



Ministry for the
Environment
Manatū Mō Te Taiao

New Zealand's Greenhouse Gas Inventory 1990–2007

AN OVERVIEW

APRIL 2009



New Zealand Government



New Zealand's greenhouse gas emissions for 2007 totalled 75.6 Mt CO₂-e.

Emissions are now **22 per cent higher** than the 1990 level of 61.9 Mt CO₂-e.

Background

Greenhouse gases in the Earth's atmosphere trap warmth from the sun and make life as we know it possible. However, since the industrial revolution (about 1750) there has been a global increase in the atmospheric concentration of greenhouse gases such as carbon dioxide, methane and nitrous oxide¹. This increase is attributed to human activities, particularly the burning of fossil fuels and land-use change.

In 2007, the Intergovernmental Panel on Climate Change (IPCC) concluded that most of the increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations¹. The IPCC has projected that continued greenhouse gas emissions at, or above, current rates would cause further warming and induce many changes in the global climate system during the 21st century.

This overview presents a summary of the latest information on New Zealand's greenhouse gas emissions and removals. The information is from the most recent national inventory report (the inventory) under the United Nations Framework Convention on Climate Change (*New Zealand's Greenhouse Gas Inventory 1990–2007*). This latest inventory contains information from 1990 through to the current inventory year of 2007. Each inventory report is 15 months in arrears of the reported calendar year, allowing time for data to be collected and analysed.

Greenhouse gas estimates are based on international guidance established by the IPCC and follow an internationally agreed reporting format that groups emissions and removals into six sectors:

- agriculture
- energy (including transport)
- industrial processes
- solvent and other product use
- waste
- land use, land-use change and forestry.

The greenhouse gases estimated in the inventory include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), sulphur hexafluoride (SF₆), perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs). To compare the warming effect of different gases, all emissions are converted to carbon dioxide equivalents (CO₂-e). This is achieved by multiplying emissions by the appropriate global warming potential (Table 1).

Table 1
Units and global warming potentials

Units

Standard metric prefixes used in this overview are:

- kilo (k) = 10³ (one thousand)
- mega (M) = 10⁶ (one million)
- giga (G) = 10⁹ (one thousand million)

Emissions are expressed in megatonnes (Mt) in this overview. Numbers are generally rounded to one decimal place (this can lead to rounding errors in some figures).

1 megatonne (Mt) = 1,000,000 tonnes = 1,000 gigagrams (Gg)

Global warming potentials

A global warming potential is an index, representing the combined effect of the differing times greenhouse gases remain in the atmosphere and their relative effectiveness in absorbing thermal infrared radiation¹. For instance, one tonne of methane has the same warming effect as 21 tonnes of carbon dioxide over a 100-year time period.

The internationally agreed global warming potentials for the direct gases in the inventory are:

- CO₂ = 1
- CH₄ = 21
- N₂O = 310
- SF₆ = 23,900

For further information on the global warming potentials used within this inventory refer to http://unfccc.int/ghg_emissions_data/items/3825.php

¹ IPCC 2007. Solomon S, Qin D, Manning M, Chen Z, Marquis M, Averyt K, Tignor MB, and Miller HL (Eds). *Climate Change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press: UK.

The United Nations Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (the Climate Change Convention) is an international agreement addressing climate change. All countries that ratify the Climate Change Convention are required to tackle climate change through national or regional programmes. The long-term objective of the Climate Change Convention is to “stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system”. Developed countries agreed to non-binding targets to reduce greenhouse gas emissions to 1990 levels by the year 2000.

Developed countries that are signatories to the Climate Change Convention, including New Zealand, are required to submit an annual greenhouse gas inventory. Inventory reporting covers all human-induced greenhouse gas emissions and removals.

The Kyoto Protocol

The international community recognised that the provisions of the Climate Change Convention alone were not enough to ensure greenhouse gases would be reduced to safe levels, and that more urgent action was required. In 1997, the Kyoto Protocol was adopted, committing Annex I Parties (developed countries) that ratified it to limit or reduce their greenhouse gas emissions to an agreed target and to take responsibility for emissions in excess of their target.

New Zealand ratified the Kyoto Protocol on 19 December 2002. New Zealand’s target is to ensure that average annual emissions over the first commitment period of the Kyoto Protocol (2008–2012) are less than, or equal to, emissions in 1990. Parties can use carbon sinks and the Kyoto Protocol flexibility mechanisms, for example carbon trading, to meet their target. The Kyoto Protocol came into force on 16 February 2005.

Under Article 7.1 of the Kyoto Protocol, New Zealand is required to include supplementary information with the inventory. The supplementary information becomes mandatory for the 1990–2008 inventory to be submitted in 2010. However, in order to fully participate in Kyoto mechanisms, for example carbon trading, a Party must submit a complete inventory containing some of the supplementary information under the Kyoto Protocol from 2007 and continue to do so for all years of the commitment period.

In the 2009 inventory submission, New Zealand has reported supplementary information under the Kyoto Protocol in Annex 8 of the inventory. This includes information on transactions of transferred and/or acquired units under Kyoto mechanisms during the 2008 calendar year.



New Zealand's national greenhouse gas inventory

In New Zealand, the inventory is managed and produced by the Ministry for the Environment. Emission and removal estimates are compiled using data from a number of government agencies, particularly the Ministry of Economic Development, the Ministry of Agriculture and Forestry and Statistics New Zealand. The inventory forms part of the Ministry for the Environment's wider 'state of the environment' reporting.

The guiding documents in preparing the inventory are the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, the *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, *Good Practice Guidance for Land Use, Land-Use Change and Forestry*² and the Climate Change Convention guidelines on reporting and review³. These guiding documents contain methods to estimate emissions at different levels, starting from a Tier 1 or general approach. Higher tier or more complex methods are used for the sources and sinks with the largest emissions.

A brief overview of the methods used to estimate emissions and removals in each sector is provided below. The full inventory report contains a thorough description of the methods used in each sector.

Energy sector

The Ministry of Economic Development compiles the greenhouse gas emission estimates from the energy sector. The data used to calculate the emissions is supplied directly from industry or from Statistics New Zealand. New Zealand-specific emission factors are used for calculating carbon dioxide emissions. Applicable IPCC default factors are used for calculating non-carbon dioxide emissions where New Zealand emission factors are not available.

Industrial processes sector and the solvent and other product use sector

The Ministry for the Environment compiles the greenhouse gas emission estimates from the industrial processes sector and the solvent and other product use sector. Activity data and the associated carbon dioxide emissions are supplied directly to the Ministry for the Environment and/or the Ministry of Economic Development by industry sources. New Zealand-specific emission factors are used for calculating carbon dioxide emissions. Data for the non-carbon dioxide gases are collected via an industry survey.

Agriculture sector

The Ministry of Agriculture and Forestry compiles the greenhouse gas emission estimates from the agriculture sector. Livestock population data are obtained from Statistics New Zealand through the agricultural production census and surveys. A model with New Zealand-specific emission factors is used to estimate methane emissions from dairy cattle, non-dairy cattle, sheep and deer. This model uses New Zealand animal productivity data to estimate dry matter intake and methane production. The same dry matter intake data and different New Zealand-specific emission factors are used to calculate nitrous oxide emissions from animal excreta. IPCC default emission factors are used to calculate methane and nitrous oxide emissions for other livestock species.

Land use, land-use change and forestry (LULUCF) sector

The Ministry for the Environment and the Ministry of Agriculture and Forestry compile the emissions and removals reported in the LULUCF sector. Changes in planted forest stocks are assessed from national forest survey data and modelling of the planted forest estate. The IPCC default approach is used for the cropland, grassland, wetland, settlements and other land categories. Results from New Zealand's Land Use and Carbon Analysis System (LUCAS) will improve the reporting for the LULUCF sector and provide consistency with reporting under the Kyoto Protocol. This information will be included in the next inventory submission in 2010.

Waste sector

The Ministry for the Environment compiles the greenhouse gas emission estimates from the waste sector. Emissions from the waste sector are estimated using waste survey data combined with population data from Statistics New Zealand. Calculation of emissions from solid waste disposal uses New Zealand-specific emission factors. Methane and nitrous oxide emissions from domestic and industrial wastewater handling are calculated using a refinement of the IPCC method and IPCC default emission factors. Waste incineration emissions are calculated using IPCC default emission factors.

² IPCC. United Nations Framework Convention on Climate Change. Methodology reports (see: <http://www.ipcc.ch/ipccreports/methodology-reports.htm>).

³ United Nations Framework Convention on Climate Change. FCCC/SBSTA/2006/9 (see: <http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf>).

International review of New Zealand's greenhouse gas inventory

To ensure the quality of reporting meets the standards required of the Climate Change Convention, the inventory is subject to an annual international review. The results of the reviews are available on the Climate Change Convention website⁴.

New Zealand has consistently met the reporting requirements of the Climate Change Convention and the Kyoto Protocol. The inventory has been submitted annually within the allocated six weeks of 15 April, as required under decision 15/CMP.1⁵.

To become eligible to participate in the Kyoto Protocol mechanisms such as carbon trading, the national system for the inventory, the national registry, and the 1990 (base year) inventory were reviewed by an expert review team in February 2007. The expert review report⁶ concluded that:

- “New Zealand's greenhouse gas inventory is consistent with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance, and adheres to the reporting guidelines under Article 7 of the Kyoto Protocol
- New Zealand's national system is prepared in accordance with the guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol and reported in accordance with the guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol
- New Zealand's national registry is fully compliant with the registry requirements as defined by decisions 13/CMP.1⁷ and 5/CMP.1⁷.”

This progress allowed New Zealand to be one of the first four Annex 1 Parties to be eligible to participate in the Kyoto Protocol mechanisms. New Zealand's registry for recording and holding national carbon trading units was operational on 1 January 2008.

Improvements in the 2009 inventory submission

The New Zealand inventory is under continuous improvement. The full inventory report contains a thorough description of the improvements in each sector.

During the 2008 calendar year, improvements focussed on building capacity within the national inventory system and documenting inventory procedures.

Emissions and removals for the whole time series were recalculated due to the following:

- year-specific calorific values for all fuel types were applied to the energy sector
- updated emission factors and assumptions, and the inclusion of new activity data within various categories of the industrial processes sector
- activity data within the agriculture sector was updated with the latest data from Statistics New Zealand
- updated solid waste compositional values, adjustments to waste-water activity data and corrections made to modelling errors for incinerated waste
- revised planted forest modelling and an updated emission factor for cropland.

The overall effect of all of the recalculations is a 0.2 per cent (0.1 Mt CO₂-e) decrease in emissions in 1990 and a 0.3 per cent (0.3 Mt CO₂-e) decrease in emissions for the 2006 year.



⁴ United Nations Framework Convention on Climate Change. Inventory review reports (see: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/3723.php).

⁵ United Nations Framework Convention on Climate Change. 15/CMP.1 and 13/CMP.1 (see: <http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf>).

⁶ United Nations Framework Convention on Climate Change. FCCC/IRR/2007/NZL (see: <http://unfccc.int/resource/docs/2007/irr/nzl.pdf>).

⁷ United Nations Framework Convention on Climate Change. 5/CMP.1 (see: <http://unfccc.int/resource/docs/2005/cmp1/eng/08a01.pdf>).

Total emissions and removals: 1990–2007

In 2007, New Zealand's total greenhouse gas emissions were 75.6 Mt CO₂-e. This estimate excludes the emissions and removals from the land use, land-use change and forestry (LULUCF) sector. Total emissions in 2007, were 22 per cent higher (13.7 Mt CO₂-e) than the 1990 level of 61.9 Mt CO₂-e (Figure 1).

Removals and emissions of greenhouse gases in the LULUCF⁸ sector (net removals) (Figure 1) amounted to 23.8 Mt CO₂-e in 2007. This was an increase of 31 per cent above removals in 1990 (18.1 Mt CO₂-e). Deforestation was based on provisional data for 2007 (refer to page 18).

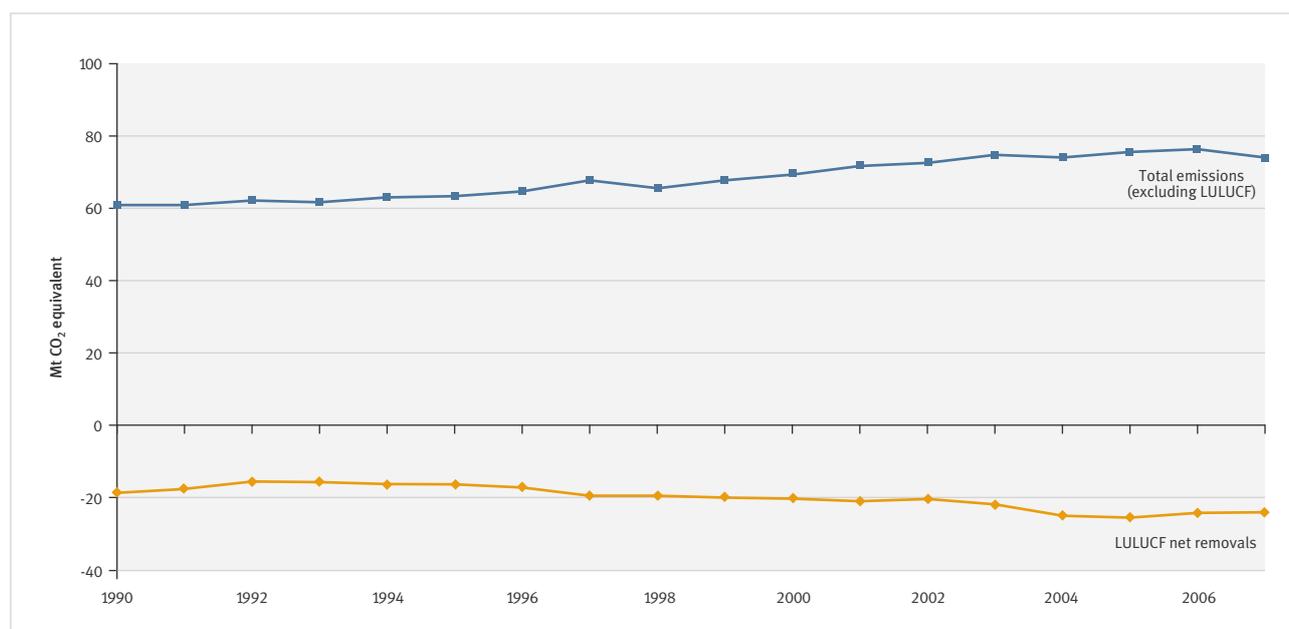
There is statistical uncertainty around the values reported in national inventories. For New Zealand, the uncertainty in total emissions (excluding removals) for the 2007 calendar year is ± 21 per cent. Uncertainty in the trend in emissions since 1990 is ± 5 per cent. The trend has lower uncertainty because the uncertainty in emissions factors in any one year cancels out over time. It is the trend in emissions that is paramount to the requirements under the Climate Change Convention and the Kyoto Protocol.

Changes in emissions between 2006 and 2007

Between 2006 and 2007 emissions decreased by 2.0 Mt CO₂-e (3 per cent). This was due to two major factors. The first was a drought throughout the summer and autumn of 2007/2008. The drought affected many regions, leading to reduced livestock numbers and productivity. The second factor was the commissioning of Genesis Energy's combined cycle gas turbine at Huntly and the corresponding reduction in coal-fired electricity generation.



Figure 1
New Zealand's total greenhouse gas emissions and removals: 1990–2007



⁸ The LULUCF sector of the inventory is not the same as forest sinks or afforestation under the Kyoto Protocol. The inventory reports emissions and removals from all forests (planted and natural) for all years, whereas under the Kyoto Protocol only new plantings (after 31 December 1989) and any deforestation over the first commitment period enters the accounting system.

Emissions by gas

Inventory reporting under the Climate Change Convention covers six direct greenhouse gases: carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perfluorocarbons and hydrofluorocarbons. Trends in emissions over the period 1990–2007 are shown in Figure 2. The change in the total emissions between 1990 and 2007 is shown in Figure 3. Figures 4 and 14 provide an indication of the contribution of each direct greenhouse gas to total emissions in 2007. Removals of carbon dioxide from the atmosphere are reported in the LULUCF sector. As required by the Climate Change Convention guidelines, indirect greenhouse gases (carbon monoxide, sulphur dioxide, oxides of nitrogen, and non-methane volatile organic compounds) are reported in the inventory but are not included in total emissions.

- Carbon dioxide contributed the largest share of all 2007 emissions at 47 per cent (35.2 Mt CO₂-e). In 2007, carbon dioxide emissions had increased by 39 per cent (9.9 Mt CO₂-e) from the 1990 level of 25.3 Mt CO₂-e.
- Methane contributed 35 per cent (26.6 Mt CO₂-e) of total emissions in 2007. In 2007, methane emissions had grown by 4 per cent (1.1 Mt CO₂-e) from the 1990 level of 25.4 Mt CO₂-e.
- Nitrous oxide contributed 17 per cent (12.8 Mt CO₂-e) of emissions in 2007. This was an increase of 23 per cent (2.4 Mt CO₂-e) from the 1990 level of 10.4 Mt CO₂-e.
- Perfluorocarbons, sulphur hexafluoride and hydrofluorocarbons accounted for the remaining 1 per cent (0.9 Mt CO₂-e).
- Emissions of perfluorocarbons had decreased from 0.64 Mt CO₂-e in 1990, to 0.04 Mt CO₂-e in 2007, or 94 per cent (0.60 Mt CO₂-e).
- Emissions of sulphur hexafluoride had decreased 3 per cent (0.001 Mt CO₂-e), from the 1990 level of 0.02 Mt CO₂-e to the 2007 level of 0.01 Mt CO₂-e.
- In 1990, no hydrofluorocarbons were used in New Zealand. In 2007, 0.9 Mt CO₂-e of hydrofluorocarbon emissions were produced.

Figure 2
Trends in greenhouse gas emissions by gas: 1990–2007

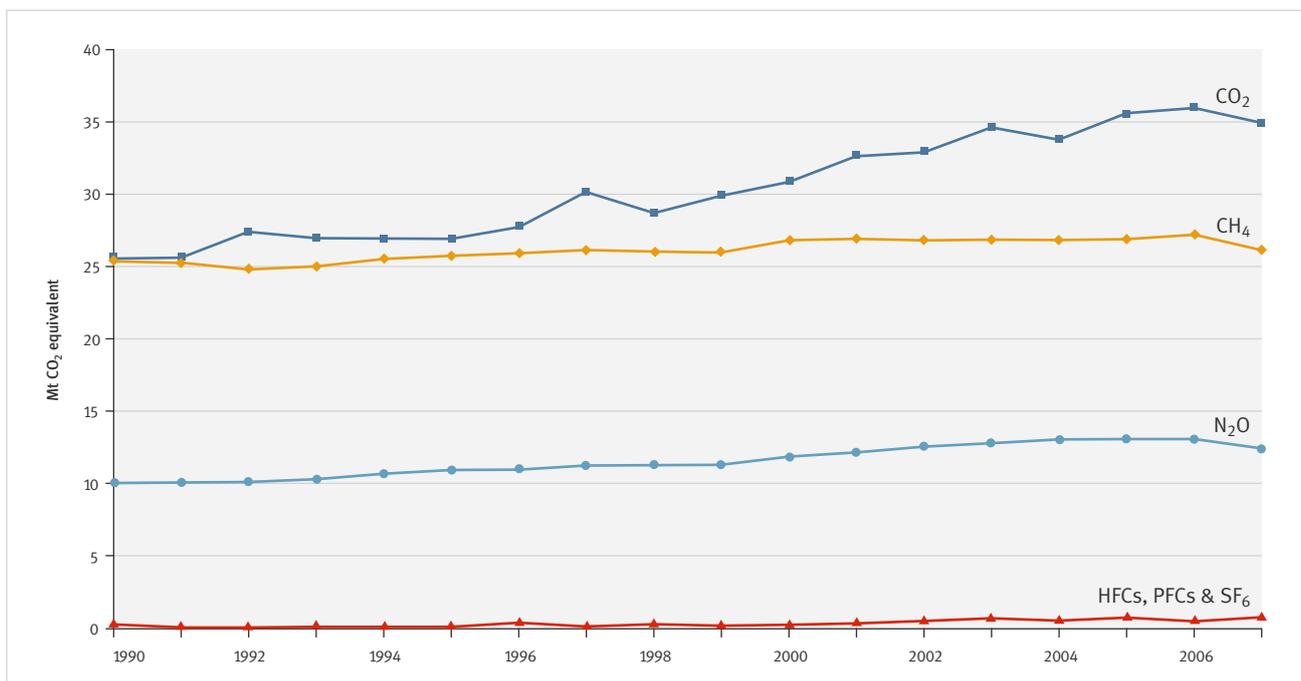
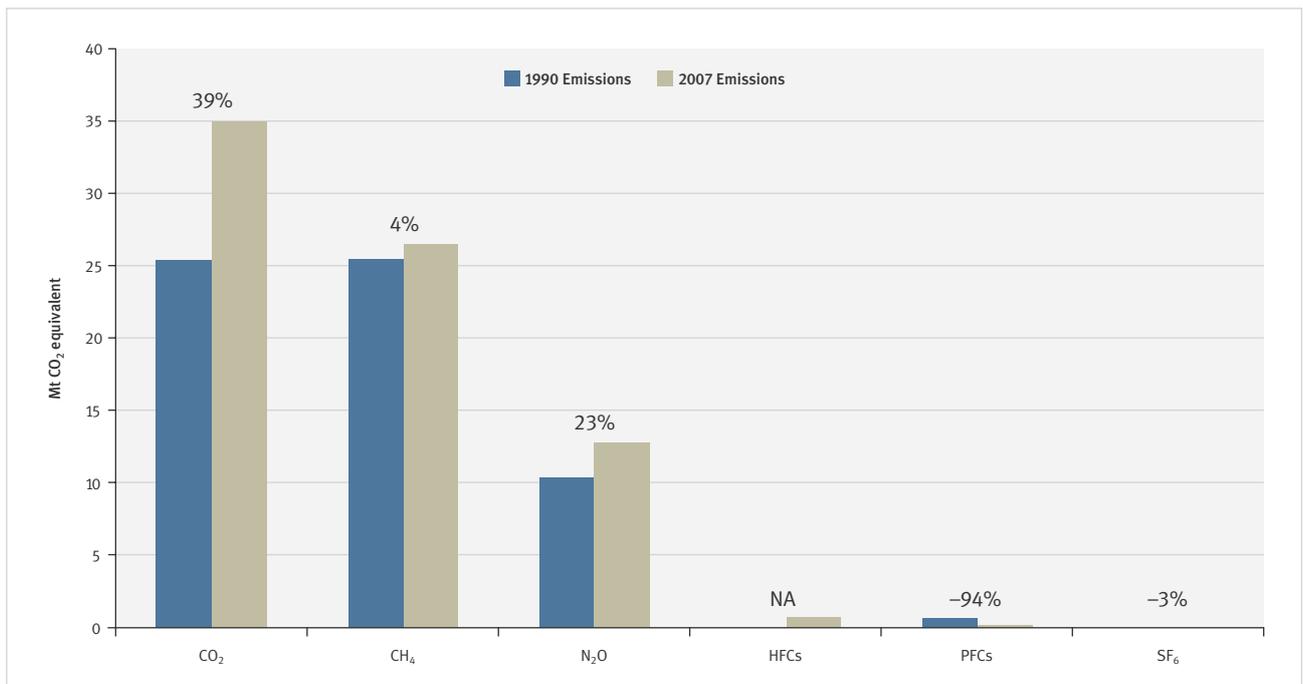
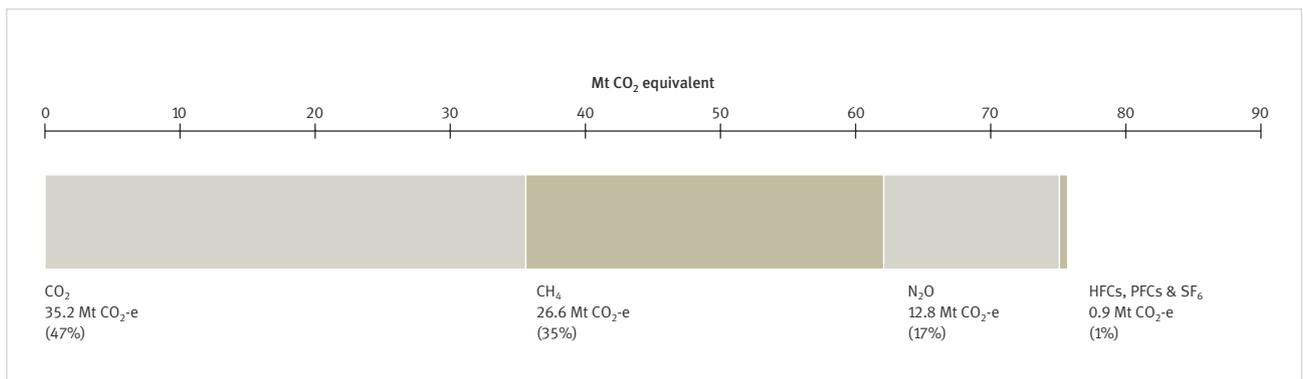


Figure 3
Change in greenhouse gas emissions by gas 1990 to 2007



Note: The per cent change for hydrofluorocarbons is not applicable (NA) as there was no production of hydrofluorocarbons in 1990.

Figure 4
New Zealand's total greenhouse gas emissions by gas: 2007



Emissions by sector

Greenhouse gas emission estimates are based on international guidance established by the IPCC and follow an internationally agreed reporting format that groups emissions and removals into six sectors. Trends in emissions by sector over the period 1990–2007 are shown in Figure 5. The change in total emissions between 1990 and 2007 for all reported sectors except LULUCF is shown in Figure 6. The contribution of each sector to total emissions in 2007 is indicated in Figures 7 and 14.

- In 2007, the agriculture sector was the largest source of emissions, contributing 48 per cent (36.4 Mt CO₂-e) to total emissions. As a result, New Zealand has a unique emissions profile compared to other developed countries where agricultural emissions are typically around 11 per cent of national emissions. In 2007, agricultural emissions had increased 12 per cent (3.9 Mt CO₂-e) from the 1990 level of 32.5 Mt CO₂-e. In 2007, the agriculture sector contributed 96 per cent (12.4 Mt CO₂-e) of New Zealand's total nitrous oxide emissions and 91 per cent (24.1 Mt CO₂-e) of total methane emissions.
- The energy sector was the source of 43 per cent (32.7 Mt CO₂-e) of total emissions in 2007. In 2007, energy emissions had increased 39 per cent (9.2 Mt CO₂-e) from the 1990 level of 23.5 Mt CO₂-e. This growth in emissions was primarily from electricity generation, heat production and transport.
- The industrial processes sector accounted for 6 per cent (4.6 Mt CO₂-e) of total emissions in 2007. In 2007, emissions from the industrial processes sector had increased 35 per cent (1.2 Mt CO₂-e) from the 1990 level of 3.4 Mt CO₂-e. The increase was mainly due to growth in emissions from increased metal production and consumption of hydrofluorocarbons.
- The solvents and other products sector is a minor contributor to New Zealand's total direct greenhouse gas emissions, as it accounted for 0.1 per cent (0.04 Mt CO₂-e) of total emissions in 2007.
- The waste sector accounted for 2 per cent (1.8 Mt CO₂-e) of total emissions in 2007. In 2007, emissions from the waste sector had decreased 25 per cent (0.6 Mt CO₂-e) from a 1990 level of 2.4 Mt CO₂-e. This decrease was due to initiatives to improve solid waste management practices in New Zealand.
- The net removals from LULUCF were 32 per cent (23.8 Mt CO₂-e) of total emissions in 2007. LULUCF net removals had increased 31 per cent (5.7 Mt CO₂-e) from the 1990 level of 18.1 Mt CO₂-e.

Figure 5
Trends in greenhouse gas emissions by sector: 1990–2007

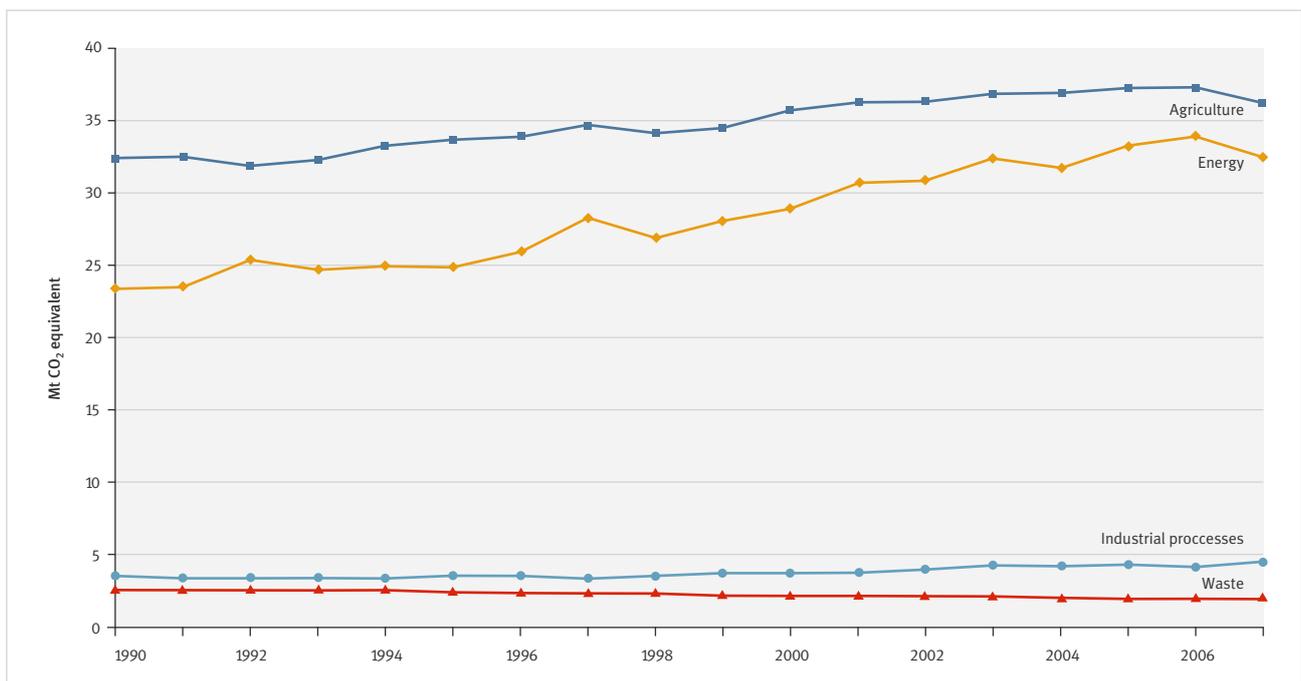


Figure 6
Change in sectoral greenhouse gas emissions from 1990 to 2007

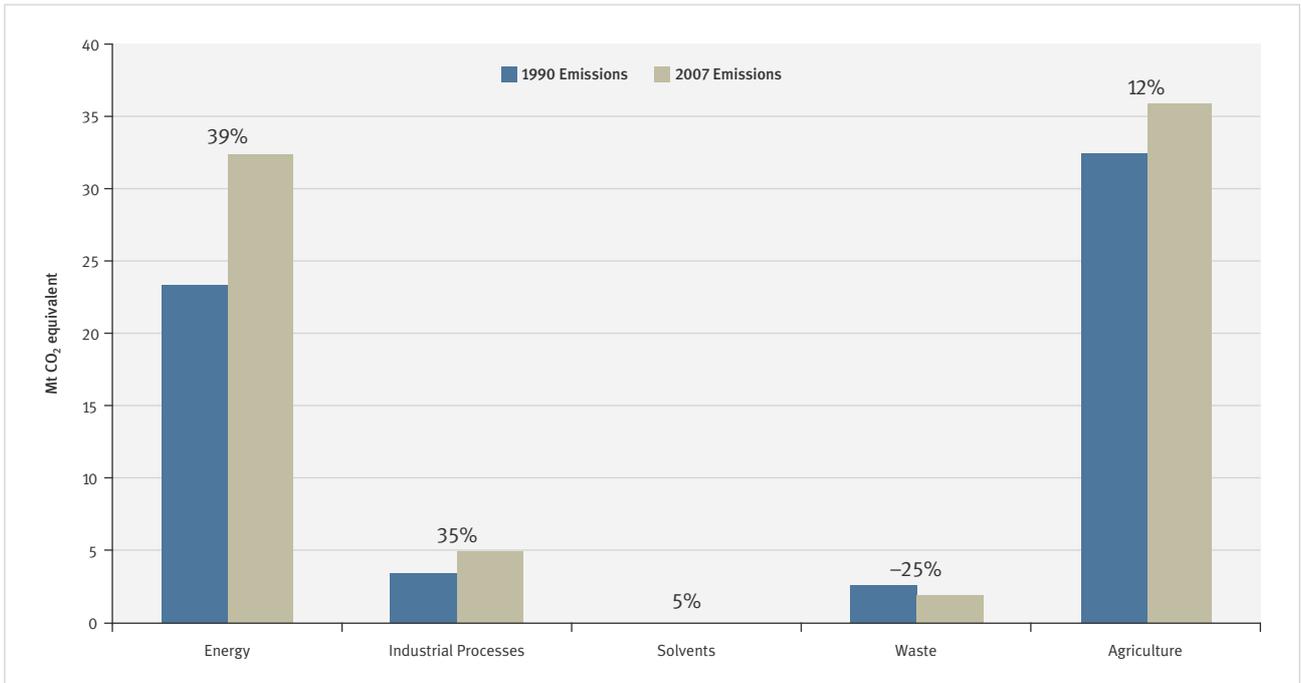
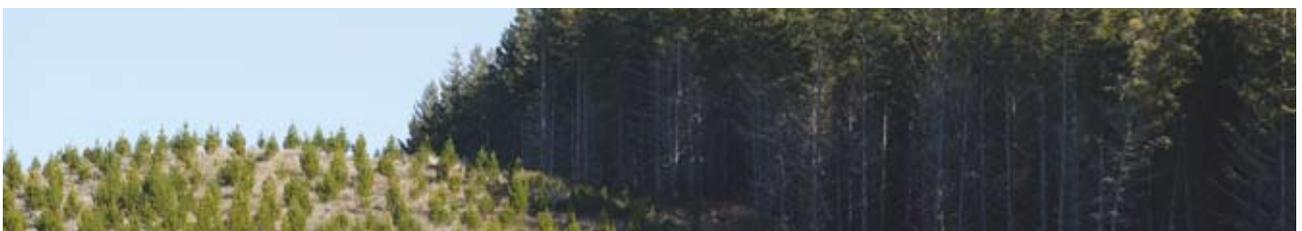
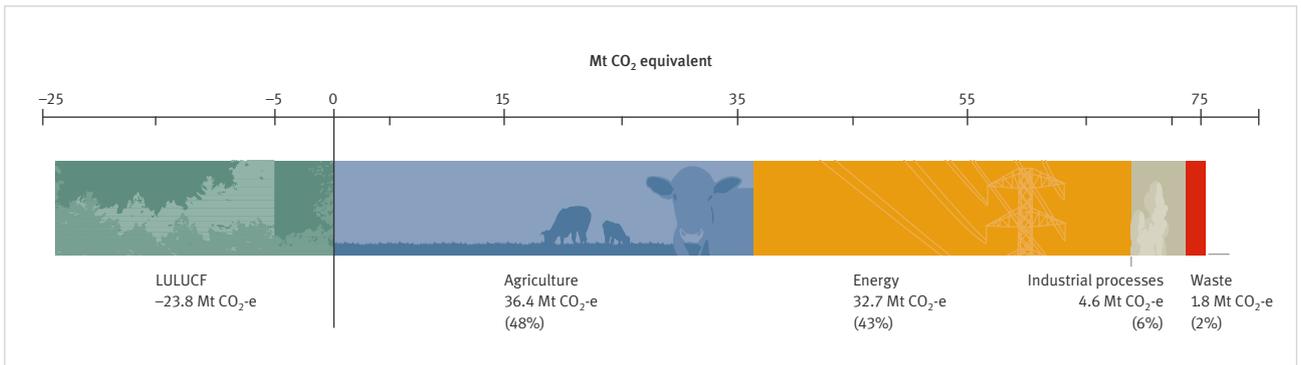


Figure 7
New Zealand's total greenhouse gas emissions by sector: 2007



Agriculture sector

The agriculture sector includes emissions from enteric fermentation, agricultural soils, the management of manure and the burning of savanna and agricultural residues. Emissions of methane or nitrous oxide are produced when biomass (organic matter) is consumed, decays or is burned. Figure 8 provides an indication of the emission profile from the agriculture sector in 2007.

Enteric fermentation

Methane is a by-product of digestion by ruminant livestock. Enteric fermentation is New Zealand's largest single emissions category, contributing 31 per cent (23.3 Mt CO₂-e) of total emissions in 2007 and 64 per cent of all emissions from agriculture. Emissions from enteric fermentation had increased by 7 per cent (1.5 Mt CO₂-e) from the 1990 level of 21.8 Mt CO₂-e.

Ruminant livestock are animals with complex digestive systems consisting of a four-part stomach where microbes break down food. Methane is produced as a by-product of the microbial activity (enteric fermentation) and is mostly released when the animal exhales.

Agricultural soils

Emissions of nitrous oxide are associated with the application of nitrogenous fertilisers, burning of crop residues, animal wastes (dung and urine), cultivation of peat soils and the use of nitrogen fixing crops. Emissions can come directly from the soil, and indirectly through atmospheric deposition, leaching and run-off. In 2007, agricultural soils contributed 16 per cent of New Zealand's total emissions and 34 per cent (12.3 Mt CO₂-e) of all agricultural emissions. Emissions from agricultural soils had increased 22 per cent (2.3 Mt CO₂-e) from the 1990 level of 10.0 Mt CO₂-e.

Manure management

The manure management category estimates emissions from the decomposition of animal waste held in manure management systems before being applied to the soil eg, dairy effluent temporarily stored in lagoons or ponds. In 2007, emissions from manure management were 2 per cent (0.8 Mt CO₂-e) of total agriculture emissions. The estimated emissions from manure management had increased by 28 per cent (0.2 Mt CO₂-e) from the 1990 level of 0.6 Mt CO₂-e.

Savanna burning

Emissions in the savanna burning category are from the controlled burning of tussock in the high country areas of Canterbury, Otago and Southland. The amount of tussock burned has been steadily decreasing over the past 50 years. In 2007, emissions were 0.001 Mt CO₂-e, a decrease of 68 per cent (0.002 Mt CO₂-e) from the 1990 level of 0.003 Mt CO₂-e.

Burning of agricultural residues

Emissions are produced from field-burning crop residues, including those from barley, wheat and oats. In 2007, emissions were 0.02 Mt CO₂-e, a decrease of 39 per cent (0.01 Mt CO₂-e) from the 1990 level of 0.03 Mt CO₂-e.



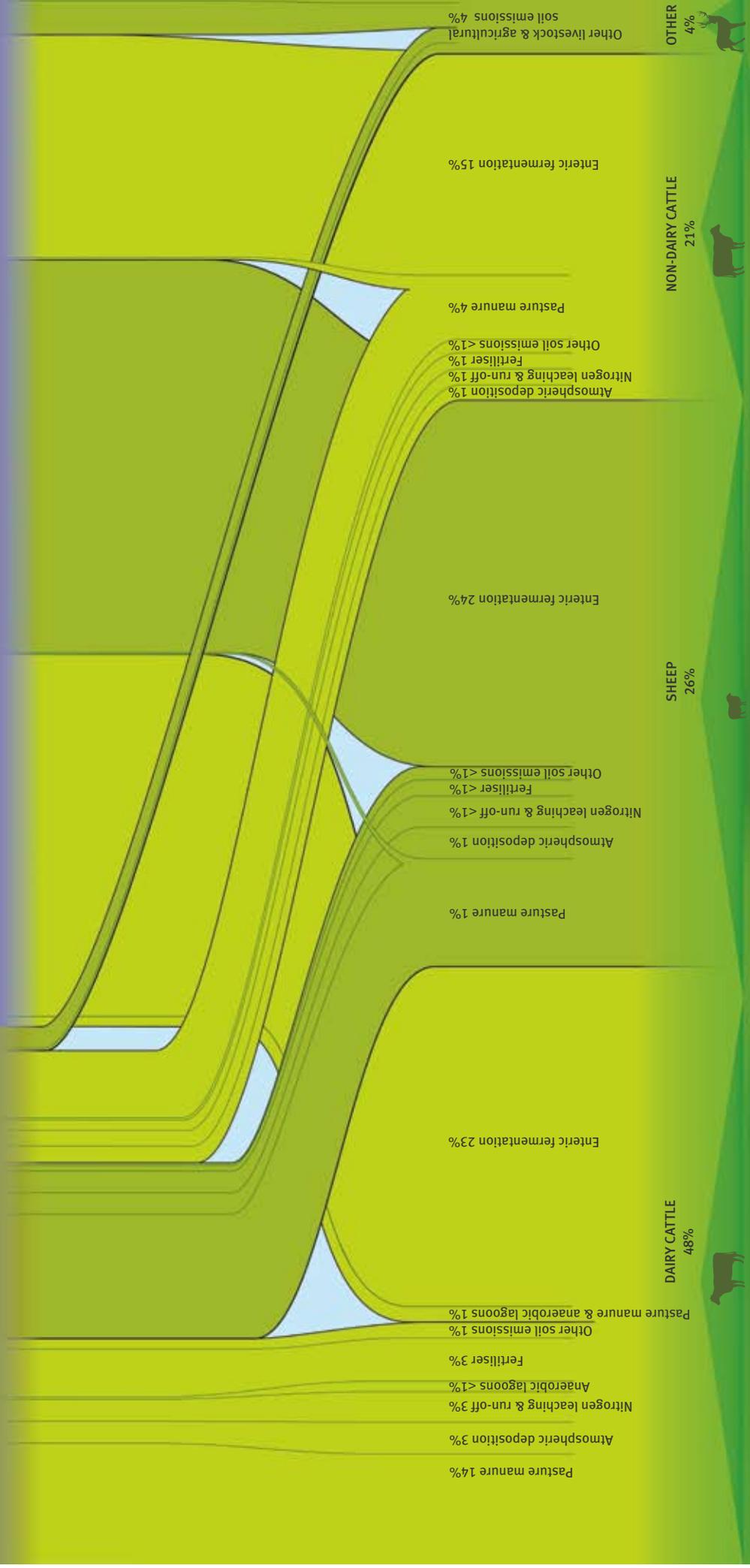
Figure 8:

New Zealand's greenhouse gas emissions from agriculture

In 2007, agriculture emissions were 36.4 Mt CO₂-e.

Nitrous Oxide (N₂O)
34%

Methane (CH₄)
66%



Energy sector

The energy sector includes emissions from fuel combustion (including for transport and to produce heat in industry), and fugitive emissions. Figure 9 provides an indication of the emission profile from the energy sector in 2007.

Fuel combustion is the controlled burning of solid, liquid or gaseous fossil fuels (such as coal, petrol and natural gas) to generate heat or energy.

Fugitive emissions are non-combustion emissions associated with the production, processing, transport, storage, transmission and distribution of fossil fuels such as coal, oil and natural gas.

Fuel combustion

Transport

Transport emissions include those from road, rail, domestic air and shipping. To maintain consistency with the Climate Change Convention reporting guidelines, emissions from international air and shipping are reported in the inventory but are not included in the national total.

In 2007, transport contributed 20 per cent (14.9 Mt CO₂-e) of New Zealand's total emissions and 46 per cent of total energy emissions. Emissions in 2007 had increased by 70 per cent (6.1 Mt CO₂-e) from the 1990 level of 8.8 Mt CO₂-e.

- In 2007, road transport represented 91 per cent (13.5 Mt CO₂-e) of domestic transport emissions, 18 per cent of total emissions and 41 per cent of total energy emissions. Emissions from road transport in 2007 had increased 76 per cent (5.8 Mt CO₂-e) from the 1990 level of 7.6 Mt CO₂-e.
- Aviation contributed 6 per cent (0.9 Mt CO₂-e) of emissions from domestic transport in 2007. Emissions from aviation in 2007 had increased 19 per cent (0.1 Mt CO₂-e) from the 1990 level of 0.8 Mt CO₂-e.
- Shipping emissions were 2 per cent (0.3 Mt CO₂-e) of domestic transport emissions in 2007. Emissions from shipping in 2007 had increased 23 per cent (0.1 Mt CO₂-e) from the 1990 level of 0.2 Mt CO₂-e.
- Rail emissions were 1 per cent (0.2 Mt CO₂-e) of all emissions from domestic transport in 2007. Emissions from rail in 2007 had increased 95 per cent (0.1 Mt CO₂-e) from the 1990 level of 0.1 Mt CO₂-e.

Energy industries

Electricity generation, petroleum refining, gas processing and solid fuel manufacturing are all reported under the energy industries category. Emissions from energy industries were 7.9 Mt CO₂-e in 2007 and 10 per cent of national emissions. Emissions from energy industries had increased 31 per cent (1.8 Mt CO₂-e) from the 1990 level of 6.0 Mt CO₂-e. This increase was primarily due to growth in electricity demand in New Zealand, requiring more electricity to be generated by burning gas, coal and oil.

In 2007, electricity generation and heat production comprised 9 per cent (6.6 Mt CO₂-e) of total emissions, or 84 per cent of the energy industries subcategory. Emissions from electricity generation and heat production had increased 91 per cent (3.2 Mt CO₂-e) from the 1990 level of 3.5 Mt CO₂-e. The remaining emissions in the energy industries category were from petroleum refining (0.9 Mt CO₂-e), gas processing, solid fuel manufacturing and other energy industries (0.3 Mt CO₂-e). In 2007, emissions from petroleum refining had increased 16 per cent (0.1 Mt CO₂-e) from a 1990 level of 0.8 Mt CO₂-e. In 2007, emissions from solid fuel manufacturing and other energy industries were 81 per cent (1.4 Mt CO₂-e) lower than the 1990 level of 1.8 Mt CO₂-e.

Manufacturing industries and construction

Emissions from the manufacturing industries and construction category included emissions from the manufacture of steel, non-ferrous metals, pulp and paper, and food processing. Emissions from manufacturing industries and construction contributed 7 per cent (5.4 Mt CO₂-e) to total emissions in 2007. This was an 18 per cent (0.8 Mt CO₂-e) increase from the 1990 level of 4.6 Mt CO₂-e.

Other fuel combustion

Emissions from the commercial, institutional and residential sectors are reported under the other fuel combustion category. This category includes emissions from agricultural, fisheries and forestry equipment. Emissions were 4 per cent (2.8 Mt CO₂-e) of total emissions in 2007 and had decreased 4 per cent (0.1 Mt CO₂-e) from the 1990 level of 2.9 Mt CO₂-e.

Fugitive emissions

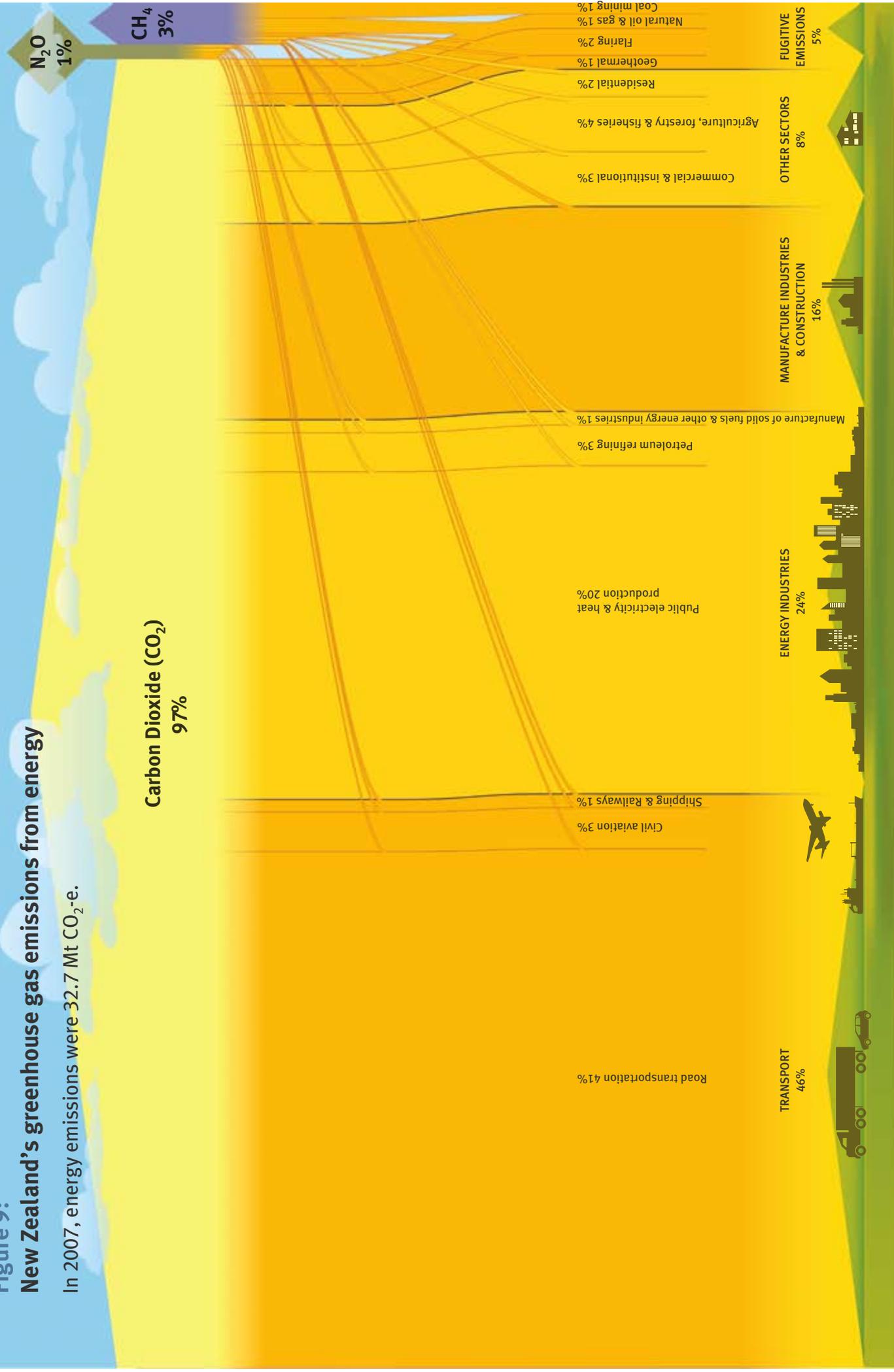
Fugitive emissions in 2007 were 1.8 Mt CO₂-e, and contributed 2 per cent of total emissions. This was an increase of 43 per cent (0.5 Mt CO₂-e) from the 1990 level of 1.2 Mt CO₂-e.

Figure 9:

New Zealand's greenhouse gas emissions from energy

In 2007, energy emissions were 32.7 Mt CO₂-e.

Carbon Dioxide (CO₂)
97%



Industrial processes sector and solvents and other product use sector

Industrial processes

The industrial processes sector includes emissions from the production of metals, minerals and chemicals and the consumption of halocarbons and sulphur hexafluoride. These emissions are produced from the chemical transformation of one product to another. For example, the reduction of iron sand in steel production releases carbon dioxide. The main industrial processes producing greenhouse gases in New Zealand are:

- reduction of iron sand in steel production
- oxidation of anodes in aluminium production
- production of hydrogen
- calcination of limestone for use in cement production
- calcination of limestone for lime production
- production of ammonia and urea.

The emissions from energy used to produce heat in the processes are reported within the energy sector. Figure 10 provides an indication of the emissions profile for the industrial processes sector in 2007. Most of the greenhouse gas emissions from the industrial processes sector are carbon dioxide (80 per cent). Small contributions come from hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.

Metal production

Emissions from metal production came from the production of iron and steel, ferroalloys, aluminium and magnesium. Metal production contributed 3 per cent (2.3 Mt CO₂-e) of total emissions in 2007 or 49 per cent of the emissions from industrial processes. Emissions had decreased 6 per cent (0.1 Mt CO₂-e) from the 1990 level of 2.4 Mt CO₂-e.

Consumption of halocarbons and sulphur hexafluoride

Emissions from the consumption of halocarbons are from the use of a wide range of equipment and products from refrigeration systems to aerosols. The consumption of halocarbons contributed 18 per cent of emissions from the industrial processes sector in 2007. There was no use of halocarbons in New Zealand in 1990.

Emissions from sulphur hexafluoride consumption are largely from the use of electrical equipment. In 2007, the consumption of sulphur hexafluoride accounted for 0.3 per cent (0.015 Mt CO₂-e) of emissions from industrial processes. In 2007, emissions had increased by 19 per cent (0.002 Mt CO₂-e) from the 1990 level of 0.0123 Mt CO₂-e.

Mineral products

Mineral products includes emissions produced from the chemical transformation in the production of cement and lime, soda ash production and use, asphalt roofing, limestone and dolomite use, road paving with asphalt, and glass production. Mineral products made up 19 per cent (0.9 Mt CO₂-e) of emissions from the industrial processes sector in 2007. This was an increase of 57 per cent (0.3 Mt CO₂-e) over the 1990 level of 0.5 Mt CO₂-e. The emissions from cement and lime production account for the majority of the emissions from mineral products.

Chemical industry

The major chemical processes occurring in New Zealand that fall into this category are the production of ammonia and urea, methanol, hydrogen, superphosphate fertiliser and formaldehyde. The chemical industry accounted for 13 per cent (0.6 Mt CO₂-e) of emissions from the industrial processes sector in 2007. Emissions from this category had increased by 34 per cent (0.2 Mt CO₂-e) from the 1990 level of 0.5 Mt CO₂-e. The production of ammonia was responsible for 60 per cent (0.4 Mt CO₂-e) of emissions from the chemical industry in 2007. This was an increase of 30 per cent (0.1 Mt CO₂-e) from the 1990 level of 0.3 Mt CO₂-e.

Solvent and other product use

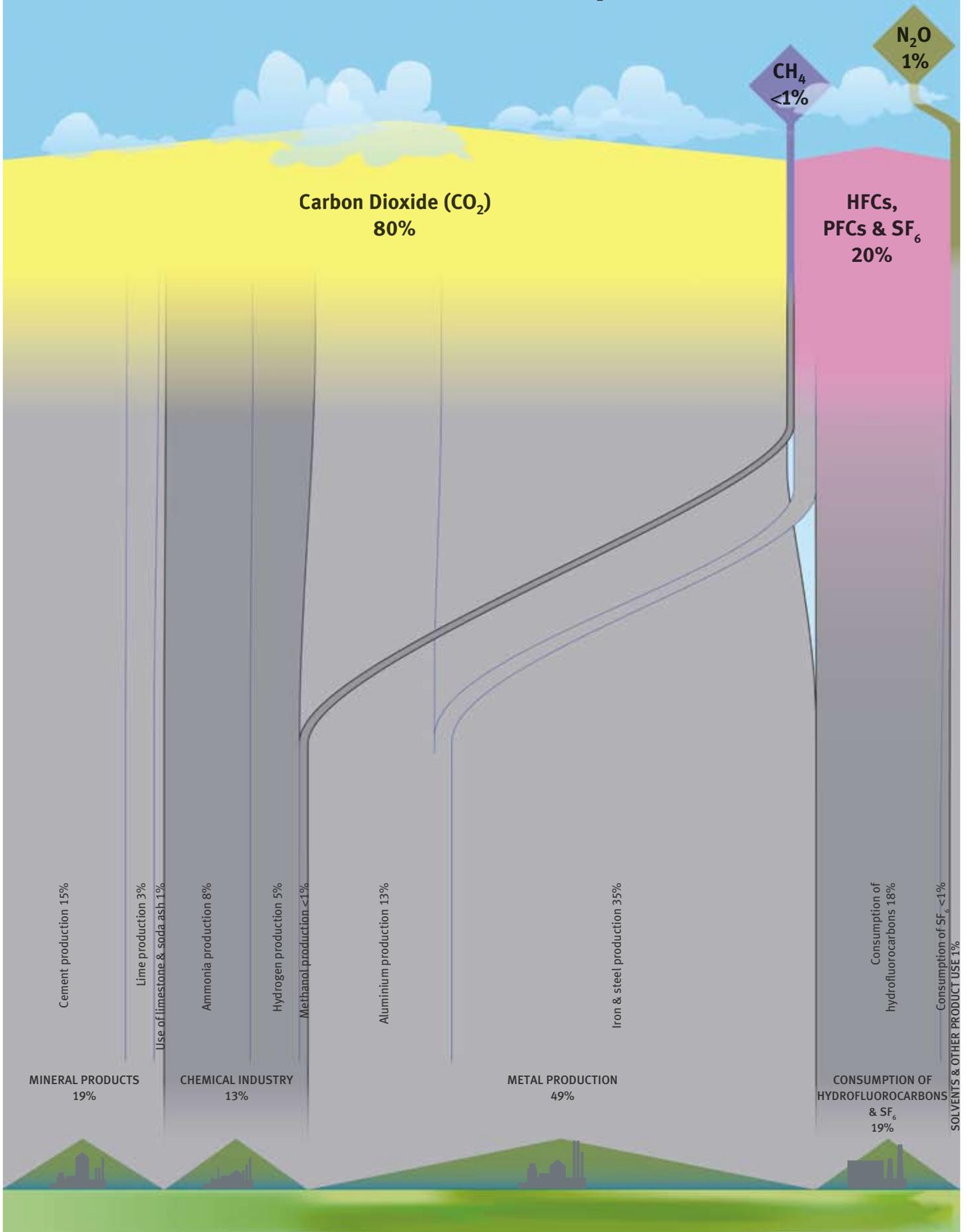
Nitrous oxide is the only direct greenhouse gas reported in the solvent and other product use sector. Nitrous oxide is mostly used for anaesthesia with insignificant amounts used in motor sports and in scientific analysis. Emissions reported from the solvent and other product use sector are insignificant (0.1 per cent of New Zealand's total emissions). In 2007, emissions from solvent and other product use were 0.043 Mt CO₂-e, an increase of 4 per cent (0.002 Mt CO₂-e) from the 1990 level of 0.042 Mt CO₂-e.

The solvents and other product use sector also reports indirect greenhouse gas emissions from chemical cleaning substances used in dry-cleaning and printing, metal degreasing and the use of paints, lacquers and thinners. Indirect greenhouse gas emissions result from the evaporation of volatile chemicals when solvent-based products are exposed to air.

In accordance with the Climate Change Convention reporting guidelines the indirect greenhouse gases reported in the solvent and other product use sector do not count towards New Zealand's reported total emissions.

Figure 10:
New Zealand's greenhouse gas emissions from industrial processes

In 2007, emissions from industrial processes were 4.6 Mt CO₂-e.



All figures have been rounded. CH₄ = Methane, N₂O = Nitrous oxide and HFCs, PFCs and SF₆ = Hydrofluorocarbons, Perfluorocarbons and Sulphur Hexafluoride.

Waste sector

The waste sector includes emissions from the disposal of solid waste, wastewater handling and incineration of waste. Greenhouse gas emissions from waste are predominantly methane, formed from decaying organic waste. Small amounts of nitrous oxide are generated from the decomposition of human waste and the incineration of solvents. The only carbon dioxide emissions included are from the incineration of waste with a fossil origin. Carbon dioxide emissions from the breakdown of organic material are not reported because the carbon dioxide emitted is assumed to be reabsorbed by growth in vegetation and other organic matter in the following year. Figure 11 provides an indication of emissions from the waste sector in 2007.

In 2007, solid waste disposal on land represented 79 per cent (1.4 Mt CO₂-e) of total waste emissions. These emissions had decreased by 30 per cent (0.6 Mt CO₂-e) from the 1990 level of 2.1 Mt CO₂-e.

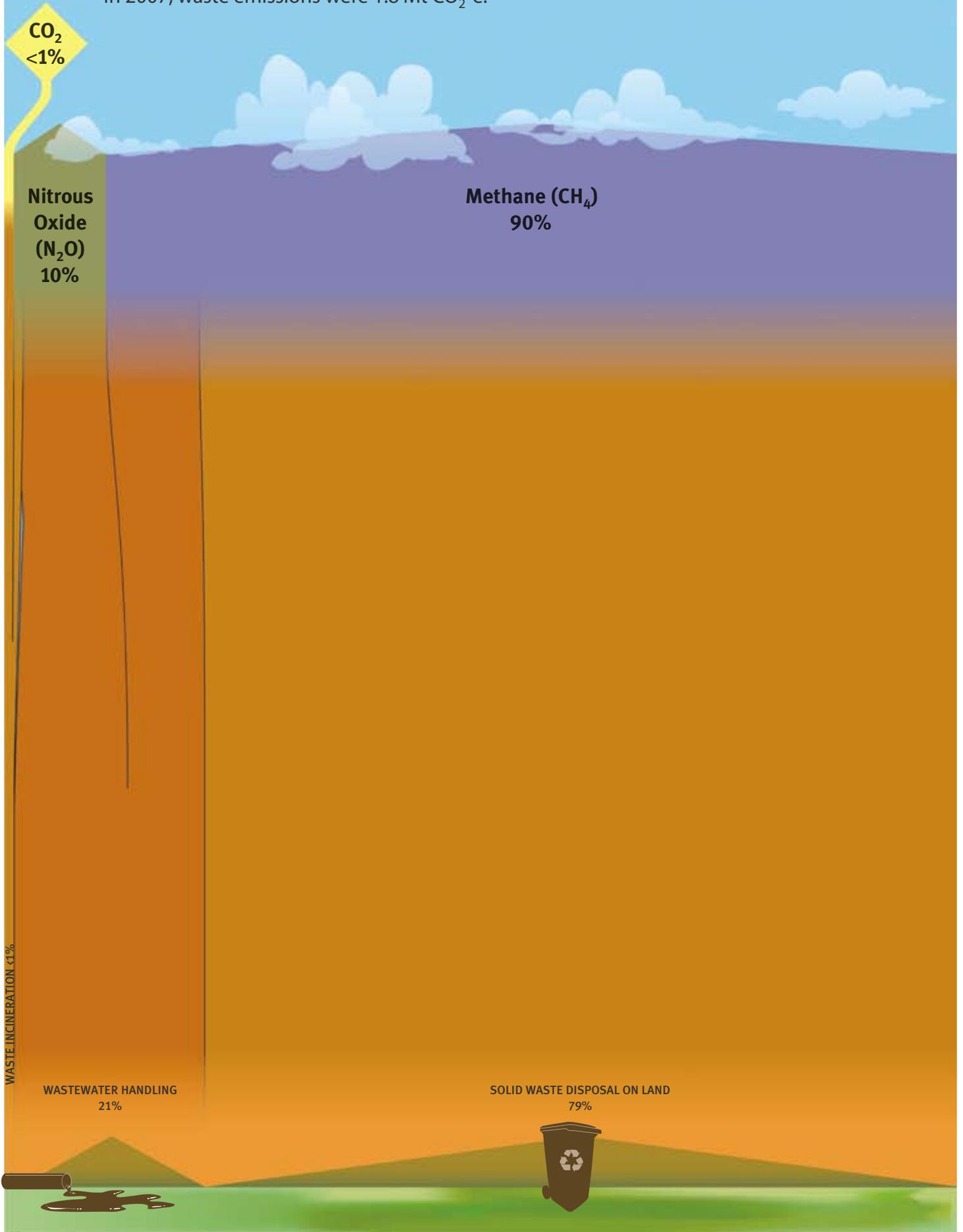
Wastewater handling contributed 21 per cent (0.38 Mt CO₂-e) of total waste emissions in 2007. These emissions had increased by 6 per cent (0.02 Mt CO₂-e) from the 1990 level of 0.36 Mt CO₂-e.

Waste incineration accounted for 0.1 per cent (0.002 Mt CO₂-e) of total waste emissions in 2007. These emissions had decreased by 85 per cent (0.012 Mt CO₂-e) in 2007 from the 1990 level of 0.015 Mt CO₂-e.



Figure 11:
New Zealand's greenhouse gas emissions from waste

In 2007, waste emissions were 1.8 Mt CO₂-e.



All figures have been rounded.

Land use, land-use change and forestry sector

Changes in the amount of carbon removed by, and emitted from, vegetation and soil as a result of human activity are covered in the land use, land-use change and forestry (LULUCF) sector. This sector also includes emissions of nitrous oxide and methane resulting from land-use activity, and carbon dioxide from liming soils. These emissions are reported within six land-use categories as defined by the IPCC inventory guidelines. These categories are forest land, cropland, grassland, wetlands, settlements, and other land.

Transfers of land use from one category to another can result in changes in emissions or removals. Some categories of land staying in the same land use are currently assumed to be in steady-state whereby they are neither gaining nor losing carbon eg, grassland or natural forests. For other categories, such as growing plantation forests, the land use is not changing but forest growth removes carbon dioxide from the atmosphere and stores it as biomass. Emissions can arise from the burning and decay of biomass and changes in soil carbon.

In New Zealand, the LULUCF sector is a net carbon sink. In 2007, net removals from LULUCF were 23.8 Mt CO₂-e. This is an increase of 31 per cent (5.7 Mt CO₂-e) from the 1990 level of 18.1 Mt CO₂-e. The trend observed in the LULUCF sector reflects New Zealand's changing land use and forestry activity, particularly during the 1990s (Figure 12). Figure 13 provides an indication of the emissions and removals profile from the LULUCF sector in 2007.

Removals from LULUCF were 25.1 Mt CO₂-e in 2007. This has included carbon dioxide emitted from harvested forests, but excludes all other reported LULUCF emissions. Of these removals, forest land accounted for 24.6 Mt CO₂-e (98 per cent), an increase of 32 per cent (5.9 Mt CO₂-e) from the 1990 level of 18.7 Mt CO₂-e.

Removals fluctuate with annual forest planting and harvesting. Cropland accounted for the remaining 2 per cent (0.6 Mt CO₂-e).

In 2007, non-harvesting emissions from LULUCF were 1.3 Mt CO₂-e, an increase of 24 per cent (0.3 Mt CO₂-e) from the 1990 level of 1.0 Mt CO₂-e. The emissions from LULUCF in 2007 include the following:

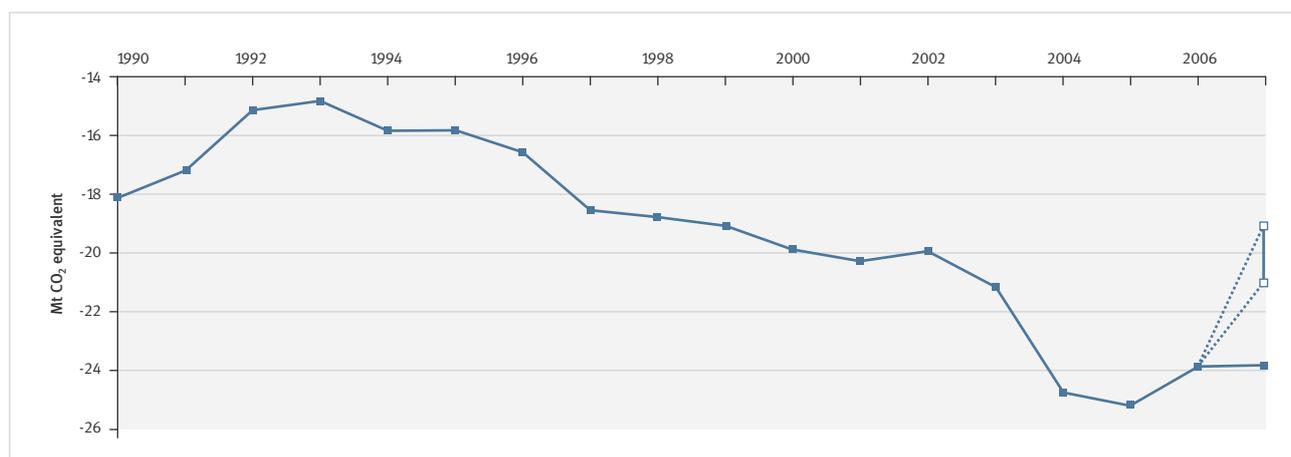
- liming of soils produced 0.6 Mt CO₂-e, an increase of 70 per cent (0.3 Mt CO₂-e) from the 1990 level of 0.4 Mt CO₂-e
- conversion to grassland produced 0.4 Mt CO₂-e, a decrease of 10 per cent (0.05 Mt CO₂-e) from the 1990 level of 0.5 Mt CO₂-e
- biomass burning accounted for 0.07 Mt CO₂-e, an increase of 24 per cent (0.01 Mt CO₂-e) from the 1990 level of 0.05 Mt CO₂-e
- other land-use changes accounted for 0.15 Mt CO₂-e, an increase of 20 per cent (0.02 Mt CO₂-e) since the 1990 level of 0.12 Mt CO₂-e.

The 2009 inventory submission includes a provisional estimate of 10,000 hectares of deforestation in 2007. Updated information in April 2009 indicates the area of deforestation in 2007 was in the range of 15,000–20,000 hectares. Based on this information, a provisional calculation indicates that LULUCF net removals would be in the vicinity of 19 to 21 Mt CO₂-e. The recalculation for the updated area will be included in the 2010 submission.

Results from New Zealand's Land Use and Carbon Analysis System (LUCAS) will improve the reporting for the LULUCF sector and provide consistency with reporting under the Kyoto Protocol. LUCAS will use satellite and photographic imagery to determine changes in land use from 1990 and over the first commitment period of the Kyoto Protocol (2008–2012). Estimates of emissions and removal factors are being updated from a comprehensive survey of a national network of permanent plots. This information will be included in the next inventory submission in 2010.

Figure 12

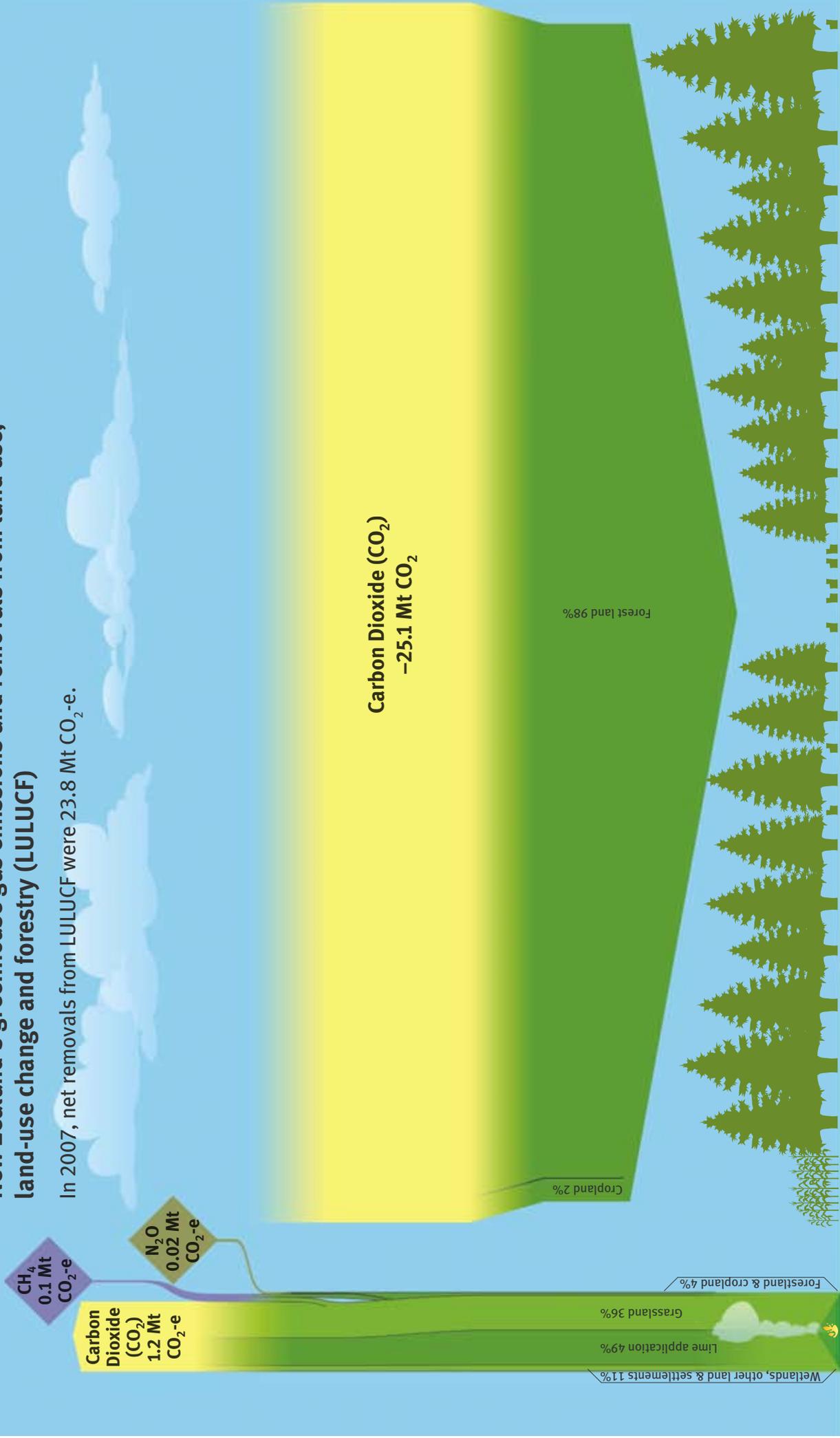
LULUCF sector net removals: 1990–2007



Note: The dotted lines and empty markers for 2007 provide an indicative range of net removals once updated deforestation data is included in the 2010 submission.

**Figure 13:
New Zealand's greenhouse gas emissions and removals from land use,
land-use change and forestry (LULUCF)**

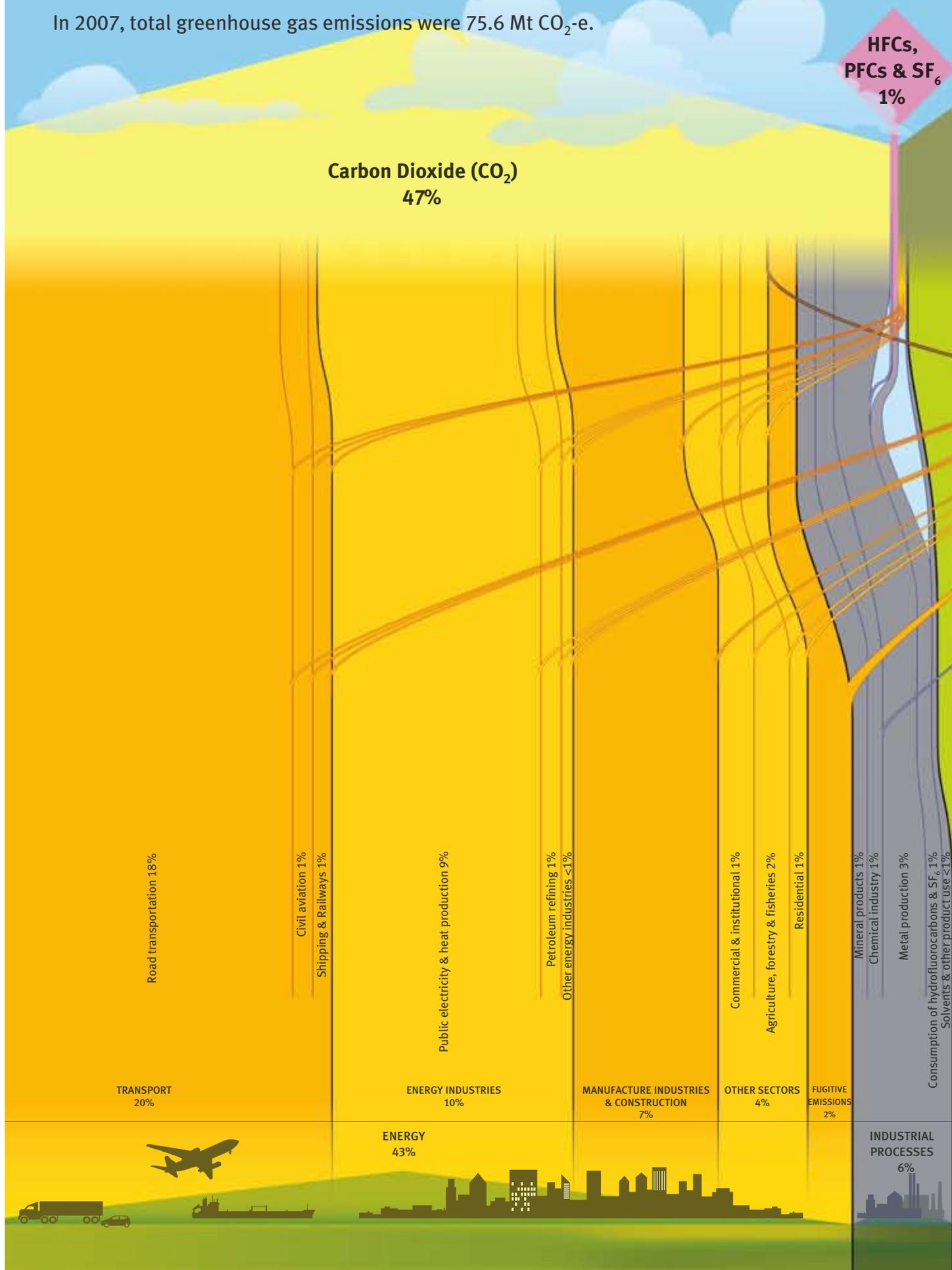
In 2007, net removals from LULUCF were 23.8 Mt CO₂-e.

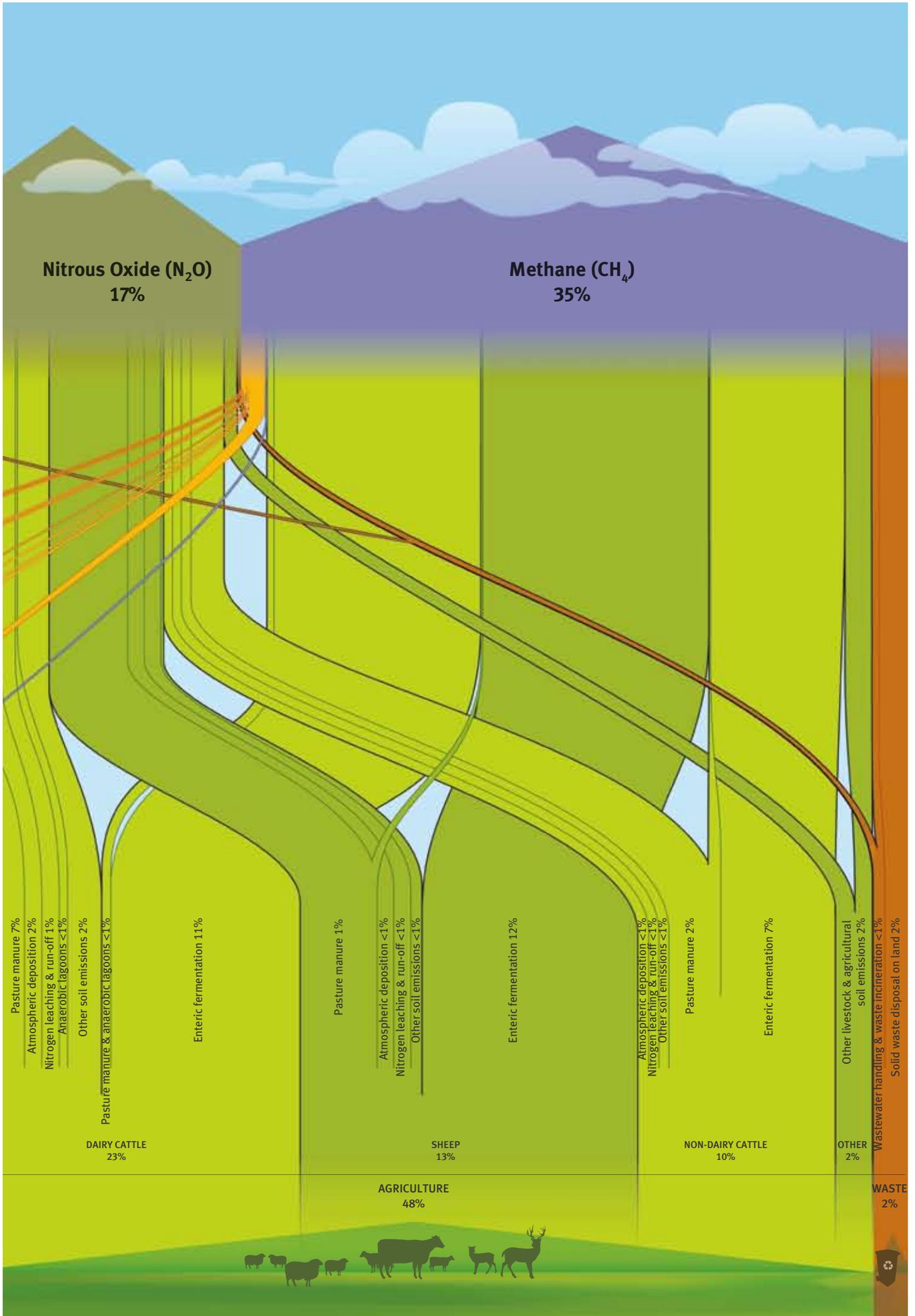


The removals account for carbon dioxide emitted from harvested forests. All figures have been rounded. CH₄ = Methane and N₂O = Nitrous Oxide.

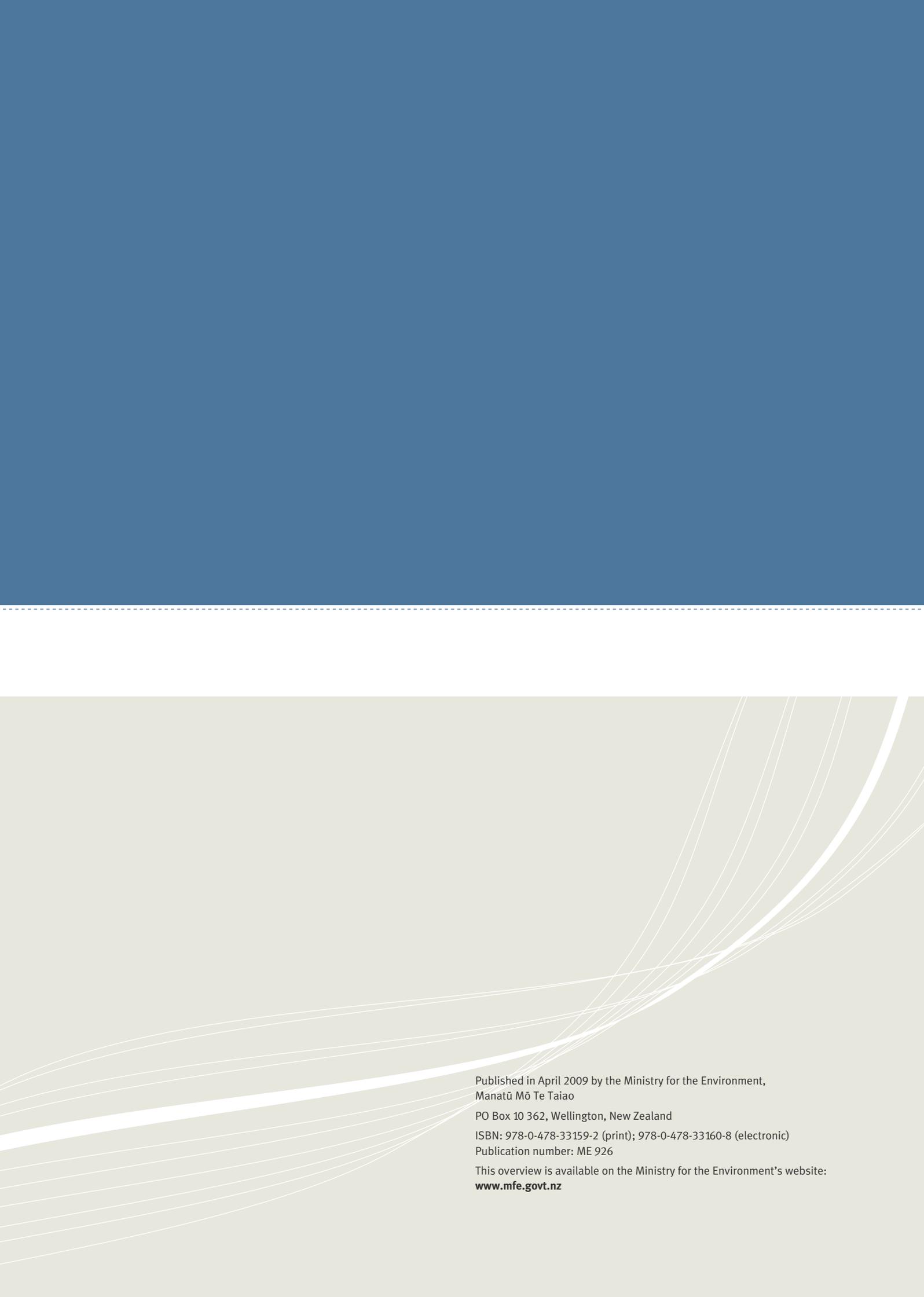
Figure 14:
New Zealand's greenhouse gas emissions

In 2007, total greenhouse gas emissions were 75.6 Mt CO₂-e.





All figures have been rounded. HFCs, PFCs and SF₆ = Hydrofluorocarbons, Perfluorocarbons and Sulphur Hexafluoride.



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