



NEW ZEALAND'S GREENHOUSE GAS INVENTORY 1990–2013

This snapshot presents commonly asked questions about New Zealand's emissions and provides the answers based on *New Zealand's Greenhouse Gas Inventory 1990–2013* (Inventory) released on 10 April 2015. The Inventory is the official annual report of human-caused emissions of greenhouse gases in New Zealand. The complete Inventory submission is available on the Ministry for the Environment's website at: www.mfe.govt.nz/publication-search under the climate change section.

In the Inventory, emissions are categorised into five different sectors:

- > energy (eg, road transport and electricity production)
- > industrial processes and product use, (IPPU) (eg, metals, minerals and chemicals)
- > agriculture (eg, methane from livestock digestive systems¹ agricultural soils and manure management)
- > LULUCF
- > waste.

The timing of the Inventory reporting is based on guidelines under the United Nations Framework Convention on Climate Change (UNFCCC). Each Inventory report is submitted 15 months after the end of the calendar year, providing time for the data to be collected, processed and analysed.

How much does each sector contribute to total emissions?

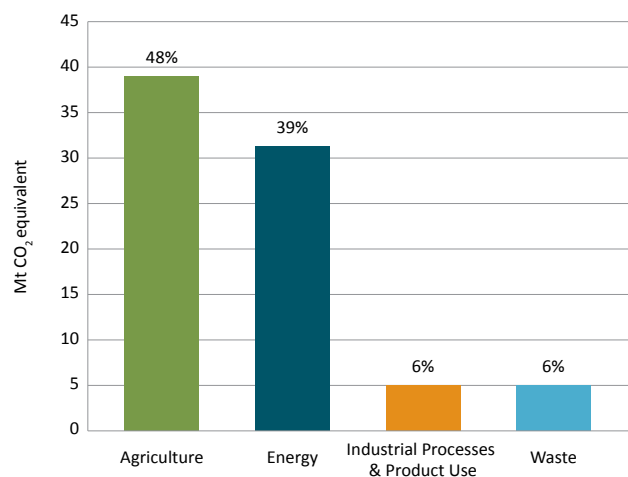
Agriculture was the largest contributing sector to New Zealand's emissions in 2013. It contributed 39.2 Mt CO₂-e, and comprised 48 percent of total emissions (figure 1). Energy was the second largest sector, contributing 31.7 Mt CO₂-e, comprising 39 percent of total emissions.

IPPU and waste both contributed 5.1 Mt CO₂-e, (each making up 6 percent of total emissions).

Key points:

- > In 2013, New Zealand's total greenhouse gas emissions were 81.0 million tonnes of carbon dioxide equivalent (Mt CO₂-e)². This is an increase of 14.2 Mt CO₂-e from the 1990 level of 66.7 Mt CO₂-e (a 21.3 percent increase). Total emissions decreased by 1.1 Mt CO₂-e (1.4 percent) between 2012 and 2013, while net emissions remained static.
- > The agriculture and energy sectors are the two largest contributors to New Zealand's emissions profile, together contributing approximately 87.5 percent of total emissions in 2013.
- > In 2013, New Zealand's net emissions were 54.2 Mt CO₂-e. This is a result of 26.8 Mt CO₂-e removals by the land use, land use change and forestry sector (LULUCF).

Figure 1: New Zealand's greenhouse gas emissions in 2013 (by sector, in million tonnes of CO₂ equivalent)



Note: Emissions from the LULUCF sector are not included in the estimate of total emissions. Percentages may not add up to 100 due to rounding

¹ Livestock emit methane from their digestive systems as part of a process called enteric fermentation.

² Carbon dioxide equivalent (CO₂-e) is a measure for describing how much global warming a given type and amount of greenhouse gas may cause, using the equivalent amount of CO₂ as the reference. CO₂-e is used to account for the different global warming potency of the different greenhouse gases, and allows them to be reported consistently. Gases are converted to CO₂-e using the amount of warming they would cause in the 100 years following emission, compared to the effect of CO₂ itself.

Why have New Zealand's total emissions increased since 1990?

In 1990, New Zealand's total emissions were 66.7 Mt CO₂-e. In 2013, this total increased by 14.2 Mt CO₂-e (21.3 percent) to 81.0 Mt CO₂-e. The five sources that contributed the most to the increase in total emissions were carbon dioxide from road transport and electricity generation, nitrous oxide from agricultural soils, hydrofluorocarbons (HFCs) released from industrial and household refrigeration and air-conditioning systems, and methane from livestock digestive systems.² New Zealand's total emissions peaked in 2005, decreased from 2006 to 2009, and showed an increasing trend from 2009 to 2012 before lessening again in 2013 (figure 2).

Agriculture

Between 1990 and 2013, agriculture emissions increased 14 percent. Although agriculture was New Zealand's largest emitting sector in 2013, the emissions intensity of New Zealand's agricultural production has declined since 1990. Agricultural productivity has increased due to improvements in technology, feed and stock management, and animal breeding.

Agricultural emissions decreased between 2006 and 2008 due to a reduction in sheep, non-dairy cattle and deer populations as a result of widespread drought. The drought also reduced livestock productivity. Since 2008, agricultural emissions have been increasing due to more favourable growing conditions, as well as greater demand for New Zealand agricultural produce in the dairy sector – driven by international dairy prices. A widespread drought during the 2012-2013 summer season did not affect 2012 emissions, but resulted in reduced agricultural emissions for 2013, also due to a decrease in national livestock population and performance. There was also a decrease in emissions from agricultural liming in 2013 compared with 2012, reflecting the long-term trend of decreasing limestone use.

Energy

Between 1990 and 2013, emissions from the energy sector increased by 32 percent. Most of this increase came from road transport and electricity generation. Energy emissions increased between 1990 and 2008 and then significantly decreased between 2008 and 2011 for a number of reasons, including:

- > a reduction in coal-fired and gas-fired electricity generation and an increase in renewable electricity generation (hydro, geothermal and wind)
- > a decrease in electricity demand after the Canterbury earthquake in 2011
- > a decrease in road transport emissions between 2008 and 2009 due to the economic downturn
- > a decrease in the release of methane emissions from coal mining activities between 2010 and 2011 (a result of the sealing of the Pike River mine following an explosion and the suspension of coal production at Spring Creek mine on the West Coast of the South Island).

Between 2012 and 2013, changes in emissions from the energy sector reflected inflow levels into hydroelectric catchments. Low inflows in 2012 resulted in decreased hydroelectric electricity production and an increase in non-renewable electricity sources (eg. coal based electricity production) that have higher emissions intensities. Higher inflow levels in 2013 caused emissions to decrease with the shift back to a greater proportion of hydroelectric power.

Industrial Processes and Product Use

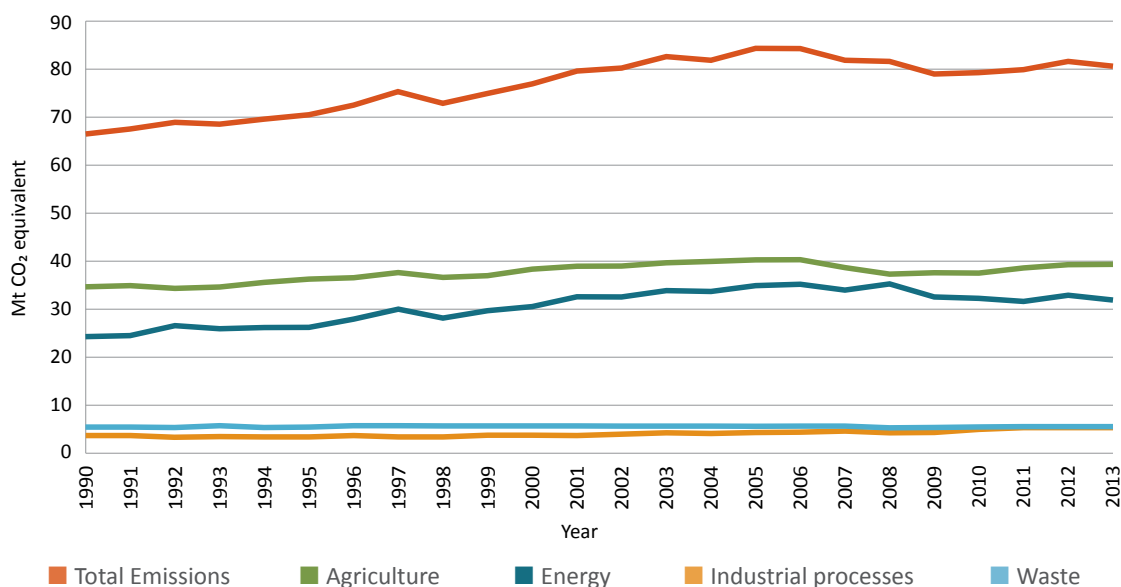
Emissions from industrial processes and product use have increased 55 percent since 1990 due to the continued increase in the release of HFCs from industrial and household refrigeration and air-conditioning systems. This increase is due to their use as a substitute for chlorofluorocarbons, which were phased out under the Montreal Protocol. In addition, CO₂ emissions from mineral, chemical and metals production have gradually increased due to increasing product outputs. These increases have been partially offset by a reduction in emissions of PFCs from aluminium production, due to improved control of anode effects in aluminium smelting.

Waste

Emissions from the waste sector have decreased by 1 percent since 1990 due to improved landfill management practices, particularly methane recovery. These improvements offset an increase in the total amount of solid waste disposed on land and increases in emissions from industrial and domestic wastewater handling.

² Carbon dioxide equivalent (CO₂-e) is a measure for describing how much global warming a given type and amount of greenhouse gas may cause, using the equivalent amount of CO₂ as the reference. CO₂-e is used to account for the different global warming potency of the different greenhouse gases, and allows them to be reported consistently. Gases are converted to CO₂-e using the amount of warming they would cause in the 100 years following emission, compared to the effect of CO₂ itself.

Figure 2: New Zealand's total greenhouse gas emissions (1990-2013)



What are New Zealand's net emissions?

Net emissions are calculated by adding net LULUCF emissions for the LULUCF sector to total emissions. In 1990, New Zealand's net greenhouse gas emissions under the UNFCCC were 38.0 Mt CO₂-e. In 2013, net greenhouse gas emissions increased by 16.1 Mt CO₂-e (42.4 percent) to 54.2 Mt CO₂-e due to current removals of mature pre 1990 trees as part of the normal harvest cycle

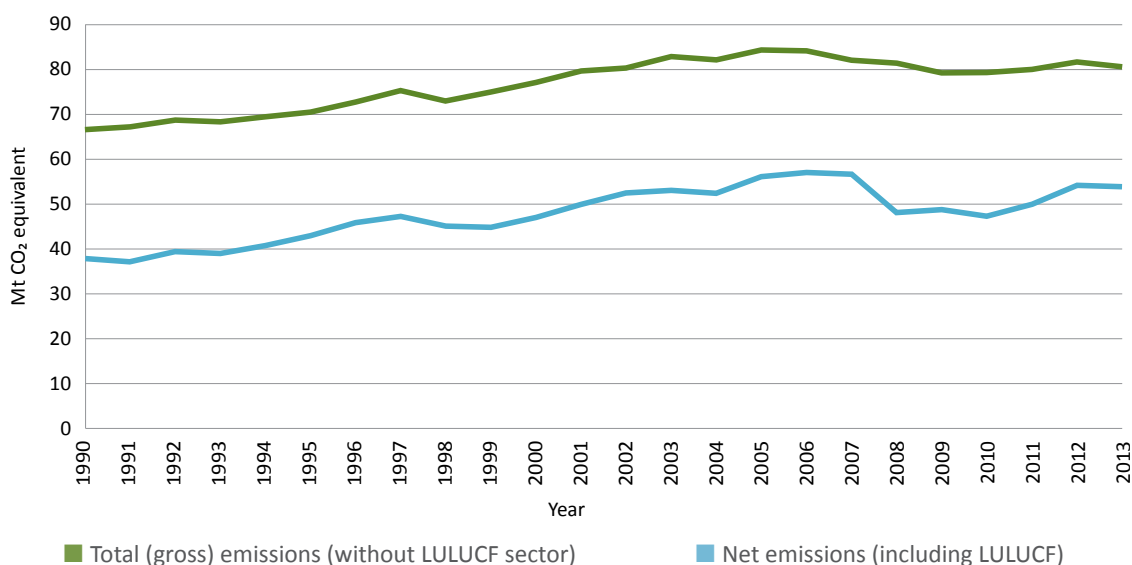
Definitions

Total emissions reported under the UNFCCC and under the Kyoto Protocol come from the following sectors: agriculture, energy, industrial processes and product use and waste.

Net emissions under the UNFCCC are total emissions plus emissions and removals from LULUCF.

Net emissions under the Kyoto Protocol are total emissions plus emissions and removals from post 1989 activities under Articles 3.3 and 3.4 of the Kyoto Protocol (afforestation, reforestation, deforestation and forest management).

Figure 3: New Zealand's total and net emissions (under the UNFCCC) from 1990 to 2013



How much carbon is removed from the atmosphere by New Zealand's forests?

Forests act as a carbon sinks because they absorb carbon dioxide from the atmosphere as they grow, storing carbon in tree trunks, branches, leaves, roots and soils.

When trees are harvested, they switch from being a carbon sink to a carbon source as the roots and branches left behind after harvesting begin to decay. Consequently, planting and harvesting cycles have a large impact on the amount of CO₂ removed by New Zealand's forests. The speed at which the stored carbon in harvested wood is released is hard to predict, as it depends on the product into which the wood is transformed. New Zealand is reporting emissions and removals for harvested wood products in the Inventory for the first time in 2013.

In New Zealand, the LULUCF sector is currently a net carbon sink, and for this reason the term 'net removals' has been used in the Inventory to describe the contribution from this sector.³ Net removals of CO₂ from New Zealand's forests have fluctuated over the period 1990–2013 (figure 4, overleaf). This is due to tree growth, harvesting and changes in the forest area. In 2013, under UNFCCC reporting, New Zealand's net removals from the LULUCF sector were – 26.8 Mt CO₂-e.

Net removals by forest land in 2013 were 33.7 Mt CO₂-e, an increase of 3.5 Mt CO₂-e (11.5 percent) from 1990.

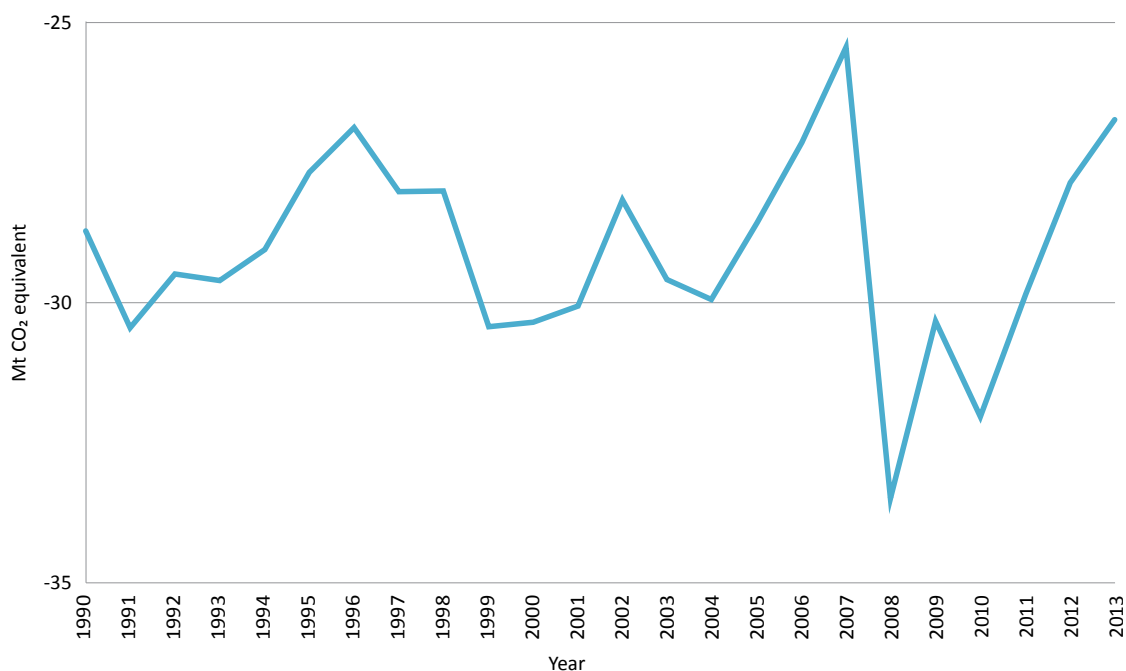
What influences the area of forest?

The size of planted forest is influenced by government policy, returns from forestry, and the relative returns compared with other land uses.

New Zealand's planted forest area increased significantly between 1992 and 1998. This followed a change in the taxation regime, an unprecedented price spike for forest products with subsequent favourable publicity, a government focus on forestry as an instrument for regional development, and the conclusion of the state forest assets sale.⁴ The removal of agricultural subsidies in New Zealand and generally poor performance of the New Zealand and international share markets also encouraged investors to seek alternative investments such as forestry, during this time.

Between 2004 and 2008, the area of New Zealand's forests decreased due to deforestation of planted forests before the introduction of the New Zealand Emissions Trading Scheme (NZ ETS). Since 2008, annual deforestation has averaged approximately 8,500 hectares. This is more than the average area of new forest planting over the same period.

Figure 4: Net removals from land use, land-use change and forestry (under the UNFCCC)⁵



³ Net emissions under UNFCCC reporting also include emissions from non-forest land categories that are excluded from Kyoto Protocol accounting.

⁴ Rhodes D, Novis J. 2002. The impact of incentives on the development of plantation forest resources in New Zealand. MAF Information Paper No: 45. MAF Policy Division. ISSN no: 1171-4654, ISBN no: 0-47807681-9. August 2002.

⁵ Net removals are expressed as a negative value to help the reader clarify the value is a removal and not an emission.

Reporting progress

New Zealand remains a party to the Kyoto Protocol and has taken a quantified economy-wide emissions reduction target under the UNFCCC for the period 2013 to 2020. New Zealand will be applying the Kyoto Protocol framework of rules in reporting against this target.

For reporting under the Kyoto Protocol, New Zealand has categorised its forests into three subcategories: pre-1990 natural forest, pre-1990 planted forest and post-1989 forest.

For post-1989 forests, emissions and removals from carbon losses and gains due to afforestation, reforestation and deforestation are reported under Article 3.3. Emissions from deforestation of pre-1990 natural and pre-1990 planted forests are also reported under Article 3.3. For all forest land that existed on 31 December 1989, which has been categorised as pre-1990 natural forest or pre-1990 planted forest, all emissions and removals not associated with deforestation are reported under Article 3.4, forest management.

From 2013, New Zealand is also reporting on carbon captured and released in harvested wood products following the Kyoto Protocol framework of rules.

How and why have New Zealand's emissions changed between 2012 and 2013?

Between 2012 and 2013:

- > There was a decrease in total emissions of 1.1 Mt CO₂-e (1.4 percent).
- > Emissions from the energy sector decreased by 1.0 Mt CO₂-e (3.2 percent) due to a decrease in emissions from electricity and heat production. Hydroelectric power generation increased because of a return to higher lake capacity in key hydroelectric catchment areas. There has also been a significant decrease in fugitive emissions as a result of decreased coal mining and handling.
- > Emissions from IPPU increased by 0.01 Mt CO₂-e (2.3 percent) due to increases in emissions from products used as substitutes for ozone depleting substances and small increases in the metal and mineral industries.
- > Agricultural emissions decreased by 0.2 Mt CO₂-e (0.4 percent). This is most likely due to drought in early 2013 that affected key pastoral areas.
- > Net removals from LULUCF decreased by 1.0 Mt CO₂-e (3.9 percent) as a greater proportion of forest land reached harvest age in 2013 compared with 2012 (due to the age structure of New Zealand's production forests). Emissions have also increased for land converted to grassland due to the area of forest land being converted to grassland being larger in 2013 than in 2012.
- > Waste emissions decreased by 0.03 Mt CO₂-e (0.5 percent). This was largely attributed to improvements in landfill management practices, particularly methane recovery. These improvements offset increased emissions from solid waste disposed on land and wastewater handling.

Definitions

Afforestation

The establishment of a forest in an area where there was no forest for at least 50 years.

Reforestation

The re-establishment of a forest in an area where forest was converted to other land uses during the past 50 years. For the first and second commitment periods of the Kyoto Protocol (2008-2020), reforestation is limited to areas that were non-forest on 31 December 1989.

Deforestation

The removal of a forest from an area, which is then converted to a non-forest use for any period of time (eg, dairy farm).

Natural disturbances

Events not caused by humans or circumstances that cause significant emissions in forests and are beyond the control of, and not materially influenced by a country. These may include wildfires, insect and disease infestations, extreme weather events, and/or geological disturbances.

Forest management

System of practices for stewardship and use of forest land.

How do New Zealand's emissions compare with other countries?

New Zealand is committed to playing its part in a global response to climate change. New Zealand has a broad range of measures to address climate change, on both a domestic and an international level, and focuses efforts where it can make the greatest contribution.

New Zealand's total emissions are low compared with our major trading partners and are approximately 0.15 percent of total world emissions.⁶

However, New Zealand's emissions intensity by population is high. In 2012, New Zealand's emissions per person were the fifth highest among 40 Annex 1 countries,⁷ at 17.2 tonnes CO₂-e per person (figure 5).⁸

New Zealand has fewer low-cost options to reduce emissions compared with most other developed countries, with three quarters of electricity generated from renewable energy, a growing and dispersed population, and 48 percent of our emissions coming from agriculture.

New Zealand's emissions profile is unusual among developed countries. For many developed countries, the agricultural sector constitutes only a small proportion of emissions, on average around 12 percent. Furthermore, CO₂ makes up about 80 percent of most developed countries' emissions.⁸ Due to the high level of agricultural production in New Zealand, most of it for export, our emissions profile is quite different. In New Zealand, methane and nitrous oxide (largely from agriculture)

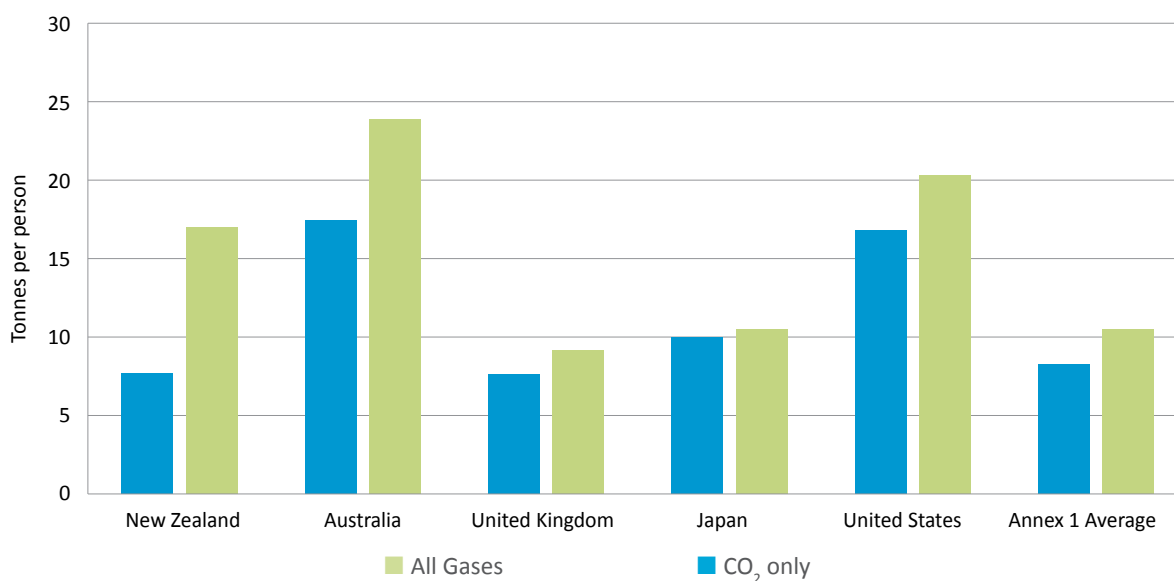
comprise over half of total national emissions (54.8 percent in 2013), while the remaining emissions consist largely of CO₂ (42.7 percent in 2013). New Zealand continues to improve the efficiency of its agricultural production, which resulted in a decreasing intensity of emissions from the agriculture sector.

When considering atmospheric concentrations of greenhouse gases, CO₂ presents a long term challenge because it persists in the atmosphere for thousands of years. Methane and nitrous oxide have a strong warming effect, but do not persist in the atmosphere for a prolonged period of time. If New Zealand is compared with other countries on a CO₂-only basis, our emissions are 20th highest among Annex 1 countries and below the Annex 1 average, at 8.3 tonnes CO₂ per person (figure 5).⁸ A lower value of CO₂ emissions per person in New Zealand reflects the high proportion of our renewable energy generation.

How has New Zealand's emissions intensity improved from 1990 levels?

New Zealand's emissions have increased from 1990 levels on the back of strong economic and population growth. However, it is important to note that the emissions intensity of our economy has decreased by 33 percent since 1990 (figure 6). This means that our economy is growing faster than our emissions and that we are decoupling emissions from economic growth.

Figure 5: International comparisons for per capita emissions in 2012⁸

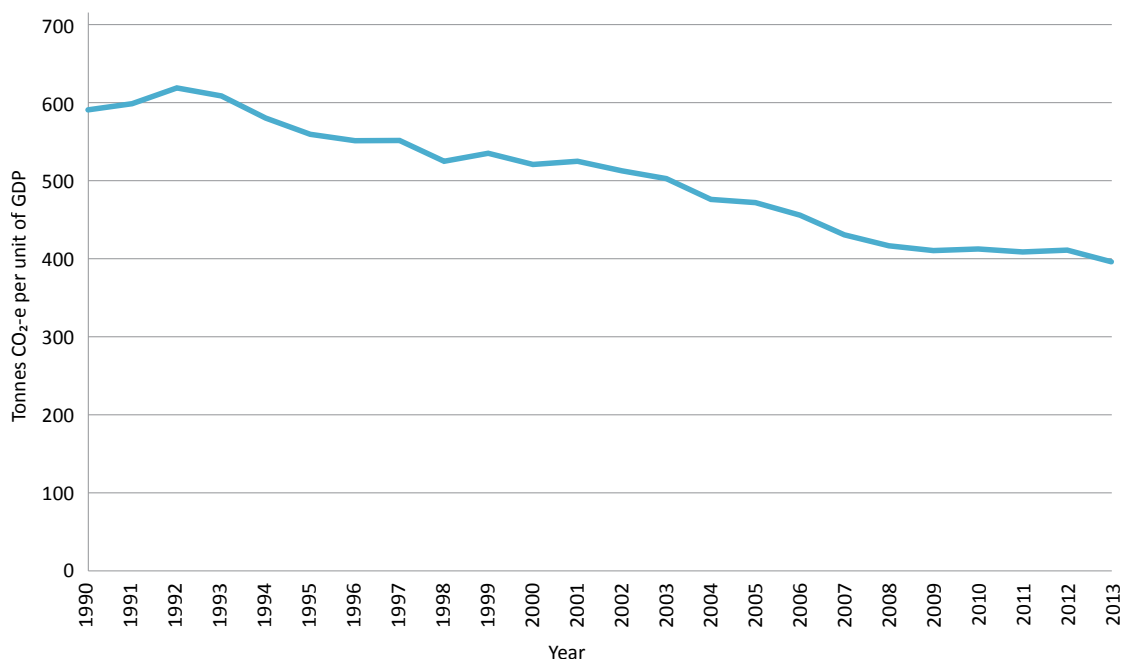


6 Based on 2012 data. The estimate of 53.5 Gt CO₂-e for global emissions comes from the Emission Database for Global Atmospheric Research (EDGAR) <http://edgar.jrc.ec.europa.eu/overview.php?v=GHGts1990-2010>

7 A group of developed countries which took commitments under the UNFCCC. http://unfccc.int/essential_background/glossary/items/3666.php

8 UNFCCC. Annex 1 countries' emissions for 2012. <http://unfccc.int/di/Indicators.do>

Figure 6: New Zealand's total emissions per unit of GDP⁹ from 1990-2013



How has the accuracy of estimates improved?

The continuous improvement of Inventory development and reporting is an underpinning principle of UNFCCC reporting requirements. Greenhouse gas inventories are examined each year by a team of international expert reviewers, who critique the report against internationally agreed guidelines and recommend areas for improvement.

To implement these improvements, it is sometimes necessary to recalculate previous estimates of greenhouse gas emissions and removals. The recalculations can arise from improvements in activity data, emission factors and methodology, or the identification of additional emission sources. It is international good practice to recalculate the entire time-series from 1990 (base year) to the latest Inventory year to ensure consistency in emission estimates and trends. This means emissions reported in previous inventories differ from those reported in this year's Inventory.

Since the last Inventory submission, improvements have been made to the accuracy of the emission estimates. The most significant improvements in this year's Inventory are described below:

Energy

- > Reporting of methanol and urea production has been aligned with the new Intergovernmental Panel on Climate Change (IPCC) reporting guidelines

Industrial Processes and Product Use

- > Recalculations of emissions estimates from HFC134a
- > Improvements in activity data of hydrocarbons and other alternative refrigerants
- > Improvement of activity data of the Other SF₆ category
- > Improvement in emissions estimates of SF₆ from electrical equipment
- > Analysis of discrepancies between information provided to the NZ ETS and Inventory data provided to the Ministry of Business, Innovation and employment (MBIE)

Agriculture

- > The equation used to calculate N₂O emissions from urea fertiliser has been revised to use values specific to New Zealand Parameter values for calculating nitrogen retention in cattle milk and deer velvet have been updated

Land-Use, Land-Use Change and Forestry

- > Estimates of carbon stock change in pre-1990 natural forest have been revised
- > There has been a recalibration of pre-1990 age-class distribution to reflect the latest available activity data
- > Post -1989 and pre-1990 forest yield tables have been updated
- > Continued improvements to increase the accuracy and consistency of the 1990, 2008 and 2012 land-use maps have resulted in increased deforestation being detected for the whole period.
- > Incorporation of new data collected from post-1989 planted forests into the mineral soil organic carbon estimates

⁹ GDP figures sourced from Statistics New Zealand, SNE – Series, GDP(P), Chain volume, Actual, Total (Annual-Mar), 2009/10 prices.

Waste

- > Use of emission returns submitted under the NZ ETS as a primary source for activity data for most landfills
- > Ongoing use of waste placement data collected under the Waste Minimisation Act 2008.

Inventory changes as a result of shifting to IPCC 2006 Guidelines

For the first time, New Zealand and other countries are required to use new reporting guidelines developed by the IPCC to prepare their greenhouse gas Inventory (the IPCC 2006 Guidelines). These new guidelines update the IPCC 1996 Guidelines and Global Warming Potentials (GWPs) from the IPCC's Second Assessment Report (AR2), which countries have been using for many years.¹⁰

One of the main implications of the use of the IPCC 2006 guidelines is that New Zealand has adopted new GWPs from the IPCC's Fourth Assessment Report (AR4) to calculate its emissions. As a result of this, the factors by which CO₂ equivalent emissions are calculated have changed. Figure 7 illustrates the effect of this shift across

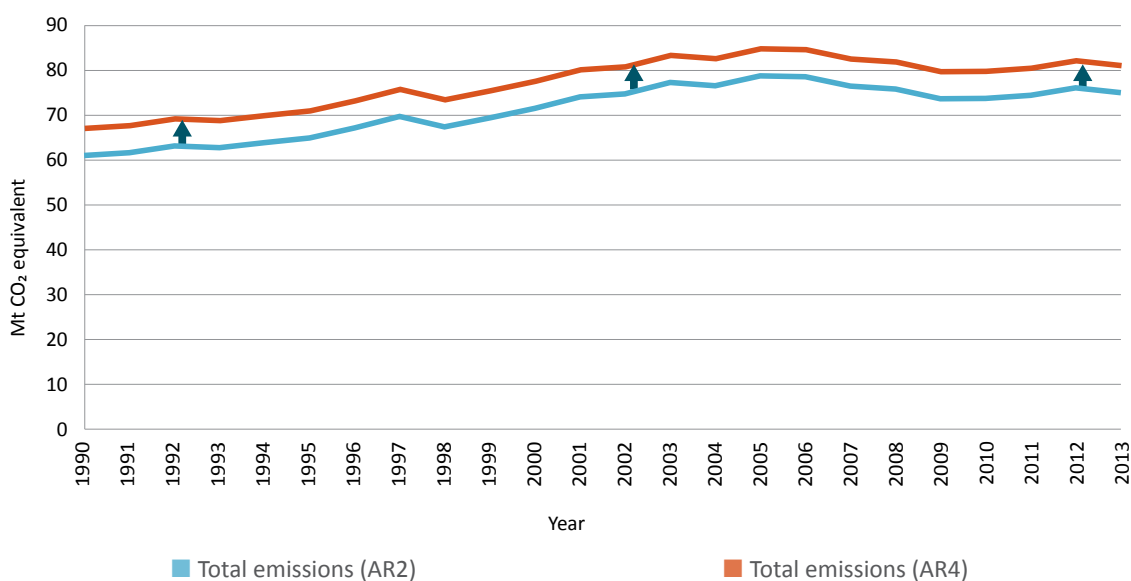
the 1990 – 2013 time series in this year's Inventory. The main drivers of this shift are changes to the GWPs of nitrous oxide (N₂O) and methane (CH₄). The GWPs of these two gases have decreased by 4 percent and increased by 19 percent respectively, which has resulted in an increased contribution of emissions from the agricultural sector, due to methane forming the bulk of emissions in this sector. Along with this, there have also been less significant changes to the GWPs of HFCs and SF₆.

In addition, there have also been changes to methodologies for the calculation of emissions, and changes to the composition of some sectors (eg, emissions from solvents are now reported under the IPPU sector, instead of separately, and liming has shifted from being reported in the LULUCF sector to the Agriculture sector. This means emissions from liming are now included in the estimate of total emissions).

The complete Inventory submission is available on the Ministry for the Environment's website at:

www.mfe.govt.nz/publications/climate/

Figure 7: The effect of migrating this Inventory to IPCC (2006) guidelines and IPCC AR4¹⁰ Global Warming Potentials from 1990-2013



¹⁰ A Global Warming Potential (GWP) is a relative measure of how much heat a greenhouse gas traps in the atmosphere relative to CO₂. This Inventory uses AR4 GWPs as recommended by the IPCC 2006 guidelines. This represents a change from AR2 guidelines used in previous inventories.



FOR MORE INFORMATION:

- > about the state of New Zealand's environment go to: www.mfe.govt.nz/environmental-reporting
- > about climate change go to: www.mfe.govt.nz/climate-change
- > about the Ministry for the Environment's reporting on New Zealand's greenhouse gases contact: info@mfe.govt.nz



New Zealand Government

Published in April 2015 by the Ministry for the Environment, Manatū Mō Te Taiao, PO Box 10362, Wellington 6143, New Zealand
Publication number: INFO 735