

# Scotland's path to a low-carbon economy

Committee on Climate Change  
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# Foreword

The Climate Change (Scotland) Act, adopted in August 2009, includes ambitious targets to reduce emissions by 42% in 2020 relative to 1990 and 80% in 2050 relative to 1990. These targets are more ambitious than currently legislated UK carbon budgets, which require a 34% cut in 2020 and exclude international aviation and shipping.

This report sets out the Committee's advice on the implementing framework for the Climate Change (Scotland) Act as requested by the Scottish Government. It builds on analysis published in our previous reports *Building a low-carbon economy – the UK's contribution to tackling climate change* (December 2008) and *Meeting carbon budgets – the need for a step change* (October 2009).

Our approach disaggregates the 42% target into targets for traded and non-traded sectors. For the traded sector, we focus on opportunities for early decarbonisation of the power sector through investment in renewable electricity generation. In the non-traded sector, we assess scope for emissions reductions through energy efficiency improvement, increased penetration of renewable heat, more carbon and fuel efficient new cars and changed consumer behaviour in the transport sector, and changed farming practices.

Our conclusion is that the 42% target is achievable through domestic effort in a context where there is a new global deal to reduce emissions which triggers the EU's target to reduce emissions by 30% in 2020 relative to 1990. However, new policies will be required if the emissions reduction potential that we have identified is to be unlocked in practice.

For the period before a global deal has been reached, we set out various options including adjusting the target, purchasing credits, and identifying additional emissions reduction potential. Whatever the choice, the committee is very clear that the level of domestic effort aimed for in the non-traded sector should be invariant to whether or not a global deal is agreed.

Going forward, we will work with the Scottish Government as requested in developing a Scottish emissions reduction strategy. We will continue to report on progress reducing Scottish emissions in our annual progress reports to the UK Parliament and will also report directly to the Scottish Government from 2011.

The Committee would like to express our thanks to the Secretariat for their excellent support and hard work towards the delivery of this report.

# The Committee on Climate Change



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**Lord Adair Turner, Chair**

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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).



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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.



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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.



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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.



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**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 2008, 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.



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**Lord John Krebs**

Professor Lord Krebs Kt FRS, is Principal of Jesus College Oxford. He studied Zoology and population ecology of birds for his undergraduate and D Phil degrees at Oxford. He has 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 has published more than 300 papers, books and reviews, has been awarded 14 honorary degrees and numerous prizes and medals. He is a Fellow of the Royal Society and a Foreign Member of the U.S. National Academy of Sciences, American Philosophical Society and American Academy of Arts and Sciences. He is a cross-bencher and a member of the Science and Technology Select Committee in the House of Lords.



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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.

# Acknowledgements

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# Executive Summary

The Scottish Climate Change Act, passed in August 2009, sets out a comprehensive framework for emissions reduction in Scotland. In particular, the Act sets a long-term target to reduce emissions of Scottish greenhouse gases by 80% in 2050 relative to 1990, with an interim target to reduce emissions by 42% in 2020 relative to 1990. The Act also provides for setting of annual emissions reduction targets.

In August 2009, the Scottish Government requested advice from the Committee on Climate Change primarily relating to interim targets under the Act. Specifically, the Committee was asked to advise on:

- The highest achievable interim target for 2020,
- The first batch of annual targets from 2010-2022,
- A cumulative emissions budget for Scotland,
- The proposed methodology for inclusion of Scotland's share of international aviation and international shipping emissions and use of non-CO<sub>2</sub> multipliers,
- Limits on the use of offset credits to meet Scottish targets.

This report sets out the Committee's advice, which is structured as follows:

- Our approach is first to compare the Scottish and UK targets for emissions reduction in 2020,
- We then consider the appropriate methodology for inclusion of international aviation and shipping in Scottish targets, and implications of inclusion for required emissions reductions in other sectors,
- We propose an approach to accounting for emissions in the Scottish traded sector, and we consider potential for emissions reduction in the non-traded sector,
- We assess any gap between potential emissions reductions and Scottish targets and set out options through which this might be addressed,

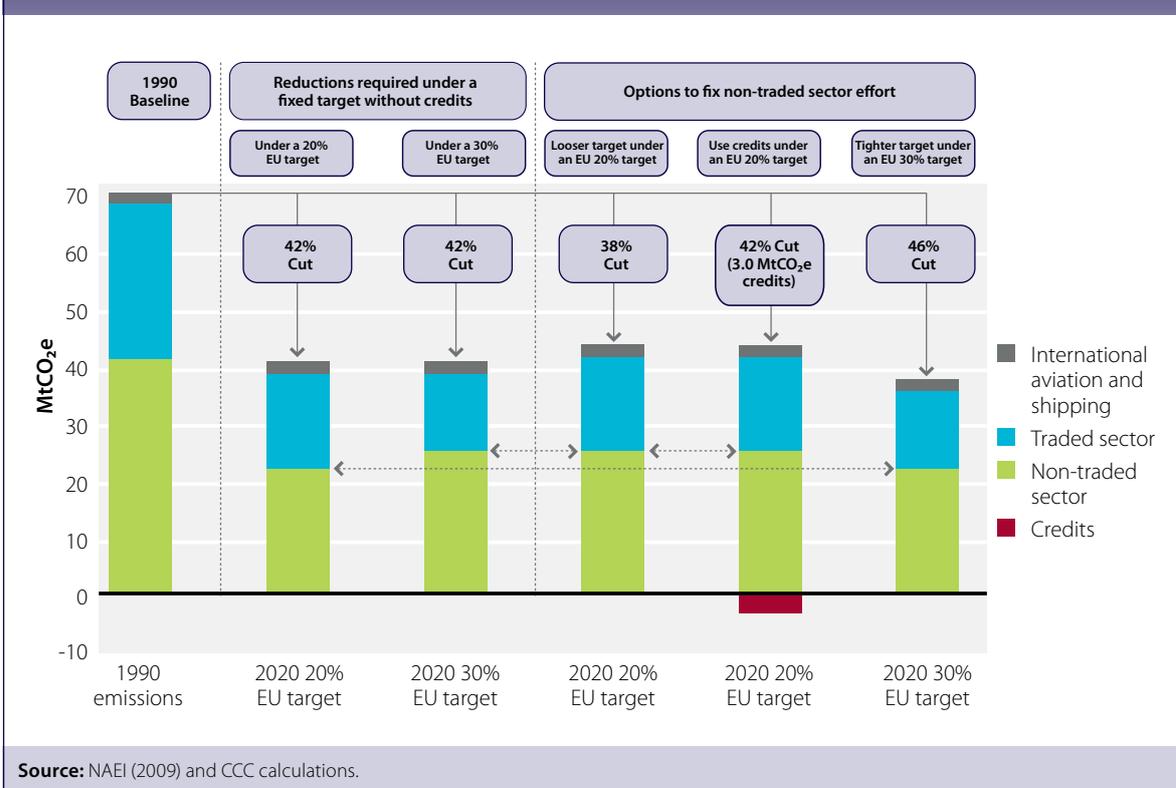
- We summarise analysis of possible broader economic and social consequences from reducing Scottish emissions.

The key messages from our analysis are:

- **The 2020 target:** the interim target in the Scottish Climate Change Act to reduce emissions by 42% in 2020 relative to 1990 is ambitious when compared to that of the UK. The UK approach is based on a 34% emissions cut in 2020 relative to 1990, rising to a 42% cut following agreement of a global deal to reduce emissions. The Scottish target is an appropriate contribution to required global emissions reductions in 2020, and is on the path to meeting the 2050 target to reduce emissions by 80%.
- **Aviation and shipping:** the Scottish Climate Change Act includes emissions from international aviation and shipping, whereas these sectors are not included in the UK framework. Given that emissions from these sectors will not fall in line with the required economy-wide 42% cut, the implication is that other sectors will have to achieve emissions cuts of more than 42%. Our analysis suggests that cuts in sectors other than aviation and shipping of 44% in 2020 relative to 1990 will be required in order that the economy-wide 42% target is achieved.
- **Traded sector emissions:** this sector comprises emissions from energy-intensive industries covered by the EU Emission Trading Scheme (EU ETS). We propose that Scottish traded sector emissions should be calculated as Scotland's share of the EU ETS emissions cap. Under this approach, traded sector emissions would be at least 39% below 1990 levels in 2020, with further cuts following a global agreement to reduce emissions triggering more ambitious EU-wide emissions reduction targets and a tighter EU ETS cap.

- **Opportunities for reducing power sector emissions:** within the traded sector, there are particular opportunities for reducing emissions in the Scottish power sector to 2020. There is an important role for the Scottish Government enabling investment in renewable electricity (e.g. through approving planning applications), both to support sector decarbonisation on the path to the longer-term 80% emissions reduction target, and to unlock employment and other economic benefits.
- **Non-traded sector emissions:** this sector comprises all emissions not covered by the EU ETS (e.g. transport, heat, agriculture, waste, etc.). Deep cuts will be required in the non-traded sector to meet the economy-wide target. There is scope for deep cuts, but new Scottish policies will be required in order that these are delivered.
  - Our analysis suggests that non-traded emissions reductions up to 47% in 2020 relative to 1990 are required in order to meet the economy-wide 42% target.
  - There is scope for significant emissions reduction in the non-traded sector through a range of measures to improve energy efficiency, to increase levels of renewable heat penetration, to improve fuel and carbon efficiency of cars and implement Smarter Choices initiatives, and to reduce agricultural emissions through a range of soils and livestock measures.
  - A step change is required in order that emissions reduction potential is unlocked, with an important role for the Scottish Government given the balance of reserved and devolved powers (e.g. in leading a national programme for energy efficiency improvement, promoting Smarter Choices and electric car initiatives, introducing new incentives for more efficient farming and land use, etc.).
- **Meeting the 2020 target following a global deal:** given appropriate policies, our analysis suggests that it could be feasible to meet the 42% target following a global deal. This would trigger a tightening of the EU ETS cap and larger emissions reductions in Scotland's net carbon account for the traded sector, leaving required emissions reductions in the non-traded sector commensurate with the feasible emissions reduction potential that we have identified.
- **Meeting the 2020 target before a global deal:** it is not clear that there is sufficient emissions reduction potential in the non-traded sector to achieve the 42% target before a global deal triggering emissions reductions in the traded sector is reached. Moreover, it is perverse that the required non-traded sector effort to meet the 42% target falls once a global deal has been reached. The Committee therefore recommends that the Scottish climate strategy should be based on aiming for a level of emissions reduction effort in the non-traded sector that is invariant to the EU framework, and proposes three options for consideration (Figure 1):
  - The Scottish target could be made conditional upon a global deal being reached, with a lower target (e.g. 38%) before there is a global deal.
  - The Scottish strategy could aim for the domestic effort expected to be required in the non-traded sector under an EU 30% target and purchase credits to meet the currently legislated target absent a global deal. However, such credit purchase would not help Scotland to be on the path to meeting the 80% emissions reduction target in 2050, and would have limited global environmental impact.
  - The Scottish strategy could aim to deliver the larger domestic emissions reductions required in the non-traded sector to achieve the 42% target before a global deal is reached, outperforming this target (e.g. a 46% reduction) following a global deal. It is not clear from our analysis, however, how such reductions could be achieved.

Figure 1 Options for meeting Scottish emissions targets and fixing effort in the non-traded sector



- **Annual Targets:** the Scottish framework is less flexible than the UK framework as it is based around targets for individual years, rather than five-year periods, and does not allow banking or borrowing between periods. This poses a risk to budget management and could lead to the need for significant credit purchase to meet targets in years of natural upward variation in emissions – for example if there is a particularly cold winter. We therefore recommend that mechanisms to add flexibility are considered.

- **Broader social and economic considerations:** Scottish emissions reduction targets can be met at manageable economic cost (e.g. of the order less than 1% of GDP to meet the 42% target following a global deal). Although there could in principle be adverse impacts for competitiveness of energy-intensive industries and fuel poverty, in practice these can be mitigated: competitiveness impacts will be addressed through the EU framework; fuel poverty impacts from higher energy prices would be offset by energy bill reductions from energy efficiency improvements, with scope for addressing residual fuel poverty through social tariffs or income transfers.

**Scotland has adopted ambitious targets including an interim target to reduce emissions by 42% in 2020, which is on track to the longer-term 80% emissions reduction target in 2050 and is an appropriate contribution to global efforts to mitigate climate change.**

**Our analysis suggests that the interim 42% target is challenging but achievable under a significantly strengthened policy framework and following a tightening of the EU ETS cap as part of a move to a 30% EU-wide target for emissions reduction.**

**It is important now that the Scottish Government commits to a clear and constant target for the non-traded sector and sets out a strategy to deliver this, including strengthening of existing policies and introduction of new policies to drive the required step change in reducing emissions from buildings, transport, electricity, agriculture and waste. Given a new policy framework, the opportunities are there for Scottish people and businesses to drive down emissions and build a low-carbon economy.**



# Chapter 1: Background and methodology for the Committee's advice under the Scottish Climate Change Act

The Climate Change (Scotland) Act, adopted in August 2009, sets out a framework for deep cuts in Scottish emissions. In particular, the Act includes ambitious targets to cut emissions in 2020 by 42% relative to 1990, and in 2050 by 80%.

In this chapter, we consider recent trends in Scottish emissions. We then summarise key aspects of the Act, and compare these with relevant aspects of the UK Climate Change Act. On the basis of this comparison, we provide a view on the level of ambition for emissions cuts in Scotland.

The key messages are:

- Scottish emissions have fallen by around 20% between 1990 and 2007, with a significant reduction expected in 2008 reflecting the impact of the economic recession.
- The 2020 emissions target in the Scottish Climate Change Act would put Scotland on track to meeting the 2050 target, and is an appropriate contribution to required global emissions cuts in 2020.
- The Scottish 2020 target is more ambitious than the target on which the currently legislated UK carbon budget is based.

We set out the chapter in five sections:

1. Scottish emissions trends
2. The Climate Change (Scotland) Act
3. Comparison of Scottish and UK frameworks
4. Considerations in setting a target for emissions in 2020
5. The Committee's approach in this report.

## 1. Scottish emissions trends

Net greenhouse gas (GHG) emissions for Scotland have fallen further since 1990 (19%) than the UK average (15%). Scottish emissions were 56.9 MtCO<sub>2</sub>e in 2007, compared to 70.0 MtCO<sub>2</sub>e in 1990; emissions fell 7% in the last year for which we have final data (2007), or 2% excluding power (Figure 1.1):

### *Domestic CO<sub>2</sub> emissions*

- Power station emissions accounted for over a quarter of Scotland's total GHG emissions in 2007. Emissions were up 1% on 1990 levels, although they dropped 17% from 2006,
- Residential emissions have continued on a long-term downwards trend, down 8% in 2007 on 1990 levels and 3% on the previous year,
- Emissions from non-residential buildings and industry accounted for 20% of Scottish GHG emissions in 2007, down 31% on 1990 levels, and 3% on the previous year,
- Transport emissions accounted for around a quarter of the Scottish GHG total in 2007, up 10% on 1990 levels, driven by increasing demand for road transport (which accounts for three-quarters of all transport emissions), and up 1% from 2006.

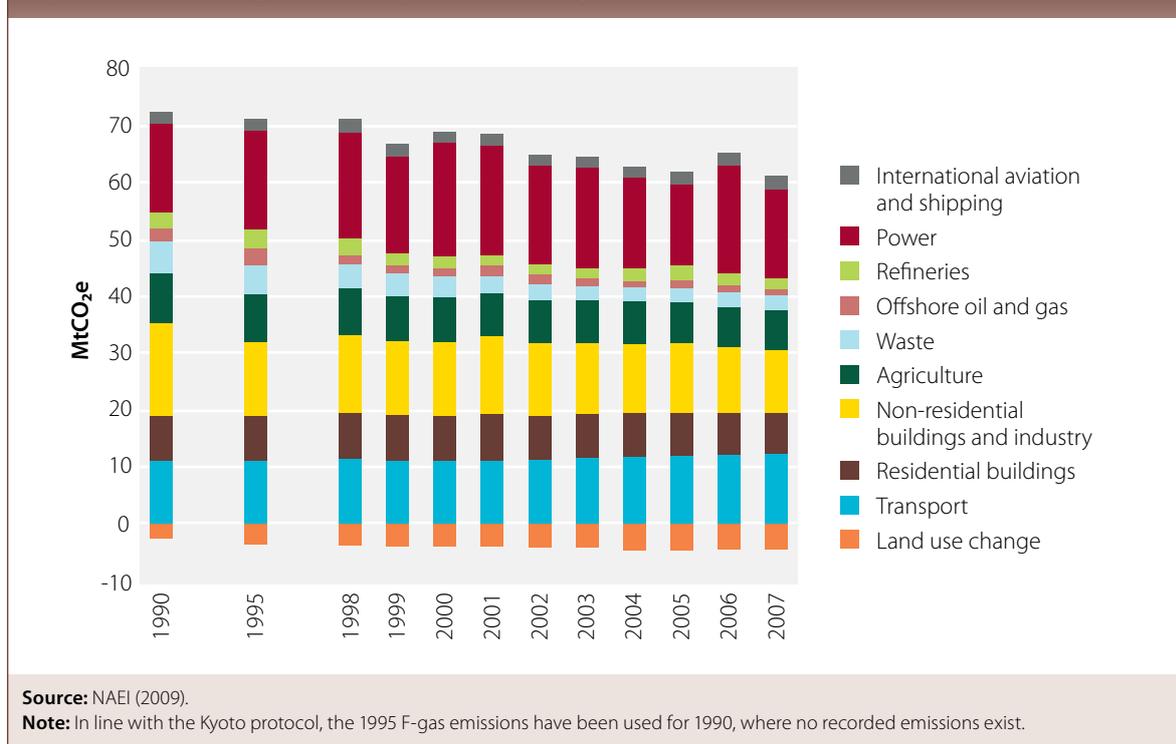
### *International aviation and shipping emissions*

- Emissions from international aviation and shipping increased by 21% from 1990 to 2007.

### *Non-CO<sub>2</sub> emissions*

- Agriculture emissions in 2007 were down 21% on 1990 levels, falling 4% from 2006,
- Waste emissions in 2007 were down 54% on 1990 levels, up 1% on the previous year.

Figure 1.1 Scottish greenhouse gas emissions by sector (1990-2007)



## 2. The Climate Change (Scotland) Act

The Climate Change (Scotland) Act was passed in August 2009. Key elements of the Act include a long-term emissions reduction target and a target for 2020 (which both include international aviation and shipping emissions), provisions for a path to 2020, and limits on the use of offset credits to meet targets:

- **The 2050 target.** The Act includes a target to cut emissions of Kyoto greenhouse gases (GHGs)<sup>1</sup> across all sectors of the Scottish economy, including international aviation and shipping, by 80% in 2050 relative to 1990.
- **The target for 2020.** On the path to the 2050 target, the Act commits Scotland to a 42% emissions reduction in 2020 relative to 1990. The target for 2020 includes emissions from international aviation and shipping.
- **The path to 2020.** The Act requires that a set of annual targets for the period to 2022 are enacted in secondary legislation following advice from the Committee. Under the Act, emissions must fall year-on-year from 2010, and by at least 3% per year from 2019 onwards.
- **Use of credits.** The Act envisages limited use of credits, with a minimum of 80% of effort met through domestic emissions reduction (i.e. a maximum of 20% of effort through purchase of offset credits).

The Committee was requested by the Scottish Government in August 2009 to advise on a range of issues relating to implementation of the Act<sup>2</sup>:

- **The 2020 target.** The Committee was asked to advise on the highest achievable target in 2020.

<sup>1</sup> The Kyoto greenhouse gases are carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and the families of F-gases – hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF<sub>6</sub>).

<sup>2</sup> The request for advice is published on the Scottish Government's website: <http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/climatechangeact/request20090828>.

- **The path to 2020.** Advice was requested on the levels at which Scotland's annual emissions targets should be set for each of the years in the period 2010-2022.
- **International Aviation and Shipping.** Advice was requested on the appropriate methodology for accounting for international aviation and shipping emissions at the Scottish level and on the use of a multiplier to reflect non-CO<sub>2</sub> impacts of aviation.
- **Offset credits.** Advice was requested on how far annual targets should be met by domestic effort or through purchase of offset credits, and specifically on limits to credit purchase in the years 2010-12.
- **Cumulative emissions.** The Committee was asked to advise on the aggregate amount of net Scottish emissions in the period 2010-2050 that would be an appropriate contribution to international action to tackle climate change.
- **Approach to international aviation and shipping.** These sectors are not included in UK carbon budgets. Assuming that Scottish aviation and shipping will not achieve a 42% emissions reduction in 2020 (e.g. net aviation emissions will remain at 95% of 2004-06 levels under the EU ETS), emissions cuts of more than 42% will be required in other sectors to achieve the economy-wide 42% target. The Scottish target therefore requires more emissions reduction against 1990 than the UK's Intended carbon budget.
- **Carbon budgets versus annual targets.** The UK framework sets carbon budgets covering five year periods, within which an emissions trajectory is not specified. This approach was adopted in order to provide some flexibility given year-on-year fluctuations in emissions (e.g. emissions are higher in a year with a cold winter). The UK approach therefore contrasts with the Scottish approach under which annual targets will be specified.

### 3. Comparison of Scottish and UK frameworks

The scope of the Scottish framework is broadly similar to the UK framework, and both frameworks are anchored in a 2050 target to reduce emissions of GHGs by 80% relative to 1990. However, there are a number of areas of difference between the two frameworks including the level of ambition prior to a global deal on emissions reduction being reached, the approach to aviation and shipping, carbon budgets versus annual targets, possible borrowing from and banking to future periods to meet targets, and the use of credits:

- **Interim versus Intended budgets.** Based on the Committee's advice, the UK adopted an approach where an Interim budget based on a 34% emissions cut in 2020 relative to 1990 has been legislated prior to a global deal on emissions reductions being agreed, with a commitment to move to the Intended budget based on an indicative 42% reduction in 2020 relative to 1990 after such a deal. The legislated 2020 target of 42% in Scotland therefore reflects the Intended budget to which the UK is committed but has not yet legislated.
- **Borrowing from future periods.** The UK Climate Change Act provides additional flexibility through allowing any gap between emissions and the budget to be covered through borrowing of up to 1% of the emissions from the next budget period. The Scottish framework does not allow borrowing of emissions from future periods.
- **The use of credits to meet targets.** The UK framework allows the purchase of credits to meet carbon budgets subject to a limit set out in secondary legislation and to be based on advice from the Committee. The legislation covering the first budget period (2008-2012) does not envisage any purchase of credits. The Scottish framework puts a limit of 20% of emissions reduction effort to be provided by credits, with limits for credit use in specific periods to be set in advance.

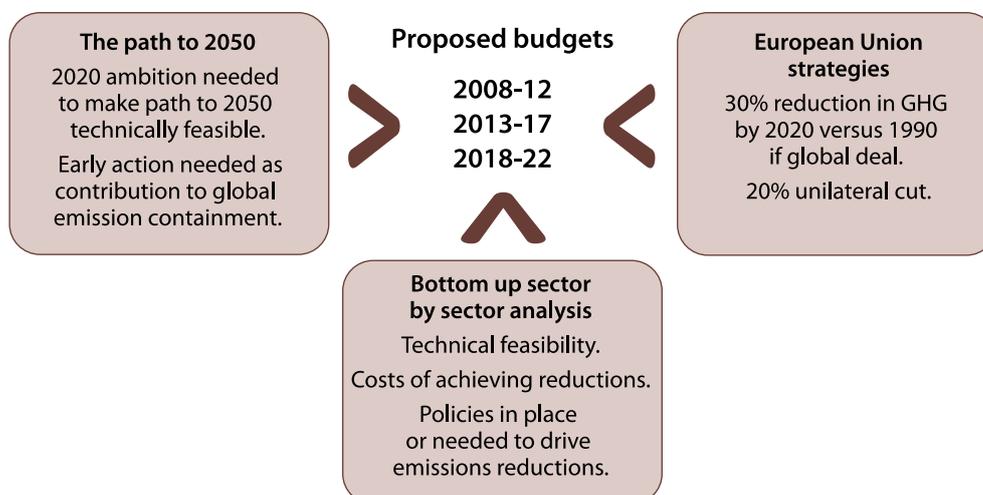
The Scottish framework is therefore more ambitious than the UK framework in at least two respects: Scotland has already committed to a level of ambition the UK has indicated it will legislate to following a global deal; inclusion of international aviation and shipping in the Scottish framework will require deeper cuts in other sectors to achieve a 42% cut than would be the case in the UK, where aviation and shipping are not included in carbon budgets. The Scottish framework also has less flexibility between years.

#### 4. Considerations in setting a target for emissions in 2020

There are four sets of factors that the Committee considered when advising the UK Government on the first three carbon budgets covering the period 2008-2022 (Figure 1.2), and which are relevant in considering the appropriate Scottish target for 2020. These are the long-term emissions reduction target, national-level implications of the global emissions trajectory, the EU framework, and potential for domestic emissions reduction:

- **Long-term target.** This has implications for the 2020 target (e.g. ambitious long-term targets at the UK and Scottish levels imply the need for significant emissions cuts in 2020) for two reasons:
  - Infrastructure assets are typically long-lived. Given the risk of locking-in to high-carbon technologies (e.g. conventional coal-fired power generation), investment in low-carbon technologies in the period to 2020 may be desirable.
  - There is a maximum feasible pace of annual emissions reductions. It is therefore not plausible to plan to achieve the long-term target only through deep emissions cuts further out in time.

Figure 1.2 Factors considered in setting the first three carbon budgets



Source: CCC (2008), *Building a low-carbon economy – the UK's contribution to tackling climate change*.

- **Global trajectory.** National targets should be consistent with global emissions reduction effort required to achieve climate change objectives. In our December 2008 report we suggested that global emissions should peak by 2020 and then fall to 50% or more below current levels by 2050. Peaking of global emissions in the period to 2020 implies the need for significant emissions cuts in developed countries given that emissions in developing countries are likely to continue to grow for an interim period.
- **EU framework.** This requires that EU emissions in 2020 are 20% below 1990 levels (the '20% world'), rising to 30% following a global deal to reduce emissions (the '30% world'). The 30% reduction is broadly an appropriate contribution to the required global emissions reduction in 2020. The EU framework has implications for Member States (e.g. in the 20% world it requires a UK emissions reduction of 34% in 2020 relative to 1990). Whilst there is no explicit cap on Scottish emissions under the EU framework, Scotland will be directly affected by the EU Emissions Trading Scheme (EU ETS) and indirectly affected by obligations that the EU framework places on the UK.
- **Potential for emissions reduction.** It is important that emissions targets are achievable. The 2020 target should therefore reflect feasible and affordable potential for emissions reduction in Scotland.

### Appropriateness of Scottish emissions targets

Our recommendations at the UK level were that the Interim budget is sufficiently ambitious to be on the path to meeting the 2050 target to reduce emissions by 80% in 2050 relative to 1990. However, deeper cuts as embodied in the Intended budget are required as part of international efforts to ensure that global emissions peak in the period to 2020. Therefore the Scottish legislated target, which is more ambitious than the Intended budget, is on track to meeting the 2050 target and contributes sufficiently to required global emissions cuts.

In the UK case, we showed how both Interim and Intended budgets could be achieved based on domestic emissions reductions. We consider the extent to which the Scottish 2020 emissions reduction target is achievable in Chapter 4.

## 5. The Committee's approach in this report

In this report we first consider the implications of inclusion of international aviation and shipping in the Scottish emissions target for emissions reductions in other sectors. We then set out our recommendations on the appropriate treatment of emissions for the Scottish traded sector (i.e. energy-intensive firms including power generation in the EU ETS). We next set out our assessment of potential for emissions reductions in the non-traded sectors (e.g. heat, transport, agriculture). Given this assessment, we set out options for meeting the 2020 target including introduction of new policies and the purchase of credits, together with an assessment of the appropriate path to 2020 and options to provide greater flexibility along this path. Finally, we consider the broader economic and social circumstances set out in the Act and conclude with the next steps for implementing the Scottish climate change mitigation framework.



# Chapter 2: International aviation and shipping

The Scottish Climate Change Act includes international aviation and shipping emissions in its targets. This is in contrast to the UK framework, where carbon budgets exclude emissions from these sectors.

This chapter considers methodologies for including aviation and shipping emissions in the Scottish target, together with implications for emissions reduction in other sectors given the likely path of emissions in aviation and shipping.

The key messages are:

- Pending an international agreement or development of more accurate methodologies, inclusion of aviation emissions in Scottish targets should be on the basis of bunker fuel emissions at the UK level allocated to Scotland on the basis of the Scottish share in departing flights. Going forward, net emissions should be assumed to follow the trajectory set in the EU ETS.
- Inclusion of international shipping emissions should be on the basis of bunker fuel emissions at the UK level allocated to Scotland on the basis of Scottish share in port activity.
- Given likely trajectories for emissions from international aviation and shipping, emissions reductions in other sectors of 44% in 2020 will be required to achieve the economy-wide 42% target.

The chapter is set out in four sections:

1. Methodology for including international aviation emissions in the target
2. Methodology for including international shipping emissions in the target
3. Implications of including international aviation and shipping emissions
4. Non-CO<sub>2</sub> emissions from aviation.

## 1. Methodology for including international aviation emissions in the target

There is currently no agreed methodology for allocating emissions from international aviation to individual countries. The United Nations Framework Convention on Climate Change (UNFCCC) has recommended that four methodologies be considered further: bunker fuels, nationality of airline, departures/arrivals on an aircraft basis, departures/arrivals on a passenger basis (Box 2.1).

In our December 2008 report we showed that for the UK, each of these methodologies allocates a similar percentage (7-8%) of total global emissions.

In the Scottish case, however, it is likely that these methodologies would give differing estimates, for example if much of the bunkering for Scottish flights occurs outside Scotland.

### Box 2.1 Alternative approaches to measure international aviation emissions

There are several possible ways to determine a country's share of international aviation emissions. The UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) recommend four methodologies for further consideration:

- **Bunker fuels:** Emissions from fuel used for international flights and sold in the UK would be attributed to the UK (this is the methodology used to report international aviation emissions to the UNFCCC as a memorandum item),
- **Airline nationality:** Emissions from British airlines would be attributed to the UK,
- **International departures and arrivals on an aircraft basis:** Emissions of out-bound flights from the UK would be attributed to the UK while emissions of the return flight would be attributed to the destination country,
- **International departures and arrivals on a passenger basis:** Emissions of out-bound flights from the UK, adjusted by a passenger-km index, would be attributed to the UK.

In order to estimate Scotland's share of UK aviation emissions, the Scottish Government commissioned AEA Technology to develop a methodology for allocating a share of UK bunker fuels to Scotland on the basis of departing flights from Scottish airports relative to the UK total. Under this methodology, Scottish international aviation emissions are estimated to have been 0.4 MtCO<sub>2</sub> in 1990, from a UK total of 15.9 MtCO<sub>2</sub> (2.5% of the UK total), rising to 1.1MtCO<sub>2</sub> in 2007 (3% of the UK total).<sup>3</sup>

<sup>3</sup> NAEI (2008) *Greenhouse Gas Emissions Data for International Aviation and Shipping, 1990-2006*, <http://www.naei.org.uk/reports.php>.

In our report on UK aviation in December 2009, we proposed that measurement of aviation emissions on a bunker fuels basis is appropriate for the time being, in keeping with the current convention (e.g. the UK's inventory and the UNFCCC's National Register both record aviation emissions on a bunker fuels basis). We noted that going forward more precise measures based on flight specific fuel consumption data may become available, particularly when aviation enters the EU ETS in 2012 (airlines will then have to submit actual fuel use and emissions data for all flights to/from Europe to the relevant authorities). The Committee therefore accepts that the proposed (AEA) methodology is currently an appropriate basis for measuring Scottish aviation emissions, whilst noting that more precise methodologies may become available over time.

## 2. Methodology for including international shipping emissions in the target

There is currently no accepted methodology for accurately allocating shipping emissions between countries (Box 2.2). Allocation of international shipping emissions to the UK level gives a wide range under alternative methodologies. On a bunker fuels basis, the UK was responsible for 9 MtCO<sub>2</sub> shipping emissions in 2000, of which two-thirds was international. On a freight tonne loaded basis, UK emissions could already be 17 MtCO<sub>2</sub>, rising to 28 MtCO<sub>2</sub> by 2020. It is not clear which of these or other methodologies best reflect actual UK shipping emissions, nor which is likely to be consistent with any future international agreement on shipping emissions.

### Box. 2.2 Alternative approaches to measure international shipping emissions

Allocating global international shipping (ships and cargo) emissions to the country level is more difficult than for aviation, and similar allocation methodologies to those listed in Box 2.1 produce a far greater range of emissions estimates. Bunker fuels, ship nationality and ship departures are possible options, with freight tonne miles the relevant index in place of passenger-km.

In our December 2008 report we illustrated that on a ship departure or cargo basis UK estimates of international shipping could be two or three times greater than corresponding bunker fuels estimates due to international shipping having different traffic and bunkering patterns from those of international aviation.

The Scottish Government commissioned AEA Technology to develop a methodology for estimating Scottish international shipping emissions. The approach recommended by AEA is based on UK bunker fuel emissions disaggregated on the basis of Scottish port activity. Under this approach, Scottish international shipping emissions in 1990 were estimated to be 1.6 MtCO<sub>2</sub>e (23% of the UK total), and 1.2MtCO<sub>2</sub>e in 2007 (17% of the UK total).

The Committee accepts that this methodology is currently the best option to account for shipping emissions under the Scottish Climate Change Act. However, we cannot be confident that it accurately reflects underlying Scottish shipping emissions, nor that it will be consistent with future methodologies adopted under an international agreement. Development of a methodology to better reflect Scotland's share of international shipping emissions may require data that is currently not available (e.g. freight tonne-miles). It is important to note that a new methodology could increase estimated Scottish international shipping emissions, which would require more emissions reductions in other sectors to achieve a given economy-wide emissions target.

### 3. Implications of including international aviation and shipping emissions

At the UK level, the emissions reduction target under the Intended budget is 42% in 2020 relative to 1990 excluding international aviation and shipping emissions. Emissions from aviation (both domestic and international) are however reflected in the target:

- 42% for the UK in other sectors is consistent with the EU's target to reduce emissions by 30% in 2020 relative to 1990 across all sectors (including aviation),
- EU targets for non-aviation sectors are tighter than they would otherwise be to reflect the fact that aviation emissions in 2020 will be 95% of 2004-06 levels under the current cap for aviation within the EU ETS.

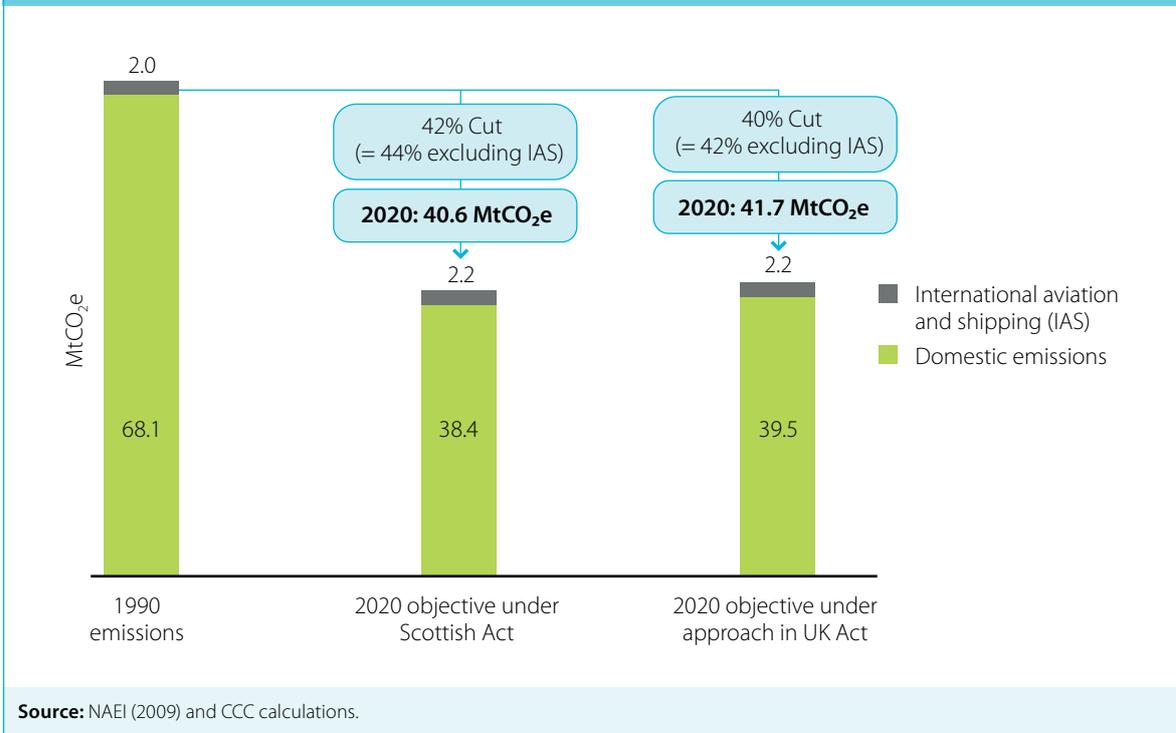
In the Scottish case, international aviation and shipping emissions are explicitly included in the 2020 target. The Committee recommends that international aviation emissions should be included in the Scottish carbon account on a net basis (i.e. after any purchase of credits, and therefore at the level of the EU ETS cap), subject to the caveat that it is not prudent that the aviation industry should plan for large-scale purchase of credits in the period to 2020. Under methodologies that allocate a share of UK bunker fuels to Scotland as described above, net international aviation emissions rise considerably, while international shipping emissions fall slightly:

- International aviation emissions in 1990 were 0.4 MtCO<sub>2</sub>, and will be 1.0 MtCO<sub>2</sub> in 2020 (150% increase) under the current EU ETS cap,
- International shipping emissions in 1990 were 1.6 MtCO<sub>2</sub>e, and are projected to reduce to 1.2 MtCO<sub>2</sub>e in 2020 (21% decrease) in a business as usual scenario<sup>4</sup>.

Emissions reductions in other sectors will therefore have to be higher than 42% in order that an economy-wide target of 42% is achieved. Specifically, emissions reductions of 44% in 2020 relative to 1990 are required in other sectors given international aviation emissions under the current EU ETS cap and business as usual emissions projections for international shipping (Figure 2.1). The incremental emissions reduction effort required due to inclusion of international aviation and shipping is around 1.1 MtCO<sub>2</sub>e in 2020.

<sup>4</sup> Scotland's international shipping emissions were forecast using the model developed for the CCC by Cambridge Econometrics (see Chapter 4). Non-CO<sub>2</sub> emissions are assumed to follow trends in CO<sub>2</sub> emissions.

**Figure 2.1** Required emissions reductions for Scotland with and without international aviation and shipping



#### 4. Non-CO<sub>2</sub> emissions from aviation

The Scottish Government has asked the Committee to advise on the appropriate approach to non-CO<sub>2</sub> effects of aviation. The Committee considered these effects in our report *Meeting the UK aviation target – options for reducing emissions to 2050*<sup>5</sup>. We concluded that whilst the precise scale of these effects is unclear and there are significant scientific uncertainties still to be resolved, it is highly likely that they are significant. It will therefore be important that they are accounted for in future international policy frameworks and in the overall UK policy framework for emissions reduction.

There are a number of ways in which these non-CO<sub>2</sub> effects could be incorporated into UK and Scottish targets (as discussed in *Meeting the UK aviation target*) but it is unclear what the most appropriate response is at this stage, particularly as most of the non-CO<sub>2</sub> effects are not covered by the Kyoto basket of gases. The Committee therefore recommends that Scottish targets do not take non-CO<sub>2</sub> effects into account for the time being (i.e. any multiplier should currently be set at 1)<sup>6</sup>. Future work of the Committee will consider the implications of including non-CO<sub>2</sub> effects and the latest scientific understanding relating to the global warming effects in more detail.

<sup>5</sup> See Chapter 6 of that report for more detail, available at: <http://www.theccc.org.uk/reports/aviation-report>.

<sup>6</sup> In considering the use of multipliers for aviation we have focused on the potentially significant effects that are not currently captured in conventional emissions accounting. There is additionally a very small amount of methane and nitrous oxide attributed to aviation in the NAEI. Scotland's share of these emissions should be included in emissions targets, and are included in our analysis in this report.



# Chapter 3:

## The traded sector target

The Scottish traded sector comprises power generation and other energy-intensive industries. In this chapter, we propose an approach to accounting for emissions from the traded sector. We also consider the role of power sector decarbonisation in meeting the 2020 and 2050 targets, and highlight levers for the Scottish Government to support power sector decarbonisation.

The key messages in the chapter are:

- The Scottish traded sector is part of the wider and capped European traded sector. It should therefore be regarded as having a cap which tracks the European cap.
- We estimate a Scottish cap which requires a 28% reduction in emissions in 2020 relative to 2005 (39% relative to 1990) under the currently legislated EU target to reduce economy-wide emissions by 20% in 2020 relative to 1990. When the EU increases its economy-wide ambition to a 30% cut in 2020, the Scottish cap would become tighter, requiring an indicative 42% cut in 2020 relative to 2005 (50% relative to 1990).

- There is a very good opportunity for investment in renewables in Scotland given scheduled retirement of existing plant and abundant wind and other renewable resources. There is an important role for the Scottish Government within the UK framework in supporting low-carbon investment, particularly as regards granting planning approval for investments in both generation and transmission.

We set out the chapter in three sections:

1. Overview of the Scottish traded sector
2. Setting the traded sector cap
3. Power sector decarbonisation.

## 1. Overview of the Scottish traded sector

We have defined the traded sector in the UK context as those firms that will be included in the EU ETS. Under this approach, the traded sector in Scotland comprises power generation, cement, chemicals, gas production, food and drink, glass, offshore oil and gas, pulp and paper, refineries, some services and domestic aviation<sup>7</sup>.

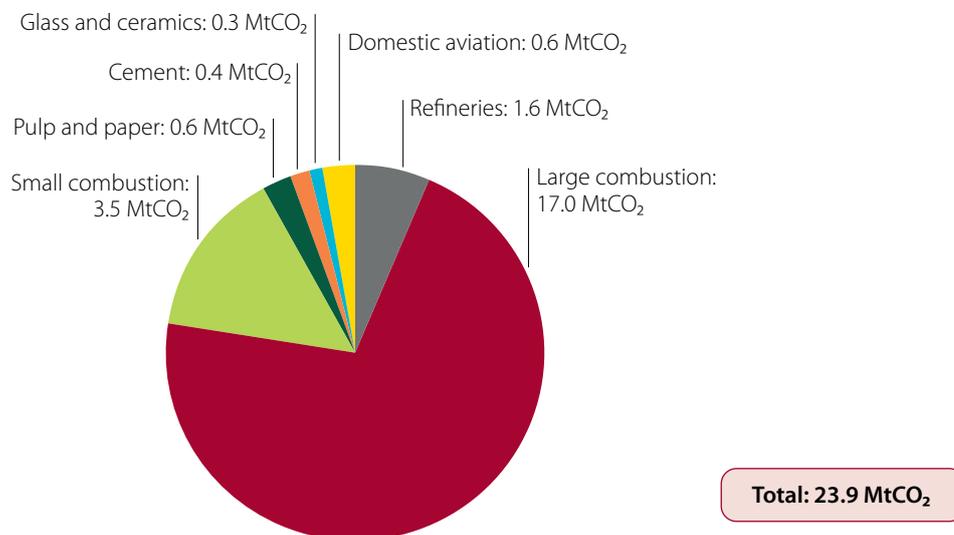
Traded sector emissions have fallen by 11% in the period between 1990 and 2007 (15% from 1990 to 2005). Traded sector emissions accounted for 42% of total emissions in 2007. Within the traded sector, power generation accounts for 65% of emissions, with refineries, offshore oil and gas and chemicals also important (Figure 3.1).

## 2. Setting the traded sector cap

As in the UK framework, the Scottish Climate Change Act measures traded sector emissions on a net carbon account basis – that is, net of any purchase of emissions allowances and offset credits by firms within the EU ETS. In advising on UK carbon budgets, the Committee worked from the EU traded sector cap:

- The traded sector cap at the EU level requires that emissions are reduced by 22% in 2020 relative to 2005 levels in the context of the current economy-wide target to reduce emissions by 20% in 2020 relative to 1990.

**Figure 3.1** Scottish traded sector emissions by sub-sector (2007)



**Source:** NAEI (2009) and EU ETS verified emissions data.

**Note:** Large Combustion covers combustion plants with emissions exceeding 0.25MtCO<sub>2</sub>, and includes emissions from large power plants. Sources are defined by EU ETS activity codes, and include installations that opted-out from Phase I.

<sup>7</sup> Domestic aviation will not enter the Scheme until Phase III (2013-2020), but for consistency we include it in the traded sector throughout our analysis. We exclude international aviation, since it is dealt with in Chapter 2 and could in future be included in a separate global agreement.

- Following a successful global deal that would trigger the EU's economy-wide target to reduce emissions by 30% in 2020 relative to 1990, the European Commission (EC) has proposed an indicative tightening of the traded sector cap to deliver emissions reductions of 37% in 2020 relative to 2005. There remains significant uncertainty around this proposal as the final decision will be the result of further international negotiation (Box 3.1).

### Box 3.1 Uncertainties in the 30% world

The EC proposed a climate change package in January 2008, some elements of which were not included in the final package agreed in December 2008. Key elements not agreed were:

- The split of emissions reduction effort between the traded and non-traded sectors,
- Burden shares between Member States,
- The treatment of industries potentially at risk of carbon leakage.

Agreement of these issues will be reached through international negotiation, the results of which are difficult to predict. The likely traded sector caps at the UK and Scottish levels are therefore also highly uncertain. The figures quoted in this chapter are based on those agreed in December 2008 where relevant and on the proposals made by the EU in January 2008 otherwise. They would need to be revised following finalisation of the EU package in a transition to the 30% world.

For the first two phases of the EU ETS, each country devised its own National Allocation Plan (NAP); from 2013 (Phase III), there will no longer be allocations on a Member State basis. National level caps can however be derived using a methodology that reflects Member States' rights to revenues from EU ETS auctions, and free allowances distributed to firms within their jurisdiction.

Applying this methodology in the case of the UK requires that traded sector emissions are 29% below 2005 levels for a 20% EU economy-wide emissions reduction target, and 42% below 2005 levels under the proposals for a 30% EU target.

We have extended this methodology to derive caps for the Scottish traded sector corresponding to the EU's 20% and 30% economy-wide emissions reduction targets (Box 3.2 and Table 3.1):

- For a 20% EU economy-wide target, the Scottish traded sector cap requires that emissions in 2020 are 28% below 2005 levels, or 39% below 1990,
- For a 30% EU economy-wide target, the traded cap tightens such that emissions in 2020 are 42% below 2005 levels, or 50% below 1990.

**Table 3.1** Traded sector emissions reduction under the EU ETS cap for the EU, the UK and Scotland

	2005-2020 under 20% EU target	2005-2020 under 30% EU target
EU	22%	37%
UK	29%	42%
Scotland	28%	42%

Source: CCC calculations.

### Box 3.2 Setting a cap for the Scottish traded sector

To estimate a traded sector cap for Scotland requires an estimate of allowances that will be freely allocated to EU ETS installations in Scotland and an assumption over Scotland's share of UK auctioned allowances.

• **Allocated allowances:** Under the EU package, allowances for each year in Phase III will be allocated to installations in certain sectors based on benchmarks (representing the average performance of the 10% most efficient installations in a sector or sub-sector), where feasible. However, as these benchmarks have yet to be determined, UK legislated budgets assume free allowances will be allocated to installations as a proportion of their verified emissions from 2005-2007 (Phase I), scaled down over time at the same rate as the overall cap for the EU traded sector (as benchmarks will be). We calculate Scotland's freely allocated allowances by applying the same proportion to verified 2005-07 emissions for those parts of the sector that will be allocated free allowances (allowing for the move towards full auctioning for all sectors).

• **Auctioned allowances:** At the EU level, the overall cap is also linked to 2005-07 verified emissions, with the remaining allowances after allocation available for auctioning. Some of the rights to these revenues will be held at the EU level to fund support for CCS demonstration projects. The rest will be shared between Member States with some redistribution on the basis of national income, meaning the UK will receive a below average share due to its relatively high income level. We assume that the Scottish share of UK auctioned allowances is equal to the Scottish share of UK verified emissions in 2005-07 for those parts of the sector that will not receive freely allocated allowances (i.e. we assume that auctioned allowances in Scotland fall at the same rate as in the UK). We also assume that net emissions from domestic aviation fall to 95% of their 2004-06 level by 2020.

Under the EU burden sharing methodology, the UK auction pot falls more quickly over the period to 2020 than allocations of free allowances. Relative to the UK, a greater proportion of Scotland's 2005-07 traded sector emissions lie in sectors with high levels of auctioning planned for Phase III. Scotland's traded sector cap therefore declines slightly quicker overall than the UK average. However, for comparisons to 2005 the declines are similar, as Scotland's emissions in 2005 were relatively low compared to the 2005-07 average.

**Table B3.2** Calculating a traded sector cap for Scotland

		Emissions share – Auctioned	Emissions reduction – Auctioned (2020 versus 2005-07)	Emissions reduction – Allocation (2020 versus 2005-07)	Reduction in traded sector emissions in 2020 versus 2005-07	2005 emissions as proportion of 2005-07 average	Reduction in traded sector emissions in 2020 versus 2005
20% EU target	<b>UK</b>	68%	38%	23%	33%	96%	29%
	<b>Scotland</b>	75%	38%	23%	34%	93%	28%
30% EU target	<b>UK</b>	68%	50%	37%	45%	96%	42%
	<b>Scotland</b>	75%	50%	37%	46%	93%	42%

**Source:** CCC calculations.

**Note:** Total reductions also reflect small shares of domestic aviation (1% in the UK, 3% in Scotland).

### 3. Power sector decarbonisation

The traded sector cap will by definition be exactly achieved so long as the EU ETS cap is in place: to the extent gross emissions exceed the cap, these will be offset by purchase of credits (European Union Allowances or offset credits) as required under the EU ETS. However, given that Scotland has an 80% target to reduce emissions, it is important not only that the traded sector cap is achieved, but that the way this is achieved is consistent with the longer-term path to an 80% emissions reduction in 2050 relative to 1990. Specifically, this path requires early decarbonisation of the power sector, and extension of low-carbon power to other sectors, namely through electric forms of transport and heat.

At the UK level, the Committee's analysis suggests that there is scope to cut power sector emissions in 2020 by around 50% relative to current levels, for example through adding 23 GW of wind capacity and up to four carbon capture and storage (CCS) demonstration plants, with up to three new nuclear plants by 2022. Such a pattern of investment would put the UK on track to achieving the deep power sector decarbonisation required through the 2020s in the context of the UK's 80% target for 2050.

There is scope for power sector decarbonisation in Scotland given scheduled retirement of 1,200 MW of coal-fired plant in 2016, which could be replaced by investment in wind generation (e.g. 30% of the UK's onshore wind capacity is in Scotland), marine (e.g. Pentland Firth), and CCS (e.g. Scottish Power has one of two remaining proposals in the UK's competition for CCS demonstration funding). There will also be the need to replace existing low-carbon capacity as the nuclear power stations at Hunterston and Torness reach the scheduled ends of their lives (in 2016 and the 2020s, respectively).

There are currently no plans to add nuclear capacity in Scotland. The Committee's position on nuclear is that this is likely to be an economic form of low-carbon generation, with a potentially important role if concerns around safety and waste disposal are adequately addressed.

The policy framework to support required investment in low-carbon generation will comprise elements at EU, UK and Scottish levels:

- The carbon price will be determined at the EU level, with possible measures to strengthen the carbon price set by the UK Government,
- Financial support for renewables will be determined by the UK Government, with transmission access rules set by Ofgem,
- Possible mechanisms in addition to the carbon price (e.g. low-carbon obligation, emissions performance standard, etc.) will be determined by the UK Government,
- Planning applications (e.g. for renewables projects and transmission infrastructure) will be considered by the Scottish Government.

Given that planning has been a major barrier to renewables projects and their connection in recent years, there is a crucial role for the Scottish Government in ensuring that projects gain planning approval going forward, both as regards renewable generation and supporting investments in transmission network strengthening and expansion. For example, the January 2010 approval of the Beaully-Denny transmission line upgrade is an important milestone in this process. Devolved levers relating to research and development and skills policies will also have a role in supporting the deployment of low-carbon power sources.



# Chapter 4:

## Reducing emissions in the non-traded sector

The Scottish non-traded sector includes emissions from heating, transport, agriculture and waste. Required emissions reduction in the non-traded sector can be derived from the 42% economy-wide emissions reduction target, together with assumptions on future emissions in the traded sector and in international aviation and shipping.

In this chapter we estimate required emissions reduction for the non-traded sector. We then assess scope for emissions reductions based on disaggregation of UK-level analysis. We set out emissions scenarios and compare these with emissions targets, and highlight areas where the Scottish Government can support required policy strengthening in order to unlock abatement potential.

The key messages are:

- Given that the traded sector cap is effectively set at the EU level, more ambition in the Scottish target translates directly into a need for greater effort in the non-traded sector.
- With a fixed economy-wide 2020 target for Scotland of a 42% emissions reduction, the required effort in the non-traded sector is greatest under an EU target to reduce emissions by 20% in 2020 relative to 1990. Under this assumption, a non-traded sector emissions reduction of 32% in 2020 relative to 2005 (47% relative to 1990) is required in Scotland in order to achieve the 42% target.
- The effect of tightening the EU target following an international agreement is that the required balance of effort between the Scottish traded and non-traded sectors would shift. While the traded sector cap would tighten, required emissions reduction in the non-traded sector would fall to 22% in 2020 relative to 2005 (39% relative to 1990).

- There is likely to be sufficient emissions reduction potential to meet the 42% Scottish target, following tightening of the EU ETS cap for a 30% EU target. However, it is not clear how the target could be met through domestic emissions reduction effort in a world with a 20% EU target.
- Policy strengthening at the UK and Scottish levels will be required in order that emissions reduction potential is unlocked.

The chapter is set out in four parts:

1. The non-traded sector target
2. Emissions reduction potential
3. Emissions scenarios for the non-traded sector
4. Scottish levers for unlocking emissions reduction potential.

### 1. The non-traded sector target

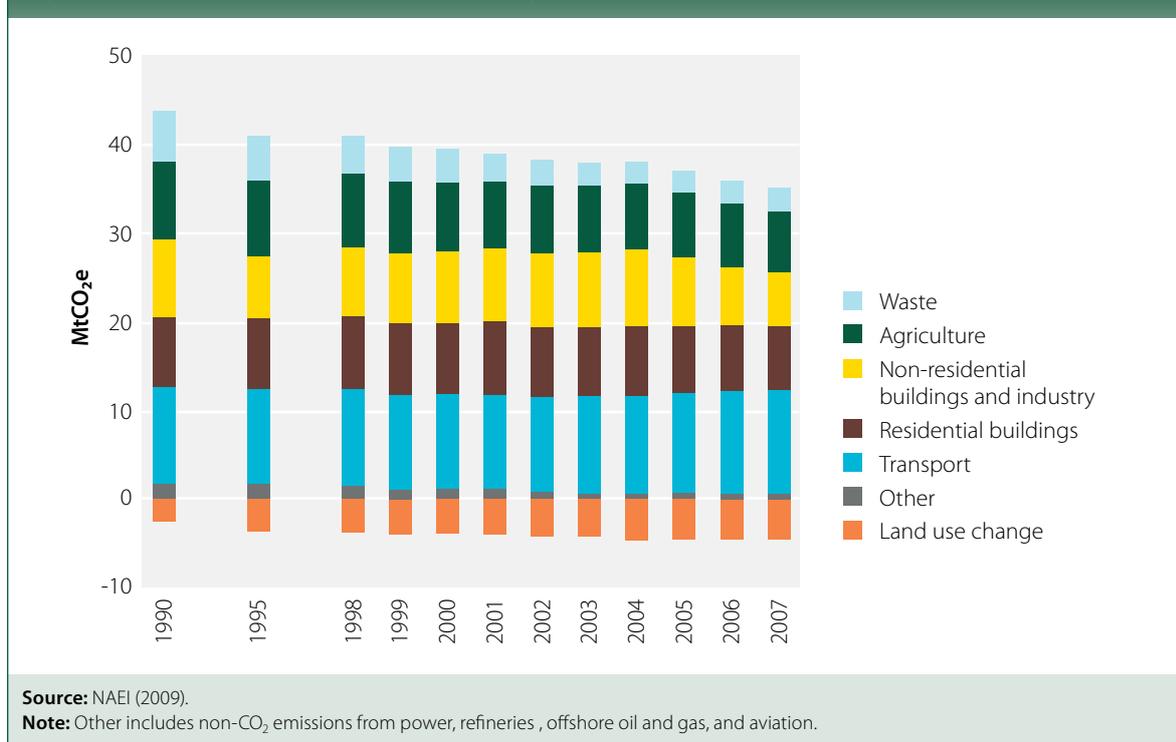
#### Non-traded sector emissions trends

The non-traded sector comprises all emissions not covered by the EU ETS. The main source sectors are surface transport, residential, commercial and public sector buildings, agriculture, waste, and land use, land use change and forestry (LULUCF)<sup>8</sup>. Non-traded sector emissions in Scotland have fallen by 26% in the period from 1990 to 2007, and by 3% from 2006 (Figure 4.1):

- Non-traded sector emissions from buildings and industry have fallen by 20% since 1990, driven by improvements in energy efficiency in buildings and industry and the changing composition of industrial output,
- Emissions from transport have increased by 7% over the period since 1990, driven by increases in demand for mobility,

<sup>8</sup> For the purposes of this chapter we exclude emissions from international shipping, since these are dealt with in chapter 2 and could be affected by any future global agreements on their treatment.

Figure 4.1 Scottish non-traded emissions by sector (1990-2007)



- Emissions from agriculture have fallen by 21% since 1990, driven by falling livestock numbers and reducing fertiliser use,
- Net removals from LULUCF have increased by 76% since 1990, largely as a result of increased tree-planting between the 1970s and 1990,
- Emissions from waste have fallen by 54% since 1990, as waste was diverted away from landfill.

### The non-traded sector emissions target

The target for reduction of non-traded sector emissions in Scotland follows from analysis in previous chapters:

- Analysis in Chapter 2 suggests that achieving the Scottish target to reduce emissions by 42% in 2020 relative to 1990 (29% relative to 2005) would require emissions reductions of 44% relative to 1990 (30% relative to 2005) in sectors other than aviation and shipping,
- Analysis in Chapter 3 suggests that traded sector emissions in 2020 will be 28% below 2005 levels (39% below 1990) for an EU-wide target to reduce emissions by 20% in 2020 relative to 1990, and 42% below 2005 levels (50% below

1990) for an EU-wide target to reduce emissions by 30% in 2020 relative to 1990.

The target for the non-traded sector can then be calculated as total allowed emissions in sectors other than international aviation and shipping net of the traded sector cap. With a fixed Scottish economy-wide target, a lower EU target (implying a looser cap for the traded sector) will translate directly to a need for greater effort in the Scottish non-traded sector (Table 4.1):

- Given an EU-wide target to reduce emissions by 20% in 2020, allowed non-traded sector emissions in 2020 are therefore 22.0 MtCO<sub>2</sub>e, implying a non-traded sector emissions reduction of 32% in 2020 relative to 2005 (47% relative to 1990),
- Given an EU-wide target to reduce emissions by 30% in 2020, allowed non-traded sector emissions in 2020 are 25.0 MtCO<sub>2</sub>e, implying a non-traded sector emissions reduction of 22% in 2020 relative to 2005 (39% relative to 1990).

**Table 4.1** Emissions reductions required in 2020 to meet an economy-wide 42% target

	20% EU target	30% EU target
<b>1990 emissions (MtCO<sub>2</sub>e)</b>	<b>70.0</b>	
1990 international aviation and shipping emissions	2.0	
1990 traded sector emissions	26.9	
1990 non-traded sector emissions	41.2	
<b>2020 emissions targets (MtCO<sub>2</sub>e)</b>	<b>40.6</b>	<b>40.6</b>
2020 international aviation and shipping emissions projection	2.2	2.2
2020 traded sector target	16.4	13.4
2020 non-traded sector target	22.0	25.0
<b>Required emissions reduction 1990-2020</b>	<b>42%</b>	<b>42%</b>
International aviation and shipping reduction	-14%	-14%
Traded sector reduction	39%	50%
Non-traded sector reduction	47%	39%

**Source:** NAEI (2009) and CCC Calculations.

**Note:** figures may not sum due to rounding.

In chapter 5 we discuss the implications of effort required in the non-traded sector being reduced in a world where the EU target is 30% because emissions reduction in the traded sector is increased.

### Non-traded sector reference emissions projections

In assessing scope for meeting the non-traded sector emissions target, we start by setting out reference emissions projections designed to reflect possible outcomes in the absence of new emissions reduction policies.

We commissioned Cambridge Econometrics to develop reference projections for CO<sub>2</sub> emissions from buildings and industry and non-road transport:

- This work<sup>9</sup> took as its starting point our previous emissions projections for the Devolved Administrations. It uses UK government projections produced by DECC and disaggregates these to the Scottish level under assumptions about the relationship between Scottish and UK energy demand.

- The reference projections are based on DECC's fossil fuel price assumptions, GDP assumptions from HM Treasury, population assumptions from the General Register Office for Scotland, and official estimates of emissions reductions from firm and funded emissions reduction policies (e.g. the Carbon Emissions Reduction Target, the Renewable Transport Fuels Obligation, etc.)<sup>10</sup>.

For emissions projections for road transport, non-CO<sub>2</sub> emissions and CO<sub>2</sub> emissions from LULUCF, we have used projections produced by the Transport Model for Scotland, National Atmospheric Emissions Inventory<sup>11</sup> and the Centre for Ecology and Hydrology<sup>12</sup> respectively.

Reference emissions projections in 2020 are up to 7% above current levels (Figure 4.2):

<sup>9</sup> Cambridge Econometrics (2009), *Assessing the appropriate methodology for projecting Scottish CO<sub>2</sub> emissions to 2030*.

<sup>10</sup> All policies included in the Climate Change Programme 2006 are included, with policies introduced or announced in the Energy White Paper 2007 or thereafter excluded.

<sup>11</sup> NAEI (2009), *Non-CO<sub>2</sub> greenhouse gas projections for England, Scotland, Wales and Northern Ireland*, <http://www.naei.org.uk/reports.php>.

<sup>12</sup> Projections available at: <http://www.edinburgh.ceh.ac.uk/ukcarbon/invproj.htm>.

- Under central case assumptions about fossil fuel prices, GDP growth and population growth, emissions rise by 4% in the period to 2020. The main upward drivers here are GDP growth, and declining removals from LULUCF, with offsetting emissions reduction due to increasing fossil fuel prices and the impact of the firm and funded emissions reduction policies (e.g. for energy efficiency improvement, biofuels, etc.),
- In a high fossil fuel price scenario, emissions rise 2% on 2007 levels by 2020 (i.e. there is some energy demand response to higher prices resulting in lower emissions than under central case assumptions),
- In a low fossil fuel price scenario, emissions increase by 7% in the period to 2020.
- Reference emissions projections for transport are 3% lower than current levels, as increased use of biofuels offsets increased demand for mobility,
- Reference emissions projections for agriculture are 7% higher than current levels, driven by increases in N<sub>2</sub>O emissions from agricultural soils, and slight increases in methane from agricultural sources, such as enteric fermentation from cattle. Reference emissions projections for LULUCF are 66% higher than current levels, driven by reduced removals following a reduction in tree-planting rates since 1990,
- Reference emissions projections for waste are 8% lower than current levels, driven by further reductions in waste being sent to landfill.

Reference emissions projections at the sectoral level rise or fall relative to current levels depending on the sector (Figure 4.3):

- In the central case, reference emissions projections for buildings and industry are 10% lower than current levels, with energy efficiency improvements more than offsetting increased energy demand due to GDP growth,
- Under central case assumptions, and assuming an EU-wide target to reduce emissions by 20% in 2020, non-traded sector reference emissions projections are 10 MtCO<sub>2</sub>e higher than the target in 2020,

### Gap between reference projections and the target

Reference emissions projections are 6 to 11 MtCO<sub>2</sub>e above the level required to meet the 42% economy-wide target in 2020:

**Figure 4.2** Emissions projections for the Scottish non-traded sector (2007-2020)

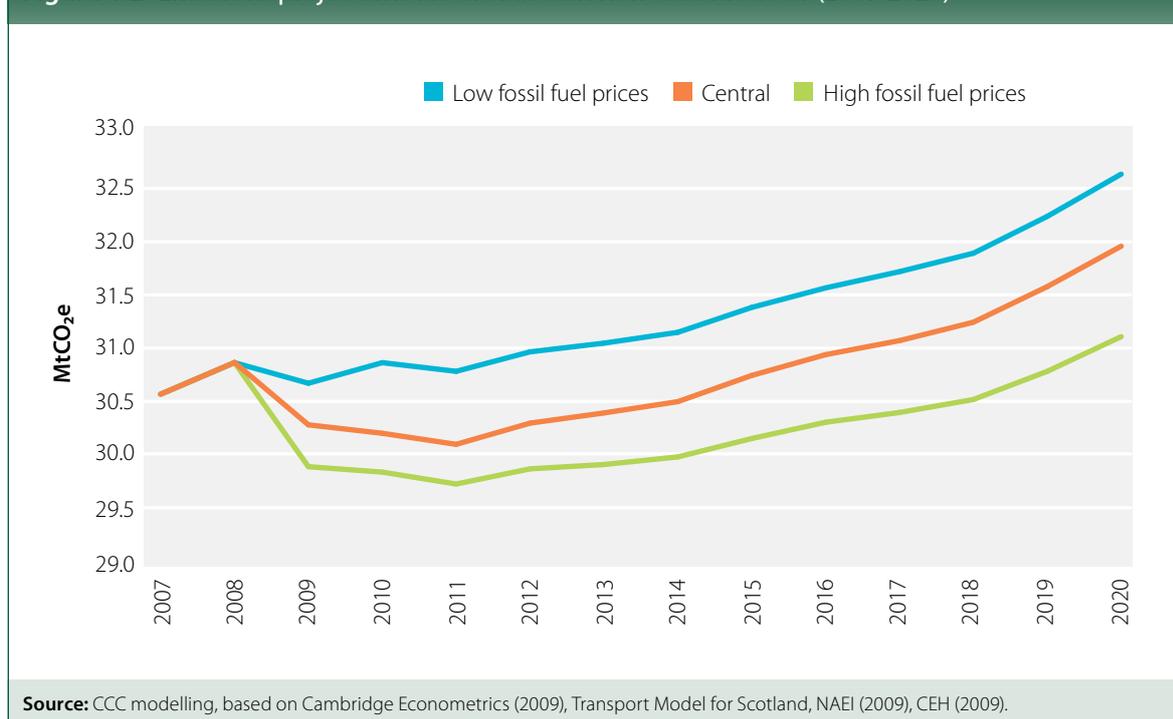
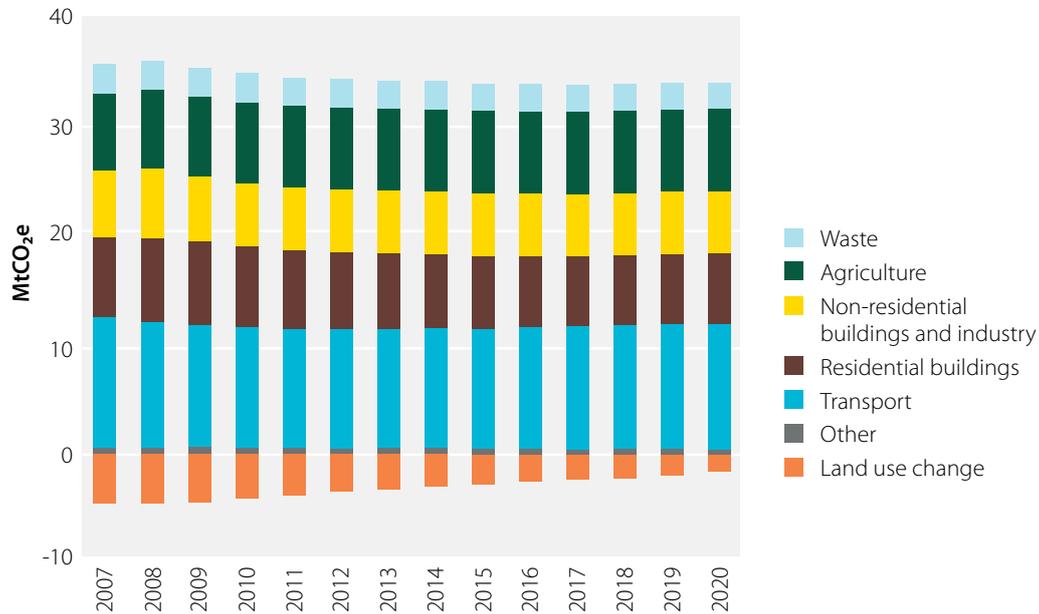


Figure 4.3 Scottish non-traded emissions projections by sector (2007-2020)



Source: CCC modelling, based on Cambridge Econometrics (2009), Transport Model for Scotland, NAEI (2009), CEH (2009).

Note: Other includes non-CO<sub>2</sub> emissions from power, refineries, offshore oil and gas, and aviation.

- Under central case assumptions, and assuming an EU-wide target to reduce emissions by 30% in 2020, non-traded sector reference emissions projections are 7 MtCO<sub>2</sub>e higher than the target in 2020,
- With low fossil fuel prices, the gap increases to up to 11 MtCO<sub>2</sub>e,
- With high fossil fuel prices, the gap falls to a minimum of 6 MtCO<sub>2</sub>e.

A gap exists in all cases, and new policies driving additional emissions reductions are therefore required if the target is to be achieved.

We now consider further opportunities (i.e. over and above those targeted by firm and funded policies) for emissions reductions in the non-traded sector and the policy levers available to the Scottish Government to deliver these reductions, before discussing in Chapter 5 whether the 42% target is the appropriate interim target for Scotland.

## 2. Emissions reduction potential

Our UK analysis has identified scope for emissions reduction in the non-traded sector through a number of measures:

- **Residential buildings**, for which the pattern of abatement potential will differ in Scotland given the different characteristics of the housing stock (e.g. greater proportion of flats and homes off the mains gas grid than the UK average):
  - Improved insulation (e.g. cavity walls, lofts, some solid walls),
  - More efficient appliances and lighting to reduce electricity demand<sup>13</sup>,
  - Lifestyle and behavioural measures (e.g. turning down heating thermostats).

<sup>13</sup> Measures relating to electricity demand will not affect emissions in the non-traded sector, since electricity generation is covered by the EU ETS. However, pursuing these measures is still important to ensure overall targets can be met and to contain the costs of doing so. There is also an important role for all energy efficiency measures in combating fuel poverty.

• **Non-residential buildings and non-EU ETS industry**, which include public buildings directly under the Scottish Government's control:

- Improved efficiency of heating and cooling buildings, insulation and heat recovery,
- Better management of energy (e.g. motion sensitive lights, optimising heating temperatures and timing),
- Use of more efficient lights and appliances,
- Improved efficiency of electrical machinery.

• **Renewable heat**, where Scotland has a particular advantage in access to local forestry for biomass and with rural homes off the mains gas grid that may currently have emissions-intensive heating systems. However, Scotland is likely to have less industrial potential (given the smaller share in emissions) and may face barriers in urban areas:

- Increased penetration of renewable heat technologies (e.g. biogas, biomass boilers, and biomass CHP) across residential, commercial, public and industrial sectors.

• **Transport**, for which Scotland has a similar vehicle use per capita to the UK average:

- Improved fuel efficiency of cars (both due to technology innovation and changing car purchase behaviour), and improved fuel efficiency of vans and HGVs based on conventional technologies,
- Widespread introduction of electric and plug-in hybrid technologies for cars,
- A range of demand-side measures including Smarter Choices measures, eco-driving (e.g. smoother acceleration and braking), and effective enforcement of the speed limit.

• **Agriculture, land use and waste**, which are relatively more important for Scotland than the UK given the size of the sectors:

- Changed farming practices and use of new technology on farms to reduce emissions (in particular improved resource efficiency to reduce N<sub>2</sub>O from fertiliser use, improved feed conversion for livestock to reduce

CH<sub>4</sub> emissions and increased take-up of anaerobic digestion),

- Increased afforestation,
- Changed waste management/collection process (in particular reduced use of landfill, with diversion to anaerobic digestion for biodegradable wastes and mechanical biological treatment for mixed waste streams).

In total, we have estimated a range for feasible emissions reductions in the UK's non-traded sector of up to 67 MtCO<sub>2</sub>e in 2020.

Disaggregating this analysis on the basis of our best estimate of Scotland's share of UK emissions reduction potential (Box 4.1) suggests that there may be scope for emissions reductions of the order up to 8 MtCO<sub>2</sub>e in 2020.

### 3. Emissions scenarios for the non-traded sector

In our UK analysis, we have set out scenarios for non-traded sector emissions under alternative assumptions about policy. In our 2009 report to the UK Parliament we focused on two scenarios:

- The **Extended Ambition** scenario is broadly in line with policies to which the UK Government is committed in principle, but where precise definition and implementation of policies is required. It includes, for example, ambitious targets for energy efficiency improvement (including some solid wall insulation), significant penetration of renewable heat, deep cuts in emissions from cars, and some lifestyle changes in homes and transport.
- The **Stretch Ambition** scenario adds further abatement opportunities for which no policy commitment is in place and where there is more uncertainty over potential delivery, including large numbers of solid wall insulation, deep cuts in agriculture emissions and more significant lifestyle adjustments.

We have applied these definitions to the analysis in this chapter and developed Extended and Stretch Ambition scenarios for Scotland (Figure 4.4):

### Box. 4.1 Identifying emissions reduction potential in Scotland: method and limitations

To inform our advice to the UK government on carbon budgets, the CCC has carried out a range of analyses to estimate the cost-effective, feasible abatement potential in each sector of the economy for the UK as a whole. We have used the results of this work to estimate the scope for emissions reductions in Scotland.

In industry, non-residential buildings, transport, renewable heat, agriculture and waste we have disaggregated the UK-wide results for Scotland<sup>14</sup>.

The disaggregation methods are based on the relevant factors in each sector which influence abatement potential, e.g. energy use in non-residential buildings, share of crop hectares and livestock numbers, current waste patterns. For the domestic sector in Scotland, we have combined our UK-level

analysis with the DEMScot<sup>15</sup> model of the Scottish housing stock to give an improved consideration of the differences in housing stock between the UK and Scotland.

The approach we have taken to estimating emissions reduction potential in Scotland's non-traded sector is unlikely to precisely reflect available potential as the methodologies used do not capture the full range of factors that influence the scope for cost-effective abatement potential in each sector. Additional research into opportunities for emissions reductions in Scotland could enhance the accuracy of these estimates.

It is also possible that Scotland could enhance emissions reductions beyond those identified in our analysis by implementing policies which would result in a greater share of UK abatement being achieved in Scotland.

- In the Extended Ambition scenario, non-traded emissions fall by 19% in 2020 relative to 2005 levels, or 36% relative to 1990,
- In the Stretch Ambition scenario, non-traded emissions fall by 24% in 2020 relative to 2005 levels, or 41% relative to 1990.

Comparing these abatement scenarios with the target, a gap of up to 4 MtCO<sub>2</sub>e in 2020 remains (Figure 4.5):

- Given an EU-wide target to reduce emissions by 20%, the gap is 4.2 MtCO<sub>2</sub>e in 2020 under the Extended Ambition scenario, and 2.4 MtCO<sub>2</sub>e under the Stretch Ambition scenario,
- Given an EU-wide target to reduce emissions by 30%, the gap is 1.2 MtCO<sub>2</sub>e in 2020 under the Extended Ambition scenario, whilst a 0.6 MtCO<sub>2</sub>e surplus exists under the Stretch Ambition scenario.

We consider options for closing the gap between non-traded sector emissions and the target in Chapter 5.

## 4. Scottish levers for unlocking emissions reduction potential

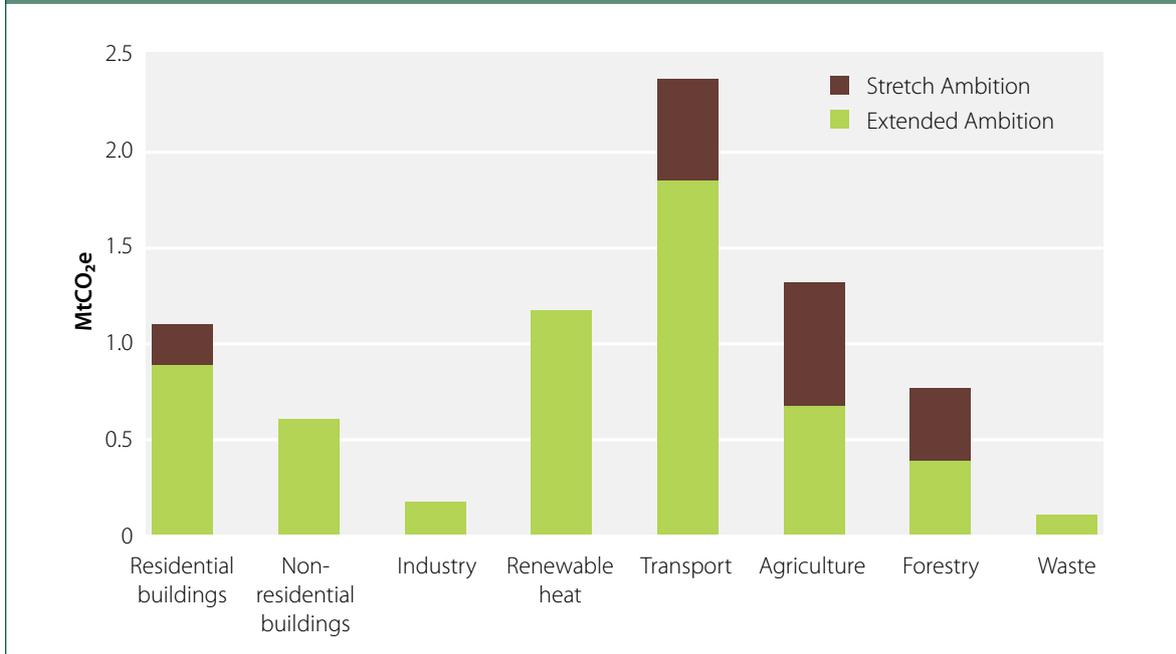
In our analysis at the UK level, we highlighted the need for a step change given limited emissions reductions in recent years and the need for deep cuts going forward to meet carbon budgets. We argued that the step change will require strengthening of existing policies and introduction of new policies covering power, buildings, industry, transport and agriculture sectors.

The same argument applies at the Scottish level, where the pace of emissions reduction will have to be accelerated in order to achieve the targets under the Climate Change Act. Some of the required policy strengthening will have to take place at the UK level, given the balance of reserved and devolved powers. For example, UK Government will set a policy framework to drive energy efficiency improvement in residential and commercial buildings, increased renewable heat penetration, support for electric car development, etc.

<sup>14</sup> For a full explanation of individual sector methodologies, see the technical appendix.

<sup>15</sup> For more information on the DEMScot tool see Scottish Government (2009), *Modelling greenhouse gas emissions from Scottish housing: final report*, <http://www.scotland.gov.uk/Publications/2009/10/08143041/0>.

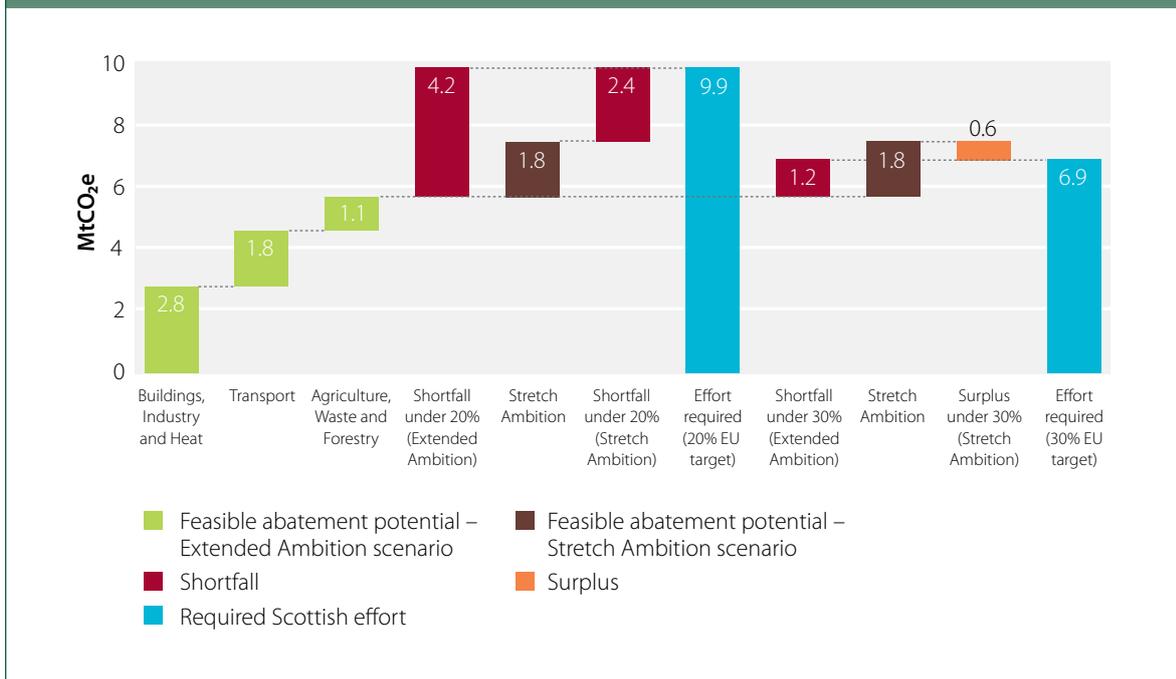
**Figure 4.4** Scottish non-traded abatement potential by sector – Extended and Stretch Ambitions (2020)



Source: CCC modelling.

Note: The abatement potentials in agriculture and waste are from non-CO<sub>2</sub> emissions.

**Figure 4.5** Abatement potential in the Scottish non-traded sector versus effort required to meet the 42% target (2020)



Source: CCC modelling.

However, just as it will be important for Scotland to support EU and UK policy in the traded sector through decisions on planning, there is an important role for the Scottish Government in supporting implementation of measures to drive emissions reductions in each of the key emitting non-traded sectors:

#### • Residential and non-residential buildings and industry

- Promote the uptake of energy efficiency measures (e.g. under current Scottish Government policies such as the Energy Assistance Package and Home Insulation Scheme, through new schemes led by local authorities, or by introducing energy efficiency standards for the private rented sector),
- Complement UK government energy efficiency funding and incentive schemes, where applicable reflecting the higher costs of measures in part of the Scottish housing stock (e.g. providing low- or no-interest loans, creating linkages to local housing allowances or Council Tax rebates, or through initiatives such as the 'boiler scrappage' scheme announced in the Scottish Government's February 2010 budget),
- Support the uptake of renewable heat technologies (e.g. by promoting heat mapping and supporting supply chains),
- Enhance support for small and medium enterprises, including wider performance reporting (e.g. roll-out of Display Energy Certificates with operational ratings to all non-residential buildings),
- Set targets for the uptake of all cost-effective measures in public buildings, including options for combined heat and power or connection to district heating.

#### • Transport

- Further promote *Smarter Choices, Smarter Places* projects (e.g. roll-out of Smarter Choices initiatives to towns that are comparable to the sustainable travel towns in England and on-going evaluation of implementation),

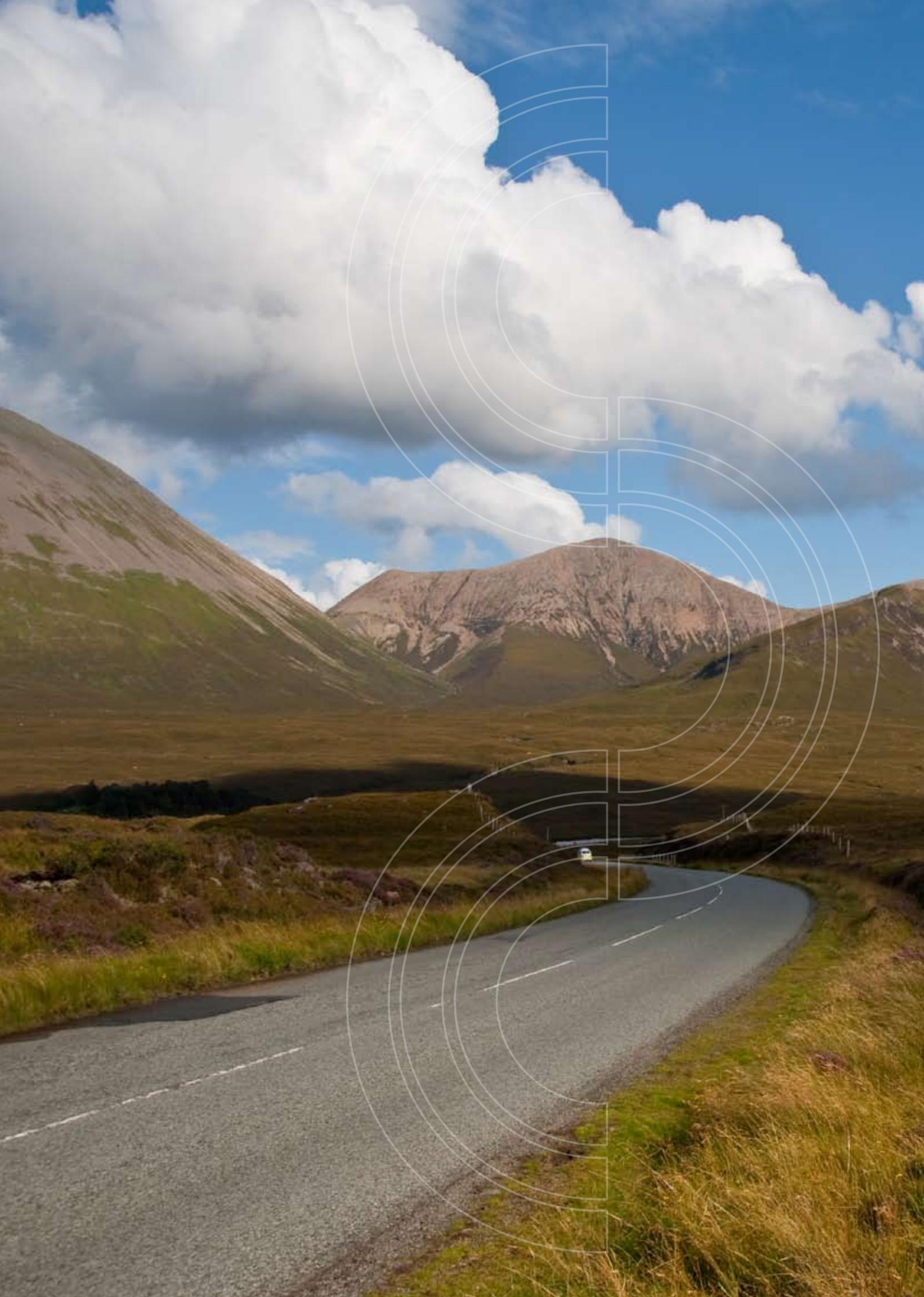
- Implement network measures (e.g. prioritising parking and allowing use of bus lanes for low-carbon vehicles),
- Support provision of electric car charging infrastructure at home and in public places (e.g. car parks and supermarkets),
- Purchase low-carbon vehicles, and particularly electric cars, for the public sector fleet,
- Promote eco-driving training, in particular in the public fleet,
- Enforce speed limits on motorways,
- Integrate land use and transport strategy (e.g. planning measures which incorporate consideration of all transport emissions and planning measures addressing any barriers to delivery of infrastructure to support roll-out of electric cars).

#### • Agriculture, land use and waste

- Provide support for farmers to improve resource efficiency, including advisory services and voluntary agreements, with the option to extend instruments currently aimed at reducing other nitrate pollutants (but also relevant for N<sub>2</sub>O),
- Provide support for increased woodland cover and improved forest management.

#### • Waste

- Increase support for diverting waste from landfill, including measures designed to influence consumer and producer behaviour either towards producing less waste or disposing of waste in the appropriate manner,
- Promotion and support for processing food waste through anaerobic digestion to produce biogas, which can substitute for fossil fuels in energy use.



# Chapter 5:

## Options for meeting Scottish emissions targets

In Chapter 4 we identified gaps between projected emissions and the target to reduce emissions by 42% in 2020 under alternative assumptions about the EU framework and the level of emissions reduction in the Scottish traded sector. Specifically, the largest gap occurred under assumptions that the EU reduces economy-wide emissions by 20% in 2020 relative to 1990 and that Scotland delivers our Extended Ambition scenario. Only if there is an EU 30% target and the Stretch Ambition scenario for the non-traded sector is delivered does our analysis suggest that the economy-wide 42% target would be achieved.

In this section, we consider options for closing any gap, including through delivery of additional emissions reductions, purchase of credits, and adjustment of the target. We also consider the path to the 2020 target.

The main messages in the chapter are:

- Delivering the Extended and Stretch Ambition scenarios in Scotland will be challenging and will require policy strengthening. Notwithstanding this, there may be scope for some additional emissions reductions over and above what is envisaged in these scenarios. It is therefore likely that the 2020 target will be achievable under a 30% EU target given appropriate policies (i.e. the highest achievable interim target is consistent with the 42% in the Scottish Climate Change Act).
- Failure to deliver these scenarios or a continuing EU target of 20% would require significant levels of credit purchase to meet the 2020 target, and would in some cases approach the constraint on credit purchase in the Scottish Act (i.e. the highest achievable interim target may be less than 42%).
- An alternative would be to adjust the target, for example, by conditioning this on the EU framework.

The choice between these alternatives requires political judgement, and is therefore beyond the remit of the Committee. However, it is important to note that the level of required emissions reduction effort in the Scottish non-traded sector falls as EU emissions reduction ambition increases. This is perverse, and Scottish climate strategy should be based on aiming for a level of emissions reduction effort in the non-traded sector that is invariant to the EU framework. Such a strategy would have implications for definition of the Scottish target (e.g. the 42% target should only apply when the EU moves to a 30% target, or Scotland should aim to outperform the 42% target in the event that the EU adopts a 30% target).

We set out the chapter in eight sections:

1. Increasing the level of emissions reduction effort
2. Purchasing credits
3. Adjusting the target
4. Aiming for a fixed level of effort in the non-traded sector
5. The path to the 2020 target
6. Use of credits in the period 2010-2012
7. Cumulative emissions in Scotland
8. Next steps in determining Scottish approach to emissions targets.

## 1. Increasing the level of emissions reduction effort

### The challenge in delivering Extended and Stretch Ambition scenarios

One option to close the gap between projected emissions and the 2020 target would be to increase the level of emissions reduction effort. This raises questions about the scope for reducing emissions more than is envisaged in our scenarios.

It is important to note that delivering even the Extended Ambition scenario will be very challenging. In the UK context, we have suggested that this will require a step change, with new policies to drive emissions reductions in residential buildings, commercial and public sector buildings, transport, power and agriculture.

Delivering the Stretch Ambition scenario is likely to be still more challenging and would require further policy strengthening (e.g. to encourage more uptake of solid wall insulation, deeper emissions cuts in agriculture, increased afforestation, etc.) and the introduction of new policies (e.g. road pricing schemes, reduction of the 70 mph speed limit).

### Scottish policies to deliver the scenarios

Given the balance of reserved and devolved powers, delivery of the Extended/Stretch Ambition scenarios would require new policies at the UK level in a number of areas. However, there is scope for the Scottish Government to complement UK policies, and to introduce national policies in a number of areas. In particular, the Scottish Government has scope to encourage emissions reductions through roll-out of a national energy efficiency programme in the residential sector, deployment of renewable heat, implementation of Smarter Choices in Scottish cities and towns, electric vehicle pilots and infrastructure provision, speed limit enforcement, city road pricing schemes, and introduction of new policies for emissions reduction in agriculture and land use sectors.

### The possibility of additional emissions reductions

Even if the Stretch scenario can be delivered, this would still leave a substantial gap relative to the 2020 emissions target if the EU does not move to a 30% target. It is possible that there are additional domestic emissions reductions available in Scotland which we have not identified in our top-down disaggregation of UK potential. In particular, it may be the case that there is a disproportionate amount of emissions reduction potential in some Scottish sectors relative to the UK as a whole, implying that Scotland could go beyond the shares we have assumed for the Extended and Stretch Ambitions. For example, the number of homes off the main gas grid together with greater access to local forestry reserves may mean that more can be achieved in renewable heat. There may also be some areas, for example peat restoration, that are relevant at the Scottish level, even though the emissions savings are relatively small at the UK level, and which therefore do not feature in our scenarios.

More detailed bottom-up analysis of emissions reduction potential in Scotland would be required to assess whether there is additional emissions reduction potential and the extent to which this may be sufficient to achieve the target. It seems unlikely however, that such additional potential would be enough to close the large gap identified where the EU retains a 20% economy-wide target. This would require, for example, delivery of emissions reductions in each sector of the economy that are a third greater than those in our Stretch scenario.

## 2. Purchasing credits

A second option to close the gap between projected emissions and the 2020 target would be to purchase credits. The Scottish Climate Change Act allows for limited credit purchase, of up to 20% of emissions reduction effort<sup>16</sup>.

In our December 2008 report we distinguished between European Union Allowances (EUAs) and offset credits (Box 5.1). We concluded that:

- There should be no limit on the extent to which EUAs are allowed to count towards the carbon budget. This is also reflected in the Scottish Act, which treats EUA purchases interchangeably with domestic emissions reduction.
- There should be a quantitative limit placed on offset credits which can count towards the UK budget, with this limit covering both offset credits purchased by the UK private sector within the EU ETS, and any purchase of offset credits to meet non-traded sector targets. The Scottish Act sets a limit on the purchase of offset credits to meet the non-traded sector target, with traded sector effort being defined at the EU level.

### Box 5.1 European Union Allowances and offset credits

European Union Allowances (EUAs) are traded in the EU ETS, a cap and trade scheme which has covered the power sector and energy-intensive industry in the EU since 2005. Each EUA is equivalent to a tonne of CO<sub>2</sub>. The EU ETS works by capping the CO<sub>2</sub> emissions of participating installations, who can then reduce emissions and sell EUAs, or emit beyond their cap and purchase EUAs in the market. Firms will abate and sell, or emit and purchase allowances, depending on the price of EUAs relative to the cost of abatement options available to them. Since the total amount of EUAs is strictly limited by the terms of the scheme, any purchases of EUAs by firms in the UK will result directly in emission reductions elsewhere in Europe.

Joint Implementation (JI) and Clean Development Mechanism (CDM) credits are produced by projects set up under the Kyoto Treaty's flexibility mechanisms. JI schemes can be set up in countries that have an emissions cap under the Kyoto agreement, whilst CDM schemes are allowed in countries without a cap (i.e. developing countries). Emissions from the projects covered by these schemes are not capped, rather projects must reduce emissions relative to a notional baseline. Any reductions relative to this baseline generate credits that can be sold in the carbon markets. Each credit is equivalent to a tonne of CO<sub>2</sub>e. Offset credits from JI and CDM projects are accepted in the EU ETS up to certain limits. However, the future of these mechanisms beyond the Kyoto compliance period (2008-2012) is currently uncertain.

<sup>16</sup> The Act states that "reductions in net Scottish emissions of greenhouse gases [should] account for at least 80% of the reduction in the net Scottish emissions account in any target year". We have interpreted this to mean 80% of the reduction effort in the period to 2020 should be through domestic measures.

We concluded that there should be limited offset credit purchase to meet the Interim traded sector budget, and no offset credit purchase to meet the Interim non-traded sector budget. In moving to the Intended budget, we suggested that one strategy would be to purchase offset credits up to the level of incremental effort required in the non-traded sector, in which case emissions reductions due to credit purchase would account for around 25% of total non-traded sector emissions reduction effort.

In the Scottish case therefore, one option would be to close the gap between projected emissions and the 2020 target through the purchase of offset credits (Table 5.1):

- For an EU-wide 20% GHG emissions reduction target, the Scottish target could be achieved through the purchase of 2.4 MtCO<sub>2</sub> (Stretch Ambition scenario) to 4.2 MtCO<sub>2</sub> (Extended Ambition scenario) offset credits. This would result in offset credit purchase accounting for 9% to 17% of total emissions reduction effort from 1990 levels. The associated cost, assuming an indicative price<sup>17</sup> for offset credits of £13/tCO<sub>2</sub> would be around £30 million to £55 million in 2020.

- For an EU-wide 30% GHG emissions reduction target, the Scottish target could be achieved through the purchase of 1.2 MtCO<sub>2</sub> offset credits under the Extended Ambition, with no purchase required under the Stretch scenario. This would result in offset credit purchase accounting for up to 5% of total emissions reduction effort against 1990. The associated cost, assuming an indicative price for offset credits of £13/tCO<sub>2</sub> would be up to around £15 million in 2020.

Implementation of measures in the Extended Ambition scenario would result in an economy-wide emissions reduction of 36% in 2020 relative to 1990 under a 20% EU target, or an emissions reduction of 40% under a 30% EU target. This level of ambition, coupled with progress in the power sector, would be sufficient to put Scotland on track to meeting the 2050 target.

Any credit purchase to meet the 42% may then be regarded as a Scottish contribution to required global emissions reductions in the period to 2020.

**Table 5.1** Credit purchase required for Scotland to meet 42% target (2020)

	Credits required alongside Extended Ambition (MtCO <sub>2</sub> e)	Cost under Extended Ambition at £13/tCO <sub>2</sub> e	Credits required alongside Stretch Ambition (MtCO <sub>2</sub> e)	Cost under Stretch Ambition at £13/tCO <sub>2</sub> e
EU target of 20%	4.2	£55m	2.4	£15m
EU target of 30%	1.2	£30m	–	–

**Source:** CCC calculations.

**Note:** costs rounded to nearest £5 million.

<sup>17</sup> We assumed a real terms 2020 price of £13/tCO<sub>2</sub> (16 Euro/tCO<sub>2</sub>) in our December 2008 report based on results from the UK Government's GLOCAF model using a central set of assumptions. There is considerable uncertainty around these projections, reflecting for example uncertainties over the nature and ambition of any future global agreement, technology costs and exchange rates.

### 3. Adjusting the target

There are at least three options for adjusting the target:

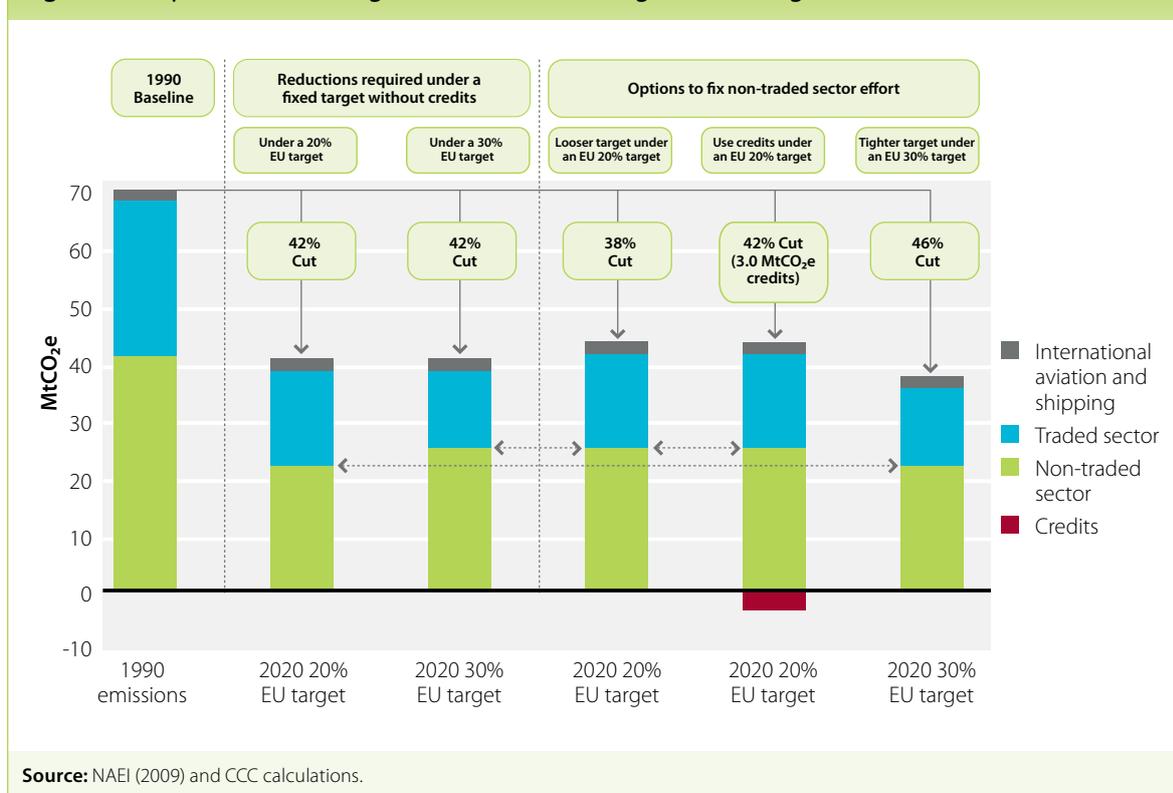
- The gap between projected emissions and the target is smaller for an EU-wide 30% GHG emissions reduction target in 2020 relative to 1990 rather than a 20% target. One possibility therefore would be to make the Scottish 42% target conditional on the EU adopting a 30% target and subsequently tightening the EU ETS cap. Reducing the economy-wide target in line with the lower effort in the traded sector under an EU 20% target would imply a 2020 target of 38% for Scotland. This would still leave a gap of 1.2 MtCO<sub>2</sub>e between projected emissions and the 2020 target in the Extended Ambition scenario, but would mean the target could be met by implementation of some measures from the Stretch scenario.
- The treatment of aviation and shipping in the Scottish Climate Change Act differs from the treatment in the UK and EU frameworks. Specifically, Scottish targets are more ambitious than UK targets derived from the EU framework, with a 44% emissions reduction required in sectors other than aviation and shipping in Scotland compared to a 42% reduction in the UK. One way to close the gap between projected emissions and the Scottish target therefore would be to align the treatment of aviation and shipping in the Scottish framework with the UK and EU frameworks. This would leave a gap of 3 MtCO<sub>2</sub>e and 1 MtCO<sub>2</sub>e in 2020 between projected emissions and the target in the Extended and Stretch Ambition scenarios respectively in a 20% world, and would mean that the Extended Ambition scenario would broadly deliver the economy-wide target in a 30% world.

- A third possibility would be to align the level of ambition in Scotland with feasible emissions reduction as identified in our scenarios or through further detailed bottom-up analysis. This could result in a target of less than 42% emissions reduction in 2020 but still consistent with being on track to meeting the 2050 target to reduce emissions by 80% in 2050 relative to 1990. Economy-wide targets of 40% and 43% emissions cuts in 2020 relative to 1990 would be consistent with delivering the Extended and Stretch Ambition scenarios under a 30% EU target. The equivalent targets under a 20% world would be 36% and 39%.

### 4. Aiming for a fixed effort level in the non-traded sector

In chapter 3 we proposed that the cap on Scottish traded sector emissions should reflect the European cap in the EU ETS. But tightening of the EU ETS cap as the EU moves from a 20% to a 30% target has the perverse consequence that emissions reductions required in the Scottish non-traded sector to achieve the 2020 target fall. In contrast, the strategy for reducing emissions in the non-traded sector should ideally be based around a constant level of emissions reduction effort. The Committee therefore recommends three options for keeping constant non-traded sector effort around a possibly changing EU level of ambition (Figure 5.1):

- Scotland could aim to deliver the non-traded sector emissions reduction expected to be required to meet the 42% target in an EU 30% world (i.e. a 39% reduction relative to 1990 in the Scottish non-traded sector), and adjust the economy-wide target to be contingent on the EU moving to the 30% world. This would imply an economy-wide target of 38% in 2020 against 1990 in a 20% world.

**Figure 5.1** Options for meeting Scottish emissions targets and fixing effort in the non-traded sector

- Scotland could aim to deliver the non-traded sector emissions reduction required in the 20% world (i.e. a 47% reduction on 1990 levels, which would require going considerably beyond the savings identified in the Stretch Ambition scenario) regardless of the EU framework, implying some over-performance against the 42% target when the EU moves to the 30% world (e.g. an economy-wide 46% emissions reduction).
- Scotland could keep the economy-wide target of 42% for both EU targets, aim to deliver the non-traded sector emissions reduction required in the 30% world (i.e. a 39% reduction from 1990 levels), and purchase offset credits to make up any shortfall to the 42% target whilst the EU remains in its 20% world<sup>18</sup>.

## 5. The path to the 2020 target

In considering the path to the 2020 target at the UK level we advised that the first budget should reflect official emissions projections, with subsequent budgets based on a straight-line path to and through the 2020 target:

- Official projections include expected emissions reductions due to policies currently in place. Given the long lead-time for new policies and ensuing emissions reductions, we assumed only those emissions reductions associated with existing policies.
- Beyond the first budget, we followed the EU framework in recommending a straight line path to the 2020 target. However, we noted that where practical, outperformance of this path may be desirable, particularly for cost saving measures such as energy efficiency improvement.

<sup>18</sup> An alternative option could be to set a fixed target for the non-traded sector based on analysis of the abatement opportunities available (e.g. our Extended Ambition scenario implies a 36% reduction relative to 1990), and to calculate the economy-wide targets that result from this target and the target for the traded sector implied by the EU framework (i.e. the overall targets would be contingent on the EU framework, but neither would necessarily be 42%). However, such an approach would be inconsistent with the Scottish Climate Change Act.

We propose a similar approach in the Scottish case. Specifically, we suggest that annual targets should be based on our emissions projections out to 2012, with straight-line emissions reductions thereafter. This would result in average annual emissions reductions of 0.05% for the economy as a whole including international aviation and shipping to 2012, and 3% between 2013 and 2020 to meet the 42% target including international aviation and shipping. Table 5.1 and Figure 5.1 report the emissions path we envisage for Scotland in the

EU 30% world, on the basis of the proposed EU package. The precise path would differ in a 20% world, and with any changes to the final agreed EU package for the 30% world compared to the indicative proposals in January 2008.

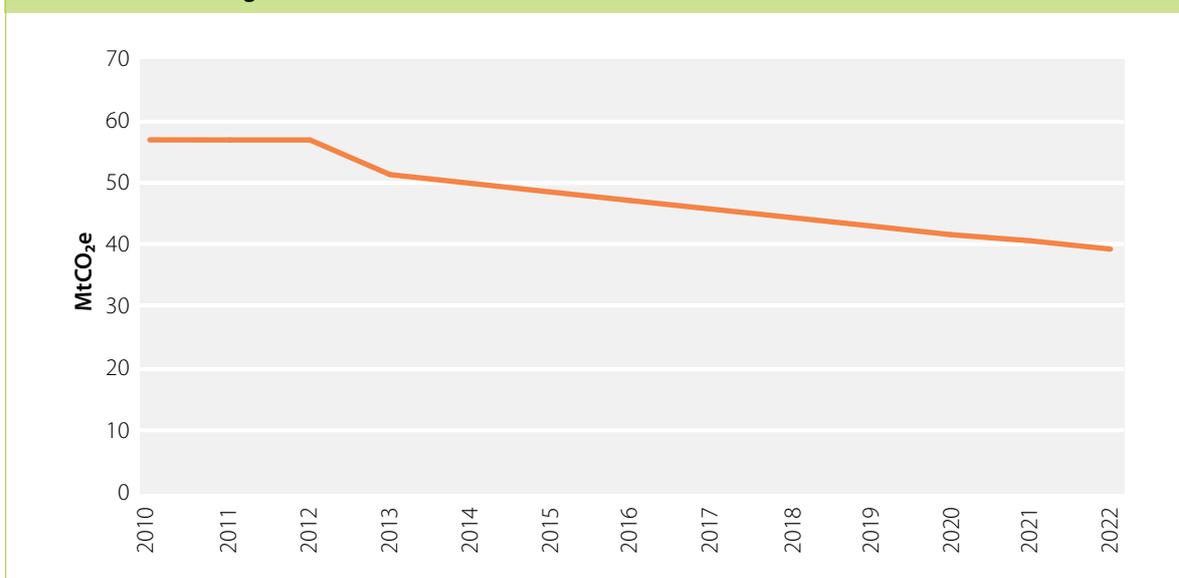
**Table 5.2** Indicative annual economy-wide emissions targets for Scotland to reach a 42% 2020 target under a 30% EU target (2010-2022)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Emissions targets (MtCO <sub>2</sub> e)	55.9	55.9	55.9	50.3	48.9	47.5	46.1	44.7	43.4	42.0	40.6	39.4	38.2
Year-on-year reduction	0%	0%	0%	10%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Reduction against 1990	20%	20%	20%	28%	30%	32%	34%	36%	38%	40%	42%	43%	45%

**Source:** CCC modelling.

**Note:** 2010-2012 reductions round to 0%, but entail small declines year-on-year. Reductions from 2019 are a minimum of 3%. The significant decline in 2013 reflects the start of Phase III of the EU ETS.

**Figure 5.2** Indicative economy-wide emissions trajectory for Scotland to reach a 42% 2020 target under a 30% EU target (2010-2022)



**Source:** CCC modelling.

**Note:** The trajectory under a 20% EU target would be the same to 2012 (during Phase II of the EU ETS), then diverge from 2013 due to differences in the Phase III cap. The trajectory above can only be considered indicative until the EU package for a 30% target is confirmed.

We note three differences between the UK and Scottish frameworks:

- In the case of the UK, we have proposed that the Government should seek to outperform the first budget given that this was based on emissions projections made before the economic recession. This is not an issue in the Scottish case, given that our Scottish emissions projections reflect GDP assumptions that have been adjusted to allow for the recession.
- We suggested in the case of the UK that it may be desirable to outperform the second and third budgets. In Scotland, where there is no provision for banking of outperformance, incentives for outperformance are limited. Options to provide incentives for outperformance include allowing banking of emissions reductions between years, or adjusting annual emissions reduction targets to reflect any outperformance.
- UK budgets are assessed over the full five-year period, with some banking and borrowing allowed between periods, whereas Scottish budgets are set on an annual basis with no banking or borrowing between years. Given the inherent volatility of emissions, due to volatility in drivers including temperature and fossil fuel prices this imposes significant potential problems for budget management (Box 5.2).

### Box. 5.2 Options for providing flexibility in meeting targets

Emissions are volatile on a year-to-year basis due to inherent volatility in the drivers of emissions (e.g. temperature, fuel prices, business and industry activity, individual behaviours). This poses a risk for budget management as any upward volatility may result in emissions targets being missed in a single year even when overall progress is being made. There are four main options for providing flexibility in meeting annual emissions targets:

- Extending target periods to cover more than a single year, as in the UK framework, but currently excluded in the Scottish context,
- Provision for some banking and borrowing between periods, which is excluded in the Scottish framework at present,
- Aiming to overachieve against targets, so that upward volatility would still result in emissions below the target,
- Using credits to make up any shortfall.

It is worth noting that some flexibility in the framework can provide incentives for over-performance, is more consistent with an approach focused on cumulative emissions and can increase the credibility of emissions targets without undermining the need for continuous progress.

## 6. Use of offset credits in the period 2010-2012

We have been asked to advise specifically on limits to credit purchase in 2010-12. Since we have set targets for these years in line with expected emissions, Scotland should not aim to purchase credits in this period. However, given the inflexibilities in the accounting framework, the option to purchase credits should not be ruled out, for example in case of an unusually cold winter leading to higher energy use and emissions.

## 7. Cumulative emissions in Scotland

The Committee has been asked to advise on a cumulative emissions budget for Scotland covering the period to 2050. Our analysis suggests that:

- The interim target to reduce emissions by 42% in 2020 relative to 1990 is an appropriate contribution to required global emissions reductions in 2020,
- The long-term target to reduce emissions in 2050 by 80% relative to 1990 is consistent with the required 50% cut in global emissions to keep the probability of dangerous climate change at very low levels.

We have not yet completed detailed analysis of the path between 2020 and 2050. However, we are currently assessing this path in the context of advice on the UK's fourth carbon budget, to be published in December 2010. Given this analysis, we will be able to draw out implications for a Scottish cumulative emissions budget.

## 8. Next steps in determining Scottish approach to emissions targets

The choice between the options for meeting the 2020 target and in fixing effort for the non-traded sector requires political judgment (e.g. over policies required to drive the Stretch Ambition scenario, fiscal implications of credit purchase, etc.) and is beyond the scope of the Committee.

Given this choice, the Committee will continue to monitor progress reducing Scottish emissions relative to targets, both as part of annual reporting to the UK Parliament and in response to specific requests from the Scottish Government.

The Committee will provide a view on the implications of Copenhagen and ongoing global negotiations for UK carbon budgets during 2010, and will highlight any implications for meeting Scottish emissions targets.



# Chapter 6:

## Broader economic and social considerations

The Scottish Climate Change Act requires that emissions targets are assessed in the context of a number of broader economic and social factors. In this chapter we focus on some of those impacts, specifically economic circumstances (macroeconomic cost, fiscal impacts, competitiveness impacts), fuel poverty, and security of supply.

The key messages in the chapter are:

- The macroeconomic cost from meeting the Scottish 2020 emissions reduction target is likely to be less than 1% of GDP, and should be accepted given the costs and consequences of not acting. Fiscal impacts from meeting the target should be limited. Competitiveness issues are potentially important, but should be mitigated through provisions in the EU ETS framework for granting of free allowances to industries at risk of leakage.
- Meeting the 2020 target will impact fuel poverty in two ways: rising prices of electricity and heat will increase the number of households in fuel poverty; however, this number will fall as energy efficiency improvements result in energy bill reductions. The net effect is likely to be a reduction in the number of fuel poor households. Residual fuel poverty can be addressed through social tariffs or income transfers.
- Adverse security of supply impacts through increasing the level of intermittent power generation can be addressed at low economic cost. Positive security of supply impacts will ensue as there is reduced reliance on imported gas for power generation and heating.

We have not assessed the impact of meeting carbon targets for rural and remote communities, although we note that this is an area to be considered by the Scottish Government in developing its climate strategy. It is likely that there may be particular opportunities for renewable heat in rural and remote areas where coal, oil or electricity are currently used for heating.

Neither have we assessed wider environmental costs and benefits, which is another consideration for the Scottish Government under the Act. In our UK analysis, we suggested that there may be adverse impacts from the use of biomass for heating in urban areas, but that this should not be problematic in non-urban areas off the gas grid. The interactions with measures to reduce agricultural emissions (many of which have synergies with reducing other pollutants) will also be important to consider.

We set out the chapter in three sections:

1. Economic circumstances
2. Fuel poverty impacts
3. Security of supply impacts.

## 1. Economic circumstances

### Macroeconomic costs

Our analysis suggested that the cost of meeting the UK's Intended carbon budget (i.e. based on a 42% cut in GHG emissions in 2020 relative to 1990) would be less than 1% of GDP:

- Based on analysis which summed costs of individual measures together with required credit purchase, we estimated that the cost of meeting the Intended budget in 2020 would be around 0.3% of GDP.
- We also used macroeconomic models which allowed for possible macroeconomic transitional costs due to changing relative prices and resulting structural changes in the economy. The cost of meeting the Intended budget as modelled by HM Treasury's General Equilibrium model remained at around 0.3% of GDP in 2020. The cost as estimated by the Cambridge Econometrics MDM-E3 model, which includes some transitional effects in response to changing relative prices, was around 0.8% of GDP in 2020.

Our approach to assessing abatement potential in Scotland has been to scale from our assessment of UK potential. We therefore assume that in a 30% world (where the Scottish targets can be met under our Stretch Ambition) the cost of meeting Scottish targets in 2020 is also less than 1% of GDP in 2020:

- This conclusion is notwithstanding the slightly different definition of the Scottish target (see Chapter 1), and slightly lower GDP per capita in Scotland compared to the UK; these two differences are not sufficiently large to increase estimated UK costs from 0.3%–0.8% of GDP in 2020 to above 1% in the Scottish case.
- The same conclusion would apply in a 20% world if the extra effort required for the non-traded sector were met through credit purchase, but there would be less certainty should substantially more expensive domestic measures be pursued to make up the shortfall.

### Fiscal impacts

In the case of the UK we considered a number of potentially significant fiscal impacts from meeting carbon budgets:

- **Revenue impacts** included increased revenues due to auctioning of EU ETS allowances, and reduced revenue from fuel duty and vehicle excise duty (VED) as cars become more carbon-efficient.
- **Spending impacts** included the purchase of credits, and support for fuel poor households to offset impacts of increased energy prices.

We concluded that there is considerable uncertainty around the order of magnitude of these impacts. There are plausible scenarios where impacts are negative in the early years (before widespread auctioning of EU ETS allowances), becoming positive further out in the period to 2020 (as the level of auctioning increases). Without aiming to quantify these impacts, we argued that any negative impact would be sufficiently small so as to be manageable.

In the case of Scotland, and given the balance of reserved and devolved powers, most of the potentially large UK fiscal impacts do not have a direct impact on Scotland's fiscal position: Scotland will not receive EU ETS auction revenues, or suffer reduced revenues from fuel duty and VED.

However, the possible purchase of credits to meet the 42% target and possible costs associated with new policies would have a fiscal impact:

- Purchasing credits to meet the target assuming domestic emissions reductions in the Extended Ambition scenario could cost of the order £15 million in 2020 in an EU 30% world, or £55 million in a 20% world.

- There will also potentially be fiscal impacts from policies to encourage uptake of abatement measures (e.g. £2 million was budgeted for the boiler scrappage scheme), though these will depend on the policy approach chosen. Given that policies are yet to be defined, we have not attempted to quantify potential fiscal impacts.

In principle, there could also be costs associated with offsetting the impact of higher energy prices on the fuel poor. In practice, our analysis in Section 3 below suggests that meeting emissions targets would result in a net reduction in the number of fuel poor households given the reduction in bills due to energy efficiency improvement. If energy efficiency improvement is to be financed off-budget, there would therefore be limited fiscal consequences in terms of additional support for the fuel poor.

### Competitiveness impacts

The potential competitiveness impacts from meeting Scottish emissions targets relate to possible leakage of production in industries which are both energy-intensive and tradable or potentially tradable, and subject to a carbon price.

In our December 2008 report, we identified Scottish energy-intensive industries potentially at risk. Specifically, we defined three categories of industry subject to carbon pricing:

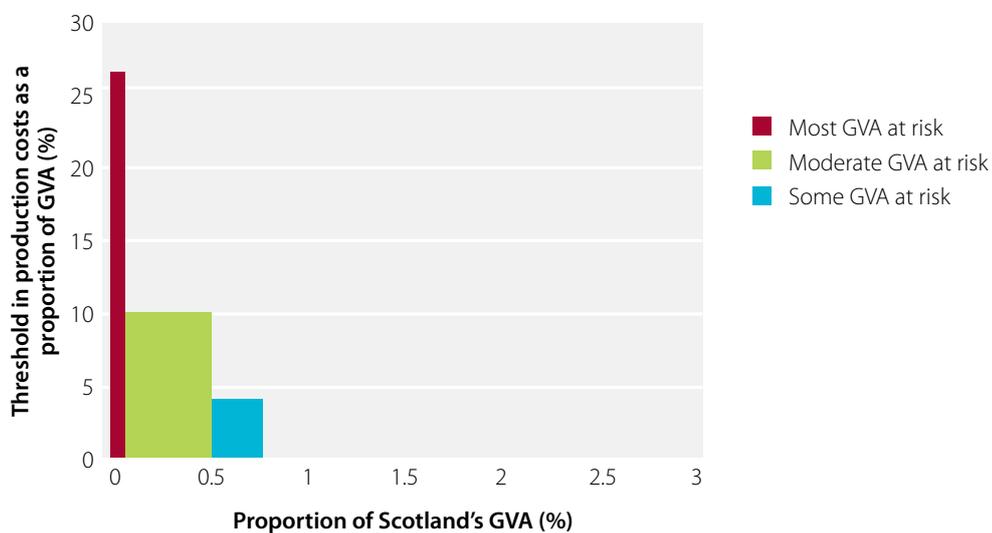
- Category 1 comprised industries with potential cost increases of more than 25% relative to Gross Value Added (GVA),
- Category 2 comprised industries with potential cost increases from 15%–25% of GVA,
- Category 3 comprised industries with potential cost increases from 5%–15% of GVA.

Scottish industries in these categories are shown in Table 6.1. Together, these industries account for around 0.7% of Scottish GDP (Figure 6.1) and less than 0.5% of employment (Figure 6.2).

**Table 6.1** Scottish industries at risk of leakage (2007)

<b>Category 1</b>	<b>Category 2</b>	<b>Category 3</b>
<b>Most GVA at risk</b>	<b>Moderate GVA at risk</b>	<b>Some GVA at risk</b>
Aluminium	Refined petroleum products	Malt
Cement	Fertilisers	Household goods, etc.
	Other inorganic chemicals	Industrial gases
	Paper and paperboard	Non-wovens
		Finishing of textiles
		Hollow glass
		Rubber tyres and tubes
		Retreading and rebuilding of rubber tyres
		Veneer sheets, plywood, etc.
		Other textile weaving
		Copper
		Casting of iron

Figure 6.1 Proportion of Scottish GVA in at risk categories (2005)



Source: CCC calculations based on ABI data.

Figure 6.2 Proportion of Scottish employment in at risk categories (2005)



Source: CCC calculations based on ABI data.

For those industries particularly at risk (i.e. those also exposed to non-EU competition), mitigating measures are an integral part of the EU framework. Specifically, the revised EU ETS Directive allows granting of free allowances to those firms identified

as being subject to the risk of competitiveness impacts. The European Commission will undertake in 2010 an in-depth assessment of industries at risk and the level of free allowances to be granted in order that risks are mitigated.

The Committee has not yet undertaken an analysis of potential competitiveness impacts for implementing stretching measures in those sectors outside the EU ETS, for example agriculture. We note however, that the presence of significant abatement potential at negative cost suggests that impacts on competitiveness may be limited in the agriculture sector. The extent to which international competitiveness carries implications for policy design in unlocking more stretching measures requires more detailed analysis.

## 2. Fuel poverty impacts

There are two offsetting fuel poverty impacts from measures to reduce emissions:

- Measures to improve energy efficiency reduce energy bills and therefore contribute to reducing fuel poverty,
- Measures to reduce emissions from power and heat sectors are more expensive than carbon-intensive alternatives, resulting in higher energy prices and increased fuel poverty.

We presented analysis in our December 2008 report of these two potential impacts in the Scottish case:

- Our analysis showed that fuel poverty could fall from the 2006 level of around 540,000 households to around 290,000 households in 2022 as a result of implementation of measures to improve energy efficiency alongside increasing incomes over time,
- Electricity and gas price increases required to pay for renewable energy would increase the number of fuel poor households by around 100,000.

The net impact would therefore be a reduction in the number of fuel poor households from the 2006 level of 540,000 to around 390,000. Whilst changes in incomes and fuel prices since our 2008 analysis may affect the overall level of fuel poverty, the net effect of emissions reduction efforts is likely to be relatively unchanged. Options for addressing fuel poverty include social tariffs or income transfers.

## 3. Security of supply impacts

In principle, the intermittent nature of wind generation proposed as a desirable means for meeting the traded sector cap could pose issues for security of supply. In practice, this can be managed through having adequate back-up capacity available to increase generation at short notice. Intermittency is therefore an issue of cost rather than security of supply, and our analysis shows that cost implications are not prohibitive as regards economic viability of wind generation.

Issues of market design may however need to be addressed to ensure that adequate investment in back-up capacity takes place; DECC and Ofgem are considering options for possible strengthening of current market arrangements given increasing levels of intermittent generation. As outlined in chapter 3, delivery of new low-carbon investment will also require removal of barriers relating to planning and transmission, for which there is an important role for the Scottish Government.

More generally, increasing levels of low-carbon power generation and energy efficiency improvement will reduce exposure to volatile oil and gas prices, and mitigate the risk of sustained high price periods and possible supply interruptions, thus providing economic benefits in addition to climate change benefits.



# Chapter 7: Next steps in finalising and implementing the Scottish climate change mitigation framework

We have identified significant opportunities for reducing Scottish emissions. The next steps for the Scottish Government are to:

- Undertake further detailed assessment of opportunities at the Scottish level,
- Consider scope for unlocking abatement potential in our Stretch Ambition scenario, given the balance of reserved and devolved powers,
- Determine the appropriate level of credit purchase to meet Scottish targets,
- Possibly adjust targets to set a constant level of effort in the non-traded sector, depending on judgements around feasible emissions reduction potential and purchase of credits,
- Put in place policies to drive the step change required to achieve deep emissions cuts.

Going forward the Committee will:

- Work with the Scottish Government on further analysis of emissions reduction potential,
- Following advice to the UK Government on the fourth carbon budget (2023-2027), draw out implications for the cumulative budget defined under the Scottish Climate Change Act,
- Report on progress reducing Scottish emissions, both as part of broader reporting under the UK Climate Change Act, and specific reporting under the Scottish Climate Change Act (from 2011).

# Glossary

**20% world**

The period whilst the EU retains a target to reduce emissions by 20% against 1990 levels by 2020.

**30% world**

The period after the EU moves to a target to reduce emissions by 30% against 1990 levels by 2020.

**Anaerobic digestion (AD)**

A treatment process breaking down biodegradable, particularly waste, material in the absence of oxygen. Produces a methane-rich biogas that can substitute for fossil fuels.

**Biofuel**

A fuel derived from recently dead biological material and used to power vehicles (can be liquid or gas). Biofuels are commonly derived from cereal crops but can also be derived from trees and even algae. Blended with petrol and diesel biofuels it can be used in conventional vehicles.

**Biogas**

A fuel derived from recently dead biological material which can be burned in a generator or a CHP plant, or upgraded to biomethane for injection into the gas grid.

**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 marine and air transportation.

**Burden share**

The share of effort for an individual country towards a common goal.

**Cap and trade schemes**

Cap and trade schemes establish binding controls on the overall amount of emissions from participants. Within this quantity ceiling, entities covered by the scheme are then free to choose where best to deliver emission reductions within the scheme by trading units which correspond to quantities of abatement.

**Carbon capture and storage (CCS)**

Technology which involves capturing the carbon dioxide emitted from burning fossil fuels, transporting it and storing it in secure spaces such as geological formations, including old oil and gas fields and aquifers under the seabed.

**Carbon dioxide equivalent (CO<sub>2</sub>e) emission**

The amount of carbon dioxide emission that would give rise to the same level of radiative forcing, integrated over a given time period, as a given amount of well-mixed greenhouse gas emission. For an individual greenhouse gas species, carbon dioxide equivalent emission is calculated by multiplying the mass emitted by the Global Warming Potential over the given time period for that species. Standard international reporting processes use a time period of 100 years.

**Carbon Emissions Reduction Target (CERT)**

CERT is a UK obligation on energy supply companies to implement measures in homes that will reduce emissions (such as insulation, efficient lightbulbs or appliances).

**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 sink**

An absorber of carbon (usually in the form of carbon dioxide). Natural carbon sinks include forests and oceans.

**Carbon units**

See 'offset credits'.

**Clean Development Mechanism (CDM)**

UN-regulated scheme which allows credits to be issued from projects reducing greenhouse gases in Kyoto non-Annex 1 countries (developing countries).

**Climate**

The climate can be described simply as the 'average weather', typically taken over a period of 30 years. More rigorously, it is the statistical description of variables such as temperature, rainfall, snow cover, or any other property of the climate system.

**Combined Heat and Power (CHP)**

A technology which generates electricity at the same time as useable heat. Technologies range from small units similar to domestic gas boilers which generate electricity whilst heating homes through to large scale CCGT plants which supply surplus heat for major industrial processes.

**DEMScot**

The Domestic Energy Model for Scotland. A model developed to analyse the impacts of policies to reduce emissions from Scottish housing.

**Devolved powers**

Policy areas governed by the relevant national authority, as defined by the relevant devolution agreement(s) and legislation.

**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.

**Domestic effort**

Emissions reduction achieved directly from Scottish sources and by net purchase of emissions allowances and credits within the EU ETS.

**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 (i.e. without an internal combustion engine) fuelled by battery power.

**Energy Assistance Package**

A four-stage package managed by the Energy Saving Trust aimed at improving energy efficiency and reducing fuel poverty in Scotland.

**European Union Allowance (EUA)**

Units corresponding to one tonne of CO<sub>2</sub> which can be traded in the EU ETS.

**European Union Emission Trading Scheme (EU ETS)**

Cap and trade system covering the power sector and energy-intensive industry in the EU.

**Fluorinated gases (F-gases)**

Family of greenhouse gases containing fluorine. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF<sub>6</sub>) are used in industrial processes, refrigeration and air conditioning. They have a high global warming potential.

**Fuel duty**

A UK tax on road fuels, 56 pence per litre for diesel and unleaded petrol until April 2010.

**Fuel poverty**

A fuel poor household is one that needs to spend in excess of 10% of household income on all fuel use in order to maintain a satisfactory heating regime.

**GLOCAF**

The Global Carbon Finance model, developed by the Office of Climate Change to look at the costs to different countries of moving to a low-carbon global economy, and the kind of international financial flows this might generate.

**Greenhouse Gas (GHG)**

Any atmospheric gas (either natural or anthropogenic in origin) which absorbs thermal radiation emitted by the Earth's surface. This traps heat in the atmosphere and keeps the surface at a warmer temperature than would otherwise be possible, hence it is commonly called the Greenhouse Effect.

**Gross Domestic Product (GDP)**

A measure of total economic activity.

**Gross Value Added (GVA)**

The difference between output and intermediate consumption for any given sector/industry.

**Heavy Goods Vehicle (HGV)**

A truck over 3.5 tonnes (articulated or rigid).

**Home Insulation Scheme**

An area-based scheme to promote and install energy efficiency measures in Scotland, managed by the Energy Saving Trust.

**Interim budget**

The UK has legislated a set of Interim carbon budgets for 2008-2022 under a 20% EU target, with an intention to move to an Intended budget after a tightening of the EU framework.

**Interim target**

Scotland has legislated an interim target for 2020, on the way to an 80% emissions reduction in 2050.

**Intermittency**

The tendency of some power sources to be unintentionally unavailable (e.g. as for wind generators when the wind is not blowing).

**Joint Implementation (JI)**

UN-regulated scheme which allows credits to be issued from projects that reduce emissions of GHGs in Kyoto Annex 1 countries.

**Kyoto gas**

A greenhouse gas covered by the Kyoto Protocol: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), sulphur hexafluoride (SF<sub>6</sub>), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

**LULUCF**

Land Use, Land Use Change and Forestry.

**Mechanical biological treatment (MBT)**

Waste treatment technology for dealing with mixed waste, involving a mechanical sorting process and a biological process, typically composting or anaerobic digestion, producing biogas.

**MtCO<sub>2</sub>**

Million tonnes of Carbon Dioxide (CO<sub>2</sub>).

**National Atmospheric Emissions Inventory (NAEI)**

Data source compiling estimates of the UK's emissions to the atmosphere of various (particularly greenhouse) gases.

**Offset credits**

Credits corresponding to units of abatement from projects, such as those generated under the Kyoto treaty's project based flexibility mechanisms, Joint Implementation (JI) and Clean Development Mechanism (CDM). Referred to as 'carbon units' in the Climate Change (Scotland) Act.

**Ofgem (Office of Gas and Electricity Markets)**

The regulator for electricity and downstream gas markets.

**Plug-in hybrid**

A full hybrid vehicle with additional electrical storage capacity which can be charged from an external electrical source such as mains supply.

**National Allocation Plan (NAP)**

A plan detailing how many emissions allowances will be allocated to each individual installation covered by the EU ETS in a Member State. Used in Phases I and II of the EU ETS (2005-2012).

**Non-traded sector**

Those parts of the economy not covered by the EU ETS.

**Renewable Transport Fuel Obligation (RTFO)**

The RTFO places an obligation on fuel suppliers to include a minimum level (5% by 2010) of biofuels in their sales.

**Renewables**

Energy resources, where energy is derived from natural processes that are replenished constantly. They include geothermal, solar, wind, tide, wave, hydropower, biomass and biofuels.

**Reserved powers**

Policy areas governed by the UK Government.

**Security of supply**

The certainty with which energy supplies (typically electricity, but also gas and oil) are available when demanded.

**Smarter Choices**

Smarter Choices are techniques to influence people's travel behaviour towards less carbon-intensive alternatives to the car such as public transport, cycling and walking by providing targeted information and opportunities to consider alternative modes. Smarter Choices, Smarter Places is the name for the Scottish Government project.

**Social tariff**

An energy tariff where vulnerable or poorer customers pay a lower rate.

**Traded sector**

Those parts of the economy covered by the EU ETS.

**United Nations Framework Convention on Climate Change (UNFCCC)**

Signed at the Earth Summit in Rio de Janeiro in 1992 by over 150 countries and the European Community, the UNFCCC has an ultimate aim of 'stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.'

**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<sub>2</sub>/km).



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