



NEW ZEALAND'S GREENHOUSE GAS INVENTORY AND NET POSITION REPORT 1990–2010

Environmental Snapshot
April 2012

Key points

- In 2010, New Zealand's total greenhouse gas emissions were 71.7 million tonnes of carbon dioxide equivalent (Mt CO₂-e), which means total emissions are now 11.9 Mt CO₂-e (19.8%) higher than the 1990 level of 59.8 Mt CO₂-e.
- In 2010, net removals from afforestation, reforestation and deforestation under the Kyoto Protocol were **17.5 Mt CO₂-e**.
- New Zealand's net emissions are less than the average assigned amount units for 2008, 2009, and 2010. We are on track to meet our Kyoto Protocol target.

Between 2009 and 2010:

- There was a small increase in total emissions of 0.2 Mt CO₂-e (0.2%).
- In the energy sector emissions decreased by 0.5 Mt CO₂-e (1.5%), due to an increase in the supply of geothermal generation, a preference for gas over coal at New Zealand's largest electricity generation plant, and higher inflows into the hydro lakes.
- Industrial processes emissions increased by 0.4 Mt CO₂-e (9.8%), due to the continued increase in hydrofluorocarbon (HFC) consumption and an increase in steel and aluminium production.
- Agricultural emissions increased by 0.3 Mt CO₂-e (0.8%), largely due to increases in the population of dairy cattle, and in the quantity of nitrogen fertiliser used.
- Net removals from land use, land-use change and forestry (LULUCF) decreased by **6.3 Mt CO₂-e (23.8%)**. This is largely the result of an increase in harvesting of pre-1990 planted forest and increased new planting. New planting results in emissions due to a loss of biomass associated with the previous land use and a loss of soil carbon with the land-use change to forestry, outweighing removals by forest growth in the first year.

OCTOBER 2012 This errata notice is to inform users that a small error has been identified in the forestry net removals data reported in New Zealand's national greenhouse gas inventory 1990–2010. **Figures highlighted in green in this snapshot have been corrected with an estimate from the Net Position Report. Figures highlighted in red contain an error of approximately 4% and have not been corrected.** For more information on this error and our response, please visit <http://www.mfe.govt.nz/publications/climate/greenhouse-gas-inventory-2012/index.html>

This snapshot presents commonly asked questions about New Zealand's emissions and provides answers from New Zealand's Greenhouse Gas Inventory 1990–2010 released on 12 April 2012.

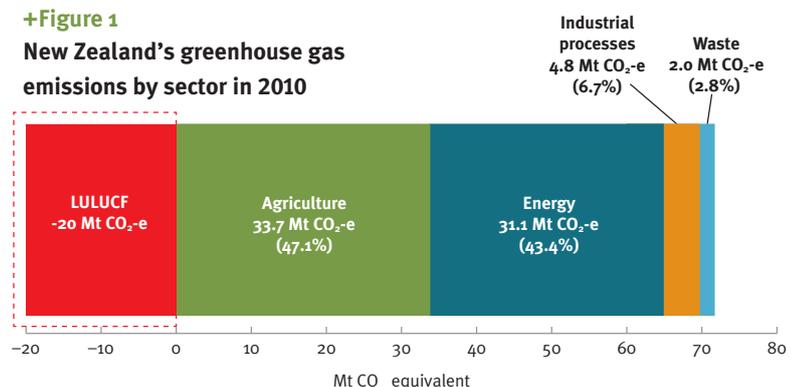
The inventory is the official annual report of all human-caused emissions and removals of greenhouse gases in New Zealand. The complete inventory submission is available on the Ministry for the Environment's website at: www.mfe.govt.nz/publications/climate/.

How much does each sector contribute to total emissions?

Agriculture was the largest sector of New Zealand's emissions in 2010, contributing 33.7 million tonnes carbon dioxide equivalent (Mt CO₂-e), 47.1% of total emissions (see figure 1). Energy was the second largest sector, contributing 31.1 Mt CO₂-e, 43.4% of total emissions.

Industrial processes, waste, and solvents and other products are smaller sectors, contributing only 4.8, 2.0 and 0.03 Mt CO₂-e respectively (making up 6.7%, 2.8% and 0.04% of total emissions respectively).

+Figure 1
New Zealand's greenhouse gas emissions by sector in 2010



Notes: Emissions from the solvent and other product use sector are not represented in this figure. Net removals from the LULUCF sector are as reported under the UN Climate Change Convention (see 'Definitions').

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

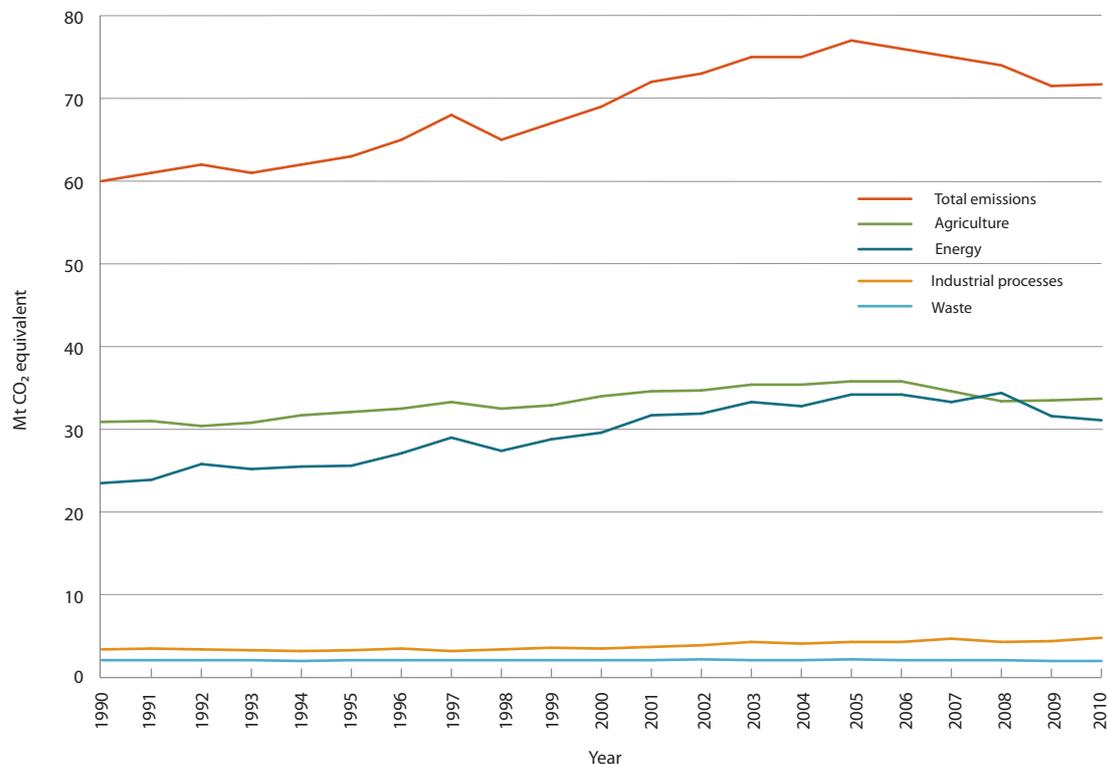
In 1990, New Zealand's total emissions were 59.8 Mt CO₂-e. In 2010, this total had increased by 11.9 Mt CO₂-e (19.8%) to 71.7 Mt CO₂-e. This long-term trend is largely due to growth in energy emissions, particularly from road transport and electricity generation.

While agriculture was New Zealand's largest emitting sector in 2010, since 1990 energy emissions have increased over twice as much as those from agriculture. Consequently, the proportion of energy emissions as part of total emissions has increased over time. Energy and agricultural emissions now occupy almost equal proportions (see figure 2).

The year-to-year changes in agricultural emissions can have a significant effect on total emissions. For instance, between 2007 and 2008 energy emissions went up, while emissions from agriculture went down. The decrease in agricultural emissions more than balanced out the increase in energy emissions and as a result total emissions went down slightly.

+Figure 2

New Zealand's total greenhouse gas emissions from 1990 to 2010



Why have New Zealand's total emissions decreased since 2006?

New Zealand's total emissions since 1990 peaked in 2005, and have been trending downwards since 2006. Between 2006 and 2010 our total emissions have been trending down because of the weather and a weaker economy affecting the two largest sectors, agriculture and energy.

Between 2006 and 2007 the decrease in total emissions resulted from:

- a reduction in coal-fired electricity generation with the commissioning of the combined cycle gas turbine at the Huntly power station
- a reduction in sheep, non-dairy cattle and deer populations because of the widespread drought.

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Between 2008 and 2009, the decrease in total emissions resulted from:

- a decrease in coal-fired electricity generation due to:
 - » an increase in inflows into hydro-electric storage lakes
 - » an increase in electricity supply from geothermal and wind generation
 - » lower industrial electricity demand due to the economic downturn
- a reduction in road transport emissions due to the effects of the economic downturn.

Between 2009 and 2010 total emissions had a small overall increase, with increases in some sectors being largely balanced by decreases in others. For example:

- in the energy sector, emissions decreased by 0.5 Mt CO₂-e (1.5%). Although there was a 3% growth in the amount of electricity generated, emissions decreased because:
 - » there was an increase in the supply of geothermal generation
 - » there was a preference for gas over coal at New Zealand's largest generating plant
 - » there were higher inflows into the hydro-electric storage lakes
- which all reduced the need for coal-fired electricity generation
- industrial processes emissions increased by 0.4 Mt CO₂-e (9.8%), due to the continued increase in HFC consumption and an increase in steel and aluminium production. HFC emissions have increased because of their use as a substitute for chlorofluorocarbons phased out under the Montreal Protocol
- agricultural emissions increased by 0.3 Mt CO₂-e (0.8%), largely due to increases in the population of dairy cattle, and in the quantity of nitrogen fertiliser used.

Definitions

Total emissions reported under the United Nations Framework Convention on Climate Change (the UNFCCC) and under the Kyoto Protocol come from the following sectors: agriculture, energy, industrial processes, waste, and solvent and other product use.

Net emissions under the UNFCCC are total emissions plus emissions and removals from land use, land-use change and forestry (LULUCF). Net emissions under the Kyoto Protocol are total emissions plus emissions and removals from activities under Article 3.3 of the Kyoto Protocol (afforestation, reforestation and deforestation since 31 December 1989).

The main difference between the two definitions of net emissions is that Kyoto Protocol reporting excludes removals and harvesting emissions from forests established before 1990. This 1990 baseline is a reference against which to measure progress, allowing for comparison between countries and between sectors.

How much carbon is sequestered by New Zealand's forests?

Net removals have fluctuated over the period 1990–2010 (see figure 3). This is due to tree growth, harvesting and changes in the area of forestry. In 2010, under UNFCCC reporting New Zealand's net removals were **20.0 Mt CO₂-e**.¹ This estimate is different to the 2010 estimate of **17.5 Mt CO₂-e** for net removals reported under the Kyoto Protocol. This is because under Article 3.3 of the Kyoto Protocol, New Zealand can only account for removals from forests established after 31 December 1989.

A key factor in the ability of a forest to remove CO₂ is the age of the forest. A newly planted forest is slow at removing CO₂, but once established the forest will enter a period of rapid growth during which it removes the most CO₂. Once a forest has reached maturity, the growth slows and the rate at which it removes CO₂ decreases. Consequently, planting and harvesting cycles have a large impact on New Zealand's net removals.

¹ Net removals under UNFCCC reporting also include emissions from non-forest land categories that are excluded from Kyoto Protocol accounting.

2009–2010

Between 2009 and 2010, net removals from LULUCF decreased by **6.3 Mt CO₂-e (23.8%)**. This decrease in net removals is largely the result of an increase in harvesting of pre-1990 planted forest and increased new planting. New planting resulted in emissions due to a loss of biomass associated with the previous land use and a loss of soil carbon with the land-use change to forestry, outweighing removals by forest growth.

What influences the area of forestry?

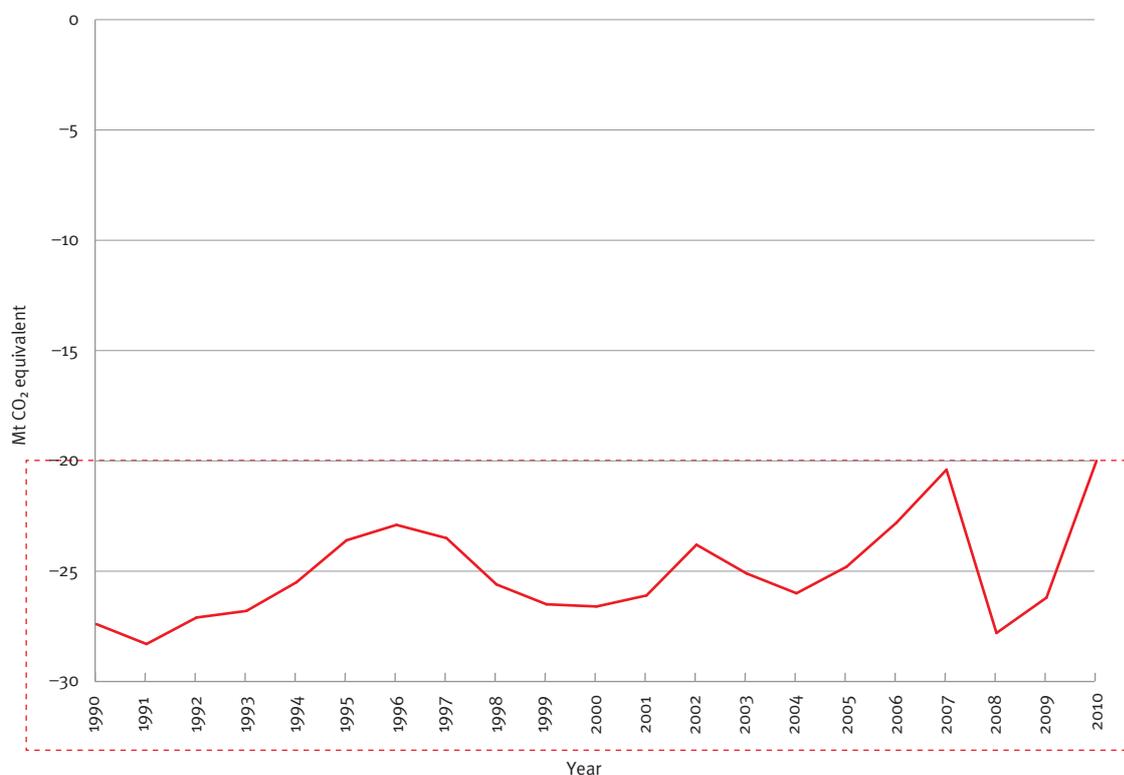
The area of a forest has historically been influenced by government policy, returns from forestry and the relative returns compared to other land uses. New Zealand's planted forest area increased significantly between 1992 and 1998. This followed a change in the taxation regime, an unprecedented price 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.² 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 alternatives.

Between 2004 and 2008, the area of New Zealand's forests decreased due to an increase in deforestation of planted forests before the introduction of the New Zealand Emissions Trading Scheme (NZ ETS). The high price of pastoral land between 2004 and 2008 also contributed to an increase in deforestation. In 2010, deforestation emissions were 1.0 Mt CO₂-e, primarily from the conversion of forest land to grassland for dairy farming. This is relatively minor compared to previous years.

The area of new planting has slowly increased since 2007. The contributing factors are the NZ ETS, the Permanent Forest Sinks Initiative and the Afforestation Grant Scheme which have been introduced by the New Zealand Government to encourage new planting and regeneration of natural forest.

+Figure 3

Net removals from land use, land-use change and forestry (under the UNFCCC)³



² 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.

³ Net removals are expressed as a negative value to assist the reader in clarifying that the value is a removal and not an emission.

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

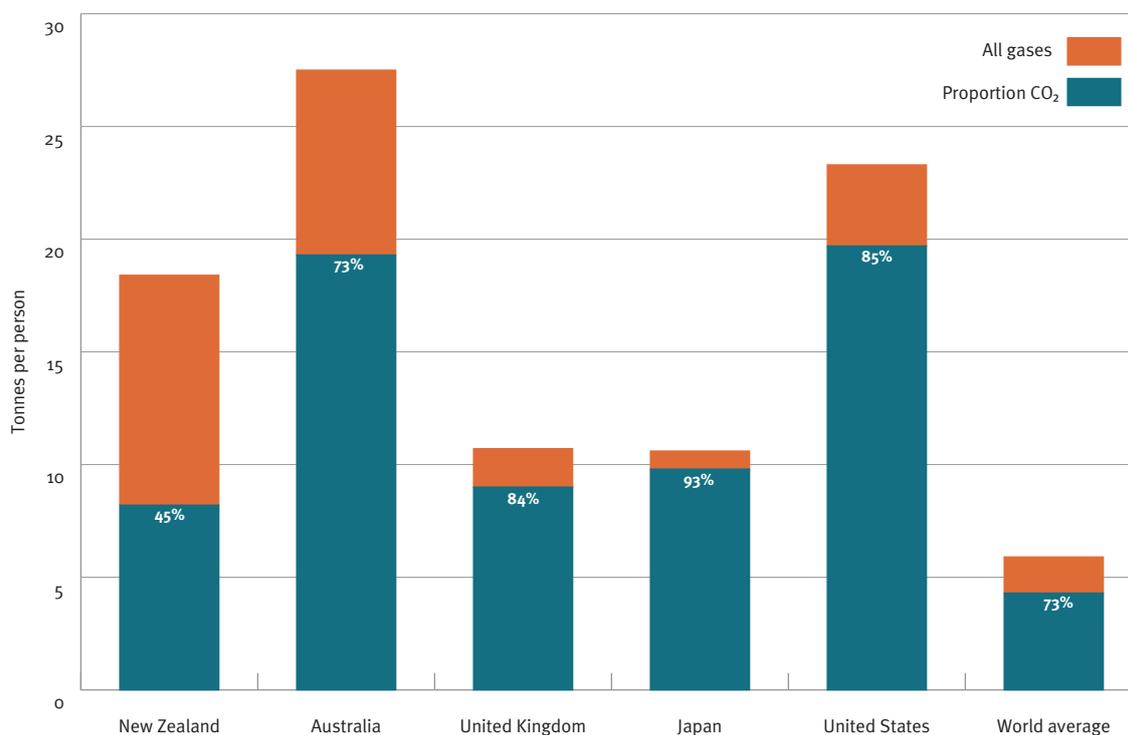
In absolute terms, New Zealand's emissions are low compared to our major trading partners. In 2005, New Zealand's total emissions were 76.5 Mt CO₂-e, approximately 0.2% of total world emissions.⁴ However, New Zealand's emissions intensity by population is high. In 2005, New Zealand's emissions per person were 13th highest in the world, at 18.3 tonnes CO₂-e per person.⁵

New Zealand's emissions profile is unique amongst developed countries. For most developed countries, agriculture is a small part of their emissions, making up 10% or less of total emissions while CO₂ makes up approximately 80% of most developed countries' emissions.⁶ Due to the high level of agricultural production in New Zealand, most of it for export, our profile is quite different. In New Zealand, agricultural methane and nitrous oxide comprise almost half of total emissions (47% in 2010) and CO₂ comprises approximately the same proportion (46% in 2010).

When considering atmospheric concentrations of greenhouse gases, reducing agricultural emissions is important, but CO₂ presents a significant challenge because it lasts a lot longer in the atmosphere, persisting for thousands of years. Agricultural gases have a very strong warming effect in the short term, but do not persist in the atmosphere. If New Zealand is compared to other countries on a CO₂ only basis, New Zealand's emissions are 39th highest in the world, at 8.2 tonnes CO₂ per person (see figure 4). New Zealand's lower CO₂ emissions reflect the high proportion of renewable generation in the electricity sector.

+Figure 4

International comparisons for per capita emissions in 2005, CO₂ and all gases⁷



⁴ 2005 is the latest year for which information is available for all gases and all countries.

⁵ World Resources Institute. Climate Analysis Indicators Tool. <http://cait.wri.org/> Retrieved 24 February 2012.

⁶ Developed countries' average for 2005 (Annex 1 countries).

⁷ World Resources Institute. Climate Analysis Indicators Tool. <http://cait.wri.org/> Retrieved 24 February 2012.

How has the accuracy of estimates improved?

The continuous improvement of inventory development and reporting is a fundamental requirement under the Kyoto Protocol and the UNFCCC. Inventory improvements can result in recalculated emission estimates. Recalculated estimates can arise from any one or a combination of, improvements in activity data, emission factors, methodology or when additional emission sources are identified. Further, it is international good practice to recalculate the entire time-series to ensure emission trends do not reflect methodological influence.

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. Since the last inventory submission, many improvements have been made to the accuracy of the emission and removal estimates. These recalculations will change the stated estimate of emissions in 2009 from what was reported last year, as improvements are applied to the whole time-series. The most significant improvements in this year's inventory are described below.

Soil carbon

This inventory has revised the approach for estimating emissions from mineral soils. In the previous inventory, a New Zealand-specific methodology was used which incorporated data on key factors that regulate mineral soil organic carbon stocks: land use, climate and soil class. For this inventory, an international default methodology was used. This change is because further development work to make the New Zealand-specific methodology acceptable to international reviewers is still ongoing, and was not ready in time to be used in this inventory. If these improvements are able to be made within the commitment period we will return to using a New Zealand-specific methodology. This change resulted in a 3.1 Mt CO₂-e increase to estimated net removals in 1990 and a 0.3 Mt CO₂-e increase to net removals in 2009, compared to what was reported last year.

Deforestation area

The accuracy of the land-use change area has been improved in this year's inventory, particularly the area of deforestation. In last year's inventory, deforestation areas were mapped based on satellite imagery with a resolution of 22 metres. For this year's inventory, four areas where most of the deforestation activity was detected in 2008 and 2009, were re-mapped using satellite imagery with 10- metre resolution. The improvement in mapping resolution only affects the estimates of deforestation in 2008 and 2009, and does not change emissions estimates for other years. These improvements have resulted in an increase in net emissions in 2008 of 1.3 Mt CO₂ and an increase in 2009 of 1.2 Mt CO₂, compared to what was reported last year.⁸

Liveweights for sheep and beef cattle

This year there have been a number of improvements to the model for estimating emissions from dairy and beef cattle and sheep. The most significant contributor to this recalculation was improving the estimate of the average liveweights of ewes and beef cows. The replacement rate of beef cows was also revised. The replacement rate is the number of beef cows estimated to be replaced each year by growing heifers. These improvements have resulted in a 0.6 Mt CO₂-e increase in estimated agricultural emissions in 1990, and a 0.7 Mt CO₂-e increase in agricultural emissions in 2009, compared to what was reported last year.

The complete inventory submission is available on the Ministry for the Environment's website at: www.mfe.govt.nz/publications/climate/.

⁸ Recalculations to net removals from changes in soil carbon methodology are not cumulative with recalculations to the deforestation area, as the change in deforestation area will affect how much land is subject to soil carbon changes. The figures stated here represent the effect of each change in isolation. For complete figures including all recalculations, see the full Inventory submission on the Ministry for the Environment website.



NEW ZEALAND'S NET POSITION UNDER THE KYOTO PROTOCOL

The latest projection of New Zealand's net position under the first commitment period of the Kyoto Protocol (the net position) is a surplus of 23.1 million units.

How is the net position calculated?

The net position is New Zealand's forecast surplus or deficit of emission units against our target for the first commitment period of the Kyoto Protocol (2008–2012). It is reported as a surplus if New Zealand's net emissions are projected to be below our Kyoto target and as a deficit if emissions are projected to be above the Kyoto target. The net position is produced using a combination of actual inventory data for 2008, 2009 and 2010, and projected data for 2011 and 2012.

Because the Kyoto target is fixed (see 'Assigned Amount Units' in the box overleaf), a small forecast change in either total emissions or in removals from forestry, can have a large effect on the size of the net position, as figure 5 shows.

Why has the net position changed since the last update in 2011?

The net position surplus has increased by 1.2 million units, from 21.9 million units in April 2011. The change in the net position from 2011 to 2012 is smaller than in previous years, because while projected total emissions rose, they were balanced by a projected rise in removals from forestry. The largest changes in the forecast are from removals from forestry, and emissions from the industrial processes and agriculture sectors.

Afforestation, reforestation and deforestation

Removals from afforestation, reforestation and deforestation under the Kyoto Protocol are now projected to be 85.8 Mt CO₂-e over 2008–2012. This is 3.0 Mt CO₂-e higher than projected last year. This increase is primarily due to improvements to our estimates of the rates at which forests sequester carbon. The improvements incorporate the latest scientific knowledge on decay rates, species-specific growth trajectories and biomass adjustments that have been developed as part of research funded under the Land Use and Carbon Analysis System.

Industrial processes

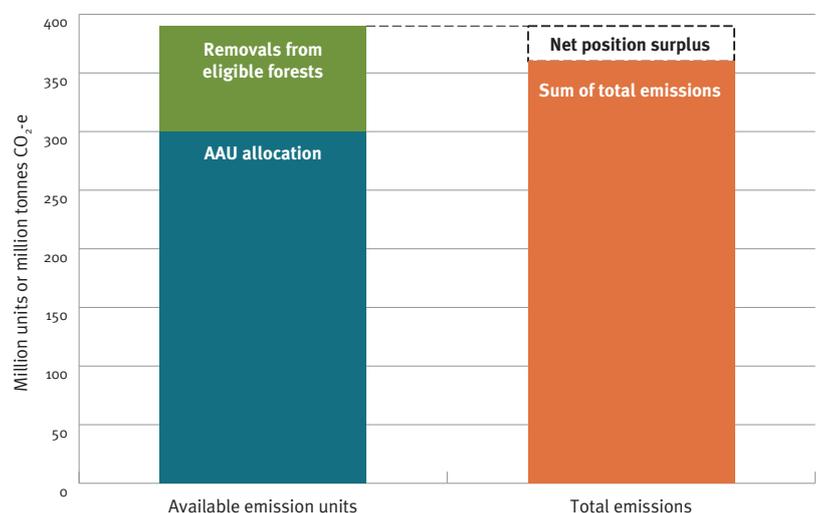
Emissions from the industrial processes sector are now projected to be 1.1 Mt CO₂-e higher over 2008–2012 than projected last year (an increase of 4.9%). This increase is due to higher than projected emissions of hydrofluorocarbons (HFCs). HFC emissions have increased because of their use as a substitute for chlorofluorocarbons phased out under the Montreal Protocol.

Agriculture

Emissions from the agriculture sector are now projected to be 0.4 Mt CO₂-e higher over 2008–2012 than projected last year (an increase of 0.2%). This increase is due to improvements to the methodology used to calculate agricultural emissions for *New Zealand's Greenhouse Gas Inventory* and updated forecasts of agricultural activity for 2011 and 2012.

+Figure 5

The net position for 2008–2012



The key methodological improvements are discussed on page 6 (see ‘How has the accuracy of estimates improved?’). Compared to last year’s projections, the methodological improvements and the updated forecasts of activity data have led to:

- an increase in projected direct emissions from sheep and beef cattle
- a decrease in projected emissions from dairy cattle, deer, poultry, pigs and indirect emissions from fertiliser application.

What are the projections of emissions for each sector?

The following table shows a breakdown of the emissions forecast for each sector for each year in the first commitment period of the Kyoto Protocol.

+Table 1

Projections of emissions and removals by sector and by year for 2008–2012

	EMISSIONS (MILLIONS OF TONNES OF CO ₂ EQUIVALENT)					
	2008	2009	2010	2011	2012	TOTAL
Energy	34.4	31.6	31.1	30.9	33.8	161.8
Industrial processes and Solvents	4.3	4.4	4.8	4.8	4.9	23.2
Agriculture	33.4	33.5	33.7	34.6	35.3	170.5
Waste	2.1	2.0	2.0	2.0	2.0	10.0
Forestry	-16.7	-17.0	-17.5	-16.9	-17.7	-85.8
<i>Gross removals</i>	-18.2	-18.3	-18.4	-18.5	-18.7	-92.2
<i>Deforestation</i>	1.5	1.3	1.0	1.6	1.0	6.4
Total	57.5	54.5	54.2	55.2	58.3	279.8

Note: Forestry figures in this table refer to net emissions and removals under Article 3.3 of the Kyoto Protocol. Positive numbers refer to emissions of greenhouse gases, and negative numbers refer to removals/sequestration of greenhouse gases. Totals may not sum due to rounding.

The Kyoto financial position

The Kyoto financial position is the monetary value of the surplus/deficit of units that must be included in the Government’s financial accounts. The Ministry for the Environment reports the Kyoto financial position on its website at www.mfe.govt.nz/issues/climate/greenhouse-gas-emissions/net-position/index.html. The Ministry updates the Kyoto financial position each month to take account of changes in the exchange rate and minor changes to the Government’s unit account, and updates the carbon price twice a year.

More information

More detail on the modelling methodology is available in the net position reports for each sector, which are available at www.mfe.govt.nz/issues/climate/greenhouse-gas-emissions/net-position/index.html.

Assigned Amount Units (AAUs)

An Assigned Amount Unit is a Kyoto unit representing an allowance to emit one metric tonne of carbon dioxide equivalent. AAUs are created (issued) up to the level of a Party’s initial assigned amount. New Zealand’s initial assigned amount is the 1990 level of emissions that was reviewed in 2007; 61.9 Mt CO₂-e multiplied by 5 for the length of the commitment period (2008–2012). While we recalculate 1990 emissions as new science improves the estimates, New Zealand’s level of AAUs is fixed.



FOR MORE INFORMATION:

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



New Zealand Government

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