



# Reducing emissions in Scotland

## 2017 Progress Report to Parliament

Committee on Climate Change  
September 2017



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## Acknowledgements

The Committee would like to thank:

**The team that prepared the analysis for this report.** This was led by Adrian Gault, David Joffe and Tanja Wettingfeld.

**Other members of the Secretariat who contributed to this report:** Jo Barrett, Owen Bellamy, Ellie Davies, Aaron Goater, Mike Hemsley, Jenny Hill, Ewa Kmietowicz, Indra Thillainathan and Steve Westlake.

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## The Committee



### **The Rt. Hon John Gummer, Lord Deben, Chairman**

Lord Deben was the UK's longest-serving Secretary of State for the Environment (1993 to 1997). He has held several other high-level ministerial posts, including Secretary of State for Agriculture, Fisheries and Food (1989 to 1993). He has consistently championed the strong links between environmental concerns and business interests. Lord Deben also runs Sancroft, a corporate responsibility consultancy working with blue-chip companies around the world on environmental, social and ethical issues. He is Chairman of Valpak Limited and the Personal Investment Management and Financial Advice Association.



### **Baroness Brown of Cambridge FRS**

Baroness Brown of Cambridge DBE FREng FRS (Julia King) is an engineer, a crossbench member of the House of Lords, a Fellow of the Royal Society, Chair of the Adaptation Sub-Committee of the Committee on Climate Change, and Deputy Chair of the Committee on Climate Change. She is also Chair of the Henry Royce Institute for Advanced Materials, Non-Executive Director of the Offshore Renewable Energy Catapult and Chair of STEM Learning Ltd. She was previously Non-Executive Director of the Green Investment Bank, held senior engineering and manufacturing positions at Rolls-Royce plc, and academic positions at Cambridge University and Imperial College. She is a former Vice Chancellor of Aston University.



### **Professor Nick Chater**

Nick Chater is Professor of Behavioural Science at Warwick Business School. He has particular interests in the cognitive and social foundations of rationality, and applying behavioural insights to public policy and business. Nick is Co-founder and Director of Decision Technology Ltd, a research consultancy. He has previously held the posts of Professor of Psychology at both Warwick University and University College London (UCL), Associate Editor for the journals Cognitive Science, Psychological Review, Psychological Science and Management Science.

**Dr Rebecca Heaton FICFor**

Rebecca Heaton is Head of Sustainability and Policy at Drax Group. She is responsible for the sustainability of the global forest supply chains used to produce biomass for its power station, and for research and policy work. She has extensive experience working for a number of energy businesses on a range of topics, including biofuels, land-use and forestry and climate change adaptation. She previously led the work of the Energy Research Partnership (ERP) Bioenergy Review 2011 and was a member of the Editorial Board of Global Change Biology – Bioenergy.

**Professor Sir Brian Hoskins**

Sir Brian Hoskins is Professor of Meteorology at the University of Reading, specialising in weather and climate processes. He is also Chair of the Grantham Institute for Climate Change and the Environment at Imperial College London and a member of the national scientific academies of the UK, USA, and China.

**Paul Johnson**

Paul Johnson is Director of the Institute for Fiscal Studies and a visiting professor at University College London (UCL). He is widely published on the economics of public policy, and he co-wrote the "Mirrlees review" of tax system design. He was previously Chief Economist at the Department for Education (2000 to 2004) and Head of Economics of Financial Regulation at the Financial Services Authority (1999 to 2000).



### **Professor Corinne Le Quéré FRS**

Corinne Le Quéré is Professor of Climate Change Science and Policy at the University of East Anglia (UEA), specialising in the interactions between climate change and the carbon cycle. She is also Director of the Tyndall Centre for Climate Change Research, a lead author of several assessment reports for the UN's Intergovernmental Panel on Climate Change (IPCC), and Director of the annual update of the global carbon budget by the Global Carbon Project (GCP).



### **Professor Jim Skea**

Jim Skea is Professor of Sustainable Energy at Imperial College, with research interests in energy, climate change and technological innovation. He is also Research Councils UK Energy Strategy Fellow and President of the Energy Institute. Jim was Research Director of the UK Energy Research Centre (2004 to 2012) and Director of the Policy Studies Institute (1998 to 2004). He was awarded a CBE for services to sustainable energy in 2013 and an OBE for services to sustainable transport in 2004.

# Executive summary

This is our sixth report on Scotland's progress towards meeting greenhouse gas emissions reduction targets, as requested by Scottish Ministers under the Climate Change (Scotland) Act 2009.

The 2009 Act requires that Scottish Ministers set out policies and proposals for meeting the legislated targets. In January 2017 the Scottish Government issued the draft Climate Change Plan, setting out how it intends to meet the legislated emissions targets to 2032, on the way to reducing emissions by at least 80% by 2050. The Scottish Government intends to publish the final version in February 2018. We assess the draft Climate Change Plan in this report (Chapter 2).

Following the Paris Agreement, the Scottish Government intends to pass new climate change legislation by early 2019. The Committee provided advice on both the design and the levels of the targets in March 2017.<sup>1</sup> The Scottish Government has proposed to move to a more ambitious 90% target for emissions reduction by 2050, from an existing target for a reduction of at least 80%.<sup>2</sup>

Scotland's level of ambition in reducing emissions is among the highest in the world. In order to achieve these ambitious targets, effective policies will be required across the economy.

Emissions data for Scotland and the other devolved administrations are produced with a significant delay compared with emissions data for the UK as a whole. We therefore focus on progress to 2015, while noting any significant subsequent developments that are not yet reflected in the emissions data.

## Our key messages on progress to date are:

- **Scotland is performing well** compared with other countries in the UK and the UK as a whole. Scotland's actual emissions, including international aviation and shipping, fell by 3% in 2015 and were 38% below 1990 emissions, compared with a reduction of 35% for the UK as a whole.
  - Emissions reductions were largely driven by decarbonisation of the power sector.
  - Power sector emissions will have fallen again sharply since 2015, following the closure of the last coal plant in Scotland, Longannet, in 2016. However, further reduction potential in electricity generation will be limited.
- **Scotland met its 'net' emissions annual target in 2015.**
  - The 2015 target for net emissions is 45.928 MtCO<sub>2</sub>e. Net Scottish emissions were 45.5 MtCO<sub>2</sub>e in 2015, below this annual target. This is the second annual target to be met.
  - Emissions on the net basis in 2015 were 41% below 1990 levels. Scotland is on track to meet the interim target for at least a 42% reduction in net emissions by 2020.
- **More effort is needed in sectors other than power.** There have not been significant emission reductions in most sectors outside electricity generation in recent years. More needs to be done, especially in sectors such as transport, agriculture and heat for non-residential buildings in which little progress is currently being made. Otherwise, Scotland's ambitious targets will be at risk.

<sup>1</sup> CCC (2017) *Advice on the new Scottish Climate Change Bill*.

<sup>2</sup> <https://consult.scotland.gov.uk/energy-and-climate-change-directorate/climate-change-bill/>

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The final version of the Climate Change Plan will need to be strong enough to put Scotland on the path to meeting not only the legislated targets under the existing Act, but also on track for the greater ambition proposed under the new legislation.

Inevitably, there are aspects of the draft Plan that need to be revised. The process of consultation adopted by the Scottish Government provides time for review and revision of the Plan. The final version of the Plan will need to include firm new policies, and should aim for a more balanced set of contributions to emissions reduction across sectors:

- **Policies and proposals.** The draft Climate Change Plan contains little beyond existing policy and commitments, although there have been some subsequent high-level announcements. Without firm new policies, the reductions in Scottish emissions seen in recent years are unlikely to continue in the 2020s. The final version of Scotland's plan should also build as fully as possible on the UK Government's Clean Growth Plan, which will set out how UK emissions targets to 2032 will be met.
- **Balance of effort across sectors.** The balance of sectoral emissions reduction in the draft Climate Change Plan should be revised. Greater ambition will be required to reduce emissions in the transport sector, as announced in the recent Programme for Government<sup>3</sup>, with less reliance on rapid deployment of low-carbon heating. The Plan as it stands lacks credibility in meeting the emissions targets to 2032 and fails to prepare properly for deeper decarbonisation in the longer term. The final version of the Plan will also need to be compatible with the Scottish Government's proposal to move to a 90% emissions reduction target for 2050 under the new climate change legislation.
- **Ambition on electric vehicles.** The draft Climate Change Plan envisages ultra-low-emission vehicles (ULEVs, e.g. electric vehicles) reaching 40% of new car and van sales by 2032, which is not ambitious enough to achieve the deep decarbonisation required by 2050 given the time it takes to turn over the vehicle stock. The recent Programme for Government announcement that petrol and diesel vehicle sales will be phased out by 2032 is a far stronger commitment, and is commensurate with the challenge set by Scotland's ambition on climate change. The final version of the Plan will need to set out the policies that will build the market for ULEVs over the next 15 years to the point that sales of petrol and diesel vehicles can be phased out.
- **Low-carbon heating.** The draft Plan includes a large contribution to emissions reduction from the buildings sector, including ambitious but achievable levels of energy efficiency improvement. However, heat decarbonisation is highly challenging, and the assumed share of low-carbon heat<sup>4</sup> of 80% by 2032 is very unlikely to be feasible. Relying on this scale of emissions reduction from heat decarbonisation would call into question the credibility of the overall strategy. The recently announced increase in ambition in the transport sector provides an opportunity to moderate the scale of the required emissions reductions from low-carbon heat.
  - Achieving ambitious levels of low-carbon heating requires immediate action, rather than waiting until 2025 for significant levels of deployment as in the draft Plan. It is a strength of Scotland's Energy Efficiency Programme (SEEP) that it joins up energy efficiency with

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<sup>3</sup> <https://news.gov.scot/news/programme-for-government-1>

<sup>4</sup> The definition of low-carbon heat used in the Plan includes resistive electric heating (e.g. storage heaters), which currently meets around 12% of buildings heat in Scotland. The Committee usually excludes resistive electric heat when presenting proportions of low-carbon heat, but have used the Plan's definition here for comparison purposes.

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low-carbon heating. It is essential that near-term opportunities are taken to deploy low-carbon heating systems in conjunction with energy efficiency improvements.

- The Committee recommends that the final version of the Plan relies on low-carbon sources providing no more than 50% of heat by 2032. This would not stop the Scottish Government aiming for a stretch target that goes beyond 50%, but meeting the overall emissions targets should not rely on doing so.
- **Power sector.** The Plan for low-carbon power generation is suitably ambitious, and is well aligned with the Committee's analysis on the importance of early power sector decarbonisation, both to provide near-term emissions reduction and to facilitate reductions in other areas through electrification (e.g. electric vehicles).
- **Carbon capture and storage (CCS).** The commitment to Scottish deployment of CCS within the Climate Change Plan and Energy Strategy is very welcome. It is important that the Scottish Government works with the UK Government on how this can be done during the 2020s, especially the crucial first step of establishing CO<sub>2</sub> transportation and storage infrastructure.
- **Forestry.** The Plan's ambition to increase tree planting rates to 15,000 hectares per year by the mid-2020s is positive. However, the Plan has a substantially higher level of forestry emissions in 2032 than the Committee's scenarios for meeting future targets, partly due to use of out-dated analysis. This analysis should be revisited for the final version of the Plan.
- **Agriculture.** There has been little recent progress in reducing agricultural emissions in Scotland. The draft Plan sets out voluntary measures to reduce emissions, building on the Farming for a Better Climate initiative. The Scottish Government should look again at going beyond a voluntary approach, in order for agriculture to make the necessary contributions to meeting Scotland's ambitious climate targets.

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# Chapter 1: Overview



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This is our sixth report on Scotland's progress towards meeting emission reduction targets, as requested by Scottish Ministers under the Climate Change (Scotland) Act 2009.

In this report, we assess the progress that Scotland has made against the targets set out in that Act:

- The Climate Change (Scotland) Act sets a long-term target to reduce emissions of greenhouse gases (GHGs) by at least 80% in 2050 relative to 1990, with an interim target to reduce emissions by 42% in 2020.
- Secondary legislation passed in October 2010, October 2011 and October 2016 also set a series of annual emission reduction targets for 2010 to 2022, 2023 to 2027 and 2028 to 2032 respectively, following advice from the Committee. These annual targets require a reduction of 66% by 2032 against 1990 emissions.

In 2016, the Scottish Government announced its intention to enact new climate change legislation, including changing the way that emissions are accounted for within legislated targets and increasing the ambition of the targets following the Paris Agreement. The Scottish Government requested advice from the Committee on the design of the new targets and on their levels, which the Committee provided in March 2017.<sup>5</sup> This advice set out two options for the level of the 2050 target, either waiting for a firmer evidence base to increase ambition or moving now to a target for a 90% emissions reduction.

In June 2017, the Scottish Government announced its intention to adopt a more ambitious 2050 target for a reduction of 90% on 1990 levels. The new Climate Change Bill has not been published and will not become law until 2019, but the Scottish Government has set out proposals for the new targets. This report therefore considers progress on the basis of what will be required to meet the new targets, as well as those under the existing legislation.

We also assess the draft of the third report on policies and proposals, the draft Climate Change Plan, published by the Scottish Government in 2017. When finalised, this Plan will set out how the Scottish Government intends to meet the emissions targets out to 2032.

Chapter 1 gives an overview on the latest Scottish emission trends in relation to the emission reduction targets. In Chapter 2, we assess the draft Climate Change Plan both against whether it puts Scotland on a credible path to meet the current legislated target as well as the new proposed more ambitious targets. The subsequent chapters focus on the different sectors of the Scottish economy. In each chapter we first present a summary of progress against targets, followed by a consideration of emission trends and a more detailed discussion on the draft Climate Change Plan proposals.

## Summary of progress

Emissions fell by 3% in Scotland in 2015, and actual emissions are now 38% below 1990 levels. Scotland met its most recent annual target, and is on track to meeting the interim target for 2020 under the Climate Change (Scotland) Act 2009 (Table 1.1).

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<sup>5</sup> CCC (2017) *Advice on the Scottish Climate Change Bill*.

**Table 1.1.** Scotland's targets and progress to date

Target	Progress to date
<b>2050 and interim targets</b>  The Climate Change (Scotland) Act 2009 sets a target to reduce emissions of greenhouse gases by at least 80% by 2050 against 1990 levels. The Act also establishes an interim target for 2020 of 42%.  <b>New Climate Change Bill</b>  The Scottish Government proposed in June 2017 that the new Climate Change Bill will set more ambitious targets on the basis of actual emissions, including emissions from international aviation and shipping: at least 56% reduction by 2020 and 90% by 2050.	<b>Net emissions targets</b>  Scotland is on track to meet the interim target for at least a 42% reduction by 2020. The reduction from the 1990 baseline was 41% in 2015.  <b>Actual emissions</b>  Actual Scottish emissions in 2015 were 48 MtCO <sub>2</sub> e, a 38% reduction on 1990 levels. Anticipating a further significant drop in power emissions in 2016 due to the closure of Longannet, the proposed 2020 target is in reach but requires greater reductions in sectors other than power.
<b>Annual target</b>  Secondary legislation passed in October 2010 and October 2011 set annual emission reduction targets for 2010-2022 and 2023 -2027 respectively.  The 2015 target for net emissions is 45.928 MtCO <sub>2</sub> e.	Net Scottish emissions in 2015 were 45.5 MtCO <sub>2</sub> e, which is below the annual target. This is the second annual target to be met.
<b>Domestic effort target</b>  The Climate Change (Scotland) Act 2009 requires that reductions in net Scottish emissions of greenhouse gases account for at least 80% of the reduction in the net Scottish emissions account in any target year.	No credit purchases were made in 2015; the domestic effort target was therefore met.

## Actual emissions

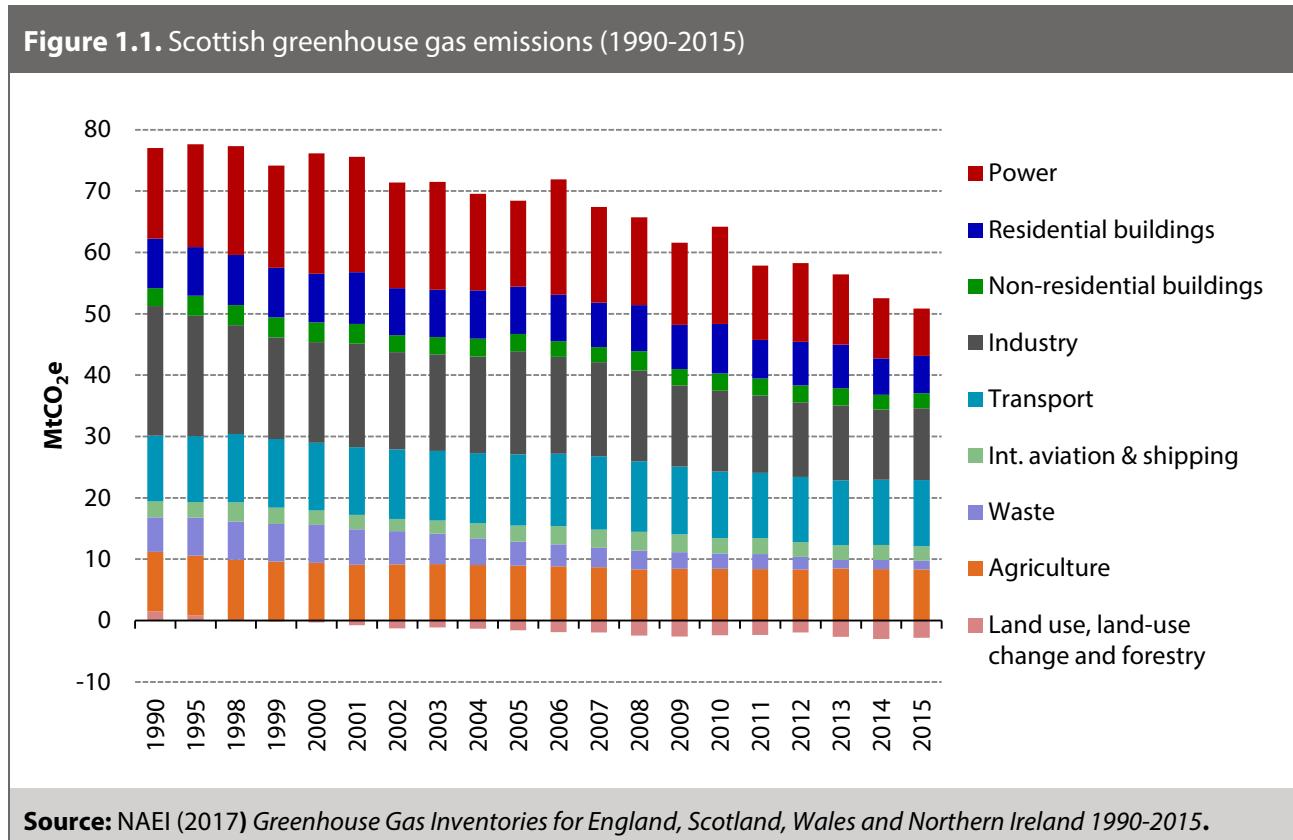
Actual Scottish emissions<sup>6</sup> (including international aviation and shipping emissions) fell by 3% to 48.1 MtCO<sub>2</sub>e in 2015, with average annual falls of 3.4% from 2009 to 2015. Emissions in 2015 were 38% below 1990 levels. This compares to a 3.6% reduction for the UK as a whole in 2015 and a 35% reduction against 1990 levels (including international aviation and shipping).

Scotland has different challenges and opportunities compared to the UK and the other devolved nations. Scotland has made strong progress in decarbonising the power sector – emissions data from 2016, to be released in 2018, is expected to show a further sharp reduction in emissions due to the closure of the Longannet coal-fired plant in March 2016. Scotland's land use, land-use change and forestry (LULUCF) sector is also a significant net sink, due to the extent of forest

<sup>6</sup> Actual emissions: all emissions that are emitted in Scotland (in contrast to 'net' emissions, which adjusts for emissions trading).

coverage. Conversely, emissions from agriculture have a larger share than compared to the UK and are particular challenging to reduce (Figure 1.1):

- There were strong falls in 2015 in emissions from the power sector (-21%), and moderate falls for LULUCF (-7%) and waste (-4%).
- There was a moderate increase in emissions from residential buildings (+3%) and non-residential buildings (+1.5%) and from the transport sector (+1.4%).



## The Scottish Net Emissions account

The emissions targets under Scotland's existing climate legislation have been set on a 'net' basis. 'Net' emissions are calculated under the Net Scottish Emissions Account (NSEA), taking into account non-traded emissions, surrendered units and Scotland's assigned EU ETS cap (known as the specified amount):

- Emissions on the 'net' measure rose by 0.8 MtCO<sub>2</sub>e in 2015, due to a slight rise in Scottish emissions outside the EU ETS (mainly transport and buildings), together with an increase in Scotland's allocation of allowances in the EU Emissions Trading System.
- For 2015, the NSEA was 45.5 MtCO<sub>2</sub>e, below the annual target of just under 46 MtCO<sub>2</sub>e. The reduction from the 1990 baseline was 41% in 2015. Scotland is therefore on track to meet the interim target for a reduction of at least 42% by 2020.

## Inventory changes

Inventory improvements are designed to increase the transparency, accuracy, consistency, comparability, and completeness of the inventory. Changes to the 2017 emissions inventory mainly affected the land use, land-use change and forestry (LULUCF) and waste sectors. The combination of both revisions had less effect on estimated emissions in 1990 than emissions in more recent years, since impacts on the balance between waste and LULUCF were different in 2015 and 1990:

- In the waste sector, a new Scotland-specific landfill model has been used, utilising more recent landfill survey data, which has caused large revisions to estimated waste emissions, particularly early in the time series.
- In the LULUCF sector, the use of a new National Forest Inventory and small woodlands datasets has improved estimates and caused large changes as a result.
- The estimate for Scottish emissions in 1990 is largely unchanged overall, due to offsetting changes: LULUCF emissions have been revised up by 3.8 MtCO<sub>2</sub>e from estimates in 2016, while waste emissions have been revised downward by 4.2 Mt (-43%). The overall revision to estimated emissions for 1990 is a reduction of 0.2 Mt (-0.2%).
- The latest estimate of the LULUCF sink for 2014 is 3.2 Mt smaller than was estimated in 2016. This is offset to a degree by a downward revision of 0.8 Mt in waste emissions (-34%). The overall revision to estimated emissions for 2014 is an increase of 2.6 Mt (6%).
- Because emissions estimates for 1990 and 2014 have been impacted differently by these inventory changes, there have been significant changes in estimates of percentage reductions on 1990 levels. Last year's report stated that total Scottish emissions had fallen by 41% between 1990 and 2014; however, after the inventory change this reduction is now estimated at 37%.
- The difference in revisions to 1990 and 2014 emissions is unusual. Previous inventory changes have tended to affect estimates for both 1990 and more recent years in similar ways (Figure 1.2), often leaving the percentage change against 1990 emissions largely unaffected.

Inventory revisions can mean large changes to estimates of Scottish emissions, reflecting the relatively large uncertainty in estimates of Scottish emissions ( $\pm 10\%$ , compared to  $\pm 3\%$  for the UK as a whole).<sup>7</sup> Together with inter-annual variations in winter temperatures, they mean that Scottish targets can be missed, even with strong policy effort to meet them.

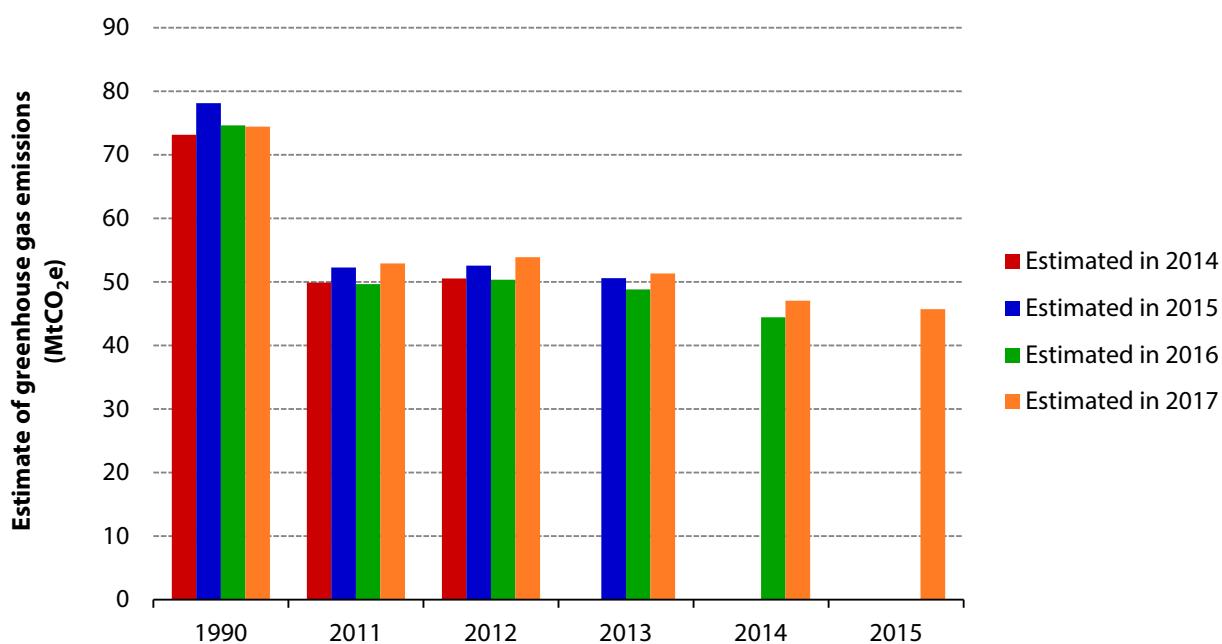
Each of the first four annual targets (2010 to 2013) were missed, in large part due to revisions to the Scottish inventory that made them more difficult to meet. A subsequent revision in the other direction has made the targets more achievable, and the 2015 target is the second consecutive one to be met.

The risk that revisions to the inventory make the targets unachievable, or too easy to meet, will be mitigated to some extent by the move to percentage reduction targets under the new climate change legislation, as recommended by the Committee.<sup>8</sup> However, the risk will remain to an extent, especially when changes affect estimates of recent emissions in different ways to those for 1990 emissions as has occurred in the latest emissions inventory.

<sup>7</sup> See CCC (2017) *Quantifying Greenhouse Gas Emissions* for more detail.

<sup>8</sup> CCC (2017) *Advice on the new Scottish Climate Change Bill*.

**Figure 1.2.** Revisions to emissions estimates for 1990 and 2011-15 under the Scottish inventory (2014-17)



**Source:** NAEI (2014, 2015, 2016, 2017).

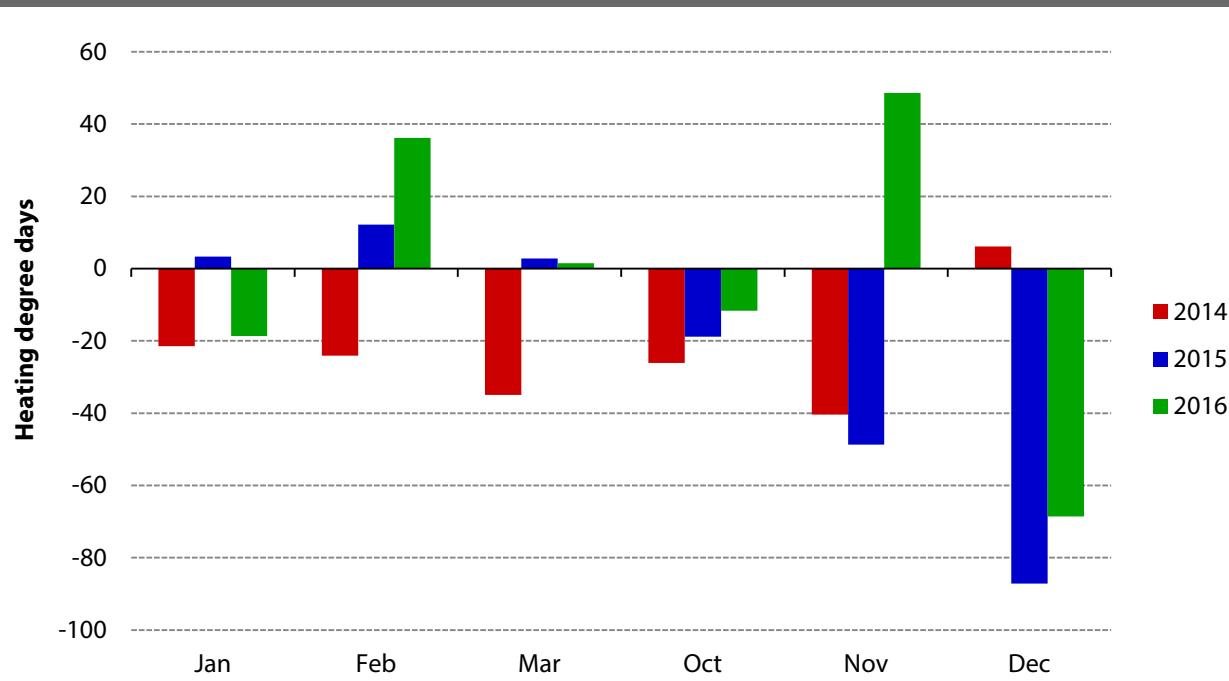
## Outlook for 2016 emissions

Data on Scottish emissions in 2016 are due to become available in June 2018. To the extent possible, we will report on 2016 Scottish emission in our UK progress report at the end of June 2018. In this section, we draw on other data that can provide an indication of what is likely to have happened to emissions in Scotland in 2016:

- **Closure of the Longannet coal-fired station.** We expect emissions from the power sector to drop sharply due to the closure of the Longannet coal-fired station. In 2015, Longannet emitted around 7.5 MtCO<sub>2</sub>e. Longannet closed on March 24th 2016, and hence only emitted 1.6 MtCO<sub>2</sub>e in 2016. The reduction in Longannet emissions alone is equivalent to 16% of Scottish 2015 emissions (10% of 1990 emissions).
- **Temperature in winter 2016.** Winter temperatures in 2016 were only slightly higher than the long-run average (Figure 1.3) and were lower than those in 2014 and 2015. The increase in heating degree days in 2016 compared to 2015 can be expected to have led to increased emissions in 2016.

It is likely that the fall in emissions from Longannet will outweigh any increase due to colder temperatures and that actual emissions in Scotland in 2016 will have decreased significantly. However, in 2015, Scottish emissions excluding the power sector increased by 1.6%.

**Figure 1.3.** Number of heating degree days variation from the long-run average (winters 2014-2016)



**Source:** Degree day data (2017) <http://www.enmanreg.org/freedd/>

**Notes:** Heating degree days (HDDs) are calculated relative to a baseline temperature, typically 15.5 degrees Celsius, which is the outside temperature above which a building needs no heating. One HDD is the number of degrees centigrade deviation from the base temperature of the actual temperature on a given day. This figure compares HDD in winter 2014, 2015 and 2016 with the long-run average (1987-2016). Points above the horizontal axis reflect colder than average temperatures and points below indicate higher than average temperatures.

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# **Chapter 2: Assessment of the draft Climate Change Plan**



Following the legislation of annual targets, the Climate Change (Scotland) Act 2009 requires the Scottish Government to publish policies and proposals for how these targets are to be met.

The annual targets for 2028 to 2032 were legislated in 2016. In January 2017 the Scottish Government published the draft Climate Change Plan, which set out how it intends to meet them, together with a wider and longer-term draft Energy Strategy. The Scottish Government has stated that the final version of the Plan will be published in February 2018.

The Scottish Government intends to increase the level of 2050 ambition to a reduction in greenhouse gas emissions of 90% on 1990 levels, to be placed in law by early 2019. However, the Climate Change Plan is required under the existing Scottish climate change legislation, and therefore relates to targets on the path to an emissions reduction of at least 80% by 2050. Nevertheless, it remains important that near-term plans and policies recognise that greater emissions reductions will be necessary under the new targets, and prepare suitably for these.

In order for the Climate Change Plan to be effective, it will need to put Scotland on the path not only to meet the annual targets to 2032, but also to achieve the much deeper level of decarbonisation by 2050. In order to provide the strongest basis on which to meet the targets, it should be robust to key uncertainties and flexible enough to adapt as circumstances change.

In this chapter, we make an assessment of the draft Climate Change Plan and, where relevant, the draft Energy Strategy. This includes a comparison with the Committee's High Ambition scenario for Scotland, on which the targets were based. Our assessment is three sections:

1. Sectoral emissions comparison
2. Feasibility of emissions reductions and preparation for deep decarbonisation by 2050
3. Conclusions and key messages

We also make more detailed comments on the sector-specific aspects of the draft Climate Change Plan and Energy Strategy in the sectoral chapters.

#### **Box 2.1. Key messages on the draft Climate Change Plan**

The final version of the Climate Change Plan will need to be strong enough to put Scotland on the path to meeting not only the legislated targets under the existing Act, but also on track for the greater ambition proposed under the new legislation.

Inevitably, there are aspects of the draft Plan that need to be revised. The process of consultation adopted by the Scottish Government provides time for review and revision of the Plan. The final version of the Plan will need to include firm new policies, and should plan for a more balanced set of contributions to emissions reduction across sectors:

- **Policies and proposals.** The draft Climate Change Plan contains little beyond existing policy and commitments, although there have been some subsequent high-level announcements. Without firm new policies, reductions in Scottish emissions are unlikely to continue in the 2020s. The final version of Scotland's plan should also build as fully as possible on the UK Government's Clean Growth Plan, which will set out how UK emissions targets to 2032 will be met.
- **Balance of effort across sectors.** The balance of sectoral emissions reduction in the draft Climate Change Plan should be revised. Greater ambition will be required to reduce emissions in the transport sector, as announced in the recent Programme for Government, with less reliance on rapid deployment of low-carbon heating. The Plan as it stands lacks credibility in meeting the emissions targets to 2032 and fails to prepare properly for deeper decarbonisation in the longer

## Box 2.1. Key messages on the draft Climate Change Plan

- term. The final version of the Plan will also need to be compatible with the Scottish Government's proposal to move to a 90% emissions reduction target for 2050 under the new climate change legislation.
- **Ambition on electric vehicles.** The draft Climate Change Plan envisages ultra-low-emission vehicles (ULEVs, e.g. electric vehicles) reaching 40% of new car and van sales by 2032, which is not ambitious enough to achieve the deep decarbonisation required by 2050 given the time it takes to turn over the vehicle stock. The recent Programme for Government announcement that petrol and diesel vehicle sales will be phased out by 2032 is a far stronger commitment, and is commensurate with the challenge set by Scotland's ambition on climate change. The final version of the Plan will need to set out the policies that will build the market for ULEVs over the next 15 years to the point that sales of petrol and diesel vehicles can be phased out.
  - **Low-carbon heating.** The draft Plan includes a large contribution to emissions reduction from the buildings sector, including ambitious but achievable levels of energy efficiency improvement. However, heat decarbonisation is highly challenging, and the assumed share of low-carbon heat of 80% by 2032 is very unlikely to be feasible. Relying on this scale of emissions reduction from heat decarbonisation would call into question the credibility of the overall strategy. The recently announced increase in ambition in the transport sector provides an opportunity to moderate the scale of the required emissions reductions from low-carbon heat.
    - Achieving ambitious levels of low-carbon heating requires immediate action, rather than waiting until 2025 for significant levels of deployment as in the draft Plan. It is a strength of Scotland's Energy Efficiency Programme (SEEP) that it joins up energy efficiency with low-carbon heating. It is essential that near-term opportunities are taken to deploy low-carbon heating systems in conjunction with energy efficiency improvements.
    - The Committee recommends that the final version of the Plan relies on low-carbon sources providing no more than 50% of heat by 2032. This would not stop the Scottish Government aiming for a stretch target that goes beyond 50%, but meeting the overall emissions targets should not rely on doing so.
  - **Power sector.** The Plan for low-carbon power generation is suitably ambitious, and is well aligned with the Committee's analysis on the importance of early power sector decarbonisation, both to provide near-term emissions reduction and to facilitate reductions in other areas through electrification (e.g. electric vehicles).
  - **Carbon capture and storage (CCS).** The commitment to Scottish deployment of CCS within the Climate Change Plan and Energy Strategy is very welcome. It is important that the Scottish Government works with the UK Government on how this can be done during the 2020s, especially the crucial first step of establishing CO<sub>2</sub> transportation and storage infrastructure.
  - **Forestry.** The Plan's ambition to increase tree planting rates to 15,000 hectares per year by the mid-2020s is positive. However, the Plan has a substantially higher level of forestry emissions in 2032 than the Committee's scenarios for meeting future targets, partly due to use of out-dated analysis. This analysis should be revisited for the final version of the Plan.
  - **Agriculture.** There has been little recent progress in reducing agricultural emissions in Scotland. The draft Plan sets out voluntary measures to reduce emissions, building on the Farming for a Better Climate initiative. The Scottish Government should look again at going beyond a voluntary approach, in order for agriculture to make the necessary contributions to meeting Scotland's ambitious climate targets.

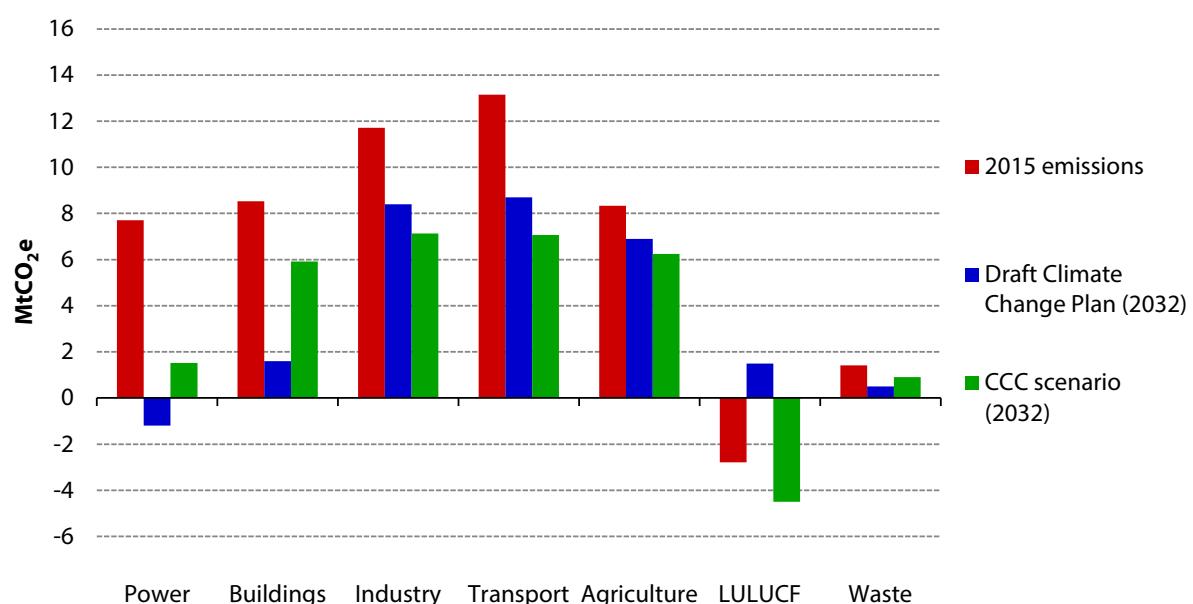
## 1. Sectoral emissions comparison

In this section, we compare the draft Plan at a sectoral level to the Committee's scenario that underpinned the recommended (and subsequently legislated) targets.<sup>9</sup> The targets require that the Net Scottish Emissions Account<sup>10</sup> falls from 45.5 MtCO<sub>2</sub>e in 2015 (a level 41% below 1990 emissions) to 26.4 Mt by 2032 (66% below 1990 emissions). Due to the requirements of the Climate Change (Scotland) Act, the Plan is also required to outperform the legislated targets by a cumulative amount of 3.3 Mt, due to previous underperformance against annual targets.

The draft Climate Change Plan has a different balance of emission reductions across sectors to that in the Committee's High Ambition scenario (Figure 2.1). This is not inherently problematic, as part of the design of the Climate Change (Scotland) Act's economy-wide emissions targets is to allow for flexibility and for Government to determine the balance of action between sectors. It is important, however, that the final Plan is credible in meeting both medium-term targets and being on track to 2050.

The first step in our assessment of the draft Plan is to identify areas in which it differs significantly from our own scenario for Scotland. We then consider the feasibility of the Plan's emissions reductions and how it prepares for deeper reductions to 2050.

**Figure 2.1.** Sectoral emissions in 2015 and 2032 under the draft Climate Change Plan and CCC High Ambition Scenario



**Source:** Draft Climate Change Plan, CCC analysis.

**Notes:** The draft Plan has emissions in the power sector going negative from the late 2020s, as a result of combining biomethane grid injection with gas CCS power plants. The CCC scenario also deploys both of these, but allocates the biomethane to the buildings and industry sectors, resulting in positive overall power sector emissions, as a result of small residual emissions from the (fossil) CCS plants. The difference in power sectors emissions is therefore due to how savings from biomethane have been allocated rather than any substantive underlying difference.

<sup>9</sup> CCC (2016) *Scottish emissions targets 2028-2032 – The high ambition pathway towards a low-carbon economy*.

<sup>10</sup> 'Net' emissions are calculated under the Net Scottish Emissions Account (NSEA), taking into account non-traded emissions, surrendered units and Scotland's assigned EU ETS cap (known as the specified amount).

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The Plan's level of emissions from the transport and forestry sectors are considerably higher than under our scenario. This imposes a greater burden upon other sectors, especially buildings:

- **Transport.** Under the draft Plan, surface transport emissions in 2032 would be 8.7 Mt, 34% below 2015 levels. This is 1.6 Mt above those in the CCC scenario, a reduction of 46% on 2015 emissions.
  - As part of the process of generating the economy-wide pathway the road transport sector results were fixed, based on the results of a study by Element Energy<sup>11</sup> on the level of emissions reduction that could be achieved in that sector, including sales of ultra-low-emission vehicles (ULEVs) reaching 40% of sales of cars and vans by 2032.
  - The recent Programme for Government announcement for the phase-out of conventional petrol and diesel car and van sales by 2032 is much more ambitious, and in line with the Committee's recommendations that allowed for such a phase-out by 2035 in order to reach emissions near zero by 2050 once the vehicle stock turns over.
  - The path to a phase-out by 2032 will lead to lower Scottish emissions in 2032, with the extent depending on the precise path for vehicle sales over the intervening period. We expect the scale of this additional emissions reduction by 2032 to be set out in the final version of the Climate Change Plan.
- **Forestry.** The draft Plan has a similar level of ambition to the CCC scenario on rates of tree planting. Despite this, the levels of emissions in 2032 are very different. Forestry emissions in 2032 are higher in the draft Plan, partly as a result of analytical differences but also due to an assumption of tree-felling during the 2020s.
  - Overall ambition on new tree planting is similar, with the Plan reaching rates of 15,000 hectares per annum by the mid-2020s, compared to the 16,000 hectares per annum in the CCC scenario.
  - There are further differences in the way the analysis has been compiled. The analysis in the draft Plan used a 2012 baseline for forestry emissions, which is not consistent with the latest emissions inventory methodology and is likely to underestimate the carbon sink from existing forests. While difficulties in projecting forestry emissions remain, the 2015 projection used in the CCC scenario better reflects the latest understanding and the current treatment within the emissions inventory. The final version of the Plan will need to update projected forestry emissions to reflect the latest evidence.
  - The draft Plan includes abatement measures from peatland restoration, even though not all peatland emissions are yet included in the emissions inventory.
- **Buildings.** The Plan has a sharp emissions reduction in the buildings sector, falling 81% from 8.5 Mt in 2015 to 1.6 Mt in 2032, as a result of both significant improvements to the energy efficiency of the buildings stock and a major increase in the proportion of heat supplied from low-carbon sources. The CCC scenario reduces 31% to 5.9 Mt over the same period.

This raises questions over whether the very rapid reductions in buildings sector emissions are feasible, and whether the need for rapid reductions is lessened by the recently announced increase in ambition for transport decarbonisation.

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<sup>11</sup> Element Energy (2017) *Greenhouse Gas Emissions Reduction Potential in the Scottish Transport Sector*.

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In assessing the draft Plan to meet the targets to 2032 it is important to go beyond a high-level comparison the respective emissions level by sector, and also assess:

- The feasibility of these actions to reduce emissions.
- Whether the planned actions to 2032 prepare sufficiently well to achieve the deep decarbonisation required in the longer term, consistent with the 2050 target for an 80% reduction under the existing Act and the 90% target proposed for the new legislation.
- Whether the policies and proposals set out in the Plan are likely to deliver these emissions reductions.

We now consider the feasibility of the actions to reduce emissions that are set out in the draft Plan, together with an assessment of how well they prepare for deeper reductions to 2050.

## 2. Feasibility of emissions reductions and preparation for deeper reductions to 2050

It is for the Scottish Government to decide how to meet the emissions targets. Nevertheless, it is important for the Plan to set out a credible path to meeting greenhouse gas emissions targets to 2032 and preparing to meet the necessary reductions by 2050.

The draft Plan as published in January 2017 did not put the transport sector on a credible path to reduce emissions sufficiently by 2050. In particular, the ambition for ultra-low-emissions (e.g. electric) vehicles was insufficient to prepare for deep decarbonisation of the transport sector to 2050. The level of ambition of low-carbon heat by 2032 in the draft Plan is also higher than the Scottish Government can credibly plan to achieve.

The recent Programme for Government announcement increases Scottish ambition on transport decarbonisation considerably. There is an opportunity for the final version of the Climate Change Plan to reconsider the overall sectoral balance of Scottish decarbonisation and in particular the scale of required emissions reduction from buildings.

### Ultra-low-emission vehicles

The level of ultra-low-emission vehicle sales in the draft Plan is much lower than under the CCC scenario, and prepares insufficiently for the necessary levels of emissions reduction by 2050:

- CCC scenarios that achieve an emissions reduction of at least 80% by 2050, both for Scotland and the UK as a whole, have at least 60% of sales of cars and vans in 2030 being ULEVs (i.e. battery electric, plug-in hybrid electric or hydrogen vehicles). The rationale for this level of uptake is to prepare for a proportion of sales being close to 100% by 2035, so that the natural rate of vehicle stock turnover would bring the share of the stock close to 100% by 2050.
- The proportion of sales that are ULEVs under the draft Plan is 27% in 2030. This would appear to allow ramp up of ULEV sales to 100% by around 2040, consistent with the UK Government's plan to end sales of conventional petrol and diesel cars and vans by 2040.<sup>12</sup> But the majority of cars and vans sold in the second half of the 2030s would be expected to be on the roads in 2050, implying significant residual emissions in 2050.

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<sup>12</sup> <https://www.gov.uk/government/news/plan-for-roadside-no2-concentrations-published>

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- Whilst it is not impossible to go from 27% of sales in 2030 to close to 100% by 2035, this rate of ramp up is extreme. This would put at risk the ability of the transport sector to contribute sufficient decarbonisation by 2050. Should ULEV sales not reach close to 100% by 2035 there would be little scope to catch up, as vehicle scrappage schemes are expensive.<sup>13</sup>
  - The Scottish Government has proposed to increase overall ambition to a reduction of 90% by 2050. As we set out in our advice on Scotland's new climate change legislation,<sup>14</sup> it is important that actions are taken now that keep open pathways to very deep emissions reductions by 2050. It is therefore important to aim for close to 100% of ULEV car and van sales by no later than 2035 so that transport emissions can reach very low levels by 2050.

The Scottish Government's recent announcement on an earlier phase-out date for conventional petrol and diesel vehicles is therefore welcome. It will be important that the policies to achieve this earlier date are put in place, including ensuring that charging infrastructure provision is not a barrier to vehicle uptake.

An increase in ambition on transport decarbonisation would also place less pressure on other sectors to 2032.

### Ambition on buildings heat

The Scottish Government has designated energy efficiency an infrastructure priority, and the Scottish Energy Efficiency Programme (SEEP) sets a long-term framework for improvements over a 15-20 year time frame. The commitment to a large-scale, long-term programme to upgrade the Scottish buildings stock is very welcome. However, in order to reduce buildings emissions to the low levels required in the long-term, improvements in energy efficiency will need to be complemented by deployment of low-carbon heating systems.

The draft Plan has extremely ambitious levels of uptake of low-carbon heating, allied to energy efficiency improvements. Emissions from residential buildings reduce 81% from 8.5 Mt in 2015 to 1.6 MtCO<sub>2</sub>e by 2032. The CCC scenario has a 31% reduction in buildings emissions over the same period, followed by an acceleration in roll-out of low-carbon heat when key options are deployable at scale.

Whilst ambition on low-carbon heat is important, the scale of the ambition to 2032 set out in the draft Plan is not credible. Furthermore, even if a more credible but ambitious level of emissions reduction by 2032 is to be achieved, immediate action is required to ramp up low-carbon heat deployment, rather than waiting until 2025:

- The draft Plan's ambition is that the low-carbon proportion of space heating reaches 80% by 2032 in residential buildings and 94% in non-residential buildings. This compares with around 40% low-carbon heat in the CCC scenario by 2032, rising to over 80% by 2050.<sup>15</sup>

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<sup>13</sup> Our analysis in 2013 indicated that allowing sales of conventional vehicle after 2035 and then scrapping them in the 2040s would cost at least £1,200 per tonne of CO<sub>2</sub> saved, over five times the estimated value of these carbon savings. See page 33 of CCC (2013) *The Fourth Carbon Budget Review Technical report – sectoral analysis of the cost-effective path to the 2050 target*.

<sup>14</sup> CCC (2017) *Advice on the new Scottish Climate Change Bill*.

<sup>15</sup> The definition of low-carbon heat used in the draft Plan includes resistive electric heating (e.g. storage heaters), which currently meets around 12% of buildings heat in Scotland. The Committee usually excludes resistive electric heat when presenting proportions of low-carbon heat, but have used the Plan's definition here for comparison purposes.

- The rapid uptake of low-carbon heat in residential buildings within the draft Plan starts in 2025, at which point the proportion of heat from low-carbon sources in the Plan is only 18%. The subsequent increases in the share of low-carbon heat implies an uptake rate that is faster than the natural replacement rate of boilers.
- The Plan does not allow for significant installation of low-carbon heating systems before 2025, with the low-carbon heat proportion unchanged at 18% from 2020. This suggests that the necessary developments in infrastructure, supply chains (e.g. for heat pump installation) and public acceptance of new technologies will not have occurred. From this base in 2025, it is not credible that such a rapid switch to low-carbon heating could take place.
- If the Scottish Government is serious about achieving a high level of low-carbon heating by 2032, immediate action is required to drive uptake so that a more gradual path for deployment can be achieved.
- Even then, lead-times for strategic decision-making and for development and reinforcement of infrastructure, together with the natural rate of stock turnover suggest that 80% low-carbon heat by 2032 is unlikely to be feasible.

The transition to a near-zero emissions buildings sector is likely to take decades. This means that Scotland needs to take action now, but also needs to be more realistic about the contribution that this sector can make toward the economy-wide emissions targets to 2032. Reaching a 50% share of space heating from low-carbon sources would be a considerable achievement, and would be a more credible basis on which to plan to meet the overall emissions targets.

The Scottish Government can improve the credibility of the Plan by taking immediate action on low-carbon heat deployment, to achieve a significantly higher share of heating by 2025.

The recently announced increase in ambition on transport decarbonisation also provides some scope to moderate ambition on the planned level of low-carbon heat roll-out by 2032. The Scottish Government should take this opportunity to reduce the reliance on buildings decarbonisation in meeting the overall emissions targets (e.g. by planning for the share of low-carbon heat to reach no more than 50% by 2032, instead of 80%). This would not stop the Scottish Government aiming for a stretch target that goes further on low-carbon heat, but meeting the overall targets should not rely on doing so.

The final version of the Plan will need to be more specific about how low-carbon heat will be rolled out, including setting out what this means for energy infrastructure and public acceptance of novel heating solutions.

### 3. Conclusions

Inevitably, a substantial proportion of the actions to reduce emissions in Scotland depend, at least in part, on UK Government policies. The draft Plan was published in January 2017, while the UK equivalent (the Clean Growth Plan) has not yet been published. Once the UK Plan is available, it will be important for the final version of Scotland's Climate Change Plan to build on this.

The draft Energy Strategy takes a flexible approach to Scotland's energy future. The Climate Change Plan should also consider uncertainty more explicitly and how flexibility can be retained in how the targets are met, allowing policy to respond to developments. However, while it is important to retain flexibility, the final versions of the Climate Change Plan and the Energy

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Strategy will need greater consideration of key decision points at which a more definitive path will be selected.

It will also be necessary to provide greater detail in terms of new Scottish Government policies to deliver the emissions reductions, in areas where powers are devolved.

The final version of the Climate Change Plan will need to be strong enough to put Scotland on the path to meeting not only the legislated targets under the existing Act, but also on track for the greater ambition proposed under the new legislation.

The process of consultation adopted by the Scottish Government provides time for review and revision of the Plan. The final version of the Plan will need to include firm new policies, and should plan for a more balanced set of contributions to emissions reduction across sectors.

Our key messages are set out in Box 2.1 at the start of this chapter.

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# Chapter 3: Power



**Table 3.1.** Summary of progress in the power sector

Milestones	Progress
The draft Energy Strategy proposes a new energy consumption target, which is not yet firm policy:  50% of Scotland's energy consumption to be met by renewable energy by 2030, interim target of 30% of total Scottish energy consumption from renewables by 2020.	In 2014, 15.2% of total Scottish energy consumption came from renewable energy, up from 12.9% in 2013. Scotland is outperforming the UK as whole, but lags behind the EU average. The interim 2030 target is achievable but consistent progress will be required.
Equivalent of 100% of gross electricity consumption in 2020 to be met from renewables, with an interim target of the equivalent of 50% of gross electricity consumption from renewables by 2015.	In 2015 the share was 59% (up from 50% in 2014). Renewable supplies grew largely due to the significant increase in operational wind sites. The interim target has been outperformed and the 2020 target is in reach, if the projects currently under construction or consented are built.
Community Energy targets <ul style="list-style-type: none"><li>• 1 GW of community and locally-owned renewable energy by 2020</li><li>• 2 GW of community and locally-owned renewable energy by 2030</li><li>• At least half of newly consented renewable energy projects to have an element of shared ownership by 2020</li></ul>	As of June 2016, estimated capacity of at least 595 MW of community and locally owned renewable energy capacity was operational in Scotland, a 17% increase from September 2015.  As the old 2020 target of 500 MW has already been surpassed, the new Energy Strategy updated the targets to be more ambitious. A further 491 MW of community or locally-owned renewable energy capacity is estimated to be in different stages of development (under construction, consented but not built, in planning, or in scoping). The updated targets are therefore achievable if progress continues at the current rate.

## Latest emission trends and drivers

The extra one-year lag to publish Scottish emissions data (relative to publication of UK data) affects the assessment of energy-related emissions, particularly the power sector given recent developments (i.e. the closure of the Longannet coal plant). This section focuses on the latest official data, which go to the end of 2015. However, more recent developments should be reflected in the Climate Change Plan and we take them into account in formulating our recommendations.

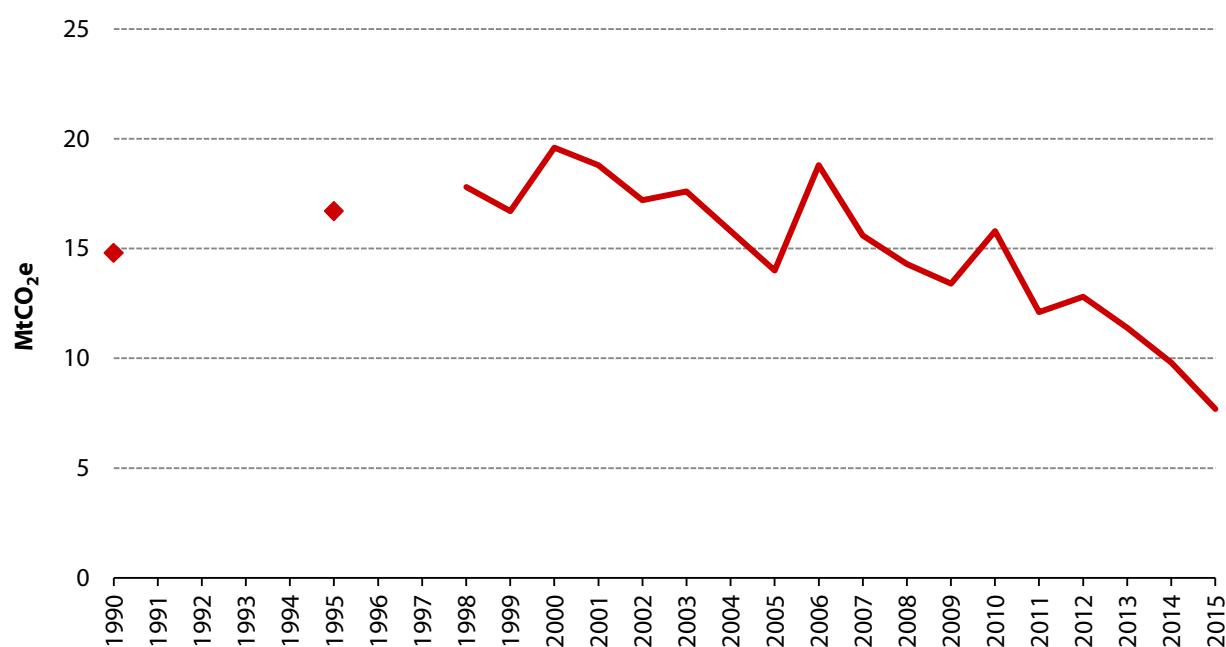
In 2015, emissions from power accounted for 7.7 MtCO<sub>2</sub> (16%) of Scotland's actual emissions. These decreased significantly between 2014 and 2015 (-21%) and were 48% below 1990 levels. Emissions decreased by an average annual rate of 8.8% between 2009 and 2015 (Figure 3.1).

The reduction in emissions has occurred despite an overall increase in electricity generation by 3% between 2014 and 2015. It is mainly due to a fall in the share of fossil fuel generation and increase in renewable and nuclear generation (Figure 3.2).

- The fall in emissions in 2015 partly reflects lower emissions from Peterhead power station (0.05 MtCO<sub>2</sub> in 2015) whilst it was undergoing upgrade work in 2015. It returned to service in November 2015, and had emissions of 0.6 MtCO<sub>2</sub> in 2016. The plant is now able to operate at loads between 240 and 400 MW.
- Coal and gas generation continued to decrease (by -18% and -30% respectively), whilst renewable generation increased further (14%).
- Renewables made up 42% of all electricity generation in Scotland in 2015, up from 38% in 2014.

Scotland's last large coal-fired plant, Longannet, closed in March 2016. In 2015, Longannet emitted 7.5 MtCO<sub>2</sub>e, 97% of Scottish power emissions.<sup>16</sup> We therefore expect that power sector emissions will fall substantially in 2016 (for which data will be available in 2018). According to data from the EU emissions trading system (EU ETS), Longannet only emitted 1.6 MtCO<sub>2</sub>e in 2016. This is a reduction of almost 80% and the reduction is equivalent to 16% of total Scottish emissions in 2015 (10% of 1990 emissions).

**Figure 3.1.** Scottish power sector emissions (1990-2015)



**Source:** NAEI (2017).

<sup>16</sup> Excluding autogeneration, which is accounted for the industry sector.

## Progress in renewables capacity

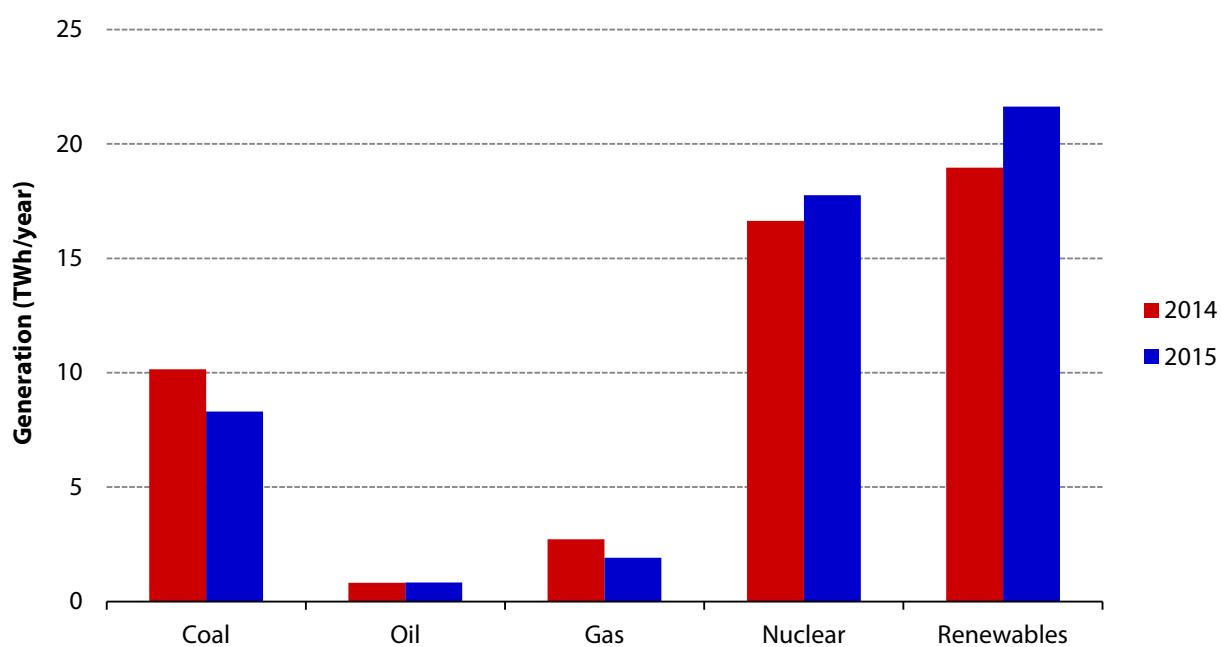
For renewable electricity generation and capacity, data are available up to 2016. Scotland accounted for 24% of UK renewable generation in 2016. Generation decreased by 10% from 2015 despite renewable capacity increasing by 11%, due to a reduction in average wind speeds compared with 2015:

- As of May 2017, an additional 11.8 GW of renewable electricity projects are either in planning (3.1 GW), awaiting construction (6.3 GW) or under construction (2.4 GW). This is a slight decrease in the project pipeline: in 2015, a total of 13.3 GW additional capacity was either in planning (4.1 GW), awaiting construction (7.7 GW) or under construction (1.5 GW).
- 10.9 GW of the 11.8 GW are wind projects, 4.2 GW offshore and 6.7 GW onshore. If all of this additional wind capacity were to be realised, it would increase generation from renewables by around 31 TWh per year, equivalent to an additional 92% of current Scottish gross electricity consumption.<sup>17</sup>

Despite this progress, the 2020 renewable electricity target remains challenging, as it is unlikely that all the projects consented will progress to the commissioning stage.

The September 2017 Contract-for-Difference auction awarded a contract for the 950 MW Moray East offshore wind farm, which is expected to generate around 4 TWh/year, at a price of £57.5/MWh (2012 prices) once fully operational in the first half of the 2020s.

**Figure 3.2.** Scottish power generation by type (2014 and 2015)



**Source:** BEIS (2016) *Electricity generation and supply figures for Scotland, Wales, Northern Ireland and England, 2004 to 2015*.

**Notes:** Chart excludes 'other' generation (hydro pumped storage, waste and other thermal).

<sup>17</sup> Using capacity factors of 26% for onshore wind and 45% for offshore wind.

## **Transmission and interconnection**

Investment in electricity infrastructure is crucial to realising Scotland's renewable energy potential, allowing power to flow from remote areas of high resource, where grid connections are often weak, to major centres of demand. This is particularly the case for the Highlands and Islands, where weak or non-existent connections to the mainland grid network have been a challenge to the deployment of renewable technologies.

To support the future growth of renewable generation, large-scale investment into Scotland's transmission system is being delivered by a series of network development and reinforcement projects, for example:

- In 2013, National Grid and Scottish Power began construction on the £1bn Western Link HVDC 'bootstrap' project. It is anticipated that power will flow through the link later in 2017. The new link with a capacity of 2.2 GW will support the export of renewable energy from Scotland to England and Wales.
- The new Caithness-Moray transmission link is on schedule to be commissioned by the end of 2018. Following completion, the link will enable the connection of 1.2 GW of new renewable electricity in the North of Scotland.
- Scottish and Southern Electricity Networks plan to connect Shetland to the National Electricity Transmission System for the first time by 2021. The proposal includes a sub-sea, 260-km long, 60 MW cable with on-island backup generation, which is supposed to replace Lerwick power station. Ofgem is yet to approve the project.

The draft Energy Strategy acknowledges the network challenges that are a result of decarbonisation and decentralisation. It commits to investing at least £7 billion over the period 2013-21 in Scotland's electricity transmission networks.

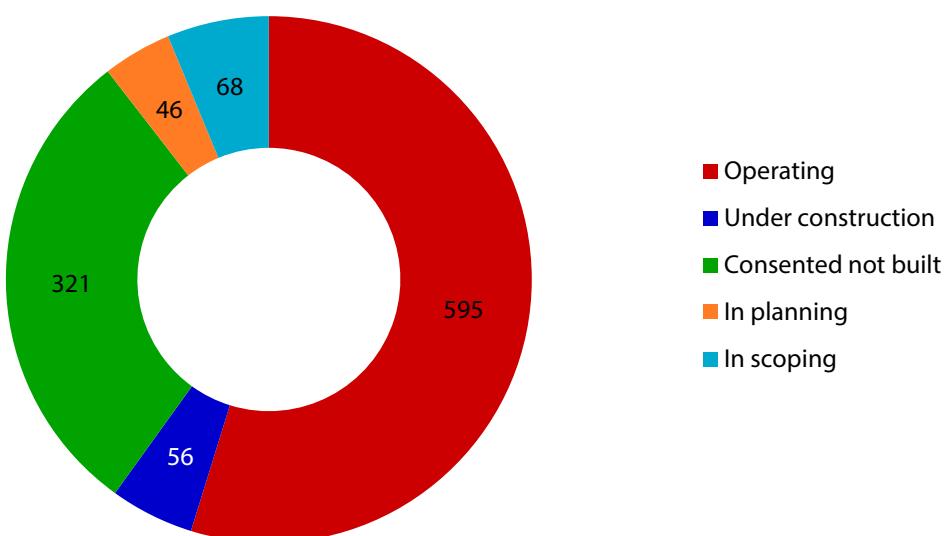
## **Community and locally-owned renewable generation**

Community and locally-owned energy can play a useful role in progress towards meeting carbon targets as it serves to raise awareness of climate change and improves acceptance of renewable energy. The Scottish Government has a target for local and community ownership of at least 500 MW of renewable energy by 2020. This was met five years early, so the new draft Energy Strategy has increased the ambition of those targets:

- 1 GW of community and locally-owned renewable energy by 2020.
- 2 GW of community and locally-owned renewable energy by 2030.
- At least half of newly consented renewable energy projects to have an element of shared ownership by 2020.

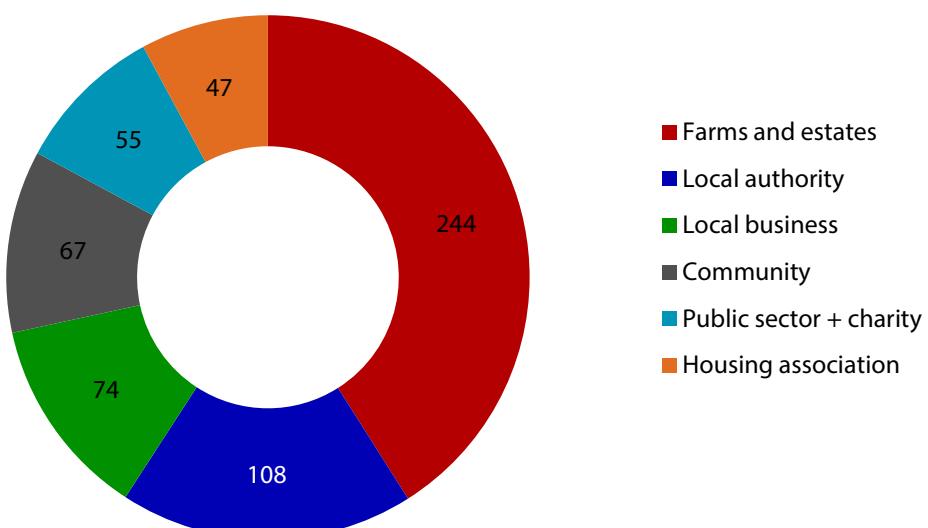
In June 2016, an estimated minimum of 595 MW of community and locally owned renewable energy capacity was operational in Scotland and a further 491 MW is in various stages of development (Figure 3.3). The majority of operational community and locally-owned renewable capacity is owned by farms and estates (41%) and the main technologies used are wind turbines (46%) and biomass (27%) (Figure 3.4).

**Figure 3.3.** Community/locally-owned renewable capacity in different stages of development (MW)



**Source:** Energy Saving Trust (2016) *Community and locally owned renewable energy in Scotland, June 2016*.

**Figure 3.4.** Capacity of operational community and locally owned renewable installations by ownership (MW)



**Source:** Energy Saving Trust (2016) *Community and locally owned renewable energy in Scotland, June 2016*.

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The Scottish Government has a number of programmes and policies to support community energy. These are in addition to the GB-wide Feed-In Tariff (FiT),

- The Scottish Government's CARES (Community and Renewable Energy Scheme) programme, managed by Local Energy Scotland, provides support, advice and loans to community groups and rural businesses that want to generate renewable energy.
- CARES manages the Local Energy Challenge Fund that provides development and capital support to projects which show a local energy economy approach linking energy generation to energy use.

## Opportunities to reduce emissions

Scotland is leading the UK in renewable energy. The scenario for power sector emission reductions to 2030 presented in our annual targets advice to the Scottish Government in March 2016 showed that power sector emissions could decrease to very low levels, corresponding to an average emissions intensity of generation below 20 gCO<sub>2</sub>/kWh; outperforming both the Scottish government's intensity target of 50g/kWh and levels which are possible at a UK level.

As Scottish power generation will have been largely decarbonised by 2016, there will be limited opportunities to reduce emissions from fossil-fired power stations. Despite this, further increases in Scottish low-carbon generation would be valuable:

- Meeting overall targets will require further reductions in emissions from other sectors. Extension of low-carbon electricity generation to other sectors (e.g. electric vehicles and heat pumps) will be an important decarbonisation pathway, potentially implying increasing electricity consumption over the longer term.
- Scotland can also contribute to wider UK decarbonisation by exporting low-carbon electricity to the rest of the GB power system.

There is considerable potential for Scotland to increase renewable generation in future, including the possibility of onshore wind projects able to proceed without subsidy.<sup>18</sup> The recent auction results show that offshore wind is also now in a strong position to compete on cost.

Scotland is also very well placed for carbon capture and storage (CCS), which will be important in achieving decarbonisation towards 2050 across a number of sectors.

## Assessment of the draft Climate Change Plan and Energy Strategy

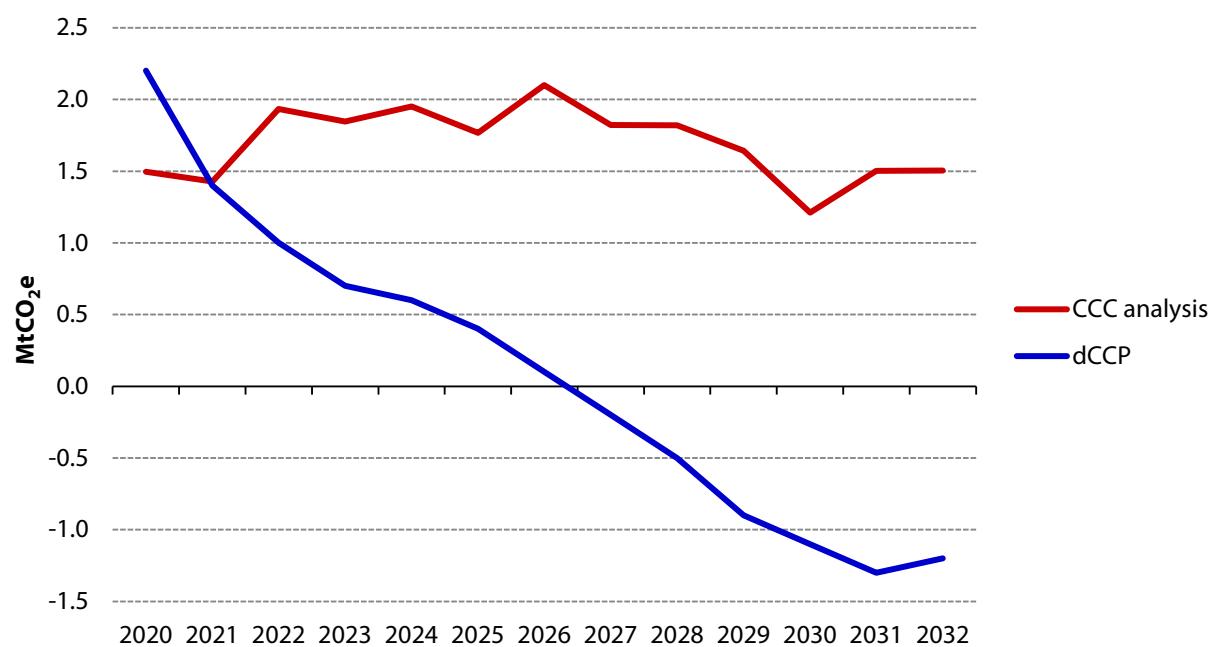
The draft Climate Change Plan and Energy Strategy set out ambition for further deployment of renewable capacity, together with an initial roll-out of carbon capture and storage (CCS) applied to gas plant starting prior to 2030. This is consistent with the Committee's recommended path for the Scottish power sector.

The draft Plan's path for the power sector has emissions going negative from 2028, unlike in the CCC's High Ambition scenario for Scotland (Figure 3.5). This is due to the Plan's assumption that some of the gas used in conjunction with CCS is biomethane, leading to negative emissions, whereas the CCC analysis allocates emissions savings from biomethane to the buildings and industry sectors. This largely explains the difference between emissions under the two scenarios.

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<sup>18</sup> Baringa (2017) *An analysis of the potential outcome of a further 'Pot 1' CfD auction in GB*. Available at <https://www.scottishrenewables.com/news/most-competitive-onshore-wind-projects-baringa/>

**Figure 3.5.** Comparison of power sector emissions in the draft Climate Change Plan and CCC High Ambition scenario



**Source:** Draft Climate Change Plan; CCC analysis.

**Note:** The draft Plan has emissions in the power sector going negative from the late 2020s, as a result of combining biomethane grid injection with gas CCS power plants. The CCC scenario also deploys both of these, but allocates the biomethane to the buildings and industry sectors, resulting in positive overall power sector emissions, as a result of small residual emissions from the (fossil) CCS plants. The difference in power sectors emissions is therefore due to how savings from biomethane have been allocated rather than any substantive underlying difference.

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# Chapter 4: Buildings



**Table 4.1.** Summary of progress in the buildings sector

Milestones	Progress
11% of non-electrical heat demand to be met from renewable sources by 2020.	In 2015, the share of non-electrical heat demand met from renewable sources is estimated to be around 5.5%. For 2014, the share was 3.8%. If this progress can be maintained, the 2020 target is achievable.
Every home to have loft and cavity wall insulation, where this is cost-effective and technically feasible, plus simple measures such as draught-proofing and pipe lagging.	The proportion of homes with loft insulation of more than 200mm (close to the recommended level of 275mm) was 64%. The share of properties with cavity wall insulation was unchanged from 2014 at 71% of cavity wall dwellings).
The Scottish Government had a statutory target to eradicating fuel poverty, as far as reasonably practicable, by the end of November 2016. In June 2016, Scottish Ministers reluctantly accepted that this target would not be met and informed Parliament.  The Scottish Government remains committed to eradicating fuel poverty and will set a new statutory target in 2018 after consulting on a new strategy.	Based on the '10% definition' of fuel poverty used in Scotland, <sup>19</sup> the 2015 Scottish House Condition Survey (SHCS) showed that around 748,000 (30.7%) households were in fuel poverty.
Reduce energy consumption (across all sectors) by 12% by 2020, against a 2005-2007 baseline.	In 2014, residential energy consumption was 19% below the baseline, while consumption in industry and commercial combined was 23% below the baseline.

<sup>19</sup> Under the '10% definition' of fuel poverty, a household is in fuel poverty if, in order to maintain a satisfactory heating regime, it would be required to spend more than 10% of its income on all household fuel use.

## Latest emission trends and drivers

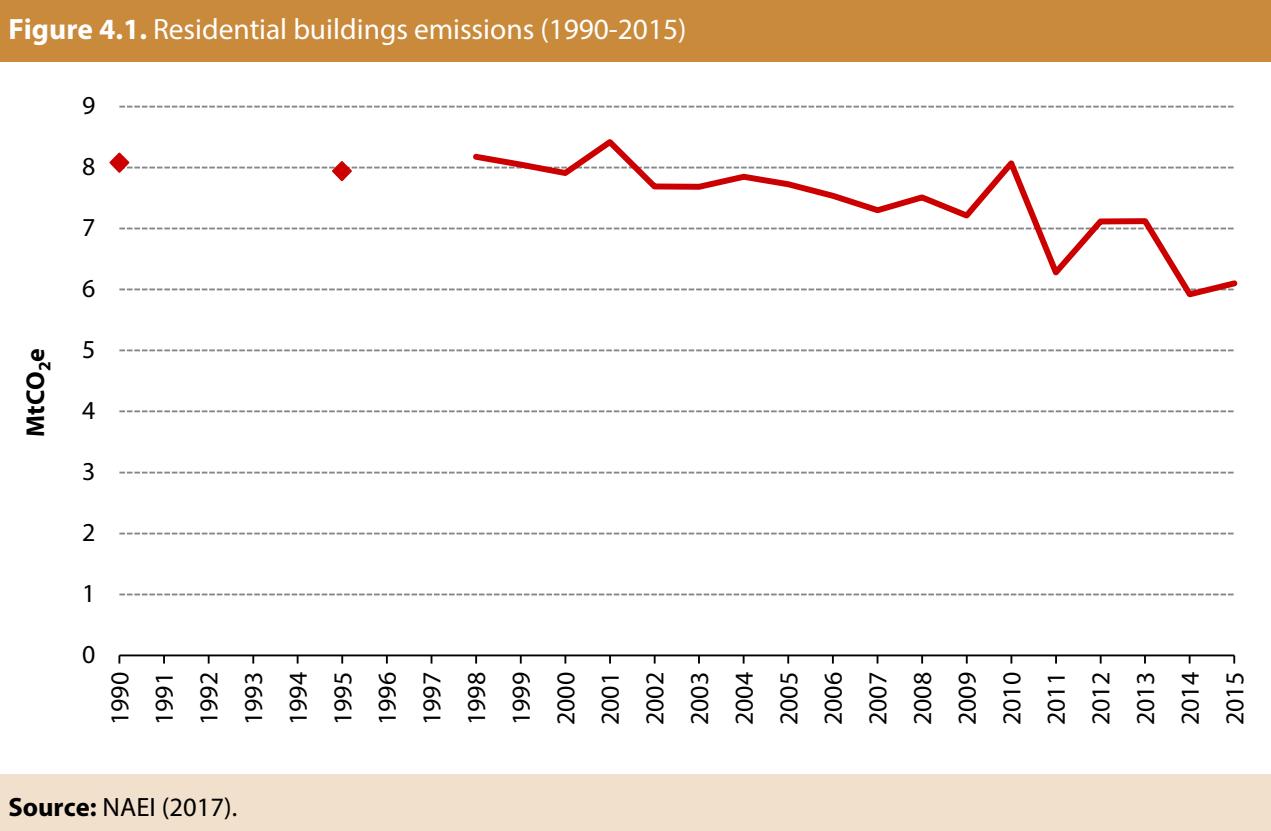
Direct residential emissions increased by 3% in 2015 to 6.1 MtCO<sub>2</sub>e.<sup>20</sup> Emissions from residential buildings accounted for 13% of total emissions and emissions were 25% lower than 1990 levels (Figure 4.1).

- On an unadjusted basis,<sup>21</sup> residential emissions increased by 3% in 2015, following a 17% decrease in 2014. The relatively low level of emissions in 2014 can be attributed primarily to winter temperatures significantly above average, leading to reduced heat demand. The winter months in 2015 were cooler than those in 2014, leading to increased demand for heating.
- Allowing for the lower winter temperatures, residential emissions on a temperature-adjusted basis fell by around 6% in 2015.

Direct non-residential emissions increased by 1.5% to 2.4 MtCO<sub>2</sub> in 2015. Emissions accounted for 5% of total emissions and were 17% lower than in 1990 (Figure 4.2):

- Emissions from commercial buildings increased by 4%.
- Emissions from the public sector decreased by 2%, to 37% below 1990 levels. This was largely driven by a reduction in the use of oil and coal for space heating.

**Figure 4.1.** Residential buildings emissions (1990-2015)

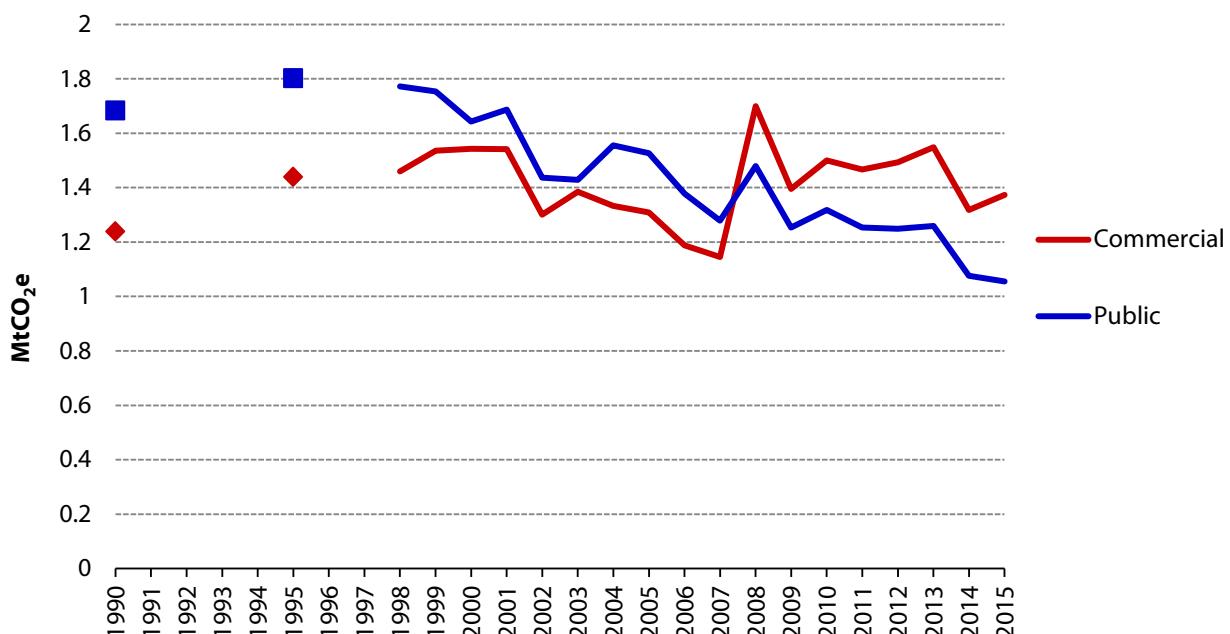


Source: NAEI (2017).

<sup>20</sup> Direct emissions exclude power sector emissions resulting from buildings electricity consumption.

<sup>21</sup> Building emissions depend on winter temperatures, as emissions are higher when more heating is necessary. In order to identify the trend in building emissions it is necessary to adjust emissions to exclude the impact of year-to-year variation.

**Figure 4.2.** Non-residential buildings emissions (1990-2015)



**Source:** NAEI (2017).

## Progress in renewable heat

The Scottish Government has set a target to source 11% of heat demand from renewable sources by 2020, and to have a largely decarbonised heat sector by 2050.<sup>22</sup> In 2014, the share of 'non-electrical' heat demand<sup>23</sup> met from renewable sources was 3.8%, up from 2.7% in 2013. For 2015, this share is estimated to be around 5.5% (Figure 4.3). If this progress can be maintained, the 2020 target is achievable:

- Most of Scotland's renewable heat output comes from biomass combustion (including biomass combined heat and power). In 2015 biomass combustion supplied almost 90% of renewable heat in Scotland. This level of biomass consumption is not building towards long-term decarbonisation of heat, as bioenergy will need to be prioritised elsewhere in order to achieve the deep reductions in emissions by 2050.<sup>24</sup>
- In 2015, 1.5 GW of renewable heat capacity produced over 4.1 TWh of delivered heat. This is a 37% increase in generation (1.1 TWh) from 2014. Both renewable heat capacity and generation have continuously and significantly increased since 2009, when Scotland had a capacity of 0.2 MW and generated 845 MWh.

<sup>22</sup> See

[http://www.energysavingtrust.org.uk/sites/default/files/reports/161006\\_Renewable%20Heat%20in%20Scotland%202015\\_FINAL.pdf](http://www.energysavingtrust.org.uk/sites/default/files/reports/161006_Renewable%20Heat%20in%20Scotland%202015_FINAL.pdf)

<sup>23</sup> The definition of 'non-electrical' heat here includes heat pumps, but excludes resistive electric solutions such as storage heating.

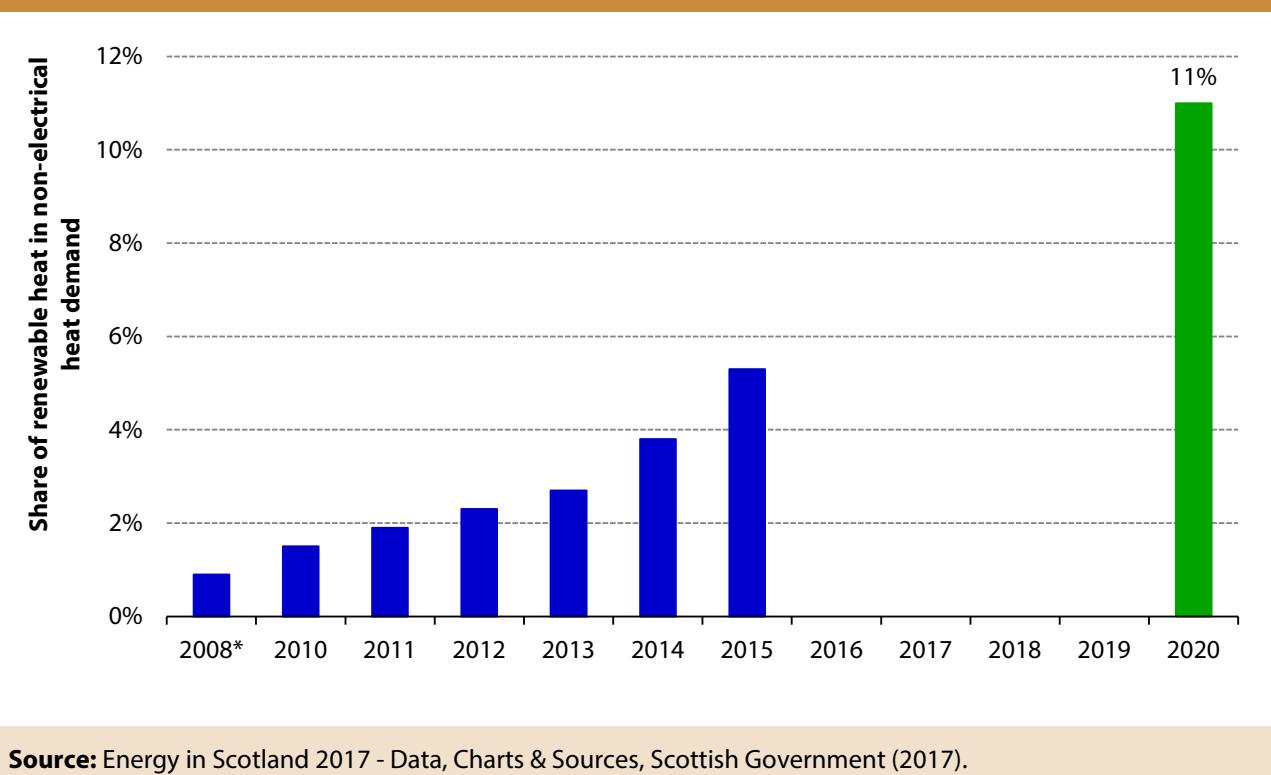
<sup>24</sup> See CCC (2011) *Bioenergy Review* and CCC (2016) *Next Steps for UK Heat Policy*.

- The increase in output and generation in 2015 is mainly due to increases in output and capacity of biomass CHP (57% and 80% respectively) and biomass primary combustion (28% and 39%).
- Although making up a relatively small proportion of the total renewable heat capacity and output, the contribution from heat pumps also increased between 2014 and 2015 (capacity increasing by 48% and output by 44%).
- By the end of December 2015, 9,030 domestic RHI installations were accredited in Scotland, with 87% of these installed in off-grid areas.

As of December 2015, it is estimated that there are around 0.34 GW of renewable heat capacity in the development pipeline, potentially contributing a further 1,468 GWh of renewable heat output in the future. If all the projects in development were completed the total renewable heat capacity in Scotland would be 1.843 GW and output could increase to 5,633 GWh per year – a 23% increase in capacity and 35% increase in output.

The projects currently in the pipeline would not meet the 11% target. Additional effort is needed. However, Scotland has in the past made gradual progress in this area and if this pace can be maintained, the 2020 target could be achieved.

**Figure 4.3.** Share of renewable heat in non-electrical heat demand (2008/9-14, estimation for 2015 and 2020 target)



## Progress in energy efficiency

Energy efficiency policy in Scotland is a mix of devolved and reserved policy. Minimum energy efficiency standards for electrical appliances, boiler and other heating technologies are set at EU level, while the main energy efficiency scheme aimed at improving the thermal performance of existing homes, the Energy Company Obligation (ECO), is GB-wide. The Scottish Government provides funding for additional energy efficiency and renewable heat programmes:

- Scotland was successful in leveraging funding from the ECO. The share of funding to Scotland is higher than the share of the housing stock.
- In April 2017 the Scottish Government announced a £30m interest-free loan scheme under the Home Energy Efficiency Programme Scotland (HEEPS), supporting energy efficiency measures including solid wall insulation (internal and external), cavity wall, loft and roof insulation, draught proofing and boilers.
- Scotland's Energy Efficiency Programme (SEEP) is the main policy to improve energy efficiency of both domestic and non-domestic buildings. The 15-20 year programme is currently in its design phase, with a consultation on different options for programme and policy design in May 2017. The government has committed to invest more than half a billion pounds to SEEP over 2017-2021.
- The Energy Agency in Scotland published the interim results of an evaluation project to investigate the success of the Scottish Government-funded insulation schemes in alleviating fuel poverty.<sup>25</sup> Households receiving insulation in 2016 under the Area Based Schemes were monitored. The results show that fuel poverty decreased following the insulation works.

## Progress on implementation of insulation measures

The proportion of Scottish homes with insulation has increased steadily in recent years; however there is still significant potential for an increased rate of loft and cavity wall insulation:

- **Loft insulation.** The Scottish House Condition Survey 2015 (SHCS) shows that, for those houses where loft insulation is applicable, the proportion of homes with loft insulation of more than 200mm (close to the recommended level of 275mm<sup>26</sup>) was 64%, a slight increase from 62% in 2014. For insulation of 300mm or more, the proportion of dwellings increased by 5 percentage points to 32% in 2015. 1% of dwellings have no loft insulation, unchanged from 2014.
- **Cavity walls.** Around three-quarters of dwellings in Scotland have external cavity walls. The SHCS indicates that in 2015, the number of properties with cavity wall insulation was unchanged from 2014 (71% of cavity wall dwellings). The SHCS notes that it is becoming increasingly difficult for SHCS surveyors to identify the presence of cavity wall insulation and that the number of homes with cavity wall insulation might be underestimated.
- **Solid walls.** Around a quarter of properties in Scotland have solid or other types of walls (including timber frame), compared to a third of properties in the UK as a whole. 11% of these dwellings had insulated walls in 2015.<sup>27</sup> At least 28,610 solid wall insulation measures

<sup>25</sup> South and East Ayrshire (2017) *Area-based schemes wall insulation evaluation*.

<sup>26</sup> As recommended by the Energy Saving Trust (EST).

<sup>27</sup> Due to the small sample size, it is not appropriate to compare this data from 2015 with data from 2014.

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were delivered in Scotland under the Energy Company Obligation since the beginning of 2013<sup>28</sup>

- **Gas and oil boilers.** The percentage of homes with gas and oil boilers installed has increased 3 percentage points to 85% since 1998, when the European Boiler Efficiency Directive Minimum came into effect. In 2015, 56% of gas and oil boilers were condensing (an increase of eight percentage points), while 48% meet the minimum efficiencies specified by the current Building Standards (a seven percentage point increase).

## Fuel poverty

In 2015, the SHCS showed that 748,000 households in Scotland (31%) were in fuel poverty.<sup>29</sup> This was four percentage points lower than 2014, and equivalent to 97,000 fewer fuel-poor households:

- In 2015, the fuel poverty rate was the lowest recorded since 2008.
- This reduction was due to a combination of factors: a substantial drop in the price of domestic fuel, especially oil (accounting for 2.3 percentage points of the reduction), improved energy efficiency (1.3 percentage point reduction) and higher household incomes (0.6 percentage points).
- The proportion of households using oil as their primary heating fuel that are in fuel poverty has decreased significantly, primarily due to the falling price of oil: 26% were fuel poor in 2015, down from 49% in 2014.

In October 2016, the Scottish Fuel Poverty Strategic Working Group outlined the requirements for a new, long-term fuel poverty strategy including recommendations on targets, scrutiny and delivery, addressing all causes of fuel poverty.<sup>30</sup> The Scottish Rural Fuel Poverty Task Force proposed "An action plan to deliver affordable warmth in rural Scotland".

In their response to these reports, the Scottish Government committed to develop a new fuel poverty strategy and consult on it in autumn 2017. They also committed to introduce a Warm Homes Bill in 2018 to set a new statutory fuel poverty target.

## Policy progress

The main GB support scheme for low-carbon heat is the Renewable Heat Incentive (RHI). This provides payments to those who generate and use renewable energy to heat their buildings:

- Scotland performed well compared to the GB average in terms of installations under the RHI. As of December 2016, 20% of non-residential capacity was installed in Scotland and 20% of residential capacity accredited in Scotland. These are higher proportions of installations than would be expected based on GVA (8%) and housing shares (9%).
- This may reflect Scotland larger share of off-grid homes, with 87% of all residential accreditation in Scotland from off-gas-grid properties (compared to 73% in GB overall).

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<sup>28</sup> Not captured by the survey and is not reflected in the numbers above.

<sup>29</sup> Scotland defines fuel poverty as follows: "a household is in fuel poverty if, in order to maintain a satisfactory heating regime, it would be required to spend more than 10% of its income on all household fuel use." This is a different definition to that used in England.

<sup>30</sup> A Scotland without fuel poverty is a fairer Scotland: Four steps to achieving sustainable, affordable and attainable warmth and energy use for all <http://www.gov.scot/Publications/2016/10/2273>

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- The Home Energy Scotland renewables loan scheme further supports funding under the RHI. Scotland has implemented further policies to encourage the uptake of renewable heat:
  - The District Heating Loan Fund offers loans to support the development of district heating networks in Scotland.
  - The publication of the Scotland Heat Map<sup>31</sup> was accompanied by a further £7 million funding for the District Heating Loan Scheme in 2016-17, and set up of the Scottish Heat Networks Partnership Practitioner Group.
  - The Scottish Government's Climate Challenge Fund supports local projects that help tackle climate change. This includes energy efficiency advice to households and improvements to community-owned properties but also greener travel, waste reduction and recycling, and local seasonal food-growing. It has awarded roughly £10m to 113 community-led projects in 2017.

Scotland is successful in securing UK-wide funding and has more developed and comprehensive energy efficiency policies than available in England and other devolved administrations. Even though progress has been made from a low base, more needs to be done to meet the targets.

## Assessment of the draft Climate Change Plan and Energy Strategy

In order to reduce buildings emissions to the low levels required in the long-term, energy efficiency improvements will need to be complemented by deployment of low-carbon heating systems.

The Scottish Government has designated energy efficiency an infrastructure priority and the Scottish Energy Efficiency Programme (SEEP) sets a long-term framework for improvements over a 15-20 year time frame. The commitment to a large-scale, long-term programme to upgrade the Scottish buildings stock is very welcome. The Scottish Government published a consultation on the SEEP in January 2017, and is currently in the design phase, which is expected to run until early 2018 after which there will be a development phase to pull the full Programme together.

The draft Plan has extremely ambitious levels of uptake of low-carbon heating, allied to energy efficiency improvements. Emissions from residential buildings in the draft Plan reduce 81% from 8.5 Mt in 2015 to 1.6 MtCO<sub>2</sub>e by 2032 (Figure 4.4). The CCC scenario has a 31% reduction in buildings emissions over the same period, followed by an acceleration in roll-out of low-carbon heat when key options are deployable at scale.

The draft Plan provides relatively small savings in energy demand due to energy efficiency improvements over the period to 2032, although we understand that these estimates appear low due to the methodology used to calculate the savings. It prioritises demand reduction measures over low-carbon heat in the period from now until 2025, at which point a clear decision on the future of gas in the UK is anticipated. However, as we set out in our October 2016 report on *Next Steps for UK Heat Policy* (Box 4.1), there are low-regret ways of deploying low-carbon heat now without waiting until the future of gas is clearer (i.e. biomethane, heat pumps in off-gas properties and low-carbon heat networks).

Whilst ambition on low-carbon heat is important, the scale of the ambition to 2032 set out in the draft Plan is not credible. Furthermore, even if a more credible but ambitious level of emissions

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<sup>31</sup> <http://www.gov.scot/heatmap>

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reduction by 2032 is to be achieved, immediate action is required to ramp up low-carbon heat deployment, rather than waiting until 2025:

- The draft Plan's ambition is that the low-carbon proportion of space heating reaches 80% by 2032 in residential buildings and 94% in non-residential buildings. This compares with around 40% low-carbon heat in the CCC scenario by 2032, rising to over 80% by 2050.<sup>32</sup>
- The rapid uptake of low-carbon heat in residential buildings within the draft Plan starts in 2025, at which point the proportion of heat from low-carbon sources in the Plan is 18%. The subsequent increases in the share of low-carbon heat implies an uptake rate that is faster than the natural replacement rate of boilers (Figure 4.5).<sup>33</sup> While low-carbon uptake beyond the natural replace rate could be part of sensible deployment of low-carbon heating (e.g. boiler scrappage due to the installation of heat network schemes in some areas or decarbonisation of heat from existing boilers via injection of biomethane or hydrogen into the gas grid<sup>34</sup>), the Plan does not provide a detailed breakdown of how the low-carbon heat is provided.
- The draft Plan does not allow for significant installation of low-carbon heating systems before 2025, with the low-carbon heat proportion unchanged at 18% over the preceding five years. This suggests that the necessary developments in infrastructure, supply chains (e.g. for heat pump installation) and public acceptance of new technologies will not have occurred. From this base in 2025, it is not credible that such a rapid switch to low-carbon heating could take place.
- If the Scottish Government is serious about achieving a high level of low-carbon heating by 2032, immediate action is required to drive uptake so that a more gradual path for deployment can be achieved.
- Even then, lead-times for strategic decision-making and for development and reinforcement of infrastructure, together with the natural rate of stock turnover suggest that 80% low-carbon heat by 2032 is not feasible (Box 4.1). Reaching a 50% share of space heating from low-carbon sources would be a considerable achievement, and would be a more credible basis on which to plan to meet the overall emissions targets.

The transition to a near-zero emissions buildings sector is likely to take decades. This means that Scotland needs to take action now, but also needs to be more realistic about the contribution that this sector can make toward the economy-wide emissions targets to 2032.

The Scottish Government can improve the credibility of the Plan by taking immediate action on low-carbon heat deployment, to achieve a significantly higher share of heating by 2025.

The Scottish Government should reduce the reliance on buildings decarbonisation in meeting the overall emissions targets (e.g. by planning for the share of low-carbon heat to reach no more

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<sup>32</sup> The definition of low-carbon heat used in the Plan includes resistive electric heating (e.g. storage heaters), which currently meets around 12% of buildings heat in Scotland. The Committee usually excludes resistive electric heat when presenting proportions of low-carbon heat, but have used the Plan's definition here for comparison purposes.

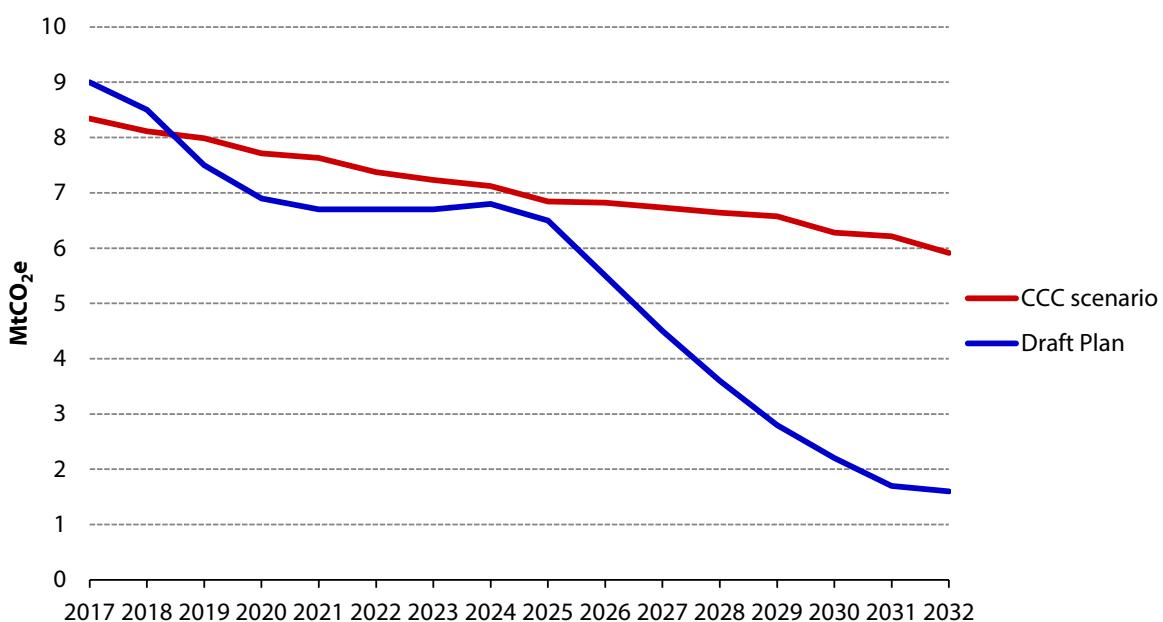
<sup>33</sup> The draft Plan does not provide an annual breakdown of low-carbon heat deployment, instead only providing proportions for 2020, 2025 and 2032 (within which there is no net increase in low-carbon heating between 2020 and 2025). The rate of low-carbon heat deployment (133% of the boiler replacement rate) is the average required to go from 18% to 80% low-carbon heat between 2025 and 2032. Whilst uptake may be lower than this in some years, this would need to be balanced by even higher rates in other years.

<sup>34</sup> The draft Energy Strategy indicates that the Plan includes a 'moderate' amount of hydrogen being injected into the gas grid from the mid-2020s.

than 50% by 2032, instead of 80%). This would not stop the Scottish Government aiming for a stretch target that goes further on low-carbon heat, but meeting the overall targets should not rely on doing so.

The final version of the Plan will need to be more specific about how low-carbon heat will be rolled out, including setting out what this means for energy infrastructure and public acceptance of novel heating solutions.

**Figure 4.4.** Comparison of buildings emissions in the draft Climate Change Plan and CCC High Ambition scenario



**Source:** Draft Climate Change Plan; CCC analysis.

#### **Box 4.1.** Timelines for heat decarbonisation

Our scenarios for buildings decarbonisation focus over the period to 2030 on efficiency improvements and 'low-regret' deployment of low-carbon heating options (Figure B4.1):

- **New-build.** Buildings constructed now should be highly energy efficient and designed to accommodate low-carbon heating.
- **Energy efficiency improvement to existing buildings.** Our scenarios include around a 15% reduction in energy used for heating existing buildings by 2030.
- **Low-carbon heat networks.** District heating schemes require a certain density of heat demand in order to be economic, which means that they are suited to urban areas, new-build developments and some rural areas. Low-carbon heat sources can include waste heat, large-scale (e.g. water-source) heat pumps, geothermal heat and potentially hydrogen.
- **Heat pumps in buildings not connected to the gas grid.** Roll-out of heat pump in properties off the gas grid would focus their installation where they are more cost-effective, and would help to build supply chains for potentially more extensive deployment post-2030.

#### Box 4.1. Timelines for heat decarbonisation

- **Biomethane.** Injecting biomethane into the gas grid is a means of decarbonising supply without requiring changes from consumers. However, its potential is limited to around 5% of gas consumption.

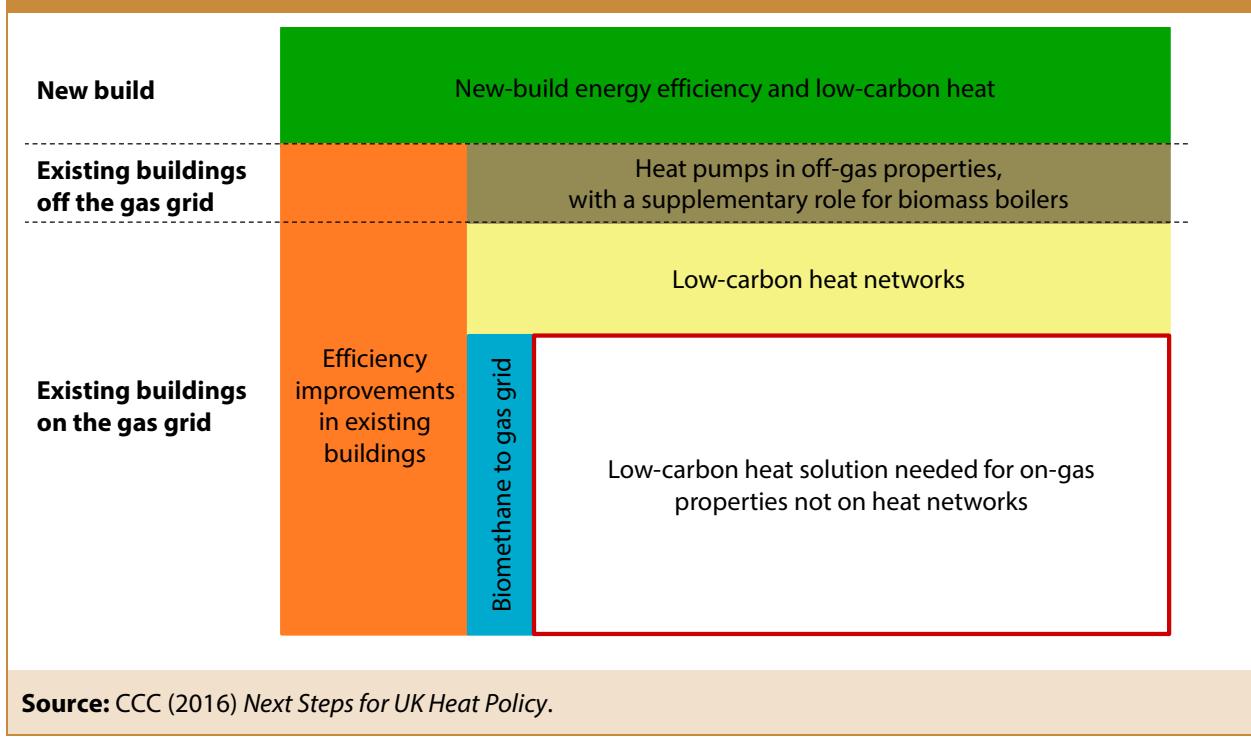
For the period after 2030, for existing homes on the gas grid there is a key strategic question around the respective balance between repurposing gas grids to low-carbon hydrogen and replacing gas boilers with heat pumps. At the moment, the evidence base is insufficient to decide the appropriate balance. In our October 2016 report on *Next Steps for UK Heat Policy*, we advised the UK Government to actively develop the evidence base, with a view to making strategic decisions in the first half of the 2020s.

While there is some scope to go beyond the deployment levels of low-carbon heat to 2030 in our scenarios (e.g. through roll-out of heat pumps in properties on the gas grid or blending hydrogen into the gas supply at small proportions), going much further would rely on making long-term choices with an inadequate evidence base, risking excessive costs of heat decarbonisation.

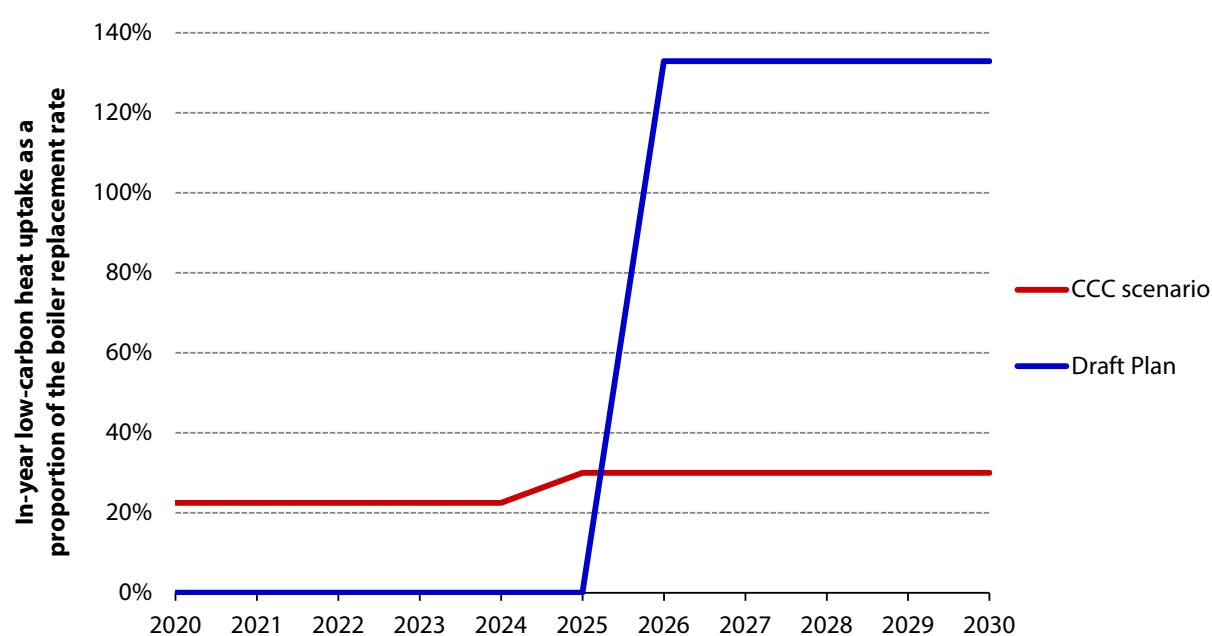
There would also be major challenges in achieving such a rapid roll-out, given limited current public knowledge and acceptance of low-carbon heating technologies, and constraints on how quickly the supply chain could install them.

On the measure of low-carbon heat used in the draft Climate Change Plan (i.e. including resistive electric heating such as storage heating), our scenario reaches a proportion of around 40% of heat from low-carbon sources in Scotland by 2032. Given some scope to go further, it may be reasonable to aim to reach a proportion of 50% by this time. Going beyond this would be highly challenging to achieve, and it should therefore not be relied upon to meet the overall emissions targets.

**Figure B4.1.** Low-regrets measures and the remaining challenge for existing buildings on the gas grid



**Figure 4.5.** Low-carbon heat deployment under the draft Plan and CCC scenario (2020-2032)



**Source:** Draft Climate Change Plan, CCC analysis.

**Notes:** The Plan does not provide annual uptake rates; rate of low-carbon heat deployment (133% of the boiler replacement rate) is the average required to go from 18% to 80% low-carbon heat between 2025 and 2032.

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# Chapter 5: Industry and F-gases



**Table 5.1.** Summary of progress in the industry sector

Milestone	Progress
Reduce energy consumption (across all sectors) by 12% by 2020 (against a 2005 -2007 baseline).	In 2014, industrial energy consumption was 23% lower than the baseline.

## Latest emission trends and drivers

Direct<sup>35</sup> emissions from industry<sup>36</sup> increased in Scotland by 2.4% to 11.7 MtCO<sub>2</sub>e in 2015, in the context of an overall 2.2% fall at UK level. Emissions from the sector accounted for 26% of total Scottish emissions and have decreased by 45% since 1990 (Figure 5.1):

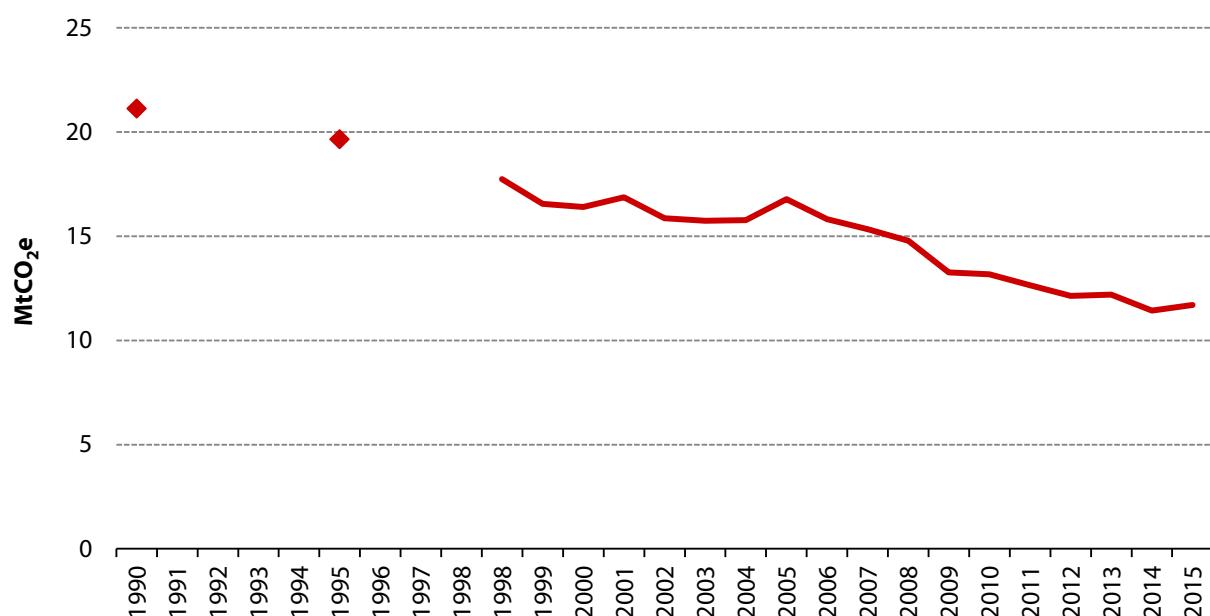
- The chemicals sector, refineries and oil and gas extraction/production are the main sources of emissions in the industry sector and together make up almost half of total industry emissions (Figure 5.2).
  - Since 1990, emissions from chemicals increased significantly but peaked in 2000 and have been decreasing until 2012, since when they have increased. Emissions increased by 7% in 2015 to 2.2 MtCO<sub>2</sub>e.
  - Emissions from refineries increased by 14% in 2015 to 2 MtCO<sub>2</sub>e.
  - Emissions from oil and gas extraction increased by 4% to 1.1 MtCO<sub>2</sub>e.
- Combustion emissions made up 55% of total industry emissions. Almost a third of combustion emissions were not attributed to a sector or segmented by use.
- Emissions in energy supply (electricity generation, which is covered in Chapter 3) have been on a downward trend since 1995, but have increased recently.
- The largest reductions in emissions since 1990 have occurred in the iron and steel sector. Emissions from iron and steel have decreased by 99% from 3.6 MtCO<sub>2</sub>e in 1990 to 0.03 MtCO<sub>2</sub>e in 2015. Most of this reduction (2.6 MtCO<sub>2</sub>e) came before 1995, due to the Ravenscraig steelworks closing in 1992.
- Scottish Gross Domestic Product (GDP) grew by 1.9% in the 2015 calendar year.<sup>37</sup> In the last decade emissions and industry output have diverged from each other (Figure 5.3).

<sup>35</sup> Direct emissions include autogeneration but exclude emissions from generation of electricity supplied through the grid, which are covered in Chapter 3.

<sup>36</sup> Industrial activity includes manufacturing, construction, water and waste management, refining of petroleum products and a range of activities linked to energy supply (extraction and production of oil, gas and solid fuels).

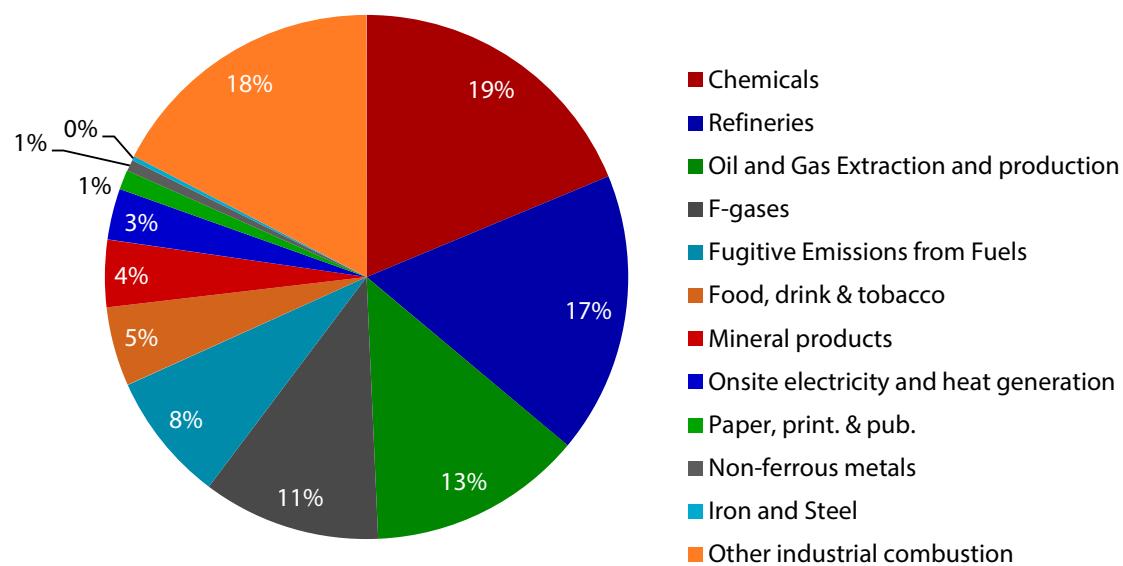
<sup>37</sup> Comparison of the four quarters of 2015 with the four quarters in 2014, see <http://www.gov.scot/Topics/Statistics/Browse/Economy/PubGDP/GDP2015Q4>

**Figure 5.1.** Industry emissions 1990-2015



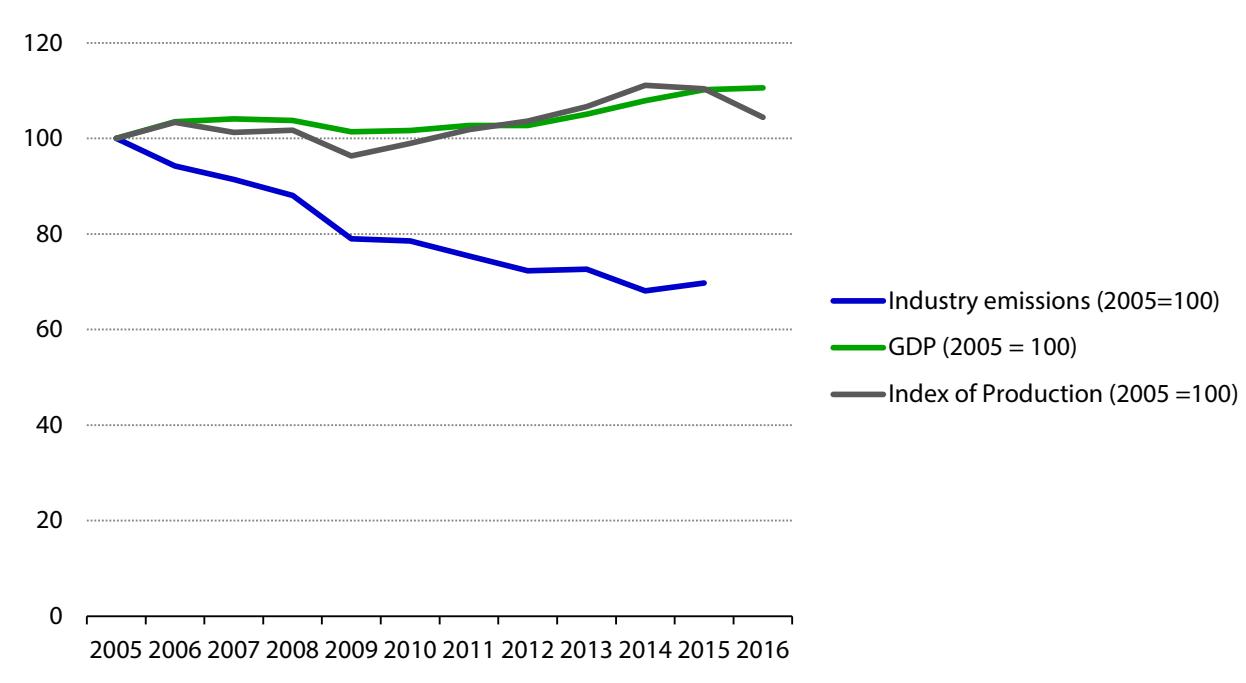
Source: NAEI (2017).

**Figure 5.2.** Industry emissions by sector in 2015



Source: NAEI (2017).

**Figure 5.3** Industry emissions and Scottish GDP / Index of production change over time (2005=100)



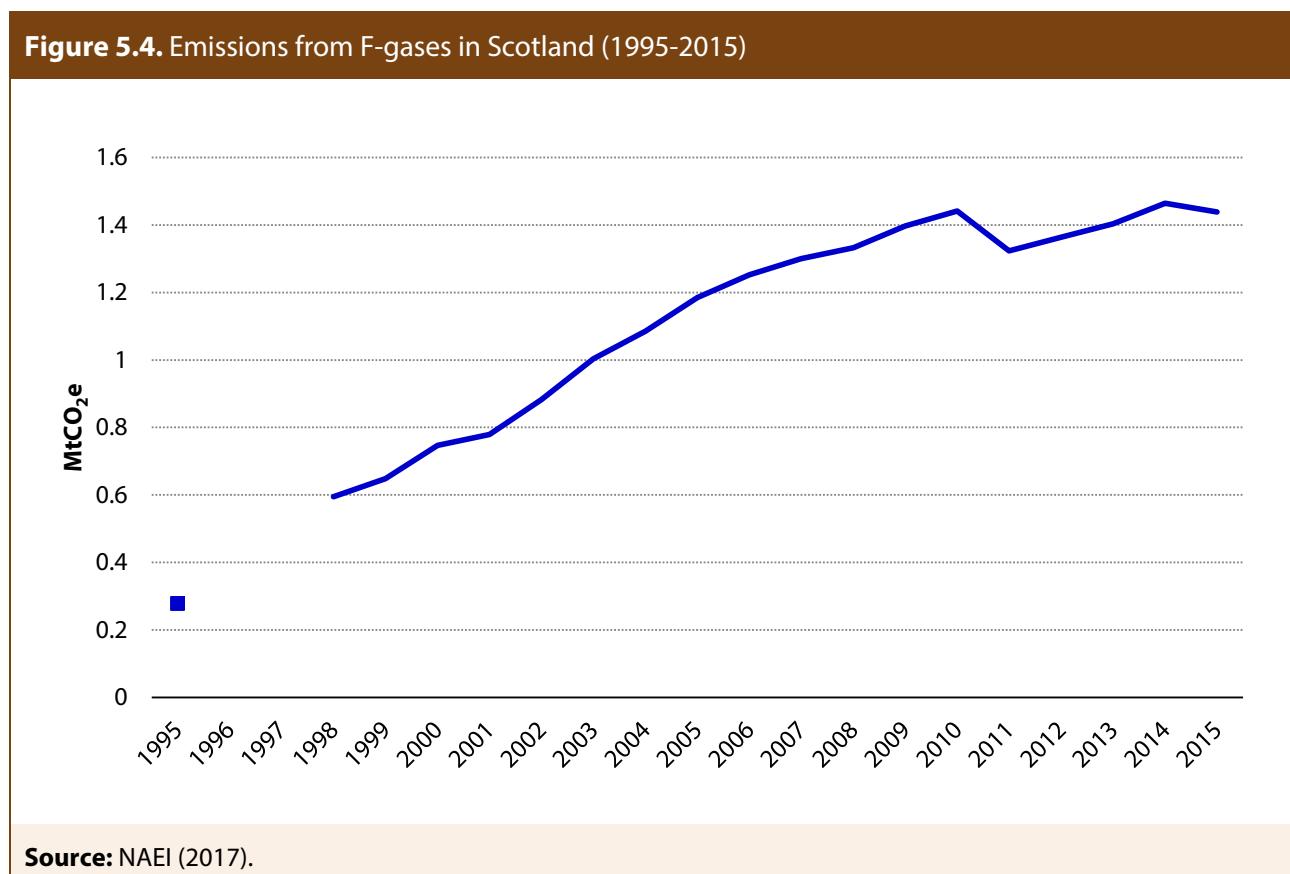
**Source:** NAEI (2017) and Quarterly National Accounts Scotland, 2017 Quarter 1 (2017).

## F-gases

F-gas emissions are currently mainly accounted for within the Industry sector of this report, even though some sources of F-gas emissions also occur in other sectors, like transport or commercial buildings:

- F-gases accounted for 3% (1.4 MtCO<sub>2</sub>e) of total Scottish emissions in 2015.
- In contrast to F-gas emissions in the UK as whole, F-gas emissions in Scotland did not peak in 1997. Rather, they have increased almost continuously since 1995, with a total increase of over 400% (Figure 5.4).
- Around 37% of F-gas emissions stem from refrigeration, 37% from air conditioning and 10% from residential emissions.
- A large part of the increase in F-gas emissions is due to use in commercial and industrial refrigeration together with an increase in air conditioning. These emissions have increased from 0.05 MtCO<sub>2</sub>e 1995 to over 1 MtCO<sub>2</sub>e in 2015:
  - Of the 0.54 MtCO<sub>2</sub>e emissions in 2015 from refrigeration, around 57% occur in commercial refrigeration, 30% in industrial refrigeration and 11% in refrigerated transport.
  - Of the 0.53 MtCO<sub>2</sub>e emissions in 2015 from air conditioning, 52% stem from mobile air conditioning.
- Without policy intervention it is likely that F-gas emissions would continue to increase due to increasing use of products and appliances using F-gases, such as refrigeration and air conditioning. Many applications already have cost-effective alternatives to F-gases available.

EU regulation currently exists to significantly reduce F-gases by 2030. The UK's decision to leave the EU causes uncertainty about the future of the F-gas regulation. F-gases are not a devolved matter, with regulation determined at the UK and EU level. For more details on this see our 2017 UK Progress Report.<sup>38</sup>



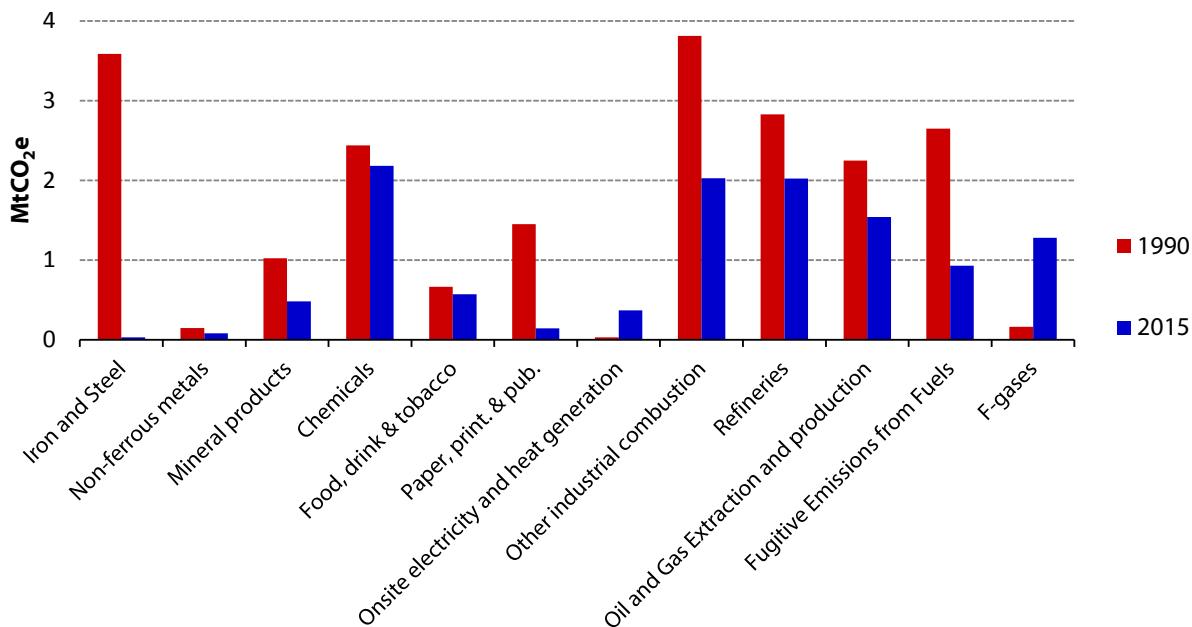
## Progress in reducing emissions

Since 1990, industry emissions have reduced by 45%, mainly due to a large decrease in iron and steel emissions (-99%) and emissions from paper, print and pulp (-90%). Emissions from refineries and the oil and gas extraction sector have also reduced emissions significantly. In contrast, emissions from on-site electricity and heat generation (i.e. autogeneration) and F-gas emissions have increased since 1990 (Figure 5.5)

The industry sector is strongly dependent on UK-wide policies (e.g. on carbon capture and storage) and EU policies (e.g. the EU Emissions Trading System and F-Gas Regulation). The Scottish Government has some direct influence on decarbonisation progress. The main lever is energy efficiency policies.

<sup>38</sup> CCC (2017) *Meeting Carbon Budgets: Closing the policy gap - 2017 Report to Parliament*.

**Figure 5.5.** Sources of industry emissions 1990 and 2015



**Source:** NAEI (2017).

## Assessment of the draft Climate Change Plan and Energy Strategy

The draft Climate Change Plan does not assume radical reductions in emissions from the industry sector over the period to 2032. In part, this reflects the reserved nature of many of the policy levers and reliance on the EU emissions trading system (EU ETS), together with constraints on the extent to which industry itself has the capacity to fund the more expensive measures while competing internationally.

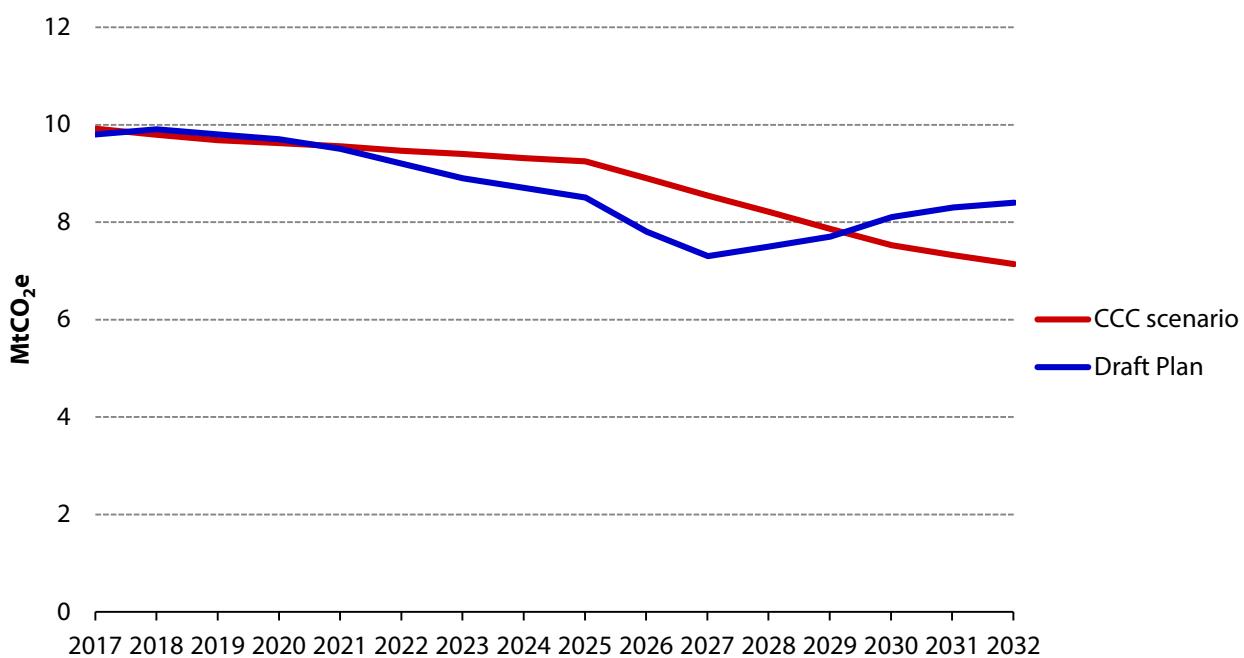
In the near term, this means that the Plan envisages a continuation of incremental deployment of energy efficiency and low-carbon heat, achieving a 28% reduction in emissions between 2015 and 2032 (Figure 5.6).

In the longer term, decarbonisation of industry will be required, including through the deployment of carbon capture and storage (CCS) on Scottish industry. Scotland is well placed to deploy CCS, given its proximity to potential CO<sub>2</sub> storage sites in the North Sea. The Energy Strategy's vision for the role of CCS in long-term decarbonisation is appropriate, emphasising the importance of its application to industrial processes, as well as potential roles in power, supporting heat decarbonisation and its combination with bioenergy for negative emissions.

Whilst the strategy remains to kick-start the deployment of CCS with power sector projects, Scotland is reliant on the UK Government to award funding and/or Contracts for Difference to power CCS projects.<sup>39</sup> If Scottish CO<sub>2</sub> transport and storage infrastructure can be developed, whether on the back of power projects or through other means, industry projects could then connect to this.

<sup>39</sup> Award of Contracts for Difference are a reserved matter.

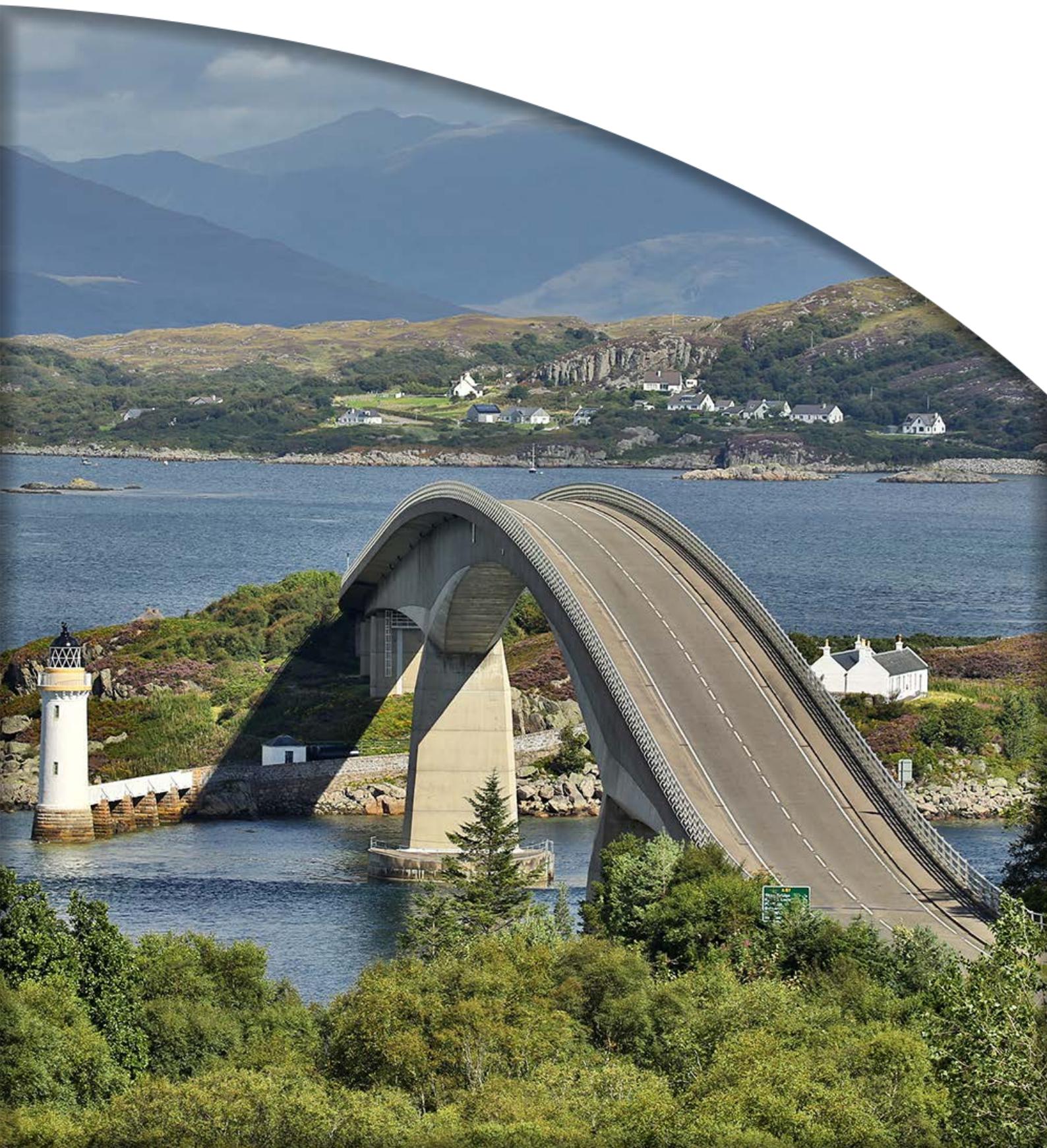
**Figure 5.6.** Comparison of industry emissions in the draft Climate Change Plan and CCC High Ambition scenario



**Source:** Draft Climate Change Plan; CCC analysis.

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# Chapter 6: Transport



**Table 6.1.** Summary of progress in the transport sector

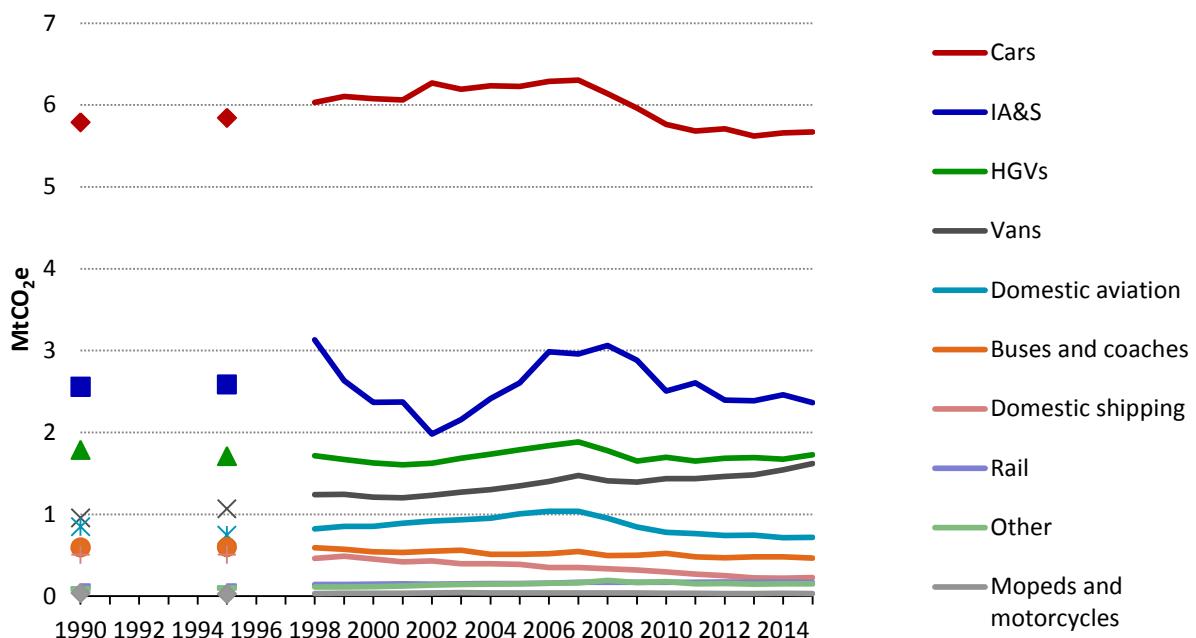
Milestones	Progress
Reduce energy consumption (across all sectors) by 12% by 2020, against a 2005-2007 baseline.	In 2014, transport energy consumption was 4% lower than the baseline.
An average efficiency for new cars of less than 95 gCO <sub>2</sub> /km	CO <sub>2</sub> test cycle efficiency of new cars in Scotland fell from 121.5 gCO <sub>2</sub> /km to 120 gCO <sub>2</sub> /km (1%) in 2016. Progress has slowed down from a decrease of 3% in 2014 and 2% in 2015.
10% of everyday journeys to be made by bike, by 2020.  'Everyday journeys' are measured by travel-to-work data in the Scottish Household Survey.	In 2015, only 2.2% of adults commuted by bike to work.

## Latest emission trends and drivers

The Scottish Government's emission targets cover emissions from all transport in Scotland, including Scotland's share of international aviation & shipping (IA&S) emissions. Transport emissions increased by 0.4% in 2015 and accounted for 27% of Scottish emissions:

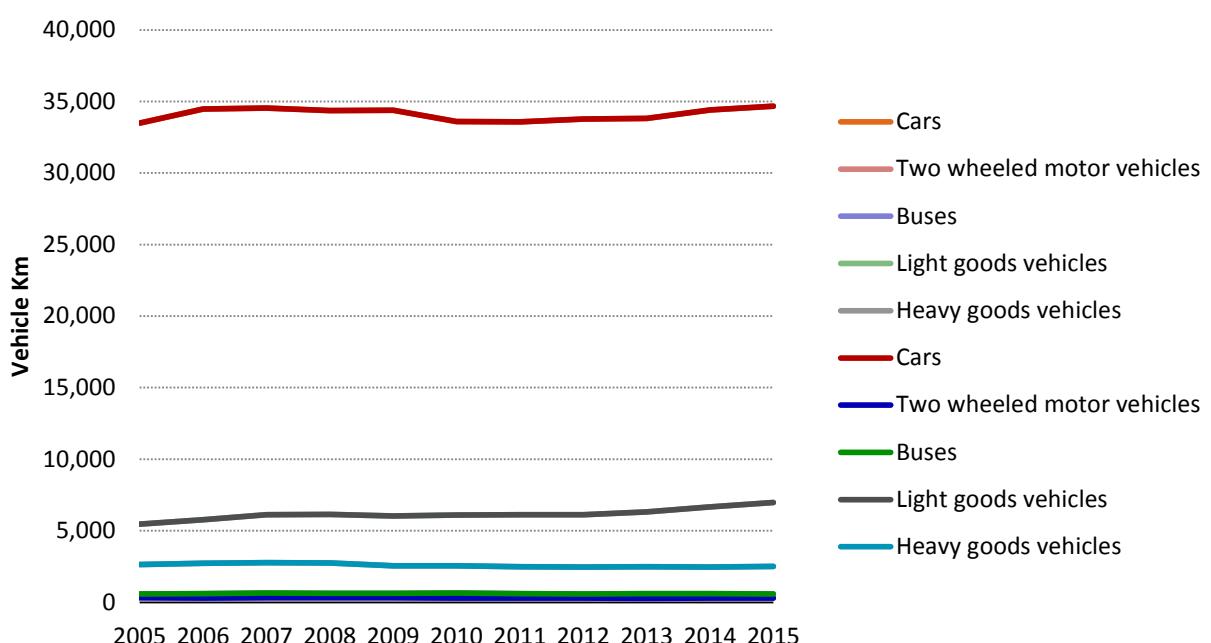
- Emissions from domestic transport emissions of 1.4% to 10.8 MtCO<sub>2</sub>e in 2015, slightly above the level in 1990. This was the second consecutive annual increase in domestic transport, whilst emissions from international aviation and shipping decreased in 2015 by 3.3%.
- Cars, vans and HGVs account for 69% of total transport emissions in Scotland and are of particular importance for the achievement of existing Scottish emissions targets. Emissions from these modes are increasing in recent years (Figure 6.1):
  - Emissions from cars increased by 1% in 2015 and 0.2% in 2014.
  - Emissions from heavy goods vehicles (HGVs) increased in 2015 by 2%, the fourth year of consecutive increases.
  - Emissions from vans have experienced significant increases since 2010, and rose by around 5% in both 2014 and 2015.
- The increase in emissions from domestic transport reflects increasing vehicle-kilometres, both of cars (+1% in 2015) and light goods vehicles (+5% in 2015). This trend has been slow but continuous and persistent since 2010 (Figure 6.2).

**Figure 6.1.** Transport emissions by mode (1990-2015)



**Source:** NAEI (2017).

**Figure 6.2.** Vehicle-kilometres by mode (2005-2015)



**Source:** Scottish Transport Statistics No 35: 2016 Edition.

## Emissions from aviation and shipping

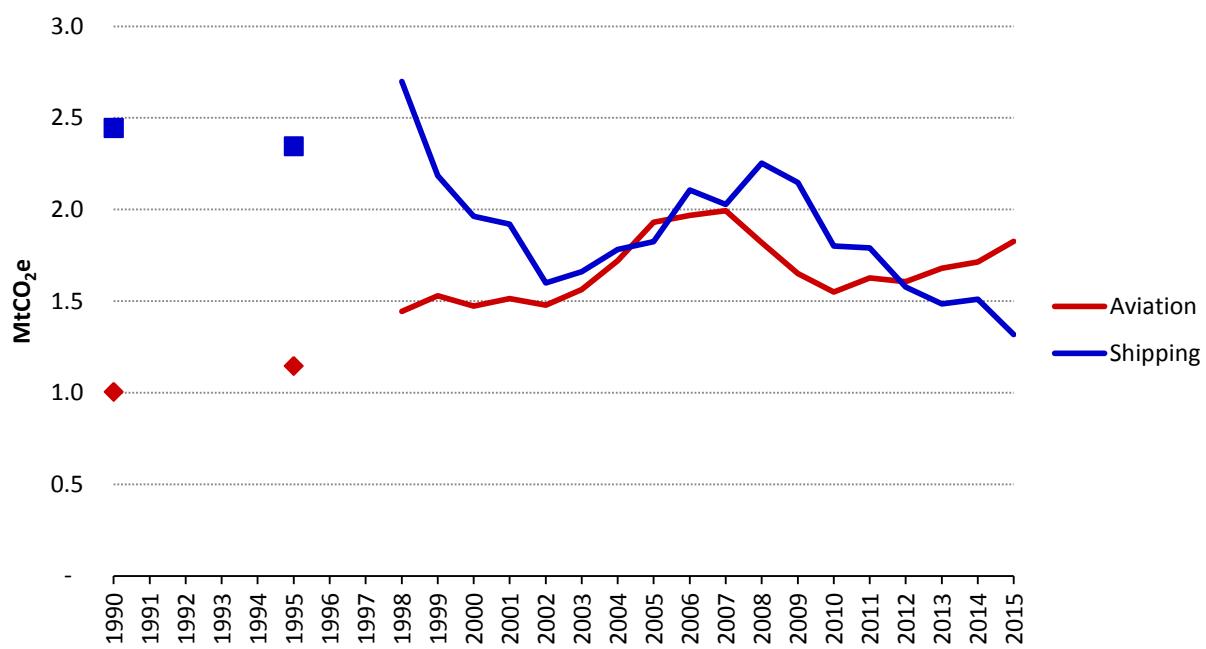
Aviation emissions grew 7% in 2015 compared to 2014, to 1.8 MtCO<sub>2</sub>e (Figure 6.3). They are now 82% higher than 1990 levels. This has largely been due to an increase in emissions from international flights.

- Emissions from domestic flights were the same in 2015 as 2014 (0.5 MtCO<sub>2</sub>e), and are only 10% above their 1990 level.
- In contrast, emissions from international flights increased by 9% in 2015 to 1.3 MtCO<sub>2</sub>e, and are more than double their 1990 level.

Shipping emissions fell 13% in 2015 compared to 2014, to 1.3 MtCO<sub>2</sub>e. They are now 46% below 1990 levels. Both domestic and international shipping emissions have been falling since 1990.

- Domestic shipping emissions rose by 5% in 2015 to 0.3 MtCO<sub>2</sub>e, but are 36% below 1990 levels.
- International shipping emissions fell 16% in 2015 to 1.0 MtCO<sub>2</sub>e, and are now 48% below 1990 levels.

**Figure 6.3.** Aviation and shipping emissions (1990-2015)



**Source:** NAEI (2017).

**Note:** Both domestic and international aviation and shipping emissions are included.

In June 2017 MSPs voted to replace Air Passenger Duty (APD) in Scotland with a new devolved Air Departure Tax (ADT) from April 2018. The level at which this new ADT will be set has not yet been agreed, but the Scottish Government has previously proposed reducing APD by 50% and abolishing it completely when resources allow.

The estimated impact of such a change is relatively small (e.g. latest estimates by Transport Scotland suggest a 50% cut would lead to a maximum increase in aviation emissions of up to around 0.1 MtCO<sub>2</sub>e, which is around a 5% increase and 0.2% of total Scottish emissions). This is therefore likely to be manageable, but will require additional emission reductions to be made elsewhere in the economy in order to stay within legislated targets. The Scottish Government should work with the UK Government to ensure there is a credible overall strategy for aviation that is in line with their climate obligations.

## Reducing emissions from transport in Scotland

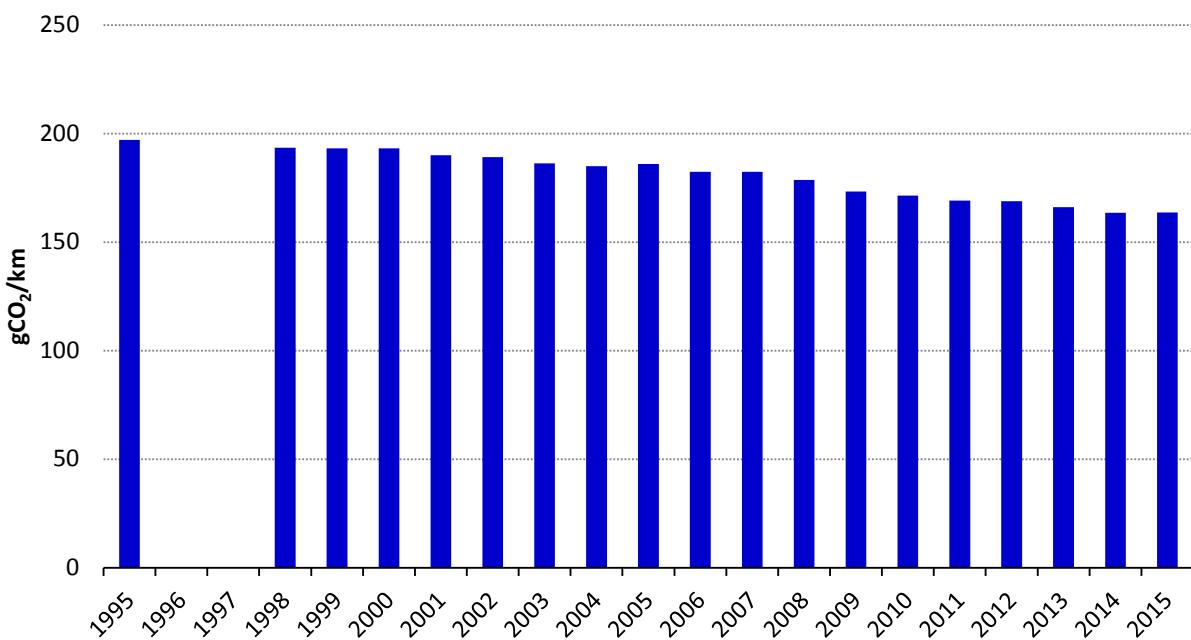
### New-car efficiency

There has been progress in improving new-car efficiency both in test-cycle efficiency and real-world CO<sub>2</sub> intensity, mainly through the EU directive targeting 95 gCO<sub>2</sub>/km by 2020. However, progress has been slow and at the current rate the 2020 target will not be reached.

- CO<sub>2</sub> test cycle efficiency of new cars in Scotland fell from 121.5 gCO<sub>2</sub>/km to 120 gCO<sub>2</sub>/km (1%) in 2016. Progress has slowed down from a decrease of 3% in 2014 and 2% in 2015.
- Progress in Scotland is in line with the UK as a whole, but behind Wales and Northern Ireland.

There has been slow progress in improving the overall emission intensity (emissions per km) of the car fleet in Scotland (Figure 6.4), but more needs to be done. Evidence has also continued to mount that there is a large and growing gap between test-cycle and real-world emissions for new cars:

**Figure 6.4.** Overall car emissions intensity (emissions per km) 1995-2015



**Source:** NAEI (2017) and Scottish Transport Statistics No 35: 2016 Edition, CCC analysis.

## **Progress developing electric vehicle markets**

There has been an increase in electric vehicle (EV) sales at the UK level since 2010, although this is from a low base and has been largely driven by sales in England (which represented 94% of the total UK market in 2016):

- Sales of electric vehicles in Scotland accounted for 3.7% of UK sales in 2016, lower than Scotland's share of total UK vehicle sales (8.2%).
- Whilst sales of EVs in England in 2016 increased by 32%, the increase was much slower in Scotland (5%): 0.6% of car sales were EVs in 2016, the same as in 2015 (compared to 1.5% in England). However, this should be seen in the context of total car sales in Scotland stagnating in 2016, with sales of conventional cars increasing by just 0.1%.

Infrastructure for electric vehicles in Scotland is improving, following on from 'Plugged in Places' funding from the Department for Transport (DfT):

- At the beginning of June 2017, there were 1,811 public charging points across Scotland (14.7% of total UK points), 141 more than in April 2016, an increase of 8.5%.<sup>40</sup>
- The Energy Saving Trust invested over £3.7 million of Transport Scotland funding to support the installation of charge points in over 1,100 homes and around 350 workplaces across Scotland.
- Transport Scotland has provided around £3.5 million to introduce around 350 new EVs across the fleets of 50 public sector organisations.

To encourage EV uptake, the Scottish Government has a number of schemes and policies in place:

- ChargePlace Scotland, which connects charge point networks and owners with EV drivers. Most of the charging points are currently free to use. There are around 650 ChargePlace Scotland charge points, with more than 1,250 connectors available for network customers. Over 150 of those are rapid charging points.
- In June 2017, an action plan for the Switched On Scotland Phase Two was published. It builds on the Switched On Scotland Roadmap. The actions include:
  - Continued support of the ChargePlace Scotland network, investing until at least August 2019 in public infrastructure that enables people to confidently charge their EVs across Scotland.
  - Continued financial support for the purchase of EVs and installation of private charging infrastructure. This includes the interest-free Electric Vehicle Loan programme, until at least 2020, which currently provide interest-free loans of up to £35,000 towards the cost of purchasing a new electric vehicle.

## **Behaviour change**

Scottish transport statistics show that in 2016 only 2.2% of journeys to work were by bike, well below the 2020 ambition of 10% of all everyday journeys. The Cycling Action plan outlines what the Scottish Government, local authorities and all key partners can do to achieve the target, mainly supporting local authorities and Regional Transport Partnerships.

<sup>40</sup> <https://www.zap-map.com/statistics/>

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The Smarter Choices Smarter Places programme and the Paths for All scheme are the main behaviour change lever and further £5m funding in 2017/18 has been agreed.

- The Smarter Choices Smarter Places programme is a grant scheme to support behaviour change initiatives to increase active and sustainable travel, funded by Transport Scotland.
  - In 2016, an evaluation was published, which showed that the programme mainly led to increased cycling (16 projects) and increased walking (13 projects).
  - This included cycle promotions; events linked to cycle and walking routes; Personalised Travel Planning (PTP), and school travel.

## Rail electrification

The Scottish Government has a rolling programme of electrification which forms part of a wider £5bn investment package for Scotland's railway infrastructure. Of the 2,776 km of rail track in Scotland, 25.3% (711 km) is electrified:

- The programme has to date delivered the Airdrie to Bathgate Railway and the £12m Paisley Canal electrification project.
- The Edinburgh to Glasgow via Falkirk line was due to be completed by December 2016 but suffered a series of delays. It is now expected to operational by October 2017.
- The electrification of the Stirling/Alloa/Dunblane lines is planned to be completed by December 2018 and will improve journey times for passengers traveling to Edinburgh or Glasgow.
- In January 2017, National Rail announced that Carillion Powerlines Ltd has won the contract to deliver the electrification of the Shotts line between Holytown Junction and Midcalder Junction. The project will deliver 74km of electrified railway and is planned to be in operation by March 2019.

## Assessment of the draft Climate Change Plan and Energy Strategy

The draft Climate Change Plan sets out the ambition for Scottish transport emissions to fall by 34%, from 13.1 Mt in 2015 to 8.7 Mt in 2032 (Figure 6.5). This is a lesser reduction than the Committee's scenario for Scotland, which implies a reduction of 46% by 2032, to 7.1 Mt.

The level of ultra-low-emission vehicle (ULEV) sales in the draft Plan is much lower than under the CCC scenario, and prepares insufficiently for the necessary levels of emissions reduction by 2050:

- CCC scenarios to achieve an emissions reduction of at least 80% by 2050, both for Scotland and the UK as a whole, have at least 60% of sales of cars and vans in 2030 being. The rationale for this level of uptake is to prepare for a proportion of sales being close to 100% by 2035, so that the natural rate of vehicle stock turnover would bring the share of the stock close to 100% by 2050.
- The proportion of sales that are ULEVs under the draft Plan is 27% in 2030 (Figure 6.6). This would appear to allow a ramp up of ULEV sales by around 2040, consistent with the UK Government's plan to end sales of conventional petrol and diesel cars and vans by 2040.<sup>41</sup>

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<sup>41</sup> <https://www.gov.uk/government/news/plan-for-roadside-no2-concentrations-published>

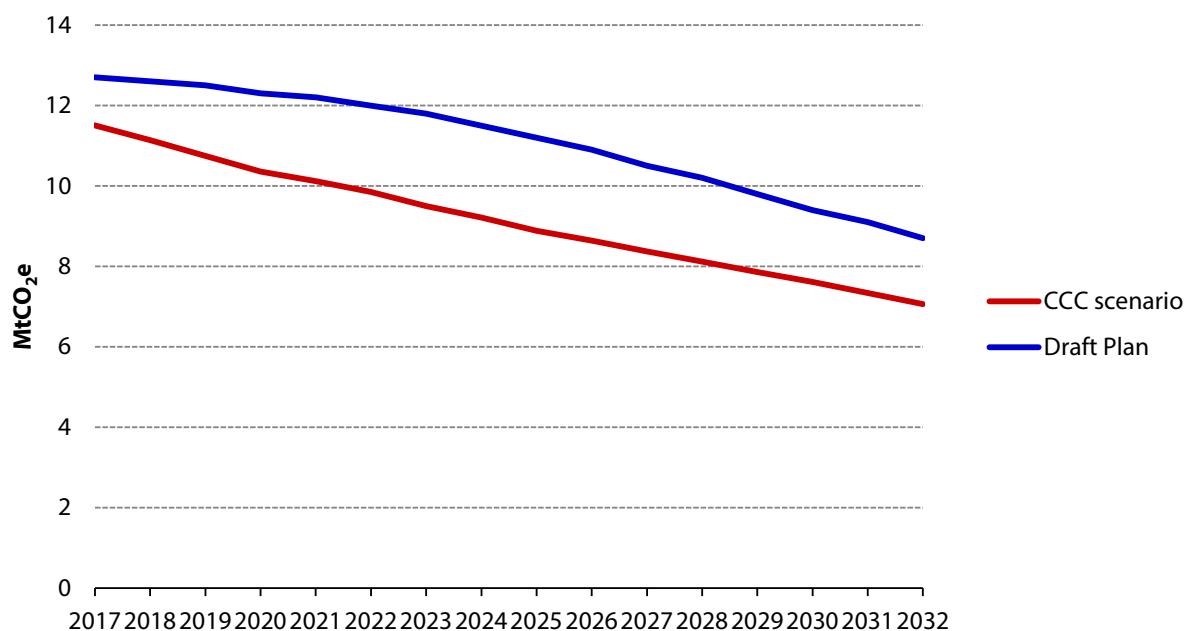
But the majority of cars and vans sold in the second half of the 2030s would be expected to be on the roads in 2050, implying significant residual emissions in 2050.

- Whilst it is not impossible to go from 27% of sales in 2030 to close to 100% by 2035, this rate of ramp up is extreme. This plan would put at risk the ability of the transport sector to contribute sufficient decarbonisation by 2050. Should ULEV sales not reach close to 100% by 2035 there would be little scope to catch up, as vehicle scrappage schemes are expensive.
- The Scottish Government has proposed to increase overall ambition to a reduction of 90% by 2050. As we set out in our advice on Scotland's new climate change legislation,<sup>42</sup> it is important that actions are taken now that keep open the possibility of very deep emissions reductions by 2050. It is therefore important to aim for close to 100% of ULEV car and van sales by no later than 2035 so that transport emissions can reach very low levels by 2050.

The Scottish Government's recent announcement on an earlier phase-out date for conventional petrol and diesel vehicles is therefore most welcome. This will affect emissions over the period to 2032, as the market for ultra-low-emissions vehicles will need to grow more quickly over the next 15 years. The final version of the Climate Change Plan will therefore need to update the path for transport emissions to 2032.

It will be important that the policies to achieve this earlier date are put in place, including ensuring that charging infrastructure provision is not a barrier to vehicle uptake. We have ongoing work looking at the necessary charging infrastructure to support electric vehicle uptake, and will work with the Scottish Government over the coming months to communicate the results of this work as they finalise the Climate Change Plan.

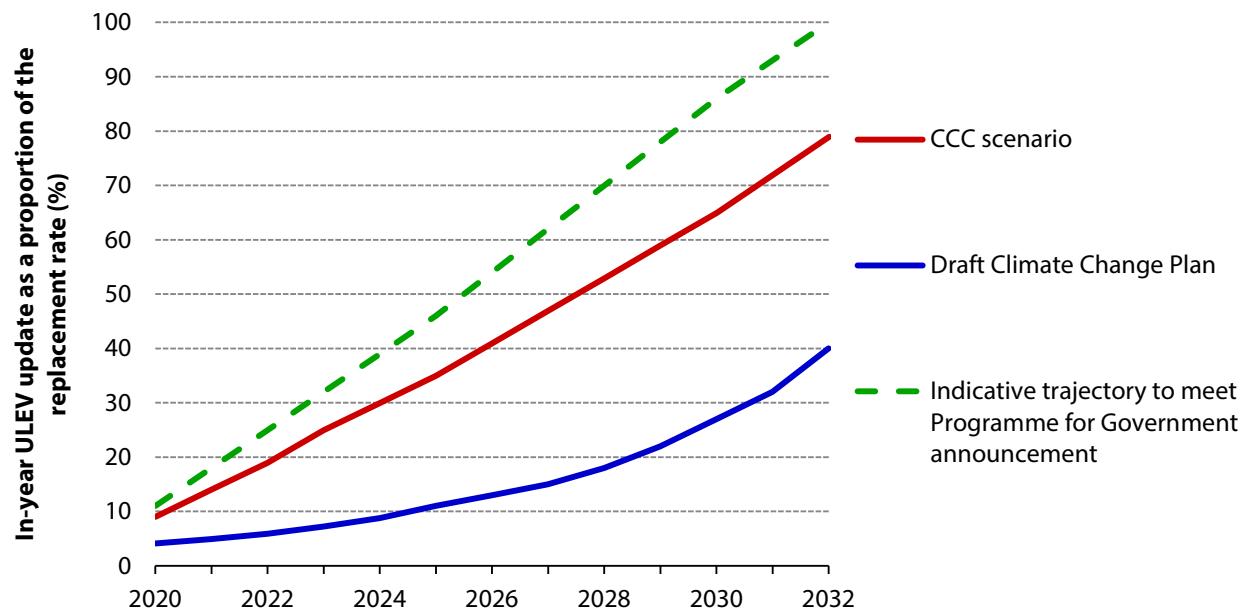
**Figure 6.5.** Comparison of CCC scenario and draft Climate Change Plan



**Source:** Draft Climate Change plan; CCC analysis.

<sup>42</sup> CCC (2017) *Advice on the new Scottish Climate Change Bill*.

**Figure 6.6.** ULEV sales under the draft Climate Change Plan and CCC scenario (2020-2032)



**Source:** Draft Climate Change Plan, CCC analysis.

**Notes:** The trajectory for ULEV uptake to reach 100% of sales in 2032, as implied by the Programme for Government announcement, is based on an indicative assumption that sales growth will be approximately linear from 2020. We anticipate that the Scottish Government will set out a trajectory in the final version of the Climate Change Plan.

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## **Chapter 7: Agriculture, land use, land-use change and forestry**



**Table 7.1.** Summary of progress in agriculture and LULUCF

Milestone	Progress
Increase the rate of afforestation to plant 10,000 hectares per year, with 100,000 hectares planted by 2020	After planting around 7,600 hectares in 2014/15, planting rates fell to 4,600 hectares in 2015/16 and 4,800 hectares in 2016/17. The annual target has been missed. Since 2012, only around 40,000 hectares have been planted. Rates will have to rise substantially if 100,000 hectares are to be planted by 2022.

## Latest emission trends and drivers

Emissions from the agriculture sector are largely non-CO<sub>2</sub> gases, with over half (57%) due to methane and almost one third (32%) due to nitrous oxide (N<sub>2</sub>O). Enteric emissions make up 51%, followed by agricultural soil emissions (26%). Emissions declined 14% between 1990 and 2015, although in recent years (after 2008), emissions have largely remained the same (Figure 7.1):

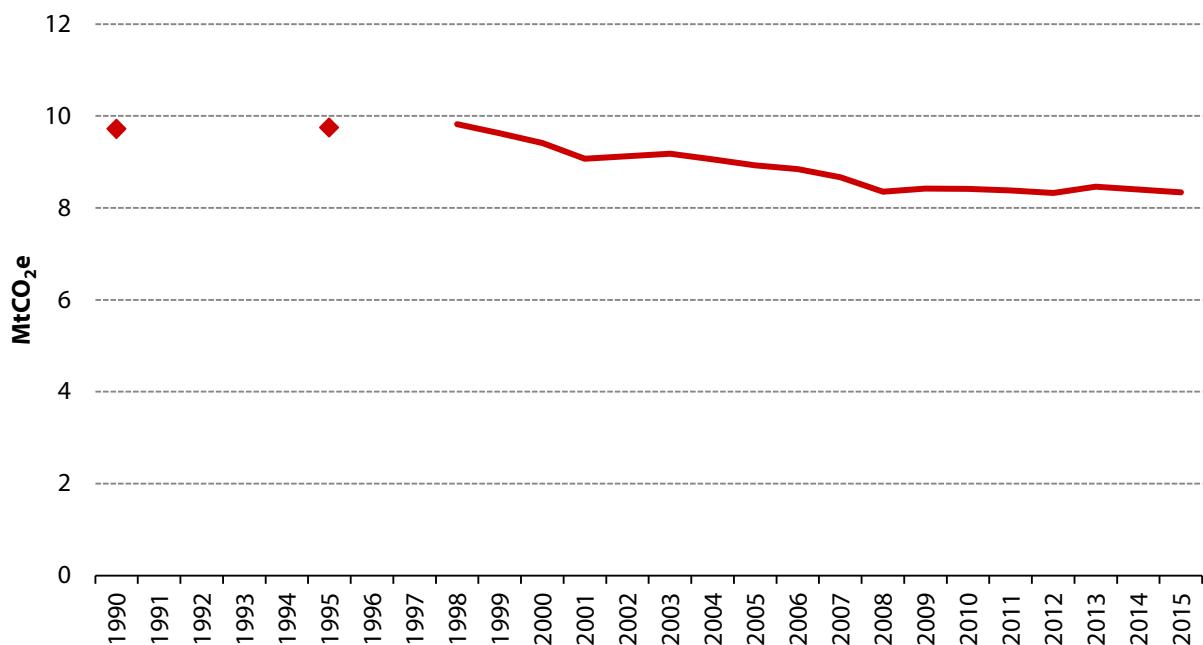
- Methane emissions fell by 15% between 1990 and 2015, which reflects the falling numbers of livestock and improving livestock productivity. However, since 2009, methane emissions have been largely flat.
- Nitrous oxide emissions have declined by 8% since 1990, reflecting a reduction in the use of fertiliser, but have only showed small changes since 2009.
- CO<sub>2</sub> emissions are only 11% of agriculture emissions, mainly from mobile machinery.

The land use, land-use change and forestry (LULUCF) sector was a net-emission sink in Scotland in 2015 (absorbing 2.8 MtCO<sub>2</sub>e),<sup>43</sup> mainly because of Scotland's large forests (around 1.3m ha), which absorbed almost 7 MtCO<sub>2</sub>e in 2015 (Figure 7.2).

- In contrast to previous estimates, the latest inventory shows that the LULUCF sector was a source of emissions in 1990, emitting 1.5 MtCO<sub>2</sub> emissions.
- The main source of emissions in this sector is land use related to agriculture (i.e. cropland and grassland), emitting 2.3 MtCO<sub>2</sub>e in 2015.
- Emissions from lowland peat and the horticultural use of peat are included in emissions accounting, but emissions from upland peatlands are not covered. This is an issue for Scotland, where most of the UK's upland peat is located. Similarly, carbon sequestration from the restoration of peat (e.g. re-wetting of peatland) is not currently captured in the emissions inventory. It is planned to be included in a future inventory.
- There is ongoing uncertainty in the emissions inventory for the agriculture, land use and forestry sector, in particular agriculture, for Scotland and for the UK as a whole. Addressing this uncertainty is the subject of a current research programme, which has started to feed through into improvements in the accuracy of the inventory. The Smart Inventory is to be delivered in 2018.

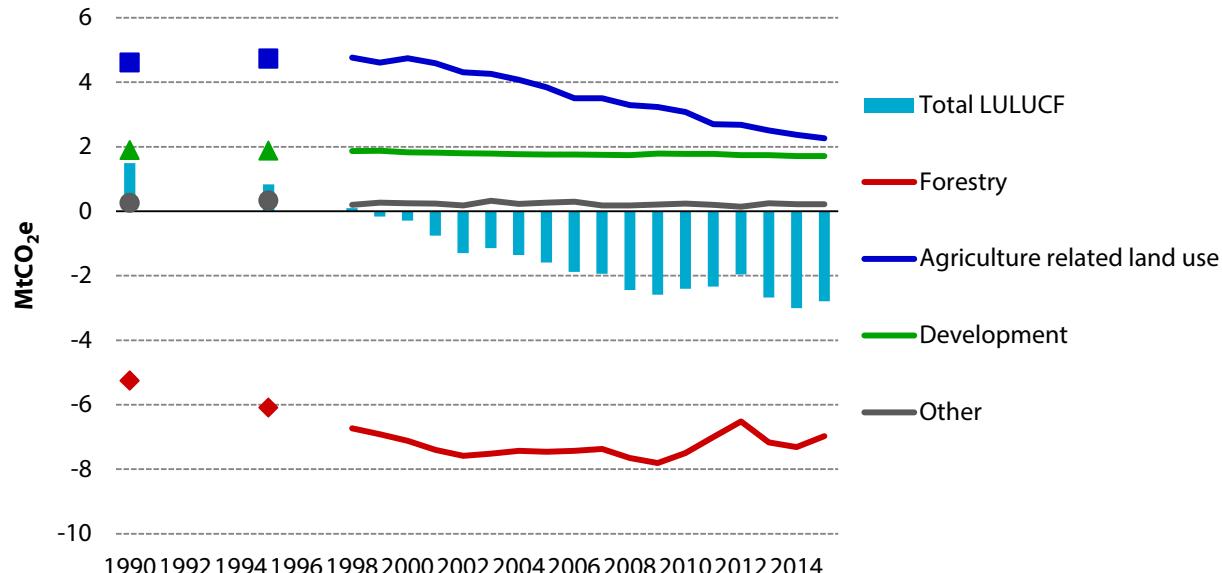
<sup>43</sup> The size of the net-sink has changed considerably since last year's report, reflecting to revisions in the inventory following improvements in the methodology. See Chapter 1 for more details.

**Figure 7.1.** Agriculture emissions (1990–2015)



**Source:** NAEI (2017).

**Figure 7.2.** LULUCF emissions by source 1998–2015



**Source:** NAEI (2017).

**Note:** Agriculture related land use includes emissions from croplands and grasslands.

## Policy progress

Emissions from agriculture account for 17% of total Scottish emissions and agriculture-related land-use accounts for another 5%, making agriculture-related emissions the third largest emissions sector (after industry and transport). This illustrates how important it will be to reduce emissions in this sector, especially as in recent years, emissions have not reduced at the rate required to meet targets.

Forestry acts as a carbon sink, although to a lesser extent than previously thought, removing only around 7 MtCO<sub>2</sub>e in 2014 and 2015, as against previous estimates of around 10 MtCO<sub>2</sub>e. Under the current business as usual projections, the carbon sink is predicted to decline further in future. More action is urgently needed to prevent carbon emissions and to utilise the carbon sequestration potential of forests and peat land restoration.

## Agriculture

### *Culture and behavioural change*

The main programme for encouraging behaviour change across farms in Scotland is the Farming for a Better Climate initiative (FFBC) launched by the Scottish Government and Scotland's Rural College in 2009 with £375,000 funding per year. It is designed to encourage voluntary uptake of 'win-win' actions in five key action areas:

- Using energy and fuels efficiently
- Developing renewable energy
- Locking carbon into soil and vegetation
- Optimising application of fertilisers and manures
- Optimising livestock management and storage of waste

The Scottish Government remains committed to the programme and plans to increase its exposure so that it reaches more farmers. Feedback to date has been positive, but a more extensive evaluation is currently ongoing:

- It is planned to ask farmers about the measures they implement, changes they are applying and in which area. This should enable a simple evaluation of some of the impacts of FFBC, although it will be difficult to assess carbon benefits.
- Academic research is currently being carried out on a wider review of FFBC and its impacts on wider cultural and behavioural change since its start in 2009, which should give a more robust and extensive insight into the impacts of FFBC.

In absence of a formal evaluation at the moment, Box 7.1 provides examples of the type of measures that FFBC has supported in the past and the impacts achieved.

If the results of the evaluation are positive, FFBC should be extended and reach more farmers. However, if the programme is not leading to real change, the Scottish Government should consider alternatives to deliver deeper cuts in this sector.

### **Box 7.1. Examples from the 'Farming for a Better Climate' programme**

The Farming for a Better Climate programme is the main policy to reduce emissions in agriculture. A formal evaluation is currently undergoing and will be published next year. The following examples aim to give an impression of the kind of impact the programme has, in lieu of a formal evaluation:

- A farm in Dumfries and Galloway saved £37,000 with an 11% carbon footprint reduction. Some of the benefits included reduced electricity and fuel uses by for example fitting a variable speed milk pump and through better use of the farm fleet.
- A farm in Perthshire saved £11,000 overall and had a 10% reduction in its carbon footprint. This was through measures such as improvements in the use of concentrates by testing, knowing the feed value of their silage and then feeding ewes accordingly and through reduced energy cost through for example reducing daily running time of their feed mixer.
- A farm in the Scottish Borders region saved around £19,000 a significant part of this was from just from knowing the nutrient value of its manure and applying that by using global positioning system soil sampling. The farm also had a 19% carbon footprint reduction.

These examples are encouraging but only a full evaluation can assess the effectiveness of the programme. We welcome the commitment of the Scottish government to improve the monitoring of the FFBC programme to further understand its impacts.

**Source:** Scottish Government.

### *Soils*

In 2015 the Scottish Government announced plans for compulsory soil testing every five to six years for arable and temporary grass. Those plans for making soil testing compulsory are not, however, being implemented by the Scottish Government. Instead, farmers are encouraged to take it up on a voluntary basis, by increasing the awareness that they will benefit from those measures. This will be re-considered if voluntary action is not showing the necessary results.

### *Nitrogen use*

The Second Report on Proposals and Policies (RPP2) proposed to achieve a 90% uptake of cost-effective nitrogen efficiency measures, but the Scottish Government no longer plans to introduce a mandatory regime. Instead, farmers are encouraged to take up better nutrient management planning through voluntary knowledge transfer and sharing of best practise guides.

Farmers can benefit from support given through the Scottish Rural Development Programme's Farm Advisory service. This offers specialist advice, mentoring and funding, not only in soil and nutrient management but also in other climate change related measures.

### *Livestock efficiency*

The Scottish Government is considering policy action in the Climate Change Plan to reduce emissions from enteric fermentation in livestock production. The commissioned ClimateXChange study "Nutritional strategies to reduce enteric methane emissions" showed that increasing the lipid content of diets has scope to reduce enteric methane emissions. Those results are now being taken forward in a second study, which aims to test its feasibility and

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results in a practical on-farm setting. Results of the second phase of this research are expected in 2018.

The Scottish Government also plans to make better use of the statistical data they obtain on livestock in Scotland. Work is currently underway on how to present this data to farmers so that they can use it to increase the efficiency and performance of their livestock.

For later in 2017, the Scottish Government will publish emissions intensity data for beef, lamb and milk.

## Land use

### *Land-use strategy*

Scotland's second land-use strategy was published in March 2016. A reporting framework has been created and will be published soon.

### *Peatlands*

Peatlands cover over 20% of Scotland's land area. Scottish peatlands account for 60% of the UK's peatlands and 4% of Europe's total peat carbon store. Historically, these peatlands have been damaged or drained, but there has been little drainage over the past two decades.

Scottish peatlands are a large carbon store. Degraded peatlands risk significant carbon emissions whether or not they are currently accounted for in the inventory. Peatlands supporting bog habitats can, in favourable states, deliver annual GHGs through sequestration of up to 0.5-0.7 tonnes carbon per hectare per year.<sup>44</sup> Peatlands in Scotland covering around 1.7 million hectares could potentially deliver around 1 MtCO<sub>2</sub>e of carbon sequestration per year.

It is therefore important that action is taken to improve the condition of degraded soils, and to limit damaging practices such as horticultural use and intensive rotational burning on upland moors.

The Scottish Government has different policies to improve peatland condition:

- **Scotland's 2014 National Peatland Plan: Working for our Future**<sup>45</sup> sets out proposals for research and awareness-raising. The main aim set out in the plan is to manage, protect and restore peatlands to maintain their natural functions, biodiversity and benefits. By 2020, the plan aims to see:
  - No more loss of peatlands with their condition improving rather than deteriorating.
  - A Peatland Code will be in place governing private funding of peatland conservation and restoration, and peatland management included in national carbon accounting.
  - The Flow Country (a large area of peatland and wetland in Caithness and Sutherland) will have moved from the UK Tentative List towards being a fully inscribed World Heritage Site.

The objectives are reasonable, but the plan does not define a mechanism for action in these areas.

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<sup>44</sup> [https://www.rspb.org.uk/Images/thepeatlandsofscotland\\_tcm9-224528.pdf](https://www.rspb.org.uk/Images/thepeatlandsofscotland_tcm9-224528.pdf)

<sup>45</sup> Scottish National Heritage (2015) *Scotland's National Peatland Plan*, <http://www.snh.gov.uk/docs/A1697542.pdf>

- **The Peatland Action project** began in 2012 to deliver restoration. It is entering a new phase, with £8 million to spend on another 8,000 ha of degraded peat on the course to recovery in 2017/18. Applications for the project began in spring 2017.
  - Since late 2012, more over 10,000 ha of degraded peatland have received restoration activity under Peatland ACTION.
  - SRDP is also working towards restoring a further 2,000 ha this year.

### *Forestry*

Tree-planting rates have been declining since the 1970s, reaching a low of just 2,700 ha in 2010 (Figure 7.3). They have increased since then, largely as a result of the Scottish Rural Development Plan (SRDP). RPP2 contained a policy to increase the afforestation rate to 10,000 hectares per year, creating 100,000 hectares by 2022. The 10,000 hectare target has yet to be achieved and the annual planting rates are lagging behind the ambition of the RPP2. Despite this, the new draft Climate Change plan has increased the ambition to 15,000 hectares per year from 2025:

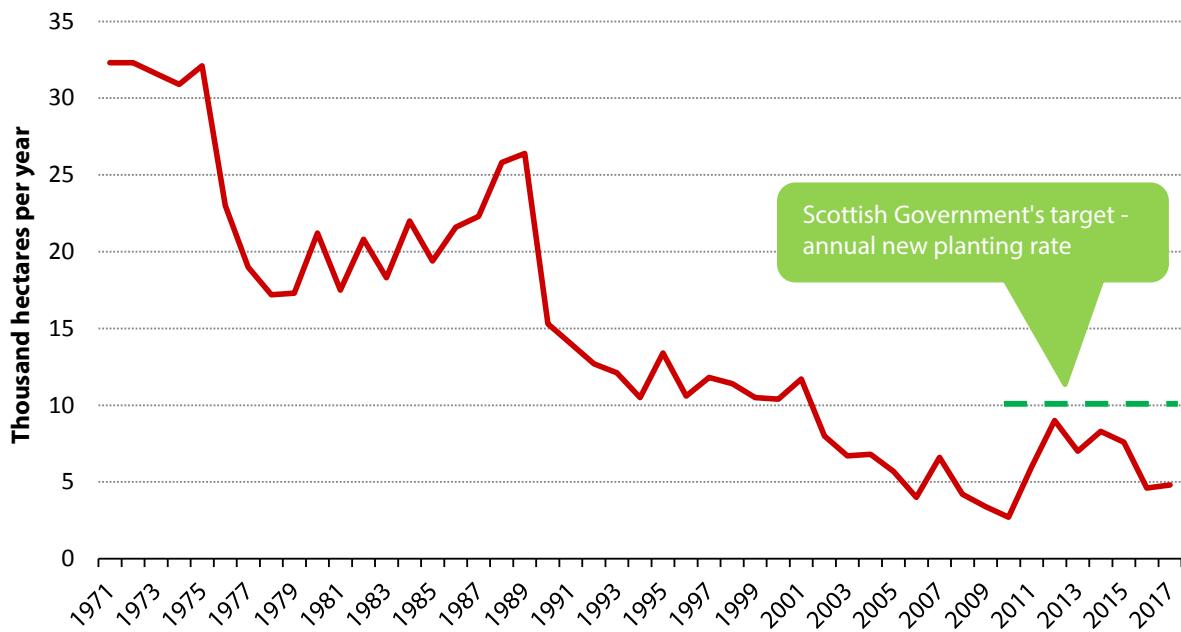
- After planting around 7,600 hectares in 2014/15, planting rates fell to 4,600 hectares in 2015/16 and 4,800 hectares in 2016/17. The reason for those low planting levels may be that the Scottish Government undertook a major transition from one grant scheme to another. Past experience has shown that applicants delay submitting proposals until they are familiar with the new grant rates.
- Since 2012, only around 40,000 ha have been planted. Rates will have to rise substantially if 100,000 ha are to be planted by 2022.

The SRDP is the main source of woodland creation in Scotland with the Forestry Grant Scheme (FGS) having £36m funding per year for 2014-2020. The scheme includes advice on types of trees to be planted. From April 2016 to March 2017, the Forestry Grant Scheme supported new planting of 3,700 hectares, providing funding of over £30m, most of which was used directly in forest creation.

The Scottish Government has also taken action to increase woodland through the implementation of the Mackinnon Report to streamline the planting approval process; more attractive grant rates for native woodlands in remote areas; and an increase in grant-funding for woodland creation of £4 million in 2017/18.

In last year's report, we attributed the 8% reduction in planting rates in 2014 to a delay in the launch of the Forestry Grant Scheme. However, planting rates have remained at low levels since then. More action will be needed if targets are to be achieved.

**Figure 7.3.** New tree planting in Scotland (1972-2015)



**Source:** Forestry Commission (2015) Woodland area, planting and restocking data, <http://www.forestry.gov.uk/forestry/infd-7aqknx>

## Assessment of the draft Climate Change Plan and Energy Strategy

### LULUCF

In our advice on annual targets to the Scottish Government, we estimated that based on our High Ambition Scenario, the LULUCF sector could deliver 1.6 MtCO<sub>2</sub>e by 2032 compared to the business-as-usual projections.

Since our analysis and the draft climate change plan were published, there has been a significant revision in the emissions inventory for the LULUCF sector. Further significant revisions are expected in the future, once the inventory includes emissions from peatland. Therefore, we do not comment on the level of the numbers in the draft Plan, but focus on the emissions trajectory, which differs significantly to our High Ambition Scenario (Figure 7.4).

In the draft Climate Change plan and in our scenario, emissions increase until 2030 and start decreasing from there. However, the increase in emissions is much greater in the draft Climate Change Plan than in our scenario.

The plan also includes around 4 MtCO<sub>2</sub>e of abatement through peatland restoration, despite the fact that upland peatland has not yet been included in the emissions inventory. We welcome abatement efforts in this sector, which will be important for meeting the targets once peatland emissions are included in the emissions inventory. We recommend that the level of peatland abatement should be revisited following the inclusion of upland peat in the emissions inventory.

A key difference between our scenario and the Plan is due to using a different, outdated baseline for forestry in the draft Plan (Box 7.2).

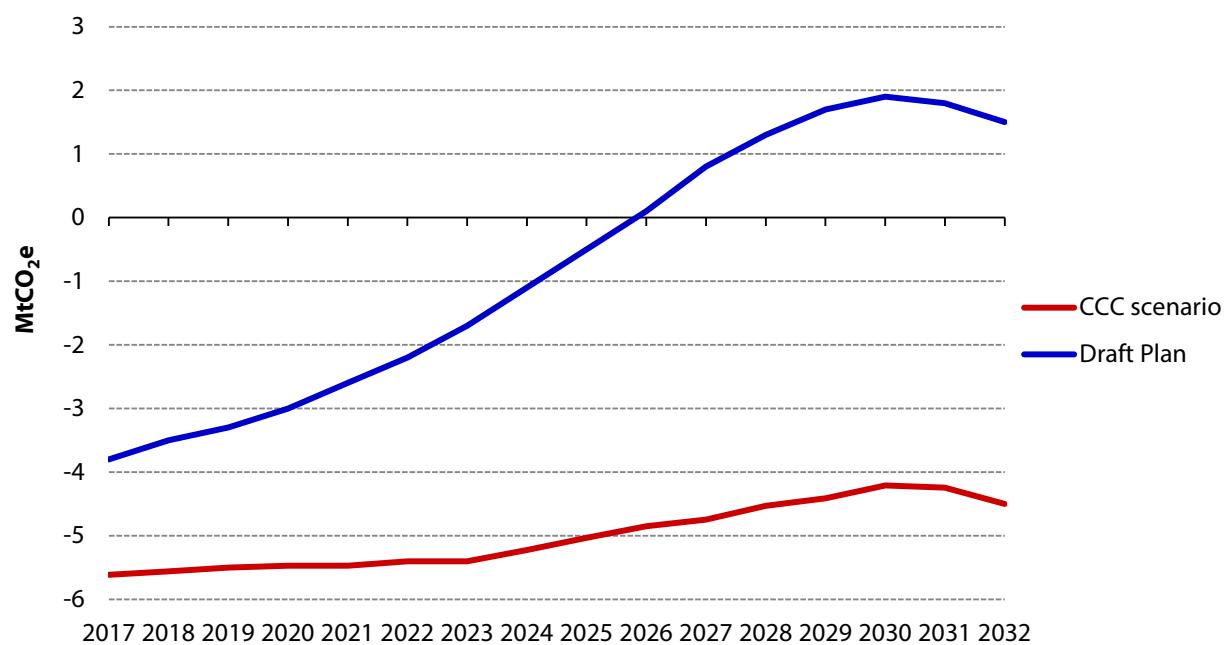
Inventory changes have had a large effect on both historical emissions and modelling future pathways, particularly in the agriculture and land-use sector. These changes are hard to avoid, and hard to predict, but there is agreement that updates to the inventory represent improvements, so using a more recent dataset is sensible.

Based on understanding of the differences in the modelled pathways, we suggest that the Scottish Government updates the analysis for the draft Climate Change Plan with a more recent evidence base.

Abatement in the LULUCF sector mainly depends on tree planting rates. The draft Climate Change Plan has a high ambition, with a planting target of 15,000 ha each year from 2024/2025. To achieve this, the Plan includes measures like forestry grants and a woodland creation programme on the National Forest Estate.

Recent annual planting rates have been significantly below the targets. We understand that in recent years this was partly due to administrative burdens of the Forestry Grant Scheme application process. We therefore welcome that the draft Plan includes measures to improve this process.

**Figure 7.4.** Comparison of LULUCF emissions in the CCC scenario and draft Climate Change Plan



**Source:** Draft Climate Change Plan; CCC analysis.

**Note:** Both scenarios are based on the non-revised inventory from 2016 and therefore differ to the latest inventory data.

## **Box 7.2** Differences in baseline used in the draft Plan and CCC modelling

For the forestry sector, projections of emissions are compiled by combining a baseline projection, for what emissions would be if no further actions were taken to reduce them, with an estimate of the emissions savings from actions to reduce emissions.

- Our scenario uses DECC's 2015 baseline (using Scottish-specific data, within DECC's overall UK baseline), which includes some tree felling.
- The draft Climate Change Plan used an earlier baseline from 2012. This would have underestimated the current forest sink, as it was based on an old carbon accounting model.
- Carbine replaced C-Flow as the new carbon accounting model for the UK forestry sector for the 2014 inventory. The new assumptions in the model offer an improved representation of the diversity of the UK's tree species, forest growth rates and forest management practices, all of which impact on forestry emissions and sequestration.

There are significant differences between the latest baseline estimates and the baseline used for the draft Climate Change Plan. It is unclear why the draft Plan used an old baseline and model, as both our own analysis and updated BEIS projections were available. We recommend using the latest evidence for the final version of the Climate Change Plan.

## **Agriculture**

The draft Climate Change Plan includes an emissions reduction in agriculture of 17% to 6.9 Mt in 2032, from 8.3 Mt in 2015. This is higher than the level of emissions in the Committee's High Ambition Scenario, which includes a reduction of 25% against 2015 emissions to 6.2 Mt (Figure 7.5).

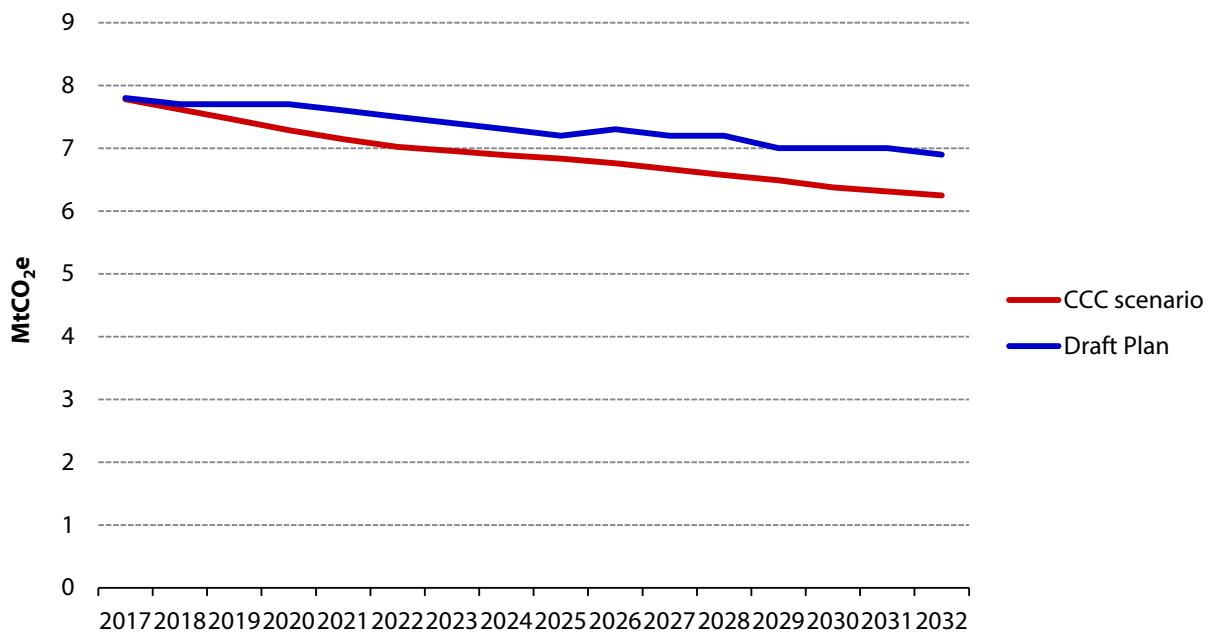
In our advice on annual targets to the Scottish Government, we estimated in our High Ambition Scenario, on which the targets were based, that the agriculture sector could reduce emissions by 23% compared to 2014 emissions. This included contributions from measures such as improving management of crops and soils, improving animal health and diets, waste management and on-farm efficiency measures. This scenario is stretching and includes a move away from the current voluntary approach to reducing emissions in this sector.

The draft Climate Change Plan does not set out any non-voluntary measures and instead of mandatory policies, the plan focuses on setting incentives. Even though the Plan shows a gradual decline in emissions, the reductions are less ambitious than in our scenario.

The plan includes policies like encouraging pH testing and carbon audits, encouraging planting of woodland on agricultural land (agro-forestry) and reducing emissions from use and storage of manure and slurry. After publishing research on an appropriate metric of the intensity of emissions for beef, sheep and dairy sectors, an annual percentage target for emission intensity will be set. Again, achieving this target would depend on non-mandatory measures, like encouraging farmers to undertake genotyping, improve fertility, reducing animal mortality and adopt improving farm management practices.

Overall, the ambition in the agricultural sector and the focus on voluntary measures is concerning. Agriculture will need to make a greater contribution to meeting emissions targets. We recommend that the final Climate Change Plan should reconsider non-voluntary measures in order to ensure a more ambitious reduction of emissions.

**Figure 7.5.** Comparison of agriculture emissions in the CCC scenario and draft Climate Change Plan



**Source:** Draft Climate Change Plan; CCC analysis.

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# Chapter 8: Waste



**Table 8.1.** Summary of progress in the waste sector

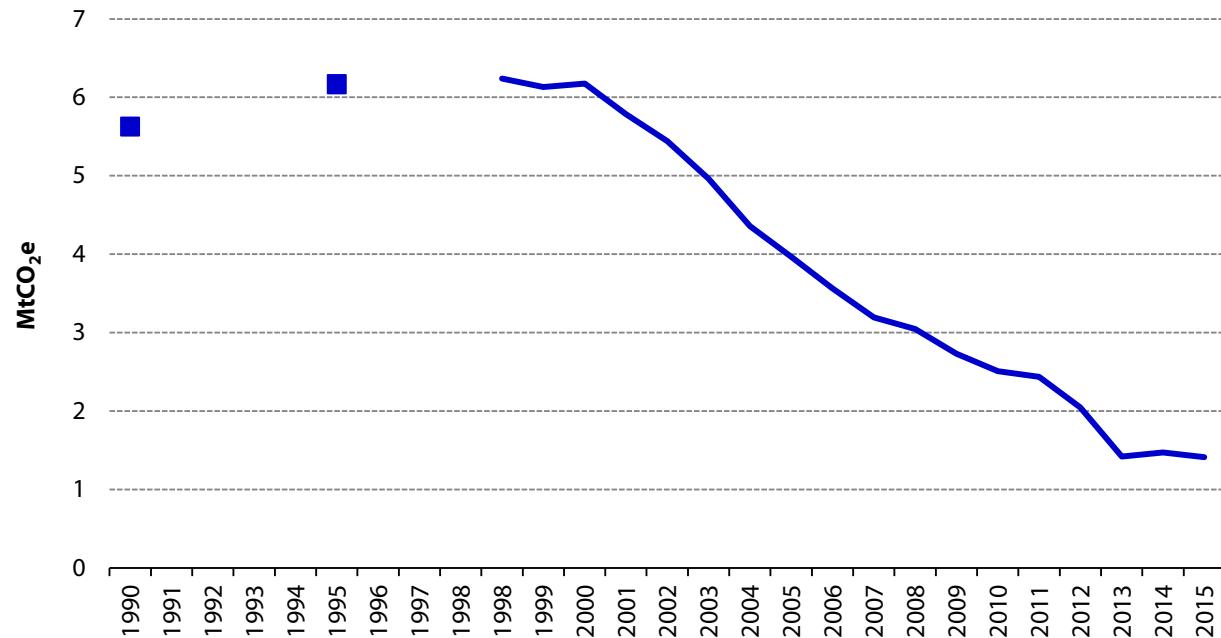
Milestones	Progress
Proportion of household waste recycled/composted/reused: <ul style="list-style-type: none"><li>• 40% by 2010</li><li>• 50% by 2013</li><li>• 60% by 2020</li><li>• 70% by 2025</li></ul>	44.2% of household waste was being composted, recycled or reused in 2014, an increase of 1.4 percentage points from 2013. Scotland has not reached the Zero Waste Plan target for 2013 (50%), two years after the target year. Scotland is therefore not on track to achieve a rate of 60% in 2020.
Recycling 70% of all waste (including commercial and industrial waste) by 2025.	In 2015, total generated waste from household, construction and demolition and commercial and industrial sources was over 11.5m tonnes. Almost 6.5m tonnes (55%) were recycled. The recycling rate has not changed from 2014.
Reducing the proportion of total waste sent to landfill to a maximum of 5% of all waste by 2025.	The share of total waste from all sources sent to landfill decreased by 5.1% in 2015 to 37% of total waste.
Safeguarding Scotland's Resources – Blueprint For A More Resource Efficient and Circular Economy report contains the following targets: <ul style="list-style-type: none"><li>• Reduce waste arisings in Scotland by 7% by 2017 against a 2011 baseline</li><li>• Reduce waste arisings in Scotland by 15% by 2025</li></ul>	In 2015, total waste arisings increased by 14% to 11.5m tonnes. This is the highest level since 2012. Compared to the 2011 baseline, this is a 2.8% reduction.

## Latest emission trends and drivers

Waste policy is fully devolved to the Scottish Government. Waste emissions account for only 3% of total emissions of Scotland, due to a sharp reduction since 1990 (when they were 7.5% of Scottish emissions). In 2015, emissions from waste in Scotland decreased by 4% to 1.4 MtCO<sub>2</sub>e, 75% below 1990 levels, compared to a 7% reduction in the UK as a whole (Figure 8.1).

Methane released from waste in landfill is the main source of emissions in the waste sector, accounting for over 91% of emissions in 2015. Landfill emissions fell steadily until 2013, reflecting a reduction in the amount of waste sent to landfill through a reduction in waste arising and waste diversion. Action to capture or flare landfill methane has also contributed to a reduction in emissions from waste management. However, the fall in emissions has slowed down since 2013.

**Figure 8.1.** Emissions from waste 1990-2015



**Source:** NAEI (2017).

Total waste arising in Scotland increased by nearly 14% in 2015 and is at its highest level since 2012:<sup>46</sup>

- The share of total waste from all sources sent to landfill decreased by 5.1% in 2015 to 37% of total waste. The Zero Waste Plan target for 2025 is 5%.
- The recycling rate of waste from all sources has increased to 56.7%. The target for 2025 set out in the Zero Waste Plan is 70%.<sup>47</sup>

Total waste is a very volatile indicator from year to year (e.g. total waste was 16.8% lower in 2012 compared to 2011 and 14.6% lower in 2014). There is a question of whether assessing progress against the target in one particular year is the right indicator.

Household recycling rates have increased in 2015 to 44.2%. The Zero Waste Plan set an interim target for 2013 of 50%. Despite a gradual increase in recycling rates, Scotland is still falling short of this target.

<sup>46</sup> Scotland's Environment Waste Discover Data Tool (2016), <http://www.environment.scotland.gov.uk/get-interactive/data/waste-from-all-sources/>

<sup>47</sup> Scotland revised the methodology of the measurement of the total tonnage of waste that was recycled in 2014. Prior to 2014, household waste composted that did not reach the quality standards set by PAS 100/110 was included in the recycling figures. Therefore, rates pre-2014 should not be compared with post-2014 rates.

## Progress and policies

The Scottish Government's Zero Waste Plan<sup>48</sup> (2010) and Safeguarding Scotland's resources in (2013)<sup>49</sup> were superseded in February 2016 with a Circular Economy Strategy.<sup>50</sup> The Strategy carries forward existing waste reduction and recycling targets, which Scotland is currently on track to meet (Table 8.1, Figure 8.2), and has £20 million of funding in 2016/17. The strategy prioritises four sectors where the biggest environmental and economic impact can be made:

- Food and drink: inclusion of a Scottish Food Waste Reduction Target to achieve a 33% reduction in food waste by 2025, estimated to save £500 million per year.
- Energy infrastructure: opportunities of equipment reuse from wind turbines and decommissioned oil and gas platforms.
- Construction and buildings: construction accounts for about 50% of all waste in Scotland, and is a major influence on efficient use of resources.
- Remanufacturing: already worth £1.1 billion to the economy, and has potential to create an additional £620 million turnover with 5,700 new jobs by 2020.
- Since the strategy was published, progress has been made:
  - The £18 million Scottish Institute for Remanufacture (SIR) is funded by the Scottish Funding Council and Zero Waste Scotland. The centre of excellence works to increase innovation in remanufacturing (increase reuse, repair and remanufacture).
  - Circular Economy Investment Fund is funded by the Scottish Government and the European Regional Development Fund and to support work that will help deliver circular economy growth.
  - The Cabinet Secretary announced in July 2017 that Zero Waste Scotland is investigating design options for a Deposit Return scheme for Scotland.
  - Scotland now has three large-scale reuse superstores, one online, which aim to present re-use as a quality, attractive and good value shopping experience for customers, and drive up rates of reuse and economies of scale for retailers.
  - The Scottish Government received the Award for Circular Economy Governments, Cities and Regions at the Circulars Awards, presented at the World Economic Forum Annual Meeting in Davos.

Scotland has put in place detailed targets, an annual report detailing progress and programmes to help meet these, specifically with the ban on municipal biodegradable waste going to landfill. However, more action is needed if such ambitious targets are to be achieved.

- Scotland is not on track to meet the 2020 target of 60% of household waste being recycled, composted or reused.
- In 2015, total generated waste from household, construction and demolition and commercial and industrial sources increased to over 11.5 million tonnes. Almost 6.5 million tonnes (55%) were recycled. The recycling rate has not changed from 2014. In order to

<sup>48</sup> Scottish Government (2010) *Scotland's Zero Waste Plan*, <http://www.gov.scot/Resource/0045/00458945.pdf>

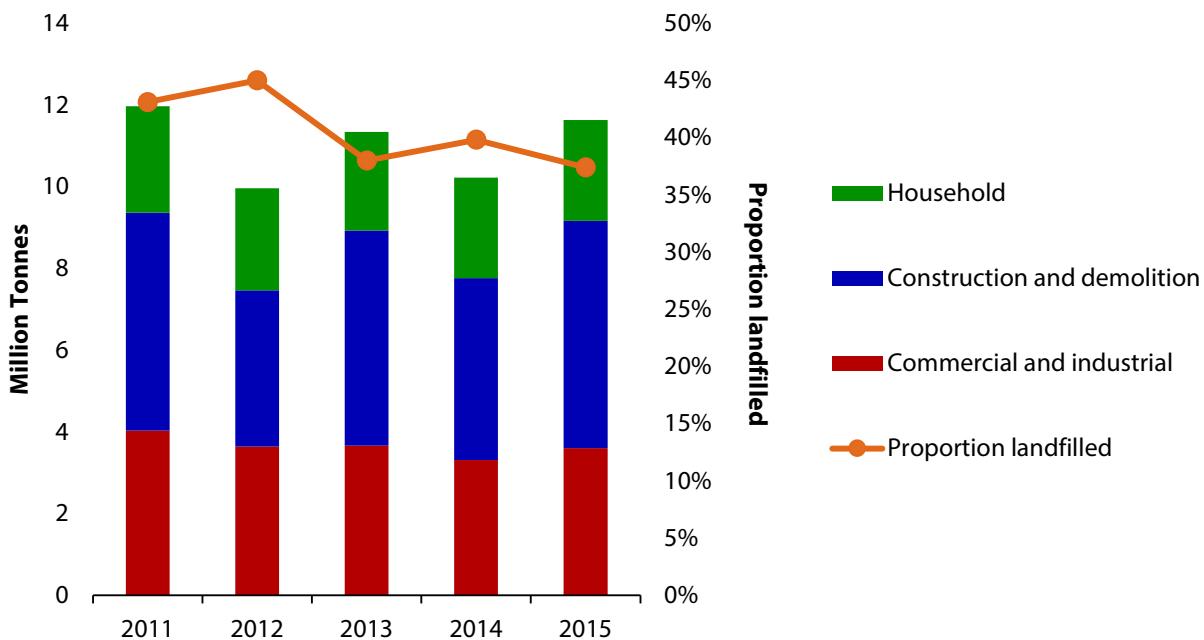
<sup>49</sup> Scottish Government (2013) *Zero Waste Safeguarding Scotland's Resources*,  
<http://www.gov.scot/Resource/0043/00435308.pdf>

<sup>50</sup> Scottish Government (2016) *Making Things Last*, <http://www.gov.scot/Resource/0049/00494471.pdf>

achieve the target of recycling 70% of all waste (including commercial and industrial waste) by 2025, greater progress is required.

- The share of total waste from all sources sent to landfill decreased by 5.1% in 2015 to 37% of total waste. The target is 5% of total waste by 2025, which is achievable considering the ban on municipal biodegradable waste going to landfill from 2021.

**Figure 8.2.** Waste arisings in Scotland by source and proportion of waste landfilled (2004-2014)



**Source:** Scotland's Environment Waste Discover Data Tool (2016), <http://www.environment.scotland.gov.uk/get-interactive/data/waste-from-all-sources/>

## Assessment of the draft Climate Change Plan and Energy Strategy

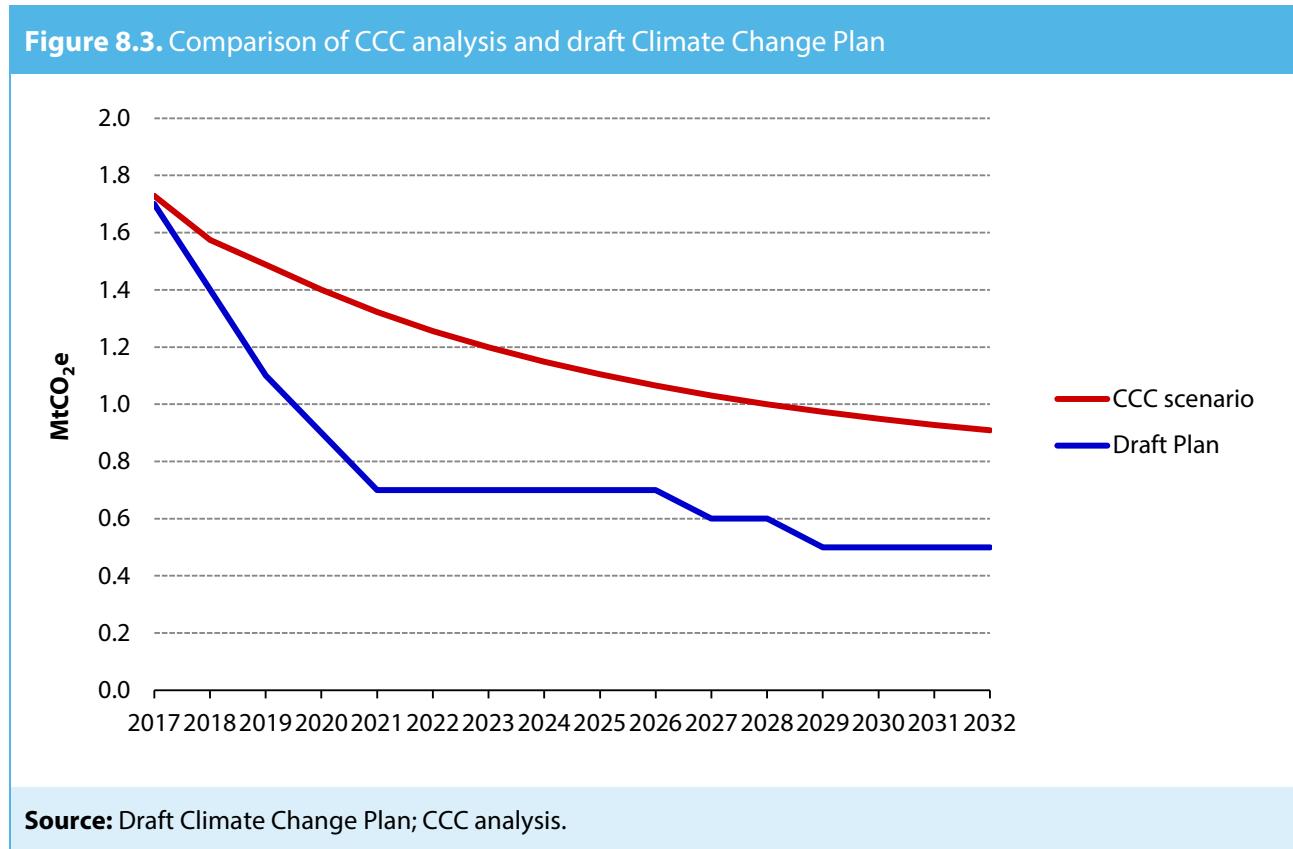
The draft Climate Change Plan includes a 64% reduction in waste emissions to 0.5 MtCO<sub>2</sub>e by 2032, from 1.4 MtCO<sub>2</sub>e in 2015. This ambition goes further than the 0.5 MtCO<sub>2</sub>e level of abatement that the Committee estimated for the High Ambition scenario as set out in our annual targets advice (Figure 8.3).

Our High Ambition scenario assumed waste emissions could continue to fall as Scotland moves towards a circular economy through reducing waste arising, diversion from landfill and greater capture of methane at landfill sites. In the draft Climate Change Plan, the higher level of reduction assumes the following targets covering these same themes:

- The phase out of biodegradable municipal waste going to landfill by 2020, which is a year earlier than the statutory ban
- The amount of waste going to landfill to fall to 5% by 2025, and to reduce food waste in general by 33% by 2025

- Increase deployment of innovative technologies such as flaring to better manage emissions from existing closed and older operational landfill sites; and support the closure of 12 closed landfill sites by 2022.

These targets reflect Scotland's priorities as set out in the Circular Economy Strategy and partly explains why the emissions reduction is higher than the CCC's own assessment.





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