



## NEW ZEALAND'S GREENHOUSE GAS INVENTORY 1990–2014

This snapshot of New Zealand's greenhouse gas emissions summarises *New Zealand's Greenhouse Gas Inventory 1990–2014* and how the inventory data are used for climate change reporting. The inventory is the official annual report of human-caused emissions of greenhouse gases in New Zealand. It is available on the Ministry for the Environment's website at: [www.mfe.govt.nz/climate-change/reporting-greenhouse-gas-emissions/nzs-greenhouse-gas-inventory](http://www.mfe.govt.nz/climate-change/reporting-greenhouse-gas-emissions/nzs-greenhouse-gas-inventory).

For definitions used in this publication see page 7.

In the inventory, emissions are categorised into five sectors:

- > energy (eg, road transport and electricity production)
- > industrial processes and product use (IPPU) (eg, metals, minerals and chemicals)
- > agriculture (eg, nitrous oxide from fertiliser, methane from livestock digestive systems and manure)
- > land use, land-use change and forestry (LULUCF)
- > waste.

The inventory report is submitted 15 months after the end of the calendar year, providing time for the data to be collected, processed and analysed.<sup>1</sup> The timing of reporting is based on guidelines under the United Nations Framework Convention on Climate Change (UNFCCC).

### Gross emissions are mostly from agriculture and energy

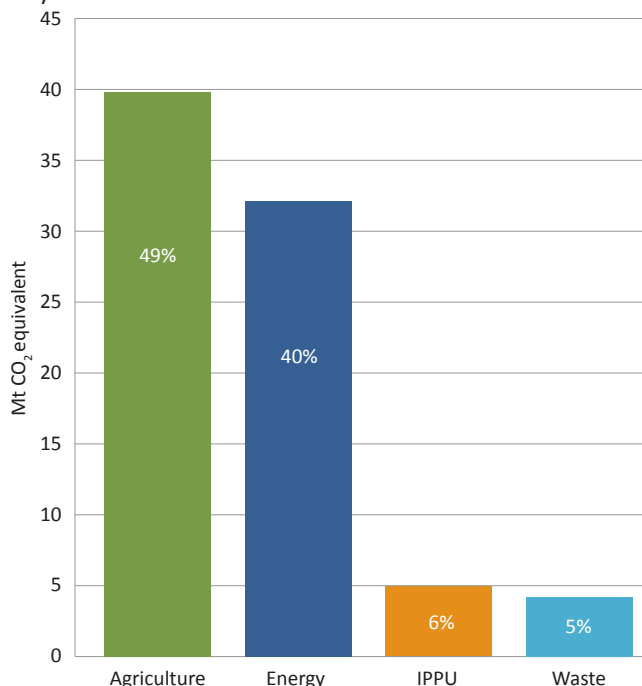
The agriculture sector contributed 49 per cent of New Zealand's gross emissions in 2014. This amounted to 39.6 million tonnes of carbon dioxide equivalent (Mt CO<sub>2</sub>-e)<sup>2</sup> (figure 1). The energy sector was next, comprising 40 per cent of gross emissions or 32.2 Mt CO<sub>2</sub>-e.

The IPPU and waste sectors contributed 6 per cent (5.2 Mt CO<sub>2</sub>-e) and 5 per cent (4.1 Mt CO<sub>2</sub>-e) of gross emissions, respectively.

### Key points

- > In 2014, New Zealand's gross greenhouse gas emissions increased 1 per cent since the previous year to 81.1 Mt CO<sub>2</sub>-e.
- > Since 1990, New Zealand's gross emissions have increased 23 per cent (15.3 Mt CO<sub>2</sub>-e).
- > The agriculture and energy sectors are the two largest contributors to New Zealand's emissions profile, together contributing 89 per cent of gross emissions in 2014.
- > New Zealand's net emissions under the UNFCCC were 56.7 Mt CO<sub>2</sub>-e in 2014. This is calculated by subtracting the 24.4 Mt CO<sub>2</sub>-e of net removals from land use, land-use change and forestry from gross emissions.

Figure 1: New Zealand's gross greenhouse gas emissions by sector in 2014



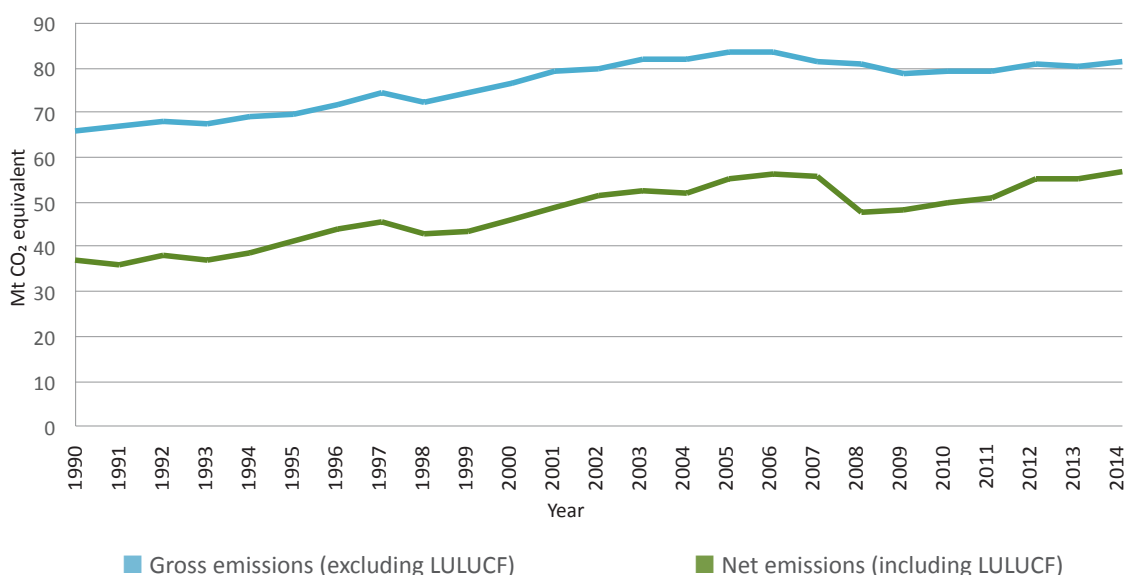
1 The publication of *New Zealand's Greenhouse Gas Inventory 1990–2014* was delayed due to technical issues with the UNFCCC software used for the inventory submission.

2 Carbon dioxide equivalent (CO<sub>2</sub>-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 CO<sub>2</sub> as the reference. CO<sub>2</sub>-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 CO<sub>2</sub>-e using the amount of warming they would cause in the 100 years following emission, compared to the effect of CO<sub>2</sub> itself.

## Production and population growth increase gross emissions

In 1990, New Zealand's gross emissions were 65.8 Mt CO<sub>2</sub>-e. Between 1990 and 2014, gross emissions increased 23.2 per cent to 81.1 Mt CO<sub>2</sub>-e. The largest contributors were carbon dioxide from road transport, manufacturing industries and construction, nitrous oxide from agricultural soils, and methane from livestock digestive systems.<sup>3</sup> Our gross emissions increased from 1990 to 2006, decreased from 2006 to 2009, and slightly increased again from 2009 to 2014 (figure 2). Gross emissions increased by 1 per cent since 2013.

**Figure 2:** New Zealand's gross and net emissions (under the UNFCCC) from 1990 to 2014



### Agriculture

Between 1990 and 2014, agriculture emissions increased 15 per cent (figure 3). This is primarily due to a 94.7 per cent increase in the national dairy herd size since 1990 and a more than five-fold increase in the application of nitrogen-containing fertiliser.

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. Between 2008 and 2014, agricultural emissions have been increasing due to more favourable growing conditions and demand for New Zealand agricultural produce.

Between 2013 and 2014, agriculture emissions rose by 0.8 per cent (0.3 Mt CO<sub>2</sub>-e) following a 3.3 per cent increase in the size of the nation's dairy herd.

### Energy

Between 1990 and 2014, emissions from the energy sector increased 36 per cent. Most of this increase came from road transport and electricity generation.

Energy emissions increased between 1990 and 2008 and then decreased between 2008 and 2011 for a number of reasons, including:

- > reduced coal-fired and gas-fired electricity generation and more renewable electricity generation (hydro, geothermal and wind)
- > lower electricity demand after the Canterbury earthquake in 2011
- > decreased road transport emissions between 2008 and 2009 due to the economic downturn
- > decreased methane emissions from coal mining between 2010 and 2011 (a result of the sealing of the Pike River mine and the suspension of coal production at Spring Creek mine).

Between 2013 and 2014, our energy emissions rose by 1.2 per cent (0.4 Mt CO<sub>2</sub>-e). This reflected increases in production in the chemical and food processing industries. There was also a small rise in emissions due to more oil and natural gas production in 2014. These increases were largely offset by decreases in emissions from the electricity sector as the share of electricity production from renewable sources rose from 75 per cent in 2013 to 80 per cent in 2014. This was due to higher hydro and geothermal generation which reduced the need for electricity generation from coal and gas.

<sup>3</sup> Livestock emit methane from their digestive systems as part of a process called enteric fermentation.

## Industrial processes and product use

Emissions from industrial processes and product use have increased 45 per cent since 1990 due to continued increases in the release of hydrofluorocarbons (HFCs) from industrial and household refrigeration, and air-conditioning systems. This is due to the use of HFCs as a substitute for chlorofluorocarbons, which were phased out to protect the ozone layer under the Montreal Protocol. In addition, CO<sub>2</sub> emissions from mineral, chemical and metals production have gradually increased due to increasing production. These increases were partially offset by a reduction in emissions of perfluorocarbons from aluminium production as a result of improved control of anode effects in aluminium smelting.

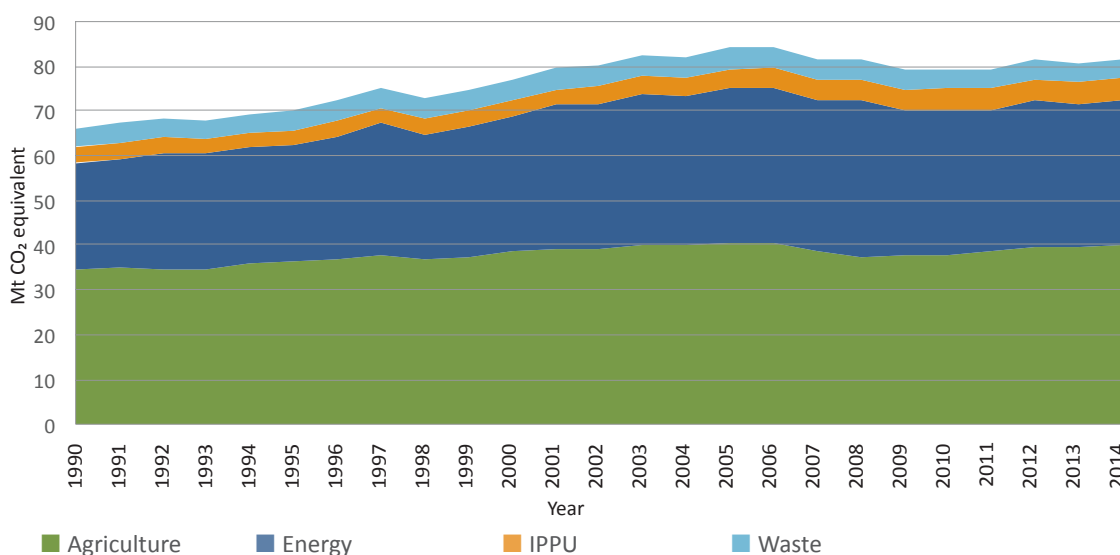
Between 2013 and 2014, our IPPU emissions increased by 2.8 per cent (0.1 Mt CO<sub>2</sub>-e) due to increased production in the mineral, chemical and metal industry categories.

## Waste

Emissions from the waste sector have decreased by 0.5 per cent since 1990 due to improved landfill management practices, particularly methane recovery. These improvements offset an increase in the amount of solid waste disposed on land and increases in emissions from industrial and domestic wastewater handling.

Between 2013 and 2014 waste emissions decreased by 0.7 per cent (0.03 Mt CO<sub>2</sub>-e).

**Figure 3:** New Zealand's gross greenhouse gas emissions by sector from 1990 to 2014



## Net emissions increased 53.6 per cent from 1990 levels

Net emissions under the UNFCCC include gross emissions and emissions and removals from land use, land-use change and forestry. Forests act as a carbon sink because they absorb carbon dioxide from the atmosphere as they grow, storing carbon in tree trunks, branches, leaves, roots and soils. When forests are harvested, the roots and branches left behind after harvesting begin to decay, emitting carbon. Harvested wood products also emit carbon as they decay, are discarded from use, or are burnt. Consequently, planting and harvesting cycles have a large impact on the amount of CO<sub>2</sub> removed by our forests.

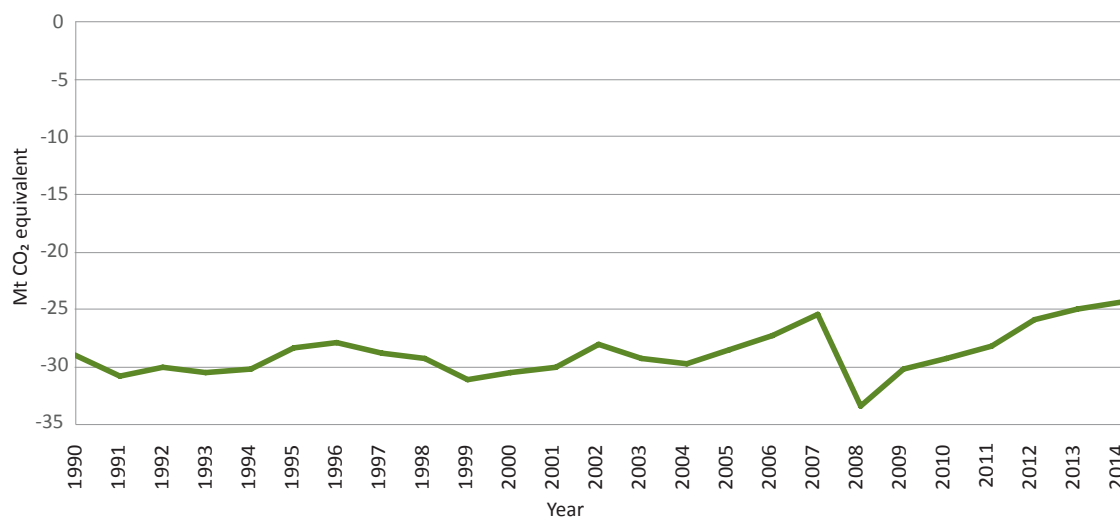
In 1990, New Zealand's net greenhouse gas emissions under the UNFCCC were 36.9 Mt CO<sub>2</sub>-e. In 2014, net greenhouse gas emissions had increased by 53.6 per cent (19.8 Mt CO<sub>2</sub>-e) from the 1990 level to 56.7 Mt CO<sub>2</sub>-e. This is attributable to increased gross emissions as well as an increase in land-use and forestry emissions as the proportion of planted forests being harvested increased.

## Our forests removed 23.5 Mt of CO<sub>2</sub> in 2014

In New Zealand, the LULUCF sector is currently a net carbon sink. For this reason the term 'net removals' has been used in the inventory to describe the contribution from this sector.<sup>4</sup> Net removals of CO<sub>2</sub>-e from New Zealand's forests have been reasonably flat over the period 1990–2014 (figure 4) but have been decreasing in recent years due to the increasing proportion of plantation forests being harvested. In 2014, New Zealand's net removals from the LULUCF sector were -24.4 Mt CO<sub>2</sub>-e,<sup>5</sup> a decrease of 15.6 per cent (4.5 Mt CO<sub>2</sub>-e) from 1990. Most of the removals came from forest land (23.5 Mt CO<sub>2</sub>-e in 2014).

Between 2013 and 2014, net removals from the LULUCF sector decreased by 2.5 per cent (0.6 Mt CO<sub>2</sub>-e) as a greater proportion of forest land reached harvest age in 2014. Emissions also increased as more forest was converted to grassland in 2014 than in 2013.

**Figure 4:** Net removals from land use, land-use change and forestry (under the UNFCCC)<sup>5</sup>



In addition to the UNFCCC LULUCF sector reporting, New Zealand accounts for emissions and removals from afforestation, reforestation and deforestation, and forest management under the Kyoto Protocol. This is a subset of the land included in UNFCCC reporting, and special accounting rules are applied to this land. For instance, emissions and removals for pre-1990 forests (referred to as forest management) are only accounted for where they vary from business-as-usual levels. Accounting under the Kyoto Protocol is used in the net position report to monitor progress towards our 2020 target (see page 5).

## Every year the accuracy of inventory estimates improves

UNFCCC reporting requires us to continuously improve our inventory reporting. Every year international expert reviewers examine the inventory and critique the report against internationally agreed guidelines. They then recommend areas for improvement.

To make improvements, it is sometimes necessary to recalculate estimates of greenhouse gas emissions and removals for some or all years in the time series, not just the latest reporting year. The recalculations can arise from improvements in 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 this year.

The most significant improvements in this year's inventory are:

### Industrial processes and product use

- > emissions are now reported from the following minor sources:
  - carbonates in clays used in ceramics industries
  - lead production from lead-acid batteries
  - lubricant use
  - paraffin wax use

### Land use, land-use change and forestry

- > updated production and trade volumes for harvested wood products
- > improved accuracy and consistency of the 1990, 2008 and 2012 land-use maps resulting in increased deforestation being detected for the whole period
- > use of historic trends in land-use change to model forest land conversions to other land uses

### Waste

- > revised emission factors, source data, and methods for the industrial wastewater category.

<sup>4</sup> Net removals under UNFCCC reporting also include emissions from non-forest land categories that are excluded from Kyoto Protocol accounting.

<sup>5</sup> Net removals are expressed as a negative value to be clear that the value is a removal and not an emission.

## Uses for the inventory data

New Zealand's inventory data are used to monitor progress towards our emissions reduction targets and for international and domestic reporting.<sup>6</sup>

New Zealand has not signed up to the second commitment period (CP2) of the Kyoto Protocol. Instead, we have taken a target of 5 per cent below 1990 levels by 2020 under the UNFCCC and will apply Kyoto Protocol rules to our target.

This means New Zealand will report gross emissions as well as emissions and removals for the parts of the LULUCF sector included in the Kyoto Protocol.

New Zealand has also announced a further target to reduce emissions to 30 per cent below 2005 levels by 2030. This target has been taken under the international climate change agreement established at COP 21 in Paris in 2015. New Zealand will confirm this target, and the accounting methods we will use, when we ratify the new international climate change agreement.<sup>7</sup>

## New Zealand's 2020 Net Position Report

Progress towards New Zealand's 2020 target of reducing greenhouse gas emissions to 5 per cent below 1990 levels is published in the Ministry for the Environment's 2020 Net Position Report.<sup>8</sup> This is updated to reflect the most recent reported historic and projected emissions.

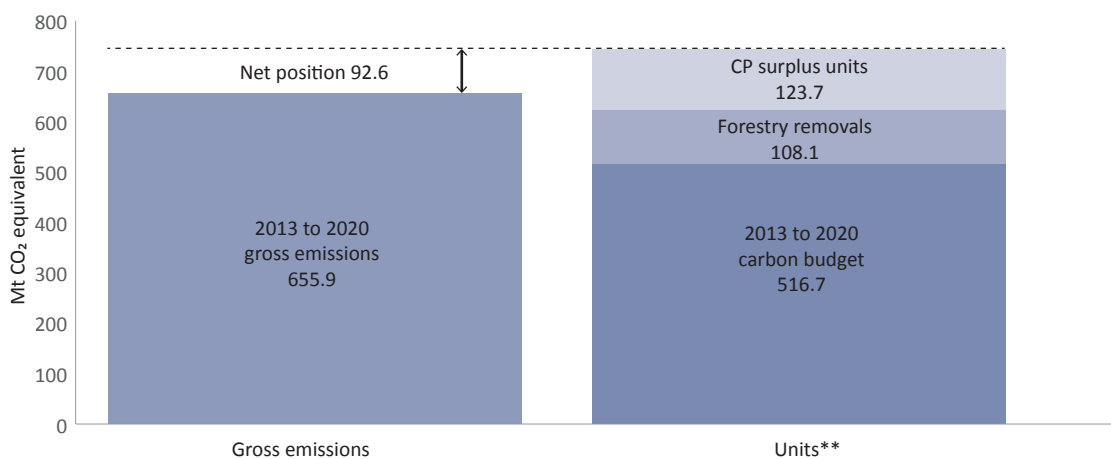
The 2015 Net Position Report shows New Zealand is expected to meet its 2020 target with a surplus of 92.6 million units (figure 5).

A country must hold units that are *at least equivalent* to its gross emissions from 2013–2020 at the end of the period, according to the Kyoto Protocol rules we operate under.

Based on the 2016 inventory submission, the updated 2020 net position projections are:

- > New Zealand's gross emissions from 2013 to 2020 are projected to be 655.9 million tonnes CO<sub>2</sub>-e
- > New Zealand is projected to hold 748.5 million units at the end of the period. This consists of:
  - a carbon budget of 516.7 million units
  - 108.1 million units due to removals from forestry and land-use activities included in the Kyoto Protocol
  - a surplus of 123.7 million units from the first commitment period (2008–2012).

**Figure 5:** New Zealand's projected gross emissions and units over the 2013–2020 period\*



\* Rounded to one decimal place

\*\* One unit is equivalent to one Mt CO<sub>2</sub>-e

6 See: <http://www.mfe.govt.nz/climate-change/reducing-greenhouse-gas-emissions/emissions-reduction-targets>.

7 For more information on New Zealand's post-2020 climate change target see: <http://www.mfe.govt.nz/climate-change/reducing-greenhouse-gas-emissions/New-Zealand%E2%80%99s-post-2020-climate-change-target>.

8 See: <http://www.mfe.govt.nz/climate-change/reporting-greenhouse-gas-emissions/latest-2020-net-position>.

## Our emissions profile is unusual for a developed country

New Zealand's emissions profile is unusual among Annex I countries<sup>9</sup> where the agricultural sector typically constitutes only a small proportion of emissions, on average around 11 per cent.<sup>10</sup> The high level of agricultural production in New Zealand means we produce a lot of methane and nitrous oxide which have high global warming potentials compared with CO<sub>2</sub>.<sup>11</sup> Methane and nitrous oxide (largely from agriculture) make up more than half of our gross national emissions (54.1 per cent in 2014), while the remaining emissions consist largely of CO<sub>2</sub> (43.9 per cent in 2014) mostly from the energy and IPPU sectors.

New Zealand's CO<sub>2</sub> emissions rank 20th among the 41 Annex I countries. At 7.7 tonnes of CO<sub>2</sub> per person, this is below the Annex I average (figure 6). A lower value of CO<sub>2</sub> emissions per person in New Zealand reflects our high proportion of renewable electricity generation.

Because of the non-CO<sub>2</sub> emissions from the agriculture sector our total emissions per person are high. In 2012, New Zealand's gross emissions per person were the fifth highest among the 41 Annex I countries at 17.2 tonnes CO<sub>2</sub>-e per person (figure 6).<sup>12</sup>

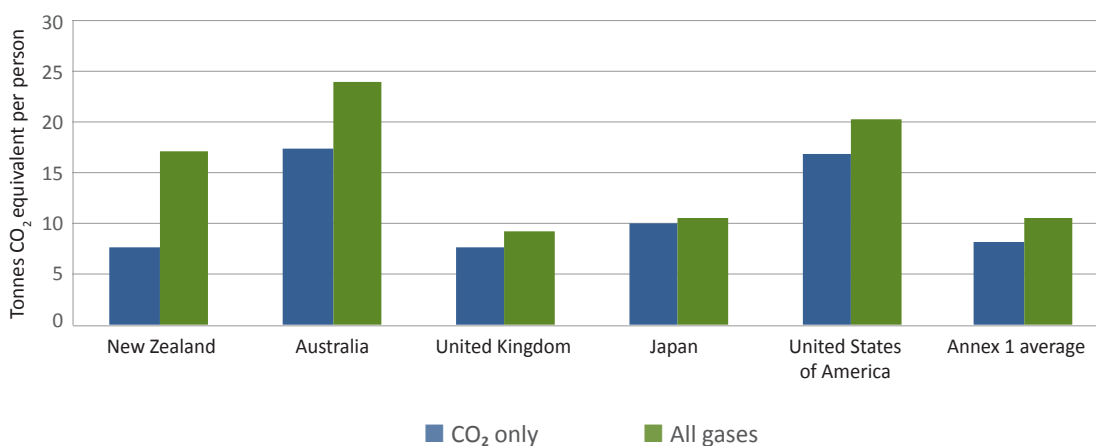
New Zealand's gross emissions are approximately 0.16 per cent of total world emissions.<sup>13</sup>

Some of the challenges New Zealand faces when reducing emissions include:

- > a growing population
- > almost half our emissions are from agriculture where there are fewer options currently available to reduce emissions
- > an electricity sector that is already 80 per cent renewable (meaning that we have fewer 'easy wins' available to us compared to other countries who can more easily make significant emissions reductions by switching to renewable sources of electricity).

Despite these challenges, 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. Our primary tool is the New Zealand Emissions Trading Scheme (NZ ETS) which is currently under review to ensure it remains fit for purpose.

Figure 6: International comparisons for per capita emissions in 2012\*



\* UNFCCC. User defined indicators for 2012. <http://unfccc.int/di/Indicators.do>.

9 A group of developed countries that took commitments under the UNFCCC see: [http://unfccc.int/parties\\_and\\_observers/parties/annex\\_i/items/2774.php](http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php).

10 UNFCCC (2012) <http://unfccc.int/di/FlexibleQueries.do>.

11 A global warming potential (GWP) is a measure of how much heat a greenhouse gas traps in the atmosphere relative to CO<sub>2</sub>.

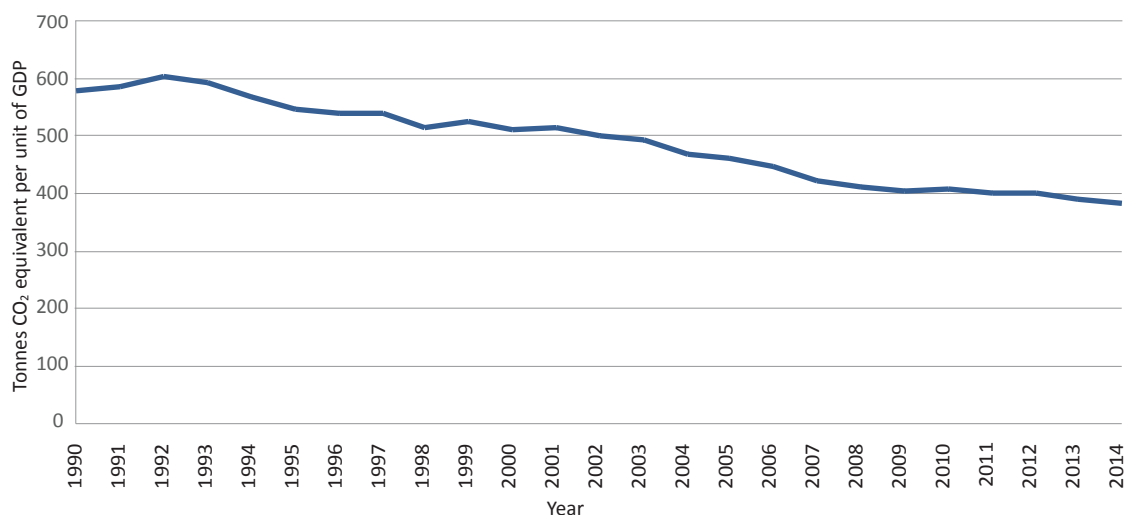
12 UNFCCC(2012) <http://unfccc.int/di/Indicators.do>.

13 Based on 2012 data. The estimate of 49.3 Gt CO<sub>2</sub>-e for global emissions comes from the Emission Database for Global Atmospheric Research. (EDGAR) <http://edgar.jrc.ec.europa.eu/overview.php?v=GHGs1990-2012>.

## Our economy is growing faster than our emissions

New Zealand's emissions have increased between 1990 and 2014 on the back of strong economic and population growth. During this time, the emissions intensity of the economy has decreased by 34 per cent (figure 7). This means the economy is growing faster than the increase in emissions. It indicates that emissions are decoupling from economic growth.

**Figure 7:** New Zealand's gross emissions per unit of GDP from 1990–2014\*



\* GDP figures sourced from Statistics New Zealand, SNE – Series, GDP(P), Chain volume (effects of inflation are removed), Actual, Total (Annual-Mar), 2009/10 prices. Data was accurate at 17 March 2016. Table reference: SNE053AA.

### Definitions

**Gross emissions** come from the agriculture, energy, industrial processes and product use, and waste sectors. They do not include emissions and removals from land use, land-use change and forestry.

**Net emissions** under the UNFCCC include gross emissions and emissions and removals from land use, land-use change and forestry.

**Afforestation** is the establishment of a forest in an area where there was no forest for at least 50 years.

**Reforestation** is 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** is the removal of a forest from an area which is then converted to a non-forest use (eg, farming) for any period of time.

**Forest management** is a system of practices for stewardship and use of forest land.

**Carbon budget** is the quantity of emissions we are allowed to emit if we are to reduce our emissions to meet a target.



> The complete inventory submission is available on the Ministry for the Environment's website at: [www.mfe.govt.nz/climate-change/reporting-greenhouse-gas-emissions/nzs-greenhouse-gas-inventory](http://www.mfe.govt.nz/climate-change/reporting-greenhouse-gas-emissions/nzs-greenhouse-gas-inventory).



### New Zealand Government

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