Carbon Dioxide

GHG Inventory summary Factsheet

Territorial coverage: UK including Crown Dependencies and Overseas Territories
Total emissions: Quoted with respect to emissions including net LULUCF
Sector Definition: National Communication

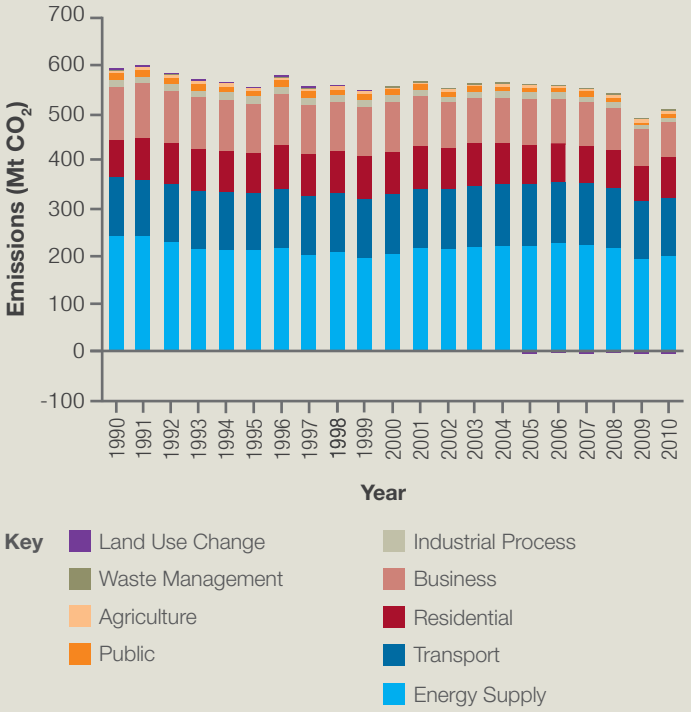
GHG summary - historic emissions

- Carbon dioxide emissions have decreased by 15.9% from 1990 to 2010 and are currently 497.9 $MtCO_2$ (84.4% of UK total GHGs).
- The main sources of carbon dioxide emissions in 2010 are fuel combustion for electricity and heat production (31.6%), road transport (22.4%) and to a lesser extent residential fuel combustion (17.0%) and manufacturing and construction (13.3%).
- Carbon dioxide emissions from electricity production reduced by 22.9% over the period and contributed to nearly half (49.8%) of the total net change in carbon dioxide.
- Road transport and residential fuel combustion emissions have increased over the period by 2.7% and 9.2% respectively.
- Manufacturing and construction industry carbon dioxide emissions decreased by 34.5% from 1990 to 2010, which equated to 37.2% of the total net reduction in carbon dioxide.

Sources of emissions and data sets

- The predominant source of emissions is fuel combustion with the main uses being to generate electricity and use in the transport sector, manufacturing industries and residential sector.
- The Digest of UK Energy Statistics (DUKES) and EU Emissions Trading System (EU ETS) are key datasets for stationary combustion sources, together with information from trade associations such as Tata Steel and the Mineral Products Association.
- For transport key data sources include DUKES, UK Department for Transport publication Transport Statistics Great Britain, Association of Train Operating Companies (ATOC), fuel consumption data from the Ministry of Defence and Civil Aviation Authority movement data.
- Most emission factors for carbon dioxide are UK specific, based on data supplied by organisations such as the UK Petroleum Industries Association.

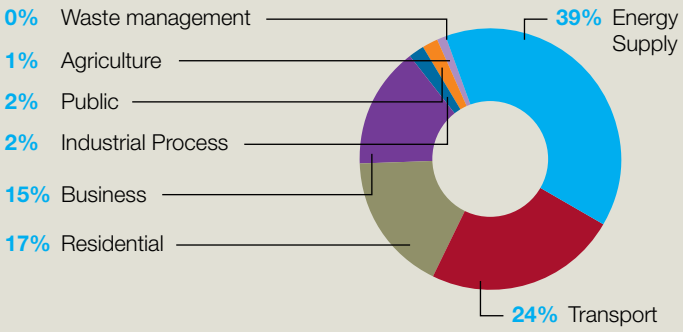
Total Net Carbon Dioxide Emissions, 1990 - 2010



Source: UK GHG Inventory (UNFCCC coverage) (AEA, 2012)

Note: Categories used are based on source emissions not end-user. Excludes the impact of traded allowances.

Total Emissions by Sector (2010, Excluding LULUCF)



Methodology

- For large combustion sources, emissions are estimated by combining activity data (from DUKES) with emission factors that are taken from a variety of sources including the EU-ETS, data provided by industry groups and literature based sources. For some plant site specific data are available.
- Carbon dioxide emissions from transport are estimated from fuel consumed and the carbon content of fuels, with movement and journey characteristics taken into account where applicable.
- Residential fuel combustion emissions are estimated by multiplying the fuel use estimates in DUKES by an emission factor. Emission factors are either UK specific or are taken from published inventory guidelines (IPCC and UNECE).
- Emissions from Land Use, Land Use Change and Forestry are modelled according to IPCC Good Practice Guidance for LULUCF.

Uncertainties

- The GHG Inventory quantifies uncertainties on emission factors and activity data, which in turn allow for the production of uncertainty estimates on the: emissions; overall uncertainty by gas; and indicative-only estimates of sector level uncertainties.
- Uncertainty in UK carbon dioxide emissions in 2010 is 2%. Total emissions of carbon dioxide are dominated by fuel combustion. Carbon dioxide emissions from fuel combustion are relatively certain, since the ca-ba content of fuel is well known, and the energy statistics are of good quality.
- The central estimate of total carbon dioxide emissions in 2010 was estimated as 497.9 $MtCO_2$ with Monte Carlo uncertainty analysis suggested that 95% of the values were between 490.2-505.5 $MtCO_2$.
- Uncertainty in the trend: 95% probability that carbon dioxide emissions in 2010 were between 14% and 18% below the level in 1990.

Improvements

- Work is ongoing to better understand the differences between DUKES and EU ETS data, and to reconcile any discrepancies.
- The 2012 inventory included improvements to road transport to take account of information about the fleet mix from Automatic Number Plate Recognition (ANPR) data.

Projections

- Projected emissions of carbon dioxide are expected to decrease by 25% from 2010 levels by 2025.
- Emissions continue to be dominated by fuel combustion for electricity and heat production and road transport.
- The overall decrease in carbon dioxide emissions between 1990 and 2025 is estimated to be 37%.
- The projections presented here exclude the impact of emissions trading.
- The projections are taken from Updated Energy and Emissions Projections: October 2011 (DECC); historic data taken from the 2012 inventory.

Historic and Projected Emissions of Carbon Dioxide

Source: Updated Energy and Emissions Projections: October 2011 (DECC).

Links

- NAEI website: http://naei.defra.gov.uk/
- DECC GHG statistics: http://www.decc.gov.uk/en/content/cms/statistics/climate_stats/gg_emissions/gg_emissions.aspx
- DECC projections: http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/en_emis_projs/en_emis_projs.aspx

AEA

DEPARTMENT OF ENERGY & CLIMATE CHANGE

F-gases

GHG Inventory summary Factsheet

Territorial coverage: UK including Crown Dependencies and Overseas Territories
Total emissions: Quoted with respect to emissions including net LULUCF
Sector Definition: National Communication

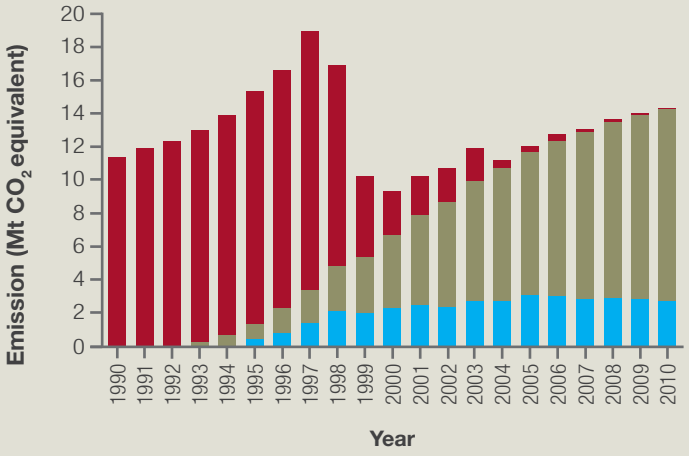
GHG summary - historic emissions

- Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur Hexafluoride (SF_6) together comprise the F-gases. Their Global Warming Potentials (GWPs), given relative to the same volume of carbon dioxide range from 140 to 23,900.
- Emissions of the F-gases have increased by 10.2% from 1990 to 2010 and are currently 15.2 $MtCO_2e$ (2.6% of UK total GHGs).
- PFC emissions have decreased by 84.3% from 1990 to 2010, and SF_6 emissions by 33.0%. However, HFC emissions have increased by 25.7% over this same period
- In 2010 F-gases accounted for 2.6% (15.2 $MtCO_2e$) of the UK's greenhouse gas emissions, of which the majority, 94.0% (14.3 $MtCO_2e$), are HFCs, with the remainder comprised of 0.7 $MtCO_2e$ SF_6 and 0.2 $MtCO_2e$ PFCs.
- Between 1998/99 there has been a fall in emissions from F-Gas manufacture (2E1, HFC by-product emissions from HCFC manufacture), due to the installation of abatement equipment at two of the three UK manufacturers. Emissions from certain end use sectors, such as refrigeration (2F1) are continuing to grow.

Sources of emissions and data sets

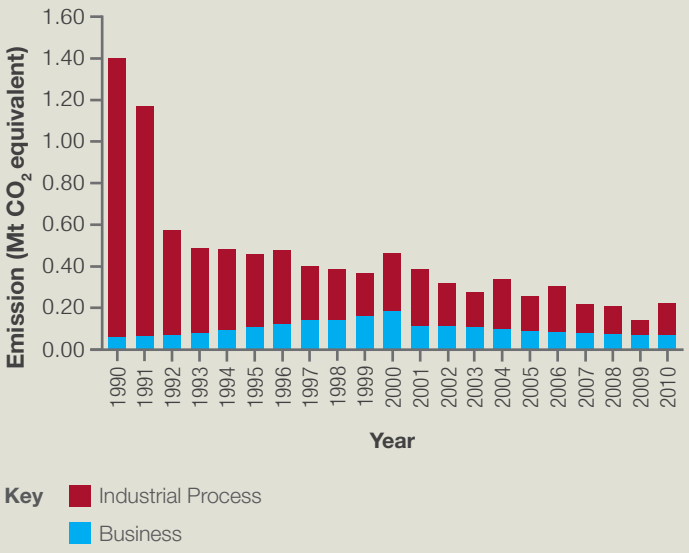
- The main source of HFCs is refrigeration and air conditioning. More than half of PFC emissions arise from aluminium production, and electrical equipment and sporting goods account for 81% of total SF_6 emissions.
- For refrigeration and air conditioning, key sources of data are refrigerant sales data from the British Refrigeration Association, literature sources, stakeholder consultation with industry experts, and the IPCC Guidelines.
- Key data sets for other sources include the Environment Agency's Pollution Inventory, data supplied directly by plant operators, literature sources and international guidance.

UK HFC emissions by source (1990 - 2010)



Note: Categories used are based on source emissions not end-user.

UK PFC emissions by source (1990 - 2010)



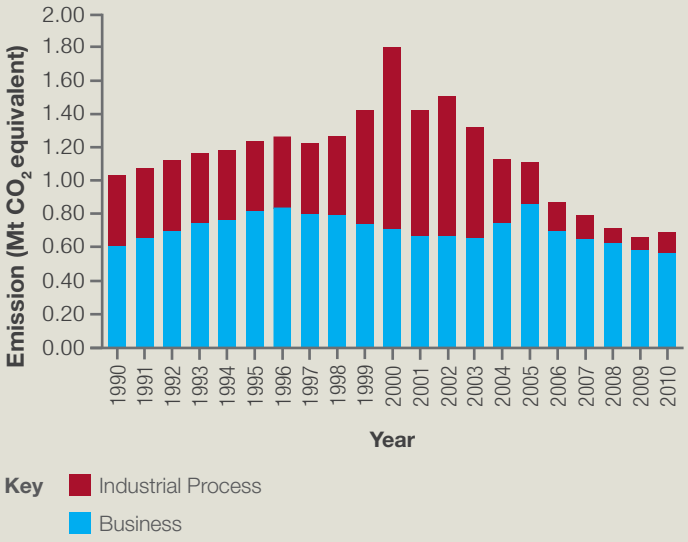
Methodology

- Emissions of f-gases can occur:
  - As a by-product or fugitive emission from the production of fluorinated gases
  - As a by-product from certain industrial processes
  - Through the use of F-gases, either in products or for specific industrial applications
- Emissions of F-gases from fluorinated gas manufacture and aluminium production are based on data supplied either directly from the operators to the inventory compilers, or via the regulators' inventories (e.g. the Pollution Inventory).
- When F-gases are filled into products, emissions can occur during manufacture or filling of the product, through leakage during the product's lifetime, and at disposal. Examples of this type of source include refrigeration and air conditioning equipment, aerosols and metered dose inhalers, and electrical equipment.
- Emissions from these types of sources are modelled. This requires information about the amount of products in use, their typical lifetime, the amount of gas which leaks at manufacture or filling, annually during the lifetime of the product, and at the end of life.

Uncertainties

- Uncertainties in UK F-gas emissions in 2010 are 6% for HFCs, 22% for PFCs and 15% for SF_6
- Uncertainty on the trend: The Monte Carlo analysis indicates that there is a 95% probability that emissions in 2010 differed from those in 1990 by 10% to +45% for HFCs, -87% to -81% for PFCs and -45% to -18% for SF_6

UK SF_6 emissions by source (1990 - 2010)



Improvements

- In 2011 the refrigeration and air-conditioning model was re built, to replace top down estimates of refrigerant use with bottom up data, based on literature sources and stakeholder engagement. All parameters in the model have been reviewed and updated

Projections

- Projected emissions of F-gases are expected to decrease by 34% from 2010 levels by 2025.
- Emissions continue to be dominated by emissions of HFCs in the business and residential sectors.
- The overall decrease in F-gases emissions between 1990 and 2025 is estimated to be 48%.
- The projections presented here exclude the impact of emissions trading.
- The projections are taken from Updated Energy and Emissions Projections: October 2011 (DECC); historic data taken from the 2012 inventory.

Historic and Projected Emissions of F-Gases

Source: Updated Energy and Emissions Projections: October 2011 (DECC).

Links

- NAEI website: http://naei.defra.gov.uk/
- DECC GHG statistics: http://www.decc.gov.uk/en/content/cms/statistics/climate_stats/gg_emissions/gg_emissions.aspx
- DECC projections: http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/en_emis_projs/en_emis_projs.aspx

Methane

GHG Inventory summary Factsheet

Territorial coverage: UK including Crown Dependencies and Overseas Territories
Total emissions: Quoted with respect to emissions including net LULUCF
Sector Definition: National Communication

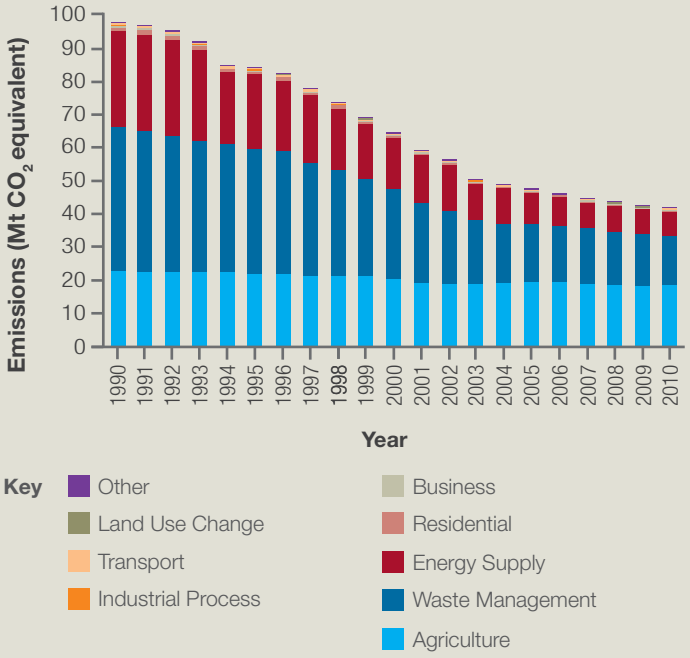
GHG summary - historic emissions

- Methane emissions have decreased by 57.6% from 1990 to 2010 and are currently 41.4 $MtCO_2e$ (7.0% of UK total GHGs).
- The main sources of methane emissions are landfilled waste (35.6% in 2010), agriculture (43.6% in 2010) and fugitive emissions (16.9% in 2010).
- landfilled waste methane emissions reduced by 65.8% over the period and contributed to over half (50.5%) of the total methane reduction.
- Fugitive methane emissions from fuels decreased by 75.6%, which equated to 38.4% of the total reduction of methane emissions over the period.
- Agricultural methane emissions from enteric fermentation and manure management reduced by 17.7% and 25.3%, respectively, and combined are responsible for only 7.5% of the reduction of total methane emissions since 1990.

Sources of emissions and data sets

- The main sources of methane emissions are waste management (mostly landfill), agriculture and fugitive emissions from fuels (within the Energy Supply sector).
- Key data for waste management includes the Environment Agency's Pollution Inventory, Expenditure and Food Survey (Defra), UK population statistics (Office National Statistics), water company returns to Ofwat, and data supplied directly by the water companies. Waste arisings data are taken from the WasteDataFlow.
- For agriculture, the main dataset used in estimation is the June Survey of Agriculture and Horticulture, published by Defra.
- Key data for fugitive emissions from fuels are from the Coal Authority, Oil and Gas UK, gas network operators and the Environmental Emissions Monitoring System (EEMS).

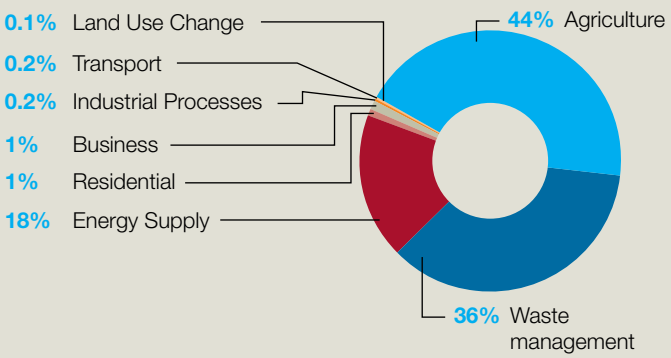
UK Methane emissions by source (1990 - 2010)



Source: UK GHG Inventory (UNFCCC coverage) (AEA, 2012)

Note: Categories used as based on source emissions not end-user.

Total Emissions by Sector (2010)



Methodology

- Emissions from landfill are modelled, based on the amount and type of waste sent to landfill, the characteristics of the waste, and information about landfill management (e.g. the amount of gas captured and used). The model is called "MELMod". Emissions from waste water treatment are based on the June returns to Ofwat, combined with emissions data supplied directly by certain water companies, and scaled up to represent total UK emissions.
- Methane emissions from enteric fermentation and manure management are estimated by combining livestock numbers with livestock specific emission factors. The emission factors used are a mixture of IPCC global average values and UK specific from research.
- Emissions from operating coal mines are estimated by combining coal production data with an emission factor. Emissions from closed coal mines are modelled, based on estimates of the methane reserves, information about flooding and mine closure dates.
- Emissions from offshore oil and gas production are estimated by the offshore operators themselves, and reported by Oil and Gas UK via the EEMS reporting mechanism.
- Total natural gas leakage from gas distribution is modelled by the network operators and combined with the methane content of gas to produce estimated methane emissions from this source.

Uncertainties

- The GHG Inventory quantifies uncertainties on emission factors and activity data, which in turn allow for the production of uncertainty estimates on the: emissions; overall uncertainty by gas; and indicative-only estimates of sector level uncertainties.
- Uncertainty in UK methane emissions in 2010 is 20%.
- The central estimate of total CH_4 emissions in 2010 was estimated as 41.5 $MtCO_2e$ with Monte Carlo uncertainty analysis suggested that 95% of the values were between 35.5-49.0 $MtCO_2e$
- Uncertainty in the trend: 95% probability that methane emissions in 2010 were between 45% and 67% below the level in 1990.

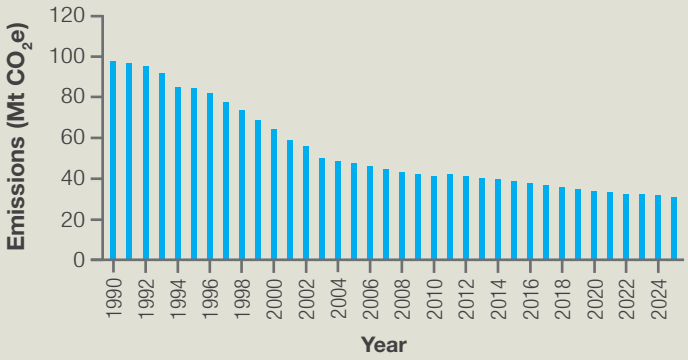
Improvements

- Model input data for the landfill model was updated for the 2011 inventory. This was done as part of a research project commissioned by Defra. A peer review on the revised model has since resulted in the revision of some values assigned to DDOC in the model.
- A programme of agricultural research projects is ongoing, which includes research into the availability of more detailed emission factors and activity data from across the UK.
- DECC commissioned a study in 2011 to update emissions from closed coal mines. The revised emissions from this source were included in the 2012 inventory submission.

Projections

- Projected emissions of methane are expected to decrease by 24% from 2010 levels by 2025.
- Emissions continue to be dominated by landfilled waste, agriculture and fugitive emissions.
- The overall decrease in methane emissions between 1990 and 2025 is estimated to be 68%.
- The projections presented here exclude the impact of emissions trading.
- The projections are taken from Updated Energy and Emissions Projections: October 2011 (DECC); historic data taken from the 2012 inventory.

Historic and Projected Emissions of Methane



Source: Updated Energy and Emissions Projections: October 2011 (DECC).

Links

- NAEI website: http://naei.defra.gov.uk/
- DECC GHG statistics: http://www.decc.gov.uk/en/content/cms/statistics/climate_stats/gg_emissions/gg_emissions.aspx
- DECC projections: http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/en_emis_projs/en_emis_projs.aspx

Nitrous Oxide

GHG Inventory summary Factsheet

Territorial coverage: UK including Crown Dependencies and Overseas Territories
Total emissions: Quoted with respect to emissions including net LULUCF
Sector Definition: National Communication

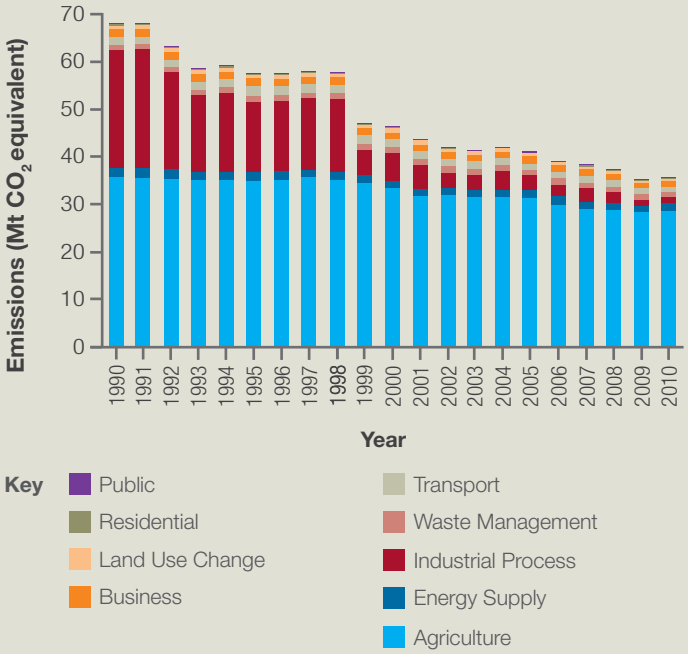
GHG summary - historic emissions

- Nitrous oxide emissions have decreased by 47.5% from 1990 to 2010 and are currently 35.6 $MtCO_2e$ (6.0% of UK total GHGs).
- The main sources of nitrous oxide emissions are currently agricultural soils (74% in 2010), fuel combustion (12% in 2010) and nitric acid production (3.7% in 2010). Historically the chemical industry was a significant source in the 1990s.
- Emissions from agricultural soils decreased by 19.6% over the time series and contributed 20.0% to the total decrease in nitrous oxide emissions.
- Emissions from fuel combustion have decreased by 31%, contributing 6% to the total decrease.
- Emissions from chemical industry processes (nitric and adipic acid production) decreased by 94.7% with a significant decrease seen between 1998 and 1999. The decrease in these emissions equates to 72.3% of the total decrease in nitrous oxide emissions over the period.

Sources of emissions and data sets

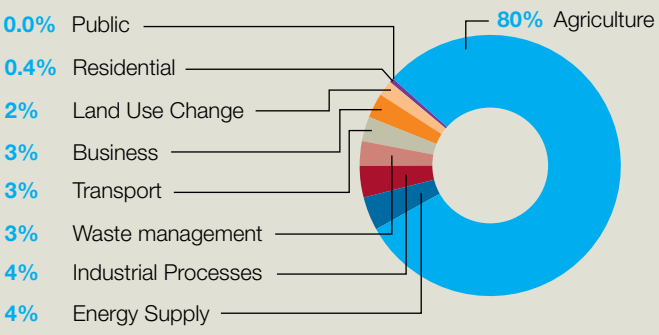
- Agricultural soils, fuel combustion and nitric acid production accounted for almost 90% of total N_2O emissions in 2010.
- The main datasets used in estimation are the June Survey of Agriculture and Horticulture and the British Survey of Fertiliser Practice published by Defra.
- For fuel combustion, the key datasets are the Digest of UK Energy Statistics (DUKES) and emission factors from IPCC and UNECE guidance.
- For industrial processes, the key dataset is the Environment Agency Pollution Inventory and site specific information directly from plant operators.

UK Nitrous oxide emissions by source (1990 - 2010)



Note: Categories used as based on source emissions not end-user.

Total Emissions by Sector (2010)



Methodology

- Nitrous oxide emissions from manure management are estimated by combining livestock numbers with livestock specific and animal waste system specific emission factors. The emission factors used are from UK specific research.
- Emissions from agricultural soils are modelled using various statistical inputs, such as crop areas and fertiliser use to estimate the nitrogen cycle processes such as biological fixation and leaching in order to calculate soil nitrous oxide emissions.
- Emissions from fuel combustion are estimated by combining activity data (from DUKES) with emission factors that are taken from a variety of sources, mostly literature based sources.
- Emissions from nitric acid production are now estimated based information supplied directly from the plant operators. For the early part of the time series, emissions were based on total nitric acid produced and an appropriate emission factor.

Uncertainties

- The GHG Inventory quantifies uncertainties on emission factors and activity data, which in turn allow for the production of uncertainty estimates on the: emissions; overall uncertainty by gas; and indicative-only estimates of sector level uncertainties.
- Uncertainty in UK nitrous oxide emissions in is heavily skewed, with the 97.5th percentile 100 times greater than the 2.5th percentile.
- The central estimate of total nitrous oxide emissions in 2010 was estimated as 36.1 $MtCO_2e$ with Monte Carlo uncertainty analysis suggested that 95% of the values were between 9.1-108.4 $MtCO_2e$
- Uncertainty in the trend: 95% probability that nitrous oxide emissions in 2010 were between 29% and 76% below the level in 1990.

Improvements

- A programme of agricultural research projects is ongoing, which includes research into the availability of more detailed emission factors and activity data from across the UK.

Projections

- Projected emissions of nitrous oxide are expected to decrease by 9% from 2010 levels by 2025.
- Emissions continue to be dominated by emissions from agriculture.
- The overall decrease in nitrous oxide emissions between 1990 and 2025 is estimated to be 52%.
- The projections presented here exclude the impact of emissions trading.
- The projections are taken from Updated Energy and Emissions Projections: October 2011 (DECC); historic data taken from the 2012 inventory.

Historic and Projected Emissions of Nitrous Oxide

Source: Updated Energy and Emissions Projections: October 2011 (DECC).

Links

- NAEI website: http://naei.defra.gov.uk/
- DECC GHG statistics: http://www.decc.gov.uk/en/content/cms/statistics/climate_stats/gg_emissions/gg_emissions.aspx
- DECC projections: http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/en_emis_projs/en_emis_projs.aspx