1990–2021

Te Rārangi Haurehu Kati Mahana a Aotearoa: He Whakarāpopoto

New Zealand's Greenhouse Gas Inventory: Snapshot

Ministry for the Environment
Manatū Mō Te Taiao

Te Kāwanatanga o Aotearoa
New Zealand Government

Our 2021 emissions

76.8M

Gross emissions were 76.8 million tonnes of CO_2-e

55.7M

Net emissions were 55.7 million tonnes CO_2-e

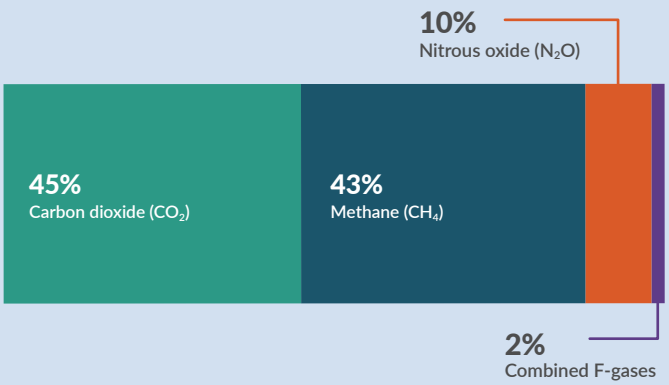
COVID-19 still had an impact on emissions in 2021, particularly on the Energy sector, while other impacted sectors largely returned to pre-pandemic levels

Gross emissions **decreased by 0.7%** compared to 2020, mainly due to decreases from agriculture emissions

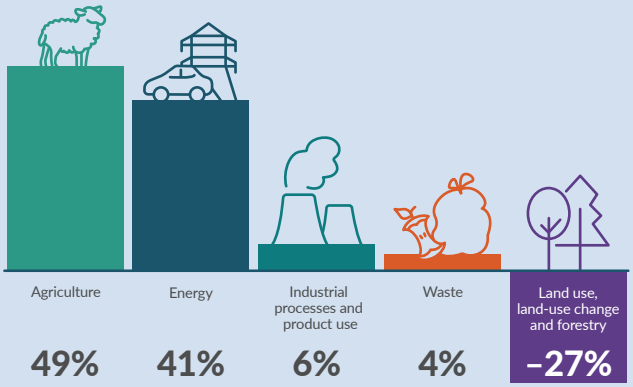
Net emissions **increased by 3%** compared to 2020, due to a decrease in removals from forestry

Forestry **offset 27%** of gross emissions

Emissions by gas



Emissions by sector



Between 1990 and 2021

Gross emissions increased by **19%**

Net emissions increased by **25%**

This was driven by:

↗ 123% Emissions from dairy cattle

↗ 85% Emissions from transport on our roads

At the same time:

↘ 44% Emissions from sheep

↘ 18% Emissions from waste

Since peaking in 2006, gross emissions have been stable

New Zealand's gross and net emissions

In New Zealand's Greenhouse Gas Inventory (the inventory), emissions and removals are categorised into five sectors:

- Agriculture (eg, livestock digestive systems, fertiliser and manure)
- Energy (eg, road transport and electricity production)
- Industrial Processes and Product Use (IPPU) (eg, production of metals and chemicals, and use of refrigerants)
- Waste (eg, landfills and wastewater processing)
- Land Use, Land-Use Change and Forestry (LULUCF). The LULUCF sector keeps track of greenhouse gases from land use such as forests, crops and pasture. This is separate from the livestock emissions reported in the Agriculture sector. It covers changes that occur in soils and vegetation from land management and land-use change, and is the only sector where both emissions and removals of carbon dioxide occur
- New Zealand's 'Other' sector, Tokelau.

Gross emissions are New Zealand's total emissions from the Agriculture, Energy, IPPU and Waste sectors, as well as emissions from Tokelau. Tokelau does not report LULUCF emissions, therefore, gross and net emissions for Tokelau are the same.

Net emissions are gross emissions combined with emissions and removals from the LULUCF sector.

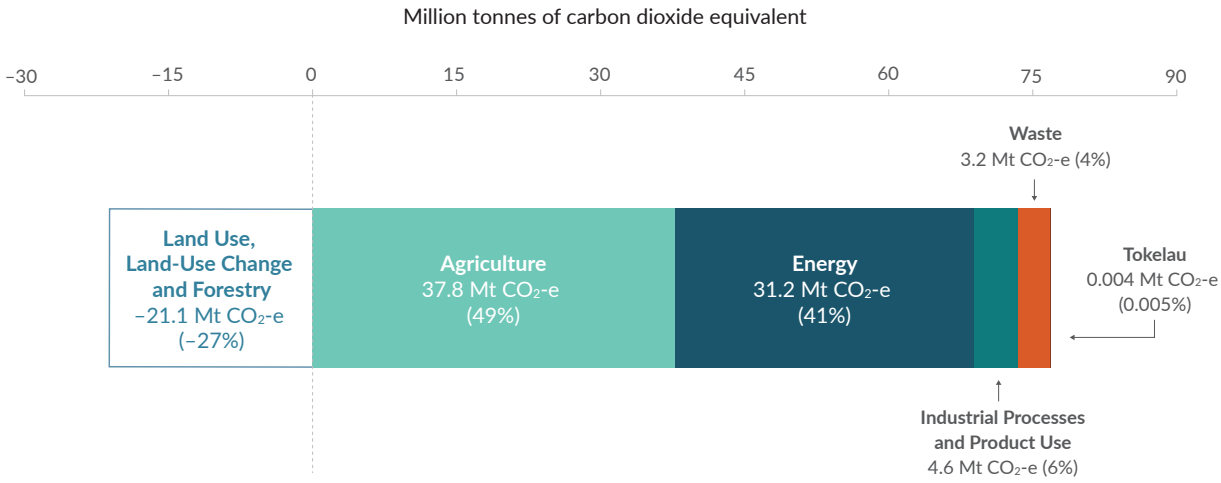
New Zealand's greenhouse gas (GHG) emissions and removals in 2021 from each sector are shown in figure 1. As Tokelau is an overseas dependant territory, all emissions from Tokelau are reported together in the 'Other' sector in the inventory.

Gross emissions are dominated by the Agriculture and Energy sectors

The Agriculture and Energy sectors contributed the most to New Zealand's emissions at 49 per cent and 41 per cent of gross emissions in 2021, respectively (figure 2). Emissions from road transport, a sub-category of the Energy sector, made up 16 per cent of gross emissions.

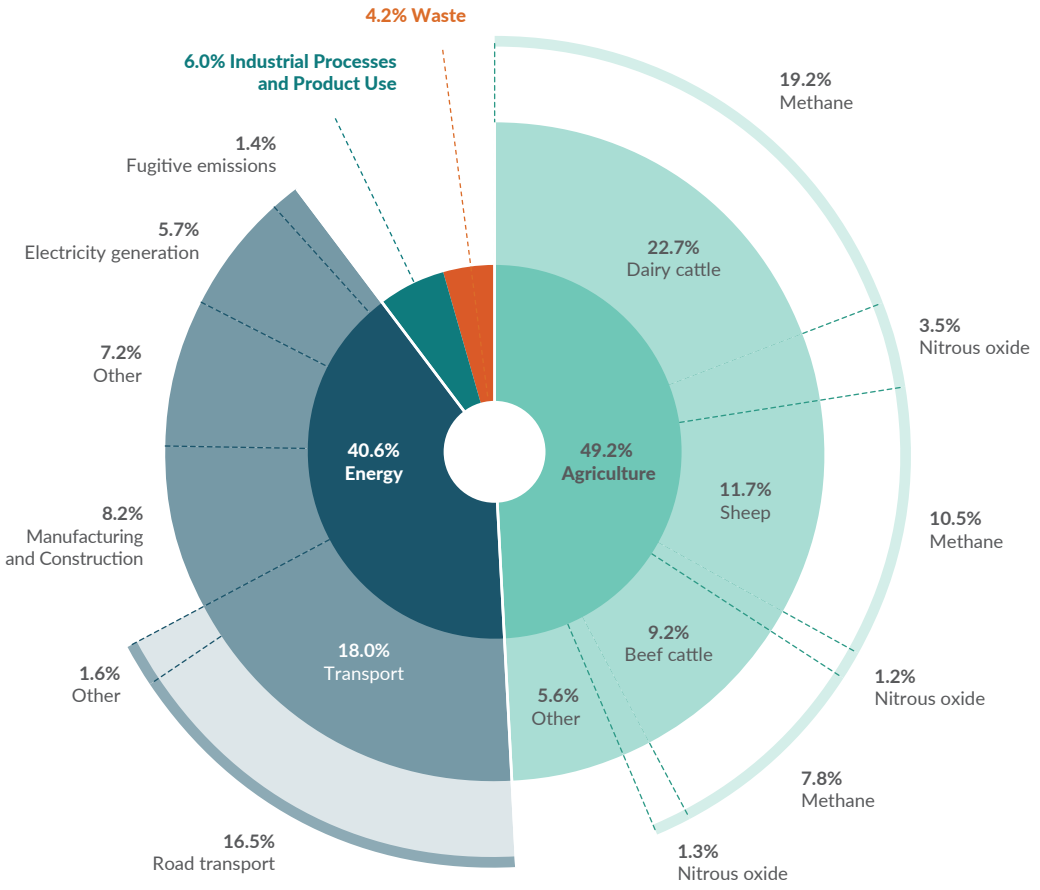
Together, methane and nitrous oxide, largely from agricultural sources, made up over half of our gross emissions (43 and 10 per cent, respectively). The remaining emissions consisted mostly of carbon dioxide (45 per cent), largely from the Energy and IPPU sectors.

Figure 1: Breakdown of New Zealand's emissions (in million tonnes of carbon dioxide equivalent, Mt CO_2-e) by sector in 2021



Net emissions from the LULUCF sector are expressed as a negative number because the sector removes more GHGs from the atmosphere than it emits.

Figure 2: Gross greenhouse gas emissions in 2021 by sector, sub-category and gas type



Breakdown of emissions by sector (Agriculture, Energy, Industrial Processes and Product Use (IPPU), and Waste) and sub-category, and greenhouse gas by type. The emissions contribution from Tokelau is too small to be shown in the figure.

Gross emissions have increased between 1990 and 2021

New Zealand's gross greenhouse gas emissions were 76.8 million tonnes of carbon dioxide equivalent (**Mt CO_2-e***) in 2021. This is a 19 per cent increase from emissions in 1990 (the base year for United Nations Framework Convention on Climate Change (UNFCCC) reporting). However, since 2006, when gross emissions peaked, emissions have stayed relatively stable with yearly fluctuations (figure 3).

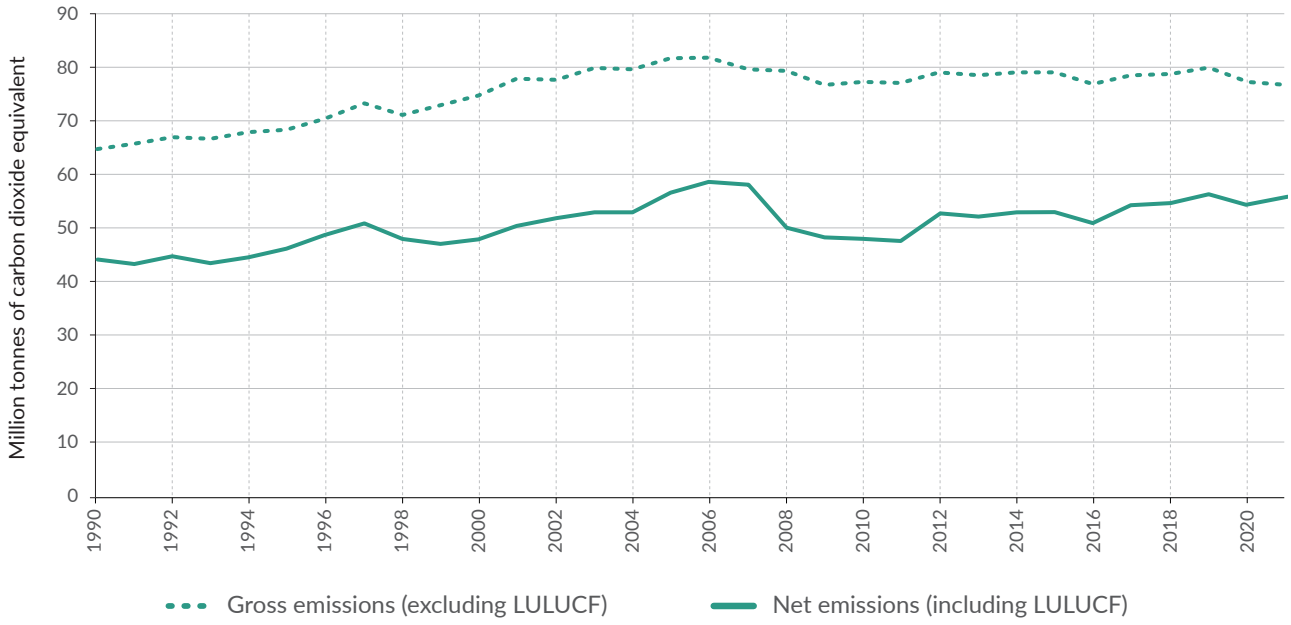
* Carbon dioxide equivalent (CO_2-e)

Carbon dioxide equivalent (CO_2-e) is a measure for comparing different GHGs based on the heating effect of each gas relative to an equivalent amount of carbon dioxide. CO_2-e is used for expressing emissions of different GHGs in a common unit, which allows them to be reported and compared consistently.

The five emission sources that contributed the most to this increase were:

- enteric fermentation due to an increase in the dairy cattle population (methane) (7.4 Mt CO_2-e)
- fuel use in road transport due to traffic growth (carbon dioxide) (5.9 Mt CO_2-e)
- agricultural soils due to increased fertiliser use (nitrous oxide) (2.1 Mt CO_2-e)
- fuel use in manufacturing and construction, due to economic growth leading to increased production (carbon dioxide) (1.5 Mt CO_2-e)
- use of hydrofluorocarbon-based refrigerants in industrial and household refrigeration and air conditioning systems that replaced ozone-depleting substances (1.5 Mt CO_2-e).

Figure 3: New Zealand's gross and net emissions (in Mt CO_2-e) from 1990 to 2021



Gross emissions exclude the Land Use, Land-Use Change and Forestry (LULUCF) sector. Net emissions include the LULUCF sector.

Since 1990, the Waste sector had the only overall reduction in gross emissions, with a decrease of 18 per cent due to ongoing improvements in the management of landfills.

COVID-19 had a significant impact on New Zealand's emissions in 2020, with a 3 per cent reduction on 2019 levels. This was largely due to decreases in fuel use from road transport, manufacturing and construction, and domestic aviation, as a result of COVID-19 restrictions.

In 2021, emissions continued to decrease, with a 0.7 per cent decrease from 2020 emissions, largely due to decreases in emissions across the Agriculture sector. COVID-19 continued to have an impact in 2021, particularly on the Energy sector, while other impacted sectors largely returned to pre-pandemic levels.

Net emissions are influenced by forest planting cycles

Net emissions include gross emissions combined with the emissions and removals from the LULUCF sector. Forests remove carbon dioxide from the atmosphere as they grow but can also release it, for example, after being harvested, deforested, or following natural disturbances such as storm damage. This means that historical planting rates and harvesting cycles have a large impact on the net amount of carbon dioxide removed by our forests in any given year. Despite this, since 1990, the LULUCF sector has remained a net **carbon sink***.

To estimate net emissions, the Ministry for the Environment and the Ministry for Primary Industries have calculated the area of forest in New Zealand. According to these estimates, approximately 54,268 hectares of new forest were planted and 2,610 hectares were deforested in 2021.

New Zealand's net emissions were 55.7 Mt CO_2-e in 2021. This was calculated by subtracting the 21.1 Mt CO_2-e of net removals that occurred in the LULUCF sector, from gross emissions of 76.8 Mt CO_2-e. Net emissions have increased by 25 per cent compared with 1990 levels.

Net emissions from the LULUCF sector offset 27 per cent of New Zealand's gross emissions in 2021 (figure 3). This is a decrease from 1990 when the LULUCF sector offset 31 per cent of New Zealand's gross emissions (figure 3). This change is mainly the result of an increase in gross emissions between 1990 and 2021, and the impact of harvesting cycles on net emissions.

* Carbon sink

A **carbon sink** is any process, activity or mechanism which removes a GHG from the atmosphere. The LULUCF sector in New Zealand is a net carbon sink as it removes more carbon dioxide from the atmosphere than it emits.

Emissions trends by sector

Figure 4: New Zealand's gross greenhouse gas emissions (in Mt CO_2-e): Absolute change by sector from 1990 to 2021

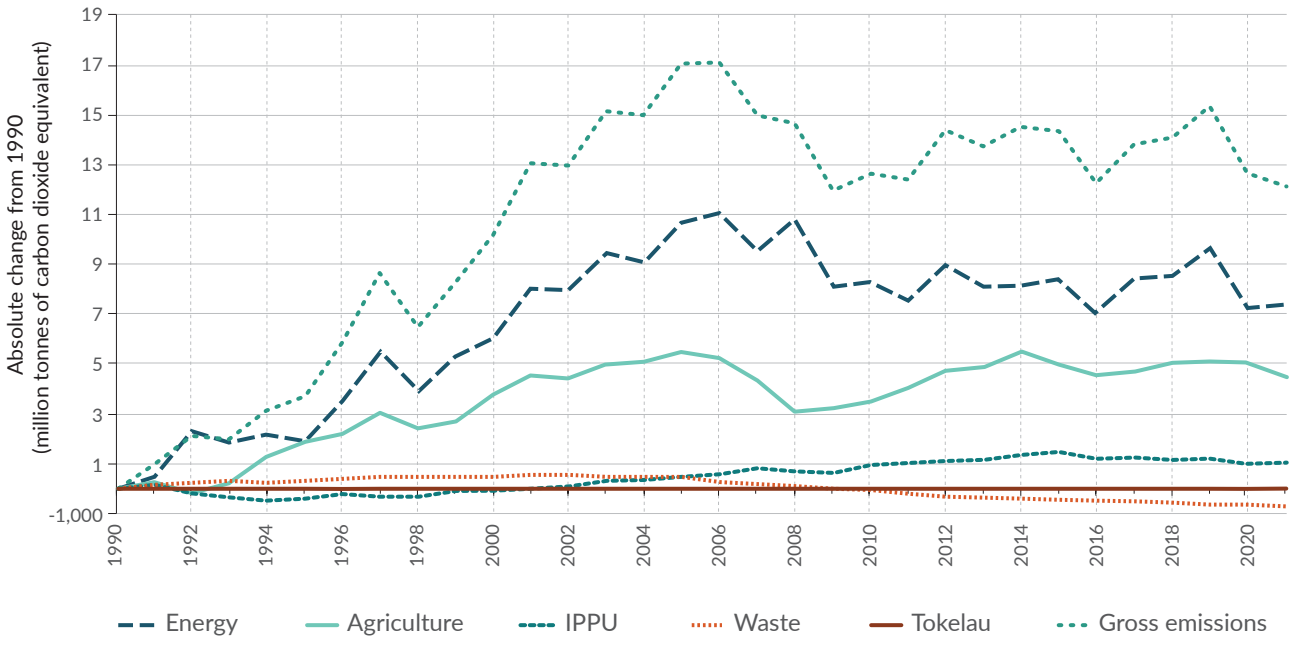
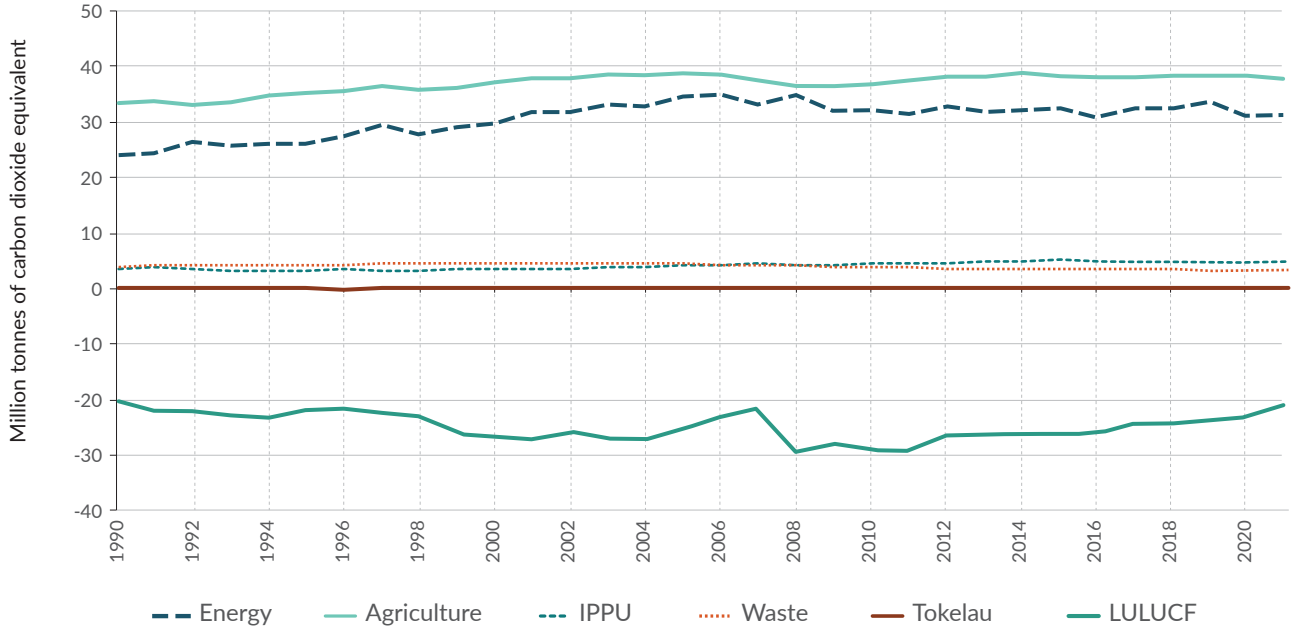


Figure 5: New Zealand's greenhouse gas emissions (in Mt CO_2-e): Trends by sector from 1990 to 2021



Agriculture

1990–2021

Between 1990 and 2021, emissions from the Agriculture sector increased by 13 per cent (figures 4 and 5). This was primarily due to an 88 per cent increase in the national dairy herd since 1990, and a 644 per cent increase in the application of synthetic nitrogen fertiliser since 1990. These increases have been partially offset by decreases in the populations of sheep (56 per cent), beef cattle (14 per cent) and deer (17 per cent) since 1990. Agriculture emissions most recently peaked in 2014, corresponding with a peak in the national dairy herd, after which they have stayed relatively stable.

2020–2021

In 2021, emissions from the Agriculture sector decreased by 1.5 per cent. This decrease was mainly due to decreases in the dairy cattle and sheep populations, and decreased synthetic fertiliser use. Longer-term changes across the agricultural sector are contributing to decreases in livestock numbers and fertiliser. These include: industry-driven initiatives such as improved genetics and productivity, and the uptake of more sustainable farming practices; changes in New Zealand's regulatory environment, such as improving freshwater quality; and market forces increasing the price of fertilisers.

COVID-19 restrictions did not have any discernible impacts on emissions from the Agriculture sector in 2021.

Energy

1990–2021

Emissions from the Energy sector in 2021 were 31 per cent higher than in 1990 (figures 4 and 5). Most of this increase came from road transport (an increase in emissions of 85 per cent), and the use of fossil fuels for food, electricity and heat production. The increases in transport are driven by New Zealand's increased population and economic activity. The trend shows emissions increasing until 2006, before decreasing slightly, after which they have been relatively stable (figures 4 and 5).

2020–2021

The COVID-19 pandemic and associated restrictions resulted in a decrease in emissions from the Energy sector by 7 per cent between 2019 and 2020. In 2021, there was a slight rebound with an increase in emissions of 0.3 per cent, however, emissions remained below pre-2020 levels due in part to ongoing COVID-19 restrictions. COVID-19 and global supply chain disruptions have continued to impact the Energy sector, particularly for basic metals and mining. In 2021, transport emissions were 5 per cent higher than 2020, but were still 5 per cent lower than the pre-pandemic levels in 2019.

Industrial Processes and Product Use (IPPU)

1990–2021

Emissions from the IPPU sector in 2021 were 29 per cent higher than in 1990 (figures 4 and 5). The increase was mainly caused by: phasing out ozone-depleting substances under the Montreal Protocol and replacing them with hydrofluorocarbons in refrigeration and air conditioning; and increased use of household and commercial air conditioning in New Zealand.

In addition, carbon dioxide emissions have also increased due to increased production of metals, lime and cement, although at a slower rate. In 2020 and 2021, the increase was offset by reduced emissions due to COVID-19 restrictions and the progressive shutdown of the Marsden Point oil refinery.

2020–2021

Between 2020 and 2021, emissions from IPPU increased by 0.6 per cent. This slight increase was due to the recovery of production rates and emissions across the sector following plant shutdowns related to COVID-19 restrictions in 2020. Despite this slight increase, emissions have remained lower than pre-pandemic levels – 2021 emissions are 3 per cent lower than 2019 levels. This is in part due to emissions from the Marsden Point oil refinery, as activity reduced in preparation for the closure of the plant in March 2022.

Waste

1990–2021

In 2021, Waste sector emissions were 18 per cent below 1990 levels (figures 4 and 5). Growth in population and economic activity has resulted in increasing volumes of waste since 1990. In spite of this, emissions have declined due to improvements in the management of solid waste at landfills, particularly in landfill gas recovery. Drivers for these improvements include the National Environmental Standards for Air quality introduced in 2004, and the New Zealand Emissions Trading Scheme since 2013. Annual emissions increased between 1990 and 2002, before stabilising then declining steadily since 2005.

2020–2021

Between 2020 and 2021, emissions from the Waste sector decreased by 1.6 per cent. This decrease was largely the result of a decrease in methane emissions from landfill. This is due to improvements and increases in landfill gas capture, and a reduction in the proportion of garden, food, and paper waste disposed to landfill.

COVID-19 restrictions did not have any discernible impacts on emissions from the Waste sector in 2021.

Land Use, Land-Use Change and Forestry (LULUCF)

1990–2021

Between 1990 and 2021, net removals from the LULUCF sector increased by 4 per cent (figures 5 and 6). This increase in removals was largely due to increased removals from forest growth and an increase in the production of harvested wood products, such as milled timber. Creating these products from harvested trees keeps the carbon 'locked up' in the products and delays the emission of carbon dioxide into the atmosphere. Since 1990, forest harvesting rates have increased, but the amount of carbon 'locked up' in wood products has also increased.

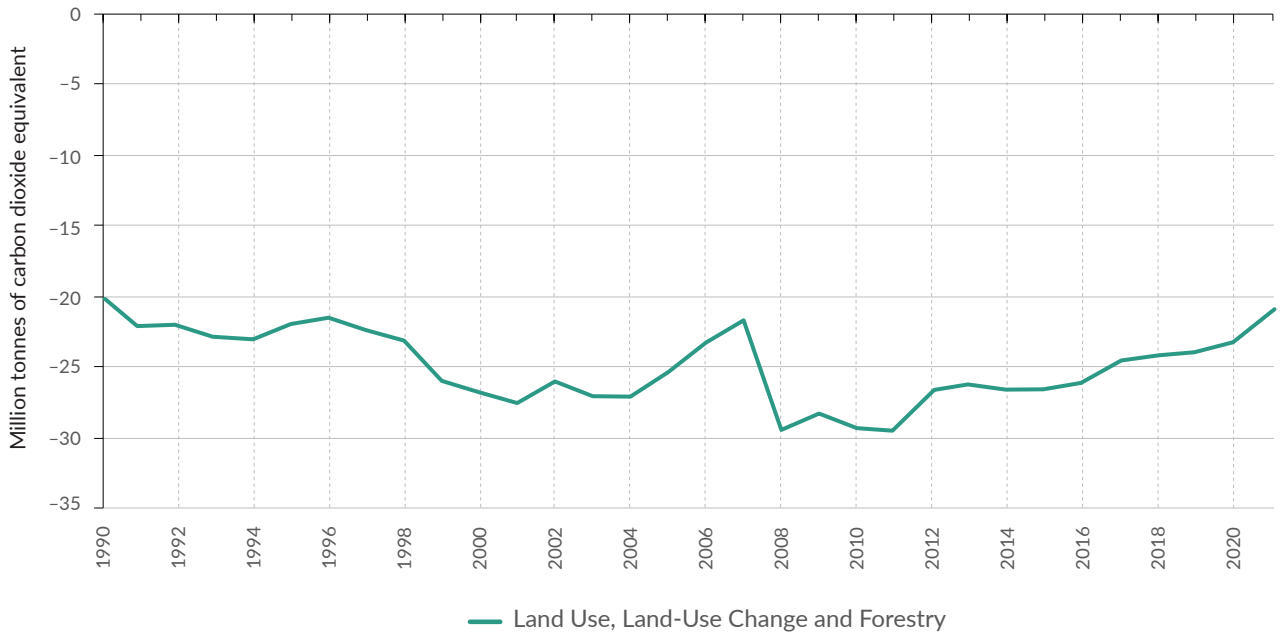
Over the past decade, net emissions from the LULUCF sector have generally been increasing (figure 6). This is a result of near historic high levels of harvest rates due to the significant planting in the 1980s and into the early 1990s. These production forests have progressively been reaching maturity and this will continue into the 2020s. As the high harvesting rates continue, the average age of the planted forest estate is reduced each year, as those harvested forests are replanted. Young stands have low growth rates compared with older, faster growing stands. This trend will reverse in the future. Harvest and replanting cycles of New Zealand's planted forests will continue to affect the trajectory of New Zealand's net emissions in the future due to their uneven age-class profile.

2020–2021

Between 2020 and 2021, net removals from the LULUCF sector decreased by 9 per cent, largely driven by an increase in harvesting.

In the LULUCF sector, there was a small reduction in harvesting of planted forests in 2020 due to COVID-19, however, harvesting rates increased again in 2021.

Figure 6: New Zealand's net greenhouse gas emissions (in Mt CO_2-e): Trends in the LULUCF sector from 1990 to 2021 (under UNFCCC reporting)



The Land Use, Land-Use Change and Forestry sector net emissions are negative as removals from the atmosphere are greater than emissions.

How New Zealand compares to other countries

New Zealand has a unique emissions profile

New Zealand's emissions profile is different to that of most of the other 43 **Annex I countries***. This is because approximately half of our emissions come from the Agriculture sector. This is in part due to having a relatively small energy sector. While we have high per-capita transport emissions, the high proportion of renewable electricity generation has a significant impact on our emissions profile, and drives up the relative contribution of the Agriculture sector to our overall profile.

New Zealand has the highest proportion of Agriculture sector emissions compared to other Annex I countries, followed by Ireland (36 per cent) and Denmark (26 per cent). Typically, in other Annex I countries, the Agriculture sector constitutes only a small proportion of gross emissions (13 per cent on average).

New Zealand also has high per-capita transport emissions, the fifth highest in Annex I countries. This is due to New Zealand's small but widely distributed population, and long narrow geography, resulting in road transport being the central element of the transport system. New Zealand's Energy sector emissions per capita are 6.3 tonnes of carbon dioxide equivalent (T CO_2-e), similar to the Annex 1 average of 6.4 T CO_2-e. This is because New Zealand's high proportion of renewable electricity generation is offsetting our relatively high transport emissions.

Based on the latest available Inventory data for 2020 for Annex I countries, New Zealand's gross emissions ranked 20th among the Annex I countries, but New Zealand's emissions per person were the fifth highest at 15.7 tonnes of carbon dioxide equivalent (CO_2-e) per capita (figure 7).

The high level of agricultural production in New Zealand means methane and nitrous oxide make up a higher proportion of gross emissions, which have a greater warming effect compared with carbon dioxide while in the atmosphere.

* Annex I

Annex I to the UNFCCC lists the industrialised countries that were members of the Organisation for Economic Co-operation and Development and countries with economies in transition in 1992 (the year in which the UNFCCC was agreed). Countries listed in Annex I that are parties to the UNFCCC are required to report regularly on their climate change data, policies and measures.

New Zealand is the only Annex I country where carbon dioxide emissions make up less than half of the proportion of greenhouse gases (43.7 per cent in 2020). Ireland was the next closest at 60.6 per cent. When looking at New Zealand's gross CO_2-only emissions, our per-capita emissions reduce reflecting our unique emissions profile.

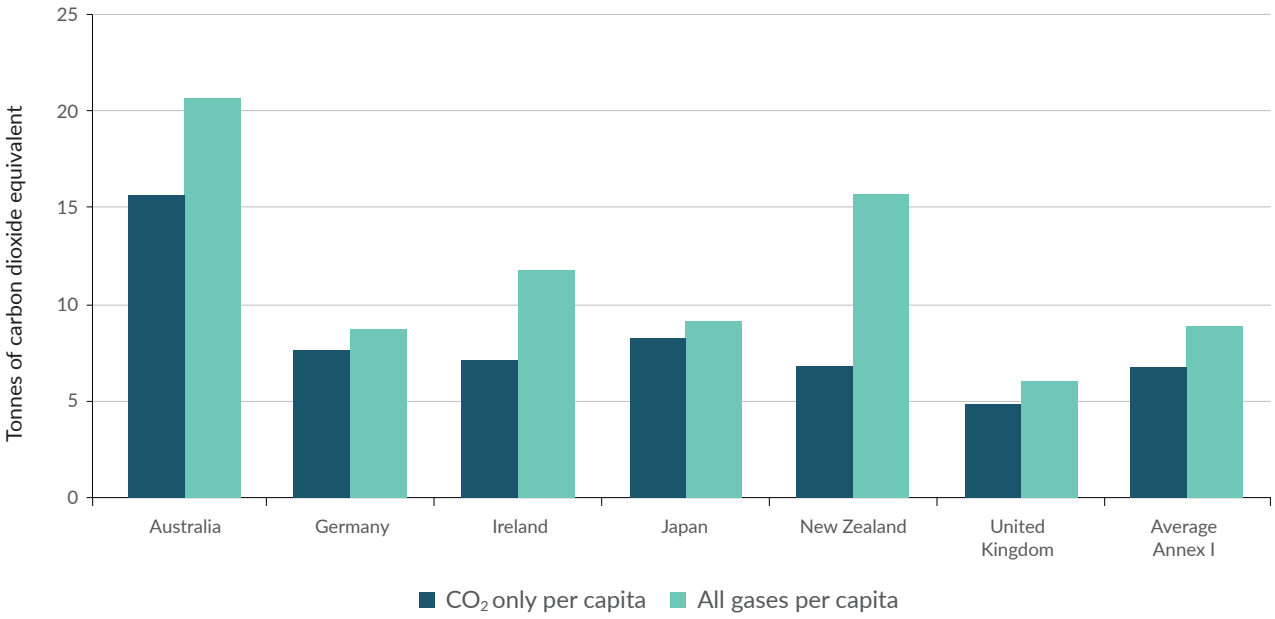
New Zealand's gross CO_2-only emissions in 2020 were 6.9 tonnes of CO_2 per capita, which is very close to the Annex I 2020 average of 6.8 tonnes of CO_2 per capita (figure 7).

All emissions data in this section are from the **United Nations Framework Convention on Climate Change (UNFCCC) Data Interface (2022)**. Annex I data in these comparisons count the members of the European Union (EU) separately and exclude the EU as a whole. Note that the comparison is made with Annex I countries because these countries all use the same greenhouse gas reporting guidelines to report their emissions and removals.

Why New Zealand's emissions trends are different

Gross emissions in New Zealand have increased since 1990, whereas in many other Annex I countries (eg, the United Kingdom and Germany), emissions are now below 1990 levels. Transforming energy systems by decarbonising electricity generation has provided significant opportunities for many countries to effectively reduce emissions.
In 1990, 81 per cent of New Zealand's electricity supply was being generated from renewables which was very high by international standards and still is. In 2021, the share of electricity generated from renewable energy sources in New Zealand was 82 per cent. This means that New Zealand has not been able to bring emissions down by switching from non-renewables to renewables for electricity generation – we need to make emissions reductions in harder-to-reduce areas, including agriculture and transport.

Figure 7: International comparisons for per-capita emissions (in tonnes of CO_2-e) in 2020



*Note: All emissions data in this section is from **UNFCCC Data Interface (2022)**. Annex I data in these comparisons count the members of the EU separately, and exclude the EU as a whole.*

*The population data used to generate figure 7 was taken as 2020 population data from the **UN Population Division**.*

Annex I countries (UNFCCC) are compared with Australia, Japan, New Zealand, the United Kingdom, and the United States of America. Each country shows two bars which represent 'CO_2 only per capita' and 'all gases'.

Moving towards a lower-emissions economy

New Zealand's emissions have increased between 1990 and 2021 on the back of strong economic and population growth. During this time, the emissions intensity of the economy decreased by 48 per cent (figure 8). This means the economy has been growing faster than the increase in emissions, which indicates a move towards a lower-emissions economy.

Commitment to reducing greenhouse gas emissions

New Zealand has set domestic emissions budgets to drive our transition to a low-emissions economy. They set decreasing limits on domestic emissions to ensure we are on track to meet our net-zero 2050 target under the Climate Change Response Act 2002.

Our **first emissions reduction plan** released in May 2022 sets out how New Zealand will reduce emissions to meet the first emissions budget for the period 2022–2025. The plan is currently being implemented and includes strategies and policies across every sector to reduce emissions. It will allow us to play our part in the global effort under the Paris Agreement to reduce emissions and limit global temperature increase to 1.5 degrees Celsius.

Tracking progress towards our emissions reduction goals

New Zealand's first domestic emissions budget covers the period 2022–2025 which is outside the period covered by this inventory.

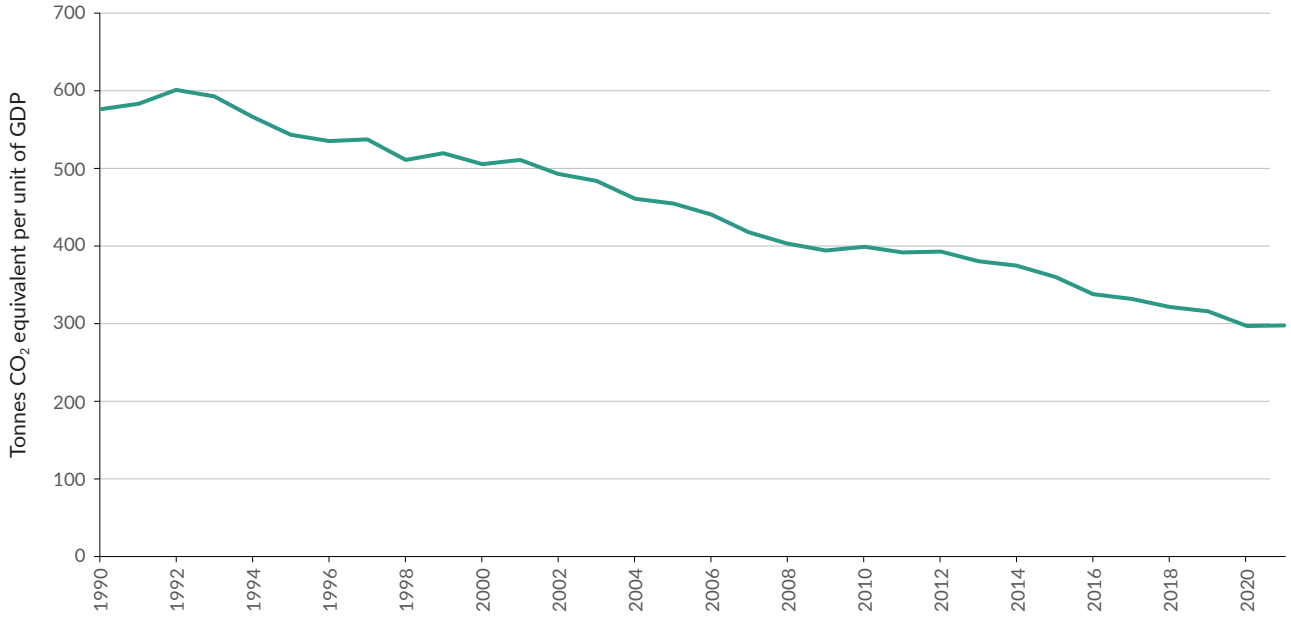
New Zealand has also set an international emissions reduction target. This has been communicated through our first **Nationally Determined Contribution** (NDC1), as required under the Paris Agreement. NDC1 sets a target of a 50 per cent reduction of net emissions below our gross 2005 levels by 2030.

While this year's inventory contains emission estimates for the first year covered by the Paris Agreement, it is a transition year for reporting. Reporting under the Paris Agreement begins in 2024.

New Zealand will submit its first Biennial Transparency Report under the Paris Agreement in 2024. This report will contain information necessary to track progress towards New Zealand's achievement of our first NDC, as well as information on adaptation measures and financial contributions to developing countries to address climate change.

Updated tracking towards NDC1 based on the 2023 inventory will be released at the end of 2023. See the **latest currently available progress update** based on the 2022 inventory.

Figure 8: New Zealand's gross emissions per unit of GDP from 1990–2021



Note: GDP figures sourced from Statistics New Zealand: Group: National Accounts – SNA 2008 – SNE, Table: Series, GDP(P), Chain volume, Actual, Total (Annual-Mar). Data was accurate at 15 March 2023. Table reference: SNE053AA.

About the inventory

The inventory is a reporting requirement under the United Nations Framework Convention on Climate Change (UNFCCC). It adheres to UNFCCC reporting guidelines and the international methodology guidelines set out by the Intergovernmental Panel on Climate Change.

Preparing and compiling the inventory is a cross-government effort, led by the Ministry for the Environment. The Inventory report is submitted about 15 months after the end of the calendar year being reported on, providing time for the data to be collected, verified, processed and analysed.

The inventory is the authoritative source of evidence on New Zealand's greenhouse gas emissions and removals trends

The inventory informs New Zealand's action on climate change. Accurate emissions data are essential to understand current emissions and past trends, generate policy recommendations on climate change, and develop and monitor emissions reduction targets. New Zealand's inventory data are used for both international and domestic reporting.

To learn more about how New Zealand reports and measures progress towards our targets and other emissions reporting, see the Ministry for the Environment's webpage on **New Zealand's emissions reduction targets**.

Global warming potentials

The 1990–2021 inventory uses the 100-year global warming potential (GWP100) values from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4). See **Annex III of UNFCCC decision 24/CP.19**. This is because it is submitted under the UNFCCC.

New Zealand's first Nationally Determined Contribution under the Paris Agreement and domestic emissions budgets use GWP values from the IPCC Fifth Assessment Report. This means that they cannot be directly compared to the values in the 2023 inventory.

The 2023 inventory marks the transition from reporting under the UNFCCC and its Kyoto Protocol to that of the Paris Agreement. While the 2023 inventory is reported in AR4, the Ministry for the Environment has published an AR5 summary of the 2023 inventory following the inventory release. This is available alongside **New Zealand's Greenhouse Gas Inventory 1990–2021**.

Reporting under the Paris Agreement begins next year. This will mean from 2024, the inventory will use AR5 values, as stipulated in the guidelines for GHG inventory reporting under the Paris Agreement.

Inventory estimates are continuously improved

The whole inventory time series, from the base year (1990) to the latest year, is recalculated when the methodology or underlying data change. This means the emissions estimates are only up to date in the latest inventory, and previous inventories are not useful for comparisons. Changes made to the inventory are often related to improvements in activity data collection, emission factors and methodology, or the identification of additional emission sources.

The Ministry for the Environment has published information on the **methodological improvements introduced into the 1990–2021 inventory** and their estimated impact on emissions.

Other sources of information

New Zealand's Greenhouse Gas Inventory is the official source of information for New Zealand's greenhouse gas emissions data.

To learn more about how New Zealand reports and measures progress towards our targets and other emissions reporting, go to our webpage on **New Zealand's emissions reduction targets**.

Inventory publications (released April 2023) and Emissions Tracker

- The full report: **New Zealand's Greenhouse Gas Inventory 1990–2021** – Access the latest inventory publication, including supporting tables and files.
- **Interactive Greenhouse Gas Emissions Tracker** – Use the interactive tool to access and manipulate data from the latest inventory to see how New Zealand's emissions have changed over time.

Links to other sources of data derived from the inventory for domestic purposes

- The Ministry's **Measuring Emissions: A guide for organisations**
- Stats NZ's emissions products:
  - **Industry and household emissions (SEEA)**
  - **Quarterly emissions**
  - **Regional emissions**
  - **Consumption emissions**

Next Inventory publication

New Zealand's Greenhouse Gas Inventory 1990–2022 will be published on 18 April 2024.

Acknowledgements

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Te Kāwanatanga o Aotearoa
New Zealand Government

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