The Scottish Government
Riaghaltas na h-Alba

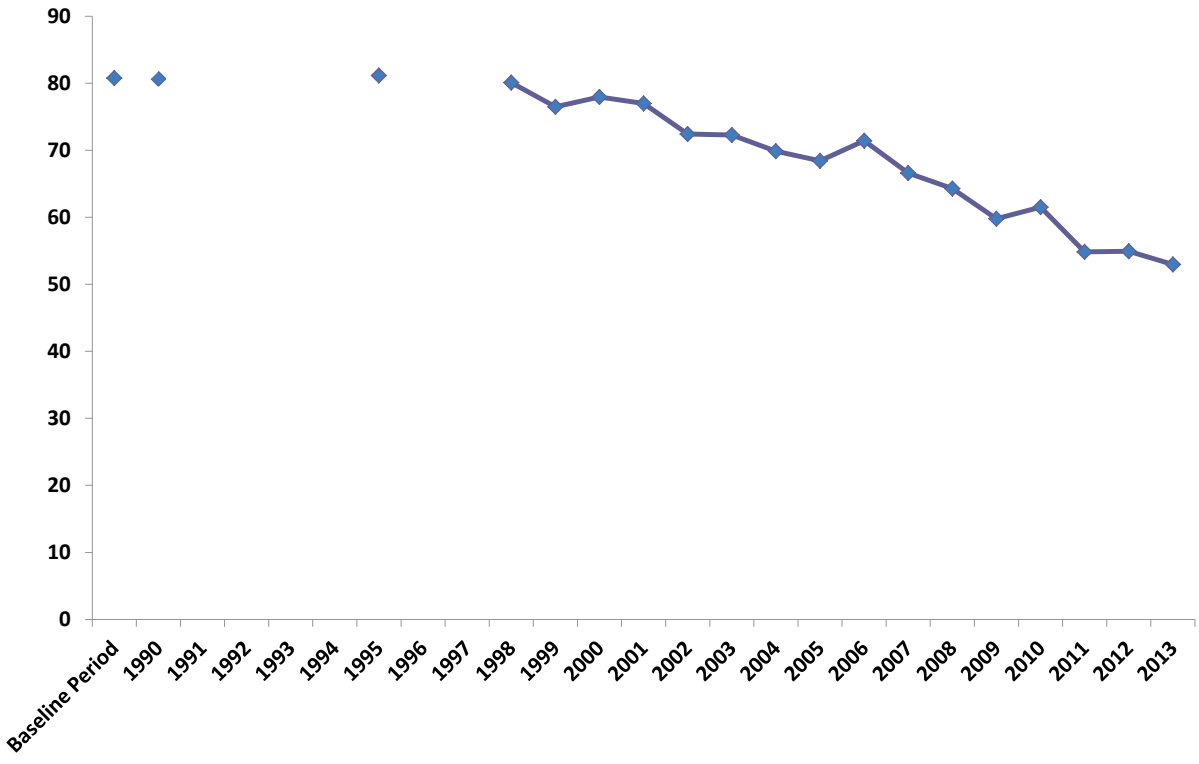
# Scottish Greenhouse Gas Emissions 2013

## An Official Statistics Publication for Scotland

This publication provides estimates of greenhouse gas emissions in Scotland for the years 1990 to 2013. Except where stated, the emissions figures shown in this release include an estimate of emissions from international aviation and shipping.

The release also provides information on the performance against emission reduction targets, taking account of trading in carbon units. These targets are prescribed in the Climate Change (Scotland) Act 2009.

**Scottish Greenhouse Gas Emissions, 1990 to 2013. Values in $MtCO_2e$**



- In 2013, Scottish emissions of the basket of seven greenhouse gases are estimated to be 53.0 million tonnes carbon dioxide equivalent ($MtCO_2e$).
- This is 3.6 per cent lower than the 2012 figure of 54.9 $MtCO_2e$, a 2.0 $MtCO_2e$ decrease.
- Between 1990 and 2013, there was a 34.3 per cent reduction in estimated emissions. Section A states what the greenhouse gases are and how they are categorised. Section B contains results in more detail. The main contributors to this reduction have been a fall in waste management and in energy supply emissions (such as in the production of electricity).
- When emissions are adjusted to take account of trading in the EU Emissions Trading System (EU ETS), emissions decreased by 14.0 per cent between 2012 and 2013 (from 57.8 $MtCO_2e$ to 49.7 $MtCO_2e$). Section C provides information on what the EU ETS is and what it means for Scotland's Greenhouse Gas Emissions statistics.
- Compared with the Baseline Period [1], emissions in 2013 (after taking account of trading in the EU ETS) were 38.4 per cent lower. Section A contains more information on how the Baseline Period is defined and Section C contains results in more detail.

The annual target for 2013, as published in the Climate Change (Annual Targets) (Scotland) Order 2010, is 47.976 $MtCO_2e$. The target is assessed using the adjusted emissions (49.725 $MtCO_2e$) in 2013.

Note that as part of this release all of the figures have been revised since the previous publication in June 2014, to incorporate methodological improvements and new data. Comparing the 2013 figures with the 2012 figures published a year ago will therefore give a different year-on-year percentage change; one which is incorrect and should not be used. Details of these revisions can be found later in this statistical release in Section D.

[1] The Baseline Period uses 1990 for carbon dioxide, methane and nitrous oxide and 1995 for hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride

## Contents



## List of tables



## List of charts

# Section A. Introduction to Greenhouse Gases

## Purpose of this Publication

The "Scottish Greenhouse Gas Emissions 2013" Official Statistics publication contains the results of the Scottish Greenhouse Gas Inventory for 1990-2013. The Scottish Greenhouse Gas Inventory is the key tool for understanding the origins and magnitudes of the emissions and the assessment of policies designed to control or reduce emissions. The inventory is compiled in line with international guidance from the Intergovernmental Panel on Climate Change (IPCC). Data are reported by source sector (such as energy supply) and by greenhouse gas (such as carbon dioxide). The inventory is also used to report data against targets as required under the Climate Change (Scotland) Act 2009.

## Using the Statistics. Which measure to use and when?

The "Scottish Greenhouse Gas Emissions 2013" Official Statistics publication includes data on two categorisations of greenhouse gas emissions.

- **Estimated net source emissions.** These are sometimes referred to as "territorial" emissions, as they are produced within a country's territory or economic sphere. Section B contains results using this categorisation.
- **Estimated net source emissions which have been adjusted to take into account of trading in the EU Emissions Trading System (EU ETS).** Section C contains results using this categorisation.

The publication does not contain information on "consumption" estimates, with the spending of Scottish residents on goods and services, wherever in the world these emissions arise along the supply chain, and those which are directly generated by Scottish households through private motoring and heating. This information was most recently published in March 2015 for the years 1998 to 2012 as part as part of the Official Statistics publication: "Scotland's Carbon Footprint 1998-2012".

The table below shows how to use the different categorisations of statistics on greenhouse gas emissions.

| | Estimated Source Emissions<br><br>(Section B) | Estimated Source Emissions Adjusted to take into account of EU Emissions Trading System<br><br>(Section C) |
|---|---|---|
| Adjusted for EU Emissions Trading System | ✗ | ✓ |
| Used for reporting progress against Scotland's Climate Change Targets [1] | ✗ | ✓ |
| Can be compared with EU countries – note that comparable data for 1990-2013 will not be available for the time of this release [2] | ✓ | ✗ |
| Can be compared with UK [3] | ✓ | ✗ |
| Includes International Aviation and Shipping | ✓ | ✓ |
| Includes Offshore Emissions | ✗ | ✗ |
| Data on individual greenhouse gases | ✓ | ✗ |
| Data on Scottish Government source sectors | ✓ | ✓ |
| Base Year | **1990** | **Baseline Period (Variable)** |

[1] Further information on Scotland's Climate Change Targets can be found in Section C.

[2] Data for EU countries include figures offshore emissions which cannot be broken down at present, so are not directly comparable with Scottish estimates. Comparable data for EU countries will not be available for the time of this release. Figures on offshore emissions are available at a UK level, but not for devolved administrations.

[3] Direct comparisons between Scotland and the UK can be made by adding up the results for the four Devolved Administrations separately. The UK figure in this case would exclude offshore emissions.

## Which greenhouse gases are reported on and how do they contribute to global warming?

The basket of greenhouse gases consists of carbon dioxide, methane, nitrous oxide, and the four F-gases (hydrofluorocarbons- HFCs, perfluorocarbons – PFCs, sulphur hexafluoride- $SF_6$ and nitrogen trifluoride- $NF_3$). These gases are weighted by global warming potential (GWP), so that total greenhouse gas emissions can be reported on a consistent basis. The GWP for each gas is defined as its warming influence relative to that of carbon dioxide over a 100 year period. Greenhouse gas emissions are then presented in *carbon dioxide equivalent* ($CO_2e$) units. In the case of some of the F-gases, the global warming potential is listed as being within a range of values, due to the gases existing as a variety of isotopes with differing GWPs.

## Table A1. List of Greenhouse Gases and their contribution to Scotland's net greenhouse gas emissions, 2013

| Name of Greenhouse Gas | Chemical Formula | Global Warming Potential (GWP) (Conversion factor to carbon dioxide equivalent) | Contribution to Scotland's Net Greenhouse Gas Emissions in 2013 (in $MtCO_2e$) | Percentage of Scotland's Net Greenhouse Gas Emissions in 2013 (in $MtCO_2e$) | Examples of sources of gas |
|---|---|---|---|---|---|
| **Carbon dioxide** | **$CO_2$** | **1** | **39.4** | **74.4%** | All other sources of greenhouse gases, including removals (carbon sinks) |
| **Methane** | **$CH_4$** | **25** | **7.9** | **14.9%** | Waste management, enteric fermentation and animal waste |
| **Nitrous oxide** | **$N_2O$** | **298** | **4.2** | **8.0%** | Agricultural soils |
| **F-gases** | | | **1.5** | **2.8%** | Industrial air conditioning, aluminium smelting, refrigeration, use as tracer gases, semiconductors |
| - *Hydrofluorocarbons* | **HFC** | 12 - 14,800 | 1.3 | 2.5% | |
| - *Perfluorocarbons* | **PFC** | 7,390 - 17,340 | 0.1 | 0.2% | |
| - *Sulphur hexafluoride* | **$SF_6$** | 22,800 | 0.0 | 0.1% | |
| - *Nitrogen trifluoride* | **$NF_3$** | 17,200 | 0.0 | 0.0% | |
| **Total Net Greenhouse Gases** | | | **53.0** | **100.0%** | |

The Global Warming Potentials (GWPs) are based on international reporting standards, as set by the Intergovernmental Panel on Climate Change (IPCC). For 1990-2013, the global

warming potentials (GWPs) used for each gas have been updated to those published in the IPCC's 4th Assessment Report, with a new F gas (Nitrogen trifluoride – $NF_3$) also being added to the inventory[2]. More information on these changes can be found in Section D of this publication.

Section B contains further data on the individual greenhouse gases. Section D contains a more detailed discussion of the causes and impacts of revisions between the 1990-2012 and 1990-2013 inventories.

## Reporting of the Baseline Period and 1990

In this publication, a single 1990 Base Year is used for all estimated source emissions (Section B). This year is referred to as "1990" in charts, tables and text.

A different baseline is used for reporting progress against Scotland's Climate Change Targets only. This is referred to as "Baseline Period" when referring to changes over time in the charts, tables and text in charts, tables and text.

The Baseline Period for reporting against Climate Change Targets is:

- 1990 for carbon dioxide carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$)
- 1995 for Fluorinated gases (F gases): hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride ($SF_6$), nitrogen trifluoride ($NF_3$)

Within this publication, data are estimated for the Baseline Period; and the years 1990, 1995 and 1998 to 2013.

## What are net emissions and carbon sinks?

The emissions reported are the combination of emissions minus removals from the atmosphere by *carbon sinks*. Carbon sinks are incorporated within the three sectors of agriculture and related land use, development, and forestry, which include emissions as well as removals resulting from afforestation, reforestation, deforestation and forest management together with changes in land use.

## Sectors

The sector breakdowns used in this report are primarily based on the National Communication (NC) sectors, which are used in the UK Greenhouse Gas Inventory. However, in order to associate emissions from conversion of grassland to and from cropland, and liming of agricultural land with other agricultural activities, we have

[2] IPCC's 4th Assessment Report: http://www.ipcc.ch/report/ar4/

generated three new sectors from the previous two sectors *Land Use, Land Use Change and Forestry* (LULUCF) and *Agriculture*. The first new sector, *Agriculture and Related Land Use,* includes all emissions in the NC sector Agriculture together with those LULUCF emissions associated with agricultural practices. The remaining LULUCF emissions are grouped into *Forestry* (changes in emissions relating mainly to stock changes resulting from afforestation, deforestation and harvested wood products) and *Development* (changes in emissions resulting from land use change to settlements). These new sectors are the same as those that were reported in the Scottish Government publication "Low Carbon Scotland - Meeting the Emissions Reductions Targets 2013-2027".

The Scottish Government also reports on International Aviation and Shipping emissions attributed to Scotland, along with other Transport emissions. International Aviation and Shipping emissions are categorised as an IPCC international "Memo" item. A detailed mapping between the sectors used in this report and the NC sectors and Intergovernmental Panel on Climate Change (IPCC) sectors is given in Section E.

This publication provides the latest estimates of Scotland's greenhouse gas emissions by source from 1990-2013. For the purposes of reporting, greenhouse gas emissions are allocated into sectors as follows:

Energy supply - Emissions from fuel combustion for electricity and other energy production sources, and fugitive emissions from fuels (such as from mining or oil and gas extraction activities).

Business and industrial processes - Emissions from industry and from those in combustion in industrial/commercial sectors, industrial off-road machinery, process sources from decarbonisation of raw materials (such as from limestone use in cement plants) and refrigeration and air conditioning.

Transport (including International Aviation and Shipping) - Emissions from domestic aviation, road transport, railways, domestic navigation, fishing and aircraft support vehicles. It also includes international aviation and shipping emissions attributed to Scotland.

Public Sector Buildings - Emissions from combustion of fuel in public sector buildings.

Residential - Emissions from fuel combustion for heating/cooking and garden machinery and fluorinated gases released from aerosols/metered dose inhalers.

Agriculture and Related Land Use - Net emissions from cropland, grassland along with net emissions from land converted to cropland and grassland. It also covers emissions from livestock, agricultural soils, stationary combustion sources and off-road machinery.

Development - Net emissions from settlements and from land converted to settlements.

Forestry - Changes in net emissions relating mainly to stock changes, resulting from afforestation, deforestation and harvested wood products.

Waste management - Emissions from waste disposed of to landfill sites, waste incineration, and the treatment of waste water.

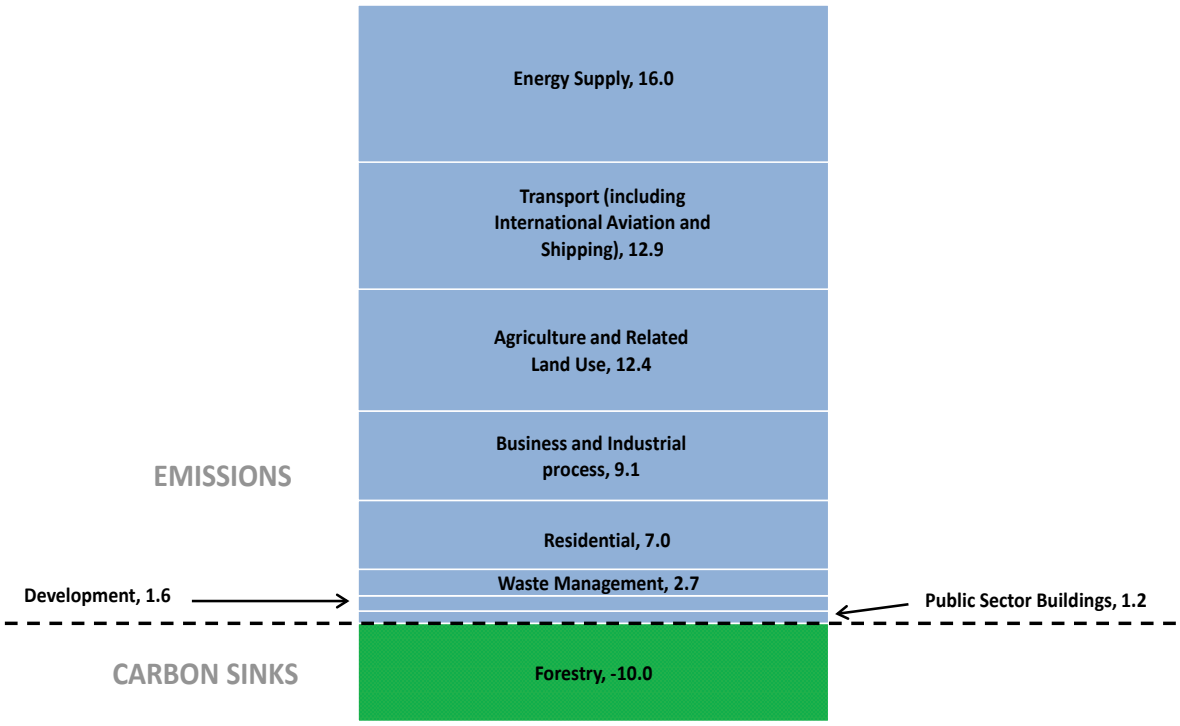
When emissions are reported by source, emissions are attributed to the sector that emits them directly. These high-level sectors are made up of a number of more detailed sectors, which follow the definitions set out by the Intergovernmental Panel on Climate Change (IPCC), and which are used in international reporting tables which are submitted to the United Nations Framework Convention on Climate Change (UNFCCC) every year. Section E contains a more detailed mapping of what is included in each source.

# Section B. Results – Net Sources of Scottish Greenhouse Gas Emissions

## 2013 figures

Chart B1 presents the sources and sinks of Scottish Greenhouse Gas Emissions in 2013, grouped by Scottish Government sector.

**Chart B1. Sources of Scottish Greenhouse Gas Emissions, 2013. Values in $MtCO_2e$**




## Main points

- In 2013, Energy supply was the largest source of net emissions (16.0 $MtCO_2e$), followed by Transport (including International Aviation and Shipping) (12.9 $MtCO_2e$ and Agriculture and Related Land Use (12.4 $MtCO_2e$). Emissions from the energy supply sector were greater than emissions from public sector buildings, development, waste management and residential sectors combined.
- Forestry was the only aggregate sector in which there has been a net emissions sink (-10.0 $MtCO_2e$).

## Table B1. Scottish Greenhouse Gas Emissions by Gas and by Scottish Government Source Sector, 2013. Values in $MtCO_2e$

| | TOTAL | *Percentage share* | Carbon dioxide | Methane | Nitrous oxide | Fluorinated gases |
|---|---|---|---|---|---|---|
| **TOTAL** | **53.0** | ***100.0%*** | **39.4** | **7.9** | **4.2** | **1.5** |
| Energy Supply | 16.0 | *30.2%* | 15.4 | 0.5 | 0.1 | 0.0 |
| Transport (including International Aviation and Shipping) | 12.9 | *24.4%* | 12.8 | 0.0 | 0.1 | 0.0 |
| *Transport (excluding IA&S)* | *10.5* | *19.9%* | *10.4* | *0.0* | *0.1* | *0.0* |
| *International Aviation and Shipping (IA&S)* | *2.4* | *4.5%* | *2.4* | *0.0* | *0.0* | *0.0* |
| Agriculture and related land use | 12.4 | *23.4%* | 4.0 | 4.7 | 3.7 | 0.0 |
| Business and Industrial process | 9.1 | *17.2%* | 7.7 | 0.0 | 0.1 | 1.3 |
| Residential | 7.0 | *13.2%* | 6.7 | 0.1 | 0.0 | 0.2 |
| Waste Management | 2.7 | *5.1%* | 0.0 | 2.6 | 0.1 | 0.0 |
| Development | 1.6 | *2.9%* | 1.5 | 0.0 | 0.1 | 0.0 |
| Public Sector Buildings | 1.2 | *2.3%* | 1.2 | 0.0 | 0.0 | 0.0 |
| Forestry | -10.0 | *-18.9%* | -10.0 | 0.0 | 0.0 | 0.0 |

## Main points

Carbon dioxide was the main greenhouse gas emitted or removed in most sectors, with the exceptions of the Agriculture and Related Land Use and Waste Management sectors.

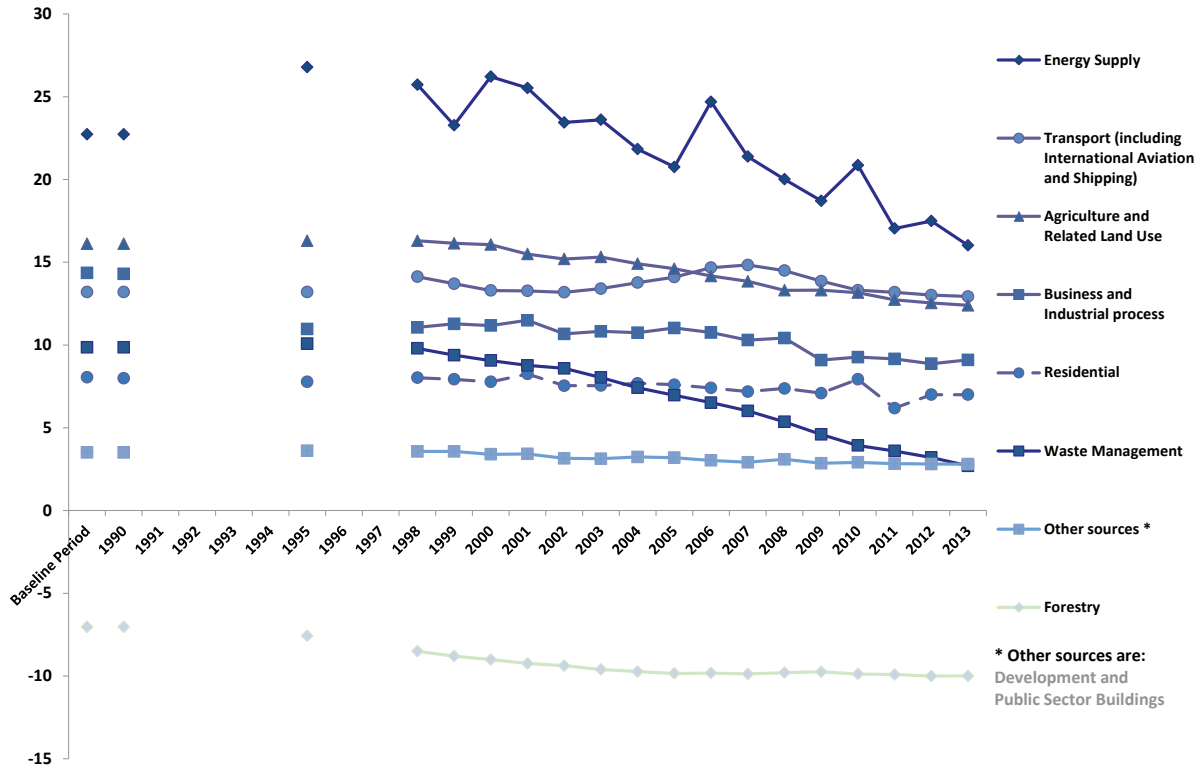
- Methane was the main net gas emitted in the Agriculture and Related Land Use sector (4.7 $MtCO_2e$), followed by carbon dioxide (4.0 MtCOe) and nitrous oxide (3.7 $MtCO_2e$).
- Almost all emissions in the Waste Management sector were emitted in the form of methane (2.6 $MtCO_2e$)

Where F gases are emitted, they have been in relatively small amounts via the Business and Industrial Process source sector, as well as in the Residential sector.

## Key Trends By Scottish Government Source Sector

Chart B2 presents the main sources of Scottish Greenhouse Gas Emissions in Scotland from 1990 to 2013, broken down by Scottish Government source sector. Note that for the purposes of presentation, some sectors have been grouped together on this chart. Chart B3 and Chart B4 specifically explore the trend in Energy Supply emissions. Chart B5 contains information on the absolute and percentage reductions in greenhouse gas emissions in every Scottish source sector over the entire time period, with Chart B6 containing the same information for the latest year.

**Chart B2. Main Sources of Greenhouse Gas Emissions in Scotland, 1990 to 2013. Values in $MtCO_2e$**




## Main Points

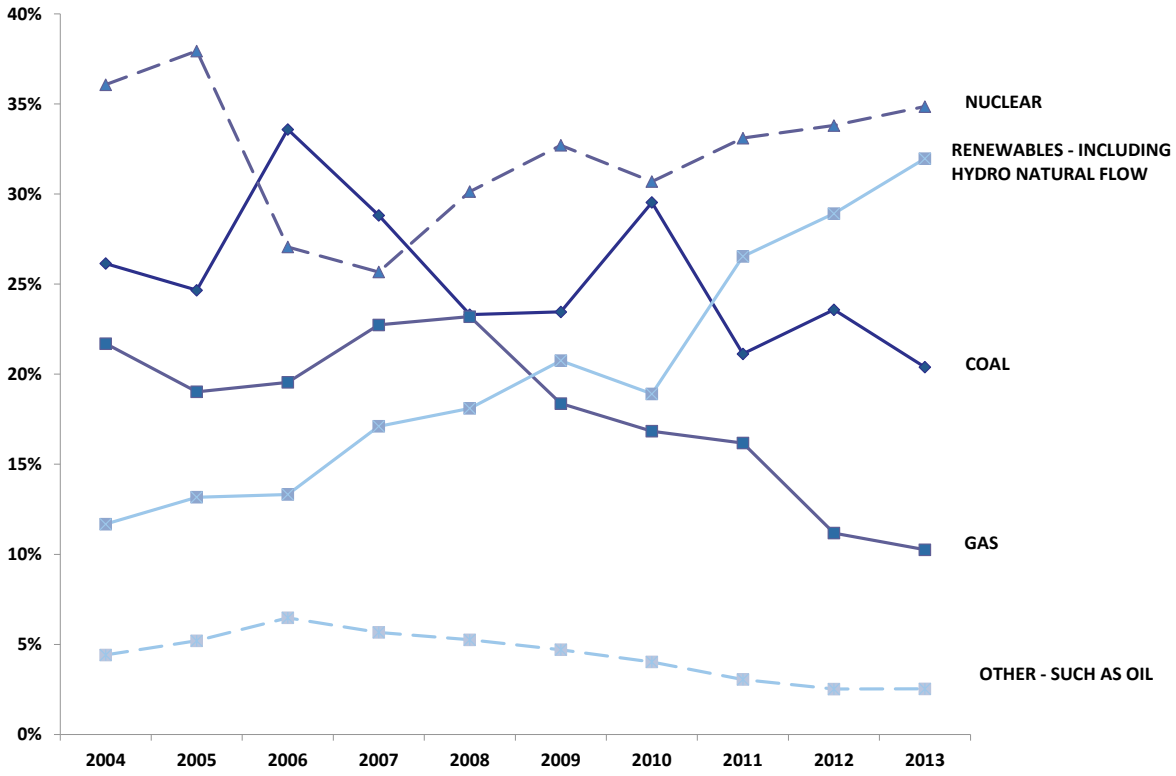
Most sectors exhibit a general downward trend between 1990 and 2013, most clearly evident since 1998.

- In all years, energy supply is the main source of greenhouse gas emissions. The chart shows that energy supply is a very volatile sector, which is linked to the ambient temperature, particularly during the winter months; and fuel used for electricity production, which in turn is largely driven by the price of coal relative to "cleaner" fuels. Charts B3 and B4 demonstrate these effects in more detail.

- Much of the fall in emissions from the Business and Industrial Process sector has occurred between 1990 and 1995. This has been driven by a decline in emissions from manufacturing and the iron and steel industry over this time period.
- Net emissions from the agriculture and related land use sector have seen a gradual decline between 1998 and 2013, which can be linked to a decline in cattle and sheep numbers, as well as from the impact of historic changes in land use change to cropland and grassland.
- Emissions from transport (including international aviation and shipping) have seen a small overall reduction between 1990 and 2013. Emissions in this sector rose to a peak in 2007, before falling slightly. The recent falls in emissions have been as a result of a number of factors and has been largely caused by changes in emissions from cars. As well as reflecting improvements in car energy efficiency, road transport emissions have been affected by changes in the make-up of the passenger car fleet, with an increase in more fuel efficient diesel engines compared with petrol vehicles.
- Waste management emissions have fallen between 1998 and 2013. This is due to the progressive introduction of landfill gas being captured and used for energy. There could also be other factors which are contributing to this reduction such as improvements in the standards of landfill sites and changes to the types of waste going to landfill.
- The size of the net carbon sink from forestry has increased between 1990 to 2005, before remaining broadly constant in more recent years. This is partly because over the rate of afforestation has decreased over the last 40 years. In addition, conifer plantations, which were established in the mid-20th century, reached their planned rotation age and are now being felled and replanted – leading a fairly constant level of carbon sequestration in recent years.

Chart B3 shows that the generation of Scotland's electricity changes over time. Emissions from the electricity supply sector (such as power stations) are associated with these changes.

**Chart B3. Generation of Electricity by Fuel, Scotland, 2004 to 2013. Percentage of Electricity Generated by Year**




Data obtained from DECC Energy Trends, published December 2014[3]

## Main Points

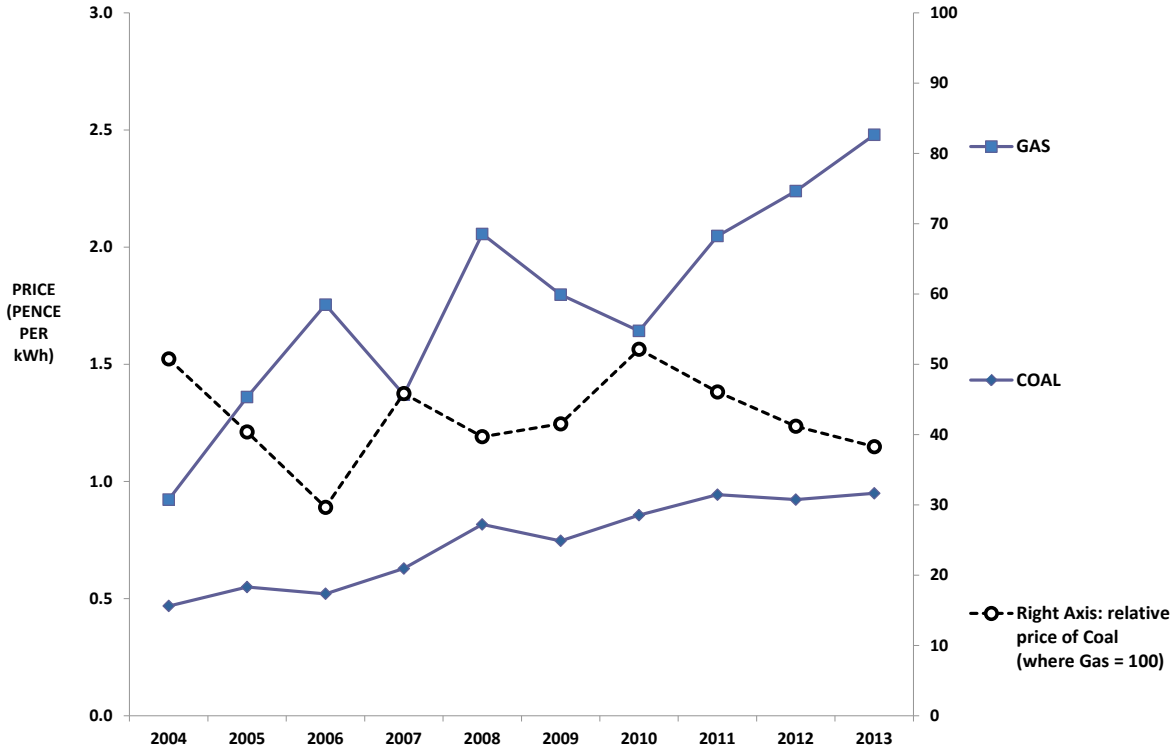
- There was a decrease between 2012 and 2013 in the percentage of gas being used for Scotland's electricity mix (from 11.2 per cent to 10.3 per cent). This continues the decline in the relative share of gas from 2006 onwards.
- There was also a decrease in the percentage of coal being used for the generation of electricity between 2012 and 2013 (from 23.6 per cent to 20.4 per cent). This is likely to be as result of the closure of a coal fired power station in 2013. Overall, there has been a relative decrease in the relative share of coal since 2006, although this series is volatile, with 29.5 per cent of Scottish electricity supply being fuelled by coal in 2010.
- The relative share of nuclear energy in Scotland's electricity supply is higher than other sources of energy at 34.9 per cent. This percentage share has increased from 2007, when nuclear energy represented 25.7 per cent of Scotland's electricity supply.

[3] https://www.gov.uk/government/statistics/energy-trends-december-2014-special-feature-article-electricity-generation-and-supply-figures-for-scotland-wales-northern-ireland-and-england-2

- The renewables sector (including hydro natural flow) has seen an overall increase from 11.7 per cent in 2004 to 32.0 per cent in 2013, and the rate of this increase has been greatest between 2010 and 2013.

Chart B4 shows the gas and coal prices for large users in the UK. The use of coal rather than gas in electricity generation can be sourced to these price effects in many cases.

**Chart B4. Gas and Coal Prices for Large Users in the UK (2004 to 2013) – pence per kWh**



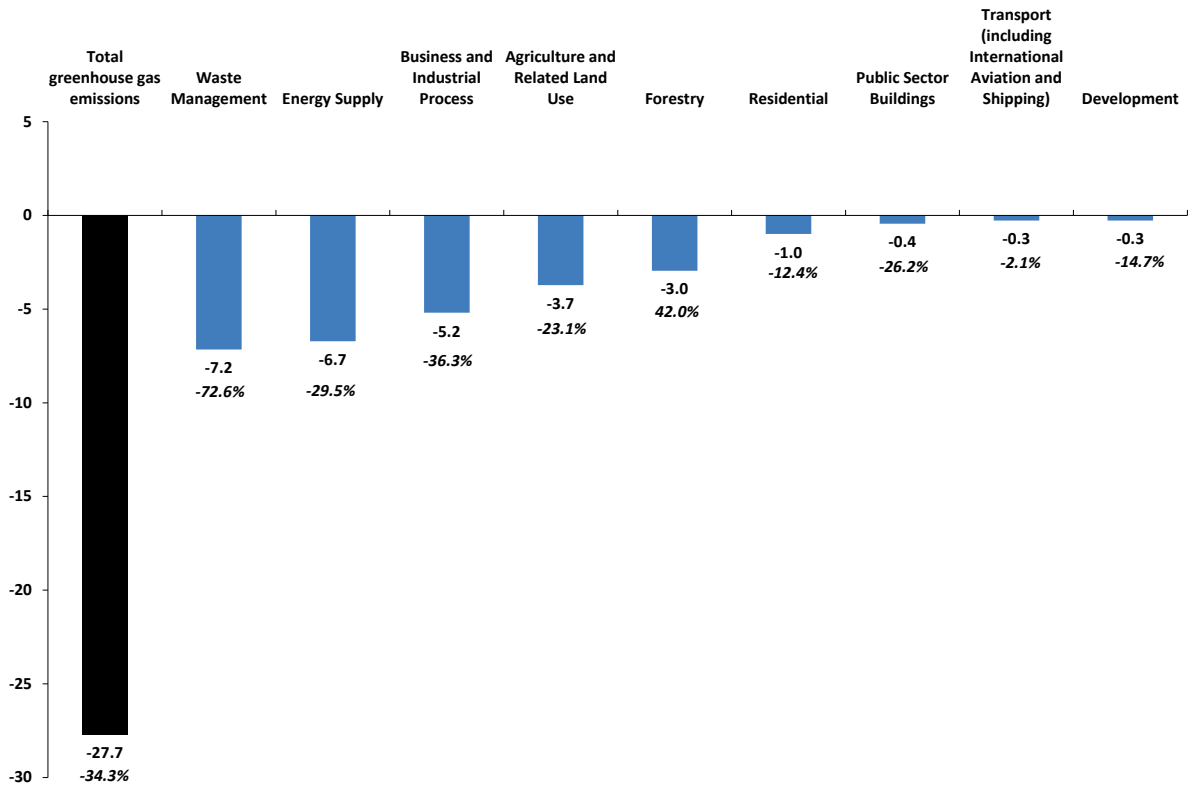

Data obtained from DECC: Digest of UK Energy Statistics[4]

[4] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/295522/qep314.xls

## Long term (1990 to 2013) and short term (2012 to 2013) trends by sector

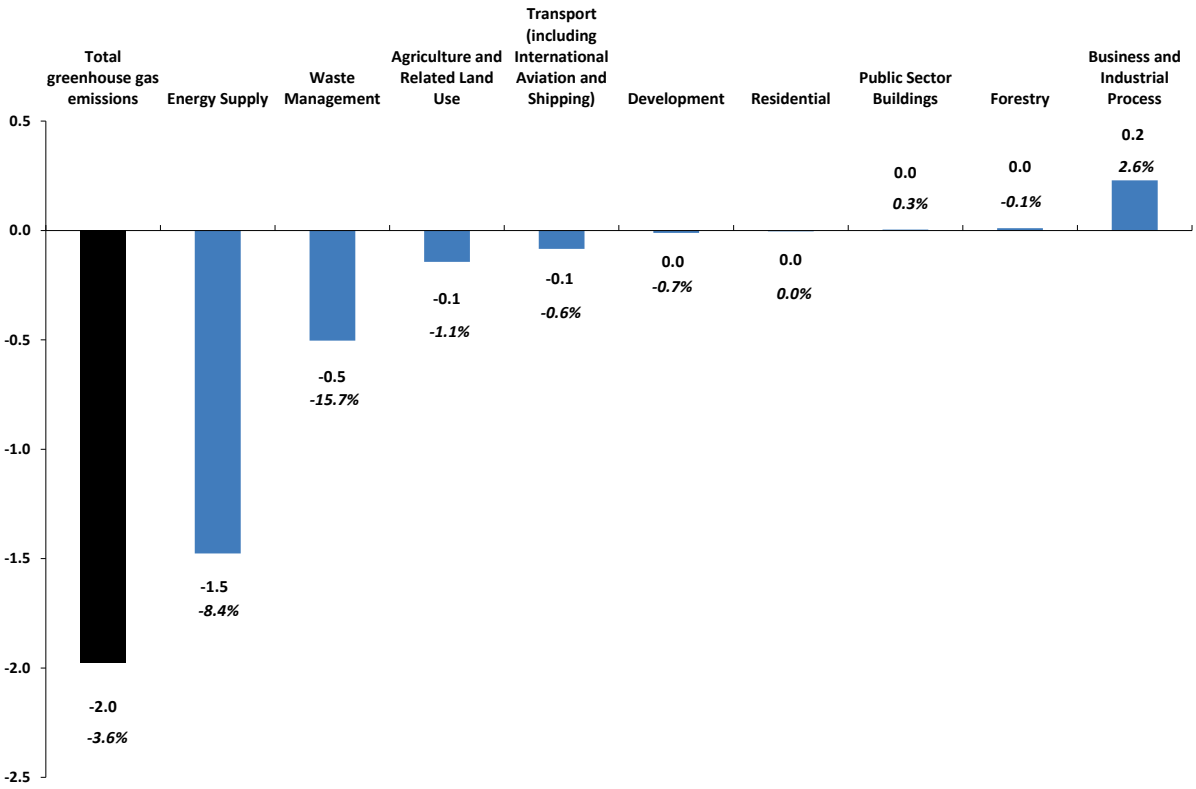
Chart B5 shows how emissions have changed between 1990 and 2013 in all source sectors and chart B6 shows how emissions have changed between 2012 and 2013.

### Chart B5. Change in Net Emissions by Scottish Government Sector Between 1990 and 2013 – in $MtCO_2e$, *and percentage changes* [5]




[5] Unlike for other source sectors, downward changes to net emissions from forestry are presented as a positive percentage change. This is because forestry causes a net removal of emissions

**Chart B6. Change in Net Emissions by Scottish Government Sector between 2012 and 2013 - in $MtCO_2e$, *and percentage changes* [6]**




## Total Emissions

Overall, there has been a 27.7 $MtCO_2e$ (34.3 per cent) decrease in net emissions between 1990 and 2013 and there has been a 2.0 $MtCO_2e$ (3.6 per cent) decrease in net emissions between 2012 and 2013.

## Energy Supply

This sector has seen a 6.7 $MtCO_2e$ (29.5 per cent) fall in emissions between 1990 and 2013 – the second largest absolute fall of any sector. The Energy Supply sector saw the largest absolute decrease of any sector between 2012 and 2013 - a 1.5 $MtCO_2e$ (8.4 per cent) decrease. Charts B2 to B4 shows that this series is very volatile and this is largely driven by changes in the fuel mix for electricity production. The fall in energy supply emissions between 2012 and 2013 is likely to be as result of the closure of a coal fired power station in 2013. In addition to the fall in emissions from power stations, there has also been a much smaller fall in refinery emissions between 2012 and 2013, and a slight increase in emissions from flaring of oil.

[6] Unlike for other source sectors, downward changes to net emissions from forestry are presented as a positive percentage change. This is because forestry causes a net removal of emissions

## Waste Management

This sector has seen a 7.2 $MtCO_2e$ (72.6 per cent) fall in emissions between 1990 and 2013 – the biggest absolute and percentage fall of any sector over this time period. This is due to the progressive introduction of landfill gas being captured and used for energy. There could also be other factors which contribute to this reduction, such as improvements in the standards of landfill and changes to the types of waste going to landfill. Between 2012 and 2013, the Waste Management sector saw a fall of 0.5 $MtCO_2e$ (15.7 per cent), which is the largest percentage decline of any sector over this time period.

## Business and Industrial Process

This sector has seen a 5.2 $MtCO_2e$ (36.3 per cent) fall in emissions between 1990 and 2013. As shown in Chart B2, much of this decrease occurred between 1990 and 1995 – linked to a decline in emissions from manufacturing and the iron and steel industry over this time period. There has been a further smaller decrease between 2008 and 2009, coinciding with the recession, with figures being more level in recent years. There was a small net increase (0.2 $MtCO_2e$; 2.6 per cent) in emissions in this sector between 2012 and 2013. There have been small fluctuations in emissions from this sector since 2009. The increase in emissions in the latest year appears to be caused by increases in emissions from gas combustion in private businesses and from combustion in the chemicals and food and drinks industries.

## Agriculture and Related Land Use

This sector has seen a 3.7 $MtCO_2e$ (23.1 per cent) fall in net emissions between 1990 and 2013. This has been driven by a fall in emissions of carbon dioxide (Chart B9), methane (Chart B10) and nitrous oxide (Chart B11).

The fall in carbon dioxide emissions from the agriculture and related land use sector has partly been due to the effects of historic land use changes. For instance, there have been changes in the area of land being converted from other uses to cropland. Between 1990 to 2013, the rate at which land has been converted to cropland has fallen, with more land now remaining as cropland. The process of land being converted to cropland releases carbon dioxide; over time, this process gradually emits less carbon dioxide.

Methane emissions from agriculture have fallen from 1990 to 2013 due to a decline in cattle and sheep numbers – with a corresponding fall in emissions from enteric fermentation and animal wastes. Nitrous oxide emissions have also fallen due to improvements in practices on agricultural soils and a decline in livestock numbers.

Between 2012 and 2013, there was a 0.1 $MtCO_2e$ (1.1 per cent) decrease in net emissions of overall greenhouse gases from this sector. This has been due to a continued reduction in emissions from land being converted to cropland and an increase in the net greenhouse gas sink from grasslands. There has been a slight increase in emissions from agricultural soils in the latest year – despite a general downward trend over time. This is due to increased use of nitrogenous fertilisers.

## Forestry

This sector has seen a 3.0 $MtCO_2e$ (42.0 per cent) increase in its carbon sink between 1990 and 2013. The majority of the sink arises from the large area of conifer plantations in Scotland, which is subject to forest management such as thinning and harvesting. The increase in the carbon sink has been because of an increase in the area of forest land over this time period, although the area of land being converted to forest from other land uses has been decreasing over time.

The carbon sequestration from forestry increased between 1990 and 2005. However, over the last 40 years the rate of afforestation has decreased. Combined with conifer plantations established in the mid-20th century reaching their planned rotation age now being felled and replanted, this has resulted in the size of this annual sink remaining relatively constant in recent years. Between 2012 and 2013, there was very little change in the size of the carbon sink from forestry.

## Transport (Including International Aviation and Shipping)

Between 1990 and 2013, emissions from transport (including international aviation and shipping) fell slightly. Chart B2 shows that emissions rose to a peak in 2007, before falling slightly. This slight fall in recent years has been largely caused by changes in road transport emissions. As well as reflecting improvements in car energy efficiency, road transport emissions have been affected by changes in the make-up of the passenger car fleet, with an increase in more fuel efficient diesel engines compared with petrol vehicles. Up to 2007, there was a large increase in car vehicle kilometres travelled. Since 2007, there has been a small drop (around 2 per cent) in car vehicle kilometres travelled, although there has been a very slight increase in the years since 2011 [7].

Breaking transport emissions down further, between 1990 and 2013, there was a 1.0 per cent decrease in transport emissions (excluding international aviation and shipping) and a 6.4 per cent decrease in emissions from international aviation and shipping. International aviation emissions have more than doubled between 1990 and 2013 (from 0.5 $MtCO_2e$ to 1.1 $MtCO_2e$). This reflects the growth in aviation and the increase in international routes at airports. Emissions from international shipping have fallen by 36.9 per cent between 1990 and 2013 (from 2.0 $MtCO_2e$ to 1.3 $MtCO_2e$). This is primarily due to a decrease in Scotland's port freight movements.

In the latest year, there was a 0.1 $MtCO_2e$ decrease in emissions from transport (excluding international aviation and shipping). There has been a slight decrease in emissions from cars between 2012 and 2013. This decrease has been partly offset by an increase in emissions from light goods vehicles and to a lesser extent, heavy goods vehicles.

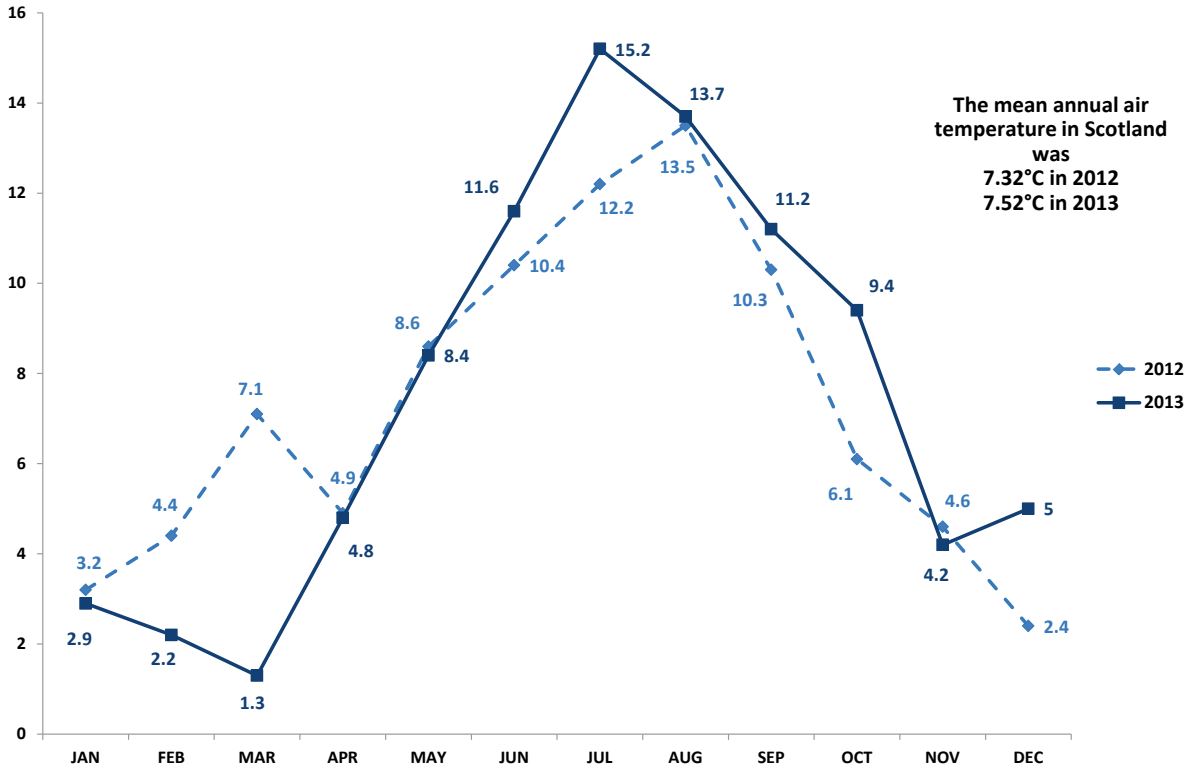
[7] Scottish Transport Statistics 2013: http://www.transportscotland.gov.uk/statistics/scottish-transport-statistics-no-33-datasets-6495

There was a 3.9 per cent increase in emissions from international aviation and a 2.8 per cent decrease in international shipping between 2012 and 2013. It should be noted that the data series for international shipping is particularly volatile.

## Residential

This sector has seen a 1.0 $MtCO_2e$ (12.4 per cent) fall in emissions between 1990 and 2013. Between 2012 and 2013, there was little change in emissions in this sector. Residential emissions are partly generated by space-heating homes and thus are related to external temperatures. Mean annual temperatures in 2013 were 0.2°C higher than in 2012[8]. Chart B7 shows that the summer and early autumn of 2013 was warmer than the equivalent period in 2012. However, the period from January to March 2013 was comparatively colder than the same period in 2012. As a result of this relationship to external temperatures, residential emissions can exhibit some large annual fluctuations.

**Chart B7. Mean air temperature by month, Scotland. 2012 and 2013. Values in °C**




Data obtained from Met Office, May 2015 [9]

[8] Source Met Office: http://www.metoffice.gov.uk/pub/data/weather/uk/climate/datasets/Tmean/date/Scotland.txt

[9] Source Met Office: http://www.metoffice.gov.uk/pub/data/weather/uk/climate/datasets/Tmean/date/Scotland.txt

## Public Sector Buildings

This sector contributes a small proportion of Scotland's net greenhouse gas emissions. The main source of emissions from this sector is the use of natural gas for heating public buildings. There was a 0.4 $MtCO_2e$ (26.2 per cent) fall in emissions from public sector buildings between 1990 and 2013. This has been largely driven by a reduction in the use of oil and coal. Between 2012 and 2013, there was little change in emissions from this sector.

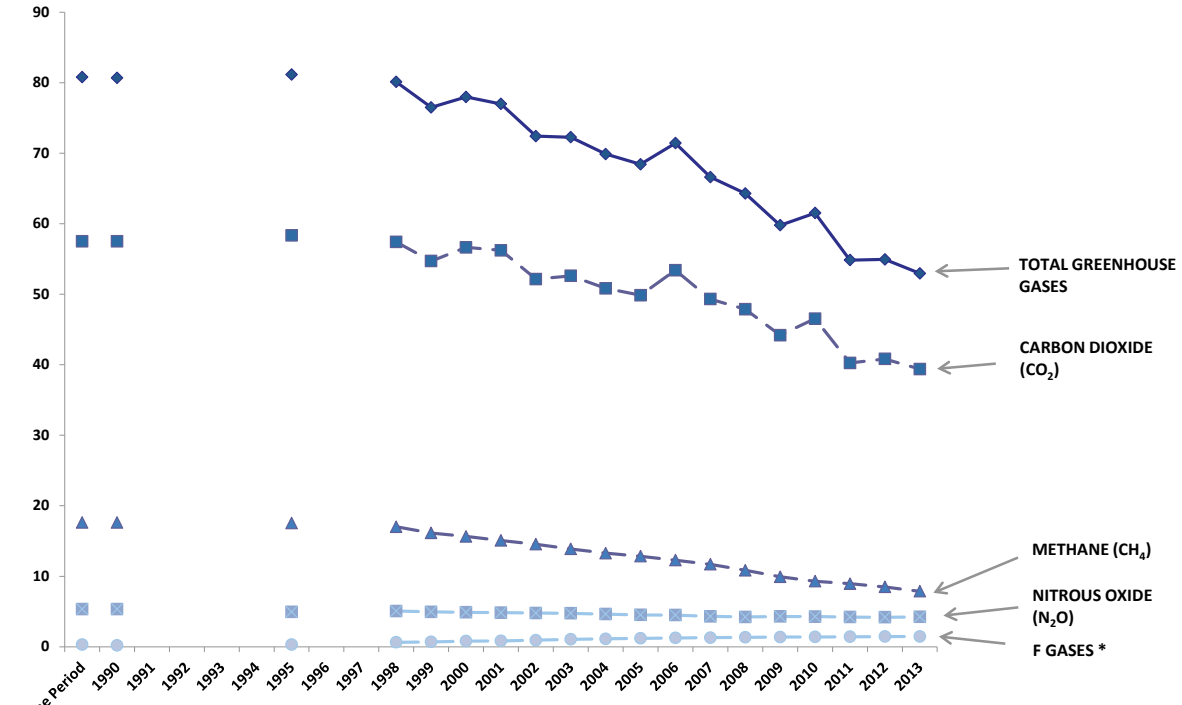
## Development Emissions

This sector contributes to a small proportion of Scotland's net greenhouse gas emissions. There was a 0.3 $MtCO_2e$ (14.7 per cent) decrease in development emissions between 1990 and 2013. Between 2012 and 2013, there was very little change in emissions from this sector.

# Emissions by type of gas

Chart B8 shows the trends in emissions, broken down by gas from 1990 to 2013.

**Chart B8. Scottish Greenhouse Gas Emissions, by Gas, 1990-2013. Values in $MtCO_2e$**




* F GASES (FLUORINATED GASES) are HYDROFLUOROCARBONS (HFCs), PERFLUOROCARBONS (PFCs), SULPHUR HEXAFLUORIDE ($SF_6$) and NITROGEN TRIFLUORIDE ($NF_3$)

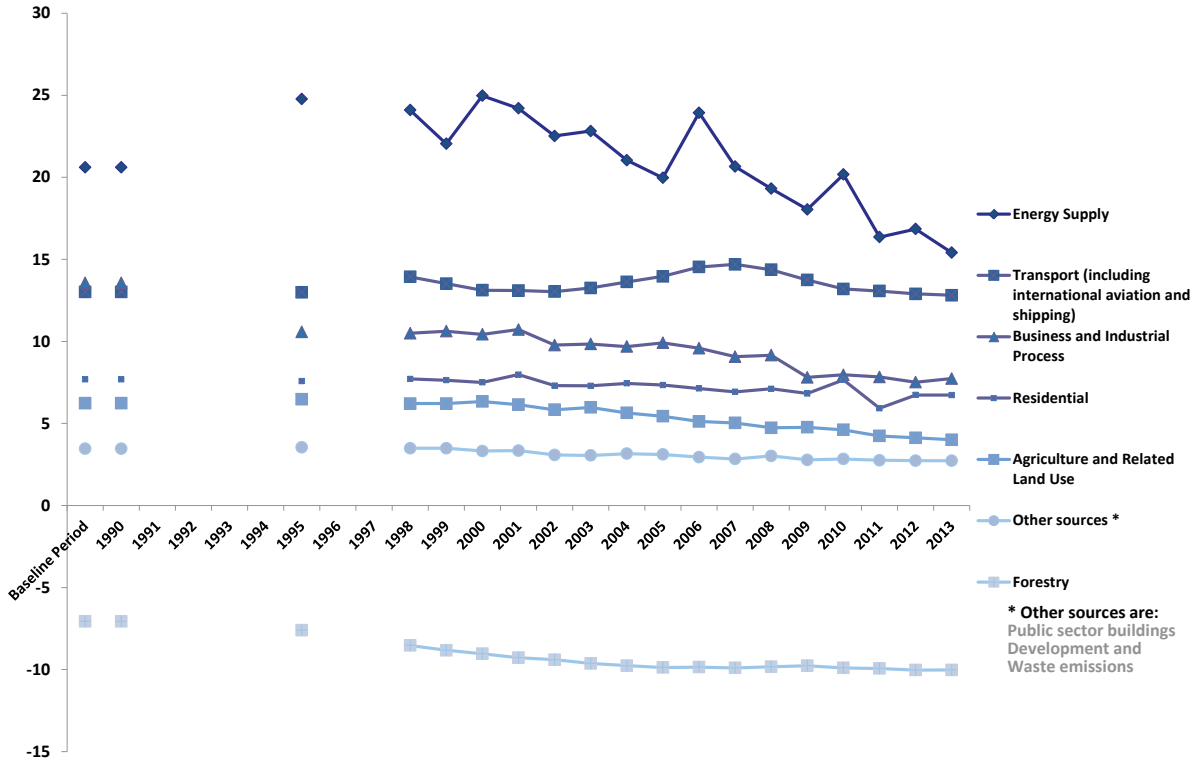
## Main Points

- Carbon dioxide is by far the largest contributor of Scottish greenhouse gas emissions in all years (74.4 per cent of all emissions in 2013) and is the most volatile series of all gases – largely driven by changes in energy supply emissions and to a lesser extent, emissions from the residential and business and industrial process sectors.
- Methane in the second most common greenhouse gas in 2013 (14.9 per cent of all net emissions) followed by nitrous oxide (8.0 per cent) and F-gases making up the remainder (2.8 per cent).
- Methane has seen the largest percentage reduction from 1990 to 2013 (55.4 per cent), which have been largely driven by a reduction in waste management emissions. There have also been percentage reductions for both carbon dioxide (31.5 per cent) and nitrous oxide (20.7 per cent). Emissions from fluorinated gases have shown a 6-fold increase from 1990 to 2013 and this increase is driven by the introduction of hydrofluourocarbons (HFCs) from 1995 onwards. These HFCs replace chlorofluorocarbons (CFCs) which were banned by the Montreal Protocol due to their impact on the ozone layer.

Charts B9 to B12 present results on individual gases broken down by main Scottish government sector over time. Table B3 contains figures on all greenhouse gas emissions across the time series. Chart B9 shows how carbon dioxide emissions have changed from 1990 to 2013.

## Carbon Dioxide ($CO_2$)

### Chart B9. Carbon Dioxide ($CO_2$) Emissions by Scottish Government Sector, 1990 to 2013. Values in $MtCO_2e$

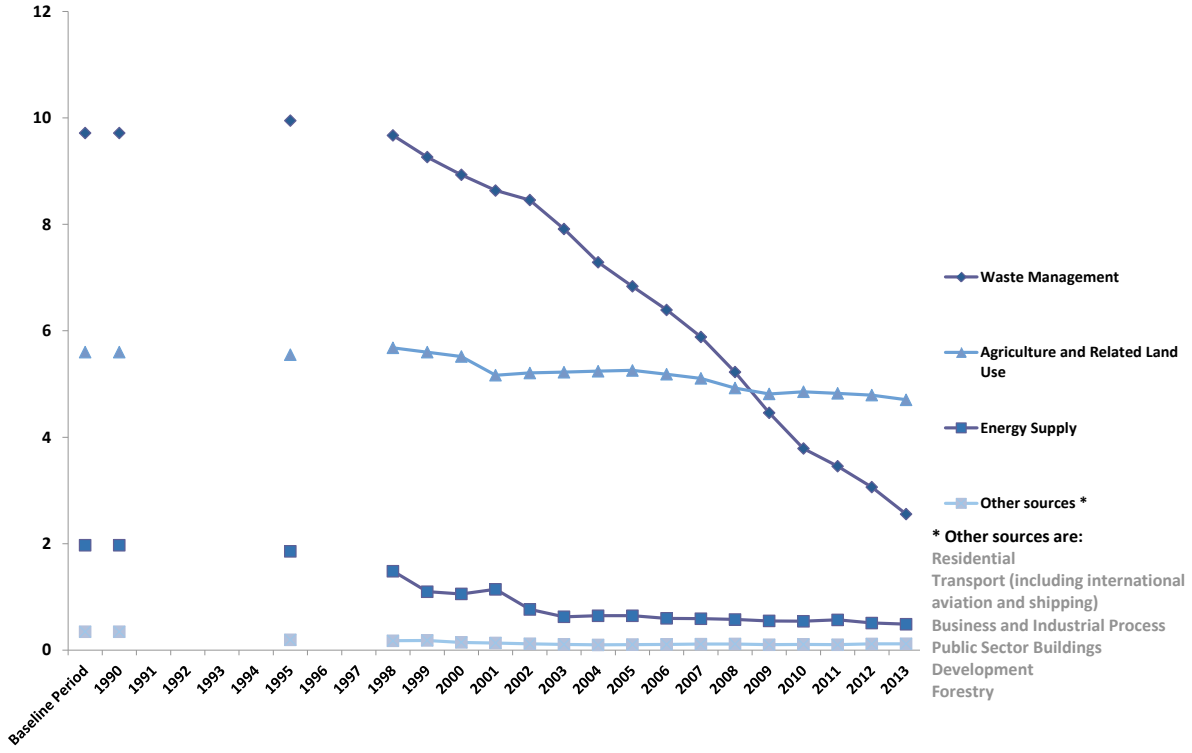



## Main Points

- Chart B9 shows that energy supply is the key source of carbon dioxide emissions in all years between 1990 and 2013. Transport (including international aviation and shipping) is the next most common source of carbon dioxide emission in all years apart from 1990.
- Much of the decrease in carbon dioxide emissions between 1990 and 2013 has been driven by overall falls in the energy supply sector across the time period and in business and industrial processes between 1990 and 1995. Carbon dioxide emissions from the energy supply sector have been quite volatile over the time period, with the highest emissions occurring between 1995 and 2003, and a spike in 2006, related to a greater use of coal in that year.
- The agriculture and related land use sector has also seen a fall in net emissions in carbon dioxide – largely due to changes in land uses
- Forestry has been a net sink of carbon dioxide consistently between 1990 and 2013.

## Methane ($CH_4$)

### Chart B10. Methane ($CH_4$) Emissions by Scottish Government Sector, 1990 to 2013. Values in $MtCO_2e$

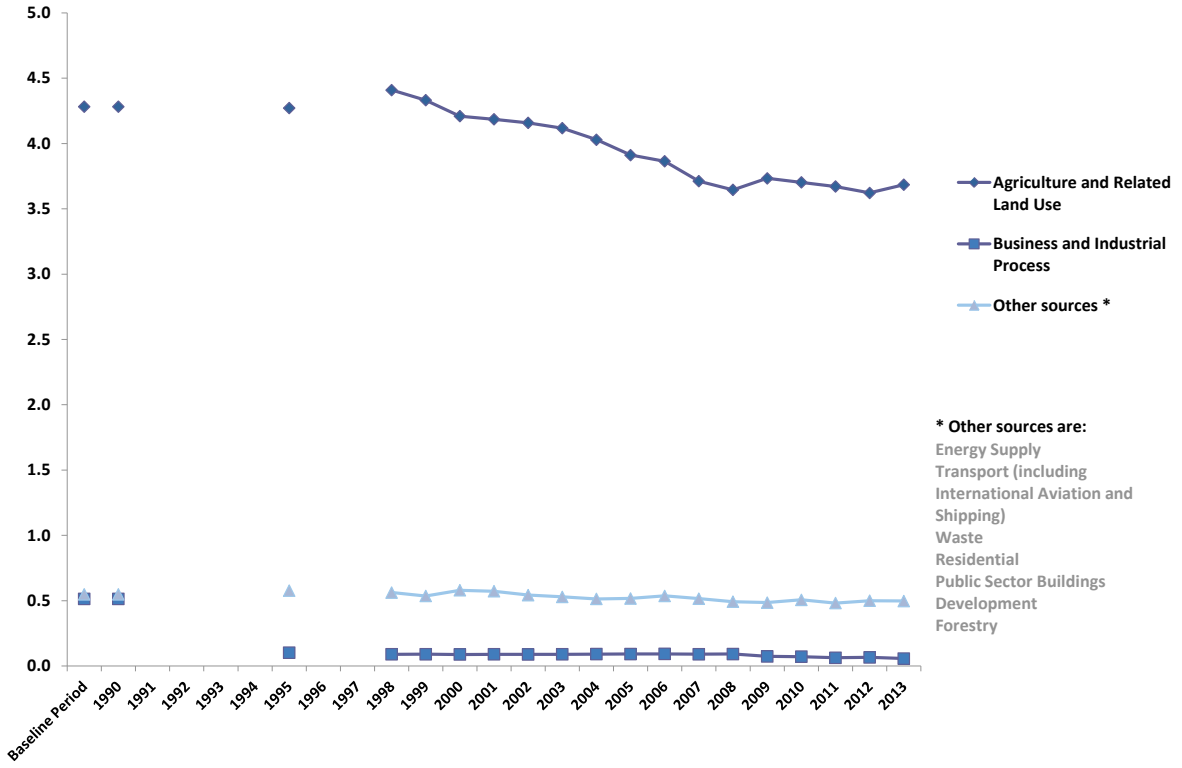



## Main Points

- Methane emissions from waste management have fallen from 9.7 $MtCO_2e$ in 1990 to 2.6 $MtCO_2e$ in 2013 (a 73.7 per cent reduction). This is due to the progressive introduction of landfill gas being captured and used for energy. There could also be other factors which contribute to this reduction, such as improvements in the standards of landfill and changes to the types of waste going to landfill.
- Methane emissions in the agriculture and related land use sector have fallen from 5.6 $MtCO_2e$ in 1990 to 4.7 $MtCO_2e$ in 2013 – a 16.0 per cent fall over this time period. This reduction is partly linked to a fall in livestock.
- In the Energy Supply sector, methane emissions have fallen from 2.0 $MtCO_2e$ in 1990 to 0.5 $MtCO_2e$ in 2013, largely due to reductions in emissions from sources such as coal mining.

## Nitrous Oxide ($N_2O$)

**Chart B11. Nitrous Oxide ($N_2O$) Emissions by Scottish Government Sector, 1990 to 2013. Values in $MtCO_2e$**

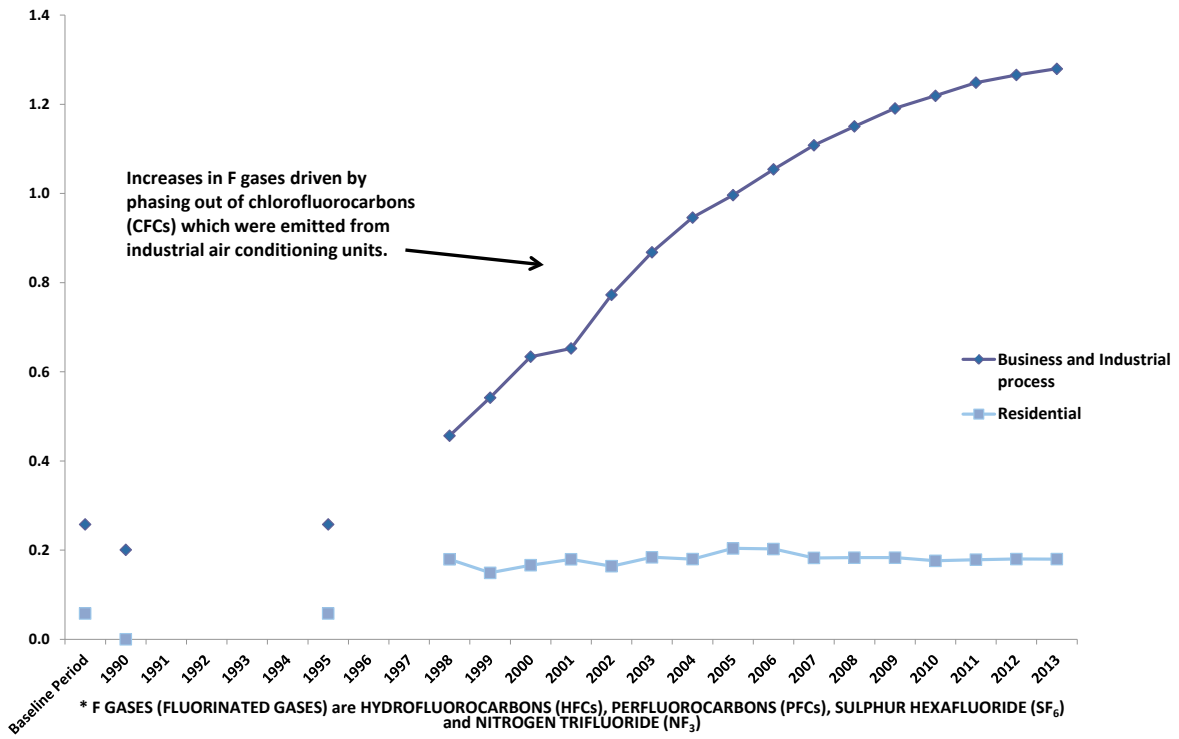



## Main Points

- Agriculture and related land use is by far the main contributor to emissions of nitrous oxide. These are largely produced by agricultural practices on soils, and to a lesser extent animal manures. Emissions of nitrous oxide in this sector have fallen from 4.3 $MtCO_2e$ in 1990 to 3.7 $MtCO_2e$ in 2013. This has been due to improvements in practices in agricultural soils and there has also been a decline in livestock numbers. There has been a slight increase in emissions from agricultural soils in the latest year. This is due to increased use of nitrogenous fertilisers.
- Emissions of nitrous oxide in the business and industrial process sector have fallen from 0.5 $MtCO_2e$ in 1990 to 0.1 $MtCO_2e$ in 2013.

## Fluorinated gases (F-gases)

**Chart B12. F-gas Emissions by Scottish Government Sector, 1990 to 2013. Values in $MtCO_2e$**




## Main Points

- F gas are the most potent greenhouse gases with high global warming potentials but they are emitted in very small quantities. As a result, they contribute less to global warming than the other greenhouse gases in Scotland. Nitrogen trifluoride was added to the basket of greenhouse gases for the 1990-2013 inventory – it represents a very small source of greenhouse gas emissions across the time series (0.0 $MtCO_2e$ in all years)
- There has been a sharp increase in F gas emissions from business and industrial processes from 1990 and 2013 (from 0.2 $MtCO_2e$ in 1990 to 1.3 $MtCO_2e$ in 2013), although the year-on-year rate of increase is slowing in recent years. This is because F gases were introduced to replace chlorofluorocarbons (CFCs), which were used in appliances such as industrial air conditioning units. CFCs were banned under the Montreal Protocol, as they were contributing to the depletion of the ozone layer.
- F gas emissions in the residential sector are caused by the use of aerosols and asthma inhalers, and represent between 0.16 and 0.20 $MtCO_2e$ between in the years between 1998 and 2013.

## Table B2. Greenhouse Gas Emissions in Scotland by source sector: 1990 to 2013. Values in $MtCO_2e$

| Source Sector | Baseline Period | 1990 | | 1995 | | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | Change between 1990 and 2013 | *% change between 1990 and 2013* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total greenhouse gas emissions** | **80.8** | **80.7** | | **81.2** | | **80.1** | **76.5** | **78.0** | **77.0** | **72.4** | **72.3** | **69.9** | **68.4** | **71.4** | **66.6** | **64.3** | **59.8** | **61.5** | **54.8** | **54.9** | **53.0** | **-27.7** | ***-34.3%*** |
| Energy Supply | 22.7 | 22.7 | | 26.8 | | 25.7 | 23.3 | 26.2 | 25.5 | 23.5 | 23.6 | 21.8 | 20.8 | 24.7 | 21.4 | 20.0 | 18.7 | 20.9 | 17.0 | 17.5 | 16.0 | -6.7 | *-29.5%* |
| Transport (including International Aviation and Shipping) | 13.2 | 13.2 | | 13.2 | | 14.1 | 13.7 | 13.3 | 13.3 | 13.2 | 13.4 | 13.8 | 14.1 | 14.7 | 14.8 | 14.5 | 13.9 | 13.3 | 13.2 | 13.0 | 12.9 | -0.3 | *-2.1%* |
| Excluding IA&S | 10.6 | 10.6 | | 10.6 | | 11.0 | 11.1 | 10.9 | 10.9 | 11.2 | 11.2 | 11.3 | 11.5 | 11.7 | 11.9 | 11.4 | 11.0 | 10.8 | 10.6 | 10.6 | 10.5 | -0.1 | *-1.0%* |
| International Aviation and Shipping (IA&S) | 2.6 | 2.6 | | 2.6 | | 3.1 | 2.6 | 2.4 | 2.4 | 2.0 | 2.2 | 2.4 | 2.6 | 3.0 | 3.0 | 3.1 | 2.9 | 2.5 | 2.6 | 2.4 | 2.4 | -0.2 | *-6.4%* |
| Agriculture and Related land Use | 16.1 | 16.1 | | 16.3 | | 16.3 | 16.1 | 16.1 | 15.5 | 15.2 | 15.3 | 14.9 | 14.6 | 14.2 | 13.8 | 13.3 | 13.3 | 13.2 | 12.7 | 12.5 | 12.4 | -3.7 | *-23.1%* |
| Business and Industrial process | 14.4 | 14.3 | | 11.0 | | 11.1 | 11.3 | 11.2 | 11.5 | 10.7 | 10.8 | 10.7 | 11.0 | 10.8 | 10.3 | 10.4 | 9.1 | 9.3 | 9.2 | 8.9 | 9.1 | -5.2 | *-36.3%* |
| Residential | 8.0 | 8.0 | | 7.8 | | 8.0 | 7.9 | 7.8 | 8.3 | 7.5 | 7.5 | 7.7 | 7.6 | 7.4 | 7.2 | 7.4 | 7.1 | 7.9 | 6.2 | 7.0 | 7.0 | -1.0 | *-12.4%* |
| Waste Management | 9.9 | 9.9 | | 10.1 | | 9.8 | 9.4 | 9.1 | 8.8 | 8.6 | 8.0 | 7.4 | 7.0 | 6.5 | 6.0 | 5.4 | 4.6 | 3.9 | 3.6 | 3.2 | 2.7 | -7.2 | *-72.6%* |
| Other sources * | 3.5 | 3.5 | | 3.6 | | 3.6 | 3.6 | 3.4 | 3.4 | 3.2 | 3.1 | 3.2 | 3.2 | 3.0 | 2.9 | 3.1 | 2.9 | 2.9 | 2.8 | 2.8 | 2.8 | -0.7 | *-20.2%* |
| Development | 1.8 | 1.8 | | 1.8 | | 1.8 | 1.8 | 1.8 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | -0.3 | *-14.7%* |
| Public Sector Buildings | 1.7 | 1.7 | | 1.8 | | 1.8 | 1.8 | 1.6 | 1.7 | 1.4 | 1.4 | 1.6 | 1.5 | 1.4 | 1.3 | 1.5 | 1.3 | 1.3 | 1.2 | 1.2 | 1.2 | -0.4 | *-26.2%* |
| Forestry | -7.0 | -7.0 | | -7.6 | | -8.5 | -8.8 | -9.0 | -9.2 | -9.4 | -9.6 | -9.7 | -9.8 | -9.8 | -9.9 | -9.8 | -9.7 | -9.9 | -9.9 | -10.0 | -10.0 | -3.0 | *42.0%* |

## Table B3. Scottish Greenhouse Gases, by gas, 1990 to 2013. Values in $MtCO_2e$

| | Baseline Period | 1990 | | 1995 | | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | Change from 1990 to 2013 (in Mt $CO_2e$) | *% Change from 1990 to 2013* | *Share of Greenhouse Gases, 2013* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total Greenhouse Gases** | **80.8** | **80.7** | | **81.2** | | **80.1** | **76.5** | **78.0** | **77.0** | **72.4** | **72.3** | **69.9** | **68.4** | **71.4** | **66.6** | **64.3** | **59.8** | **61.5** | **54.8** | **54.9** | **53.0** | **-27.7** | ***-34.3%*** | ***100.0%*** |
| Carbon dioxide ($CO_2$) | 57.5 | 57.5 | | 58.3 | | 57.4 | 54.7 | 56.6 | 56.2 | 52.1 | 52.6 | 50.8 | 49.9 | 53.4 | 49.3 | 47.9 | 44.2 | 46.5 | 40.2 | 40.8 | 39.4 | -18.1 | *-31.5%* | *74.4%* |
| Methane ($CH_4$) | 17.6 | 17.6 | | 17.6 | | 17.0 | 16.1 | 15.6 | 15.1 | 14.6 | 13.9 | 13.3 | 12.8 | 12.3 | 11.7 | 10.8 | 9.9 | 9.3 | 9.0 | 8.5 | 7.9 | -9.8 | *-55.4%* | *14.9%* |
| Nitrous oxide ($N_2O$) | 5.3 | 5.3 | | 5.0 | | 5.1 | 5.0 | 4.9 | 4.8 | 4.8 | 4.7 | 4.6 | 4.5 | 4.5 | 4.3 | 4.2 | 4.3 | 4.3 | 4.2 | 4.2 | 4.2 | -1.1 | *-20.7%* | *8.0%* |
| * F gases | 0.3 | 0.2 | | 0.3 | | 0.6 | 0.7 | 0.8 | 0.8 | 0.9 | 1.1 | 1.1 | 1.2 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.4 | 1.5 | 1.3 | *627.2%* | *2.8%* |
| *of which* HFCs | 0.2 | 0.0 | | 0.2 | | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 | 1.0 | 1.1 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | *8075.7%* | *2.5%* |
| PFCs | 0.1 | 0.1 | | 0.1 | | 0.1 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | *-28.2%* | *0.2%* |
| $SF_6$ | 0.0 | 0.0 | | 0.0 | | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | *-22.9%* | *0.1%* |
| $NF_3$ | 0.0 | 0.0 | | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | *24.7%* | *0.0%* |

Note on F-gases:

HFCs are hydrofluorocarbons
PFCs are perfluorocarbons
$SF_6$ is sulphur hexafluoride
$NF_3$ is nitrogen trifluoride

# Section C. Estimated Emissions Adjusted for Trading Within the EU Emissions Trading System (EU ETS)

## What is the EU Emissions Trading System (EU ETS)?

Launched in 2005, the EU ETS is an EU policy aimed at mitigating climate change by limiting greenhouse gas emissions from industry sectors and aviation. Participants include more than 11,000 heavy energy-using installations in power generation, the manufacturing industry and airlines across 31 countries in the European Economic Area (EEA).

## How does it work?

The EU ETS is a 'cap and trade' system. A limit (cap) is placed on the overall volume of emissions from participants in the system. Within the cap, organisations receive or buy emissions allowances which they can trade (1 emissions allowance equals 1 $tCO_2e$). Each year, an organisation must surrender enough allowances to cover its emissions. The cap is reduced over time so that by 2020, the volume of emissions permitted within the system will be 21% lower than in 2005. The reducing cap, alongside the financial considerations of trading emissions allowances, incentivises organisations within the system to find the most cost effective way of reducing their emissions. The EU ETS operates as a number of Phases. Phase III of the EU ETS began on 1 January 2013 and will operate until 31 December 2020.

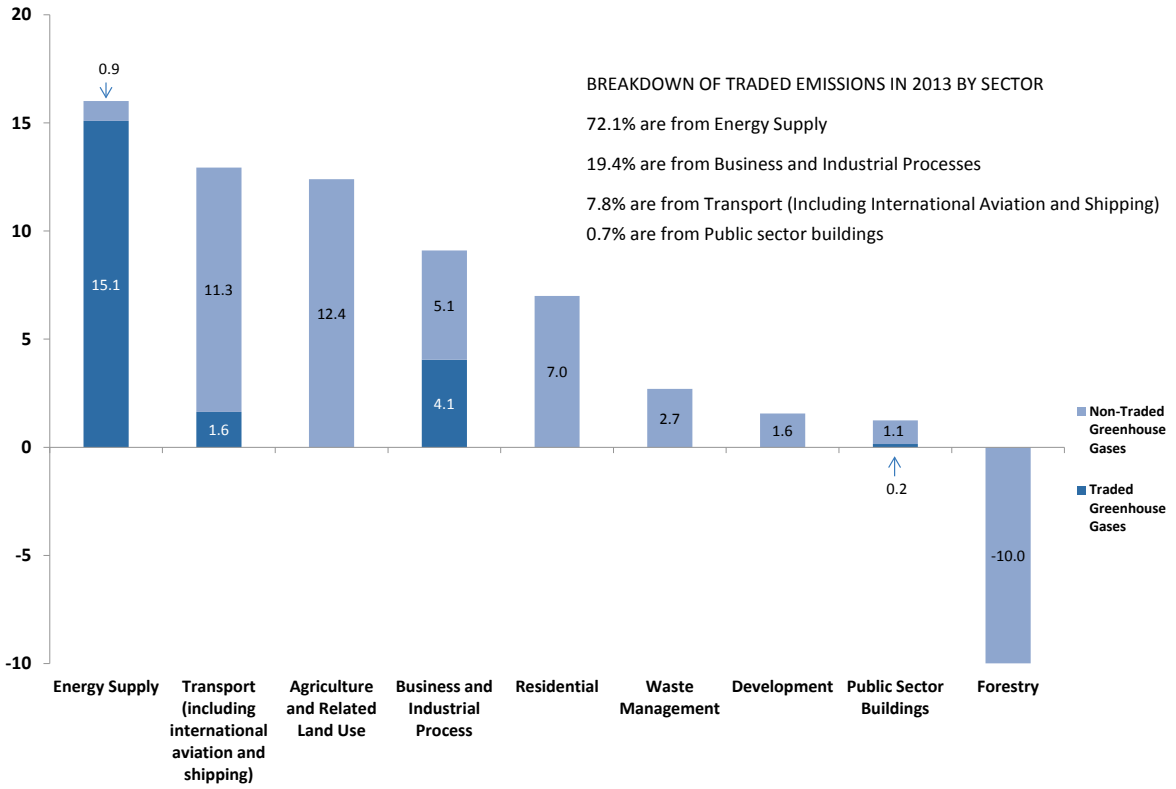
## Scotland in the EU ETS

The EU ETS contributes to delivering Scotland's Climate Change Targets through incentivising the reduction in emissions from Scottish organisations participating in the system. In 2013, there were 79 fixed Scottish installations which are regulated by Scottish Environment Protection Agency (SEPA) that surrendered emissions allowances in the EU ETS.

## What are 'traded emissions' and 'non-traded emissions'?

In the greenhouse gas inventory, source emissions can be categorised into traded and non-traded. Traded emissions capture those that come from installations covered by the EU ETS, whereas Non-traded emissions are those which do not fall within the scope of the EU ETS. The emissions from some sectors, such as the residential sector, are completely non-traded whereas emissions from other sectors, such as energy supply and business and industrial process are a combination of traded and non-traded. For 2012 and 2013, $CO_2$ emissions from domestic and international aviation are classified as being within the traded sector.

**Chart C1. Estimate of Traded Emissions Surrendered in the EU Emissions Trading System (EU ETS) and Non-Traded Greenhouse Gas Emissions by Scottish Government Sector, 2013. Values in $MtCO_2e$**




Note that the Scotland figure for the emissions which have been surrendered in the EU ETS is slightly different to that reported for traded emissions in the Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2013 report produced by Ricardo-AEA on behalf of the devolved administrations.

There are number of reasons for this:

Firstly, the estimate of surrendered emissions include an estimate of carbon dioxide emissions surrendered from domestic and international aviation. Unlike for fixed installations, it is not possible to accurately estimate Scottish emissions which have been surrendered from aviation directly from aviation operators. Instead, the Scottish Government has received advice from the Committee on Climate Change to estimate the aviation emissions surrendered in the EU ETS by using figures taken directly from the 1990-2013 greenhouse gas inventory.

Secondly, operators who participate in the EU ETS must, by 30 April in each year, surrender a number of allowances in the registry equal to the annual reportable emissions which the installation made in the previous year. However, as a result of errors or non-compliance in the EU ETS, the figure on surrendered and reported emissions can differ, until both are

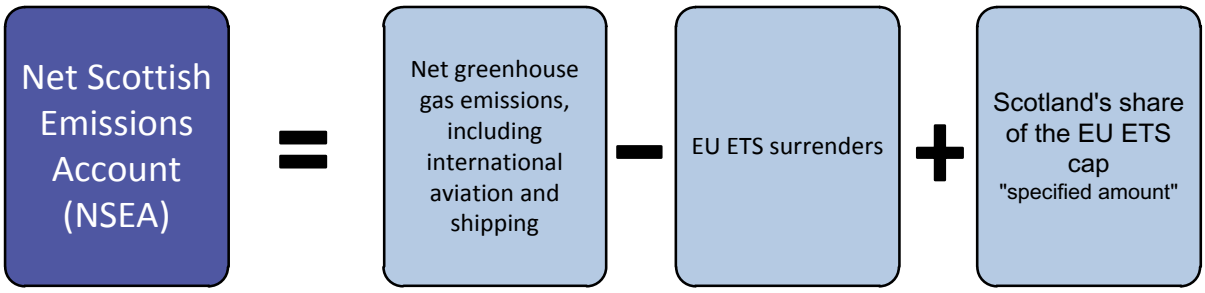
rectified. These can be on-going situations throughout each Phase of the EU ETS. By the end of each Phase any difference between the two figures should be rectified.

## What are adjusted emissions and the Net Scottish Emissions Account (NSEA)?

The Scottish climate change targets are assessed against the Net Scottish Emissions Account (NSEA), which is detailed in the Climate Change (Scotland) Act 2009 and has been reported for the years 2010, 2011, 2012 and 2013 as part of the Act. The NSEA accounts for the greenhouse gas emissions from sources in Scotland, Scotland's share of emissions from international aviation and international shipping, the effect of any relevant emissions removals (e.g. "carbon sinks" such as woodland) and the effect of the sale and purchase of relevant carbon units (tradable emissions allowances) in the EU ETS.

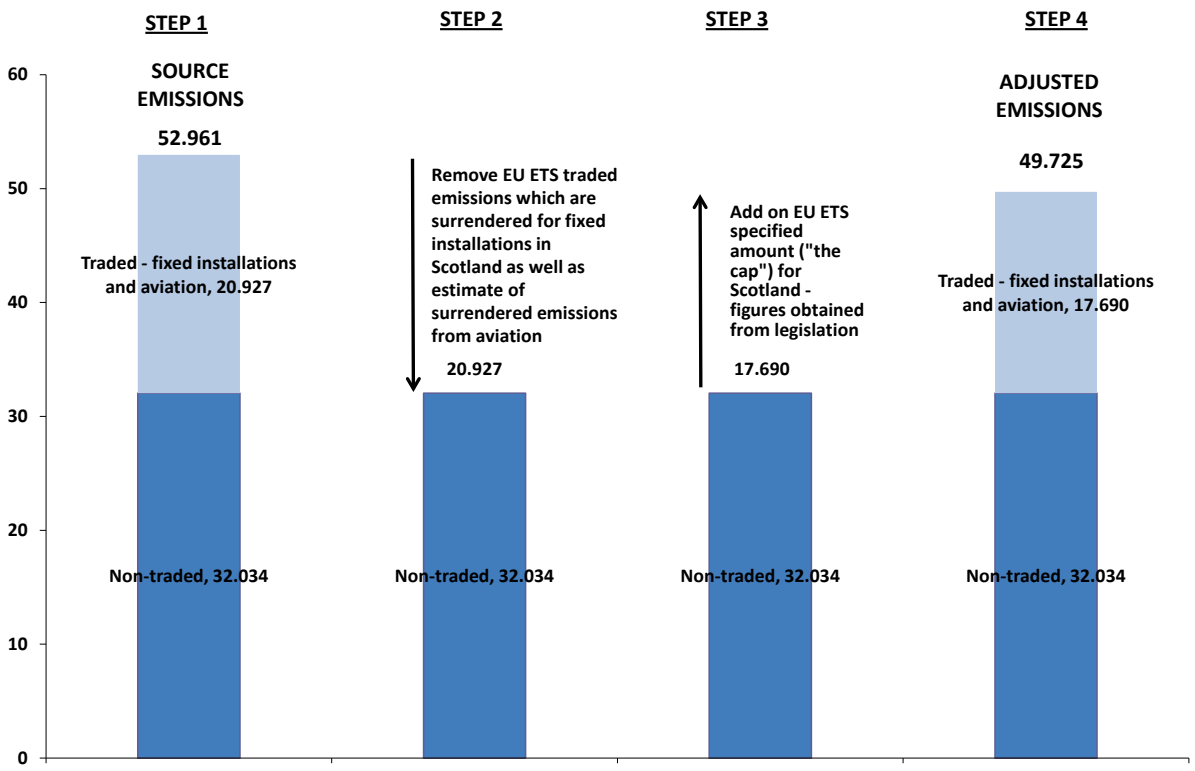
The EU ETS element of the NSEA is calculated by taking the difference between Scotland's notional share of the overall EU ETS cap and the number of emissions allowances surrendered from Scottish fixed installations in a given year, as well as an estimate of $CO_2$ emissions surrendered from Scotland's share of domestic and international aviation. This amount is then added to non-traded net emissions to get the NSEA.

The NSEA formula is as follows:




For 2013, the figure for the NSEA are known as adjusted emissions, as they are adjusted to take account of trading within the EU ETS. This adjustment takes the form of a 4-step process, which is outlined in Chart C2.

**Chart C2. Calculation of Adjusted Emissions for Trading in the EU Emissions Trading System (EU ETS), 2013. Values in $MtCO_2e$**




## Calculation of adjusted emissions

### STEP 1

Take the Scottish greenhouse gas emissions from Scottish greenhouse gas inventory (for 2013, it is 52.961 $MtCO_2e$). This figure has been comprised of:

- traded emissions units surrendered - sourced from Scottish Environment Protection Agency (SEPA) for fixed installations (19.296 $MtCO_2e$)
- an imputed estimate of surrendered $CO_2$ emissions from domestic aviation (0.516 $MtCO_2e$) and international aviation (1.115 $MtCO_2e$) - sourced from the Scottish Greenhouse Gas Inventory for 1990-2013
- non-traded emissions from sources such as residential emissions (32.034 $MtCO_2e$)

### STEP 2

Remove an amount relating to surrendered emissions from fixed installations and an estimate of surrendered emissions from domestic and international aviation. This amounts to 19.296 $MtCO_2e$ + 0.516 $MtCO_2e$ + 1.115 $MtCO_2e$ = **20.927 $MtCO_2e$**.

### STEP 3

Add on the value of the EU ETS cap which is the outlined within The Carbon Accounting Scheme (Scotland) Amendment Regulations 2015 [10]. The cap reflects an estimate of the Scottish share of the European wide EU ETS cap that is used for emissions accounting. For 2013, this cap was separated into 3 components, as shown in the table below.

## Total EU ETS cap for Scotland, 2013

| **Component** | **2013 Allocation $tCO_2e$** |
|---|---|
| Fixed Installation Cap | 16,325,296 |
| Domestic Aviation Cap | 443,255 |
| International Aviation Cap | 921,758 |
| **Total 2013 Cap** | **17,690,309** |

The Scottish EU ETS cap for 2013 is therefore **17.690 $MtCO_2e$**. The Scottish Government has published a methodological paper titled Determining a Scottish EU ETS cap for 2013 , which documents the calculations that determine how a notional emissions cap has been calculated for (i) greenhouse gas emissions from fixed installations located in Scotland (ii) and Scotland's share of emissions from domestic and international aviation.

### STEP 4

Adding on the value of the EU ETS cap gives a value of 49.725 $MtCO_2e$.

**In 2013, the adjusted emissions which take account of trading in the EU ETS is 49.725 $MtCO_2e$. This is 3.236 $MtCO_2e$ lower than the value of estimated source emissions in 2013.**

[10] http://www.legislation.gov.uk/ssi/2015/189/contents/made

## Scottish Climate Change Targets

Scotland has a number of targets for reducing greenhouse gas emissions contained in legislation, within the Climate Change (Scotland) Act 2009. These targets can be summarised as follows:

The Act creates a statutory framework for greenhouse gas emissions reductions in Scotland by setting an interim target of at least a 42 per cent reduction for 2020, and at least an 80 per cent reduction target for 2050. These reductions are based on a 1990 baseline (1995 for the F-Gases). The Act also requires that Scottish Ministers set fixed annual targets for emissions at least 12 years in advance.

In October 2010 the Scottish Parliament passed legislation setting the first batch of annual targets, for the years up to 2022[11]. Targets for 2023-2027 were set in October 2011[12], and will continue to be set at 5-year intervals.

The 2013 target is 47.976 $MtCO_2e$.

Achievement of Scotland's targets is measured against the level of the Net Scottish Emissions Account (NSEA). There is a limit on the net amount of carbon units that may be credited to the NSEA in addition to those from the EU Emissions Trading System. The Climate Change (Limit on Carbon Units) (Scotland) Order 2010[13] specifies that the net amount of carbon units that may be credited to the Net Scottish Emissions Account for the period 2010-2012 is zero. The Climate Change (Limit on Carbon Units) (Scotland) Order 2011[14] sets limits for the period 2013-2017.

[11] The Climate Change (Annual Targets) (Scotland) Order 2010, SSI 2010 no. 359: http://www.legislation.gov.uk/ssi/2010/359/contents/made
[12] The Climate Change (Annual Targets) (Scotland) Order 2011, SSI 2011 no. 353: http://www.legislation.gov.uk/ssi/2011/353/contents/made
[13] The Climate Change (Limit on Carbon Units) (Scotland) Order 2010, SSI 2010 no. 217: http://www.legislation.gov.uk/ssi/2010/217/contents/made
[14] The Climate Change (Limit on Carbon Units) (Scotland) Order 2011, SSI 2011 no. 440: http://www.legislation.gov.uk/ssi/2011/440/contents/made

Chart C3 contains data from the latest (1990-2013) inventory, adjusted for trading in the EU Emissions Trading System as well as data on progress against the 42 per cent and 80 per cent reduction targets. These percentage targets are based on a percentage reduction from the Baseline Period in the latest inventory.

**Chart C3. Percentage Reductions Targets – Based on Adjusted Emissions. Values in $MtCO_2e$**

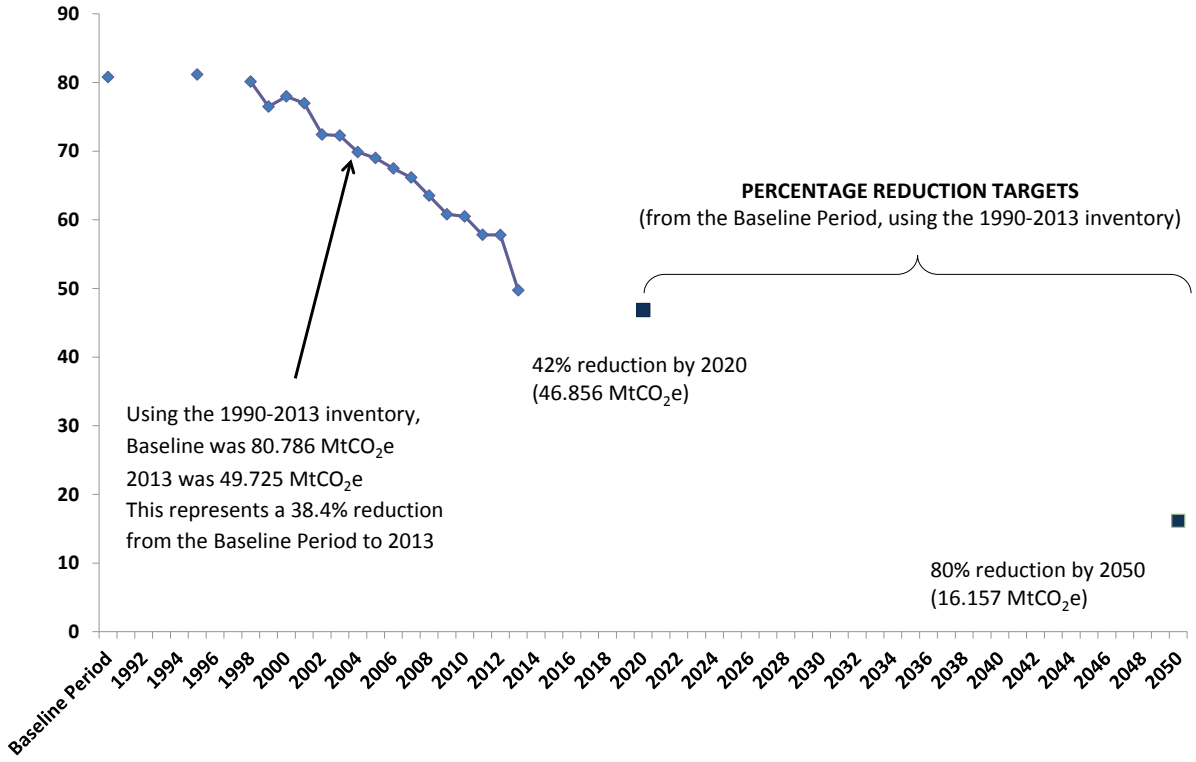
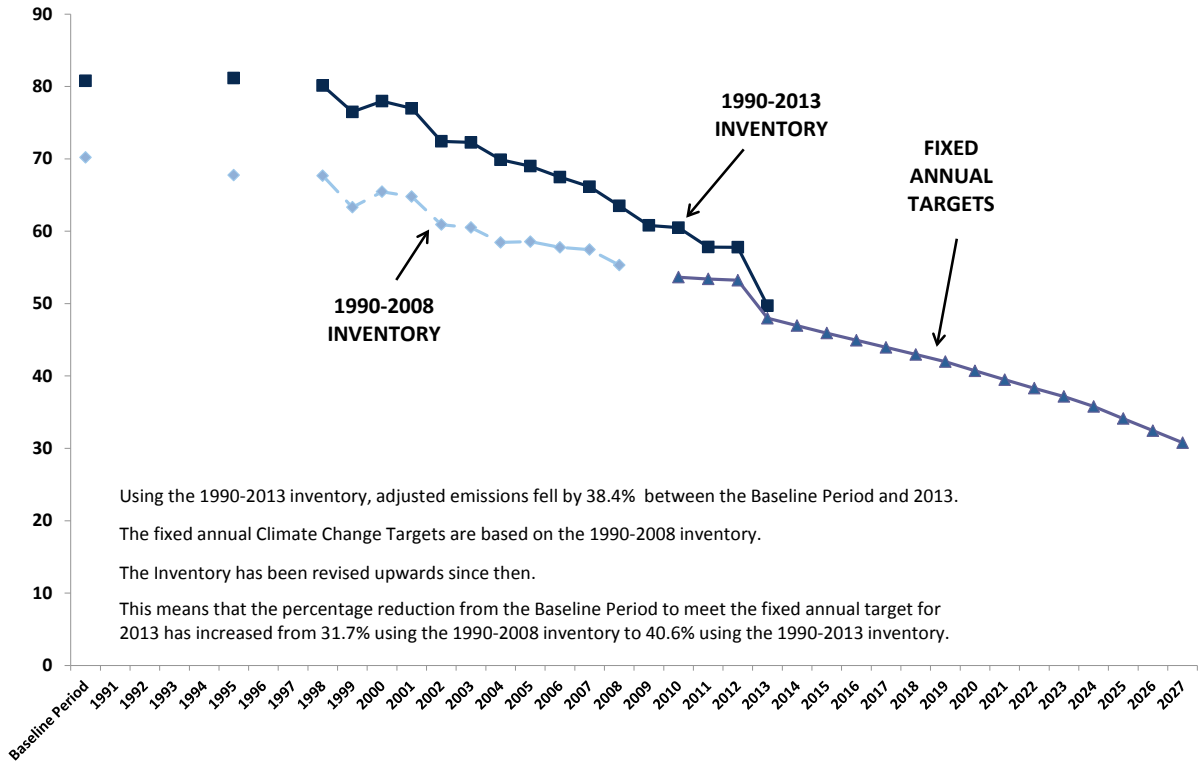



Chart C4 contains data from the latest (1990-2013) inventory, adjusted for trading in the EU Emissions Trading System. The fixed annual targets are also presented on this chart. The fixed annual targets were set at the time of the 1990-2008 inventory. Emissions adjusted for trading in the EU ETS using the 1990-2008 are shown for context.

**Chart C4. Comparison of Adjusted Emissions and the Fixed Annual Targets which are based on the 1990-2008 Inventory. Values in $MtCO_2e$**




## National performance framework sustainability purpose targets

In addition to the statutory Climate Change Targets, these statistics are used to monitor progress against the Scottish Government's Sustainability Purpose Targets

There are two targets:

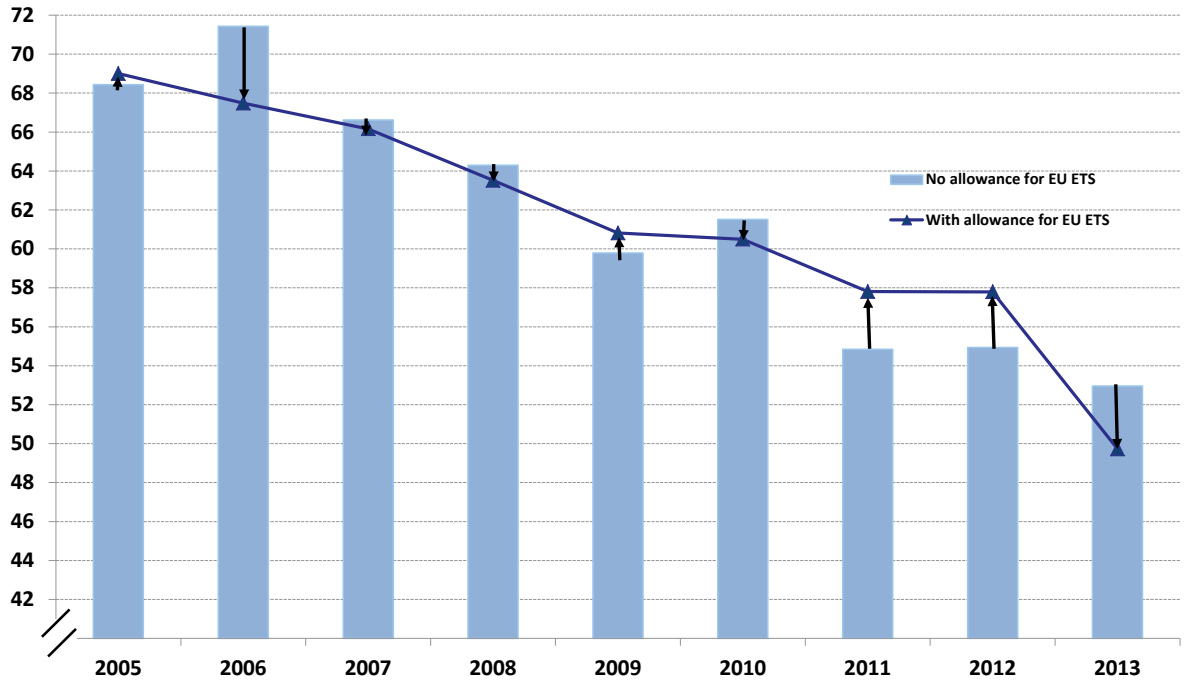
- The long term target (2050) now equates to the target in the Climate Change (Scotland) Act 2009.
- The Scottish Government also set a short term target to reduce emissions by 2011 compared with a 2006 baseline.

Information on progress towards these targets can be found on the Scottish Government Scotland Performs website.

## Effect of the adjustment to take into account of trading in the EU Emissions Trading System

Chart C5 demonstrates the effect of the adjustment for trading in the EU ETS, for calculation of the Net Scottish Emissions Account (NSEA).

**Chart C5. Greenhouse Gas Emissions Adjusted for the Emissions Trading System (EU ETS). Values in $MtCO_2e$**




In four of the last 9 years, the adjustment has increased reported emissions, with 2011 and 2012 showing sizeable increases from the adjustment. In 2013, the adjustment has seen a sizeable (3.236 $MtCO_2e$) decrease for the reported cap. This reflects Scotland's notional share of the EU ETS cap in 2013 and the tightening of the EU ETS cap between Phases II and III.

## Table C1. Scottish greenhouse gas emissions adjusted to take account of trading in the EU Emissions Trading System. Baseline Period to 2013. Values in $MtCO_2e$

| | | Baseline Period | 1995 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No allowance for EU ETS | Total Scottish greenhouse gas emissions (including international aviation and shipping) | 80.8 | 81.2 | 80.1 | 76.5 | 78.0 | 77.0 | 72.4 | 72.3 | 69.9 | 68.4 | 71.4 | 66.6 | 64.3 | 59.8 | 61.5 | 54.8 | 54.9 | 53.0 |
| | Percentage change from Baseline Period | | 0.5% | -0.8% | -5.3% | -3.5% | -4.7% | -10.3% | -10.5% | -13.5% | -15.3% | -11.6% | -17.5% | -20.4% | -26.0% | -23.9% | -32.1% | -32.0% | -34.4% |
| | Differences between EU ETS cap and EU ETS surrendered emissions for Scotland | | | | | | | | | | 0.6 | -4.0 | -0.5 | -0.8 | 1.0 | -1.0 | 3.0 | 2.9 | -3.2 |
| | Scottish share of net purchases/(sales) by UK Government at the end of Phase I of EU ETS | | | | | | | | | | 0.2 | 0.2 | 0.2 | | | | | | |
| | Scottish share of cancelled allowances by UK Government at the end of Phase II of EU ETS | | | | | | | | | | | | | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | |
| | Differences between EU ETS cap and traded emissions for Scotland - adjustment to emissions | | | | | | | | | | 0.8 | -3.8 | -0.3 | -0.9 | 0.9 | -1.1 | 2.9 | 2.8 | -3.2 |
| With allowance for EU ETS | Total Scottish greenhouse gas emissions | 80.8 | 81.2 | 80.1 | 76.5 | 78.0 | 77.0 | 72.4 | 72.3 | 69.9 | 69.0 | 67.5 | 66.2 | 63.5 | 60.8 | 60.5 | 57.8 | 57.8 | 49.7 |
| | Percentage change from Baseline Period | | 0.5% | -0.8% | -5.3% | -3.5% | -4.7% | -10.3% | -10.5% | -13.5% | -14.6% | -16.5% | -18.1% | -21.4% | -24.7% | -25.1% | -28.4% | -28.5% | -38.4% |

# Section D. Revisions Since the Last Inventory and Methodology

This section examines key revisions in estimated source emissions between the latest inventory (1990-2013) and the previous inventory (1990-2012) published in June 2014. In October 2014, the Scottish Government published a paper Scottish Greenhouse Gas Emissions 2012. Key Revisions Since 2008 which provides a breakdown of the key revisions to the data within the Scottish Greenhouse Gas Emissions Official Statistics publication over successive years from the 1990-2008 inventory. This section of the publication is intended to build on this revisions paper.

## Compilation of the Greenhouse Gas Inventory

The greenhouse gas inventory covers a wide variety of all anthropogenic sources of greenhouse gas emissions and therefore a wide variety of emissions sources which require different approaches to their estimation. There are a large number of data sources used in its compilation, obtained from Government statistics, regulatory agencies, trade associations, individual companies, surveys and censuses. The methods used to compile the greenhouse gas inventory are consistent with international guidance on national inventory reporting from the Intergovernmental Panel on Climate Change.

Most emission estimates are compiled by combining activity data (such as fuel use) with a suitable emission factor (such as amount of $CO_2$ emitted per unit of fuel used). Estimates of emissions from the industrial sector are often compiled based on plant-specific emissions data. Emissions from some sectors are based on more complicated models - such as the model used to estimate emissions from landfill, and the model used to estimate the carbon dynamics in soils when trees are planted. Much of the data on net emissions from agriculture and related land use, land use change and forestry emissions are based on modelled data for Scotland, which are consistent with, but not constrained to, the UK totals and thus are known as “bottom up” estimates.

Many of the remaining emissions sources within the inventory have been collated on a “top down” approach where estimates of emissions have been apportioned to Scotland using proportions of energy use in the Department of Energy and Climate Change (DECC) Publication “Digest of UK Energy Statistics (DUKES)”. This approach is prompted by data availability on emissions being more limited at the sub-UK level.

## Impact of Revisions

Charts D1 to D5 and Table D1 illustrate the impacts of revisions between the 1990-2012 and 1990-2013 inventories, both by sector and by greenhouse gas. This is followed by a discussion of the reasons for the key revisions.

**Chart D1. Scottish Greenhouse Gas Emissions. Comparison of 1990-2012 and 1990-2013 Inventories. Values in $MtCO_2e$**

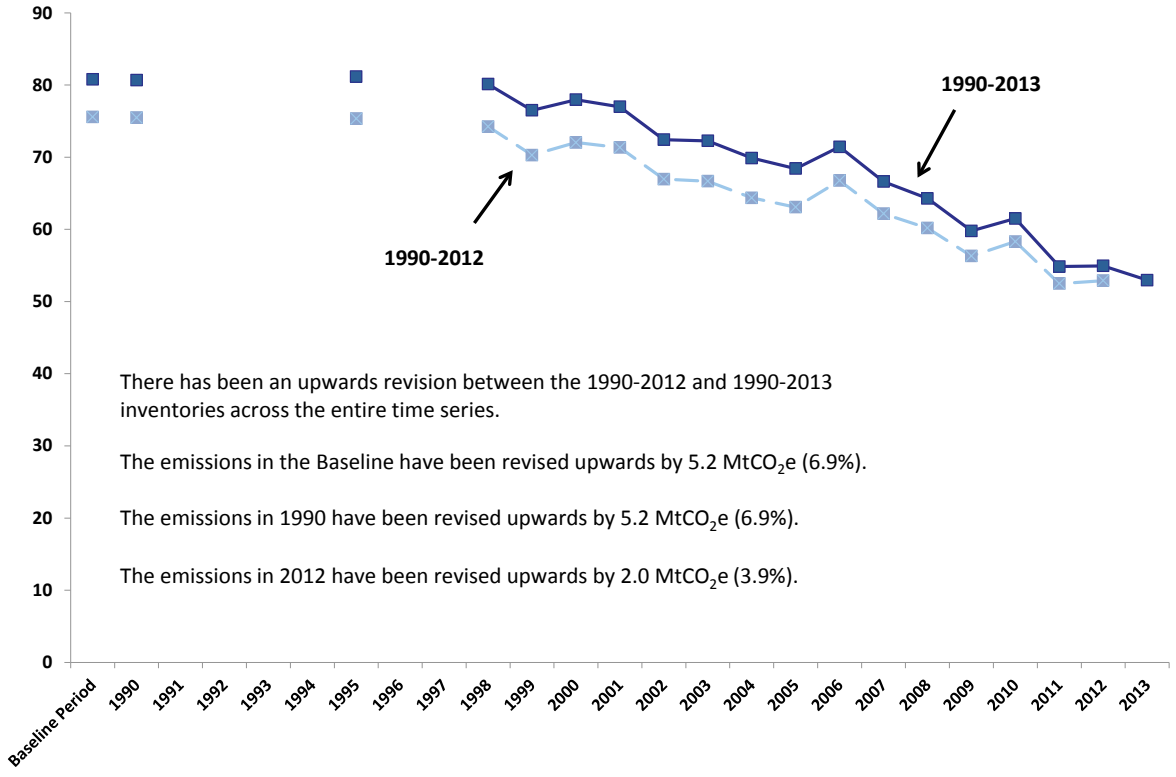


Chart D2 shows that the Waste Management sector contributed by far the greatest upwards revisions to emissions in the Baseline Period, at 3.2 $MtCO_2e$ (contributing to 60.9 per cent of the upward revision). Other sectors which saw considerable upwards revisions to emissions in the Baseline Period were Agriculture and Related Land Use (0.9 $MtCO_2e$), Business and Industrial Processes (0.8 $MtCO_2e$) and Energy Supply (0.3 $MtCO_2e$). There was a small downward revision for Residential emissions.

**Chart D2. Revisions to emissions in the Baseline Period, from the 1990-2012 inventory to the 1990-2013 inventory, by source sector. Values in $MtCO_2e$, *and percentage changes***

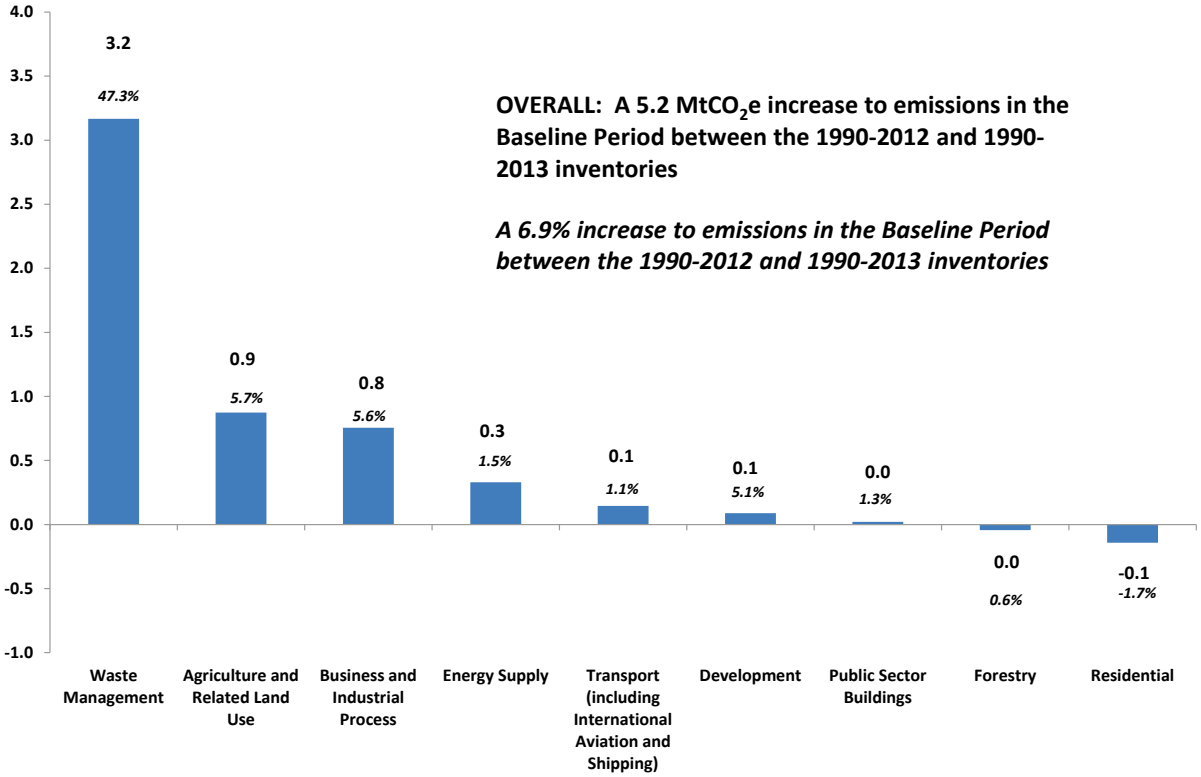



Chart D3 shows that the greatest upwards revisions in 2012 have occurred in the Agriculture and Related Land Use sector (1.4 $MtCO_2e$; contributing to 67.2 per cent of revisions). The Waste Management emissions and Energy Supply emissions have both been revised upwards by 0.4 $MtCO_2e$ in 2012. Emissions in the Business and Industrial Process sector have been revised upwards by 0.3 $MtCO_2e$.

**Chart D3. Revisions to emissions in 2012, from the 1990-2012 inventory to the 1990-2013 inventory, by source sector. Values in $MtCO_2e$, *and percentage changes***

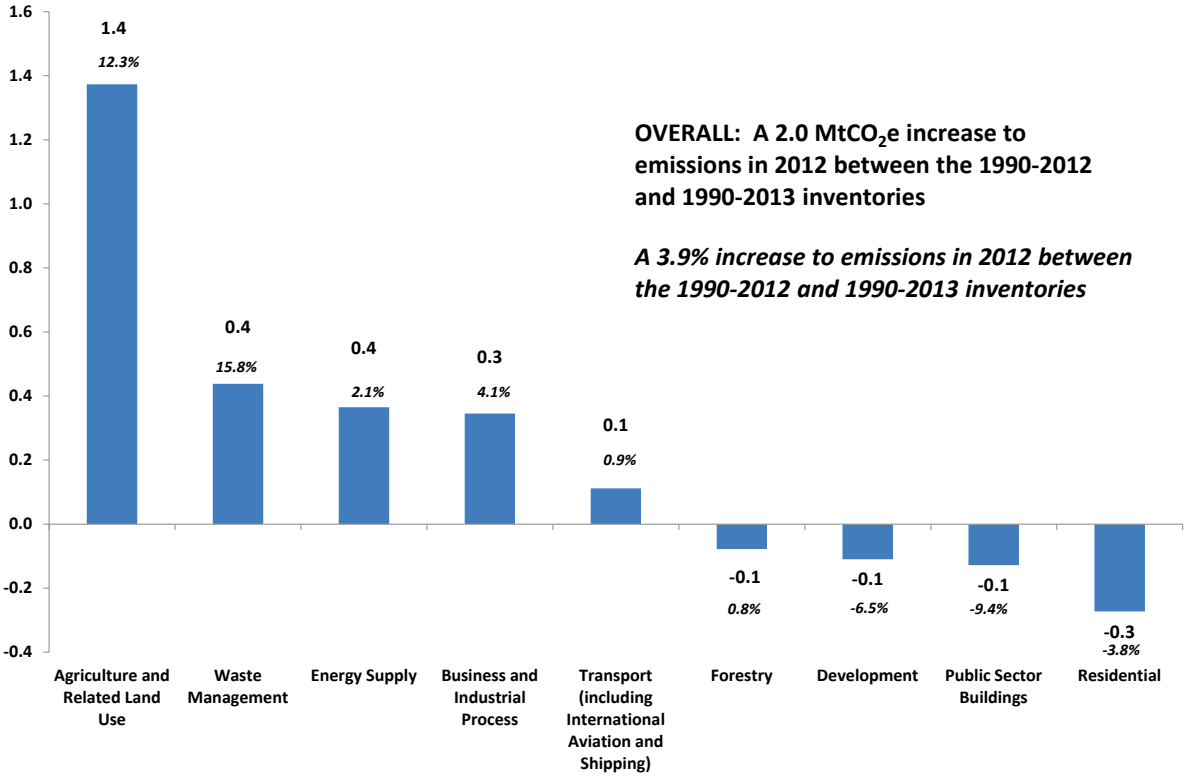
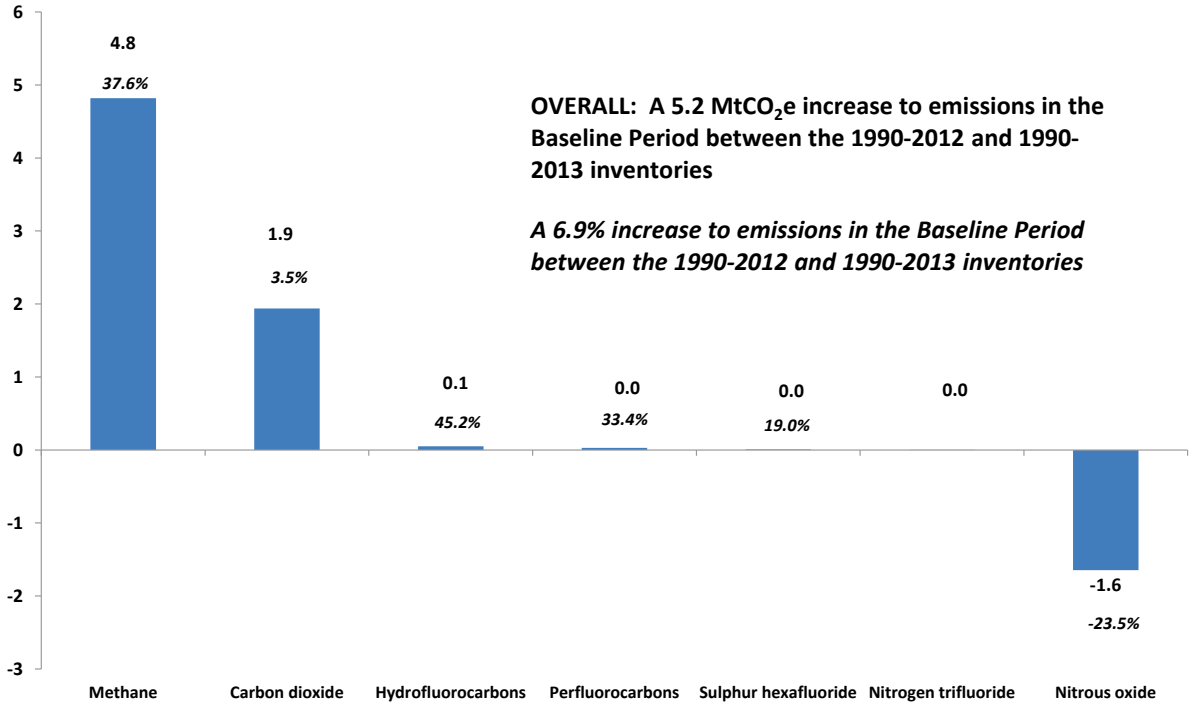


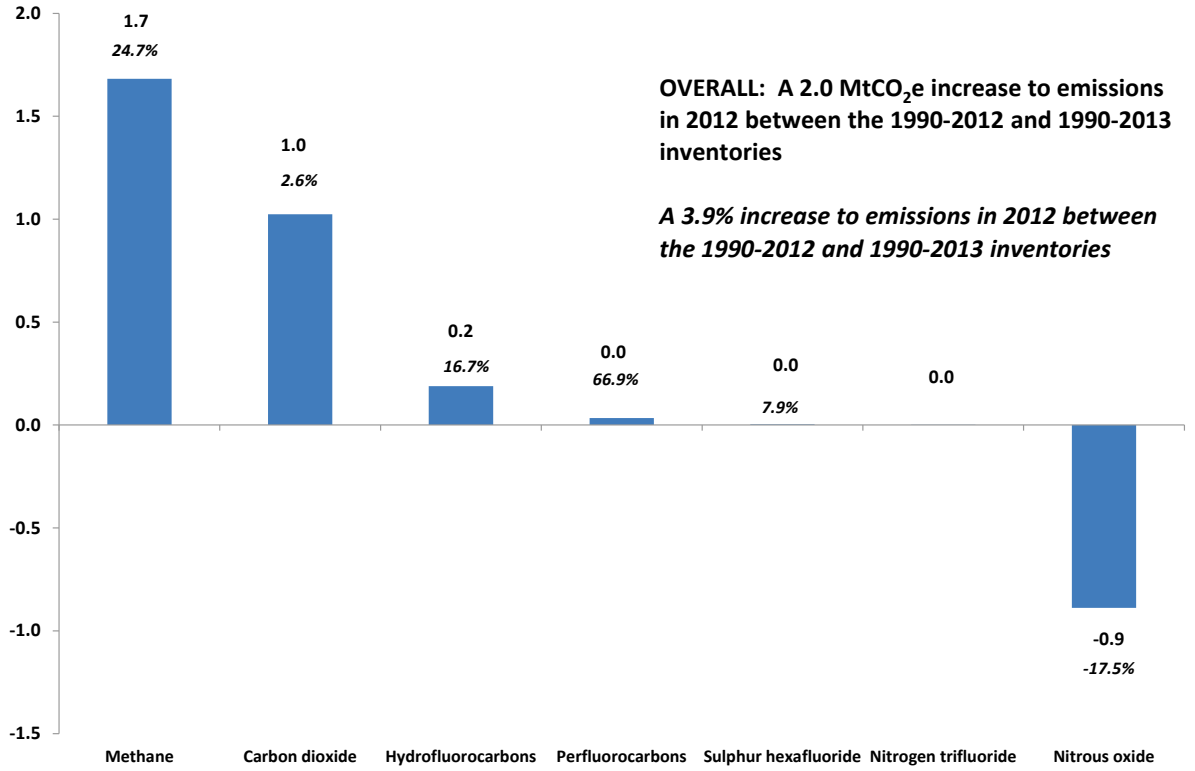

Chart D4 shows the impact of revisions to emissions in the Baseline Period for each greenhouse gas separately, with Chart D5 showing the impact of revisions in 2012. In both cases, methane emissions have seen the greatest upwards revisions, followed by carbon dioxide - with nitrous oxide emissions being revised downwards across the time series.

It is worth noting that the introduction of nitrogen trifluoride ($NF_3$) has a negligible effect on the 1990-2013 greenhouse gas inventory. It was included for the first time in the 1990-2013 inventory.

## Chart D4. Revisions to emissions in the Baseline Period, from the 1990-2012 inventory to the 1990-2013 inventory, by greenhouse gas. Values in MtCO2e, *and percentage changes*




## Chart D5. Revisions to 2012 emissions, from the 1990-2012 inventory to the 1990-2013 inventory, by greenhouse gas. Values in $MtCO_2e$, *and percentage changes*



## Table D1. Changes in emissions by source sector. Comparison of 1990-2012 and 1990-2013 inventories. Values in $MtCO_2e$

| | Baseline Period | 1990 | 2012 | 2013 | *% change between Baseline Period and 2012* | *% change between 1990 and 2012* | *% change between Baseline Period and 2013* | *% change between 1990 and 2013* |
|---|---|---|---|---|---|---|---|---|
| **Total** | | | | | | | | |
| **1990-2012** | **75.6** | **75.5** | **52.9** | | ***-30.0%*** | ***-29.9%*** | | |
| **1990-2013** | **80.8** | **80.7** | **54.9** | **53.0** | ***-32.0%*** | ***-31.9%*** | ***-34.4%*** | ***-34.3%*** |
| **Difference between 1990-2012 and 1990-2013** | **5.2** | **5.2** | **2.0** | | | | | |
| **Energy Supply** | | | | | | | | |
| 1990-2012 | 22.4 | 22.4 | 17.1 | | *-23.5%* | *-23.5%* | | |
| 1990-2013 | 22.7 | 22.7 | 17.5 | 16.0 | *-23.0%* | *-23.0%* | *-29.5%* | *-29.5%* |
| **Difference between 1990-2012 and 1990-2013** | **0.3** | **0.3** | **0.4** | | | | | |
| **Transport (including International Aviation and Shipping)** | | | | | | | | |
| 1990-2012 | 13.1 | 13.1 | 12.9 | | *-1.2%* | *-1.2%* | | |
| 1990-2013 | 13.2 | 13.2 | 13.0 | 12.9 | *-1.4%* | *-1.4%* | *-2.1%* | *-2.1%* |
| **Difference between 1990-2012 and 1990-2013** | **0.1** | **0.1** | **0.1** | | | | | |
| **Transport (excluding IA&S)** | | | | | | | | |
| 1990-2012 | 10.5 | 10.5 | 10.5 | | *0.1%* | *0.1%* | | |
| 1990-2013 | 10.6 | 10.6 | 10.6 | 10.5 | *-0.2%* | *-0.2%* | *-1.0%* | *-1.0%* |
| **Difference between 1990-2012 and 1990-2013** | **0.1** | **0.1** | **0.1** | | | | | |
| **International Aviation and Shipping (IA&S)** | | | | | | | | |
| 1990-2012 | 2.5 | 2.5 | 2.4 | | *-6.4%* | *-6.4%* | | |
| 1990-2013 | 2.6 | 2.6 | 2.4 | 2.4 | *-6.6%* | *-6.6%* | *-6.4%* | *-6.4%* |
| **Difference between 1990-2012 and 1990-2013** | **0.0** | **0.0** | **0.0** | | | | | |
| **Agriculture and Related Land Use** | | | | | | | | |
| 1990-2012 | 15.2 | 15.2 | 11.2 | | *-26.7%* | *-26.7%* | | |
| 1990-2013 | 16.1 | 16.1 | 12.5 | 12.4 | *-22.2%* | *-22.2%* | *-23.1%* | *-23.1%* |
| **Difference between 1990-2012 and 1990-2013** | **0.9** | **0.9** | **1.4** | | | | | |
| **Business and Industrial Process** | | | | | | | | |
| 1990-2012 | 13.6 | 13.5 | 8.5 | | *-37.3%* | *-37.0%* | | |
| 1990-2013 | 14.4 | 14.3 | 8.9 | 9.1 | *-38.2%* | *-37.9%* | *-36.6%* | *-36.3%* |
| **Difference between 1990-2012 and 1990-2013** | **0.8** | **0.8** | **0.3** | | | | | |
| **Residential** | | | | | | | | |

| | Baseline Period | 1990 | 2012 | 2013 | *% change between Baseline Period and 2012* | *% change between 1990 and 2012* | *% change between Baseline Period and 2013* | *% change between 1990 and 2013* |
|---|---|---|---|---|---|---|---|---|
| 1990-2012 | 8.2 | 8.2 | 7.3 | | *-11.1%* | *-10.8%* | | |
| 1990-2013 | 8.0 | 8.0 | 7.0 | 7.0 | *-13.0%* | *-12.3%* | *-13.0%* | *-12.4%* |
| **Difference between 1990-2012 and 1990-2013** | **-0.1** | **-0.2** | **-0.3** | | | | | |
| **Waste Management** | | | | | | | | |
| 1990-2012 | 6.7 | 6.7 | 2.8 | | *-58.6%* | *-58.6%* | | |
| 1990-2013 | 9.9 | 9.9 | 3.2 | 2.7 | *-67.5%* | *-67.5%* | *-72.6%* | *-72.6%* |
| **Difference between 1990-2012 and 1990-2013** | **3.2** | **3.2** | **0.4** | | | | | |
| **Development** | | | | | | | | |
| 1990-2012 | 1.7 | 1.7 | 1.7 | | *-3.4%* | *-3.4%* | | |
| 1990-2013 | 1.8 | 1.8 | 1.6 | 1.6 | *-14.1%* | *-14.1%* | *-14.7%* | *-14.7%* |
| **Difference between 1990-2012 and 1990-2013** | **0.1** | **0.1** | **-0.1** | | | | | |
| **Public Sector Buildings** | | | | | | | | |
| 1990-2012 | 1.7 | 1.7 | 1.4 | | *-17.8%* | *-17.8%* | | |
| 1990-2013 | 1.7 | 1.7 | 1.2 | 1.2 | *-26.4%* | *-26.4%* | *-26.2%* | *-26.2%* |
| **Difference between 1990-2012 and 1990-2013** | **0.0** | **0.0** | **-0.1** | | | | | |
| **Forestry** | | | | | | | | |
| 1990-2012 | -7.0 | -7.0 | -9.9 | | *41.9%* | *41.9%* | | |
| 1990-2013 | -7.0 | -7.0 | -10.0 | -10.0 | *42.1%* | *42.1%* | *42.0%* | *42.0%* |
| **Difference between 1990-2012 and 1990-2013** | **0.0** | **0.0** | **-0.1** | | | | | |

## Details of Main Revisions

A complete list of the revisions between the previous and latest inventories can be found in the National Atmospheric Emissions Inventory report Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990 - 2013 [15]. Details of the most notable revisions are listed below:

### 1. Implementation of IPCC (2006) Guidelines

The UK and the Scottish greenhouse gas inventory are required to comply with reporting guidelines as prescribed by the IPCC. These guidelines have been updated for this year's release to reflect the details published in the IPCC's 4th Assessment Report [16]. The latest set of guidelines are known as the IPCC (2006) guidelines. These have been agreed

[15] http://naei.defra.gov.uk/reports/reports?report_id=810
[16] IPCC's 4th Assessment Report: http://www.ipcc.ch/report/ar4/

internationally and replace the previous guidelines, which were referred to as the IPCC (1996) guidelines. The adoption of the IPCC (2006) guidelines has led to a number of revisions, as detailed below:

### Revised Global Warming Potentials of greenhouse gases

The global warming potentials (GWPs) used for each gas have been updated to those published in the IPCC's 4th Assessment Report. Table D2 shows the revised GWPs as used in this year's publication, compared with those used in last year's publication. The impact of the GWP changes has been greatest on the agriculture and related land use and on the waste management sectors.

## Table D2. Comparison of global warming potentials (GWP) of greenhouse gases, 1990-2012 and 1990-2013 inventories

| Name of Greenhouse Gas | Chemical Formula | 1990-2012 | 1990-2013 |
|---|---|---|---|
| **Carbon dioxide** | **$CO_2$** | **1** | **1** |
| **Methane** | **$CH_4$** | **21** | **25** |
| **Nitrous oxide** | **$N_2O$** | **310** | **298** |
| **F-gases** | | | |
| - *Hydrofluorocarbons* | **HFC** | 140 - 11,700 | 12 - 14,800 |
| - *Perfluorocarbons* | **PFC** | 6,500 - 9,200 | 7,390 - 17,340 |
| - *Sulphur hexafluoride* | **$SF_6$** | 23,900 | 22,800 |
| - *Nitrogen trifluoride* | **$NF_3$** | Not included | 17,200 |

### New data sources and methodologies

New sources include the use of nitrous oxide in anaesthesia and emissions from composting. Some existing sources have also been updated with new methodologies, such as in the emissions of F gases in the Business and Industrial Process sector.

### New greenhouse gas

A new F-gas, nitrogen trifluoride ($NF_3$) has been included in the 1990-2013 inventory for the first time. This gas is only emitted in tiny amounts in Scotland and is emitted in the semiconductor industry.

## 2. Waste Management

### Impact of IPCC (2006) guidelines

The majority of greenhouse gas emissions in the Waste Management sector are of methane. Changing the global warming potential of methane from 21 to 25 has resulted in emissions in the Baseline Period for this sector being revised upwards by around 1.2 $MtCO_2e$ and 2012 emissions being revised upwards by around 0.5 $MtCO_2e$ in 2012. There have also been new requirements under the IPCC (2006) guidelines to report on new sources for this first time – such as emissions from composting.

### Landfill gas data

New information has been used for this publication from the Scottish Environment Protection Agency on the volumes of landfill gas flared and recovered at landfill sites; previously these volumes had been estimated. This has led to a downwards revision to emissions in recent years.

### Waste decay data

New research from Defra has shown that the rate at which degradable waste is estimated to decay over time in landfill is slightly higher than previously thought. This increases methane emissions in the early part of the time series and decreases them after 2009.

### Other changes

There have been further, more minor updates to emissions in this sector. These include:

- Changes to assumptions of gas combustion engine efficiency
- New data on waste composition.
- Revisions to estimates of industrial and domestic waste water treatment methods (to be consistent with IPCC (2006) guidelines)
- New emissions from private sewage treatment works

## 3. Agriculture and Related Land Use

### Impact of IPCC (2006) guidelines

A considerable proportion of net greenhouse gas emissions in the Agriculture and Related Land Use sector are of methane and nitrous oxide. Changing the global warming potential of methane from 21 to 25 and changing that of nitrous oxide from 310 to 298 has resulted in emissions in the Baseline Period for this sector being revised upwards by around 0.6 $MtCO_2e$ and the 2012 emissions being revised upwards by around 0.5 $MtCO_2e$.

Adopting the IPCC (2006) guidelines has also meant that there have been changes to the assumptions for the emissions from animal digestion (enteric fermentation), which have increased emissions across the series.

Implementing the IPCC (2006) guidelines has also meant that emissions for agricultural soils have been revised downwards, but not to the same extent as the upwards revisions in other parts of the Agricultural and Related Land Use source sector. This downward revision has been due to changes in emissions factors for agricultural soils. There have also been changes to assumptions regarding the greenhouse gas emissions from manure management practices in farms, which results in a small drop in emissions across the time series.

### Drainage of Cropland and Grassland

DEFRA have published revised UK land areas of cropland and improved grassland on organic soils which have been drained for agricultural purposes. UNFCCC reviewers have requested for this information to be included in the inventory and they only relate to the drainage of these land use types. This has resulted in an increase in around 1.17 $MtCO_2e$ across the time series and they particularly affect the size of carbon sink from grasslands.

### Cattle Weights

New research from DEFRA has resulted in updated estimates of the average weights of dairy cattle and beef cattle. This has led to further upwards revisions to enteric fermentation emissions by cattle across the time series

## 4. Business and Industrial Process

### Chemical Industry

There has been a revision to emissions from petroleum fuels which are regarded as non-energy use due to their use in petrochemical manufacture. This has led to an increase in emissions in all years. There has also been incorporation of Phase III EU ETS data which has resulted in improvements in the completeness and allocation of the inventory for chemical sites.

## 5. Energy Supply

### Changes to Allocations of Fuel Use

Some allocations of fuel use have been changed in DECC's Digest of UK Energy Statistics (DUKES). This has increased emissions as more fuel use has been allocated to activities which combust the fuel, and therefore release emissions. There has been a slight reallocation of emissions across the UK's power stations, to be consistent with the DUKES fuel use data. This has led to a slight increase in energy supply emissions in Scotland.

### Revisions to Emission Factors For Some Fuels

Emission factors for coal, anthracite and coke have been updated to the IPCC default values as a result of questions received during the international review process. This has increased emissions by a small amount.

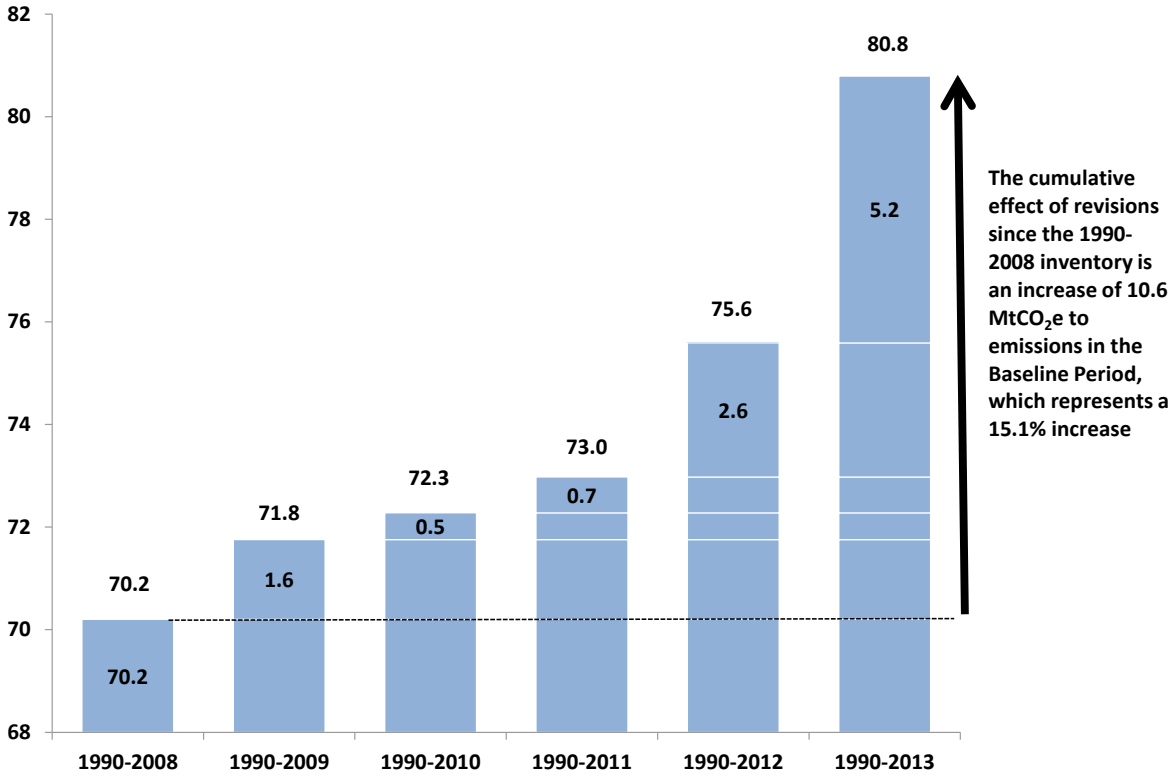
### Fugitive Emissions

Emissions from fugitive emissions from gas and oil extraction in the UK have been revised to account for venting from the gas distribution network and there are now better estimates of emissions from small coal mines.

## Cumulative revisions since 1990-2008

Revisions since the 1990-2008 inventory give a flavour of the scale of total revisions since the establishment of fixed annual Climate Change targets. Chart D6 shows that between the 1990-2008 inventory and the latest inventory, the average yearly increase in emissions in the Baseline Period has been 2.1 $MtCO_2e$.

**Chart D6. Revisions to emissions in the Baseline Period, from the 1990-2008 Inventory, to the Latest Inventory. Impact of Successive Revisions. Values in $MtCO_2e$**



## Interpretation of revisions to the inventory

The latest published Scotland greenhouse gas inventory (currently 1990-2013) represents the best available data at the time and these supersede any previous data, which should be disregarded. Very few revisions to the Greenhouse Gas Inventories arise as a result of 'errors' in the popular sense of the word. In fact, the compilation of the inventory is governed by a rigorous quality assurance process and is subject to a great deal of third party scrutiny, particularly by the UNFCCC at a UK level.

## Interpretation of uncertainties in the inventory

All estimates, by definition, are subject to a degree of statistical 'error' but in this context it relates to the uncertainty inherent in any process or calculation that uses sampling, estimation or modelling.

Estimates of greenhouse gases are compiled by a consortium of contractors. The source emissions are based upon a range of data sources, ranging from model based estimates to point source emission data. As a result, the estimates are subject to a degree of uncertainty. Full analyses of these uncertainties are provided on the National Atmospheric Emissions Inventory website.

The Scottish Government has commissioned research to overhaul and update the uncertainties model used for the Scottish greenhouse gas inventory. A detailed study has been carried out in parallel with the compilation of the Scottish greenhouse gas inventory to review and improve the uncertainty calculations and can be found on the Scottish Government website.

## Future revisions to the inventory

Every year, the greenhouse gas inventories are updated to reflect improvements in the underpinning science, data and modelling which often result in revisions to the entire time series. These revisions also reflect changes to the Intergovernmental Panel on Climate Change (IPCC) guidelines. The Scottish Government is represented at the UK's National Inventory Steering Committee, in which improvements to the Scottish and UK inventories are discussed. Some of the changes for the 1990-2014 inventory and for subsequent inventories are already known and overall, these are likely to increase Scotland's net emissions further.

There are a number of projects underway which might result in considerable upwards revisions for future inventories in a number of sectors. For instance:

- There is a project underway to better understand the behaviour of drained organic soils and the impact of this on how forests release or sequester carbon. This may considerably increase net emissions in this sector.
- An improved methodology is being developed to better represent emissions from land use changes
- There is a large scale, on-going programme of research to generate more detailed data on emissions in the agriculture sector.
- In the Waste Management sector, there is research underway to better understand the ratio of carbon dioxide to methane in landfill gas. This could considerably increase methane emissions in this sector.
- There is also likely to be a review of shipping emissions and of some carbon factors in the energy supply sector.

Note that there are likely to be further revisions in the 1990-2014 inventory which have not been noted within this publication.

# Section E. Further information and Glossary

## FURTHER INFORMATION

### Methodology and Source data

Full details of the methodology used to estimate Scottish greenhouse gas emissions together with further breakdowns are provided on the National Atmospheric Emissions Inventory website in the publication Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2013

### Scotland's Carbon Footprint

Scottish Greenhouse Gas Emissions on a Consumption Basis ("Scotland's Carbon Footprint 1998-2012 )

### Scottish Greenhouse Gas Emissions 2012. Key Revisions since 2008

This paper provides a breakdown of the key revisions to the Scottish Greenhouse Gas Emissions Official Statistics publication over successive years from the 1990-2008 inventory to the latest (1990-2012) inventory.

http://www.gov.scot/Topics/Statistics/Browse/Environment/Publications/ghgrevisions

### Climate Change (Scotland) Act 2009

This legislation outlines the requirements for percentage reductions targets for 2020 and 2050 and fixed annual targets

http://www.gov.scot/Topics/Environment/climatechange/scotlands-action/climatechangeact

### Relevant Secondary Legislation associated with Climate Change (Scotland) Act 2009

### Climate Change (Annual Targets) (Scotland) Order 2010

This Order sets the first batch of annual emissions reduction targets, for the period 2010-2022.

http://www.legislation.gov.uk/ssi/2010/359/introduction/made

### Climate Change (Annual Targets) (Scotland) Order 2011

This Order sets the second batch of annual emissions reduction targets, for the period 2023-2027.

http://www.gov.scot/Topics/Environment/climatechange/scotlands-action/climatechangeact/order2011

### The Carbon Accounting Scheme (Scotland) Regulations 2010

These Regulations establish the scheme for monitoring compliance with the annual emissions reduction targets set for 2010-2012.

http://www.legislation.gov.uk/ssi/2010/216/contents/made.

### The Carbon Accounting Scheme (Scotland) Amendment Regulations 2015

These Regulations establish the scheme for monitoring compliance with the annual emissions reduction targets set for 2013.

http://www.legislation.gov.uk/ssi/2015/189/contents/made

### The Climate Change (Additional Greenhouse Gas) (Scotland) Order 2015

This legislates for the inclusion of the new greenhouse gas (nitrogen trifluoride) to be added to the basket of gases in Scotland's greenhouse gas inventory.

http://www.legislation.gov.uk/ssi/2015/197/pdfs/ssi_20150197_en.pdf

### National Performance Framework Sustainability Purpose Targets

http://www.gov.scot/About/Performance/scotPerforms/purpose/sustainability

### Department of Energy and Climate Change (DECC) statistics

https://www.gov.uk/government/organisations/department-of-energy-climate-change/about/statistics#emissions-and-climate-change-statistics

### UK greenhouse gas inventory national system

https://www.gov.uk/government/publications/uk-greenhouse-gas-emissions-statistics-user-guidance

### Committee on Climate Change (CCC)

The CCC is an independent body established under the Climate Change Act to advise the UK Government and devolved administrations on reducing greenhouse gas emissions.

http://www.theccc.org.uk

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

The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty. The objective of the treaty is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

The treaty itself set no binding limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms. In that sense, the treaty is considered legally non-binding. Instead, the treaty provides a framework for negotiating specific international treaties (called "protocols") that may set binding limits on greenhouse gases.

http://unfccc.int/

### Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) assesses the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change. They provide advice to the UNFCCC on the scientific evidence and developments which are used to inform National Inventories.

http://www.ipcc.ch/

### Meteorological Office (Met Office)

The Meteorological (Met Office) publishes mean monthly and annual air temperature figures for Scotland from 1910 to 2014.

http://www.metoffice.gov.uk/pub/data/weather/uk/climate/datasets/Tmean/date/Scotland.txt

### EU Emissions Trading System (EU ETS)

Further information can be found in the Department for Energy and Climate Change (DECC) website.

https://www.gov.uk/participating-in-the-eu-ets

### Scottish Government Methodology Paper: Determining the Scottish EU ETS cap for 2013

This documents the calculations which determine the 'specified amounts' for emissions from (i) fixed installations located in Scotland and covered by the EU emissions trading system (EU-ETS) and (ii) aviation covered by the EU-ETS.

http://www.gov.scot/Topics/Statistics/Browse/Environment/Publications/EUETScap2013

### Scottish Energy Statistics

The Scottish Government's Energy in Scotland 2015 statistics compendium publication presents statistics on the energy sector in Scotland. It presents statistics for the following topics

- An overview of the energy sector in Scotland – including an Energy Balance for Scotland
- Energy Consumption
- Electricity
- Heat
- Transport
- Oil and Gas
- Energy Prices
- Climate Change
- Low Carbon Economy

http://www.gov.scot/Topics/Statistics/Browse/Business/Energy/EIS2015

### Scottish Transport Statistics

These statistics are produced by Transport Scotland on an annual basis, as part of a compendium publication on a wide range of transport issues.

http://www.transportscotland.gov.uk/statistics/scottish-transport-statistics-all-editions

## Table E1. Mapping between Scottish Government sectors, National Communication sectors, International Panel for Climate Change sectors and source

Note that the inventory data can be mapped in a variety of different ways. Further mappings of the 1990-2013 inventory can be found in the attached Excel tables and Pivot Table.

| SG Sector | NC Category | IPCC Sector | Source Name |
|---|---|---|---|
| Energy Supply | Energy Supply | 1A1ai Public Electricity&Heat Production | Miscellaneous industrial/commercial combustion |
| | | | Power stations |
| | | | Public sector combustion |
| | | 1A1b Petroleum Refining | Refineries - combustion |
| | | 1A1ci Manufacture of solid fuels | Coke production |
| | | | Solid smokeless fuel production |
| | | 1A1cii Oil and gas extraction | Upstream Gas Production - fuel combustion |
| | | | Upstream oil and gas production - combustion at gas separation plant |
| | | | Upstream Oil Production - fuel combustion |
| | | 1A1ciii Other energy industries | Collieries - combustion |
| | | | Gas production |
| | | | Nuclear fuel production |
| | | | Town gas manufacture |
| | | 1B1ai Underground mines:Abandoned | Closed Coal Mines |
| | | 1B1ai Underground mines:Mining activities | Deep-mined coal |
| | | 1B1ai Underground mines:Post-mining activities | Coal storage and transport |
| | | 1B1aii Surface mines:Mining activities | Open-cast coal |
| | | 1B1b Solid Fuel Transformation | Charcoal production |
| | | | Coke production |
| | | | Iron and steel - flaring |
| | | | Solid smokeless fuel production |
| | | 1B2a1 Oil exploration | Upstream Oil Production - Offshore Well Testing |
| | | 1B2a2 Oil production | Petroleum processes |
| | | | Upstream Oil Production - process emissions |
| | | 1B2a3 Oil transport | Upstream Oil Production - Offshore Oil Loading |
| | | | Upstream Oil Production - Onshore Oil Loading |
| | | 1B2a4 Oil refining/storage | Upstream Oil Production - Oil terminal storage |
| | | 1B2b1 Gas exploration | Upstream Gas Production - Offshore Well Testing |

| SG Sector | NC Category | IPCC Sector | Source Name |
|---|---|---|---|
| | | 1B2b3 Gas processing | Upstream Gas Production - process emissions |
| | | 1B2b4 Gas transmission and storage | Gas leakage |
| | | | Upstream Gas Production - Gas terminal storage |
| | | 1B2b5 Gas distribution | Gas leakage |
| | | 1B2c Flaring Gas | Upstream Gas Production - flaring |
| | | 1B2c Flaring Oil | Upstream Oil Production - flaring |
| | | 1B2c Venting Gas | Upstream Gas Production - venting |
| | | 1B2c Venting Oil | Upstream Oil Production - venting |
| | | 2A4d Other process uses of carbonates:other | Power stations - FGD |
| Transport (excluding international aviation and shipping) | Transport | 1A3a Domestic aviation | Aircraft - domestic cruise |
| | | | Aircraft - domestic take off and landing |
| | | 1A3bi Cars | Road transport - cars - cold start |
| | | | Road transport - cars - motorway driving |
| | | | Road transport - cars - rural driving |
| | | | Road transport - cars - urban driving |
| | | 1A3bii Light duty trucks | Road transport - LGVs - cold start |
| | | | Road transport - LGVs - motorway driving |
| | | | Road transport - LGVs - rural driving |
| | | | Road transport - LGVs - urban driving |
| | | 1A3biii Heavy duty trucks and buses | Road transport - buses and coaches - motorway driving |
| | | | Road transport - buses and coaches - rural driving |
| | | | Road transport - buses and coaches - urban driving |
| | | | Road transport - HGV articulated - motorway driving |
| | | | Road transport - HGV articulated - rural driving |
| | | | Road transport - HGV articulated - urban driving |
| | | | Road transport - HGV rigid - motorway driving |
| | | | Road transport - HGV rigid - rural driving |
| | | | Road transport - HGV rigid - urban driving |
| | | 1A3biv Motorcycles | Road transport - mopeds (<50cc 2st) - urban driving |
| | | | Road transport - motorcycle (>50cc 2st) - rural driving |
| | | | Road transport - motorcycle (>50cc 2st) - urban driving |
| | | | Road transport - motorcycle (>50cc 4st) - motorway driving |

| SG Sector | NC Category | IPCC Sector | Source Name |
|---|---|---|---|
| | | | Road transport - motorcycle (>50cc 4st) - rural driving |
| | | | Road transport - motorcycle (>50cc 4st) - urban driving |
| | | 1A3bv Other road transport | Road transport - all vehicles LPG use |
| | | 1A3c Railways | Rail - coal |
| | | | Railways - freight |
| | | | Railways - intercity |
| | | | Railways - regional |
| | | 1A3d Domestic navigation | Inland goods-carrying vessels |
| | | | Motorboats / workboats (e.g. canal boats, dredgers, service boats, tourist boats, river boats) |
| | | | Personal watercraft e.g. jet ski |
| | | | Sailing boats with auxiliary engines |
| | | | Shipping - coastal |
| | | 1A3eii Other Transportation | Aircraft - support vehicles |
| | | 1A4ai Commercial/Institutional | Railways - stationary combustion |
| | | 1A4ciii Fishing | Fishing vessels |
| | | 1A5b Other:Mobile | Aircraft - military |
| | | | Shipping - naval |
| | | 2D1 Lubricant Use | Marine engines |
| | | | Road vehicle engines |
| | | 2D3 Non-energy products from fuels and solvent use:Other | Road transport - urea |
| International Aviation and Shipping | International Aviation and Shipping | Aviation Bunkers | Aircraft - international cruise |
| | | | Aircraft - international take off and landing |
| | | | Aircraft between UK and CDs - Cruise |
| | | | Aircraft between UK and CDs - TOL |
| | | | Aircraft between UK and Gibraltar - Cruise |
| | | | Aircraft between UK and Gibraltar - TOL |
| | | | Aircraft between UK and other Ots (excl Gib.) - Cruise |
| | | | Aircraft between UK and other OTs (excl Gib.) - TOL |
| | | Marine Bunkers | Shipping - international IPCC definition |
| | | | Shipping between UK and Gibraltar |
| | | | Shipping between UK and OTs (excl. Gib) |
| Agriculture and Related Land Use | Agriculture | 1A4ci Agriculture/Forestry/Fishing:Stationary | Agriculture - stationary combustion |
| | | | Miscellaneous industrial/commercial combustion |
| | | 1A4cii Agriculture/Forestry/Fishing: | Agriculture - mobile machinery |

| SG Sector | NC Category | IPCC Sector | Source Name |
|---|---|---|---|
| | | Off-road | |
| | | 2D1 Lubricant Use | Agricultural engines |
| | | 3A1 Enteric Fermentation dairy cattle | Agriculture livestock - dairy cattle enteric |
| | | 3A1 Enteric Fermentation non-dairy cattle | Agriculture livestock - other cattle enteric |
| | | 3A2 Enteric Fermentation sheep | Agriculture livestock - sheep enteric |
| | | 3A3 Enteric Fermentation swine | Agriculture livestock - pigs enteric |
| | | 3A4 Enteric Fermentation other:deer | Agriculture livestock - deer enteric |
| | | 3A4 Enteric Fermentation other:goats | Agriculture livestock - goats enteric |
| | | 3A4 Enteric Fermentation other:horses | Agriculture livestock - horses enteric |
| | | 3B1 Manure Management dairy cattle | Agriculture livestock - dairy cattle wastes |
| | | 3B1 Manure Management non-dairy cattle | Agriculture livestock - other cattle wastes |
| | | 3B2 Manure Management sheep | Agriculture livestock - sheep goats and deer wastes |
| | | 3B3 Manure Management swine | Agriculture livestock - pigs wastes |
| | | 3B4 Manure Management other:deer | Agriculture livestock - deer wastes |
| | | 3B4 Manure Management other:goats | Agriculture livestock - goats wastes |
| | | 3B4 Manure Management other:horses | Agriculture livestock - horses wastes |
| | | 3B4 Manure Management other:poultry | Agriculture livestock - all poultry wastes |
| | | | Agriculture livestock - broilers wastes |
| | | | Agriculture livestock - laying hens wastes |
| | | | Agriculture livestock - other poultry wastes |
| | | 3B4 Other | Agriculture livestock - manure leaching (indirect) |
| | | | Agriculture livestock - manure liquid systems (indirect) |
| | | | Agriculture livestock - manure other (indirect) |
| | | | Agriculture livestock - manure solid storage and dry lot (indirect) |
| | | 3D Agricultural Soils | Agricultural soils |
| | | 3D1 Agricultural soils-Mineralization/Immobilization | Agricultural soils - Mineralization/Immobilization Associated with change in Soil Organic Matter |
| | | 3F Field burning | Field burning |
| | | 3G1 Liming - limestone | Liming |
| | | 3G2 Liming - dolomite | Liming |

| SG Sector | NC Category | IPCC Sector | Source Name |
|---|---|---|---|
| | | 3H Urea application | Agriculture - application of urea |
| | Land Use, Land Use Change and Forestry | 4B Cropland (Biomass Burning - controlled) | Cropland - Biomass Burning\Controlled Burning |
| | | 4B Cropland (Biomass Burning - wildfires) | Cropland - Biomass Burning\Wildfires |
| | | 4B Cropland Drainage rewetting other management of organic and mineral soils | Cropland - Drainage and rewetting and other management of organic and mineral soils |
| | | 4B1 Cropland Remaining Cropland | Cropland remaining Cropland |
| | | 4B2 Cropland -Direct N2O emission from N Mineralization/Immobilization | Direct N2O Emissions from N Mineralization/Immobilisation |
| | | 4B2 Land Converted to Cropland | Land converted to Cropland |
| | | 4C Grassland (Biomass burning - controlled) | Grassland - Biomass Burning\Controlled Burning |
| | | 4C Grassland (Biomass Burning - wildfires) | Grassland - Biomass Burning\Wildfires |
| | | 4C Grassland Drainage rewetting other management of organic and mineral soils | Grassland - Drainage and rewetting and other management of organic and mineral soils |
| | | 4C Grassland-Direct N2O emission from N Mineralization/Immobilization | Grassland - Direct N2O Emissions from N Mineralization/Immobilisation |
| | | 4C1 Grassland Remaining Grassland | Grassland remaining Grassland |
| | | 4C2 Land converted to grassland | Land converted to Grassland |
| | | 4D1 Wetlands remaining wetlands | Wetlands remaining Wetland |
| | | 4D2 Land converted to wetlands | Land converted to Wetland |
| | | 4D2 Non-CO2 emissions from drainage of soils and wetlands | Non-CO2 emissions from drainage of soils and wetlands |
| Business and Industrial Process | Business | 1A2a Iron and steel | Blast furnaces |
| | | | Iron and steel - combustion plant |
| | | 1A2b Non-Ferrous Metals | Autogeneration - exported to grid |
| | | | Autogenerators |
| | | | Non-Ferrous Metal (combustion) |
| | | 1A2c Chemicals | Chemicals (combustion) |
| | | | Other industrial combustion |
| | | 1A2d Pulp Paper Print | Pulp, Paper and Print (combustion) |
| | | 1A2e food processing beverages and tobacco | Food & drink, tobacco (combustion) |
| | | 1A2f Non-metallic minerals | Cement production - combustion |
| | | | Lime production - non decarbonising |
| | | 1A2gvii Off-road vehicles and other machinery | Industrial off-road mobile machinery |
| | | 1A2gviii Other manufacturing industries and construction | Autogeneration - exported to grid |
| | | | Autogenerators |
| | | | Other industrial combustion |

| SG Sector | NC Category | IPCC Sector | Source Name |
|---|---|---|---|
| | | 1A4ai Commercial/Institutional | Miscellaneous industrial/commercial combustion |
| | | 2B1 Chemical Industry:Ammonia production | Ammonia production - combustion |
| | | 2B8g Petrochemical and carbon black production:Other | Chemicals (combustion) |
| | | 2D1 Lubricant Use | Industrial engines |
| | | | Other industrial combustion |
| | | 2D4 Other NEU | Non Energy Use: petroleum coke |
| | | 2E1 Integrated circuit or semiconductor | Electronics - HFC |
| | | | Electronics - NF3 |
| | | 2F1a Commercial refrigeration | Commercial Refrigeration |
| | | 2F1b Domestic refrigeration | Domestic Refrigeration |
| | | 2F1c Industrial refrigeration | Industrial Refrigeration |
| | | 2F1d Transport refrigeration | Refrigerated Transport |
| | | 2F1e Mobile air conditioning | Mobile Air Conditioning |
| | | 2F1f Stationary air conditioning | Stationary Air Conditioning |
| | | 2F2a Closed foam blowing agents | Foams |
| | | | Foams HFCs for the 2006 GLs |
| | | 2F2b Open foam blowing agents | One Component Foams |
| | | 2F3 Fire Protection | Firefighting |
| | | 2F5 Solvents | Precision cleaning - HFC |
| | | 2F6b Other Applications:Contained-Refrigerant containers | Refrigerant containers |
| | | 2G1 Electrical equipment | Electrical insulation |
| | | 2G2 Military applications | AWACS |
| | | 2G2 Particle accelerators | Particle accelerators |
| | | 2G2e Electronics and shoes | Other F-Gas Use |
| | | 2G2e Tracer gas | SF6 used as a tracer gas |
| | | 2G3a Medical aplications | N2O use as an anaesthetic |
| | | 5C2.2b Non-biogenic:Other | Accidental fires - other buildings |
| | Industrial Process | 2A1 Cement Production | Cement - decarbonising |
| | | 2A2 Lime Production | Lime production - decarbonising |
| | | 2A3 Glass production | Glass - general |
| | | 2A4a Other process uses of carbonates:ceramics | Brick manufacture - all types |
| | | | Brick manufacture - Fletton |
| | | 2B1 Ammonia Production | Ammonia production - feedstock use of gas |
| | | 2B10 Chemical Industry:Other | Chemical industry - general |
| | | 2B2 Nitric Acid Production | Nitric acid production |
| | | 2B3 Adipic Acid Production | Adipic acid production |
| | | 2B6 Titanium dioxide production | Chemical industry - titanium dioxide |
| | | 2B7 Soda Ash Production | Chemical industry - soda ash |

| SG Sector | NC Category | IPCC Sector | Source Name |
|---|---|---|---|
| | | 2B8a Methanol production | Chemical industry - methanol |
| | | 2B8b Ethylene Production | Chemical industry - ethylene |
| | | 2B8c Ethylene Dichloride and Vinyl Chloride Monomer | Chemical Industry – ethylene dichloride |
| | | 2B8d Ethylene Oxide | Chemical industry - ethylene oxide |
| | | 2B8e Acrylonitrile | Chemical industry - acrylonitrile |
| | | 2B8f Carbon black production | Chemical industry - carbon black |
| | | 2B9a1 Fluorchemical production:By-product emissions | Halocarbons production - by-product |
| | | 2B9b3 Fluorchemical production:Fugitive emissions | Halocarbons production - fugitive |
| | | 2C1a Steel | Basic oxygen furnaces |
| | | | Electric arc furnaces |
| | | | Ladle arc furnaces |
| | | 2C1b Pig iron | Iron and steel - flaring |
| | | 2C1d Sinter | Sinter production |
| | | 2C3 Aluminium Production | Primary aluminium production - general |
| | | | Primary aluminium production - PFC emissions |
| | | 2C4 Magnesium production | Magnesium cover gas |
| | | 2C6 Zinc Production | Non-ferrous metal processes |
| | | 2D3 Non-energy products from fuels and solvent use:Solvent Use | Solvent use |
| Residential | Residential | 1A4bi Residential stationary | Domestic combustion |
| | | 1A4bii Residential:Off-road | House and garden machinery |
| | | 2D2 Non-energy products from fuels and solvent use:Paraffin wax use | Non-aerosol products - household products |
| | | 2F4a Metered dose inhalers | Metered dose inhalers |
| | | 2F4b Aerosols:Other | aerosols - halocarbons |
| | | 5B1a composting municipal solid waste | Composting (household) |
| | | 5C2.2b Non-biogenic:Other | Accidental fires - dwellings |
| | | 5C2.2b Non-biogenic:Other Accidental fires (vehicles) | Accidental fires - vehicles |
| Waste Management | Waste Management | 5A1a Managed Waste Disposal sites anaerobic | Landfill |
| | | 5B1a composting municipal solid waste | Total composting (non-household) |
| | | 5B2a Anaerobic digestion municipal solid waste | Anaerobic Digestion (other) |
| | | | Mechanical Biological Treatment |
| | | 5C1.1b Biogenic:Sewage sludge | Incineration - sewage sludge |
| | | 5C1.2a Non-biogenic:municipal solid waste | Incineration |
| | | 5C1.2b Non-biogenic:Clinical waste | Incineration - clinical waste |
| | | 5C1.2b Non-biogenic:Other | Incineration - chemical waste |

| SG Sector | NC Category | IPCC Sector | Source Name |
|---|---|---|---|
| | | Chemical waste | |
| | | 5D1 Domestic wastewater treatment | Sewage sludge decomposistion in private systems |
| | | | Sewage sludge decomposition |
| | | 5D2 Industrial wastewater treatment | Industrial Waste Water Treatment |
| Development | Land Use, Land Use Change and Forestry | 4E Settlements (Biomass burning - controlled) | Settlements - Biomass Burning\Controlled Burning |
| | | 4E Settlements-Direct N2O emission from N fertilisation | Settlements - Direct N2O Emissions from N Mineralization/Immobilisation |
| | | 4E1 Settlements remaining settlements | Settlements remaining Settlements |
| | | 4E2 Land converted to settlements | Land converted to Settlements |
| Public Sector Buildings | Public | 1A4ai Commercial/Institutional | Public sector combustion |
| Forestry | Land Use, Land Use Change and Forestry | 4A Forest Land (Biomass Burning - wildfires) | Forest Land - Biomass Burning\Wildfires |
| | | 4A Forest Land (organic soils drainage) | Forest Land - Drainage of Organic Soils |
| | | 4A1 Forest Land Remaining Forest Land | Forest Land remaining Forest Land |
| | | 4A2 Forest Land-Direct N2O emission from N fertilisation | Direct N2O emission from N fertilisation of forest land |
| | | 4A2 Land Converted to Forest Land | Land converted to Forest Land |
| | | 4G Harvested wood products | Harvested Wood Products |

# GLOSSARY

## Adjusted emissions

Greenhouse gas emissions that have taken into account purchases/sales through the EU ETS. Adjusted emissions may be higher or lower than actual emitted emissions depending on the quantity of purchases or sales. Scottish Government emission reduction targets are assessed using adjusted emissions.

## Afforestation

The act or process of establishing a forest on land that has not been forested in recent history.

## Baseline Period

Emissions reduction is based on a Baseline Period. For the greenhouse gases $CO_2$, $CH_4$ and $N_2O$, 1990 was specified as the baseline. 1995 is the baseline for emissions of the F-gases.

## Carbon dioxide ($CO_2$)

Carbon dioxide is one of the main gases responsible for climate change. It is mostly emitted through the oxidation of carbon in fossil fuels, e.g. burning coal.

## Carbon sink

A carbon sink is a natural or artificial reservoir that accumulates and stores $CO_2$ for an indefinite period.

## Climate change

Climate change is a long-term change in the earth's climate. This can be accelerated by human activity, e.g. by releasing $CO_2$ into the atmosphere.

## Deforestation

The removal of forest stands by cutting and burning to provide land for agricultural purposes, residential or industrial building sites, roads, etc., or the harvesting of trees for building materials or fuel.

## EU ETS

The European Union Greenhouse Gas Emissions Trading System (EU ETS) is the largest multi-national emissions trading system in the world. Launched in 2005, the EU ETS is an EU policy aimed at mitigating climate change by limiting greenhouse gas emissions from industry sectors and aviation. Operating across Europe the system is mandatory for large energy-intensive industrial installations. Compared with 2005 levels, the EU ETS aims to deliver a 21 per cent reduction in emissions by 2020 and a 43 per cent reduction by 2030. Participants include more than 11,000 heavy energy-using installations in power generation, the manufacturing industry and airlines across 31 countries in the European Economic Area (EEA).

Over 11,000 installations throughout the EU are covered by the system, accounting for nearly 50 per cent of the EU's total $CO_2$ emissions.

The EU ETS began in 2005. Phase III started in January 2013 and runs to December 2020.

## Fluorinated gases (F-gases)

F-gases are the generic name given to HFCs, PFCs, $SF_6$ and $NF_3$. These have been used as replacements for CFCs, which are ozone depleting substances that have been banned under the Montreal Protocol. They have very high global warming potentials.

## Greenhouse effect

The greenhouse effect is the process by which heat from the sun is trapped within the Earth's atmosphere by greenhouse gases. This process is also known as *radiative forcing*.

## Greenhouse gas

A greenhouse gas is a gas which absorbs infrared radiation emitted from the surface of the Earth, helping to retain a portion of that energy in the atmosphere as heat.

## Global warming potential (GWP)

GWP is a measure of how much a greenhouse gas is estimated to contribute to global warming. It is a relative scale which compares the potency of each gas to $CO_2$.

## Hydrofluorocarbons (HFCs)

HFCs are produced commercially as a substitute for chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). HFCs are largely used in refrigeration and insulating foam. Their Global Warming Potentials range from 12 to 14,800 times that of $CO_2$, depending on the gas type.

## Inventory

The inventory contains greenhouse gas emissions estimates for Scotland and the UK. The Inventory is a disaggregation of the UK Inventory, which is based on five major sectors: energy, industrial processes, agriculture, land-use, land-use change and forestry, and waste.

## IPCCC

The Intergovernmental Panel on Climate Change (IPCC) assesses the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change. They provide advice to the UNFCCC on the scientific evidence and developments which are used to inform National Inventories.

## LULUCF

Estimates of emissions and removals from land use, land use change and forestry (LULUCF) depend critically on assumptions made on the rate of loss or gain of carbon in Scotland's carbon rich soils. In Scotland, LULUCF activities, taken as a whole, acts as a sink, absorbing more greenhouse gas emissions than it releases.

## Methane ($CH_4$)

Methane is a greenhouse gas that is around 25 times more potent in the atmosphere than $CO_2$ over a 100-year time horizon. Main sources include agriculture and landfill.

## National Communication (NC) Sectors

The UK NC sectors are agreed groupings of the more detailed sectors reported to the United Nations Framework Convention on Climate Change by the UK. This report uses Scottish Government sectors. Mapping of these to NC sectors and IPCC sectors can be seen in Section E.

## Nitrogen trifluoride ($NF_3$)

Nitrogen trifluoride is a greenhouse gas that is around 17,200 times more potent in the atmosphere than $CO_2$ over a 100-year time horizon. The main source of nitrogen trifluoride is in the making of semiconductors.

## Nitrous oxide ($N_2O$)

Nitrous oxide is a greenhouse gas that is around 298 times more potent in the atmosphere than $CO_2$ over a 100-year time horizon. The main source is agricultural soil.

## Other Petroleum Gas (OPG)

This consists mainly of ethane plus some other hydrocarbons, excluding butane and propane.

## Perfluorocarbons (PFCs)

PFCs are a by-product of aluminium smelting. They are also the replacement for CFCs in manufacturing semiconductors. The Global Warming Potentials of PFCs ranges from 7,390 - 17,340 times that of $CO_2$ over a 100-year time horizon.

## Radiative forcing

An externally imposed perturbation in the radiative energy budget of the Earth's atmosphere. Such a perturbation can be brought about by changes in the concentrations of radiatively active species (e.g. greenhouse gases), changes in the solar irradiance incident upon the planet, or other changes that affect the radiative energy absorbed by the surface (e.g. changes in surface reflection properties).

## Sequestration

The process by which carbon sinks remove carbon dioxide ($CO_2$) from the atmosphere.

## Source (UNFCCC definition)

Any process or activity which releases a greenhouse gas or a precursor greenhouse gas to the atmosphere.

## Sulphur hexafluoride ($SF_6$)

It is largely used in heavy industry to insulate high-voltage equipment and to assist in the manufacturing of cable-cooling systems. Its global warming potential is 22,800 times that of $CO_2$ over a 100-year time horizon.

## UNFCCC

In 1992, the UNFCCC was adopted as the basis for a global response to climate change. The ultimate objective of the Convention is to stabilise greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system.

**AN OFFICIAL STATISTICS PUBLICATION FOR SCOTLAND**

Official and National Statistics are produced to high professional standards set out in the Code of Practice for Official Statistics. Both undergo regular quality assurance reviews to ensure that they meet customer needs and are produced free from any political interference.

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**How to access background or source data**

The data collected for this <statistical bulletin >:
☐ are available in more detail through Scottish Neighbourhood Statistics

☒ are available from National Atmospheric Emissions Inventory website and from a separate Excel workbook accompanying this publication

☐ may be made available on request, subject to consideration of legal and ethical factors. Please contact <email address> for further information.

☐ cannot be made available by Scottish Government for further analysis as Scottish Government is not the data controller.

**Complaints and suggestions**
If you are not satisfied with our service or have any comments or suggestions, please write to the Chief Statistician, 3WR, St Andrews House, Edinburgh, EH1 3DG,
Telephone: (0131) 244 0302, e-mail statistics.enquiries@scotland.gsi.gov.uk

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