30-50% from 2007 to reach 8-11 $MtCO_2e$ in 2020.
- The amount of biodegradable waste sent to landfill falls by 40-94% from 2007 levels of 29 Mt to reach no more than 17 Mt in 2020. Within this, food waste falls at least 35%, paper/card waste falls at least 46%, green waste falls at least 44% and wood waste falls at least 31%.
- At least 75% of methane is captured on average across UK landfill sites.

The reductions in landfill methane emissions set out above (section 1) are in line with our indicator trajectory, reflecting reductions in the overall amount of biodegradable waste generated in the UK. Reductions in biodegradable waste sent to landfill are also consistent with our trajectories. Based on available evidence, the 75% methane capture rate remains unchanged.

Policy milestones

In June 2011 the Government published a review of its waste policy in England, with the aim to put the UK on a path towards a 'zero waste' economy. While the landfill tax remains the key lever for reducing waste sent to landfill, the Waste Review included an Action Plan setting out further waste policy commitments or measures to consider to drive waste further up the 'waste hierarchy'[3]. Our policy milestone indicators cover actions identified in the Government's Waste Review and our recommendations for further actions.

National Waste Prevention Programme (WPP)

The Government is on track to launching its WPP to drive waste further up the waste hierarchy by helping businesses and households realise cost savings through waste prevention and resource efficiency. A call for evidence was launched in March 2013 to understand available data and barriers to reducing waste arisings in England and the programme will be launched by the end of December 2013, which we will evaluate in our 2014 progress report.

Consultation on wood waste landfill restriction and exploring potential for other material-specific landfill restrictions

The Government launched a consultation on wood waste landfill restrictions in 2012 (July to September). It concluded in February 2013 that it would not to pursue a ban at present given the additional costs likely to be incurred by businesses as well as evidence suggesting that wood waste sent to landfill will continue to decline under current policies (e.g. landfill tax and Environment Agency and WRAP efforts to manage wood waste). Moreover a cost-benefit analysis by Defra found negligible or negative benefits from diverting all wood waste from landfill (£0-50 million depending on the type of restriction), although uncertainty is attached to these estimates (e.g. if actual landfill methane capture rates are lower than what was assumed in the analysis, landfill methane emissions would be higher than currently estimated, and therefore the potential benefits of a restriction would be higher).[4]

This evidence was also used to support the Government's decision not to consider landfill restrictions for other materials at present.

However, there may be cost-effective opportunities for banning other types of biodegradable waste such as food or textiles from landfill. These should be considered on a case-by-case basis.

Consideration of such policies is important given that the European Commission has proposed phasing out landfilling progressively by 2020[5] and is currently consulting on adapting EU waste targets to reach this objective (June to September 2013). There has been recent progress in introducing landfill restrictions in other member states (e.g. Germany and Sweden). Scotland has also required the banning of landfilling biodegradable waste by 2021 under its Zero Waste Strategy, supported by Waste (Scotland) Regulations which were passed in Parliament in May 2012. Wales is also aiming to ban biodegradable waste from landfill by 2020.

3 Defined in the European Commission Waste Framework Directive as placing a priority on prevention, followed by re-use, recycling, energy recovery, and last of all disposal.
4 Defra (2013) *Wood Waste Landfill Restrictions in England: Call for Evidence Analysis.*
5 European Commission (2011) *Roadmap to a Resource Efficient Europe.*

We will continue to monitor efforts to move in this direction in the UK, including at the devolved level.

Agreeing responsibility deals with sectors specified in Waste Review

A number of responsibility deals have been launched by the Government since 2011 to encourage best practice, reduce waste and improve recycling rates in businesses. These include a Waste Management Responsibility deal to promote knowledge and recycling in businesses and a Direct Marketing deal, which aims to reduce direct marketing material through improving targeting, consumer awareness of opt-out schemes, and recycling rates.

Two key deals committed to in the Waste Review were further developed and launched in 2012:

- Building on achievements in Phase 1 and 2, Phase 3 of the **Courtauld Commitment** (2012-2015) was launched in May 2013 to reduce household food and drink waste by 5% and food and packaging waste by 3% (relative to a 2012 baseline). All major supermarkets have signed up and signatories currently represent 90% of the market. Meeting these targets would imply an overall 20% reduction in household food waste under the three phases between 2005 and 2015.
- A **Hospitality and Food Service Agreement** was launched in June 2012 with the aim to cut food and packaging waste by 5% from 2012 levels and increase food and packaging waste that is being recycled, sent to AD, or composted to 70% by 2015 (from an average of 45% today). The aim is to cover 25% of the market by food and drink sales (current signatories account for 20% of the market). First year progress against targets will be reported on in 2014.

We will continue to monitor delivery of these deals against objectives.

Improving estimates of methane captured from UK landfill sites

Recent field studies by Defra and the Environment Agency have supported the current assumption used by Government and in our indicators that on average 75% of methane is captured at landfill sites.[6] The studies, however, have found significant variation in methane emissions and surface methane oxidation across and within landfill sites. For example, in a recent Defra/Environment Agency pilot study[7] methane oxidation rates (or the proportion of methane that is not collected by landfill gas collection systems and is oxidised rather than released as methane) varied between 5% and 24% across nine landfill sites (under higher oxidation rates, fewer methane emissions are emitted into the atmosphere).

Regulatory guidance for landfill operators bases permit conditions on a target to collect at least 85% of the methane formed in landfills receiving biodegradable waste. Reducing variation by bringing sites in line with best practice could improve average capture rates and reduce emissions, although it is unclear whether this would be cost-effective across all sites. Improving

6 UK Greenhouse Gas National Inventory, 1990-2011 (2013).
7 NPL study for Defra (2012) *Measurements of Methane Emissions and Surface Methane Oxidation at Landfills: WR1125.*

methane capture rates and confidence in assumed estimates continue to be priorities for the Government and landfill operators.

Strengthening waste incentives through the waste chain

While the landfill tax is the key driver for reducing future waste emissions, we noted in our 2012 progress report that some parts of the waste chain may require direct regulation or additional incentives to encourage waste reduction and increased recycling. For example, in order to make landfill restrictions more cost-effective, further sorting and separate collection of waste streams for recycling, composting, AD and other treatment is required. We recommended that the Government explore scope to strengthen incentives throughout the waste chain using the full range of levers, for example by requiring separate collection of household food waste.

In the past year, recycling targets for English local authorities have been abolished based on the Government position that the landfill tax is a more effective driver for diverting waste from landfill.

However, there have been a number of encouraging developments in the past year by local authorities to support recycling and separate collection of waste streams, including:

- The Government's **Weekly Collection Support Scheme** (February 2012) provided £250 million to 90 councils to provide weekly waste collection services and deliver other environmental benefits. Some councils have used the funding to enhance recycling services, including providing for separate collection of food and other biodegradable wastes (e.g. textiles), and introducing recycling reward schemes. These efforts are estimated to send an additional 0.4 Mt of waste for recycling per year.
- The **Household Reward and Recognition scheme** provides a small amount of funding (£2 million between 2011 and 2013) to local authorities and community organisations to introduce or trial schemes that reward or recognise household recycling. Schemes will support development of the evidence base on environmental and financial costs and benefits of rewarding householders, with a particular focus on self-sustaining schemes (i.e. without central government funding).

We will monitor how these initiatives deliver and influence future waste policies.

In addition the number of local authorities providing for food waste collection continues to increase. In March 2013, 50% of English local authorities provided for collection of food waste (27% provided for separate collection while 23% provided for collection of food mixed in with garden waste). Food waste collection rates are higher in Scotland and Wales (56% of Scottish and 100% of Welsh local authorities provide for collection of food waste either via separate collection or mixed in with garden waste), with an average of 55% across the UK (up from 52% in 2012).[8] There is limited data on actual take up of food waste collection services by households and businesses.

Local authorities should consider further options for increasing separate collection of food waste and other recyclable materials and rewarding participation by households and businesses.

8 WRAP Household Kerbside Residual Waste Collections 2011/12, http://laportal.wrap.org.uk/Statistics.aspx

Strategies for food and paper/card waste

We previously recommended that specific strategies be developed for reducing food and paper/card waste given these waste streams are likely to be the biggest contributor to future landfill methane emissions (projected to comprise around 65% of emissions in 2020 and 2030).

The Government's position is that reductions in food waste and diversion of food waste from landfill towards other treatments are adequately covered by existing policies outlined above, including the landfill tax, the Courtauld Commitment, other responsibility deals, WRAP's Love Food Hate Waste Campaign, the Anaerobic Digestion Strategy and Action Plan, and the forthcoming Waste Prevention Programme. WRAP has also developed a Food Waste Resource Portal identifying up to date and relevant sources of data on different sources of food waste which could be used as feedstock for anaerobic digestion.

These policies have had success in reducing and diverting food waste from landfill. Household food and drink waste decreased by 13% between 2006 and 2010 and commercial/industrial food and drink waste levels were halved between 2002 and 2009.[9] We will continue to monitor the impact of these schemes.

However, it is not clear how these policies interact through the waste chain and across sectors, or whether in some areas players face weak incentives or existing policies are not effective. For example, household food waste, of which 60% is avoidable, continues to be the biggest contributor to UK food waste (7.2 Mt of a total 15 Mt in food waste) and we have previously noted that incentives for households to reduce waste may be limited given that they do not face the full costs of waste disposal.

We will monitor how these gaps are addressed in the Government's forthcoming Waste Prevention Programme and other waste policies. Government should ensure that current and forthcoming policies together provide appropriate incentives at each stage of the food waste chain and identify where new/stronger policies should be introduced as required to address areas where incentives appear weak or where progress is slow.

With regards to reducing paper/card waste, there has been good progress under existing policies:

- Paper collection rates are approximately 70%, in line with average rates across Europe. The Government has suggested that there may be practical limits to the amount of paper that can be collected for recycling[10], however higher collection rates may be possible. Industry data also suggests the UK has one of the highest recovered paper utilisation rates (the proportion of recovered paper used in relation to the amount produced is 87% compared to a Europe average of 51%).[11]
- Producer responsibility regulations require that packaging producers recover 70% of paper/card (covering the period 2012-2017).

9 WRAP Food Waste Resources Portal (2013), http://www.wrap.org.uk/content/food-waste-resources-portal
10 Government Response to the Fourth Annual Progress Report of the Committee on Climate Change: Meeting the Carbon Budgets – 2012 Progress Report to Parliament (October 2012).
11 Confederation of Paper Industries statistics (2013).

- Voluntary newspapers, magazines and direct marketing materials deals have met and exceeded recycling targets and Government is in process of developing successor deals.

We will continue to monitor paper/card waste prevention efforts and recycling rates and will identify any further opportunities for reductions and diversion. We recommend that the Government ensure that policies incentivise players across the waste chain (e.g. householders, businesses, and the public sector) to reduce paper/card waste and increase recycling efforts, introducing new/stronger policies as required.

Other policy developments

Anaerobic Digestion Strategy and Action Plan

Since launching its Anaerobic Digestion Strategy and Action Plan to tackle barriers and increase uptake of AD in England, the Government has: set up a £10 million loan fund to support new AD capacity; created an innovation fund to bring down costs of AD; identified potential sources of waste feedstock (through WRAP's Food Waste Resources Portal); and developed markets for digestate (an AD byproduct). The Green Investment Bank has also recently assessed development of the AD market and operational performance of UK facilities to improve industry and investor understanding of the sector.[12]

There has been good progress in AD in the UK, with the number of plants increasing from 78 to 112 in the past year (as of June 2013) and from 54 plants when the strategy and action plan was launched in June 2011. The number of plants specifically treating household and commercial/industrial waste (as opposed to agricultural waste) has increased from 48 to 66 in the past year, with an estimated capacity to handle 4 million tonnes.[13] The Government will report on annual progress on its AD Strategy and Action Plan in July 2013.

Devolved administrations

Waste management is a devolved issue, with each of the devolved administrations developing waste strategies and legislating waste measures. Stronger policy frameworks are in place in Wales and Scotland to encourage recycling by households and businesses. Both have set recycling targets for 2025 (70%). Scotland has also banned the landfilling of biodegradable material by 2020 and is requiring local authorities to roll-out separate food waste collection services by the end of 2013, to be completed by 2015. Wales aims to divert all municipal biodegradable waste from landfill by 2020 and is the only UK country where food and/or food and green waste is collected separately by every local authority. Northern Ireland has set a household recycling/reuse target of 50% by 2020, with a proposal to increase the rate to 60%.

12 Green Investment Bank (2013) *Anaerobic Digestion Market Report.*
13 Biogas Portal, http://biogas-info.co.uk/

3. Other non-CO_2 emissions: trends and drivers

Emission trends

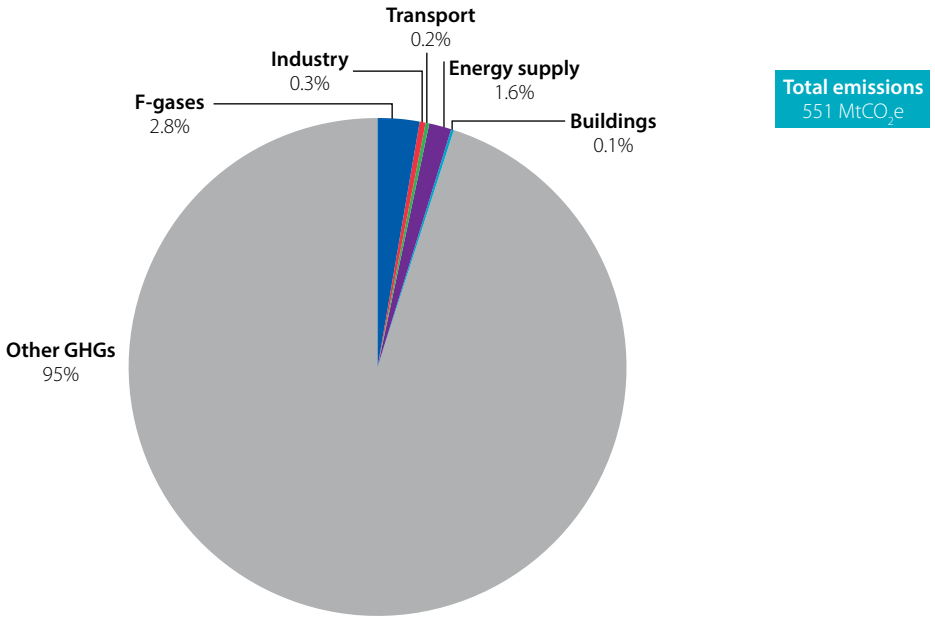
Other non-CO_2 emissions in the UK comprise emissions of methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (F-gases) that are not covered by either the agriculture or waste sectors. They include emissions from industry, energy supply, residential buildings and transport. Other non-CO_2 emissions total 28 $MtCO_2e$ in 2011 (approximately 5% of all UK greenhouse gas (GHG) emissions, Figure 7.5).

The biggest contributors to these emissions are F-gases, which account for approximately 60% of all other non-CO_2 emissions. They relate primarily to emissions from the use of F-gases as coolants in refrigeration and air conditioning. The remaining emissions come from fugitive methane and nitrous oxide emissions in the energy supply sector (32%) and nitrous oxide emissions from industry (6%) and transport (4%). Given that transport emissions are such a small proportion of total other non-CO_2 emissions, and are expected to remain fairly constant to 2030, our focus in monitoring trends is on F-gas, energy supply, and industry emissions.

Overall other non-CO_2 emissions fell 2% in 2011. They have fallen 64% between 1990 and 2011 (Figure 7.6). Within this:

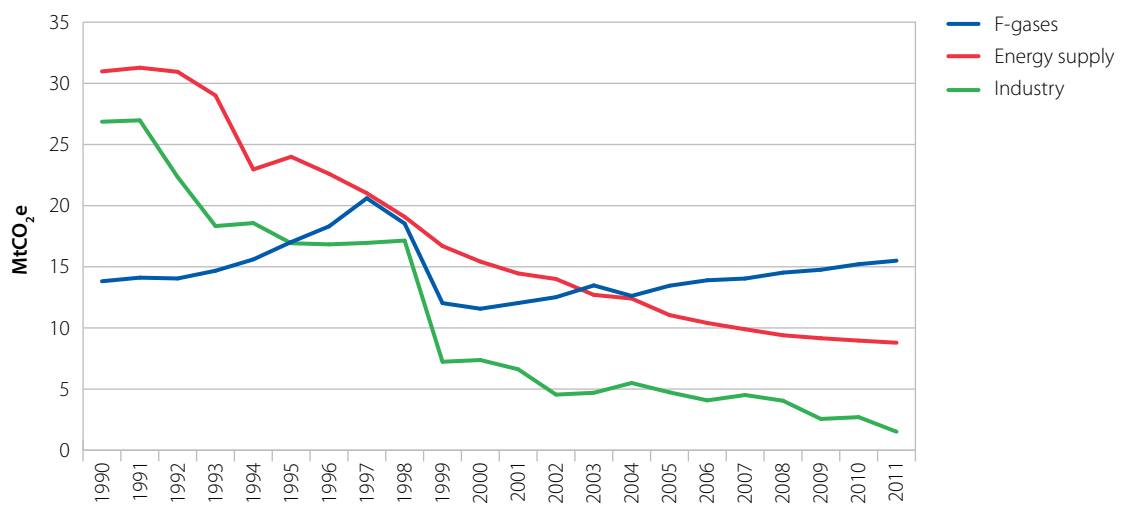
- F-gas emissions rose 2% in 2011 to 15.5 $MtCO_2e$ and have risen 12% overall since 1990.
- Emissions of methane and nitrous oxide from the energy supply sector fell 2% in 2011 to 8.8 $MtCO_2e$ and have fallen 72% since 1990.
- Nitrous oxide emissions from industry fell 44% in 2011 to 1.5 $MtCO_2e$ and have in total fallen by 94% since 1990.

Figure 7.5: Other non-CO_2 emissions as a share of all UK GHG emissions (2011)



Source: DECC (2013) *Final emissions estimates 2011.*

Figure 7.6: Other non-CO_2 emissions by source (1990-2011)



Source: DECC (2013) *Final emissions estimates 2011.*

We now consider the drivers of these changes in more detail.

Emissions sources and drivers – F-gases

F-gas emissions arise from three types of fluorinated gases; hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6). These gases are emitted in industrial processes and buildings in very small amounts but have high global warming potentials (between 140 and 23,900 times that of CO_2) and long atmospheric lifetimes.

- HFC emissions make up the largest proportion of F-gas emissions. Since the Montreal Protocol was ratified in 1989 HFCs have been used as substitutes for ozone-depleting substances (ODS) such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). HFCs are therefore now used in applications which previously used CFCs and HCFCs, such as refrigeration and air conditioning equipment, foams, aerosols and fire extinguishers. HFCs are emitted during the manufacture, lifetime and disposal of these applications.
- PFC emissions arise mostly from use in industrial processes such as aluminium production and manufacture of semiconductors. PFCs are also used as solvents, fire fighting agents and refrigerants.
- SF_6 emissions arise from use in industrial applications such as magnesium casting and photovoltaic manufacture. They are also used in sound-proof windows and switchgear equipment.

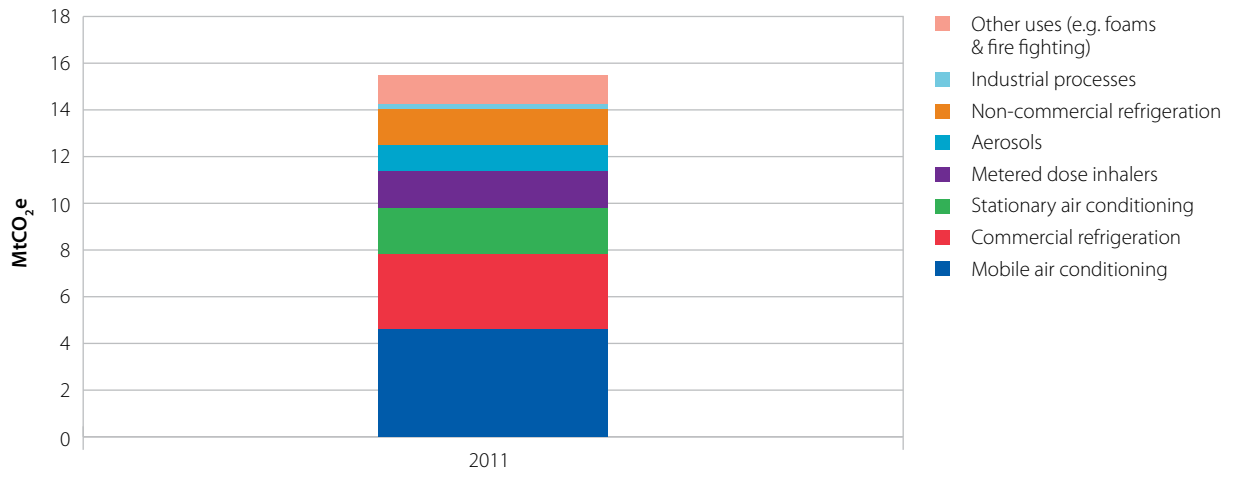
Overall F-gas emissions have been rising since 1990 mainly due to their use as a replacement for ozone-depleting substances (ODS). The increase has also been driven by growth in demand for products such as air conditioning units.

In response, the EU has introduced policies to reduce F-gas emissions (Box 7.2). These are having some effect in controlling the biggest contributors to UK emissions of F-gases (Figure 7.7):

- **Mobile air conditioning**[14] **(MAC) emissions** fell by 1.3% in 2011 to 4.6 $MtCO_2e$. This reduction is being driven by the MAC directive which came into effect in 2011 and which restricts the use of F-gases in new cars. This has reversed the historical trend of increased emissions arising from the phase out of ozone-depleting CFCs and increased demand for air conditioning in vehicles.
- **Commercial refrigeration emissions** increased 2% in 2011 to 3.2 $MtCO_2e$. This is a much lower rate of growth than the average 12% per year over the last decade. The higher rates historically were due to F-gases being used to replace ODS under the Montreal Protocol. As ODS have now been completely replaced by F-gases, the current increase in emissions is being driven by increased demand for refrigeration. The F-gas regulation (which attempts to reduce leakage and use of F-gases) may also be limiting the increase in F-gases from this sector.
- **Stationary air conditioning emissions** increased 10% in 2011 to 2 $MtCO_2e$. As ODS have been completely replaced by F-gases, this increase is also being driven by increased demand. These emissions are also covered under the F-gas regulation.
- **Inhaler emissions** increased by 1% in 2011 to 1.6 $MtCO_2e$, driven by population growth.

We consider options for stronger policy measures to reduce F-gases in section 4 below.

Figure 7.7: F-gas emissions by source (2011)



Source: DECC (2013) *Final emissions estimates 2011.*

14 Mobile air conditioning (MAC) refers to air conditioning units in vehicles.

Box 7.2: EU policy framework to reduce F-gas emissions

There are currently two EU policies in place to reduce F-gas emissions:

- The Mobile Air Conditioning (MAC) Directive was introduced in 2008 and came into effect in 2011. It prohibits the use of F-gases with a global warming potential more than 150 times greater than carbon dioxide (CO_2) in air conditioning units in new types of cars and vans introduced from 2011 and in all new cars and vans produced from 2017.
- The F-gas Regulation introduced in 2006 covers all other key applications in which F-gases are used with the aim to:
  - Improve the prevention of leaks from equipment containing F-gases. Measures comprise: containment of gases and proper recovery of equipment; training and certification of personnel and of companies handling these gases; labelling of equipment containing F-gases; and reporting on imports, exports and production of F-gases.
  - Avoid F-gases in some applications where alternatives with lower global warming potentials (such as CO_2 and ammonia) are cost-effective. Measures include restrictions on the marketing and use of certain products and equipment containing F-gases.

Source: The European Commission

Emissions drivers – methane and nitrous oxide emissions arising from energy supply and industry

The remaining other non-CO_2 emissions include fugitive methane emissions arising in energy supply processes and methane and nitrous oxide emissions arising mainly from production of nitric and adipic acid.

- **Energy supply:** Non-CO_2 greenhouse gases emitted in this sector include methane and nitrous oxide . They are caused by fugitive emissions during the production, storage, distribution and combustion of fossil fuels. The largest sources of fugitive emissions in 2011 included:
  - Coal mine methane emissions, which fell 5% in 2011 to 2 $MtCO_2e$. This was driven by the continued decrease in UK coal production (since 1990 emissions have fallen 89%, in line with a fall in total UK coal output of 80%).
  - Natural gas supply methane emissions also fell 5% in 2011 to 4 $MtCO_2e$. This was driven by a fall in leakage rates from the natural gas supply network due to continued replacement of gas pipes and improved detection of leaks (which have led to emissions falling 51% since 1990).
  - N_2O emissions from power stations increased 0.3% in 2011 to 0.9 $MtCO_2e$. This may have been driven by a slight increase in coal power generation in 2011.
- **Industry:** Methane and nitrous oxide emissions also arise from certain industrial processes. The biggest contributor historically has been N_2O emissions arising from production of nitric and adipic acid. However the installation of abatement equipment at plants has greatly reduced emissions such that emissions of N_2O from adipic acid production are now zero and emissions from nitric acid were only 0.2 $MtCO_2e$ in 2011 having fallen from 1.3 $MtCO_2e$ in 2010. The remaining 1.3 $MtCO_2e$ of industrial non-CO_2 emissions came from other industrial processes, industrial combustion and off-road machinery.

Overall non-CO_2 emissions from energy supply and industry have fallen significantly since 1990 and continued to fall in 2011.

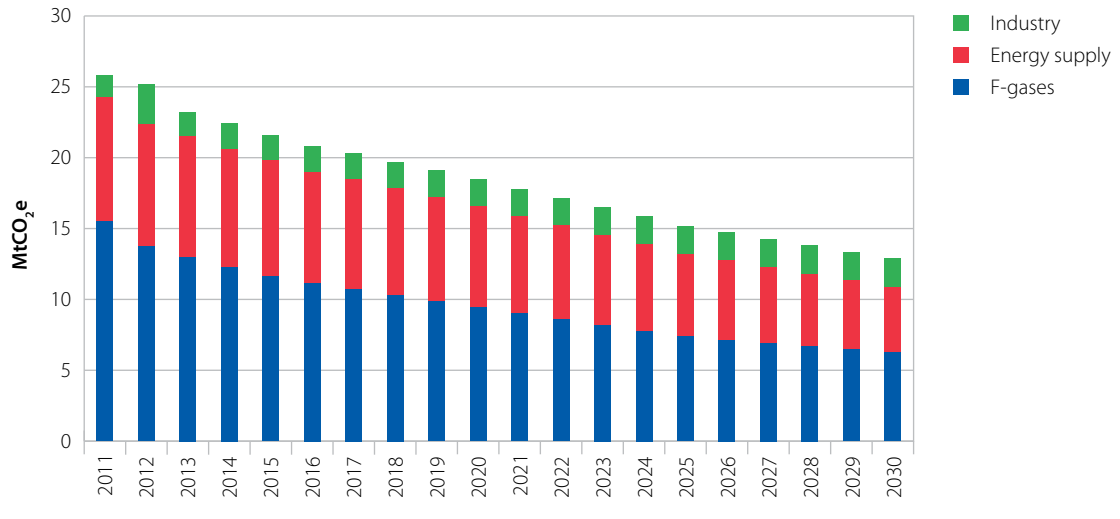
4. Other non-CO_2 emissions: projections and abatement potential

Emission projections

In DECC's central projections, emissions of non-CO_2 gases excluding agriculture and waste are expected to fall 50% by 2030 relative to 2011 levels (Figure 7.8). This primarily reflects reductions in energy supply and F-gas emissions, with emissions from industry expected to remain fairly flat:

- Emissions from F-gases are expected to fall by 61% by 2030 to 6 $MtCO_2e$:
  - Mobile air conditioning emissions are projected to reach zero by 2030. This is being driven by the EU MAC directive which has already seen a decline in emissions in 2011.
  - Refrigeration emissions and stationary air conditioning emissions are expected to fall by 70% by 2030. This is being driven by the F-gas regulation which will lead to a continued reduction in leakage rates of F-gases and replacement of F-gases with much lower GWP alternatives.
  - F-gas emissions from industrial processes, such as aluminium production, are projected to fall by 50% by 2015 and then remain flat to 2030. The fall to 2015 is mainly due to the closure of the Lynemouth aluminium plant in 2012 which accounts for 80% of UK aluminium production.
  - Emissions of F-gases from medical inhalers are projected to increase slightly due to population growth.

Figure 7.8: Projected emissions of other non-CO_2 (2011-2030)



Source: DECC (2012) *Updated emissions projections.*

- Emissions from energy supply are projected to fall by 45% to 5 $MtCO_2e$ in 2030. The two main drivers of this decrease are:
  - Methane emissions from coal mining falling 78% to 0.4 $MtCO_2e$ in 2030, reflecting further anticipated reductions in UK coal mine production.
  - Methane emissions from natural gas leakage falling 36% to 2.5 $MtCO_2e$ in 2030. These emissions are projected to decline due to a 30 year programme (started in 2002) to reduce leakage from the gas distribution network.
- Industry emissions are expected to remain fairly constant out to 2030 at approximately 1.5 $MtCO_2e$.

These reductions would result in 2030 emissions of approximately 13 $MtCO_2e$ and are expected to occur without further efforts to reduce emissions. We now consider whether more can be achieved.

Further abatement potential – F-gases

There is potential for further reductions in F-gas emissions by replacing remaining F-gases with alternative compounds. A 2010 AEA study for Defra[15] showed that there are currently much lower GWP alternatives to HFCs, some of which are commercially available and some of which are in development:

- In refrigeration and air conditioning there are several options including hydrocarbons which are already in the market, as well as CO_2 and Hydrofluoroolefins (HFOs) which are in development.
- Metered dose inhalers, which are currently used in the UK, can be replaced with dry powder inhalers which have been a known technology for over 20 years and are more widely used in some countries than in the UK.
- Currently replacements for HFCs in aerosols are not widely used in the UK. However HFOs are already being used as a replacement, with only small modifications to equipment required, in the EU.

The main barriers to further uptake of these alternatives are higher costs, whether directly or through costs of replacing existing systems. If these replacements are used they could lead to HFC emissions being reduced by a further 1 $MtCO_2e$ in 2030.

In 2012 the European Commission proposed that the current F-gas Regulation be strengthened and updated through introduction of a phase-down mechanism, and bans on certain uses:

15 AEA (2010) *HFC consumption and emissions forecasting.*

- A phase-down mechanism would involve a gradually declining cap on the placement of F-gases (in tonnes of CO_2 equivalent) on the market in the EU, with a freeze in 2015, followed by a reduction from 2016 leading to sales in 2030 at only 21% the level of those from 2008 to 2011. This will lead to producers of products and equipment which previously used F-gases switching to alternative technologies where feasible.
- Bans would prevent the placing of F-gases on the market in several subsectors between 2015 and 2020 where technologies currently exist for a full replacement.

These policies appear to be deliverable given Defra and EC[16] evidence. Together they are expected to reduce F-gas emissions in the EU by around 70% in 2030 compared to current emissions (this compares to reductions of 60% expected in the UK under current policies). Furthermore companies such as Coca-Cola and Unilever have committed to the replacement of F-gases on a more ambitious timescale than the EC proposal (for example Coca-Cola are committed to buying only HFC-free equipment by 2015). The US and China have also recently agreed a phase down in the use of HFCs.

We therefore recommend that the Government should support the EC proposal as a minimum and should consider going further given the existence of cost-effective alternatives, with more rapid phase out of some uses of these gases.

5. Other non-CO_2 emissions: indicators of progress

Our indicator framework generally comprises emissions trajectories, trajectories for key drivers of emissions, and policy milestones to strengthen incentives for implementation of measures to reduce emissions.

Extension of this framework to include other non-CO_2 emissions requires trajectories for F-gas emissions, energy supply emissions and industry emissions. We will monitor progress against the following trajectories:

- F-gas emissions fall 33-45% from 2007 levels to reach 9.3-7.5 $MtCO_2e$ in 2020. Given the potential to reduce F-gas emissions beyond current government projections, this range encompasses scenarios where emissions are only reduced in line with current projections and where they are reduced to 4 $MtCO_2e$ in 2030 in line with abatement potential identified in the Defra analysis, and potentially deliverable under the EC proposals.
- Energy supply emissions fall 25% on 2007 levels to reach 7 $MtCO_2e$ in 2020, in line with Government projections.
- Industry emissions fall 47% on 2007 levels to reach 1.4 $MtCO_2e$ in 2020, in line with current projections.

The main policy milestone for other non-CO_2 will be the update of the current F-gas regulation which should be finalised by the end of 2013. We will monitor development of this at both the UK and EU levels to ensure that it is rigorous enough to deliver the required cuts in emissions.

16 European Commission (2011) *Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases.*

Key findings

- Waste emissions fell by **3% in 2011**, and are now 64% below 1990 levels. This is largely due to reduced methane emissions from landfill, driven by reductions in the amount of biodegradable waste sent to landfill and an improved rate of methane capture at landfill sites.
- There has been **good progress** to reduce waste generated by households and businesses and to reduce waste from landfill through **voluntary responsibility deals, information awareness campaigns**, and **strategies to support anaerobic digestion**.
- Further reductions in waste emissions could be supported through **stronger levers**, particularly **targeting household food waste**.
- The Government should **consider bans on major sources of biodegradable waste** from landfill on a **case-by-case basis**.
- **Non-CO_2 emissions** arising from industry, transport, buildings and energy supply fell **4% in 2011**, continuing a longer-term trend where emissions fell 64% since 1990.
- Other non-CO_2 emissions are likely to decrease **50% by 2030** on current levels under **current policies**.
- **Further reductions in F-gas emissions** could be achieved under stronger policies.

Table 7.1: The Committee's waste and other non-CO_2 indicators

WASTE AND OTHER NON-CO_2 SOURCES		Budget 1	Budget 2	Budget 3	2011 trajectory	2011 Outturn
Waste						
Headline indicators						
Emissions (indicative % change from 2007)*						
CO_2e emissions		-9%	-22% to -33%	-32% to -50%	-7%	-12%
GHG and source emissions (% change in $MtCO_2e$ against 2007)	Landfill – CH_4*	-10% to -15%	-25% to -37%	-36% to -56%	-7%	-13%
	Wastewater treatment – N_2O*	-5%	-2%	+2%	-6%	+3%
	Incineration – total CO_2*	No more than 25%			-20%	-18%
Drivers (indicative % change from 2007 levels)**						
Biodegradable waste sent to landfill	2007 = 29 Million tonnes (Mt)	-30% (20 Mt)	-38% to -84% (18 Mt to 4.5 Mt)	-39% to -97% (17 Mt to 1 Mt)	-25% (21 Mt)	-30% (19 Mt)
Percentage of methane captured at landfill sites	2007 = 75%**	75%	75%	75%	75%	75%
Policy Milestones						
Develop National Waste Prevention Programme			End 2013			December 2013 (call for evidence launched March 2013)
Agree responsibility deals with sectors specified in Waste Review (waste management, paper, packaging, hospitality, textiles, Courtauld 2 successor)		Different timetables for various sectors; ongoing work to 2015				Ongoing; Courtauld (3 May 2013), Hospitality/Food Service deal (June 2012)
Explore scope to strengthen incentives through the waste chain			Publish findings during Budget 2			Ongoing research, including trialling of reward/recognition trial schemes by local authorities
Launch consultation on wood landfill restriction		Autumn 2012				Completed, with decision (February 2013) not to pursue wood waste landfill ban

Table 7.1: The Committee's waste and other non-CO_2 indicators

WASTE AND OTHER NON-CO_2 SOURCES	Budget 1	Budget 2	Budget 3	2011 trajectory	2011 Outturn
Policy Milestones (continued)					
Review case for material-specific landfill restrictions	2012/2013 Parliament session				Decision not to pursue other bans at present based on wood waste evidence
Improve estimates of methane captured and explore opportunities for capturing more methane from landfill	Ongoing				EA and Defra preliminary and pilot studies (December 2012) support 75% assumption; ongoing research to narrow variation within/ across sites
Develop specific food and paper/card waste strategy		End 2013			Current/forthcoming policies sufficiently address food and paper/card to be set out in greater detail
Other drivers					
Total waste arisings: total waste generated (Mt) broken down by source (municipal and commercial/industrial sectors) and type.					
Waste management: amount, proportion and type of waste (Mt) sent to landfill and to alternative treatments (e.g. recycling/composting, energy from waste, MBT); municipal recycling rates.					
Separate collection: number/percentage of local authorities providing for separate collection of food waste; percentage of food waste sent to treatment via AD.					
General: We will monitor work to improve emissions data (e.g. estimates of activity data, methane yields and decay rates) as well as costs/environmental benefits of landfill diversion options.					

Table 7.1: The Committee's waste and other non-CO_2 indicators					
WASTE AND OTHER NON-CO_2 SOURCES	**Budget 1**	**Budget 2**	**Budget 3**	**2011 trajectory**	**2011 Outturn**
Other non-CO_2 emissions					
Headline indicators					
Emissions (indicative % change from 2007)					
F gas emissions (HFCs, PFCs, SF_6)	-2%	-23%	-39% to -50%	n/a	-1.9%
Energy supply emissions (CH_4, N_2O)	-9%	-19%	-31%	n/a	-44%
Industry emissions (CH_4, N_2O)	-11%	-49%	-49%	n/a	-1.9%
Policy Milestones					
Update to the EC's F-gas regulation to make it fit for purpose		End 2013			

* Methane emissions trajectories reflect a range of emissions reductions from the Government's projections to close to full diversion of biodegradable waste from landfill. Other greenhouse gas trajectories are based on Government projections.

** An average methane capture rate of 75% is assumed across UK landfill sites.

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

Key: Headline indicators Implementation indicators Milestones Other drivers

Future work of the Committee

The Committee has a number of deliverables over the next two years, either required under the Climate Change Act or requested by Government:

Mitigation

Progress reports to Parliament to be published in June 2014 and June 2015 respectively:

These reports will incorporate latest data to consider progress against indicators. The 2014 report will assess whether the budget for the first period was achieved, and the actions taken during the period to reduce UK net emissions.

Review of the fourth carbon budget to be published in December 2013: The fourth carbon budget was recommended by the Committee in December 2010. The advice was accepted and the budget legislated in June 2011. The Government has indicated that it will undertake a review in 2014. We will provide advice for this review by December 2013. This will consider implications of progress in international negotiations and at EU level (including progress towards tightening the 2020 emission reduction target, e.g. to 30%; towards a 2030 emissions target; and latest expectations of future caps under the EU ETS). It will consider issues including competitiveness impacts for energy-intensive industry, implications of possible low gas prices for decarbonisation and latest technology cost estimates and emissions projections.

Advice on the fifth carbon budget (2028-32): The Committee is required under the Climate Change Act to advise on the appropriate level of the fifth carbon budget by the end of 2015. In undertaking this work, the Committee will consider any new scientific evidence, appropriate global trajectories, UK contributions to those trajectories, and emissions reduction opportunities.

We will also advise Northern Ireland, Scotland and Wales:

We will deliver the following pieces of advice to the devolved administrations:

- Advice to the Welsh Government on progress in reducing emissions and preparing for climate change, by March 2014.
- Advice to the Scottish Government on progress in reducing emissions in line with legislated targets, by March 2014.
- Advice to Northern Ireland's Environment Minister on the review of the methodology to measure GHG emissions per unit of commodity output at the farm-gate, by March 2014.

Adaptation

Annual assessment of UK preparedness: The 2013 assessment will extend the work of the Committee on preparedness to some of the key ecosystem services provided by the land. It will explore the way land is used and the extent to which decisions about the land are helping the country to prepare for climate change.

Assessing preparedness for the key risks identified by the first Climate Change Risk Assessment: In July 2014, the ASC plans to publish its final report assessing preparedness for the key risks identified by the first Climate Change Risk Assessment. The report will look at actions to prepare for climate risks to human health, infrastructure and business supply chains.

First statutory report to Parliament: In July 2015, the ASC will publish its first statutory report to Parliament on implementation of the UK Government's National Adaptation Programme. This report will bring together and update previous reports to provide an overall assessment of the effectiveness of the Government's programme in helping the country prepare for climate change.

Glossary

Achievable Emissions Intensity
The minimum average annual emissions intensity of electricity generation that could be achieved in a given year, given the installed capacity, projected demand and the projected profile of that demand.

Anaerobic Digestion (AD)
A treatment process breaking down biodegradable material, particularly wastes, in the absence of oxygen. Produces a methane-rich biogas that can substitute for fossil fuels.

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 biomass and used to power vehicles (can be liquid or gas). Biofuels are commonly derived from cereal crops but can also be derived from other plant material, trees and even algae.

Biomass
Biological material that can be used as fuel or for industrial production. Includes solid biomass such as wood and plant and animal products, gases and liquids derived from biomass, industrial waste and municipal waste.

Bunker fuels
Fuels consumed for air and maritime transportation.

Carbon Capture and Storage (CCS)
Set of technologies to capture the carbon dioxide emitted from industrial processes or from burning fossil fuels or biomass, transport it, and store it in secure spaces such as geological formations, including 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 mass of carbon dioxide emission that would give rise to the same level of radiative forcing, integrated over a 100-year time period, as a given mixture of greenhouse gas emissions.

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 emissions can be purchased. We use projections for the carbon price as a comparator for judging cost-effectiveness of potential emissions reduction measures.

Carbon price floor
Policy to ensure a set minimum amount is paid for every unit of carbon dioxide emitted.

Carbon Reduction Commitment (CRC)
A mandatory carbon reduction and energy efficiency scheme for large non-energy intensive public and private sector organisations. The CRC captures CO_2 emissions not already covered by Climate Change Agreements and the EU Emissions Trading System.

Carbon sink
An absorber of carbon (usually in the form of carbon dioxide). Natural carbon sinks include forests and oceans.

Carbon Emissions Reduction Target (CERT)
CERT is an obligation placed by Government on gas and electricity suppliers to deliver 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.

Contract for Difference (CfD)
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.

Credits
Emissions 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 Protocol's project-based flexibility mechanisms, Joint Implementation and Clean Development Mechanism).

Devolved administrations
The national authorities of Scotland, Wales and Northern Ireland.

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.

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
Vehicle capable of full electric operation driven by an electric motor fuelled by battery power. These include battery electric (BEV), plug-in hybrid electric (PHEV) and hydrogen fuel-cell vehicles.

Electricity Market Reform
Current reform of the electricity market, including provision of support for low-carbon generation through Feed-in Tariffs with Contracts for Difference (FiT CfDs).

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.

Energy Company Obligation (ECO)
A new Energy Company Obligation will replace CERT, CESP and Warmfront from autumn 2012 to deliver carbon savings and help alleviate fuel poverty. The cost of the measures will be passed through to consumer energy bills.

Engine downsizing
Use in a vehicle of a smaller engine that provides the power of a larger engine.

European Commission (EC)
Executive arm of the European Union.

European Union Allowances (EUAs)
Emissions credits traded within the EU ETS.

European Union Emissions Trading Scheme (EU ETS)
Cap and trade system within the EU covering the power sector, energy-intensive industry and, from the start of 2012, all domestic and international aviation.

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 generally have high Global Warming Potentials.

Fuel Cell Electric Vehicle
Vehicle that receives motive power from a fuel cell which converts hydrogen (stored in a fuel tank) into electricity, which is used to drive an electric motor.

Fuel poverty
A household is said to be in fuel poverty if it needs to spend more than 10% of its income on fuel to maintain an adequate level of warmth.

Global Warming Potential (GWP)
The standard metric used to calculate CO_2-equivalent emissions of different greenhouse gases in carbon budgets and the Kyoto Protocol. GWP measures the total radiative forcing over a given period (usually 100 years) after a pulse emission, relative to that from the same mass of CO_2.

Grazing returns
Excreta (dung and urine) from livestock kept outdoors (mainly cattle and sheep) deposited directly on land as the animal grazes and not subject to management.

Green Deal
The Green Deal is a new financial mechanism enabled through the Energy Act 2011. It eliminates the need to pay upfront for energy efficiency measures in buildings and instead allows the costs to be paid back through savings on the electricity bill. The Green Deal charge is attached to the property, not the owner.

Green Investment Bank (GIB)
The Green Investment Bank has been set up by the UK Government under the Companies Act to provide financial solutions to accelerate private sector investment in the green economy. It is capitalised with £3 billion.

Greenhouse Gas (GHG)
Any atmospheric gas 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 Domestic Product (GDP)
A measure of the total economic activity occurring in the UK.

Gt
A gigatonne (1,000 million tonnes).

Heat pumps
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. Both air source and ground source heat pumps can provide heating for buildings.

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°C) , below which buildings need to be heated.

Heavy Goods Vehicle (HGV)
A truck over 3.5 tonnes (articulated or rigid).

Hybrid vehicle
A vehicle powered by an internal combustion engine and electric motor that can provide power to the drive train individually or together.

Indirect Land Use Change
Occurs when land for an existing activity (e.g. food or timber production) is converted to grow bioenergy feedstock, which results in the relocation of that displaced activity to another land area which is converted from a different use.

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.

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 to 2022.

Kilowatt-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 Terawatt-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; specifically carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

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.

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)
Advisory body to the Secretary of State on the determination of planning applications of large infrastructure projects (e.g. over 50 MW).

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 21 (1 tonne of methane emission corresponds to 21 tonnes CO_2e).

Mitigation
Action to limit the causes of climate change, principally by reducing sources (or enhancing sinks) of greenhouse gases.

Mt
Million tonnes.

National Atmospheric Emissions Inventory (NAEI)
Data source compiling estimates of the UK's emissions to the atmosphere of various gases.

New European Drive Cycle
Stylised driving cycle used to test fuel efficiency and emisisons of new light-duty in the European Union.

Nitrous oxide (N_2O)
Greenhouse gas with a global warming potential of 310 (1 tonne of nitrous oxide emission corresponds to 310 tonnes CO_2e).

NO_x
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.

Ozone-depleting substances (ODS)
Gases which damage the ozone layer in the upper atmosphere.

Plug-in hybrid Electric Vehicle (PHEV)
A vehicle that receives 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).

Renewable Heat Incentive (RHI)
A feed-in-tariff type mechanism to provide long-term financial support to producers of renewable heat.

Renewables
Energy resources 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.

Renewable Transport Fuel Obligation (RTFO)
UK legislation requiring fossil fuel suppliers to supply a specified percentage of sustainable biofuels for each litre of fuel used by road transport in the UK.

Smarter Choices
Measures that influence travel behaviour away from cars and towards less carbon-intensive alternatives such as public transport, cycling and walking, by providing targeted information and opportunities to consider alternative modes.

Solar photovoltaics (PV)
Panels that generate electricity from sunlight.

Ultra-low emissions vehicle
Vehicle with very low tailpipe emissions (e.g. less than 50 gCO_2/km).

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).

Warmfront
Treasury-funded fuel poverty programme in England to deliver energy efficiency and heating measures. Funding expired at the end of financial year 2012-13.

World Light Duty Test Procedure
Global harmonized standard for determining emissions and energy consumption of light-duty vehicles, designed to better reflect real-world driving conditions.

Abbreviations

AD	Anaerobic Digestion
BEV	Battery Electric Vehicle
CAP	Common Agricultural Policy
CCA	Climate Change Agreement
CCL	Climate Change Levy
CCC	Committee on Climate Change
CCGT	Combined-Cycle Gas Turbine
CCS	Carbon Capture and Storage
CCT	Company Car Tax
CERT	Carbon Emissions Reduction Target
CESP	Community Energy Saving Programme
CFCs	Chloroflourocarbons
CfD	Contract for Difference
CH_4	Methane
CHP	Combined Heat and Power
CLG	Department for Communities and Local Government
CRC	Carbon Reduction Commitment
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DEC	Display Energy Certificate
DECC	Department for Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DSA	Driving Standards Agency
DUKES	Digest of UK Energy Statistics
DVLA	Driver and Vehicle Licensing Agency
EC	European Commission
ECO	Energy Company Obligation
EMR	Electricity Market Reform
ENSG	Electricity Network Strategy Group
EPC	Energy Performance Certificate

EU	European Union
EU ETS	European Union Emissions Trading Scheme
EUA	European Union Allowance
EV	Electric vehicle (BEV or PHEV)
F-gases	Flourinated gases
FCEV	Fuel Cell Electric Vehicle
FCM	Fuel Consumption Meter
FEED	Front-End Engineering Design
FYA	First Year Capital Allowance
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIB	Green Investment Bank
GSI	Gear Shift Indicator
GW	Gigawatts
GWh	Gigawatt hours
GWP	Global Warming Potential
HCFCs	Hydrochloroflourocarbons
HDD	Heating Degree Days
HFCs	Hydroflourocarbons
HFOs	HydrofloUroolefins
HGV	Heavy goods vehicle
HMG	HM Government
HMT	HM Treasury
IAS	International Aviation and Shipping
ILUC	Indirect Land Use Change
ICAO	International Civil Aviation Organisation
IMO	International Maritime Organisation
kW	Kilowatts
kWh	Kilowatt hours
LCRS	Logistics Carbon Reduction Scheme
LSTF	Local Sustainable Transport Fund
LULUCF	Land use, land use change and forestry
MAC	Mobile air conditioning

MIPU	Major Infrastructure Planning Unit
MW	Megawatts
MWh	Megawat hours
N_2O	Nitrous oxide
NAEI	National Atmospheric Emissions Inventory
NEDC	New European Drive Cycle
NO_x	Oxides of nitrogen
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NVZ	Nitrate Vulnerable Zone
Ofgem	Office of the Gas and Electricity Markets
ONS	Office for National Statistics
ODS	Ozone-depleting substances
PFCs	Perflourocarbons
PHEV	Plug-In Hybrid Electric Vehicle
PiCG	Plug-In Car Grant
PIFI	Plugged-In Fleets Initiative
PiP	Plugged-In Places
RHI	Renewable Heat Incentive
RHPP	Renewable Heat Premium Payment
RO	Renewable Obligation
ROC	Renewable Obligations Certificate
RPI	Retail Prices Index
RTFO	Renewable Transport Fuel Obligation
SF_6	Sulphur Hexaflouride
SHETL	Scottish Hydro Electric Transmission Limited
SMMT	Society of Motor Manufacturers and Traders
TW	Terawatts
TWh	Terawatt hours
ULEV	Ultra-low emission vehicle
VED	Vehicle Excise Duty
v-km	Vehicle kilometre
WLTP	World Light Duty Test Procedure

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