

Meeting Carbon Budgets – the need for a step change

Progress report to Parliament
Committee on Climate Change
Executive Summary
October 2009



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Foreword

Last December the Committee on Climate Change (CCC), in its first report recommended that the UK set a long-term target to reduce greenhouse gas emissions to 80% below 1990 levels by 2050 and we recommended the levels of the first three carbon budgets, defining an emissions reduction path from 2008 to 2022. The Government subsequently accepted our recommendations and the first three budgets became legally binding following Parliamentary approval in May 2009. In July 2009 the Government published a very comprehensive account of opportunities for reducing emissions in its Low Carbon Transition Plan.

The Climate Change Act 2008 requires that the Committee delivers annual reports to monitor progress against budgets; this is the first such annual report. Two specific factors, however mean that this years report is somewhat different in content and structure from that which we envisage in future. The first is that we are only in the second year of the first budget period, and do not yet have even first year (i.e. 2008) verified emission figures. The second is that it is now clear that the economic recession, in the UK and across Europe, will have major implications for the path of emissions in the early years of the first budget.

In these specific circumstances, we have focussed work for this report on:

- Putting in place a monitoring approach with which we will assess progress in future years, focussing not just on emissions results but on forward indicators of likely future emissions.
- Quantifying the likely impact of the recession on emissions to enable us to distinguish cyclical from underlying trends.
- Fine tuning our estimates of feasible emissions reductions in three specific areas: power generation, home energy efficiency improvement, and the potential pace of deployment of electric cars.
- Comparing the pace of emissions reduction required in the first three budgets with that achieved in 2003-07.

In some respects therefore this is a rather technical report, equipping the Committee with the tools to monitor progress in future years. But our analysis has led us to two important conclusions:

- The significant emissions reductions produced by the recession could both produce an over rosy impression of progress against budgets and undermine steps to drive long-term reductions, in particular by reducing the carbon price within the EU ETS.
- Progress in reducing emissions in the five years before the first budget period, both overall and in most sectors, was far slower than now required to meet budget commitments. A step change in pace of reduction is essential.

The report therefore considers the measures required to achieve this step change and to offset the danger that the recession slows underlying progress. It concludes that achieving the step change is likely to require new approaches in two areas in particular:

- In power generation where the current combination of markets and market instruments (the electricity markets and the EU ETS) is not best designed to deliver required long-term decarbonisation and where a combination of additional policies and more fundamental review of approaches is likely to be required.
- In home energy efficiency improvements, where a more forceful role for Government and a more integrated whole house approach is appropriate.

The report is the first of two this year. In December our report on aviation emissions will cover the steps required to meet the Government's target that UK domestic and international aviation emissions should be no higher in 2050 than in 2005. 2010 will see a review of appropriate carbon budgets in the light of the Copenhagen agreement, the second annual monitoring report, a report on low carbon research and development, recommendations on targets for the Carbon Reduction Commitment, advice to the Scottish Government on their emissions reduction targets, and recommendations for emissions reduction in the fourth budget period (2023-27).

This represents a demanding programme of work for both the Committee and the Secretariat. On behalf of the Committee I would like to thank the Secretariat for their excellent support and hard work over the last year.

The Committee on Climate Change



Lord Adair Turner, Chair

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



David Kennedy, Chief Executive

David Kennedy is the Chief Executive of the Committee on Climate Change. Previously he worked on energy strategy at the World Bank, and 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.



Dr Samuel Fankhauser

Dr Samuel Fankhauser is a Principal Research Fellow at the Grantham Research Institute on Climate Change at the London School of Economics. He is a former Deputy Chief Economist of the European Bank for Reconstruction and Development and former Managing Director (Strategic Advice) at IDEAcarbon.



Professor Michael Grubb

Professor Michael Grubb is Chief Economist at the UK Carbon Trust and Chairman of the international research network Climate Strategies. He is also senior research associate at Cambridge University and holds a visiting professorship at Imperial College.



Sir Brian Hoskins

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



Professor Julia King

Professor Julia King became Vice-Chancellor of Aston University in 2006, having previously been Principal of the Engineering Faculty at Imperial College, London, before that she held various senior positions at Rolls-Royce plc in the aerospace, marine and power business groups. In March this year, she delivered the 'King Review' that examined vehicle and fuel technologies that, over the next 25 years, could help to reduce carbon emissions from road transport.



Lord John Krebs

Lord Krebs is an internationally renowned scientist and Principal of Jesus College, Oxford University and also chair of the Adaptation Sub-Committee. He sits in the House of Lords as an independent cross-bencher and is currently chairing an enquiry by the Science and Technology Select Committee into Nanotechnology and Food.



Lord Robert May

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



Professor Jim Skea

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



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

Executive Summary

In May 2009 the Government put into legislation the Committee's recommended carbon budgets, and in July 2009 published an ambitious high level vision in its Low Carbon Transition Plan (Box 1). This is the Committee's first annual report to Parliament, required under the Climate Change Act, on progress towards meeting budgets. Comprehensive data is not yet, however, available even for the first year of the first budget (2008). In this report, therefore, we focus on developing a monitoring approach which will better enable us to track progress against budgets going forward, and on identifying clear challenges likely to be faced in meeting budgets.

Box 1 The Low Carbon Transition Plan

The Government's Low Carbon Transition Plan makes three key contributions:

- It provides an overview of opportunities for reducing emissions, and high level commitments from departments that if delivered would achieve carbon budgets.
- It gives an overview of the policy framework including policies under development (e.g. for clean coal and residential buildings)
- It sets out the economic opportunities (e.g. jobs in low carbon industries) from meeting carbon budgets

This has entailed four main blocks of work:

- **Understanding the trajectory of UK carbon emissions** as we entered the first budget period, and thus the extent to which a major change in pace is required.
- **Understanding the impact of the recession**, to enable us to distinguish underlying trends from temporary recession impacts in the first budget period.
- **Developing a set of indicators** which will enable us in future years to assess emission trends. These include forward indicators of progress in investments, and policies which are required in early years to ensure that meeting subsequent budgets is feasible.
- **Filling in gaps in our evidence base** with new analysis of emissions reduction opportunities in the UK (e.g. scope for increased penetration of renewable heat).

The key conclusions which we have reached are:

- **A major shift in the pace of UK carbon emissions reduction must be achieved.** In the five years before the first budget period (i.e. in 2003 to 2007) greenhouse gas (GHG) emissions were falling at less than 1% annually. They need now to fall at 2% annually on average in the first budget and thereafter, and 3% following a global deal at Copenhagen.
- **The recession is likely to result in reduced emissions.** This could create a false impression of rapid progress in 2008 and 2009. Implementation of measures to reduce emissions in the first budget period is required to be on track to meeting the second and third budgets.

- **The recession has also had a major impact on the EU Emission Trading Scheme (ETS) market.** Dramatic price reductions in recent months create a significant danger that the carbon price will be too low to incentivise the investment needed in energy-intensive industries to ensure progress in the second and third budget periods and beyond.

Given the need for a major shift in trajectory and the dangers of recessionary impacts undermining discipline and incentives, the Committee believes that the Government should:

- **Plan to out-perform the first budget** and, subject to the Committee's advice at the appropriate time, plan not to bank any outperformance of the first budget into subsequent budget periods.
- **Review the current set of market arrangements for power generation** and consider new rules which would strengthen the investment climate for low-carbon power generation. This should mitigate risks that investment continues to flow predominantly to conventional fossil fuel generation in the third budget period and beyond.
- **Make a major shift in the strategy on residential home energy efficiency,** moving away from the existing supplier obligation, and leading a transformation of our residential building stock through a whole house and street by street approach, with advice, encouragement, financing and funding available for households to incentivise major energy efficiency improvements.
- **Introduce a new set of financial and other incentives** to meet very ambitious renewable heat targets.
- **Put in place a clear strategy,** with appropriate financial incentives, to meet EU targets for new car emissions by 2015 and drive take-up of electric vehicles.
- **Roll-out Smarter Choices** to encourage better journey planning and increased use of public transport across the UK.

A full overview of our indicators and recommendations is provided in Box 1, with a more detailed summary set out in 5 sections below:

- 1. Progress reducing emissions**
- 2. Implications of the recession**
- 3. Delivering low-carbon power**
- 4. Making buildings and industry more carbon efficient**
- 5. Decarbonising road transport.**

The Committee will pragmatically use the indicators set out in this report for its annual assessments of progress reducing emissions as required under the Climate Change Act. The indicators should not be seen as fixed targets, but rather as an evolving framework which the Committee will develop in the light of new analysis (e.g on cost/feasibility of options for reducing emissions). The indicators will provide a basis for understanding whether emissions reductions are sustainable (i.e. through implementation of measures) and will provide the opportunity for early identification of slippage that could increase the risk of missing budgets. The Committee's next annual report to Parliament will be published in June 2010.

Box 2 Summary of indicators for monitoring progress towards meeting carbon budgets

The Committee's indicators for power generation, use of energy in buildings and industry, and transport comprise measures which will reduce emissions and new policies which will drive implementation of these measures. We summarise here the indicators and milestones set out more fully in the report – which includes indicators for the path to 2022 together with forward indicators (e.g. relating to stages of the project cycle for investment in wind generation).

Power sector indicators

The Committee's Extended Ambition scenario for power sector decarbonisation embodies around a 50% cut in emissions due to falling carbon intensity from the current level of 540 gCO₂/kWh to around 300 gCO₂/kWh in 2020, driven by:

- Addition of 23 GW of wind generation (e.g. around 8,000 3 MW turbines).
- Addition of up to 4 CCS (i.e. clean coal) demonstration plants.
- Addition of up to 2 new nuclear plants by 2020, a third by 2022.

In order to achieve deep cuts in power sector emissions through the first three budget periods and beyond, policy strengthening will be required:

- **Market rules** – Investment in low-carbon generation is risky and may not be pursued sufficiently under current market arrangements. A review of alternative options for strengthening low-carbon generation investment incentives (e.g. carbon price underpin, low-carbon obligations/feed-in tariffs, emissions performance standard, etc.) is now needed.

- **Support for CCS** – A new framework to support investment in CCS generation is required. This should include an early review of CCS viability (e.g. no later than 2016) and financial support for roll-out, limits on generation from conventional coal beyond the early 2020s, and timely commencement of a second demonstration competition; the Government will publish a CCS framework later this year.
- **Grid strengthening** – Early decisions on transmission network access and investment are required to support very significant increases in wind generation in areas where the grid is currently congested.

Indicators for energy use in buildings and industry

The Committee's scenarios for emissions reductions in buildings and industry include a 35% reduction in residential buildings in 2022 compared to 2007 figures, and a 27% reduction in non-residential buildings and industry.

We set out detailed indicators for the residential sector, with aggregate indicators for renewable heat and non-residential buildings and industry. Our indicators for residential buildings include:

- loft & cavity wall insulation (10 million lofts and 7.5 million cavities insulated by 2015)
- solid wall insulation (2.3 million by 2022)
- replacement of old boilers (12 million non-condensing boilers replaced by 2022)
- increase in stock penetration of A+ rated washing machines and dishwashers (around 80% by 2022) and A++ fridges and freezers (45% by 2022)

Policy strengthening will be required in at least three areas to achieve the emissions reductions in the Committee's scenarios

- **Energy efficiency improvement in homes**

- The current Carbon Emission Reduction Target (CERT) scheme for energy efficiency improvement in homes should be replaced by a new Government-led policy including: a whole house approach (i.e. where houses are given an energy audit followed up by hassle-free implementation of cost-effective measures); a neighbourhood approach (i.e. where local areas are systematically targeted and local authorities play an important delivery role); low-cost long-term financing for households to be repaid from energy bill reductions following energy efficiency improvement, and to be blended with grant funding (especially for the fuel poor). Additional policy measures are also likely to be required to accelerate the purchase of efficient appliances (e.g. tax incentives as have been introduced in Italy).

- **Energy efficiency improvement in the commercial sector (including SMEs) –**

- A new framework to encourage energy efficiency improvement for SMEs should be introduced. The first step towards such a framework is widespread roll out of Display Energy Certificates (DECs) and Energy Performance Certificates (EPCs) to SMEs and other commercial sector organisations.

- **Support for renewable heat** – A new framework to provide financial (such as the planned Renewable Heat Incentive) and other incentives for uptake of renewable heat is required.

Transport indicators

The Committee's scenarios for transport result in a 25% emissions reduction on 2007 levels by 2020 driven by:

- Falling carbon intensity of new cars to 95 g/km in 2020 from the current 158 g/km.
- 240 thousand electric cars and plug-in hybrids by 2015, and 1.7 million by 2020, supported by appropriate charging infrastructure.
- 3.9 million drivers trained and practicing eco-driving by 2020.

Key areas for policy strengthening to achieve required emissions reductions are:

- **Support for electric cars and plug-in hybrids** – A comprehensive strategy should be developed for rolling out electric cars and plug-in hybrids, including targets for penetration, a funded plan for charging infrastructure, and large-scale pilots starting at the end of the first carbon budget period and building on the Government's current small-scale demonstrations.
- **Smarter choices** – Phased roll-out of Smarter Choices measures across the UK to encourage better journey planning and more use of public transport.
- **Integrated land use and transport planning** – A new strategy is required to ensure that land use planning decisions fully reflect implications for transport emissions (e.g. covering urban regeneration versus new out of town settlements, investment in road infrastructure, investment in public transport infrastructure, planning reform to support electric car roll-out, etc.).



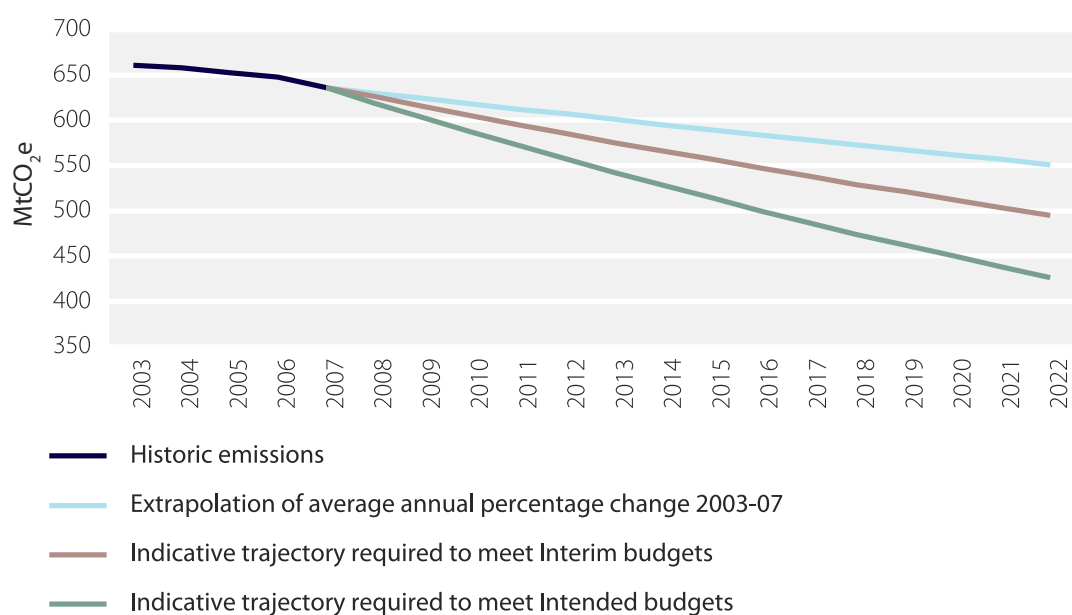
1. Progress reducing emissions

Sustainable emissions reductions in the UK through implementation of measures to improve carbon efficiency have been very limited in recent years:

- GHG emissions over the period 2003 to 2007 fell at an annual average rate under 1%.
 - Preliminary data for 2008 suggests a 2% reduction in CO₂ emissions, mainly due to switching from coal to gas in power generation in response to short-term changes in relative prices rather than any more fundamental shift to low-carbon power generation.
 - It is likely that emissions will fall in 2009 as a result of the recession, but this will not continue beyond the near term once GDP growth resumes.
- Meeting carbon budgets requires annual average emissions reduction over the first three budget periods of 1.7% for the Interim (currently legislated) budget and 2.6% for the Intended (following a new global deal) budget (Figure 1).
 - Much of the emissions reduction in recent years has been in non-CO₂ gases, where potential for further cuts in coming years is limited. CO₂ emissions reductions in the period 2003-07 averaged 0.6% annually. The need to increase the pace of emission reduction is therefore more pronounced for CO₂ than for all GHGs (Figure 2).
 - Where CO₂ emissions have fallen, the extent to which this has been through implementation of measures to improve energy or carbon efficiency is very limited. Implementation of measures will, however, be required across power, buildings and industry, and transport to meet the first three carbon budgets (Figures 3-5).

Going forward a step change will be required to achieve deep emissions cuts required through the first three carbon budget periods and beyond:

Figure 1 Recent UK GHG emissions and indicative reductions required to meet legislated carbon budgets



Source: NAEI (2009); CCC Modelling.

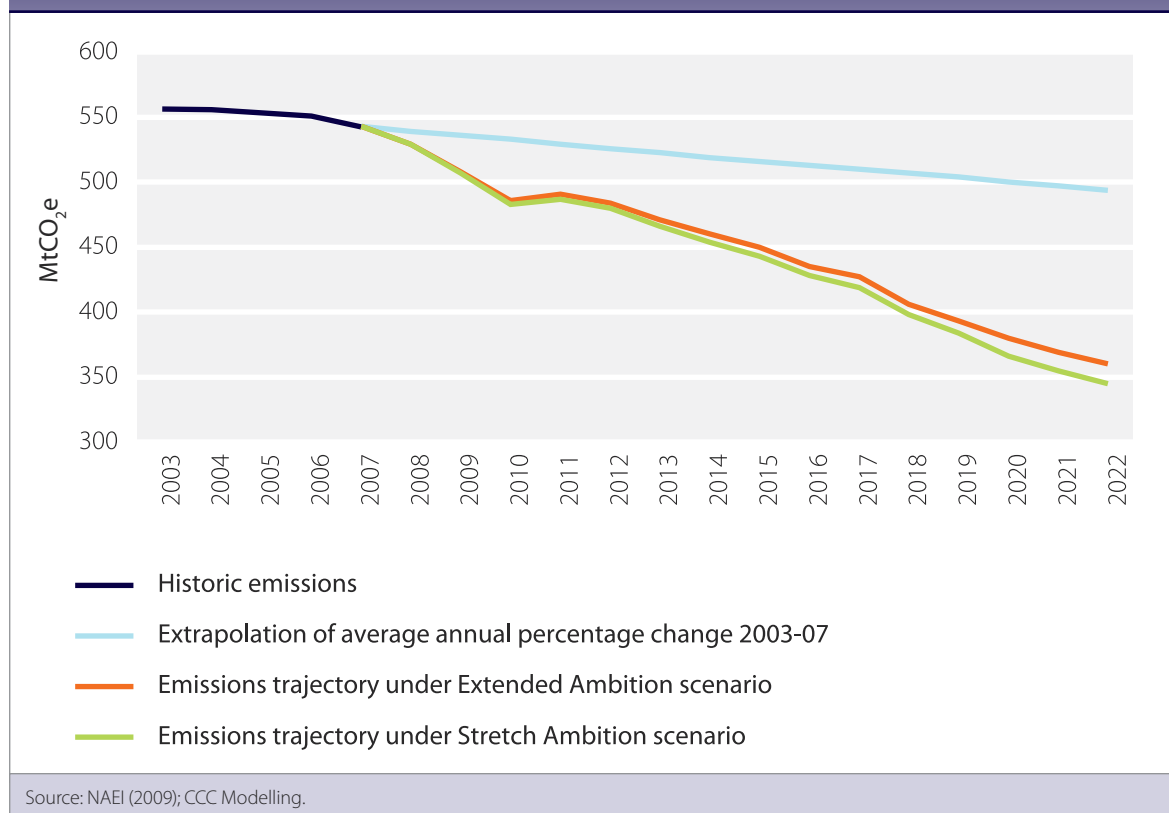
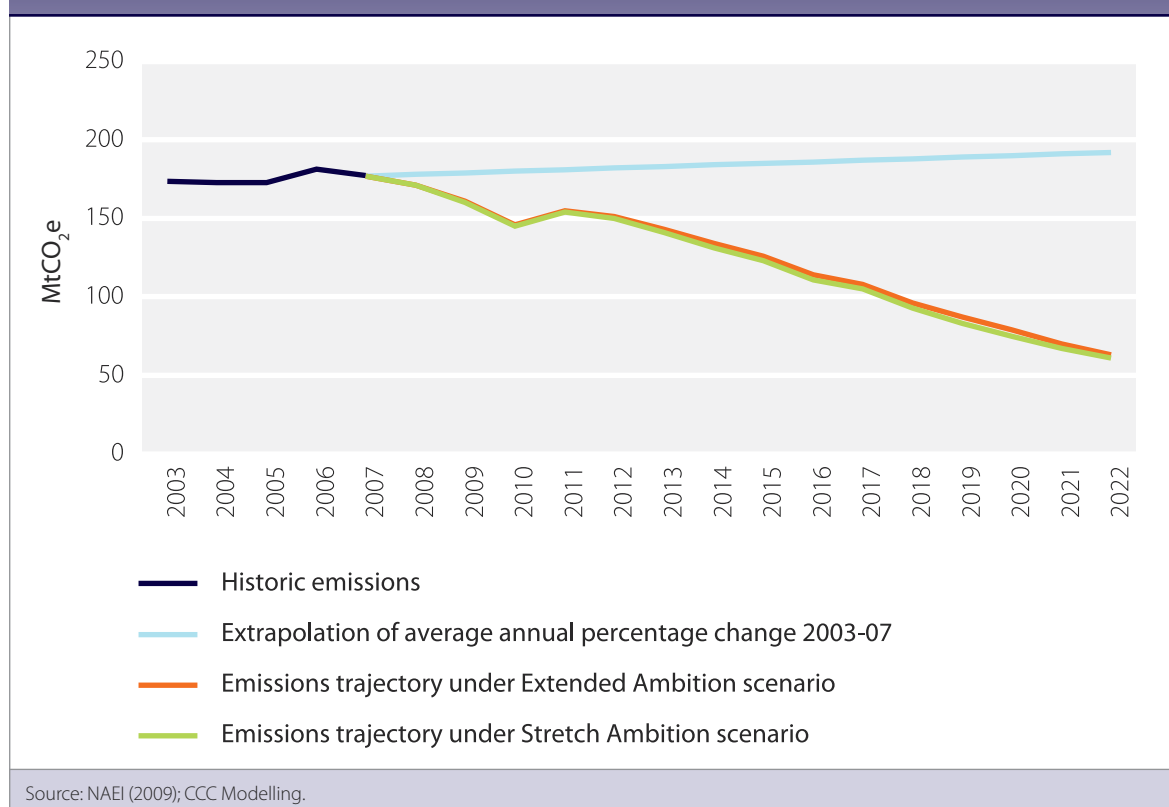
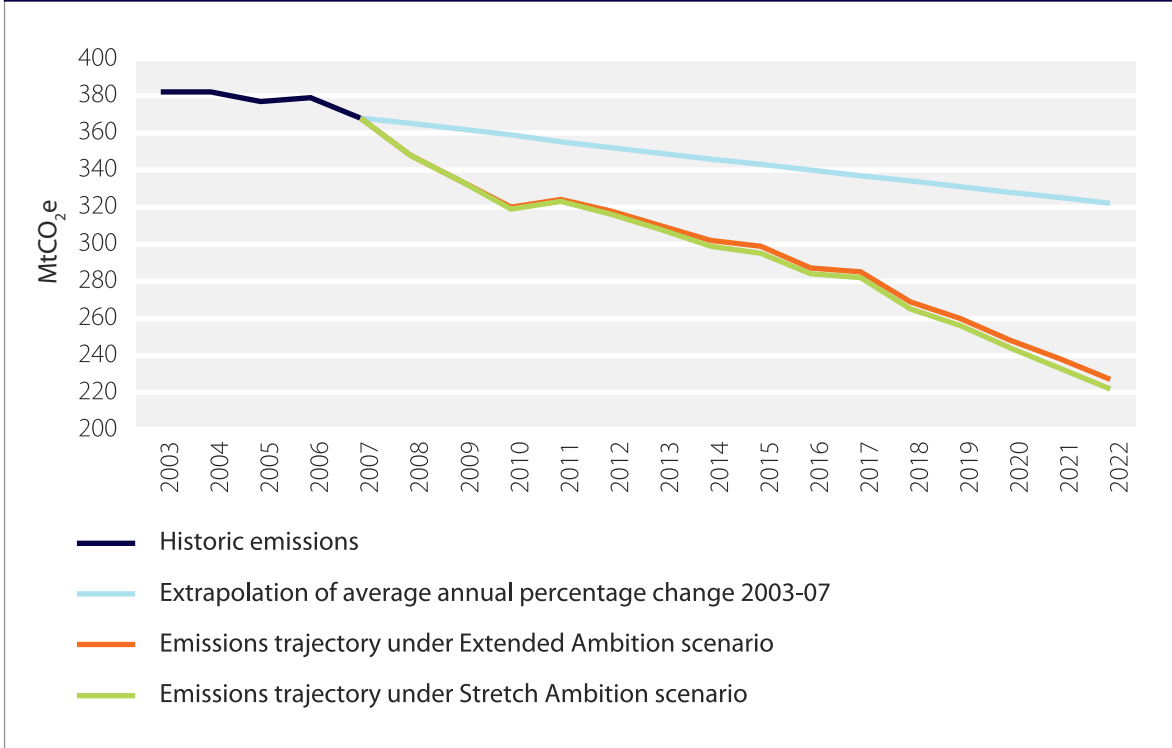
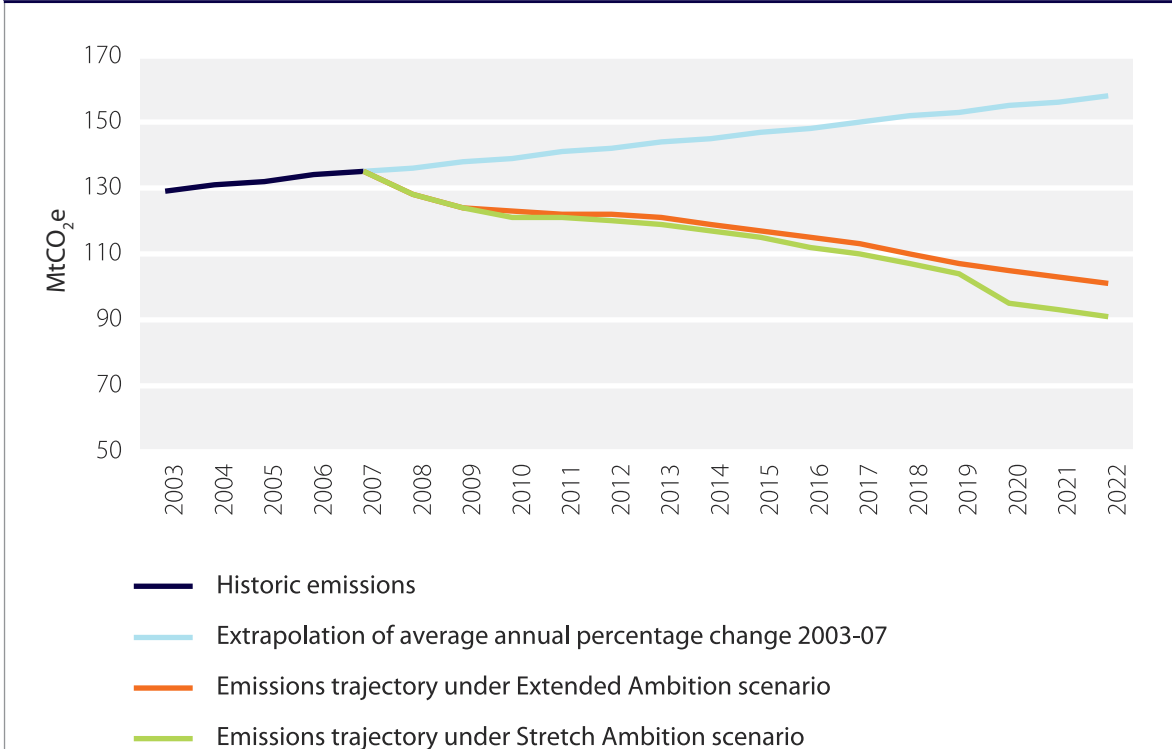
Figure 2 Recent UK CO₂ emissions and reductions under CCC emissions reduction scenarios**Figure 3** Recent power sector CO₂ emissions and reductions under CCC emissions reduction scenarios

Figure 4 Recent buildings and industry CO₂ emissions and reductions under CCC emissions reduction scenarios



Source: NAEI (2009); CCC Modelling.

Figure 5 Recent transport CO₂ emissions and reductions under CCC emissions reduction scenarios



Source: NAEI (2009); CCC Modelling.



2. Implications of the recession

The recession and credit crunch have had three key impacts on meeting carbon budgets:

- The recession has led to a reduction in emissions which will make it easier to meet the first non-traded sector budget without early implementation of required measures to improve carbon efficiency. It will not, however, take away the need for deep cuts through implementation of measures to meet the second and third budgets.
- The recession has also led to a reduction in EU traded sector emissions which has reduced the carbon price and could undermine incentives for investment in low-carbon technologies in the UK's energy-intensive sectors, including power generation.
- The credit crunch could restrict availability of finance for investment in new wind generation capacity that is required to be on track to meeting very ambitious 2020 targets and decarbonising the power sector.

Recession impact on non-traded sector emissions: aiming to outperform budgets

Emissions remain – at least in the short to medium term – a function of economic activity. With lower levels of activity than previously envisaged for the first budget period, we would expect emissions to fall, thus making the first budget easier to meet without implementation of measures to improve carbon efficiency. This would be problematic given the need for early implementation of measures to be on track to making the deep emissions cuts required through the first three budgets and beyond.

Detailed modelling suggests emissions are likely to be at least 40 MtCO₂ lower, and could be up to 75 MtCO₂ lower, over the first budget period. The first budget could therefore be achieved with little or no implementation of required measures. Given this risk, the focus of emissions reduction strategy should be implementation of required measures rather than emissions *per se*. To the extent that outperformance of budgets ensues, this should not be banked in order to preserve incentives for implementation of measures required to meet subsequent budgets.

Recession impact on traded sector emissions: the need to strengthen carbon price signals

The EU ETS carbon price is determined by the level of emissions reduction required under this scheme. For a given cap, falling emissions in the energy-intensive sectors will require less abatement within EU ETS and therefore a lower carbon price. Our analysis suggests that there will be a lower carbon price as a result of the recession (e.g. around 20 Euro/tCO₂ in 2020 compared to our previously projected 50 Euro/tCO₂). This is problematic given the extent to which we rely on the carbon price to provide incentives for investment in low-carbon technology in the energy-intensive sectors. Options to strengthen the carbon price signal which should be seriously considered include:

- Ideally EU level action would be taken to increase the carbon price (i.e. the EU ETS cap would be tightened and firmed up beyond 2020) and reduce uncertainty (e.g. through introducing an auction reserve price). Tightening the cap may be feasible as part of the move from the EU's 20% to 30% economy-wide GHG emissions reduction targets following a Copenhagen deal.
- UK action to underpin the carbon price could provide support for required low-carbon investments (e.g. through introduction of a tax that adjusts according to EU ETS price fluctuations to deliver a target carbon price in the UK).
- UK action might instead be in the form of electricity market intervention (e.g. through a low-carbon obligation, tendering for low-carbon capacity, etc. – see section 3).

The impact of the credit crunch on renewable electricity finance: the need to reduce project risks

There are currently up to 7 GW of new wind generation projects which have gained planning consent but not yet proceeded to construction. Timely implementation of these projects is important to be on track to achieving 23 GW of new investment by 2020 required to meet EU targets and be on the path to deep decarbonisation of the power sector in the 2020s. Our analysis suggests that the credit crunch has, however, restricted finance for onshore projects sponsored by independent project developers, and offshore projects in general.

The key in securing finance is to strengthen underlying project economics and reduce risks. In this respect, the Government's interim increase in financial support for offshore projects has helped secure finance for the 1 GW London Array project. Commitment of up to €4 billion by the European Investment Bank (EIB) is useful. This facility may not, however, be structured in a way that changes project risks and supports increased lending.

The Committee therefore recommends that the Government should closely follow the market response to the EIB facility, and consider interim mechanisms to provide comfort to banks (e.g. loan guarantees), as appropriate, to secure required finance over the next one to two years. Beyond the near term, the Committee proposes that further measures to mitigate project risks (e.g. indexing of ROC prices on key cost and revenue drivers) should be considered in order to secure large amounts of project finance that will be required to support investments in the second and third budget periods.



3. Delivering low-carbon power

There are four areas of focus in the report on decarbonising the power sector:

- Setting out a scenario for emissions reductions and indicators to deliver it.
- Analysis of current market arrangements to identify whether these are likely to deliver required investments in low-carbon power generation.
- Assessment of the draft framework to support investment in CCS power generation.
- Assessment of the enabling framework for investment in wind and nuclear generation

Scenario for power sector decarbonisation over the first three budget periods

The report sets out a scenario for power sector decarbonisation to 2022 that is demanding but feasible, and necessary on the path to deep decarbonisation of the power sector by 2030 (Figure 6). The scenario includes addition of 23 GW new wind capacity and four CCS demonstration plants by 2020, with three new nuclear plants by 2022 (Figure 7). The report includes a set of indicators, with forward indicators and milestones, underpinning this scenario (e.g. time series of projects in development, construction, etc.) which the Committee will use in future reports assessing progress reducing emissions to achieve budgets.

Figure 6 Declining carbon-intensity and increasing generation of electricity to 2050

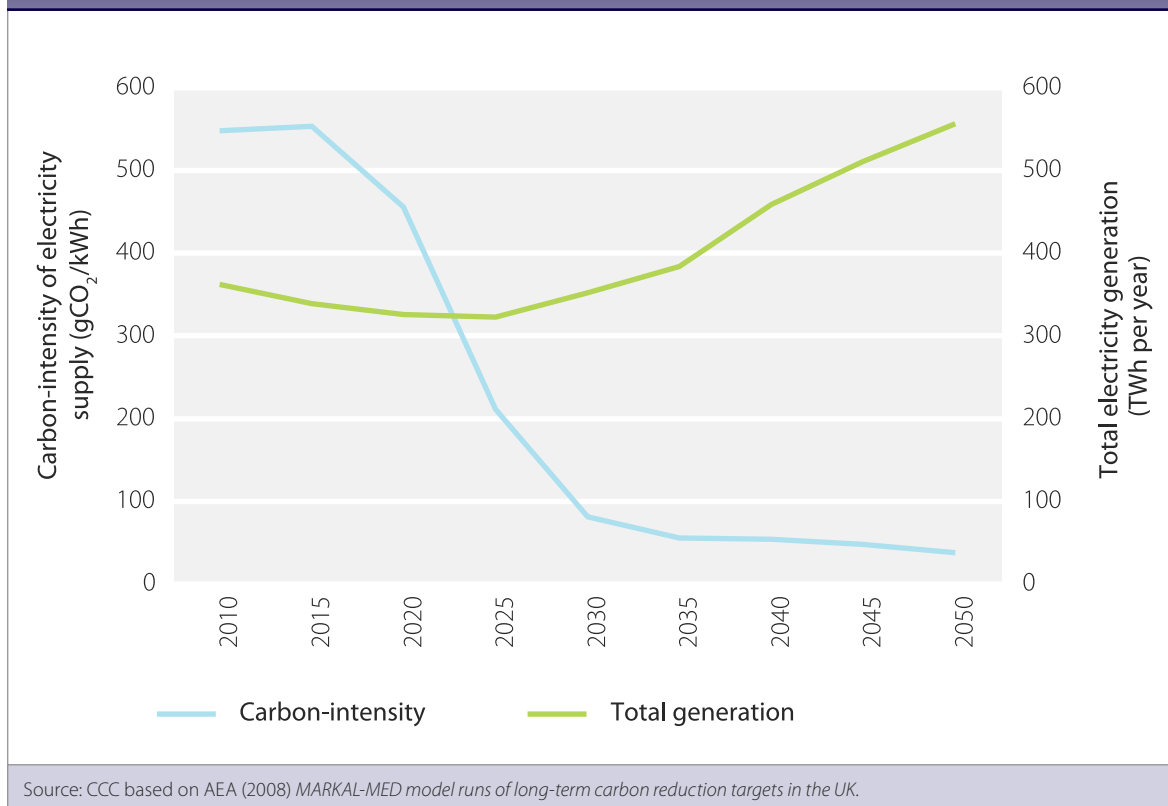
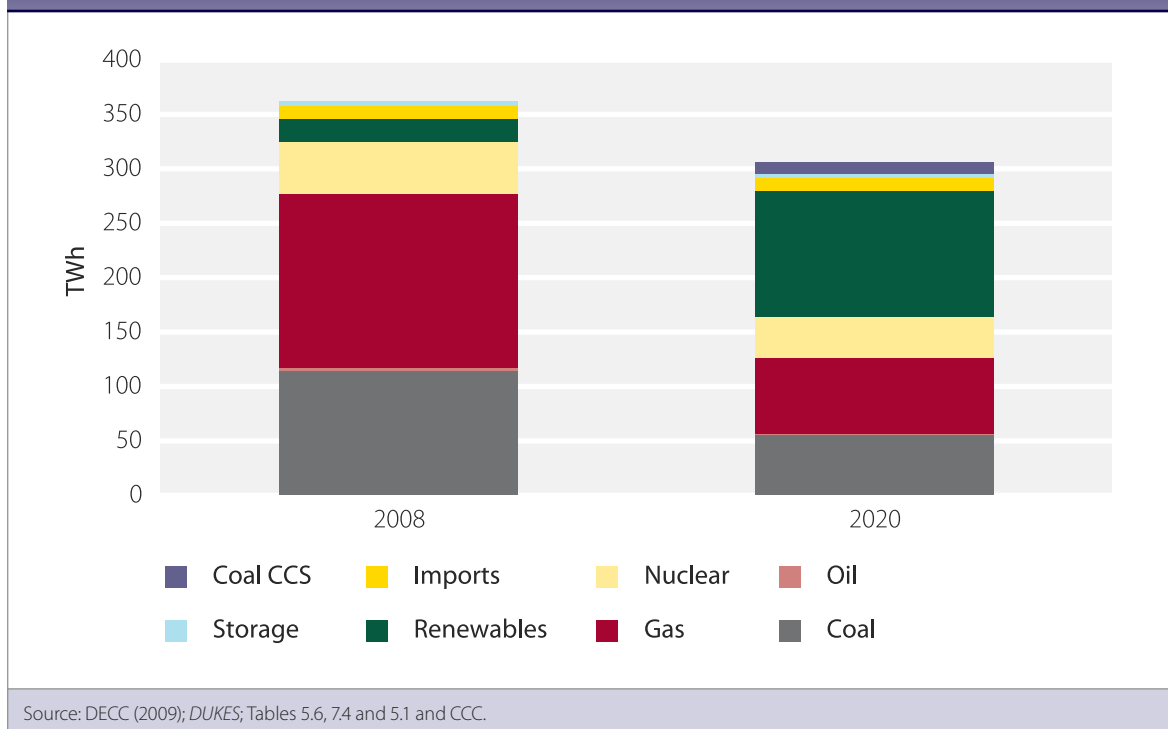


Figure 7 Scenario for generation mix in 2020 compared to actual generation mix in 2008



Changing current market arrangements to support investment in low-carbon power generation

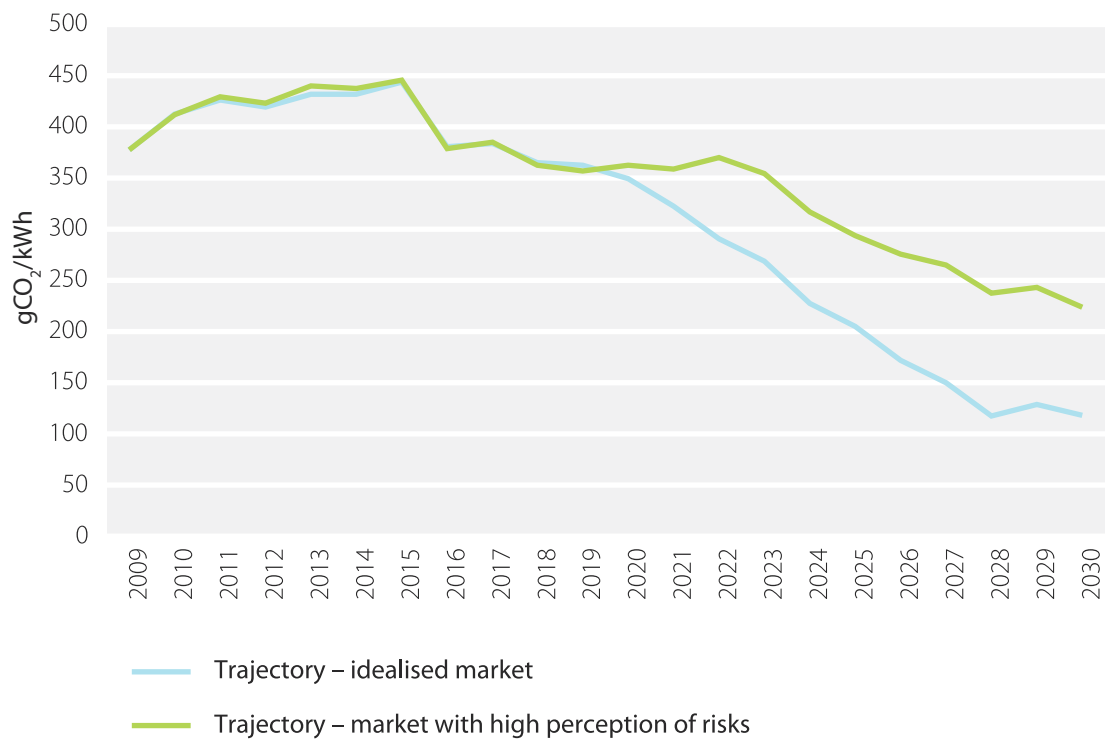
Current power market arrangements were designed to achieve efficient dispatch of fossil fuel-fired plant, and not to secure large investments in capital-intensive low-carbon technologies such as nuclear power and CCS generation.

Under current arrangements, private investors face multiple risks around fossil fuel prices, electricity prices, carbon prices, and technology costs; given these risks, investors will be biased towards investing in conventional fossil fuel fired rather than low-carbon generation. In contrast, the only relevant choice for a society committed to an 80%

emissions reduction target, given the centrality of power sector decarbonisation to cutting emissions in the wider economy, is not whether but which low-carbon technology to invest in. Therefore the only relevant risks are those that relate to the costs and performance characteristics of alternative low-carbon technologies.

We have undertaken new analysis which shows plausible scenarios where, faced with the various risks under current market arrangements, investors choose to invest in increasingly expensive gas-fired rather than low-carbon generation through the 2020s, resulting in deviation from the path towards meeting long-term targets (Figure 8).

Figure 8 CO₂ intensity of generation under alternative scenarios



Source: Redpoint modelling for the CCC

Note: Emissions intensity is not adjusted for losses during transmission and distribution.

Given the need to decarbonise power to meet longer-term emissions reduction goals, concerns over increasing prices, and possible security of supply problems with increased reliance on imported gas, the Committee recommends that a range of options to reduce risks for investing in low-carbon generation are considered:

- Measures to strengthen the carbon price (e.g. extending to all low-carbon generation an exemption from the Climate Change Levy, or a carbon price underpin/tax).
- Measures to provide certainty over the price paid to low-carbon generation (e.g. feed-in tariffs for low-carbon power generation, tendering for low-carbon capacity).
- Measures to ensure investment in low-carbon generation (e.g. an emissions performance standard, a low-carbon obligation).

The Committee recommends that these options are considered in parallel with wider consideration of any implications from Copenhagen for the carbon price, so that any changes to current arrangements can be implemented in time to support decisions at the beginning of the second budget period on the 25 GW of low-carbon investments required in the 2020s.

Providing clear and early signals about investment in clean coal generation

The Committee broadly welcomes the Government's response to recommendations in our December 2008 report, namely the draft framework – published in June 2009 – to support investment in CCS and phase out conventional coal generation.

The Committee recommends, however, five key changes to be incorporated as the draft framework is finalised:

- The Committee's analysis shows that there is a very limited role for conventional coal-fired plant beyond the early 2020s. The Government should provide a strong signal to investors now that this is the case whether or not CCS is later

proven – to prevent investments proceeding on the misconception (based on the lack of a clear carbon price signal) that conventional coal will continue to operate (even at low load factors) over the next decades.

- The economic viability of CCS should be judged (based on UK and international evidence) in the broad sense of whether the costs of this technology can be justified given its potential contribution to meeting the strategic objective of power sector decarbonisation in the UK and internationally. Viability should not be judged in the narrow sense of whether the cost penalty of CCS is covered by the carbon price.
- It is likely that there will be a period where CCS is deemed viable but where the carbon price is insufficiently high to cover the CCS cost penalty. In these circumstances, a successor support mechanism would be required. An early signal that such a mechanism would be introduced as appropriate should be provided to reduce risks for investors in the first set of partially fitted CCS plants.
- Such a mechanism should then be introduced no later than 2016. A review in 2020 as proposed by the Government would not allow roll-out until the second half of the 2020s, therefore limiting the role of CCS at a time when it is likely to have a crucial role to play decarbonising the power sector.
- Competitions for CCS demonstration finance should be designed to encourage bids for oversized pipes which could later support investment in clusters of plant that would benefit from scale economies in infrastructure provision. Before the demonstrations are complete the Government should develop a CCS infrastructure strategy and should consider the best approach to deliver that strategy (e.g. whether through a statutory monopoly).

Developing an enabling framework for investment in wind and nuclear generation

The Government has made significant progress developing the legal and regulatory frameworks for investment in wind and nuclear power. Further progress is required in the areas of network access and investment and planning including:

- Agreement on enduring arrangements for network access (i.e. to succeed the existing interim arrangements) is required by June 2010 to provide confidence for investors in wind generation.
- Agreement on new investments to ease bottlenecks in the transmission network and accommodate significant increases in the level of wind generation is required at the latest by 2011, so that construction can commence in 2012.
- A national policy statement for nuclear power generation is required by Spring 2010 to support passage of proposals for nuclear new build through the planning process.
- Timely approval of large wind and nuclear projects by the Infrastructure Planning Commission, and smaller wind projects by local authorities, is crucial to support investment proceeding on timescales required to meet targets for sector decarbonisation.

The Committee will monitor progress consolidating the enabling framework in these and other respects as part of its annual progress reporting.



4. Making buildings and industry more carbon efficient

The report focuses on three areas within buildings and industry emissions:

- Indicators and policies for energy efficiency improvement in the residential sector.
- Scenarios for increased renewable heat consumption
- Emissions reduction in non-residential buildings and industry.

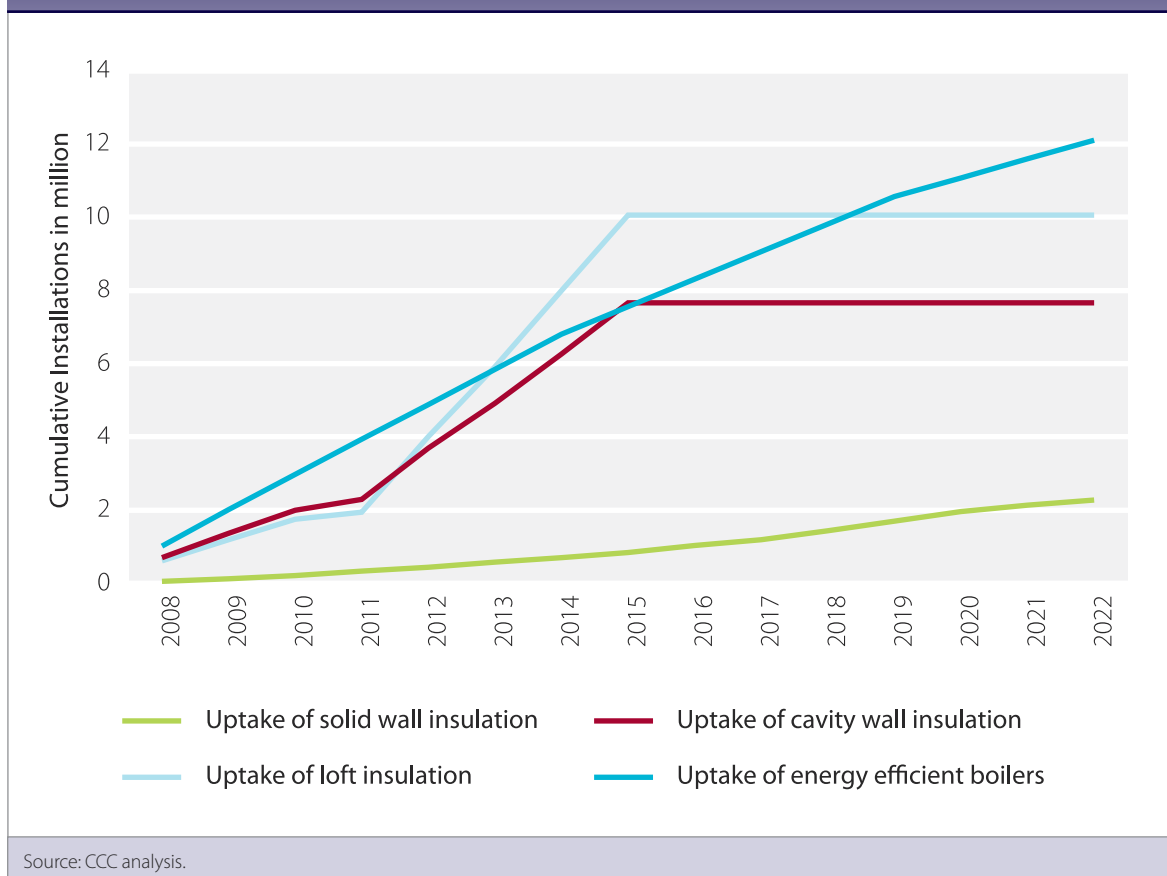
Indicators and policies for energy efficiency improvement in the residential sector

In our December 2008 report we set out high level scenarios for emissions reduction in the residential sector due to energy efficiency improvement (through better insulation, replacement of old inefficient boilers, etc.). In this report, we present detailed trajectories for implementation of required measures (Figure 9):

- 10 million lofts and 7.5 million cavity walls are insulated by 2015, supported by a high level energy audit of all homes in the UK.
- 2.3 million solid walls are insulated by 2022.
- all (i.e. 12 million) old inefficient non-condensing boilers are replaced by 2022.
- Stock penetration of A+ rated washing machines and dishwashers is increased to around 80% by 2022 and A++ rated fridges to 45% by 2022.

The Committee will report annually on progress against these indicators, which together with other residential sector measures would reduce emissions by around 50 MtCO₂ against current emissions in 2022.

Figure 9 Uptake of main residential building measures 2008 - 2022



Our analysis suggests, however, that emissions reductions will not ensue to the extent required under the current framework (i.e. CERT, led by energy suppliers, which has been most successful at providing free energy efficient lightbulbs).

The Committee has considered the high level framework proposed by the Government in its draft Heat and Energy Saving Strategy and recommends the following approach:

- **Whole house** – There should be a whole house approach involving an energy audit with a follow up package including installation and financing. The approach should be applied to the full range of cost-effective (i.e. cost per tonne saved less than the carbon price) measures: loft insulation, cavity wall insulation, solid wall insulation, early replacement of old inefficient boilers, installation of heating controls to support behaviour change.

- **Street by street/neighbourhood approach** –

The Committee has reviewed social research evidence suggesting that people are looking for a government lead on energy efficiency improvement, and want to act in a context where they can see that others are acting. The Committee therefore recommends a neighbourhood approach led by national government (e.g. providing political leadership, strategy, legislation, etc.), with a delivery role for local government in partnership with energy companies and other appropriate commercial organisations. To ensure full take up of measures under this approach, additional price or regulatory incentives may be needed particularly for the private rented sector.

- **Financing** – There may be scope for some pay as you save type individual charging. However, some element of subsidy – either socialisation of costs via energy bills or grants – should be retained, given that some measures will take a long time to pay back (e.g. solid wall insulation) and given the need to improve energy efficiency in the 4-5 million homes of the fuel poor who may be unable to take on financial obligations.

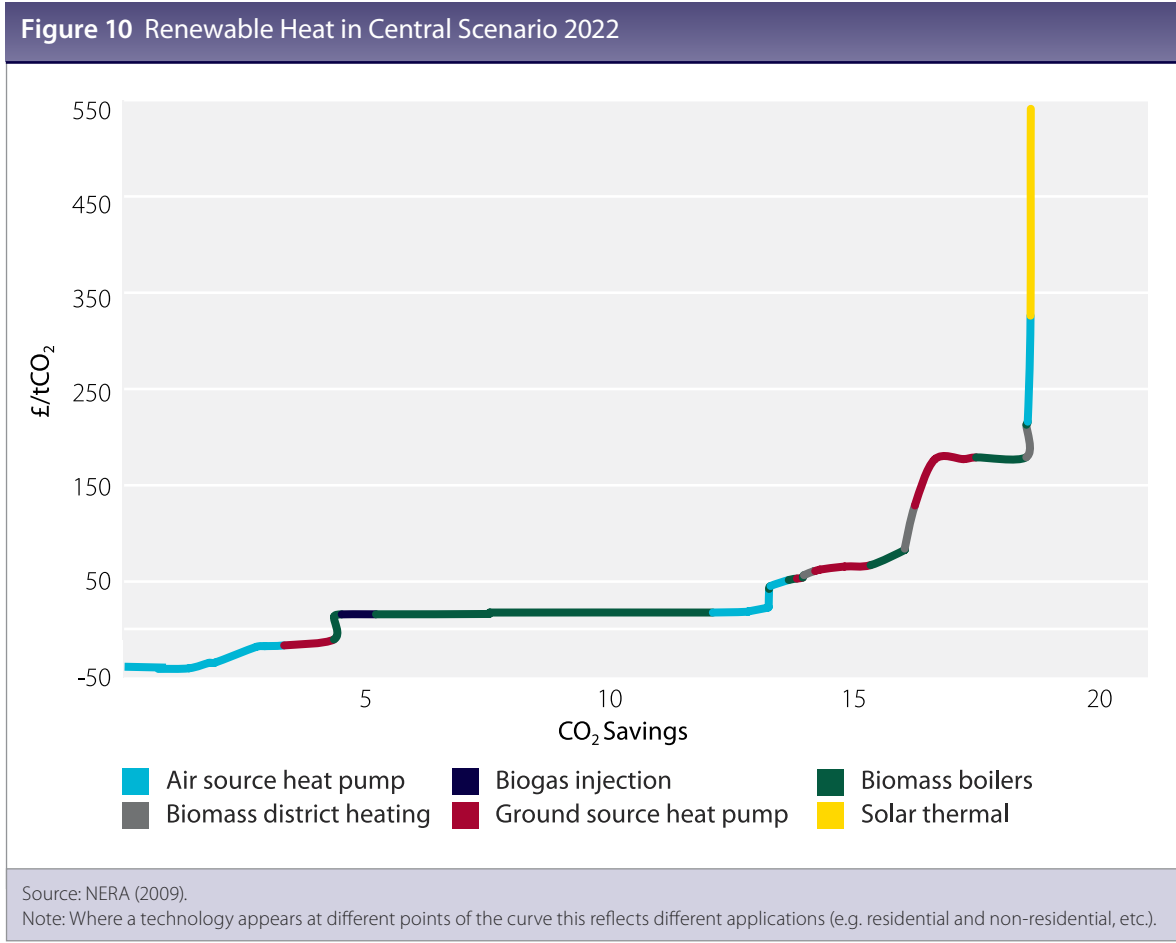
Scenarios for increased renewable heat consumption

We present new analysis of a wide range of renewable heat technologies: biomass boilers, air source and ground source heat pumps, solar thermal, and biogas. The analysis suggests that there are cost-effective opportunities (i.e. at a cost per tonne of CO₂ abated less than our projected carbon price) for deployment of each of these technologies, although deeper penetration may be more costly (Figure 10). For both cost-effective

and more expensive deployment, financial support will be required given the absence of a carbon price in most of the heat sector.

Given our assessment of costs and feasible deployment, the Committee assumes the Government’s proposed ambition as set out in its Renewable Energy Strategy to achieve 12% renewable heat penetration from current very low levels (around 1%) with roll-out incentivised by a new Renewable Heat Incentive in 2011. We note, however, that achieving this target could be very expensive at the margin.

Significantly increased penetration based on a portfolio of technologies will develop options for further deployment in the 2020s. The appropriate path for heat decarbonisation in the 2020s and beyond is currently uncertain; the Committee will review this in detail in the context of its advice on the fourth budget (2023-2027) to be published at the end of 2010.



Emissions reduction in non-residential buildings and industry

The Committee will consider the appropriate level of the first capped phase for the Carbon Reduction Commitment (CRC) in 2010.

Deployment of innovative technologies in the energy intensive sectors will be considered in the context of advice on the fourth budget.

Reducing public sector emissions is crucial because there is significant potential in this sector, because Government must reduce its own emissions in order to be credible leading on emissions reductions in other sectors, and because there is scope for encouraging behaviour change in the large number of people who use public sector buildings. The Committee proposes that all cost-effective measures in central government buildings and other public sector buildings covered by the CRC should be implemented by 2018 (i.e. the end of the first capped phase of the CRC).

The Committee recommends Energy Performance Certificates (EPCs) and Display Energy Certificates (DECs) should be required for all non-residential buildings by the end of the second budget period.

In relation to SMEs, the report builds on previous analysis of significant potential for emissions reduction and considers policy options to provide incentives for unlocking this potential. The key issue identified is the lack of an evidence base to design or implement policy. Information from EPCs and DECs would help form the basis for new policy (for example, similar to the proposed new approach for the residential sector or a regulatory approach).



5. Decarbonising road transport

The transport chapter of the report focuses on three areas:

- Indicators for emissions reduction
- Scenarios and measures to support roll-out of electric cars
- Emissions reduction from consumer behaviour change and land use planning.

Indicators for emissions reduction from cars

The Committee previously set out an Extended Ambition scenario which would reduce carbon intensity of new car emissions to 95 gCO₂/km in 2020. In April 2009 the EU adopted a 130 gCO₂/km target for new car emissions in 2015, and a 95 gCO₂/km target in 2020. The Committee believes that the UK should move from the current situation where the UK tracks above the EU average, converging on the EU target by 2015 and reaching 95 gCO₂/km by 2020.

- This is desirable both to prepare the way for deep emissions cuts in transport in the 2020s, and in order that transport makes an appropriate contribution to meeting non-traded sector budgets.
- It can be achieved through a range of supply side measures (e.g. increasing fuel efficiency of conventional engines, increased uptake of hybrid car, electric and plug-in hybrid cars, non-powertrain measures) and through some change in customer choice.

The Committee will therefore focus in its future monitoring on new car emissions and the impact that this has on overall car emissions, which we estimate could fall by 16 MtCO₂ in 2020 if 95 gCO₂/km is achieved.

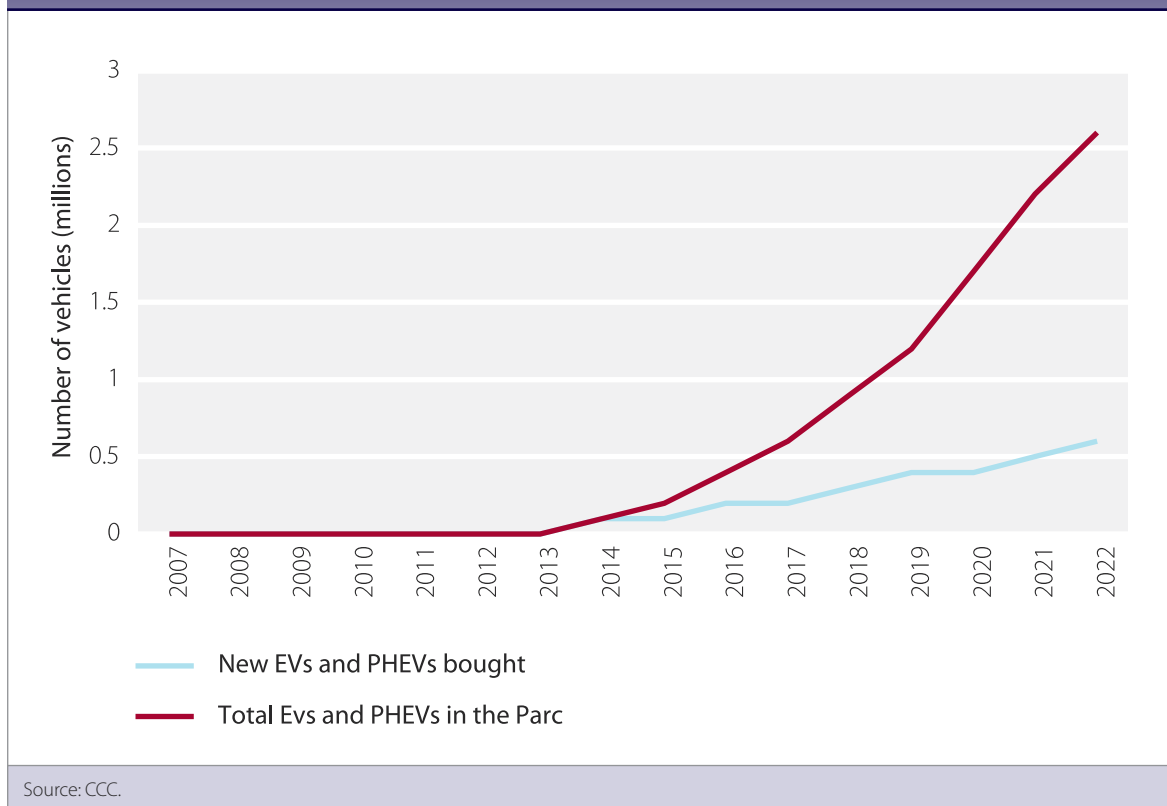
Scenarios and measures to support roll-out of electric cars

Whilst useful in helping to meet the first three carbon budgets, there is a limit to how much carbon intensity of conventional cars can be improved. It is therefore very important to develop electric car options, which currently appear to be the most viable from alternatives (e.g. second generation biofuels, hydrogen, etc.) for deep emissions cuts in road transport in the 2020s. The report includes new analysis of the technical and economic aspects of electric cars, and recommendations on arrangements to support roll-out of electric cars:

- **Market readiness** – Electric cars are market ready, with some cars already on the road, and new models scheduled to come to market in the near future.
- **Battery costs** – Upfront costs of electric cars are relatively expensive compared to conventional alternatives, mainly due to battery costs (for example, an estimated early model battery cost for a small car is around £7,800). Our analysis suggests, however, that there is scope for a 70% battery cost reduction through learning effects as electric cars are deployed. With a 70% cost reduction, electric cars would be competitive with conventional cars once operating cost savings at current levels of fuel duty are taken into account.
- **Price support** – Our analysis suggests that price support of up to £5,000 per car proposed by the Government is appropriate in conjunction with innovative business models for spreading upfront costs over time (e.g. battery leasing). Price support should no longer be required for some types of car from 2014, depending on the pace at which battery costs fall. Total support required to get to break even and to achieve a level of penetration to provide a critical mass for widespread roll-out in the 2020s is likely to be considerably higher than the Government's £250 million commitment (e.g. £800 million).
- **Charging infrastructure** – The typical range for electric cars is around 80 miles, possibly increasing to 250 miles as battery technology develops. The current range is sufficient to cover the vast majority of trips. Charging options include: off-street home charging, which would be an option for up to 75% of car-owning households; on-street home charging; workplace charging; charging in public places (e.g. car parks, supermarkets, etc.); battery exchanges. A charging infrastructure to support roll-out to 2020 could be achieved at a cost in the low hundreds of millions rising to around £1.5 billion depending on the level of sophistication of charging meters. Charging infrastructure would have to be funded at least in part by government.
- **Implications for the power system** – Roll-out of electric cars to 2020 based on overnight charging should have very limited implications for the power system. Full roll-out in the 2020s could have implications, with for example the need to upgrade distribution substations if there is widespread daytime fast charging. Such upgrades would not be prohibitively costly, and would be accommodated within the normal investment programmes of energy companies.
- **Pilot projects** – Electric car roll-out should be concentrated in certain areas to allow exploitation of economies of scale. Pilot projects should cover several cities and target deployment of around 240,000 cars by 2015 on the way to 1.7 million cars on the road in 2020. Funding required for charging infrastructure to support pilot projects should be no more than £230 million, and could be considerably less.

The report sets out scenarios in which electric cars and plug-in hybrids account for around 16% of new cars purchased in 2020 (Figure 11); this level of penetration is feasible, desirable both to meet carbon budgets and on the path to deeper cuts in the 2020s, and consistent with Government's stated objective to be a leader in ultra low-carbon vehicles.

Figure 11 Electric and Plug-in hybrid vehicles in the Extended Ambition scenario



Emissions reduction from consumer behaviour change and land use planning

Introduction of road pricing – Our December 2008 report considered evidence on travel demand and concluded that price levers are potentially useful in reducing emissions (e.g. fuel duty might be used to offset reductions in the oil price, or fuel duty might be increased to yield a short-term emissions reduction if the carbon budget is off track).

There is a good economic rationale to introduce road pricing and thereby reduce congestion. Evidence in this report suggests that road pricing would result in a significant emissions reduction (e.g. around 6 MtCO₂ in 2020) if there were no offsetting reductions in other aspects of transport pricing (i.e. fuel duty, VED). The Committee recommends therefore that the Government should seriously consider road pricing, and includes emissions reductions from this measure in our Stretch Ambition scenario.

Roll out of Smarter Choices – In our December 2008 report, we included an emissions reduction of around 3 MtCO₂ for implementation of Smarter Choices (e.g. programmes to support better journey planning, more use of public transport, etc.). In this report we summarise new evidence on Smarter Choices implementation from Sustainable Travel Town pilot projects, suggesting that emissions reduction potential is in line with, and possibly exceeds, our original estimate.

Smarter Choices therefore offer significant low cost potential for reduction of transport emissions, and the Committee recommends that there is phased roll-out of smarter travel towns and cities. We include emissions reductions of 3 MtCO₂ in 2020 in our Extended Ambition scenario; we will consider evidence of any reduction in car miles/emissions through implementation of Smarter Choices in our annual progress reports.

Land use planning and transport policy.

There are significant differences in emissions for different towns and cities in the UK and beyond – depending on urban density, the relative location of homes/workplaces/shops, public transport infrastructure and policy, network and pricing measures (e.g. bus lanes, pedestrianisation, road pricing, etc.).

This suggests that there may be an opportunity for emissions reductions depending on the approach to land use planning and transport policy (e.g. through promoting urban regeneration rather than migration of population away from urban areas, mixed use development rather than out of town shopping centres, investment in public transport infrastructure and policies to support this such as smarter choices and network management measures, etc.).

There is a specific opportunity relating to the 3 million new homes that the Government envisages will be built in the period to 2020; locating these in urban areas would result in significant emissions reduction relative to dispersed location.

The Committee recognises that a high level planning framework is in place, but is not confident that – in practice – this fully addresses risks of increasing transport emissions or scope for transport emissions reduction. We therefore recommend that an integrated land use planning and transport strategy attaching appropriate weight to transport emissions is developed by the Government.

Emissions reductions in recent years have been very modest. Going forward, a step change is required if carbon budgets are to be achieved.

The Committee has identified opportunities for deep cuts in emissions, but believes that significant policy strengthening is required to make the step change. In this report we have set out high level policy options in key areas within power, buildings and industry, and transport.

In a world where policies are strengthened and carbon budgets are achieved in 2020 we will cut emissions from current levels of 9 tCO₂/capita to 6 tCO₂ and people will typically:

- Meet more of their energy needs from low-carbon power.
- Live in well-insulated homes with new efficient boilers and advanced heating controls.
- Purchase energy efficient appliances and use these on low-carbon cycles (e.g. low temperature washing and dishwashing).
- Work in energy efficient offices with power and heating from low-carbon sources.
- Drive more carbon efficient cars, including hybrids, electric cars and plug-in hybrids, with charging infrastructure at home, at work and in public places.
- Drive in an eco-friendly manner (e.g. not carrying excess weight in the car) and within the existing speed limit.
- Plan journeys better and use public transport more.

Implementation of the required measures to achieve budgets would in some instances save people and businesses money and in total cost less than 1% of GDP. Achieving carbon budgets could lead to significant improvements in, for example, energy security of supply and air quality, therefore maintaining or enhancing quality of life.

The Committee now calls on the Government to build on its Low Carbon Transition Plan, moving from a high level vision to developing and putting in place a framework for delivery to which people and businesses can respond.



Future work of the Committee

The Committee is required either under the Climate Change Act 2008 or at the request of Government to produce a number of reports over the next year including:

UK aviation emissions review: the Committee was requested by the UK Government to review UK aviation emissions and recommend how these can be reduced to meet the target that emissions in 2050 will be no more than 2005 levels. The Committee will report back in December 2009.

Advice to the Scottish Government on emissions reduction targets. The Committee has agreed to a request by the Scottish Government to advise on appropriate Scottish emissions reduction targets, and will report back in February 2010.

Annual report to Parliament: the Committee's second annual report to Parliament is required in June 2010. This will include an assessment of progress reducing emissions to meet budgets. It will also report any new analysis, particularly as regards scope for reducing agriculture emissions.

Advice on the second phase Carbon

Reduction Commitment (CRC) cap: The Low Carbon Transition Plan noted the Government's request that the Committee advise on the CRC cap in 2010. The Committee will report back on this at a date to be determined in 2010, possibly in conjunction with the annual progress report.

A review of UK low carbon R&D: this has been requested by the Government's Chief Scientist. It will cover technologies to be supported, support mechanisms and the institutional framework. The Committee will report back in summer 2010.

Advice on the fourth budget (2023-27): the Committee is required under the Climate Change Act to advise on the appropriate level of the fourth carbon budget by the end of 2010. In undertaking this work, the Committee will consider any new scientific evidence, appropriate global trajectories, UK contributions, and emissions reduction opportunities. This work will include consideration of outcomes from Copenhagen including implications for moving from the Interim to Intended budgets.





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