



Te Rīpoata Taurua Tuarima o Aotearoa

New Zealand's Fifth Biennial Report

Under the United Nations Framework Convention on Climate Change



Ministry for the
Environment
Manatū Mō Te Taiao



Te Kāwanatanga o Aotearoa
New Zealand Government

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Chapter leads

- Lead compiler: Alice Ryan (MfE)
- Chapter 1 – Information on greenhouse gas emissions and trends: Georgia Sharp (MfE)
- Chapter 2 – Quantified economy-wide emission reduction targets and Chapter 3 – Progress in achievement of economy-wide emission reduction targets and relevant information: Cassandra Moll, Alice Ryan (MfE)
- Chapter 4 – Projections: Antony Gomez, Barnaby Pace, Alice Ryan, Frances Barnett (MfE)
 - Energy and Transport: Michael Smith, Kam Szeto (Ministry of Business, Innovation and Employment)
 - Industrial processes and product use: Jamie Higgison (MfE), Wayne Hennessy (Verum Group – contractor)
 - Agriculture: Joel Gibbs, Ben Morrow, Catherine Sangster (Ministry for Primary Industries)
 - Land use, land-use change and forestry: Craig Elvidge (Ministry for Primary Industries)
 - Waste: Chris Bean and Ivan Chirino-Valle (MfE)
- Chapter 5 – Financial, technological and capacity-building support: James Brennan and Alison Carlin (Ministry of Foreign Affairs and Trade)
- Chapter 6 – Other reporting matters: Charissa Billings (MfE)

Other advisors and principal reviewers

- Principal reviewers: Andrea Brandon, Helen Plume (MfE)
- Supplementary products: Clare Browne, Georgia Sharp (MfE)
- Communications and publishing: Joanne Butcher, Daisy Smith (MfE)
- Project management: Marion Sorez (MfE)
- Quality control: Daniel Boczniewicz (MfE)

Other contributors

Ministry for Primary Industries

- Erin Collier and Laura Gardner

Editors

- Jenny Heine, Tanya Tremewan

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Karakia

Whakataka te hau ki te uru,
Whakataka te hau ki te tonga.
Kia mākinakina ki uta,
Kia mātaratara ki tai.
E hī ake ana te atākura he tio,
he huka, he hauhunga.
Haumi e! Hui e! Tāiki e!

Get ready for the westerly
and be prepared for the southerly.
It will be icy cold inland,
and icy cold on the shore.
May the dawn rise red-tipped on ice,
on snow, on frost.
Join! Gather! Intertwine!

This karakia (prayer) speaks to the great natural forces, which bind us together. It portrays a Māori worldview to help frame our thinking, and our approach to huringa āhuarangi (climate change) in Aotearoa New Zealand. It speaks to the winds from the west (hau ki te uru) and from the south (hau ki te tonga). It acknowledges the growing challenges before us and the preparation needed to respond to them. It expresses the strengthening of our resilience and acknowledges that with unity we can overcome challenges and respond to ongoing changes in our environment.

In the context of te huringa āhuarangi, this narrative emphasises our ties to and reliance on the natural world, and the connection of each generation to those before and after. This includes the connectedness of ecosystems and society, and of actions and consequences across domains.

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Abbreviations

ASEAN	Association of Southeast Asian Nations
AAUs	Assigned amount units
BR4	<i>Fourth Biennial Report</i>
BR5	<i>Fifth Biennial Report</i>
CCRA	Climate Change Response Act 2002
CERs	Certified emissions reductions
CGIAR	Consultative Group for International Agricultural Research
CH ₄	Methane
CIHEAM	International Centre for Advanced Mediterranean Agronomic Studies
CLIFF-GRADS	Climate Food and Farming Research Network – Global Research Alliance Development Scholarship
CNGP	Carbon Neutral Government Programme
CO ₂	Carbon dioxide
CP1	First commitment period
CTF	Common tabular format
EVs	Electric vehicles
F-gases	Fluorinated gases
FRDP	<i>Framework for Resilient Development in the Pacific</i>
GCF	Green Climate Fund
GDP	Gross domestic product
GEF	Global Environment Facility
GEM	Generation Expansion Model
GHG	Greenhouse gas
GIDI	Government Investment in Decarbonising Industry
GRA	Global Research Alliance on Agricultural Greenhouse Gases
HFCs	Hydrofluorocarbons
IDC	International development cooperation
IE	Included elsewhere
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial processes and product use
kt CO ₂ -e	Kilotonnes of carbon dioxide equivalent
LULUCF	Land use, land-use change and forestry
MfE	Ministry for the Environment
Mt CO ₂ -e	Million tonnes of carbon dioxide equivalent
N ₂ O	Nitrous oxide
NA	Not applicable

NDC	Nationally Determined Contribution
NDC1	New Zealand's first Nationally Determined Contribution
NE	Not estimated
NO	Not occurring
NPS-FM	National Policy Statement for Freshwater Management
NZ ETS	New Zealand Emissions Trading Scheme
NZU	New Zealand Unit
ODA	Official Development Assistance
ODS	Ozone depleting substances
OECD	Organisation for Economic Co-operation and Development
PFCs	Perfluorocarbons
PRIF	Pacific Regional Infrastructure Facility
PSRM	Pastoral Supply Response Model
SADEM	Supply and Demand Energy Model
SF ₆	Sulphur hexafluoride
SPC	Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VFEM	Vehicle Fleet Emissions Model
WAM	With additional measures
WEM	With existing measures
WOM	Without measures

Introduction

Aotearoa New Zealand is pleased to submit its *Fifth Biennial Report* under the United Nations Framework Convention on Climate Change. The report follows the biennial reporting guidelines for developed country Parties and comprises six chapters:

1. Information on greenhouse gas emissions and trends
2. Quantified economy-wide emission reduction targets
3. Progress in achievement of quantified economy-wide emissions reduction targets and relevant information
4. Projections
5. Provision of financial, technological and capacity-building support to developing countries
6. Other reporting matters.

The report also includes all of the relevant common tabular format tables contained in Conference of the Parties Decision 19/CP.18.

Appendices include:

- emissions data, presented in appendix A
- mitigation actions and their effects, presented in appendix B
- supplementary information on projections, presented in appendix C.

1 Information on greenhouse gas emissions and trends

Key points

- Aotearoa New Zealand's gross greenhouse gas emissions in 2020 were 78,778 kilotonnes of carbon dioxide equivalent (kt CO₂-e), comprising 44 per cent carbon dioxide, 44 per cent methane, 11 per cent nitrous oxide and 2 per cent fluorinated gases.
- The two largest contributors to New Zealand's emissions profile in 2020 were the agriculture sector (at 50 per cent of gross emissions) and the energy sector (at 40 per cent).
- Gross emissions decreased by 3 per cent between 2019 and 2020. The main reason for this is the COVID-19 pandemic restrictions.
- Since 1990, New Zealand's gross emissions have increased by 21 per cent. The emission sources that contributed the most to this increase are:
 - enteric fermentation from an increase in the dairy cattle population (methane)
 - fuel use in road transport due to traffic growth (carbon dioxide)
 - fertiliser use on agricultural soils (nitrous oxide)
 - fuel use in manufacturing industries and construction due to economic growth (carbon dioxide)
 - industrial and household refrigeration and air-conditioning systems from increased use of hydrofluorocarbon-based refrigerants (fluorinated gases) that replaced ozone depleting substances.
- The land use, land-use change and forestry (LULUCF) sector offset 30 per cent of New Zealand's gross emissions in 2020.
- New Zealand's net emissions in 2020 were 55,465 kt CO₂-e. Net emissions consist of gross emissions combined with the emissions and removals of the LULUCF sector.
- New Zealand's net emissions have increased by 26 per cent since 1990, due to the underlying increase in gross emissions.

1.1 Introduction

Aotearoa New Zealand supplies a transparent, accurate and regular national greenhouse gas inventory report, which forms one of the building blocks for effective climate change mitigation. As a developed country Party (Annex I Party) to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, New Zealand is obliged to prepare, publish and update *New Zealand's Greenhouse Gas Inventory* of anthropogenic greenhouse gas emissions and removals on an annual basis.

The latest edition of *New Zealand's Greenhouse Gas Inventory*¹ was submitted to the UNFCCC in April 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*, submitted in 2022 includes information on emissions and removals of greenhouse gases for the complete time series from 1990–2020.² Inventory reporting under the UNFCCC considers five sectors: energy, industrial processes and product use (IPPU), agriculture, waste and LULUCF. For Tokelau, a non-self-governing territory of New Zealand, emissions and removals are also reported separately by sector as 'Other.'

New Zealand ratified the UNFCCC on 16 September 1993, and the Paris Agreement on 4 October 2016. New Zealand extended its ratification of the UNFCCC and the Paris Agreement to include Tokelau as of 13 November 2017.

Inventory reporting under the UNFCCC covers the following direct greenhouse gases: CO₂, CH₄, N₂O, HFCs, PFCs, SF₆ and nitrogen trifluoride.³ In accordance with UNFCCC reporting guidelines, indirect greenhouse gases are included in inventory reporting but not in the national emissions total. These indirect greenhouse gases include carbon monoxide, sulphur dioxide, oxides of nitrogen and non-methane volatile organic compounds.

1.2 National trends: emissions by sector and by gas

1.2.1 Gross emissions

In 2020, Aotearoa New Zealand's gross greenhouse gas emissions (excluding emissions and removals from the LULUCF sector) were 78,778.4 kt CO₂-e. Between 1990 and 2020, New Zealand's gross greenhouse gas emissions increased by 20.8 per cent (table 1.1 and figure 1.1). The average annual growth in emissions was 0.6 per cent.

The emissions categories that contributed the most to the increase in gross emissions were enteric fermentation from dairy cattle (methane, CH₄),⁴ road transportation (CO₂), agricultural soils (nitrous oxide, N₂O), manufacturing industries and construction (CO₂) – especially the categories of chemicals, food processing, beverages and tobacco – and fluorinated gases (F-gases) used as substitutes for ozone depleting substances (ODS).

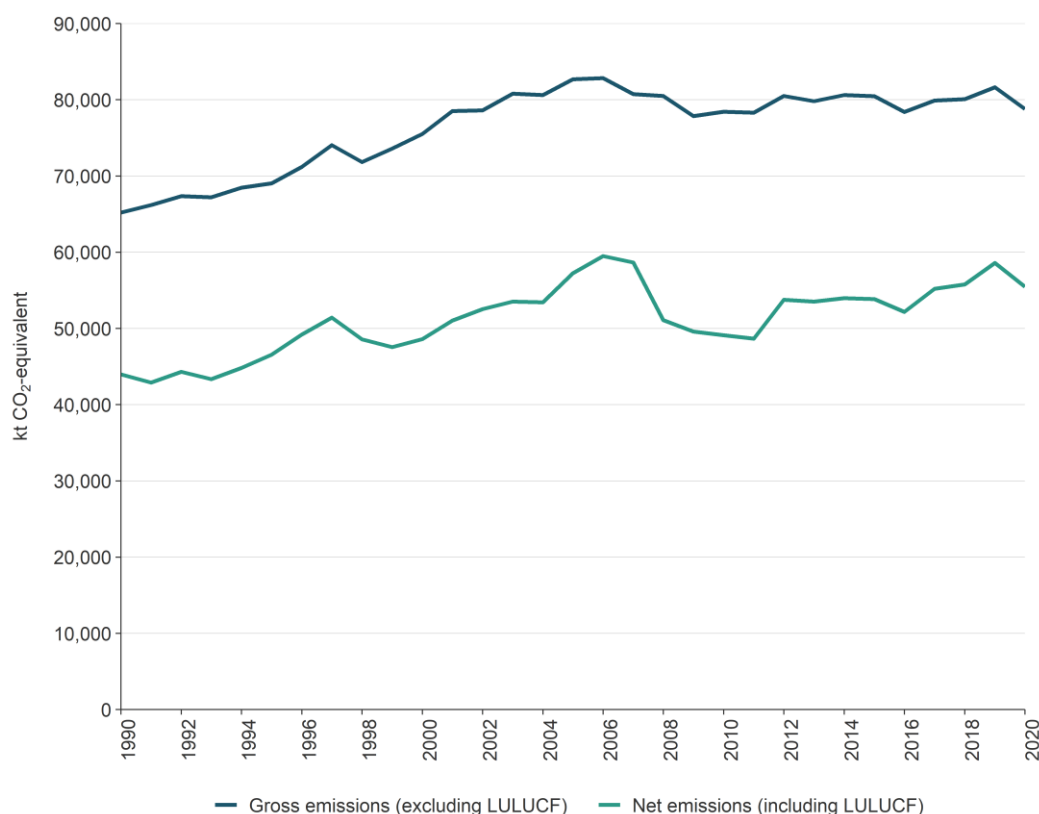
¹ Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Retrieved from environment.govt.nz/facts-and-science/climate-change/measuring-greenhouse-gas-emissions/about-new-zealands-greenhouse-gas-inventory/ (12 September 2022). The 2022 Inventory refers to the entire UNFCCC submission, which includes the National Inventory Report, the common reporting format database and the standard electronic format tables.

² To allow time for data collection and processing, there is always a gap of 15 months between the end of the most recent calendar year in the time series and the submission of the inventory.

³ Because nitrogen trifluoride emissions do not occur in New Zealand, no nitrogen trifluoride data are included in the greenhouse gas inventory report.

⁴ Enteric fermentation is a digestive process by which micro-organisms break down carbohydrates into simple molecules for absorption into the bloodstream of an animal.

Figure 1.1: New Zealand's gross and net emissions (under the UNFCCC) 1990–2020



Note: kt CO₂-equivalent = kilotonnes of carbon dioxide equivalent; LULUCF = land use, land-use change and forestry; UNFCCC = United Nations Framework Convention on Climate Change.

Source: Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment.

1.2.2 Net emissions

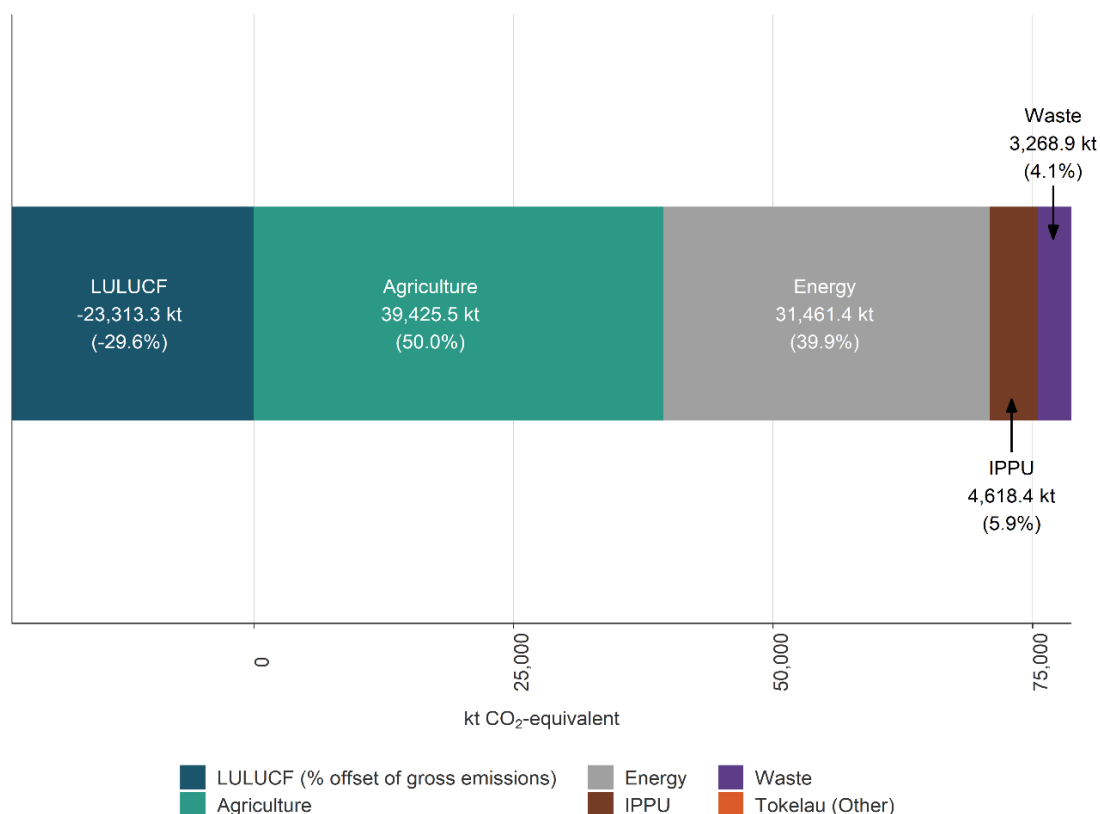
In 2020, the LULUCF sector offset 29.6 per cent of gross emissions (figure 1.2). Net emissions in 2020, at 55,465.1 kt CO₂-e, were therefore lower than gross emissions (table 1.1). Between 1990 and 2020, our country's net greenhouse gas emissions increased by 26.1 per cent (table 1.1 and figure 1.1). The categories that contributed the most to the increase in net emissions were land converted to forest land (declining CO₂ sink), enteric fermentation from dairy cattle (CH₄), road transportation (CO₂) and agricultural soils (N₂O). Despite the considerable variability that occurred from year to year over this period, overall the amount of CO₂ the LULUCF sector has removed from the atmosphere has increased since 1990.⁵ In 2020, net removals in the LULUCF sector increased by 9.8 per cent compared with 1990 levels.

1.2.3 Sector trends

The sectors contributing the most to the country's emissions profile were agriculture at 50.0 per cent and energy 39.9 per cent. Minor emission contributions came from the IPPU sector at 5.9 per cent and waste sector at 4.1 per cent. Emissions from Tokelau were negligible at only 0.005 per cent. In 2020, the LULUCF sector offset 29.6 per cent of gross emissions (figure 1.2).

⁵ The amount of CO₂-e the LULUCF sector removes is the difference between removals and any emissions in this sector from, for example, harvesting and deforestation.

Figure 1.2: New Zealand's greenhouse gas emissions by sector, 2020



Note: IPPU = industrial processes and product use; kt CO₂-equivalent = kilotonnes of carbon dioxide equivalent; LULUCF = land use, land-use change and forestry. The percentages may not add up to 100 per cent due to rounding. The LULUCF sector, which is not part of gross emissions, is included here as a negative value. The Tokelau sector is not visible due to its small contribution (4.18 kt CO₂-e or 0.005 per cent of New Zealand's gross greenhouse gas emissions).

Source: Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment.

Table 1.1: New Zealand's emissions by sector, 1990 and 2020

Sector	kt CO ₂ -equivalent		Change from 1990 (kt CO ₂ -equivalent)	Change from 1990 (%)
	1990	2020		
Energy	23,877.9	31,461.4	7,583.5	31.8
Industrial processes and product use	3,579.9	4,618.4	1,038.4	29.0
Agriculture	33,792.9	39,425.5	5,632.7	16.7
Waste	3,943.1	3,268.9	-674.2	-17.1
Tokelau	3.2	4.2	1.0	31.9
Gross (excluding LULUCF)	65,197.0	78,778.4	13,581.4	20.8
LULUCF	-21,229.2	-23,313.3	-2,084.0	-9.8
Net (including LULUCF)	43,967.8	55,465.1	11,497.3	26.1

Note: kt CO₂-equivalent = kilotonnes of carbon dioxide equivalent; LULUCF = land use, land-use change and forestry. Net emissions from the LULUCF sector are reported as a negative number because the sector removes more CO₂ from the atmosphere than it emits (see chapter 6 of *New Zealand's Greenhouse Gas Inventory 1990–2020*, submitted in 2022). Columns may not total due to rounding. Percentages presented are calculated from unrounded values.

Source: Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment.

Emissions from the energy sector have increased by 31.8 per cent between 1990 and 2020 (table 1.1). This is mainly driven by increases in three categories: road transportation increased by 76.1 per cent; food processing, beverages and tobacco increased by 83.0 per cent; and public energy and heat production increased by 32.3 per cent.

Between 1990 and 2020, emissions from the IPPU sector increased by 29.0 per cent (table 1.1). This is driven by increases in product uses as substitutes for ODS after HFCs were introduced to replace ODS in refrigeration and air-conditioning units. To a lesser degree, increased production of metals, lime and cement have also contributed to increased emissions within the sector. In the same period, substantial reductions in emissions of PFCs have occurred due to improved management of anode effects in aluminium smelting, and reductions in emissions from N₂O used for medical applications.

Between 1990 and 2020, emissions from the agriculture sector increased by 16.7 per cent (table 1.1). This has largely been driven by an increase in the population of dairy cattle, which has led to increases in emissions across several agricultural reporting categories. The population has expanded because farming dairy cattle has provided better financial returns over the period. Partially offsetting this increase was the decrease in the number of sheep and beef cattle over the same timeframe.

Between 1990 and 2020, total emissions from the waste sector decreased by 17.1 per cent (table 1.1). Annual emissions peaked in 2002 and have generally declined since then, even though the growth in population and economic activity has resulted in overall higher volumes of waste since 1990. The reason for the downward trend in emissions in the waste sector since 2005 is that the management of solid waste disposal at municipal landfills has continued to improve through increasing CH₄ recovery because of initiatives to improve practices for both managing solid waste and recovering landfill gas.

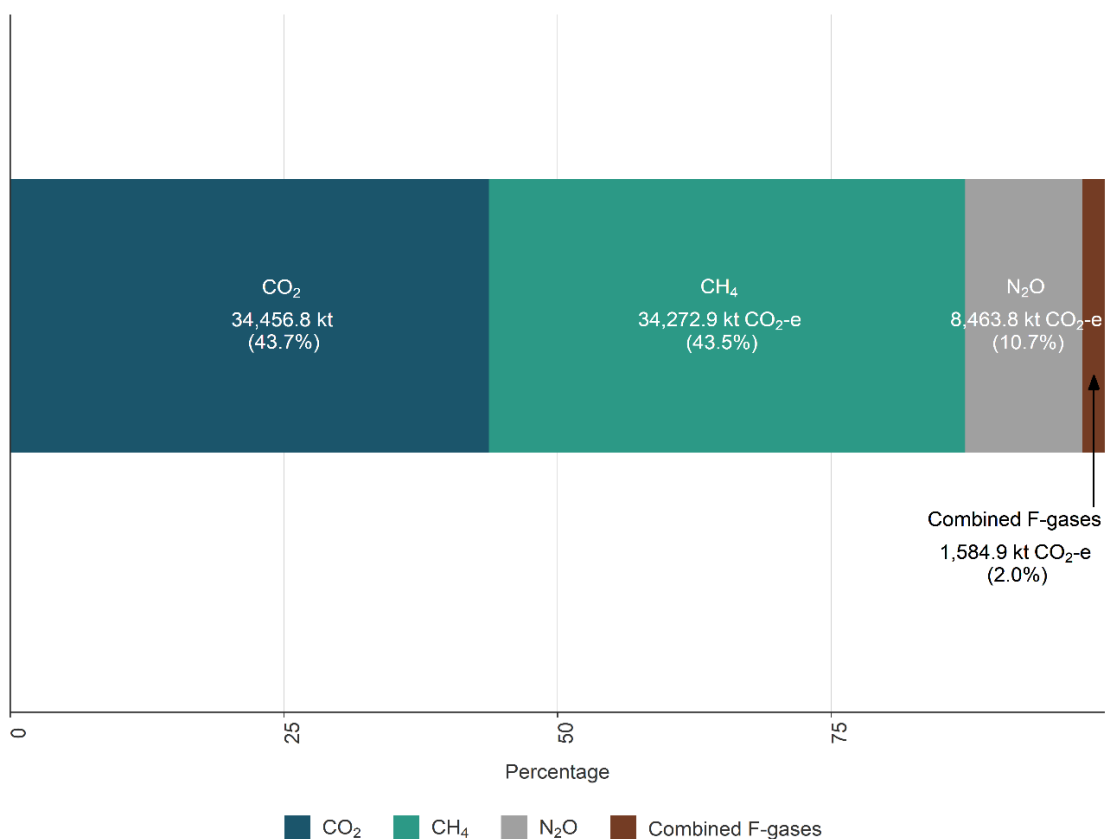
The combination of the small land area, small population and absence of industry means Tokelau has an extremely minimal impact on the environment and contributes only a minor amount of greenhouse gas emissions. The largest source of emissions in Tokelau is domestic navigation. Between 1990 and 2020, emissions from Tokelau increased by 31.9 per cent (table 1.1). This is driven by an increase in domestic navigation, which occurred after Tokelau gained ownership and use of passenger and cargo vessels, and an increase in electricity generation due to the introduction of air conditioning after 2006.

Net emissions from the LULUCF sector have fluctuated over the time series as the rate of harvesting, afforestation and deforestation changes. Between 1990 and 2020, net removals from the LULUCF sector have increased by 9.8 per cent (table 1.1). This is largely the result of increased production of harvested wood products, which have compensated for the emissions from the increase in forest harvesting.

1.2.4 Emission trends by gas

In 2020, carbon dioxide and methane contributed the largest proportion of gross greenhouse gas emissions (43.7 per cent and 43.5 per cent respectively). Nitrous oxide (10.7 per cent) and fluorinated gases (F-gases) (2.0) made up the balance (figure 1.3).

Figure 1.3: New Zealand's gross greenhouse gas emissions by gas, 2020



Note: CH₄ = methane; CO₂ = carbon dioxide; F-gases = fluorinated gases; kt CO₂-e = kilotonnes of carbon dioxide equivalent; N₂O = nitrous oxide. The percentages may not add up to 100 per cent due to rounding.

Source: Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment.

Table 1.2: New Zealand's emissions of greenhouse gases by gas, 1990 and 2020

Direct greenhouse gas emissions	kt CO ₂ -equivalent		Change from 1990 (kt CO ₂ -equivalent)	Change from 1990 (%)
	1990	2020		
CO ₂	25,502.5	34,456.8	8,954.2	35.1
CH ₄	32,972.5	34,272.9	1,300.4	3.9
N ₂ O	5,792.0	8,463.8	2,671.7	46.1
HFCs	NO	1,480.3	1,480.3	NA
PFCs	909.9	87.9	-822.0	-90.3
SF ₆	20.0	16.7	-3.3	-16.5
Gross, all gases	65,197.0	78,778.4	13,581.4	20.8

Note: CH₄ = methane; CO₂ = carbon dioxide; HFCs = hydrofluorocarbons; kt CO₂-equivalent = kilotonnes of carbon dioxide equivalent; N₂O = nitrous oxide; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride. Gross emissions exclude net removals from the LULUCF sector. The percentage change for HFCs is not applicable (NA) as emissions were not occurring (NO) in 1990. Columns may not total due to rounding. Percentages presented are calculated from unrounded values.

Source: Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment.

1.2.5 Where to find more information about emissions

For more information on New Zealand's greenhouse gas emissions, see the common tabular format (CTF) summary tables submitted with this report and reproduced in appendix A. See also *New Zealand's Greenhouse Gas Inventory 1990–2020*⁶ published in 2022, which is available on both the Ministry for the Environment and UNFCCC websites.

1.3 National Inventory System

New Zealand's National Inventory System operates in line with relevant UNFCCC and Kyoto Protocol guidelines and is constantly improved.

The Climate Change Response Act 2002 was enacted to enable Aotearoa New Zealand to meet its international obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. According to the UNFCCC definition, a national system includes all institutional, legal and procedural arrangements made within a Party included in Annex I for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information. Essentially, a Party's national inventory system is the basis on which a country inventories its greenhouse gas emissions.

A prime ministerial directive for the administration of the Climate Change Response Act 2002 names the Ministry for the Environment (MfE) as New Zealand's 'inventory agency'. MfE is responsible for the overall development, compilation and submission of the *New Zealand's Greenhouse Gas Inventory* to the UNFCCC secretariat. Part 3, section 32 of the CCRA specifies that the primary functions of the inventory agency are to:

- estimate annually New Zealand's anthropogenic emissions by sources and removals by sinks of greenhouse gases
- prepare the following reports for the purpose of discharging New Zealand's obligations:
 - i. New Zealand's annual inventory report under Articles 4 and 12 of the Convention and Article 7.1 of the Protocol, including (but not limited to) the quantities of long-term certified emission reduction units and temporary certified emission reduction units that have expired or have been replaced, retired or cancelled
 - ii. Any report of information by New Zealand under Article 13 of the Paris agreement
 - iii. New Zealand's national communication (or periodic report) under Article 7.2 of the Protocol and Article 12 of the Convention.

In carrying out its functions, the inventory agency must:

- identify source categories
- collect data by means of:
 - i. voluntary collection
 - ii. collection from government agencies and other agencies that hold relevant information
 - iii. collection in accordance with regulations made under this Part (if any)

⁶ Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Retrieved from <https://environment.govt.nz/facts-and-science/climate-change/measuring-greenhouse-gas-emissions/about-new-zealands-greenhouse-gas-inventory/> (12 September 2022).

- estimate the emissions and removals for each source category
- undertake assessments on uncertainties
- undertake procedures to verify the data
- retain information and documents to show how the estimates were determined.

Compliance provisions in section 36 of the CCRA allow inspectors to be authorised to collect information for estimating emissions or removals of greenhouse gases. The Ministry for the Environment is responsible for the overall development, compilation and submission of the inventory to the UNFCCC Secretariat. The Ministry chairs a cross-agency reporting governance group that provides leadership over the reporting, modelling and projections of greenhouse gas emissions and removals.

Based on the Kyoto Protocol and UNFCCC guidelines, New Zealand has developed its own National Inventory System guidelines to document the tasks required for producing and submitting the inventory. The guidelines cover many aspects of the inventory production, including planning, inventory processes, inventory improvement, communication, and error management. These guidelines also detail a quality assurance and control plan to formalise, document and archive the quality assurance and control processes and procedures, as well as key deliverables of the process.

1.3.1 Changes to arrangements

Inclusion of Tokelau in New Zealand's inventory system

Changes have been made to the national inventory system since the *Seventh National Communication* was submitted in December 2017. These were reported in the *Fourth Biennial Report* submitted in December 2019. Specifically New Zealand's inventory system now includes Tokelau and reports on its greenhouse gas emissions. In November 2017 New Zealand extended its ratification of the UNFCCC and the Paris Agreement to include Tokelau, and as a result Tokelau is now included in the obligatory climate change reporting managed by the Ministry for the Environment.

New Zealand and Tokelau signed a Memorandum of Understanding (MoU) for the inclusion of Tokelau in New Zealand's inventory. According to the MoU, both New Zealand's central inventory agency, the Ministry for the Environment, and the Tokelau Department for Climate Change have roles in inventory reporting.

MfE is responsible for coordinating the overall inclusion of Tokelau in New Zealand's inventory system. Part of this responsibility is to develop the reporting system and the reporting guidelines for Tokelau to use. MfE is also responsible for supporting the emissions estimates prepared by Tokelau and integrating the emissions estimates with New Zealand's main CRF data, as well as including Tokelau in the inventory report. For further details on how Tokelau's data and information are incorporated, see chapter 8 of *New Zealand's Greenhouse Gas Inventory 1990–2020*, published in 2022.

The Tokelau Ministry for Climate, Oceans and Resilience is responsible for collecting activity data, providing the written content and emissions estimates where possible and advising on Tokelau's national circumstances and specific cultural aspects for consideration.

Both New Zealand's Ministry for the Environment and the Tokelau Ministry for Climate, Oceans and Resilience are responsible for adhering to the principles and protocols for producers of Tier 1 statistics under the New Zealand official statistics system.

Further information

No other changes have been made to the legal or institutional arrangements in the National Inventory System since New Zealand's *Fourth Biennial Report* was submitted.

Aside from the changes in legal and institutional agreement, improvements designed to improve the quality and efficiency of the National Inventory System have occurred during the past two years. The focus of this work was on making the National Inventory System more robust, and achieving better transparency, comparability, consistency, completeness and accuracy in the inventory. Since New Zealand's *Fourth Biennial Report* and *Seventh National Communication* were submitted, improvements in the inventory have focused on increasing the quality and efficiency of the inventory production. They include:

- continuing to develop automated methods for the National Inventory Report production, especially where large quantities of reported data are within several different source documents
- continuing to develop the expertise of inventory contributors through coaching and structured training courses
- securing project management and quality control staff resources within the central inventory agency (MfE).

These programme and operational improvements are expected to enhance the functioning of the national system and, in doing so, ensure continuous improvement of national inventory submissions into the future.

For more information on New Zealand's National Inventory System and changes to arrangements since the *Fourth Biennial Report*, see *New Zealand's Greenhouse Gas Inventory 1990–2020*, submitted in 2022.

2 Quantified economy-wide emission reduction targets

Key points

Aotearoa New Zealand has the following international emissions reduction targets.

- **2020 target:** Reduce gross greenhouse gas emissions to 5 per cent below 1990 levels over the period 1 January 2013 to 31 December 2020 (under the United Nations Framework Convention on Climate Change).
- **2030 target:** Reduce net greenhouse gas emissions to 50 per cent below gross 2005 levels by 2030 (the target in our first nationally determined contribution under the Paris Agreement, updated in November 2021).

New Zealand also has the following domestic emissions reduction targets:

- net zero emissions of all greenhouse gases other than biogenic methane by 2050
- for biogenic methane emissions, 24 to 47 per cent reduction below 2017 levels by 2050, including to 10 per cent below 2017 levels by 2030.

2.1 Introduction

Climate change is a global issue, and Aotearoa New Zealand is committed to playing its part in the global response. To achieve this, New Zealand has set targets for reducing greenhouse gas (GHG) emissions and contributing to the global solution; and in particular, strengthening our ambition for 2030 in our first Nationally Determined Contribution (NDC1) under the Paris Agreement. This chapter describes these targets, as well as conditions and assumptions that are relevant to achieving them.

2.2 New Zealand's targets

Aotearoa New Zealand has committed to the following international and domestic emissions reduction targets.

International targets

2030 target (2021–30)

Under the Paris Agreement, New Zealand has set a headline target for NDC1 to reduce net greenhouse gas emissions to 50 per cent below gross 2005 levels by 2030. The NDC1 target is economy-wide, covering all sectors and all greenhouse gases.⁷

⁷ New Zealand Government. 2021. *Submission under the Paris Agreement: New Zealand's First Nationally Determined Contribution – Updated 4 November 2021*. Retrieved from unfccc.int/sites/default/files/NDC/2022-06/New%20Zealand%20NDC%20November%202021.pdf (1 December 2022).

2020 target (2013–20)

New Zealand's 2020 target is to reduce gross GHG emissions to 5 per cent below 1990 levels over the period 1 January 2013 to 31 December 2020.

This target is taken under the United Nations Framework Convention on Climate Change (UNFCCC) while applying the Kyoto Protocol framework of rules. This means we can meet this target through a combination of reducing our emissions, eligible forestry activities and offshore mitigation.

We are on track to meet this target based on the 2022 submission of *New Zealand's Greenhouse Gas Inventory*. This will be formally confirmed following the completion of the international expert review process.

2012 target (2008–12)

In 2015 New Zealand confirmed we had met our 2012 target for the first commitment period of the Kyoto Protocol. This was to reduce greenhouse gas emissions to 1990 levels between 2008 and 2012. New Zealand's 'True-up report'⁸ to the UNFCCC⁹ provides detail on how the target was met.

Domestic targets

In 2019, the Climate Change Response Act 2002 (CCRA) was amended to include new domestic emissions reduction targets.¹⁰ These legislated targets require:

- all GHGs, other than biogenic methane, to reach net zero by 2050
- a minimum 10 per cent reduction in biogenic methane emissions by 2030, and a 24 to 47 per cent reduction by 2050 (compared with 2017 levels).

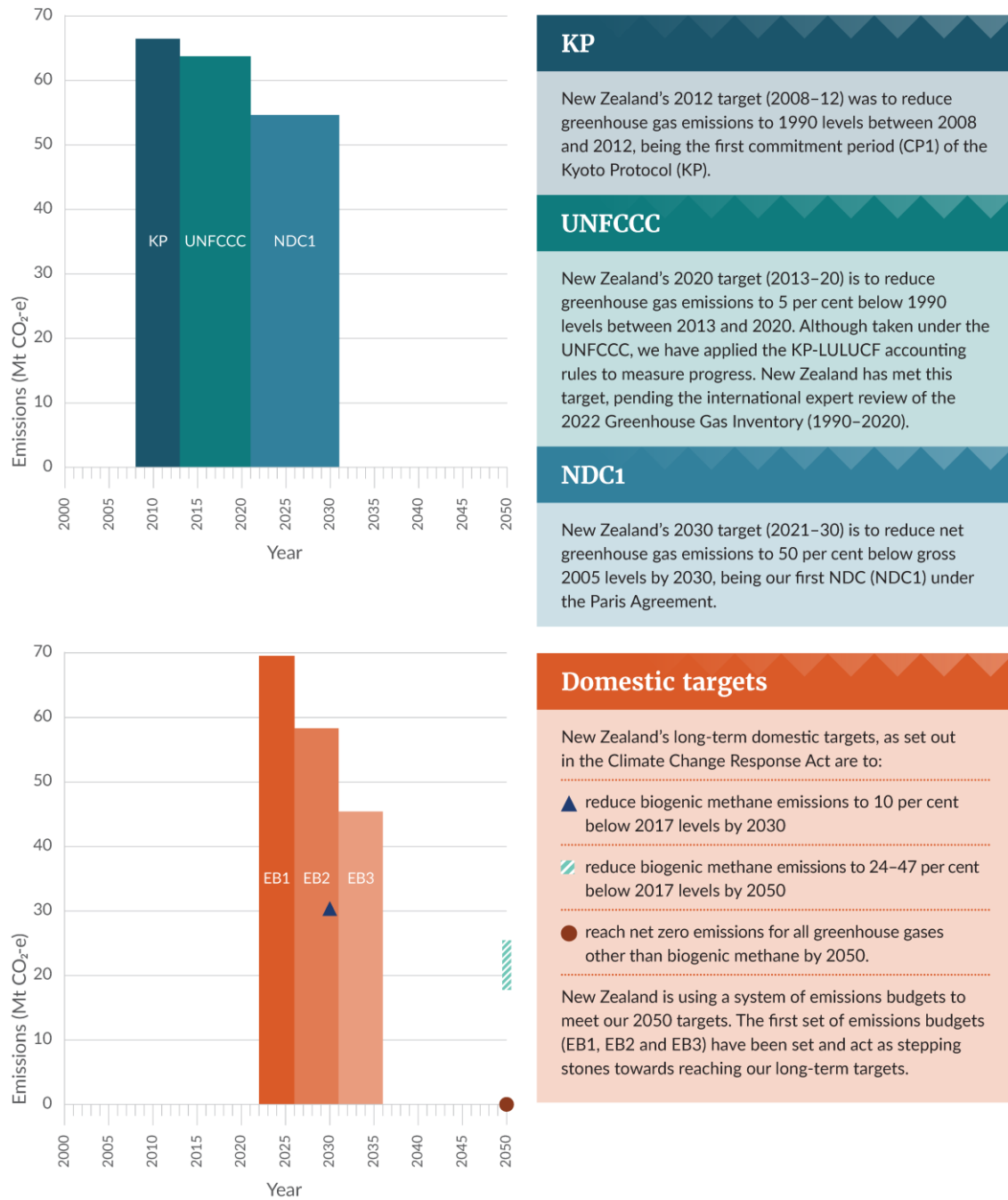
Figure 2.1 shows New Zealand's emissions reduction targets under the Kyoto Protocol for 2008–12 (KP) and under the UNFCCC for 2013–20, along with our first NDC under the Paris Agreement for 2021–30. Figure 2.2 shows New Zealand's domestic targets set under the CCRA.

⁸ environment.govt.nz/publications/report-upon-expiration-of-the-additional-period-for-fulfilling-commitments-by-new-zealand/

⁹ New Zealand Government. 2015. *Report upon Expiration of the Additional Period for Fulfilling Commitments by New Zealand* [True-up period report], submitted to the UNFCCC 16 December 2015. Retrieved from unfccc.int/files/kyoto_protocol/reporting/true-up_period_reports_under_the_kyoto_protocol/application/pdf/true-up_period_report_by_new_zealand_2015.pdf (1 December 2022).

¹⁰ CCRA, section 5Q. Retrieved from www.legislation.govt.nz/act/public/2002/0040/latest/whole.html#LMS282014 (1 December 2022).

Figure 2.1: New Zealand's emissions reduction targets



Note: The Kyoto Protocol (KP), United Nations Framework Convention on Climate Change (UNFCCC) and Nationally Determined Contribution (NDC) targets are displayed as multi-year budgets. The domestic targets under the CCRA are point-year targets; however, these targets will be achieved using a system of multi-year emissions budgets. GHGs = greenhouse gases; Mt CO₂-e = million tonnes of carbon dioxide equivalent. Budget periods cover the years 2022–25 for EB1, 2026–30 for EB2, and 2031–35 for EB3. Target and budget periods end at 31 December

Note: Shown applying the 100-year time-horizon global warming potentials (GWP₁₀₀) from the IPCC Fourth Assessment Report (AR4) for comparability purposes.

These targets are presented in further detail below.

2.2.1 New Zealand's 2020 target

New Zealand has a quantified economy-wide emission reduction target to reduce emissions to 5 per cent below 1990 gross GHG levels for the period 2013–20. With the submission of *New Zealand's Greenhouse Gas Inventory (1990–2020)* in April 2022, emissions are now reported for the full target period and, following the completion of its review, the final steps required to complete the accounting process will be undertaken. While the target for this period was taken under the UNFCCC, New Zealand has applied the Kyoto Protocol framework of rules.

Based on UNFCCC methodology, this 5 per cent below 1990 target was the equivalent of a Quantified Emission Limitation or Reduction Objective (QELRO) of 96.8 per cent on 1990 gross GHG emissions over the period 2013–20. New Zealand prepared an initial report in 2016 to facilitate the calculation of its exact emissions budget for 2013–20. Based on gross emissions in 1990, as reported in *New Zealand's Greenhouse Gas Inventory* submitted in 2016,¹¹ this target corresponds to a commitment to reduce emissions to 509.775 million tonnes of carbon dioxide equivalent (Mt CO₂-e) for the period 2013–20.¹²

New Zealand has applied the Kyoto Protocol framework of rules in reporting and measuring progress towards its target for the period 2013–20 to ensure that its actions are transparent and have integrity. This includes applying Kyoto Protocol accounting rules that were agreed in Durban in 2011 for land use, land-use change and forestry (see Decision 2/CMP.7). For 2013–20, therefore, New Zealand has included emissions and removals from afforestation, reforestation and deforestation activities, and forest management activities.

See tables 2.1–2.5 (which present common tabular format (CTF) tables 2a–2f) for further information about this target.

Table 2.1: Emissions reduction target: base year and target^a (CTF Table 2a)

Base year/base period	1990
Emission reduction target	5% below 1990 by 2020
Period for reaching the target	2013–20

Note:

^a Reporting by a developed country Party on the information specified in the common tabular format (CTF) does not prejudice the position of other Parties with regard to the treatment of units from market-based mechanisms under the UNFCCC or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

¹¹ Ministry for the Environment. 2016. *New Zealand's Greenhouse Gas Inventory 1990–2014*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/Publications/Files/national-inventory-report-2016.pdf (1 December 2022).

¹² Ministry for the Environment. 2016. *New Zealand's Report to facilitate the Calculation of its Emissions Budget for the Period 2013 to 2020*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/Publications/Files/New-Zealands-Initial-Report-July-2016.pdf (1 December 2022).

Table 2.2: Description of quantified economy-wide emission reduction target^a (CTF Tables 2b and 2c)

Gases covered	Base year	Global warming potential
CO ₂	1990	IPCC Fourth Assessment Report
CH ₄	1990	IPCC Fourth Assessment Report
N ₂ O	1990	IPCC Fourth Assessment Report
HFCs	1990	IPCC Fourth Assessment Report
PFCs	1990	IPCC Fourth Assessment Report
SF ₆	1990	IPCC Fourth Assessment Report
NF ₃	1990	IPCC Fourth Assessment Report
Sectors covered	Comments	
Energy		
Transport ^b		
IPPU		
Agriculture		
LULUCF	LULUCF is not included in the target's base year emissions	
Waste		

Note: CH₄ = methane; CO₂ = carbon dioxide; HFCs = hydrofluorocarbons; IPCC = Intergovernmental Panel on Climate Change; IPPU = industrial processes and product use; LULUCF = land use, land-use change and forestry; NF₃ = nitrogen trifluoride; N₂O = nitrous oxide; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride.

^a Reporting by a developed country Party on the information specified in the common tabular format (CTF) does not prejudice the position of other Parties with regard to the treatment of units from market-based mechanisms under the UNFCCC or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

^b Transport is reported as a subsector of the energy sector.

Table 2.3: Approach to counting emissions and removals from the LULUCF sector^{a, b} (CTF Table 2d)

Role of LULUCF	Comments
Emissions and removals from the LULUCF sector are counted towards achievement of the target	The LULUCF sector is not included in the target's base year emissions
The contribution of the LULUCF sector is calculated applying an activity-based approach	Applying LULUCF accounting rules for the second commitment period of the Kyoto Protocol (ie, afforestation, reforestation and deforestation activities and forest management activities as agreed in Decision 2/CMP.7)

Note: LULUCF = land use, land-use change and forestry.

^a Reporting by a developed country Party on the information specified in the common tabular format (CTF) does not prejudice the position of other Parties with regard to the treatment of units from market-based mechanisms under the UNFCCC or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

^b All afforestation/reforestation and deforestation activities (Article 3.3) count towards New Zealand's target. Forest management is the only Article 3.4 activity that New Zealand includes in its target accounting quantity. New Zealand has not elected to account for any other Article 3.4 activities.

Table 2.4: Possible scale of contributions of market-based mechanisms^a (CTF Table 2e)

CERs	NA
ERUs	NA
AAUs ^b	6,544,585
Carry-over units ^c	IE
Other mechanism units under the Convention (specify) ^d	NA

Note: AAUs = assigned amount units; CERs = certified emissions reductions; Convention = United Nations Framework Convention on Climate Change; ERUs = emissions reduction units; IE = included elsewhere; NA = not applicable.

- ^a Reporting by a developed country Party on the information specified in the common tabular format (CTF) does not prejudice the position of other Parties with regard to the treatment of units from market-based mechanisms under the UNFCCC or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.
- ^b AAUs issued to or purchased by a Party.
- ^c Units carried over from the first to the second commitment period of the Kyoto Protocol, as described in Decision 13/CMP.1 and consistent with Decision 1/CMP.8.
- ^d As indicated in paragraph 5I of the guidelines contained in annex I of Decision 2/CP.17.

Table 2.5: Any other information (CTF Table 2f)

New Zealand is applying the Kyoto Protocol's second commitment period rules to its 2020 target. In practice, however, some technical changes may be required to reflect the status of New Zealand's target (as the target is not inscribed in the third column of Annex B of the Doha Amendment to the Kyoto Protocol). New Zealand reserves the right to review the accounting rules it applies to ensure alignment with the Kyoto Protocol and to support a smooth transition to the Paris Agreement.

2.2.2 New Zealand's Nationally Determined Contribution

In 2021, the New Zealand Government updated its first NDC to align with the global efforts to limit global warming to 1.5°C above pre-industrial levels. New Zealand has set a target for NDC1 to reduce net greenhouse gas emissions to 50 per cent below gross 2005 levels by 2030.

The NDC1 target is economy-wide, covering all sectors and all greenhouse gases. New Zealand will report on the implementation and achievement of its NDC1 through the Paris Agreement's Enhanced Transparency Framework.

New Zealand's NDC, including a summary of the methodologies used to account for the land use, land-use change and forestry sector, can be found on the UNFCCC Secretariat's website.¹³

New Zealand's updated NDC1 of 50 per cent below gross 2005 levels by 2030 is expressed as a 'point-year target' for 2030. This corresponds to 41 per cent when managed using a multi-year emissions budget starting from New Zealand's 2020 emissions target and gross emissions estimates for 2005 as reported in *New Zealand's Greenhouse Gas Inventory for 1990–2019*. This budget provisionally equates to 571 Mt CO₂-e over 2021–30.

¹³ New Zealand Government. 2021. *Submission under the Paris Agreement: New Zealand's First Nationally Determined Contribution – Updated 4 November 2021*. Retrieved from unfccc.int/sites/default/files/NDC/2022-06/New%20Zealand%20NDC%20November%202021.pdf (1 December 2022).

New Zealand will meet its emissions budget for the period 2021–30 through a combination of:

- absolute reductions in New Zealand’s gross emissions, including all sectors and all GHGs
- net removals of carbon dioxide from eligible forestry activities, following the Kyoto Protocol framework of rules, modified for plantation forests
- offshore mitigation, through Article 6 of the Paris Agreement, ensuring environmental integrity, avoidance of double counting, and transparency, in line with the guidelines for international cooperation under Article 6 of the Paris Agreement.

To help New Zealand meet its NDCs, the CCRA was amended in 2019. For details, refer to chapter 4 of New Zealand’s Eighth National Communication.¹⁴

New Zealand will submit its national greenhouse gas inventory for the period 1990–2021 in April 2023, which will include inventory estimates for 2021, the first year of NDC1. New Zealand, along with other Parties to the Paris Agreement, will track progress towards our NDCs in our Biennial Transparency Reports, the first of which is due by 31 December 2024 at the latest.

In line with commitments under the Paris Agreement, New Zealand will continue to regularly review its contributions to international mitigation action, taking into account, inter alia, the latest science, the periodic stocktakes under the Paris Agreement, development of new technologies, progress by other countries and the commitments New Zealand has made.

2.2.3 New Zealand’s domestic targets

The Climate Change Response Act 2002 is New Zealand’s primary climate change legislation. It provides the legal framework to enable New Zealand to meet its obligations under the UNFCCC, the Paris Agreement and the Kyoto Protocol. It also includes the framework for the New Zealand Emissions Trading Scheme.

In 2019, amendments to the CCRA introduced the Zero Carbon Framework. Under this framework, New Zealand can develop and implement climate change policies that:

- contribute to global efforts under the Paris Agreement to limit the global average temperature increase to 1.5°C above pre-industrial levels
- allow New Zealand to prepare for, and adapt to, the impacts of climate change.

The 2019 amendments:

- established He Pou a Rangi – Climate Change Commission (the Commission)¹⁵ to:
 - provide independent advice to the Government on climate change mitigation and adaptation
 - monitor and review the Government’s progress towards meeting the emissions budgets and 2050 target, as well as the implementation of emissions reduction and national adaptation plans
- set new domestic emissions reduction targets for 2050

¹⁴ Ministry for the Environment. 2022. *Te Whakawhitiwhiti Kōrero Tuawaru ā-Motu o Aotearoa: New Zealand’s Eighth National Communication under the United Nations Framework Convention on Climate Change and the Kyoto Protocol*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/publications/new-zealands-eighth-national-communication (1 December 2022).

¹⁵ The Climate Change Commission was established in December 2019.

- established a system of emissions budgets to step New Zealand towards these 2050 targets
- require the development of an emissions reduction plan for each budget period that sets out the policies and strategies for achieving the emissions budget
- require the Commission to prepare a national climate change risk assessment every six years¹⁶
- require the Government to develop a national adaptation plan that responds to the Commission’s risk assessment.

As required by the CCRA, the Minister for Climate Change set New Zealand’s first three emissions budgets for 2022–25, 2026–30 and 2031–35 in May 2022 (table 2.6).

Table 2.6: New Zealand’s first three emissions budgets (Mt CO₂-e), 2022–35

	First emissions budget (2022–25)	Second emissions budget (2026–30)	Third emissions budget (2031–35)
All gases, net (AR5)*	290	305	240
Annual average	72.5	61.0	48.0

Note: * Emissions in million tonnes of carbon dioxide equivalent (Mt CO₂-e) are based on the 100-year time-horizon global warming potentials (GWP100) metric values from the Intergovernmental Panel on Climate Change’s (IPCC) Fifth Assessment Report (AR5), as required under the Paris Agreement (Decision 5/CMA.3).

Sector sub-targets

For the first three emissions budgets, the Government has set sector sub-targets for key economic sectors.¹⁷ Sector sub-targets will help to track progress across these key sectors over each emissions budget period. Unlike emissions budgets, sub-targets are not legislated.

The Climate Change Chief Executives Board is responsible for monitoring and reporting on overall progress towards the emissions budgets, including sector sub-targets. This will involve advising on how to adjust policy settings to manage variances within – and between – sector sub-targets to support meeting the overall emissions budgets.

¹⁶ The Government prepared the first national climate change risks assessment. Progress reports and subsequent risk assessments are to be prepared by the Climate Change Commission.

¹⁷ environment.govt.nz/publications/aotearoa-new-zealands-first-emissions-reduction-plan/playing-our-part/

3 Progress in achievement of quantified economy-wide emission reduction targets and relevant information

Key developments

Aotearoa New Zealand will meet its 2020 target.

Progress has also been made in the Government's three main responses to climate change:

- durable institutional arrangements set a long-term direction and keep us on track towards targets, including support for innovation and investment
- effective emissions pricing
- key sector policies and regulations to support emissions reductions and ensure the transition is just and inclusive.

3.1 Introduction

This chapter outlines Aotearoa New Zealand's progress towards achieving its emissions reduction targets. In addition to the key developments explained above, a number of new climate change policies are in place across all sectors. Section 3.3 gives estimates of emissions reductions and removals, while section 3.4 explains the progress made in achieving New Zealand's 2020 target.

3.2 Mitigation actions and their effects

Chapter 4 of Aotearoa New Zealand's Eighth National Communication provides a comprehensive overview of New Zealand's policies and measures to address climate change.¹⁸ These are organised by sector and cover all greenhouse gas emissions. Policies are also summarised in Annex B, CTF Table 3 of this report. Where the information is available, Annex B CTF Table 3 quantifies the emissions reductions expected from the policies set out in chapter 4 of New Zealand's Eighth National Communication. Chapter 4 also covers enabling policies and proposals that seek to mitigate and manage the economic and social consequences of the transition as well as maximise the opportunities, including green jobs, green investment and local climate action.

¹⁸ Ministry for the Environment. 2022. *Te Whakawhitiwhiti Kōrero Tuawaru ā-Motu o Aotearoa: New Zealand's Eighth National Communication under the United Nations Framework Convention on Climate Change and the Kyoto Protocol*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/publications/new-zealands-eighth-national-communication (1 December 2022).

3.3 Estimates of emissions reductions and removals from land use, land-use change and forestry activities

3.3.1 Reporting for the period 2013–20

As noted in chapter 2, Aotearoa New Zealand has applied the Kyoto Protocol framework of rules for its target for the period 2013–20.

Table 3.1 presents New Zealand’s emissions and removals from eligible activities as prescribed under the Kyoto Protocol for the period 2013–20. This includes Article 3.3 activities (afforestation/reforestation and deforestation) and Article 3.4 activities (forest management), though accounting for these activities is against a forest management reference level.¹⁹ Deviations of emissions above or below this reference level are able to be included in the target accounting quantity. New Zealand has elected to account for its 2020 target at the end of the 2013–20 period. Emissions/removals from forest management activities for the full period are included in the target accounting quantity presented in tables 3.1 and 3.2.

Table 3.1: New Zealand’s emissions and removals from land under the Kyoto Protocol as reported for the period 2013–20

	2013	2014	2015	2016	2017	2018	2019	2020
A.1 Afforestation and reforestation								
Net cumulative area since 1990 (ha)	687,861	690,819	694,233	696,925	702,355	709,838	735,240	775,385
Area in calendar year (ha)	7,285	5,937	5,937	5,784	8,434	8,779	27,070	40,887
Net emissions from afforestation and reforestation in calendar year (kt CO ₂ -e)	-17,520.3	-17,913.5	-18,054.1	-18,004.8	-18,486.5	-17,741.1	-16,733.5	-14,764.7
A.2 Deforestation								
Net cumulative area since 1990 (ha)	172,456	182,963	190,942	198,104	203,048	206,874	211,633	214,077
Area in calendar year (ha)	13,897	10,507	7,980	7,162	4,944	3,826	4,759	2,443
Net emissions in calendar year (kt CO ₂ -e)	8,936.6	6,657.5	4,965.3	4,442.4	2,845.7	2,319.2	3,131.8	1,320.5

¹⁹ UNFCCC Secretariat. 2011. *Report of the Technical Assessment of Forest Management Reference Level Submission of New Zealand submitted in 2011*. Retrieved from unfccc.int/documentation/documents/advanced_search/items/6911.php?priref=600006559#beg (30 November 2022).

	2013	2014	2015	2016	2017	2018	2019	2020
B.1 Forest management								
Area included (ha)	9,220,386	9,212,857	9,207,401	9,203,943	9,203,689	9,202,953	9,200,443	9,198,965
Net emissions in calendar year (kt CO ₂ -e)	-24,180.7	-21,978.2	-20,019.5	-18,515.0	-15,503.6	-15,247.1	-15,220.7	-16,031.9
Total area included (ha)	10,080,703	10,086,639	10,092,576	10,098,972	10,109,092	10,119,666	10,147,316	10,188,427
Net emissions in calendar year (kt CO ₂ -e)	-32,764.3	-33,234.2	-33,108.3	-32,077.4	-31,144.4	-30,669.0	-28,822.5	-29,476.1

Note: ha = hectares; kt CO₂-e = kilotonnes of carbon dioxide equivalent. The areas stated are as at 31 December 2020. They are net areas; that is, areas of afforestation and reforestation that were deforested during the period are only included in the figures as deforestation. Afforestation and deforestation areas may differ from other reports because the carbon equivalent forest provision has been applied to some of these areas and they are reported under forest management. Net removals are expressed as a negative value to help clarify that the value is a removal and not an emission. Columns may not total due to rounding.

Source: Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment.

Table 3.2: New Zealand's accounting quantity under Article 3.3 and Article 3.4 of the Kyoto Protocol during the second reporting period (kt CO₂-e)

Activity	2013	2014	2015	2016	2017	2018	2019	2020	Net emissions in period to 2020 (kt CO ₂ -e)
Afforestation/reforestation	-17,520.32	-17,913.5	-18,054.1	-18,004.8	-18,486.5	-17,741.1	-16,733.5	-14,764.7	-139,218.6
Deforestation	8,936.6	6,657.5	4,965.3	4,442.4	2,845.7	2,319.2	3,131.8	1,320.5	34,619.1
Forest management	-24,180.7	-21,978.2	-20,019.5	-18,515.0	-15,503.6	-15,247.1	-15,220.7	-16,031.9	-146,696.7
Net emissions	-32,764.3	-33,234.2	-33,108.3	-32,077.4	-31,144.4	-30,669.0	-28,822.5	-29,476.1	-251,296.2
Excluded emissions from natural disturbances									
Technically corrected forest management reference level (FMRL _{corr})									-14,339.3
Forest management cap for period to 2020									-18,681.6
Accounting quantity excluding forest management									-104,599.5
Accounting quantity including forest management									-123,281.1
Annual forest management emissions against FMRL	-9,841.4	-7,638.9	-5,680.2	-4,175.7	-1,164.3	-907.7	-881.4	-1,692.6	
Cumulative forest management emissions against FMRL	-9,841.4	-17,480.3	-23,160.5	-27,336.1	-28,500.4	-29,408.2	-30,289.6	-31,982.2	-18,681.6

Note: FMRL = forest management reference level; FMRL_{corr} = technically corrected forest management reference level; ha = hectares; kt CO₂-e = kilotonnes of carbon dioxide equivalent. The accounting quantity is calculated as the sum of emissions and removals from afforestation and reforestation, deforestation and post-1989 forest harvested wood products in accordance with changes to the accounting rules for the second commitment period.

Source: Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment.

3.4 New Zealand will meet its 2020 target – April 2022 update

Based on the 2022 submission of New Zealand’s Greenhouse Gas Inventory:

- Aotearoa New Zealand’s gross emissions for the 2013–20 period were 639.6 million tonnes of carbon dioxide equivalent (Mt CO₂-e)
- forestry activities removed 123.3 Mt CO₂-e from the atmosphere over the 2013–20 period
- New Zealand’s net emissions are 1.03 per cent higher than the carbon budget available after accounting for forestry activities.

New Zealand’s emissions budget for the 2013–20 period is 509.8 Mt CO₂-e.²⁰ The difference required to meet the 2020 target will be made up of 6.5 million international units retained from the first commitment period of the Kyoto Protocol (CP1). This will leave a surplus of 21.5 million CP1 units.(table 3.3 and figure 3.1).

The 2022 inventory submission is yet to go through the formal United Nations Framework Convention on Climate Change expert review process. Until then, the findings in this update on New Zealand’s target achievement are provisional.

Tables 3.4 to 3.6 (which present CTF table 4, CTF table 4(a)ii and CTF table 4b respectively) provide a further breakdown of historical data, including any units from market-based mechanisms.

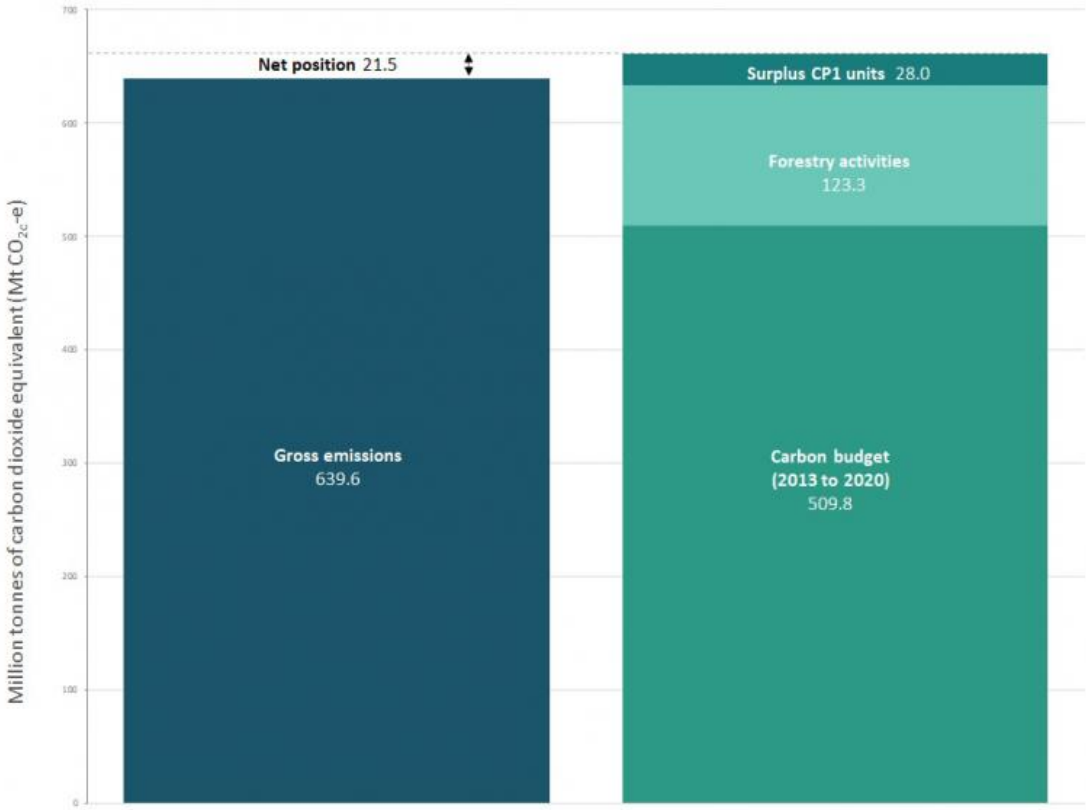
Table 3.3: New Zealand’s target accounting for 2013–20 with a sector breakdown of emissions and removals 2013–20 (million tonnes of carbon dioxide equivalent)

	2013	2013	2015	2016	2017	2018	2019	2020	TOTAL
2013 to 2020 carbon budget									509.8
Forestry activities: Afforestation and reforestation, and deforestation	8.6	11.3	13.1	13.6	15.6	15.4	13.6	13.4	104.6
Forestry activities: Forest management								18.7	18.7
CP1 carryover									28.0
Total									661.1
Emissions									
Energy	32.1	32.2	32.4	31.0	32.5	32.5	33.9	31.5	258.0
Industrial processes and product use	4.8	5.0	5.1	4.9	4.9	4.8	4.9	4.6	39.1
Agriculture	39.3	39.9	39.4	39.0	39.1	39.4	39.5	39.4	315.1
Waste	3.6	3.5	3.5	3.5	3.4	3.4	3.3	3.3	27.4
Gross emissions	79.8	80.6	80.4	78.4	79.9	80.1	81.6	78.8	639.6
Net position*									21.5

Note: *This is a surplus of CP1 units after subtracting the 6.5 Mt CO₂-e needed for target achievement. CP1 = first commitment period. Numbers may not add to totals due to rounding.

²⁰ Ministry for the Environment. 2016. *New Zealand’s report to facilitate the calculation of its emissions budget for the period 2013 to 2020*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/Publications/Files/New-Zealands-Initial-Report-July-2016.pdf

Figure 3.1: New Zealand’s gross emissions for the period 2013–20 and balance of emissions, removals and anticipated use of units towards the 2020 target



Note: Numbers may not add to totals due to rounding to one decimal place.

Table 3.4: Reporting on progress (CTF Table 4) ^{a, b}

Year ^c	Total emissions excluding LULUCF	Contribution from ^d	Quantity of units from market-based mechanisms under the Convention ^e		Quantity of units from other market-based mechanisms	
	(kt CO ₂ -e)	(kt CO ₂ -e)	(number of units)	(kt CO ₂ -e)	(number of units)	(kt CO ₂ -e)
Base year/base period	65,196.98	NA	NA	NA	NA	NA
2013	79,805.66	-8,583.68	NA	NA	NA	NA
2014	80,618.40	-11,255.97	NA	NA	NA	NA
2015	80,450.06	-13,088.79	NA	NA	NA	NA
2016	78,391.48	-13,562.41	NA	NA	NA	NA
2017	79,889.59	-15,640.75	NA	NA	NA	NA
2018	80,079.58	-15,421.97	NA	NA	NA	NA
2019	81,617.06	-13,601.76	NA	NA	NA	NA
2020	78,778.37	-32,125.83	6,544,585	6,544.58	NA	NA

Note: Convention= United Nations Framework Convention on Climate Change; kt CO₂-e = kilotonnes of carbon dioxide equivalent; LULUCF = land use, land-use change and forestry; NA = not applicable.

- ^a Reporting by a developed country Party on the information specified in the common tabular format (CTF) does not prejudice the position of other Parties with regard to the treatment of units from market-based mechanisms under the UNFCCC or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.
- ^b For the base year, information reported on the emission reduction target shall include the following: (a) total greenhouse gas (GHG) emissions, excluding emissions and removals from the LULUCF sector; (b) emissions and/or removals from the LULUCF sector, based on the accounting approach applied, taking into consideration any relevant decisions of the Conference of the Parties and the activities and/or land that will be accounted for; (c) total GHG emissions, including emissions and removals from the LULUCF sector. For each reported year, information reported on progress made towards the emission reduction targets shall include, in addition to the information noted in paragraphs 9(a–c) of the UNFCCC biennial reporting guidelines for developed country Parties, information on the use of units from market-based mechanisms.
- ^c Parties may add rows for years other than those specified below.
- ^d Information in this column should be consistent with the information reported in table 4(a)ii. The Parties for which all relevant information on the LULUCF contribution is reported in table 1 of this common tabular format can refer to table 1.
- ^e The units reported in this table are KP CP1 units as per table 3.6.

Table 3.5: Progress in achievement of the quantified economy-wide emission reduction targets: further information on mitigation actions relevant to the counting of emissions and removals from the LULUCF sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol (CTF Table 4(a)ii)a,b,c

Greenhouse gas source and sink activities	Base year ^d	Net emissions/removals ^e									Accounting parameters ^h	Accounting quantity ⁱ
		2013	2014	2015	2016	2017	2018	2019	2020	Total ^g		
		(kt CO ₂ -equivalent)										
A. Article 3.3 activities												
A.1. Afforestation/reforestation		-17,520.3	-17,913.5	-18,054.1	-18,004.8	-18,486.5	-17,741.1	-16,733.5	-14,764.7	-139,218.6		-139,218.6
Excluded emissions from natural disturbances (5)		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Excluded subsequent removals from land subject to natural disturbances (6)		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
A.2. Deforestation		8,936.6	6,657.5	4,965.3	4,442.4	2,845.7	2,319.2	3,131.8	1,320.5	34,619.1		34,619.1
B. Article 3.4 activities												
B.1. Forest management										-146,696.7		-31,982.2 ^m
Net emissions/removals ^e		-24,180.7	-21,978.2	-20,019.5	-18,515.0	-15,503.6	-15,247.1	-15,220.7	-16,031.9	-146,696.7		
Excluded emissions from natural disturbances (5)		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Excluded subsequent removals from land subject to natural disturbances (6)		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Any debits from newly established forest (CEF-ne) (7), (8)		NA	NA	NA	NA	NA	NA	NA	NA	NA		
Forest management reference level (FMRL) (9)											11,150	
Technical corrections to FMRL (10)											-25,489.3	
Forest management cap ^l											2,335.2	

Greenhouse gas source and sink activities	Base year ^d	Net emissions/removals ^e								Total ^f	Accounting parameters ^h	Accounting quantity ⁱ
		2013	2014	2015	2016	2017	2018	2019	2020			
B.2. Cropland management (if elected)		NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA		NE, NA
B.3. Grazing land management (if elected)		NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA		NE, NA
B.4. Revegetation (if elected)		NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA		NE, NA
B.5. Wetland drainage and rewetting (if elected)		NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA		NE, NA

Note: 1 kt CO₂-eq equals 1 Gg CO₂-eq; CRF = common reporting format; LULUCF = land use, land-use change and forestry; NA = not applicable; NE = not estimated.

- ^a Reporting by a developed country Party on the information specified in the common tabular format (CTF) does not prejudice the position of other Parties with regard to the treatment of units from market-based mechanisms under the UNFCCC or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.
- ^b Developed country Parties with a quantified economy-wide emission reduction target as communicated to the secretariat and contained in document FCCC/SB/2011/INF.1/Rev.1, or any update to that document, that are Parties to the Kyoto Protocol may use table 4(a)ii for reporting of accounting quantities if LULUCF is contributing to the attainment of that target.
- ^c Parties can include references to the relevant parts of the national inventory report, where accounting methodologies regarding LULUCF are further described in the documentation box or in the biennial reports.
- ^d Net emissions and removals in the Party's base year, as established by decision 9/CP.2.
- ^e All values are reported in the information table on accounting for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, of the CRF for the relevant inventory year as reported in the current submission and are automatically entered in this table.
- ^f Additional columns for relevant years should be added, if applicable.
- ^g Cumulative net emissions and removals for all years of the commitment period reported in the current submission.
- ^h The values in the cells '3.3 offset' and 'Forest management cap' are absolute values.
- ⁱ The accounting quantity is the total quantity of units to add to or subtract from a Party's assigned amount for a particular activity in accordance with the provisions of Article 7, paragraph 4, of the Kyoto Protocol.
- ^j In accordance with paragraph 4 of the annex to decision 16/CMP.1, debits resulting from harvesting during the first commitment period following afforestation and reforestation since 1990 shall not be greater than the credits accounted for on that unit of land.

- ^k In accordance with paragraph 10 of the annex to decision 16/CMP.1, for the first commitment period a Party included in Annex I that incurs a net source of emissions under the provisions of Article 3 paragraph 3 may account for anthropogenic GHG emissions by sources and removals by sinks in areas under forest management under Article 3, paragraph 4, up to a level that is equal to the net source of emissions under the provisions of Article 3, paragraph 3, but not greater than 9.0 megatonnes of carbon times five, if the total anthropogenic GHG emissions by sources and removals by sinks in the managed forest since 1990 is equal to, or larger than, the net source of emissions incurred under Article 3, paragraph 3.
- ^l In accordance with paragraph 11 of the annex to decision 16/CMP.1, for the first commitment period of the Kyoto Protocol only, additions to and subtractions from the assigned amount of a Party resulting from forest management under Article 3, paragraph 4, after the application of paragraph 10 of the annex to decision 16/CMP.1 and resulting from forest management project activities undertaken under Article 6, shall not exceed the value inscribed in the appendix of the annex to decision 16/CMP.1, times five.
- ^m The value in this cell shall not be added to or subtracted from a Party's assigned amount, as it is subject to the Forest management cap.

Table 3.6: Reporting on progress (CTF Table 4(b))

Kyoto Protocol Units ^d		2019	2020
	Quantity of units	IE, NO	6,544,585
	kt CO ₂ -e	IE, NO	6,544.585
AAUs		IE	6,544,585
ERUs		NO	NO
CERs		NO	NO
tCERs		NO	NO
ICERs		NO	NO
Units from market-based mechanisms under the UNFCCC ^e		NO	IE ^f
Units from other market-based mechanisms ^{d, e}		NO	NO
Total	Quantity of units	IE, NO	6,544,585
	kt CO ₂ -e	IE, NO	6,544.585

Note: AAUs = assigned amount units; CERs = certified emissions reductions; ERUs = emissions reduction units; IE = included elsewhere; kt CO₂-e = kilotonnes of carbon dioxide equivalent; ICERs = long-term certified emissions reductions; NO = not occurring; tCERs = temporary certified emissions reductions; UNFCCC = United Nations Framework Convention on Climate Change. New Zealand understands 'surrender' to mean retire. New Zealand retired international units in 2015 to fulfil its emissions reduction target for the first commitment period of the Kyoto Protocol. The final number of units required to fulfil our 2013–20 target will be confirmed following review of our 2022 inventory submission. New Zealand has more units available if needed to meet our target. The process New Zealand will perform in order to fulfil our emissions reduction target for 2013–20 will be to cancel the number of units needed to meet the carbon budget.

- ^a Reporting by a developed country Party on the information specified in the common tabular format (CTF) does not prejudice the position of other Parties with regard to the treatment of units from market-based mechanisms under the UNFCCC or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.
- ^b For each reported year, information reported on progress made towards the emission reduction target shall include, in addition to the information noted in paragraphs 9(a–c) of the reporting guidelines, the use of units from market-based mechanisms.
- ^c Parties may include this information as appropriate and if relevant to their target.
- ^d Units surrendered by that Party for that year that have not been previously surrendered by that or any other Party.
- ^e Another row for each market-based mechanism should be added, if applicable.
- ^f The units reported in table 3.4 are the KP AAUs reported in this table.

New Zealand will account for contributions from market-based mechanisms by cancelling a sufficient quantity of units during its target true-up (ie, after the conclusion of the individual review of *New Zealand's Greenhouse Gas Inventory* submitted in 2022).

4 Projections

Key points

- The effects of Aotearoa New Zealand’s key quantifiable policies and measures on our greenhouse gas emissions and removals are projected out to 2035.
- Three scenarios are modelled, ‘With existing measures’, ‘without measures’ and ‘with additional measures’.
- New Zealand’s gross emissions (excluding emissions and removals from the land use, land-use change and forestry (LULUCF) sector) were reported as 78.8 million tonnes of carbon dioxide equivalent (Mt CO₂-e) in 2020 (20.8 per cent above 1990 levels).
- New Zealand’s net emissions (including emissions and removals from the LULUCF sector) are reported as 55.5 Mt CO₂-e in 2020 (26.1 per cent above 1990 levels).
- Under the ‘with existing measures’ scenario (which does not capture most of the new policies in the emissions reduction plan):
 - New Zealand’s gross emissions (excluding emissions and removals from the LULUCF sector) are projected to be 66.7 Mt CO₂-e (2.3 per cent above 1990 levels) in 2035.
 - New Zealand’s net emissions (including emissions and removals from the LULUCF sector) are projected to be 41.2 Mt CO₂-e (6.3 per cent below 1990 levels) in 2035.
 - New Zealand’s net emissions are projected to be 30.7 Mt CO₂-e lower in 2035 than projected in the ‘without measures’ scenario.
- In comparison to *New Zealand’s Fourth Biennial Report* published in 2019:²¹
 - New Zealand’s gross emissions are projected to be 7.6 per cent lower in 2035 than projected in the *Fourth Biennial Report*.
 - New Zealand’s net emissions are projected to be 28.8 per cent lower in 2035 than projected in the *Fourth Biennial Report*.
- Care needs to be taken when assessing the trends in net emissions as they are strongly influenced by the harvest and growth cycles of New Zealand’s production forests, which can mask policy impacts.

4.1 Introduction

This chapter presents Aotearoa New Zealand’s projected greenhouse gas emissions and removals under the following three scenarios:²²

- ‘with existing measures’ (WEM) – currently implemented and adopted policies and measures
- ‘without measures’ (WOM) – excludes implemented, adopted and planned policies and measures

²¹ Ministry for the Environment. 2019. *New Zealand’s Fourth Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/Publications/Files/fourth-biennial-report.pdf (1 December 2019).

²² These projections do not measure progress towards New Zealand’s domestic emissions budgets or New Zealand’s first Nationally Determined Contribution under the Paris agreement, and do not take into account all of the policies in New Zealand’s first emissions reduction plan.

- ‘with additional measures’ (WAM) scenario²³ – includes *planned* policies and measures, in addition to implemented and adopted policies and measures.

Section 4.2 estimates the impacts of the three policy scenarios on New Zealand’s gross and net greenhouse gas emissions (ie, under the WEM, WOM and WAM scenarios) from 1990 to 2035, disaggregated by sector and by gas.

The projections are calibrated against estimates reported in *New Zealand’s Greenhouse Gas Inventory 1990–2020*,²⁴ alongside the historical and projected key assumptions driving the emission scenarios.

Section 4.3 discusses the combined assessed effect of policies and measures.

Changes since New Zealand’s last biennial report submission are presented in section 4.4, including a detailed breakdown by sector.

Lastly, section 4.5 presents information on the methodologies applied, as well as underlying assumptions specific to each sector and sensitivity analyses.

4.2 Projections under the United Nations Framework Convention on Climate Change

Aotearoa New Zealand’s reported (historical) and projected gross greenhouse gas emissions²⁵ are summarised in figure 4.1. Figure 4.2 summarises New Zealand’s historical and projected net greenhouse gas emissions.²⁶

The estimates for 1990–2020 are consistent with data reported in *New Zealand’s Greenhouse Gas Inventory 1990–2020*, while the estimates for 2021–35 are projections. The timing for when each policy and measure impacts each sector and scenario are provided in table 4.1.

New Zealand’s gross greenhouse gas emissions were 78.8 million tonnes of carbon dioxide equivalent (Mt CO₂-e) in 2020 (20.8 per cent above 1990 gross emissions). Under the WEM scenario, gross emissions are projected to remain steady in the short term, before decreasing to 73.3 Mt CO₂-e in 2025 and to 66.7 Mt CO₂-e in 2035 (2.3 per cent above 1990 gross emissions).

Under the WEM scenario New Zealand’s net greenhouse gas emissions are projected to increase to 63.8 Mt CO₂-e in 2025 (45.0 per cent above 1990 net emissions) before decreasing to 41.2 Mt CO₂-e (6.3 per cent below 1990 net emissions) in 2035. The increase in net emissions from 2017 to 2025 is due to higher than usual harvest rates occurring in production forests over this period. However, the LULUCF sector is expected to see a reversal in this trend from around 2025 due to the replanting of these harvested forests, and additional sequestration from projected afforestation activities. See section 4.5.5 for more information.

²³ See tables 4.1 and 4.9 for the additional policies considered in this scenario.

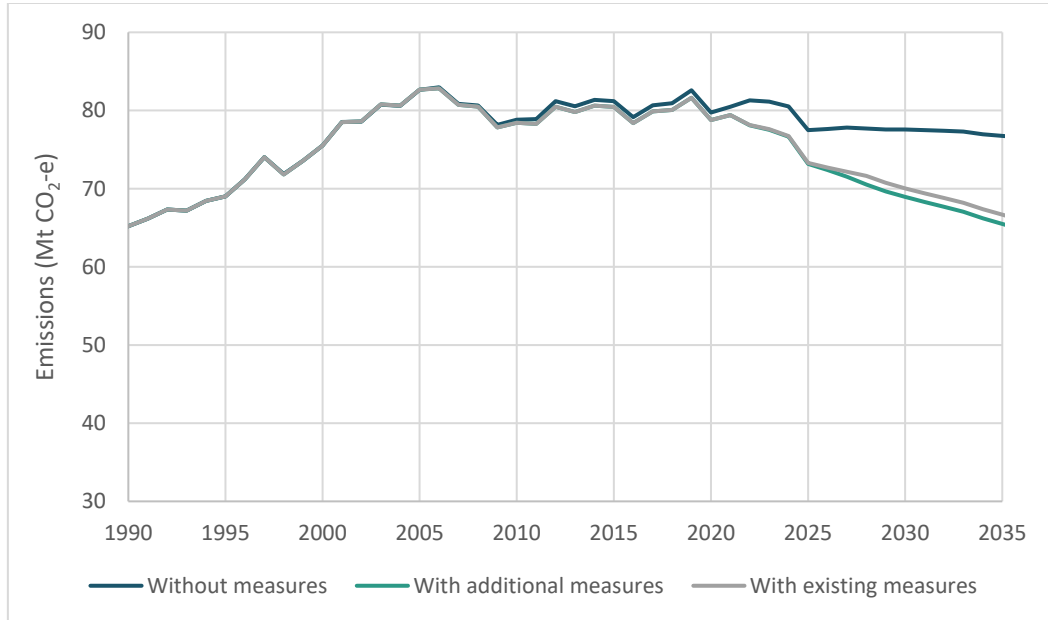
²⁴ Ministry for the Environment. 2022. *New Zealand’s Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/publications/new-zealands-greenhouse-gas-inventory-1990-2020 (18 August 2022).

²⁵ Gross emissions are New Zealand’s total emissions from Agriculture, Energy, IPPU and Waste sectors as well as gross emissions from Tokelau.

²⁶ Net emissions are made up of gross emissions combined with emissions and removals from the LULUCF sector.

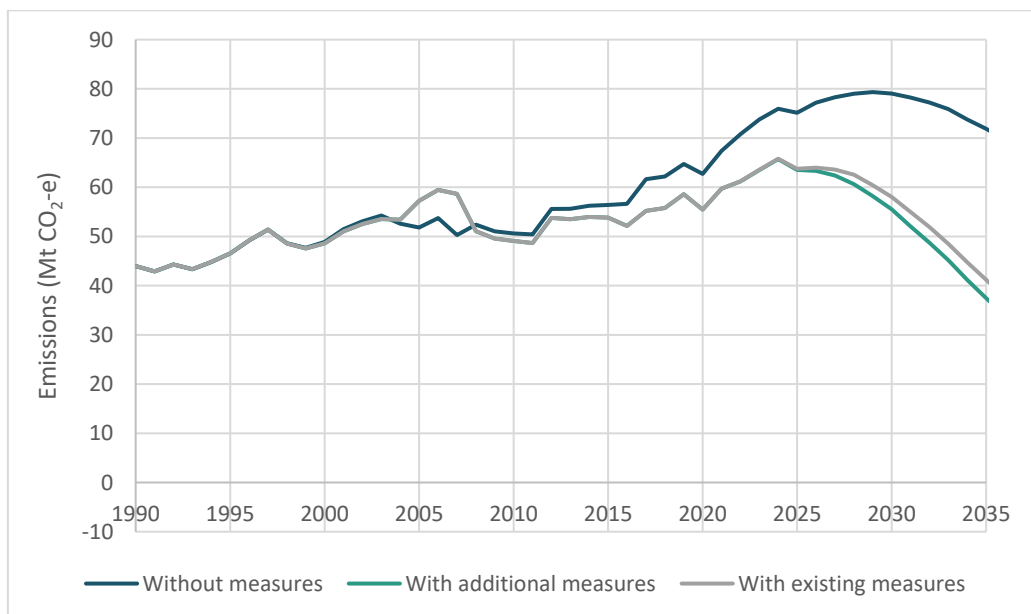
The gap between the WOM and WEM estimates shows the impact of the policies and measures introduced by the New Zealand Government on emissions. These projections do not capture most of the new policies included in New Zealand’s first emissions reduction plan, published in May 2022.

Figure 4.1: New Zealand’s gross emissions under the WEM, WOM and WAM scenarios, 1990–2035 (excluding emissions and removals from LULUCF)



Note: LULUCF = land use, land-use change and forestry; Mt CO₂-e = million tonnes of carbon dioxide equivalent; WAM = with additional measures; WEM = with existing measures; WOM = without measures. Excludes indirect emissions (such as carbon monoxide, nitrogen oxides, non-methane volatile organic compounds and sulphur oxides) and emissions from international transport.

Figure 4.2: New Zealand’s net emissions under the WEM, WOM and WAM scenarios, 1990–2035 (including emissions and removals from LULUCF)



Note: LULUCF = land use, land-use change and forestry; Mt CO₂-e = million tonnes of carbon dioxide equivalent; WAM = with additional measures; WEM = with existing measures; WOM = without measures. Excludes indirect emissions (such as carbon monoxide, nitrogen oxides, non-methane volatile organic compounds and sulphur oxides) and emissions from international transport.

4.2.1 Policies and measures considered under the WEM, WOM and WAM scenarios

Table 4.1 gives an overview of the policies and measures considered under the different scenarios. For details about each policy and measure, see chapter 3.

Table 4.1: Policies and measures included in the WEM, WOM and WAM scenarios

Policy or measure	Timeframe			WEM	WOM	WAM	Remarks
	implemented	Sector					
New Zealand Emissions Trading Scheme	2008–	Cross-sectoral ²⁷	✓			✓	Obligations for: forestry from 2008; stationary energy, industrial processes and transport from 2010; fluorinated gases from 2013; waste from 2013
GIDI ²⁸ expansion	2026–	Energy				✓	GIDI expansion from 2026
Regulatory amendment project (Energy Efficiency and Conservation Act)	2024–	Energy				✓	
Road User Charges exemptions for EVs	2012–2024, 2025	Transport	✓			✓	For light EVs until 2024, heavy EVs until 2025
Kigali Amendment to the Montreal Protocol	2020–	IPPU	✓			✓	
Proposals to prohibit imports of pre-charged equipment containing high global warming potential HFCs	2023–	IPPU				✓	
Emission pricing on agricultural emissions with 95% free allocation	2025–	Agriculture	✓			✓	Planned policy and measure
Synthetic nitrogen fertiliser cap (N-cap)	2021–	Agriculture	✓			✓	
Essential Freshwater package (excluding the impact of the N-cap)	2020–	Agriculture	✓			✓	
Afforestation Grant Scheme	2008–2018 ²⁹	LULUCF	✓			✓	

²⁷ The impact of the NZ ETS is only quantified for energy and forestry.

²⁸ Government Investment in Decarbonising Industry Fund www.eeca.govt.nz/co-funding/industry-decarbonisation/about-the-government-investment-in-decarbonising-industry-fund/

²⁹ The Afforestation Grant Scheme and Erosion Control Funding Programme were replaced by the One Billion Trees Programme in December 2018. Planned planting already funded under these schemes will continue until 2028.

Policy or measure	Timeframe implemented	Sector	WEM	WOM	WAM	Remarks
Permanent Forest Sink Initiative	2008–2021 ³⁰	LULUCF	✓		✓	
Sustainable Land Management Hill Country Erosion Programme	2009–	LULUCF	✓		✓	
Erosion Control Funding Programme ³¹	1993–2018 ³²	LULUCF	✓		✓	
One Billion Trees Programme	2018–2028	LULUCF	✓		✓	
Maximising carbon storage	2024–	LULUCF			✓	
Native afforestation initiative	2025–	LULUCF			✓	
Woody biomass	2023–	LULUCF			✓	
National Environmental Standard for Air Quality (landfill methane)	2005–	Waste	✓		✓	
Waste Disposal Levy	2010–	Waste	✓		✓	
Emissions reduction plan – existing waste sector policies	2023–	Waste	✓	✓	✓	The 'without measures' scenario does not exclude the impact of these policies
Emissions reduction plan – additional waste sector policies	2023–	Waste			✓	
Tokelau Renewable Energy Project	2012–	Tokelau	✓		✓	

Note: Under the WAM scenario, some measures are strengthened compared with the WEM scenario (see remarks column). EVs = electric vehicles; GIDI = Government Investment in Decarbonising Industry; HFCs = hydrofluorocarbons; IPPU = industrial processes and product use; LULUCF = land use, land-use change and forestry; WAM = with additional measures; WEM = with existing measures; WOM = without measures.

³⁰ The Permanent Forest Sink Initiative was discontinued at the end of 2021 and replaced with a new activity in the NZ ETS.

³¹ Impacts from the Erosion Control Funding Programme are calculated from the year following its establishment in 1992.

³² The Afforestation Grant Scheme and Erosion Control Funding Programme were replaced by the One Billion Trees Programme in December 2018. Planned planting already funded under these schemes will continue until 2028.

4.2.2 Details on scenarios

Table 4.2 provides further details on the scenarios used in the analysis.

Not all implemented policies and measures that are likely to have a significant emissions impact were able to be quantified under WEM and WAM due to data constraints, lack of certainty, and model design constraints.

Table 4.2: Details on scenarios

Scenario	Description	Notes
'With existing measures' (WEM) scenario	Currently implemented and adopted policies and measures	This scenario reflects the current state of legislation, also taking into account the stipulated strengthening of existing policies and measures (ie, any strengthening foreseen under current legislation)
'Without measures' (WOM) scenario	Excludes all implemented, adopted and planned policies and measures to the extent possible	This scenario acts as a reference scenario against which WEM and WAM can be compared
'With additional measures' (WAM) scenario	Includes <i>planned</i> policies and measures, in addition to implemented and adopted policies and measures	This scenario considers the planned strengthening of existing policies and measures, as well as new policies and measures that have been approved but are not yet implemented into law. Because only a small number of policies are approved but not in law at any one time, this is reflected in the size of the difference between WEM and WAM

4.2.3 Key assumptions and variables

An overview of the key assumptions used for modelling of the WEM, WOM and WAM scenarios is presented in table 4.3. For further key variables and assumptions used in the projections analysis (CTF table 5), please see appendix C.1 and sector-specific information in section 4.5.

Projections and their underlying assumptions are inherently uncertain. New Zealand's population and gross domestic product (GDP) are assumed to increase over the coming decades. Net migration is anticipated to be at 35,100 people per year in 2025, decreasing to 25,000 by 2035, while the New Zealand dollar (NZ\$)–United States dollar (US\$) exchange rate is assumed to remain constant at the long-term historical average of 0.65. The effective carbon price in the WEM scenario is assumed to increase from NZ\$64 in 2025 to NZ\$115 in 2035. This increase is not intended as a forecast of the expected New Zealand Unit (NZU) price, and it does not preclude future decisions that the Government is yet to agree to or adopt that may alter the NZU price.

As well as including assumptions about net migration, the labour force and the NZ\$–US\$ exchange rate, a variation of the carbon price projections was used in the energy and transport modelling, as presented in table 4.4.

Table 4.3: Summary of key assumptions for modelling New Zealand’s greenhouse gas emission projections, 1990–2035

Key underlying assumptions	Historical							Projected		
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Population (30 June, million inhabitants)	3.46	3.67	3.86	4.13	4.35	4.59	5.09	5.32	5.55	5.76
Gross domestic product (real 2009/10 NZ\$ billion)	112.7	130.5	152.1	184.1	196.7	225.3	261.9	294.2	323.9	354.0
WEM, WAM carbon price (NZ\$ tonne CO ₂ -e)							\$25	\$64	\$97	\$115
WOM carbon price (NZ\$ tonne CO ₂ -e)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

Note: CO₂-e = carbon dioxide equivalent; WAM = with additional measures; WEM = with existing measures; WOM = without measures.

Table 4.4: Summary of key assumptions for energy and transport for modelling New Zealand’s greenhouse gas emission projections, 1990–2035

Key underlying assumptions	Historical							Projected		
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Population (30 June, million inhabitants)	3.46	3.67	3.86	4.13	4.35	4.59	5.09	5.28	5.58	5.80
Gross domestic product (real 2009/10 NZ\$ billion)	112.7	130.5	152.2	184.2	196.8	225.9	253.3	291.4	325.3	351.7
Net migration (thousand people)								35.1	32.8	25
Exchange rate (NZ\$/US\$)								0.65	0.65	0.65
WEM, WAM carbon price (NZ\$ tonne CO ₂ -e)								\$82	\$140	\$167
Labour force (million people)								3.02	3.21	3.34

Note: CO₂-e = carbon dioxide equivalent; WAM = with additional measures; WEM = with existing measures.

4.2.4 Projected greenhouse gas emissions and removals

Tables 4.5 and 4.6 detail New Zealand’s greenhouse gas emissions by sector and by gas under the WEM, WOM and WAM scenarios. The information contained in these tables is the same as the information in common tabular format (CTF) tables 6a, 6b and 6c reproduced in appendix C. For New Zealand’s progress against the 2013–20 emissions reduction target, see figure 3.1 in chapter 3. Figures 4.3 and 4.4 present the WEM, WOM and WAM scenarios, disaggregated by sector and gas. Note the WAM scenario estimates what emissions would be if current policies and measures continued as assumed in the WEM scenario, agriculture was included in the New Zealand Emissions Trading Scheme (NZ ETS) with 95 per cent free allocation and the carbon price increased at a faster rate.

Table 4.5: New Zealand greenhouse gas emissions by sector, 1990–2035 (Mt CO₂-e)

Sector		Historical						Projected			
		1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Energy	WEM	15.75	15.62	18.37	21.59	18.90	18.60	18.29	13.59	12.05	10.99
	WOM	15.75	15.62	18.37	21.59	18.90	18.60	18.29	15.91	16.05	15.99
	WAM	15.75	15.62	18.37	21.59	18.90	18.60	18.29	13.59	11.34	10.49
Transport	WEM	8.13	10.25	11.65	13.06	13.35	13.81	13.18	15.11	14.80	13.75
	WOM	8.13	10.25	11.65	13.06	13.35	13.81	13.18	15.33	15.23	14.41
	WAM	8.13	10.25	11.65	13.06	13.35	13.81	13.18	15.11	14.80	13.75
IPPU	WEM	3.58	3.17	3.44	4.06	4.59	5.14	4.62	4.02	3.91	3.72
	WOM	3.58	3.18	3.45	4.04	4.56	5.13	4.61	4.25	4.22	4.10
	WAM	3.58	3.17	3.44	4.06	4.59	5.14	4.62	3.94	3.81	3.48
Agriculture	WEM	33.79	35.73	37.61	39.57	37.71	39.42	39.43	37.43	36.30	35.33
	WOM	33.79	35.73	37.61	39.57	37.71	39.56	39.82	38.23	38.35	38.60
	WAM	33.79	35.73	37.61	39.57	37.71	39.42	39.43	37.39	36.17	35.11
Waste	WEM	3.94	4.23	4.43	4.38	3.87	3.49	3.27	3.14	2.98	2.88
	WOM	3.94	4.23	4.43	4.38	4.30	4.09	3.85	3.78	3.71	3.66
	WAM	3.94	4.23	4.43	4.38	3.87	3.49	3.27	3.14	2.84	2.66
Tokelau	WEM	0.003	0.003	0.003	0.004	0.005	0.003	0.004	0.004	0.004	0.003
	WOM	0.003	0.003	0.003	0.004	0.005	0.003	0.004	0.004	0.004	0.003
	WAM	0.003	0.003	0.003	0.004	0.005	0.003	0.004	0.004	0.004	0.003
Total (excluding LULUCF)	WEM	65.20	69.01	75.52	82.67	78.43	80.45	78.78	73.29	70.04	66.68
	WOM	65.20	69.02	75.53	82.65	78.82	81.19	79.74	77.49	77.56	76.76
	WAM	65.20	69.01	75.52	82.67	78.43	80.45	78.78	73.17	68.96	65.49
LULUCF	WEM	-21.23	-22.45	-26.93	-25.42	-29.33	-26.61	-23.31	-9.53	-12.01	-25.48
	WOM	-21.23	-22.47	-26.65	-30.84	-28.21	-24.80	-17.04	-2.37	1.48	-4.86
	WAM	-21.23	-22.45	-26.93	-25.42	-29.33	-26.61	-23.31	-9.64	-13.43	-28.03
Total (including LULUCF)	WEM	43.97	46.57	48.58	57.24	49.10	53.84	55.47	63.76	58.03	41.20
	WOM	43.97	46.54	48.88	51.81	50.61	56.39	62.70	75.12	79.05	71.90
	WAM	43.97	46.57	48.58	57.24	49.10	53.84	55.47	63.53	55.53	37.46

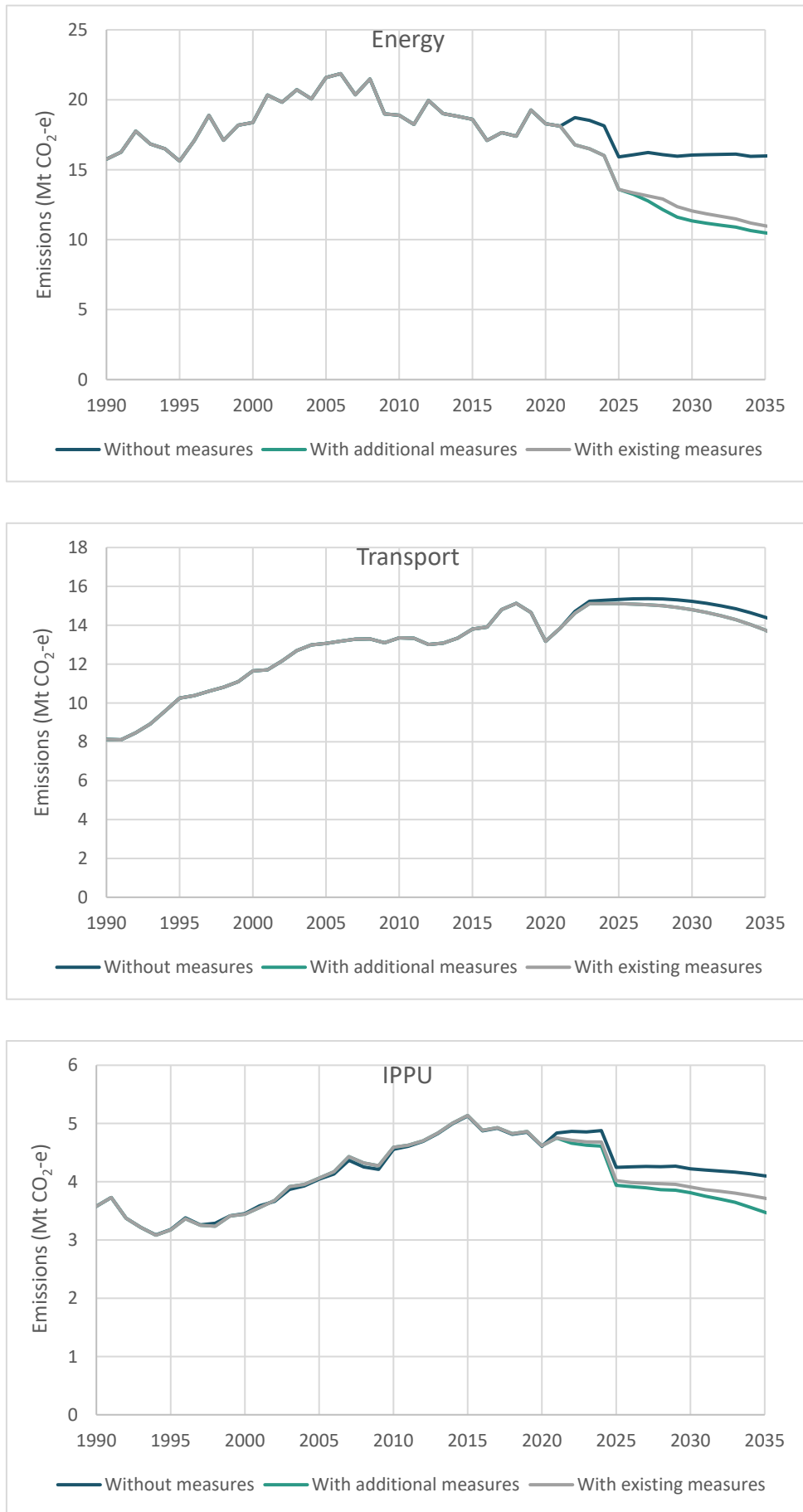
Note: IPPU = industrial processes and product use; LULUCF = land use, land-use change and forestry; Mt CO₂-e = million tonnes of carbon dioxide equivalent; WAM = with additional measures; WEM = with existing measures; WOM = without measures. Numbers may not add to totals due to rounding to two decimal places.

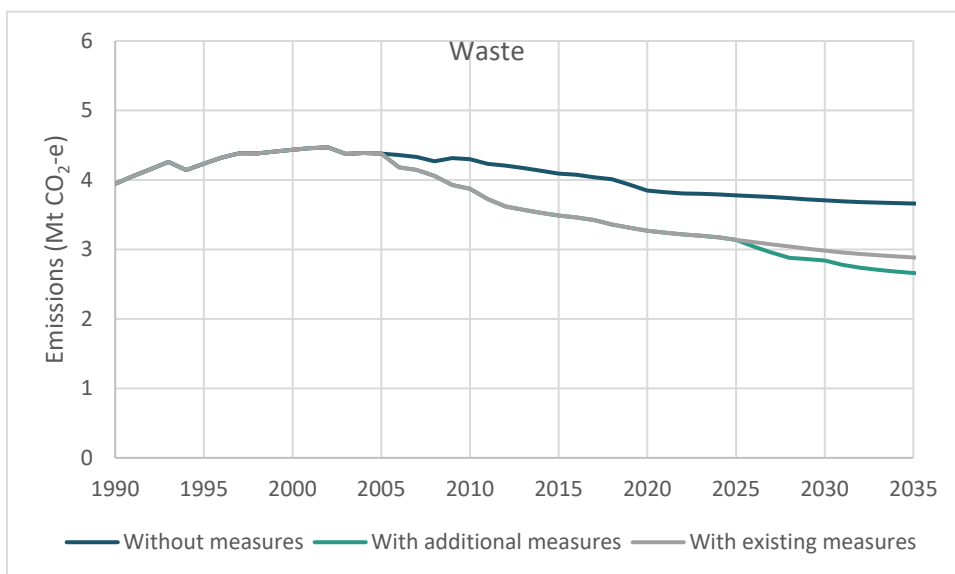
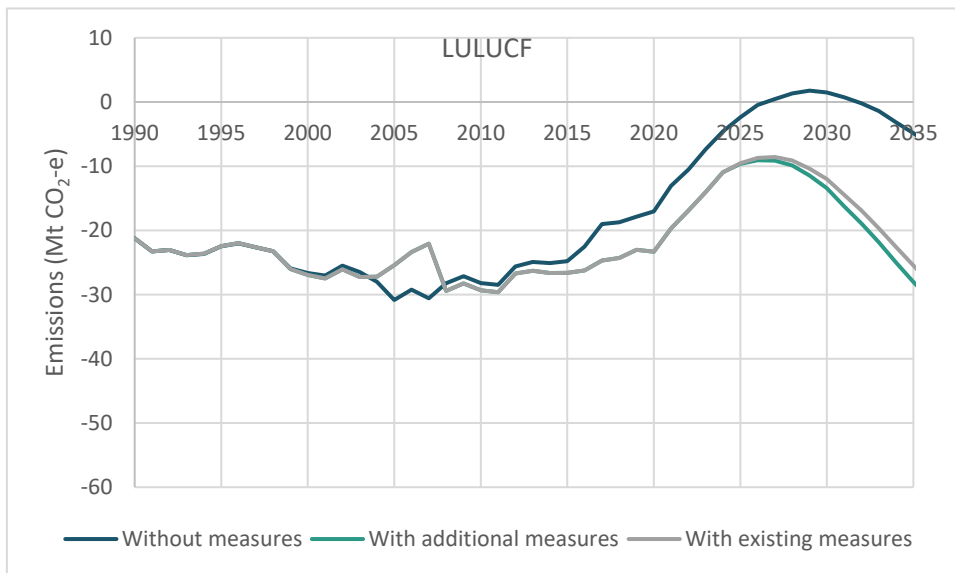
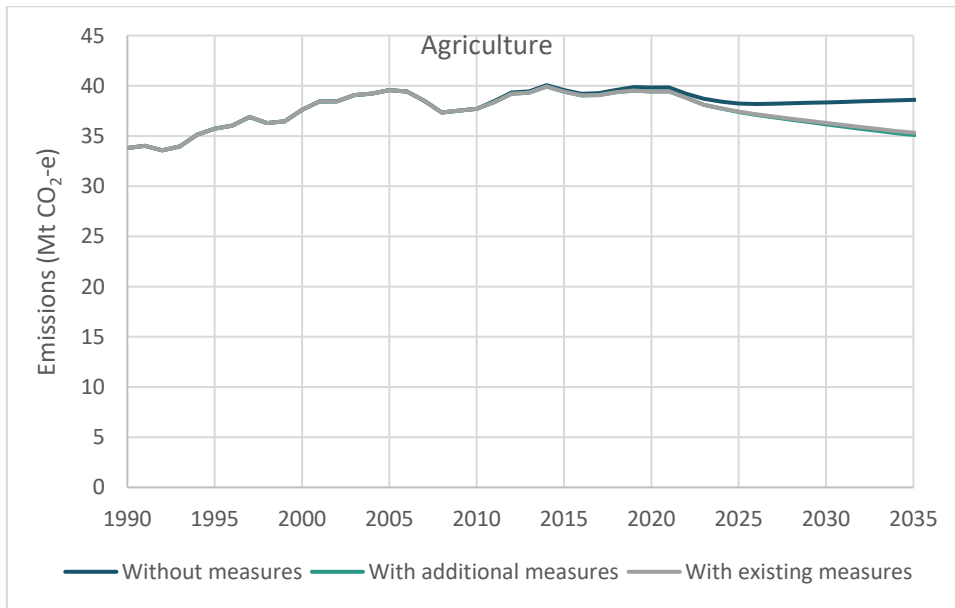
Table 4.6: New Zealand greenhouse gas emissions by gas, 1990–2035 (Mt CO₂-e)

Gas		Historical							Projected		
		1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
CO ₂	WEM	25.50	28.00	32.25	37.42	34.81	35.81	34.46	31.28	29.42	27.29
	WOM	25.50	28.00	32.25	37.42	34.81	35.81	34.46	33.81	33.86	32.99
	WAM	25.50	28.00	32.25	37.42	34.81	35.81	34.46	31.28	28.70	26.79
CH ₄	WEM	32.97	34.24	35.95	36.52	34.76	34.99	34.27	32.57	31.51	30.68
	WOM	32.97	34.24	35.95	36.52	35.19	35.72	35.19	33.89	33.88	34.03
	WAM	32.97	34.24	35.95	36.52	34.76	34.99	34.27	32.53	31.23	30.24
N ₂ O	WEM	5.79	6.57	7.00	7.93	7.68	8.19	8.46	8.12	7.89	7.68
	WOM	5.79	6.57	7.00	7.93	7.68	8.20	8.52	8.25	8.29	8.33
	WAM	5.79	6.57	7.00	7.93	7.68	8.19	8.46	8.11	7.89	7.67
HFCs	WEM	0.00	0.02	0.23	0.69	1.10	1.39	1.48	1.30	1.21	1.01
	WOM	0.00	0.03	0.24	0.68	1.07	1.38	1.47	1.53	1.52	1.39
	WAM	0.00	0.02	0.23	0.69	1.10	1.39	1.48	1.22	1.11	0.76
PFCs	WEM	0.91	0.15	0.07	0.07	0.05	0.06	0.09	0.00	0.00	0.00
	WOM	0.91	0.15	0.07	0.07	0.05	0.06	0.09	0.00	0.00	0.00
	WAM	0.91	0.15	0.07	0.07	0.05	0.06	0.09	0.00	0.00	0.00
SF ₆	WEM	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02
	WOM	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02
	WAM	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02
NF ₃		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (excluding LULUCF)	WEM	65.20	69.01	75.52	82.67	78.43	80.45	78.78	73.29	70.04	66.68
	WOM	65.20	69.02	75.53	82.65	78.82	81.19	79.74	77.49	77.56	76.76
	WAM	65.20	69.01	75.52	82.67	78.43	80.45	78.78	73.17	68.96	65.49
CO ₂ (including LULUCF)	WEM	3.88	5.10	4.83	11.49	5.04	8.83	10.79	21.40	17.05	1.47
	WOM	3.88	5.07	5.12	6.08	6.16	10.64	17.06	31.09	34.99	27.78
	WAM	3.88	5.10	4.83	11.49	5.04	8.83	10.79	21.29	14.92	-1.59
CH ₄ (including LULUCF)	WEM	33.04	34.31	36.02	36.63	34.86	35.07	34.35	32.66	31.59	30.76
	WOM	33.04	34.31	36.02	36.63	35.28	35.80	35.27	33.97	33.96	34.11
	WAM	33.04	34.31	36.02	36.63	34.86	35.07	34.35	32.62	31.32	30.33
N ₂ O (including LULUCF)	WEM	6.12	6.95	7.41	8.33	8.04	8.49	8.74	8.38	8.16	7.95
	WOM	6.12	6.95	7.41	8.33	8.04	8.50	8.79	8.52	8.55	8.60
	WAM	6.12	6.95	7.41	8.33	8.04	8.49	8.74	8.38	8.15	7.93
Total (including LULUCF)	WEM	43.97	46.57	48.58	57.24	49.10	53.84	55.47	63.76	58.03	41.20
	WOM	43.97	46.54	48.88	51.81	50.61	56.39	62.70	75.12	79.05	71.90
	WAM	43.97	46.57	48.58	57.24	49.10	53.84	55.47	63.53	55.53	37.46

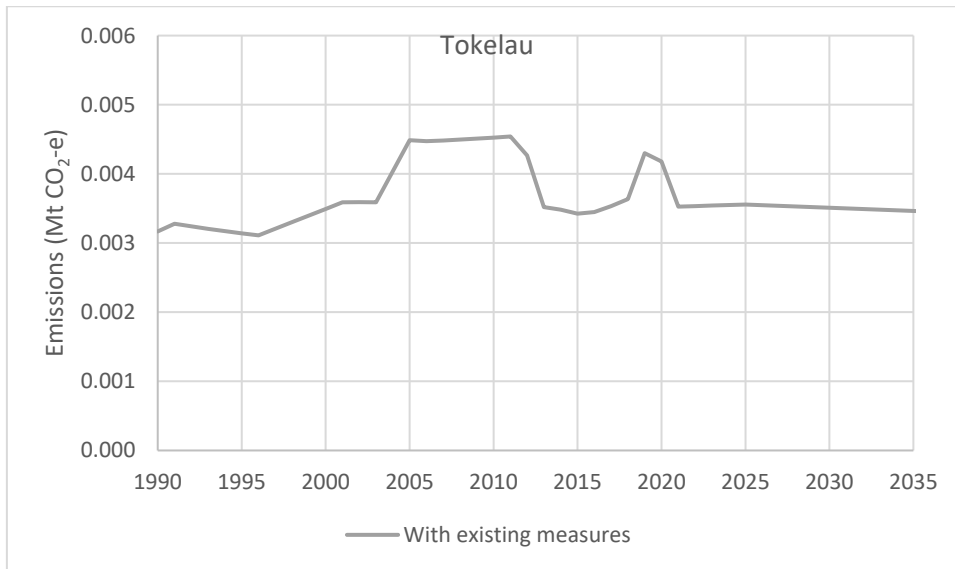
Note: CH₄ = methane; CO₂ = carbon dioxide; HFCs = hydrofluorocarbons; LULUCF = land use, land-use change and forestry; Mt CO₂-e = million tonnes of carbon dioxide equivalent; NF₃ = nitrogen trifluoride; NO = not occurring; N₂O = nitrous oxide; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride; WAM = with additional measures; WEM = with existing measures; WOM = without measures.

Figure 4.3: Greenhouse gas emissions (and removals) for the WEM, WOM and WAM scenarios by sector, 1990–2035



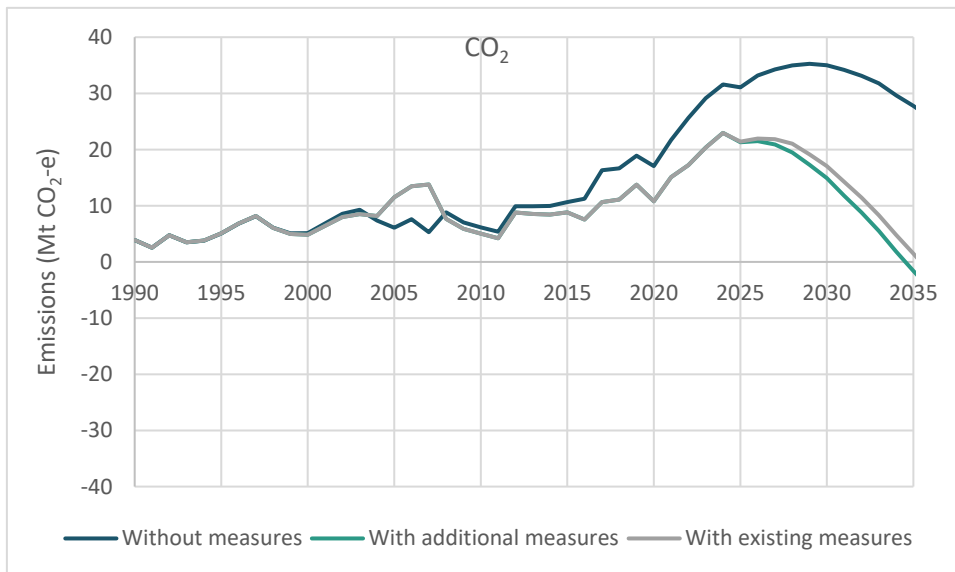


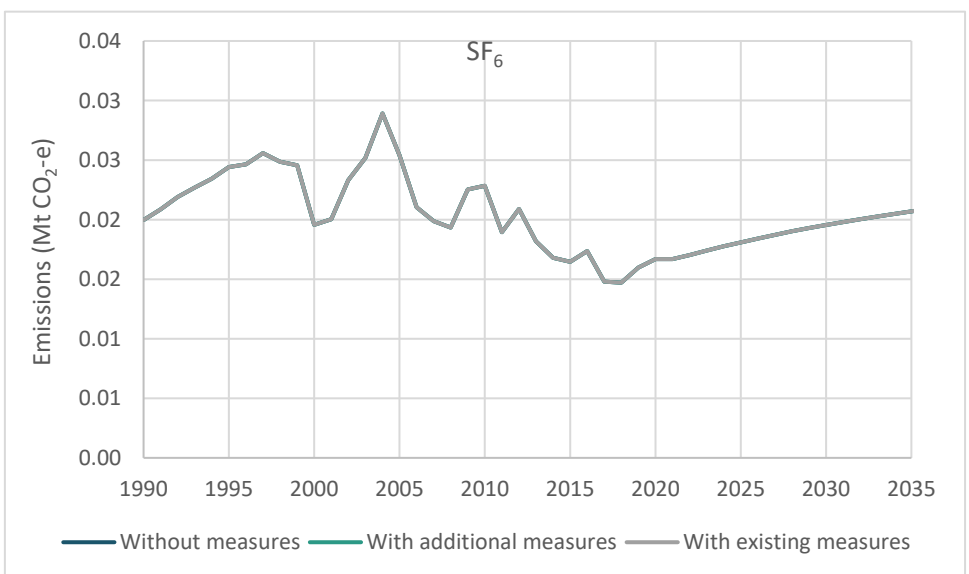
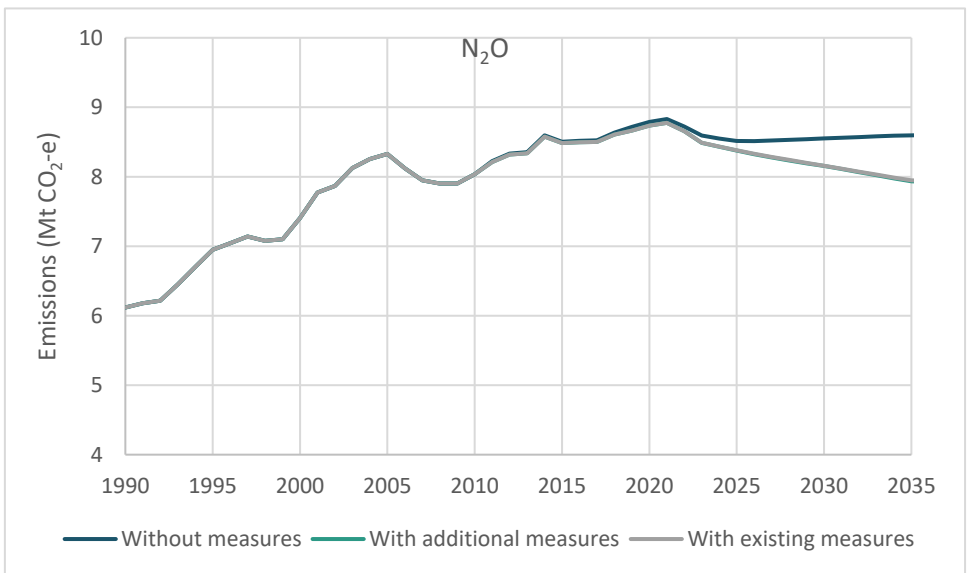
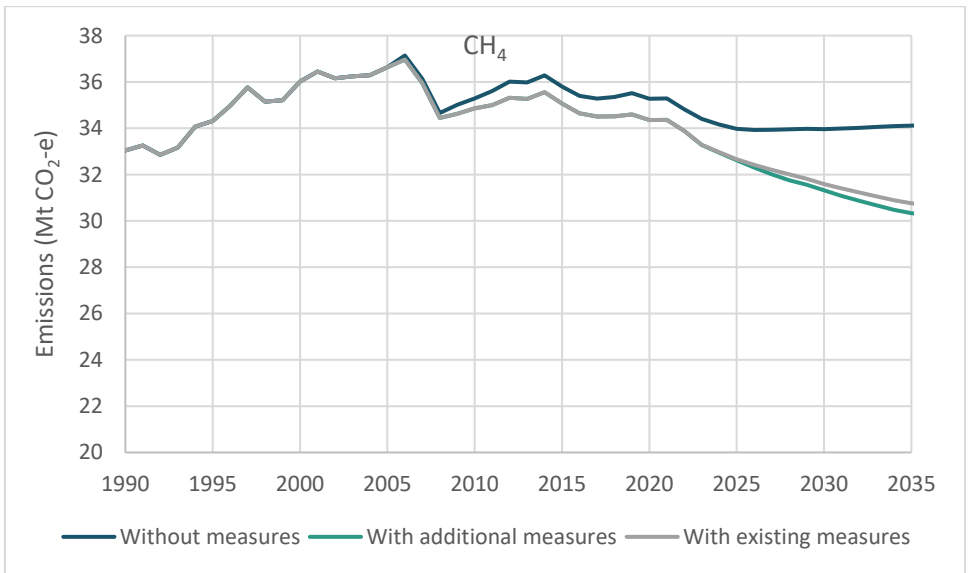
Note: The 'without measures' scenario does not exclude the impact of existing policies and measures under the emissions reduction plan for waste.

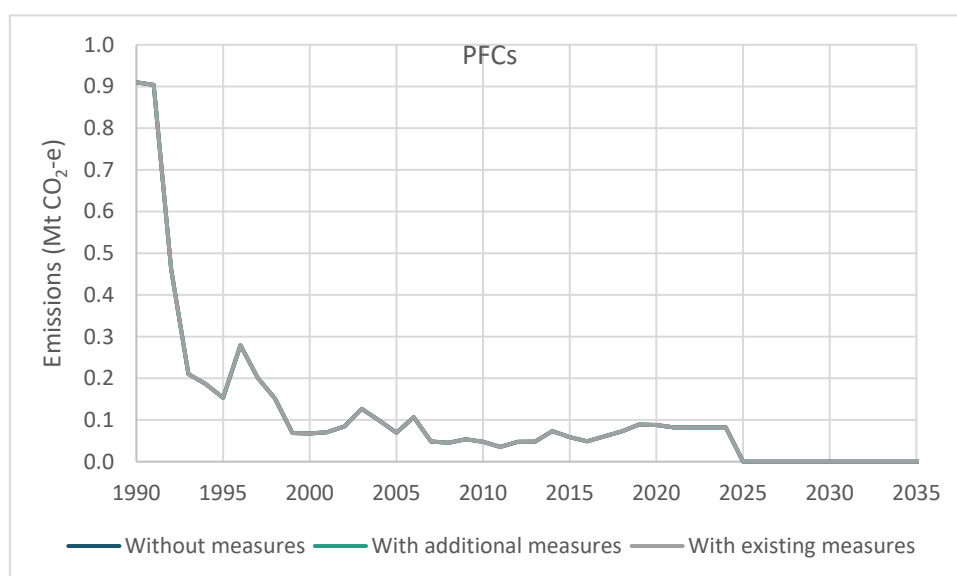
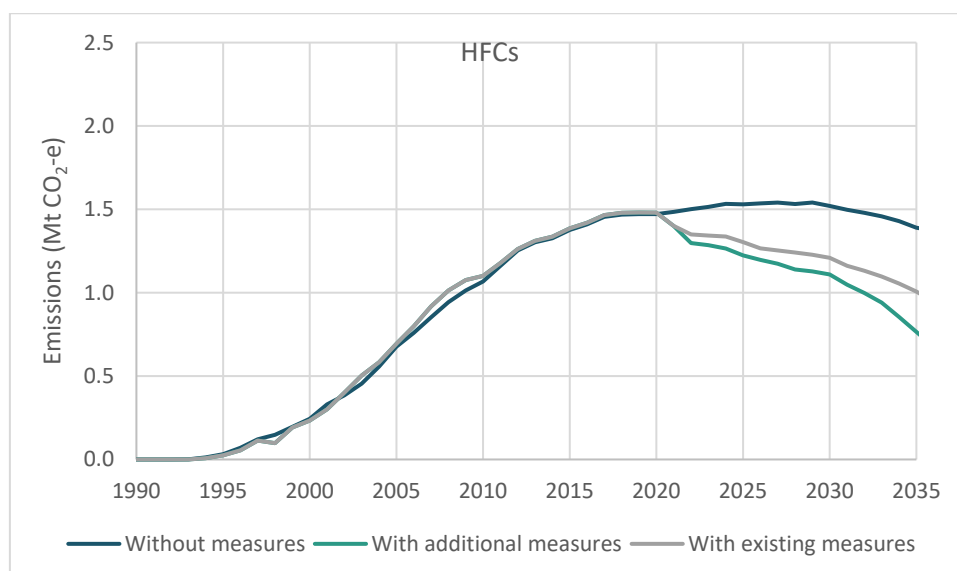


Note: y-axis varies in scale between sectors. IPPU = industrial processes and product use; LULUCF = land use, land-use change and forestry; Mt CO₂-e = million tonnes of carbon dioxide equivalent; WAM = with additional measures; WEM = with existing measures; WOM = without measures; WAM = with additional measures. Tokelau does not have WOM and WAM scenarios.

Figure 4.4: Net greenhouse gas emissions for the WEM, WOM and WAM scenarios by gas, 1990–2035







Note: y-axis varies in scale between gases. All gases are reported in million tonnes of carbon dioxide equivalent (Mt CO₂-e). CH₄ = methane; CO₂ = carbon dioxide; HFCs = hydrofluorocarbons; LULUCF = land use, land-use change and forestry; N₂O = nitrous oxide; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride; WAM = with additional measures; WEM = with existing measures; WOM = without measures.

4.3 Assessment of the total effect of policies and measures

4.3.1 Total effect of currently implemented and adopted policies and measures

The quantified effect of currently implemented and adopted policies and measures, calculated based on the difference between WOM and WEM scenarios (emissions and removals), is presented in table 4.7 by sector and table 4.8 by gas. For 2025, the total effect of currently implemented and adopted policies and measures excluding LULUCF is estimated to be a reduction of 4.2 Mt CO₂-e (annual reduction, not cumulative). When LULUCF is included, the total effect in 2025 is estimated to be 11.4 Mt CO₂-e. In 2035, the total effect of currently implemented and adopted policies and measures is estimated to be 10.1 Mt CO₂-e (30.1 Mt CO₂-e including LULUCF).

Table 4.7: Total effect of current policies and measures by sector, 1990–2035 (kt CO₂-e)

Sector	Historical							Projected		
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Energy	NA	0	0	0	0	0	0	2,323	4,002	4,996
Transport	NA	0	0	0	0	0	0	218	434	657
IPPU	NA	7	10	-18	-34	-10	-9	227	311	383
Agriculture	NA	0	0	0	0	146	396	793	2,048	3,267
LULUCF	NA	-29	286	-5,415	1,120	1,809	6,270	7,162	13,496	20,616
Waste	NA	NA	NA	0	427	603	578	639	725	776
Tokelau	NA	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total	NA	-22	296	-5,433	1,513	2,549	7,235	11,362	21,015	30,694

Note: IPPU = industrial processes and product use; kt CO₂-e = kilotonnes of carbon dioxide equivalent; LULUCF = land use, land-use change and forestry; NA = not applicable; NE = not estimated. An increase in net emissions to the atmosphere is expressed as a negative (-) while a reduction in net emissions to the atmosphere is expressed as a positive.

Table 4.8: Total effect of current policies and measures by gas, 1990–2035 (kt CO₂-e)

Gas	Historical							Projected		
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
CO ₂	NA	-29	286	-5,415	1,120	1,809	6,270	9,684	17,941	26,311
CH ₄	NA	0	0	0	427	731	919	1,317	2,370	3,352
N ₂ O	NA	0	0	0	0	18	55	134	394	648
HFCs	NA	7	10	-18	-34	-10	-9	227	311	383
PFCs	NA	NE	NE	NE	NE	NE	NE	NE	NE	NE
SF ₆	NA	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total	NA	-22	296	-5,433	1,513	2,549	7,235	11,362	21,015	30,694

Note: CH₄ = methane; CO₂ = carbon dioxide; HFCs = hydrofluorocarbons; kt CO₂-e = kilotonnes of carbon dioxide equivalent; NA = not applicable; NE = not estimated; N₂O = nitrous oxide; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride. An increase in net emissions to the atmosphere is expressed as a negative (-), while a reduction in net emissions to the atmosphere is expressed as a positive.

4.3.2 Total effect of additional policies and measures

The quantified effect of additional policies and measures, calculated based on the difference in emissions and removals between WEM and WAM scenarios emissions and removals, is presented in table 4.9 by sector and table 4.10 by gas. For 2025, the total effect of additional policies and measures including LULUCF is estimated to be a reduction of 0.2 Mt CO₂-e (annual reduction, not cumulative). In 2035, the total effect of additional policies and measures is estimated to reduce emissions by 3.7 Mt CO₂-e (1.2 Mt CO₂-e excluding LULUCF).

Table 4.9: Total effect of additional policies and measures by sector, 1990–2035 (kt CO₂-e)

Sector	1990	2020	2025	2030	2035
Energy	0	0	2	713	503
Transport	0	0	0	0	0
IPPU	0	0	79	100	242
Agriculture	0	0	42	133	222
LULUCF	0	0	105	1,414	2,557
Waste	NA	NA	0	142	223
Total	0	0	228	2,502	3,747

Note: IPPU = industrial processes and product use; kt CO₂-e = kilotonnes of carbon dioxide equivalent; LULUCF = land use, land-use change and forestry; NA = not applicable; NE = not estimated. An increase in net emissions to the atmosphere is expressed as a negative (–), while a reduction in net emissions to the atmosphere is expressed as a positive.

Table 4.10: Total effect of additional policies and measures by gas, 1990–2035 (kt CO₂-e)

Gas	1990	2020	2025	2030	2035
CO ₂	0	0	107	2,127	3,060
CH ₄	0	0	37	273	432
N ₂ O	0	0	5	3	14
HFCs	0	0	79	100	242
PFCs	0	NE	NE	NE	NE
SF ₆	0	NE	NE	NE	NE
Total	0	0	228	2,502	3,747

Note: CH₄ = methane; CO₂ = carbon dioxide; HFCs = hydrofluorocarbons; kt CO₂-e = kilotonnes of carbon dioxide equivalent; N₂O = nitrous oxide; NE = not estimated; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride.

4.4 Differences from the *Fourth Biennial Report*

Table 4.11 summarises the differences in greenhouse gas emissions projections between this report and *New Zealand's Fourth Biennial Report under the United Nations Framework Convention on Climate Change*³³ (*Fourth Biennial Report*), which was based on projections produced in 2019. The main differences between the two projections include: additional implemented and adopted policies; re-estimations of the impact of policies; and revised carbon price, population growth and economic growth assumptions.

Since the *Fourth Biennial Report*, the assumed 2025 carbon price has been revised up to NZ\$64 (138.1 per cent increase) to reflect current NZ ETS market prices, while the 2030 carbon price is 223.0 per cent higher than assumed in the *Fourth Biennial Report*. Projections of population have also been revised up, increasing from the *Fourth Biennial Report* by 0.4 per cent in 2025 and 0.4 per cent in 2030. Economic growth is assumed to be the same as in the *Fourth Biennial Report* (see table 4.11).

³³ Ministry for the Environment. 2019. *New Zealand's Fourth Biennial Report under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/Publications/Files/fourth-biennial-report.pdf (1 December 2019).

Table 4.11: Revision of assumptions since *New Zealand's Fourth Biennial Report*

Variable	Fourth Biennial Report			Fifth Biennial Report			Change (%)		
	2020	2025	2030	2020	2025	2030	2020	2025	2030
Population (millions)	5.00	5.29	5.52	5.09	5.32	5.55	1.8	0.4	0.4
GDP (real 2009/10 NZ\$ billion)	261.9	294.2	323.9	261.9	294.2	323.9	0.0	0.0	0.0
Exchange rate (NZ\$/US\$)	0.65	0.65	0.65	0.65	0.65	0.65	0.0	0.0	0.0
Effective carbon price (NZ\$ per tonne CO ₂ -e)	25.00	26.88	30.00	25.00	64.00	97.00	0.0	138.1	223.3
Effective carbon price used for energy and transport (NZ\$ tonne CO ₂ -e)	25.00	26.88	30.00	25.00	82.00	140.00	0.0	205.1	366.7

Note: CO₂-e = carbon dioxide equivalent; GDP = gross domestic product.

The projections have also been updated to include improvements to the historical inventory and other improvements to methods, emission factors and activity data. The effects of changes to the inventory are summarised in chapter 1.

The net effect of these changes is to decrease projected 2025 WEM gross emissions by 5.4 Mt CO₂-e (6.9 per cent) since the *Fourth Biennial Report*, as shown in table 4.12. The projected decrease in gross emissions is mainly due to decreased emissions projections for energy (3.0 Mt CO₂-e, 18.1 per cent). Net emissions are also projected to be 8.3 Mt CO₂-e (11.5 per cent) lower than previously forecast.

In 2030, gross emissions are projected to be 5.2 Mt CO₂-e (6.9 per cent) lower than reported in the *Fourth Biennial Report*. This reduction is primarily due to reduced emissions from energy (3.3 Mt CO₂-e, 21.4 per cent) and IPPU (1.7 Mt CO₂-e, 29.8 per cent). Net emissions are projected to be 8.0 Mt CO₂-e (12.2 per cent) lower than previously forecast.

Table 4.12: Comparison of WEM projections (including LULUCF) with *Fourth Biennial Report* (Mt CO₂-e)

Gas	Projected emissions 2025				Projected emissions 2030			
	BR4	BR5	Absolute change	Change (%)	BR4	BR5	Absolute change	Change (%)
CO ₂	28.7	21.4	-7.3	-25.3	24.1	17.1	-7.1	-29.3
CH ₄	32.5	32.7	0.2	0.6	31.5	31.6	0.1	0.4
N ₂ O	8.7	8.4	-0.3	-4.0	8.4	8.2	-0.3	-3.3
HFCs	2.1	1.3	-0.8	-38.3	2.0	1.2	-0.8	-39.0
PFCs	0.1	0.0	-0.1	-100.0	0.1	0.0	-0.1	-100.0
SF ₆	0.02	0.02	0.0	12.9	0.02	0.02	0.0	28.7
Sector								
Agriculture	36.7	37.4	0.8	2.1	35.5	36.3	0.8	2.4
Energy	16.6	13.6	-3.0	-18.1	15.3	12.1	-3.3	-21.4
IPPU	5.7	4.0	-1.7	-29.5	5.6	3.9	-1.7	-29.8
Transport	15.8	15.1	-0.7	-4.1	14.9	14.8	-0.2	-1.0
Waste	4.0	3.1	-0.9	-21.5	4.0	3.0	-1.0	-24.6
LULUCF	-6.7	-9.5	-2.9	42.7	-9.2	-12.0	-2.8	30.7
Total gross emissions	78.7	73.3	-5.4	-6.9	75.3	70.0	-5.2	-6.9
Total net emissions	72.0	63.8	-8.3	-11.5	66.1	58.0	-8.0	-12.2

Gas	Projected emissions 2035			
	BR4	BR5	Absolute change	Change (%)
CO ₂	17.0	1.5	-15.5	-91.4
CH ₄	31.1	30.8	-0.3	-1.1
N ₂ O	8.3	7.9	-0.4	-4.6
HFCs	1.4	1.0	-0.4	-27.5
PFCs	0.1	0.0	-0.1	-100.0
SF ₆	0.01	0.02	0.0	42.5
Sector				
Agriculture	35.0	35.3	0.3	0.8
Energy	14.1	11.0	-3.1	-22.0
IPPU	5.0	3.7	-1.3	-25.4
Transport	14.1	13.8	-0.4	-2.5
Waste	3.9	2.9	-1.0	-26.5
LULUCF	-14.3	-25.5	-11.2	78.4
Total gross emissions	72.2	66.7	-5.5	-7.6
Total net emissions	57.9	41.2	-16.7	-28.8

Note: BR4 = *Fourth Biennial Report*; BR5 = *Fifth Biennial Report*; CH₄ = methane; CO₂ = carbon dioxide; HFCs = hydrofluorocarbons; IPPU = industrial processes and product use; LULUCF = land use, land-use change and forestry; Mt CO₂-e = million tonnes of carbon dioxide equivalent; N₂O = nitrous oxide; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride. A decrease from BR4 to BR5 in net emissions to the atmosphere is expressed as a negative (-) in the absolute change and percentage, while an increase in net emissions to the atmosphere is expressed as a positive. Numbers may not add to totals due to rounding to one decimal place.

Sector-specific differences from the *Fourth Biennial Report* are described under their respective headings below.

4.5 Overview of methods by sector

The methodologies applied to calculate Aotearoa New Zealand's greenhouse gas emission scenarios are tailored to the particular characteristics of each sector, while using key underlying assumptions that are consistent across sectors. To provide a basic understanding of the models and approaches used, details relevant for each sector are summarised in table 4.13 and discussed in the following sections.

Table 4.13: Overview of models and approaches used to project New Zealand's greenhouse gas emissions from different sectors

Sector(s)	Gases	Type and characteristics of approach or model	Original purpose of approach or model	Strengths and weaknesses	Accounting of overlaps and synergies
Energy and transport	CO ₂ , CH ₄ , N ₂ O	Bottom-up estimates based on economic data, energy sector data and inventory models	Assessment of electricity demand and generation scenarios in New Zealand	Use of economic modelling, industry forecasts and expert opinion to generate activity data inputs and assumptions Difficulty in modelling the expected effect of	Accounts for anticipated changes in production levels across industries Does not account for changes in energy demand

Sector(s)	Gases	Type and characteristics of approach or model	Original purpose of approach or model	Strengths and weaknesses	Accounting of overlaps and synergies
				carbon prices and other policies and measures outside of the electricity sector Limited representation of potential mitigation technologies	for land use activities
Industrial processes and product use (IPPU)	CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆	Top-down estimates based on historical emissions, industry forecasts and regulation of imports of F-gases	Projection of IPPU greenhouse gases	Calculations at the level of single gases and by inventory category level	
Agriculture	CO ₂ , CH ₄ , N ₂ O	Bottom-up estimates based on economic data, agricultural data and inventory models	Projection of agricultural production	Use of economic modelling and expert opinion to generate activity data inputs Difficulty in modelling the expected effect of carbon prices	Accounts for interactions between the effects of different policies and measures
Land use, land-use change and forestry (LULUCF)	CO ₂ , CH ₄ , N ₂ O	Bottom-up modelling approach, based on historical and projected activity data to determine the impact of policies and measures	Projection of LULUCF greenhouse gas emissions and removals	Model allows for scenario building. Activity data and emission factors either based on either <i>New Zealand's Greenhouse Gas Inventory 1990–2020</i> or expert external research and analysis	Accounts for interactions between the effects of different policies and measures
Waste	CO ₂ , CH ₄ , N ₂ O	Bottom-up estimates using inventory models in line with 2006 IPCC guidelines for national greenhouse gas inventories	Greenhouse gas inventory	Calculations are consistent with the inventory at category level, requiring a full set of projections of activity data and emission factors	Policies and measures are assumed to target distinct sources of greenhouse gases
Tokelau	CO ₂ , CH ₄ , N ₂ O, HFCs	A hybrid top-down, bottom-up approach, based on historical emissions	Projection of Tokelau's emissions	Based on historical trends and prepared at the level of single gases	Policies and measures adopted by New Zealand (including the NZ ETS) do not extend to Tokelau
International transport	CO ₂ , CH ₄ , N ₂ O	Top-down estimates, based on historical emissions	Projection of international transport greenhouse gases	Based on historical trends and prepared at the level of single gases	NA

Note: CH₄ = methane; CO₂ = carbon dioxide; F-gases = fluorinated gases; HFCs = hydrofluorocarbons; IPCC = Intergovernmental Panel on Climate Change; N₂O = nitrous oxide; NA = not applicable; NZ ETS = New Zealand Emissions Trading Scheme; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride.

4.5.1 Energy

Emissions from the energy sector are anticipated to slowly decline over the medium term. Emissions are projected to decrease from 18.3 Mt CO₂-e in 2020 to 11.0 Mt CO₂-e in 2035 (table 4.14).

In the longer term, the main driver for greenhouse gas emissions from stationary energy is economic activity. Total energy demand is expected to continue to grow throughout the modelled period, but at the same time the emission intensity of energy (emissions per unit of energy delivered) is expected to decline.

Thermal baseload electricity generation is expected to be replaced mainly by a combination of wind, geothermal and gas-fired peaking plants, resulting in lower emissions. The following decommissioning schedule is currently anticipated:

- Stratford Combined Cycle Gas Turbine (380 megawatts) in 2023
- Whirinaki Diesel Peaker (155 megawatts) in 2024
- Huntly Coal Power station (400 megawatts) in 2030/31.

Manufacturing and construction is projected to remain the largest contributor to energy sector emissions, with smaller amounts coming from the primary, commercial and residential subsectors.

Table 4.14: Historical and projected energy sector emissions by gas and subsector under the ‘with existing measures’ scenario, 1990–2035 (Mt CO₂-e)

Gas	Historical							Projected		
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
CO ₂	14.6	14.4	17.0	20.2	17.3	17.5	17.5	12.7	11.2	10.1
CH ₄	1.1	1.1	1.3	1.2	1.5	0.9	0.7	0.8	0.8	0.8
N ₂ O	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Total	15.8	15.6	18.4	21.6	18.9	18.6	18.3	13.6	12.1	11.0

Note: CH₄ = methane; CO₂ = carbon dioxide; Mt CO₂-e = million tonnes of carbon dioxide equivalent; N₂O = nitrous oxide.

Methodology

The energy sector modelling system is composed of two main models: the Supply and Demand Energy Model (SADEM) and the Generation Expansion Model (GEM). SADEM performs three key functions. First, it projects energy demand for all sectors of the economy based on exogenous projections of population and economic growth, and incorporating econometric relationships based on historical relationships and observed trends of energy efficiency growth. Second, it provides a central hub to incorporate electricity supply information from GEM. Finally, it calculates projections of energy sector greenhouse gas emissions by applying emission factors.

GEM is used to project the timing and type of new-generation plant built. GEM is a long-term planning model used to study capacity expansion specifically in the New Zealand electricity sector. While it is most often used to conduct research on generation capacity expansion given a fixed transmission network, it can also be configured to simultaneously optimise generation and transmission capacity investment decisions. However, GEM only considers large-scale generation that is connected to the grid. GEM requires fuel prices and electricity demand projections from SADEM as inputs.

Electricity intensity in the residential sector is a measure of electricity used per capita. We have continued to apply our methodology and judgement on the projected trend of electricity intensity of the residential sector. In this *Fifth Biennial Report*, we assume a negative historical trend will continue, with a rate of decline in electricity intensity of around 0.8 per cent per year until 2030.

Electrification is the process of powering by electricity, changing away from end uses that have historically been met by the combustion of fossil fuels. In this *Fifth Biennial Report*, we continue to assume that some low-grade heat will be electrified. Much of this electrification can be accomplished using heat pumps that have a relatively high coefficient of performance. As a result of the electrification of process heat, about 0.7 terawatt hours of energy is switched from the combustion of fossil fuels to electricity in 2035.

Differences from the *Fourth Biennial Report*

Some minor adjustments were made to sub-modules of the model.

Strengths and weaknesses of models or approach

The GEM is technically a comprehensive model of the New Zealand electricity system. However, the model does not account for departures from assumptions underlying a perfect competition framework. GEM is formulated as a mixed integer programming (MIP) problem with a cost-minimisation objective function. Selecting from a large list of potential new generation facilities, the model determines which plant to construct and in which year each new plant is to be commissioned, all the while satisfying a number of technical, physical and economic constraints. Each potential new plant is characterised by parameters describing attributes such as location, technology, fuel type, capacity, capital cost and operating costs. The model is typically run for a series of scenarios describing possible future outcomes for factors such as demand for electricity (energy and peak), hydro and thermal fuel availability, fuel prices, plant costs, and policies such as carbon pricing, renewables targets or transmission pricing. Under each scenario, a build plan and a supporting set of prices are generated. The time horizon over which the model is operated is typically 20–40 years.

GEM is written and solved using the GAMS modelling software. Input data are supplied to the model in the form of GDX files. Model output is produced as a collection of GDX and CSV files.

SADEM projects energy demand for all sectors in the economy. However, the modelling is of the energy sector only, not of the entire economy. SADEM also has limited representation of potential mitigation technologies and their uptake in response to a carbon price. The main drivers in this modelling are exogenous (eg, GDP, oil and carbon prices), meaning that secondary effects are not modelled (eg, the potential link between oil and carbon prices and GDP is not included). Because SADEM has been developed in house, it offers the flexibility to be further modified and improved.

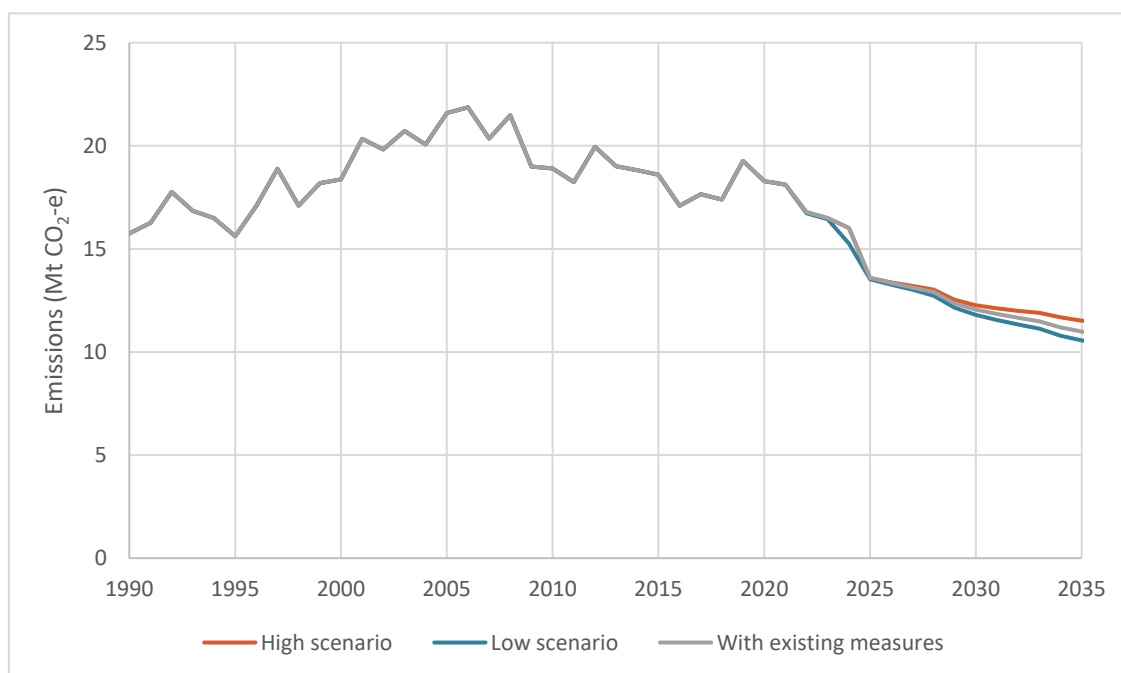
Historical emission factors are used to estimate future emissions. However, there is inherent uncertainty around the impact of new energy developments, particularly (for instance) the location and nature of future geothermal fields and the technologies used to extract and generate electricity from geothermal fluids.

Sensitivity analysis for energy emissions

To understand the potential uncertainty range of projected emissions from energy, a set of high- and low-emissions scenarios (relative to the WEM scenario) is estimated. The results from these scenarios are displayed in table 4.15 and figure 4.5.

Under a low-emissions scenario, emissions are 3.6 per cent lower than 2035 emissions in the WEM scenario. Under the high-emissions scenario, emissions are 4.0 per cent higher.

Figure 4.5: Projected energy emissions under ‘with existing measures’, high- and low-emissions scenarios (Mt CO₂-e)



Note: Mt CO₂-e = million tonnes of carbon dioxide equivalent.

Table 4.15: Projected energy emissions under ‘with existing measures’, high- and low-emissions scenarios, 1990–2035 (Mt CO₂-e)

Scenario	1990	2020	2025	2030	2035	Change from WEM in 2035 (%)
High emissions	15.8	18.1	13.6	12.3	11.5	4.5
WEM	15.8	18.3	13.6	12.1	11.0	0
Low emissions	15.8	18.3	13.5	11.8	10.6	-3.6

Note: Mt CO₂-e = million tonnes of carbon dioxide equivalent; WEM = with existing measures.

4.5.2 Transport

Emissions from transport activities are expected to rise in the short term due to growth in travel demand. They are then anticipated to plateau at 15.1 Mt CO₂-e in 2023, before declining due to the uptake of electric vehicles (EVs) (which predominantly use renewable electricity) and continued improvements in fuel efficiency for new vehicles without the implementation of any specific policy or measure. In 2035 emissions from transport are projected to be 13.8 Mt CO₂-e (table 4.16).

The New Zealand vehicle fleet is near saturation on a per capita basis. Because New Zealand has a slow rate of vehicle replacement, the vehicle fleet is older than in many other countries; consequently, fuel efficiency improvements or the uptake of EVs will take longer to have an effect in New Zealand relative to other developed countries.

Table 4.16: Historical and projected transport sector emissions by gas and subsector under the ‘with existing measures’ scenario, 1990–2035 (Mt CO₂-e)

Gas	Historical						Projected			
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
CO ₂	7.9	10.0	11.4	12.8	13.1	13.6	13.1	15.0	14.7	13.6
CH ₄	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N ₂ O	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Total	8.1	10.2	11.6	13.1	13.3	13.8	13.2	15.1	14.8	13.8

Note: CH₄ = methane; CO₂ = carbon dioxide; Mt CO₂-e = million tonnes of carbon dioxide equivalent; N₂O = nitrous oxide.

Methodology

The transport sector also incorporates the improvements that were made to the energy projections outlined above. Road transport projections were modelled using the Ministry of Transport’s Vehicle Fleet Emissions Model (VFEM)³⁴ and were informed by the latest road transport statistics and vehicle efficiency trends. VFEM uses a detailed bottom-up approach for developing the projections by considering individual road vehicle type, power type, vehicle size and age. VFEM is SAS-based and needs exogenous input data from several sources such as vehicle kilometres travelled and scrappage patterns, from which it can then project future energy use and emissions.

EVs continue to increase in popularity as car manufacturers bring new and improved models to the market or have announced plans for future models. This trend has already been incorporated into our projections, so our EV assumptions for the *Fifth Biennial Report* remain largely unchanged compared from the *Fourth Biennial Report*. We project that EVs will comprise 13.3 per cent of the light vehicle fleet and 4.0 per cent of the heavy vehicle fleet by 2035.

For more information, see appendix B.1, CTF table 5 and *Electricity Demand and Generation Scenarios: Scenario and results summary*.³⁵

Strengths and weaknesses of the models or approach

Strengths of VFEM

- VFEM uses a bottom-up approach – that is, emissions are estimated and projected at very detailed levels.
- Where possible, New Zealand-specific data are used, including on vehicle fleet mix and travel.

³⁴ Ministry of Transport. 2022. *Vehicle Fleet Emissions Model*. Retrieved from www.transport.govt.nz/assets/Uploads/Data/Transport-outlook-updated/Vehicle-Fleet-Emissions-Model-Documentation-20220608.pdf (22 November 2022).

³⁵ Ministry of Business, Innovation and Employment. 2019. *Electricity Demand and Generation Scenarios: Scenario and Results Summary*. Wellington: Ministry of Business, Innovation and Employment. Retrieved from www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-modelling/electricity-demand-and-generation-scenarios/ (24 September 2019).

- In particular, real-world fuel use data in New Zealand are used.
- The model incorporates a high degree of expert judgement where possible.

Weaknesses of VFEM

- Due to the long time horizon, large uncertainty might be associated with its long-term projections.
- This is particularly true for projections for uptake of EV heavy vehicles resulting from limited data and information available.
- Given the complex structure of the model, it may not be easy to project the impacts of some interventions.

Due to time and capacity constraints, some existing interventions could not be included in this *Fifth Biennial Report*, for example clean car policies. The Ministry of Transport plans to include more measures in the modelling work for future reporting.

4.5.3 Industrial processes and product use

In New Zealand, carbon dioxide (CO₂) emissions from IPPU result from the manufacture of iron, steel, aluminium, urea, cement, lime and hydrogen, as well as from the production of methanol. Large-scale manufacturing in New Zealand is dominated by a small number of firms. As a result, projections from these sources are subject to an unusually high degree of variability because small changes in one firm (or a closure) will significantly affect the total emissions. Many of these industries are assumed to be at or near production capacity, so their emissions are projected to remain constant unless a closure date for a particular site is assumed.

Emissions from the IPPU sector are projected to generally steadily decrease from 4.6 Mt CO₂-e in 2020 to 3.7 Mt CO₂-e in 2035 (table 4.17). However, a significant step change is expected with the closure of New Zealand's sole aluminium smelter at Tiwai Point, which would reduce emissions by 0.6 Mt CO₂-e (a 0.5 Mt reduction in CO₂ emissions and a 0.1 Mt CO₂-e reduction in PFC emissions). It has been assumed this closure will occur in 2024, as publicly announced by the smelter's owner in 2021. There is still a reasonable level of uncertainty around whether the smelter will close or continue to operate because in 2022 the smelter's owner issued a statement that it now saw a viable future for the smelter to continue operating beyond 2024. Emissions of perfluorocarbons (PFCs) are also expected to stop occurring in New Zealand with the closure of the aluminium smelter.

Aside from the reductions anticipated through the closure of the aluminium smelter, CO₂ emissions are expected to remain relatively constant from the IPPU sector.

The non-CO₂-based components of IPPU include emissions of hydrofluorocarbons (HFCs), PFCs, sulphur hexafluoride (SF₆) used in electricity transmission and distribution, and methane (CH₄) from the production of methanol, as well as nitrous oxide (N₂O) emissions from the application and use of medical products. Emissions of nitrogen trifluoride (NF₃) do not occur in New Zealand, because the industries that could be potential sources of the gas do not exist in the country and no nitrogen trifluoride is imported.

The emissions from methanol production are expected to step down to zero by 2040 as all methanol production facilities are anticipated to be closed by 2040. The emissions from SF₆ and N₂O are expected to slowly increase out to 2050 but remain at relatively low levels.

Emissions of PFCs declined during the 1990s as a result of the Tiwai Point aluminium smelter making changes to its processing and control methods. The smelter also closed one of its four potlines in 2012 and then re-opened it in 2018, which is likely to have caused variation in perfluorocarbon emissions from aluminium processing.

Hydrofluorocarbon emissions are expected to have reached a peak level at around 1.5 Mt CO₂-e from 2017 to 2020. Starting in 2021, HFC emissions are then expected to steadily decline, reaching 1.0 CO₂-e Mt in 2035 and 0.6 CO₂-e Mt in 2050. The use of HFCs has grown rapidly since the early 1990s when they replaced chlorofluorocarbons, which are being phased out under the Montreal Protocol. The phase-down of HFC consumption in New Zealand is expected to reduce HFC emissions in line with the Kigali Amendment to the Montreal Protocol.³⁶ The HFC phase-down, likely along with the recently increased NZ ETS price, has already started to have an impact on HFC consumption, which in turn is expected to impact emissions. Note that New Zealand’s ratification of the Kigali Amendment does not extend to Tokelau.³⁷

As the NZ ETS price has recently increased substantially, it has become evident that NZ ETS pricing has had a major impact on a few sectors that use HFCs while having no significant impact on most other sectors. The combination of NZ ETS pricing, Kigali Amendment phase-down and particularly international shifts in equipment design to use lower global warming potential alternatives are expected to have a significant impact on driving reductions in emissions from HFCs in all sectors. The expected level of impact is highly uncertain in each user sector, and it is not possible to separately attribute the impacts of NZ ETS pricing, Kigali Amendment phase-down and international technology shifts.

Table 4.17: Historical and projected IPPU emissions by gas under the ‘with existing measures’ scenario, 1990–2035 (kt CO₂-e)

Gas	Historical							Projections		
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
CO ₂	2,520	2,814	2,922	3,209	3,319	3,510	2,864	2,547	2,551	2,554
CH ₄	28	79	139	20	48	107	96	58	29	29
N ₂ O	102	79	61	45	53	60	74	94	101	107
HFCs	0	25	234	694	1,101	1,386	1,480	1,303	1,209	1,006
PFCs	910	153	68	69	48	59	88	0	0	0
SF ₆	20	24	20	25	23	16	17	18	20	21
NF ₃	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total	3,580	3,174	3,443	4,062	4,591	5,137	4,618	4,020	3,910	3,718

Note: CH₄ = methane; CO₂ = carbon dioxide; HFCs = hydrofluorocarbons; IPPU = industrial processes and product use; kt CO₂-e = kilotonnes of carbon dioxide equivalent; N₂O = nitrous oxide; NF₃ = nitrogen trifluoride; NO = not occurring; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride.

³⁶ Ministry for the Environment. nd. *Kigali Amendment to the Montreal Protocol*. Retrieved from environment.govt.nz/what-government-is-doing/international-action/vienna-convention-and-montreal-protocol/kigali-amendment-to-the-montreal-protocol/ (22 November 2022).

³⁷ United Nations. 2019, 3 October. Amendment to the Montreal Protocol on substances that deplete the ozone layer, New Zealand: Territorial exclusion in respect of Tokelau. Retrieved from <https://treaties.un.org/doc/Publication/CN/2019/CN.490.2019-Eng.pdf> (5 November 2019).

Methodology

The CO₂, CH₄ and PFC emissions projections are estimated largely by holding emissions constant where facilities are assumed to be at production capacity and reducing emissions when site closures are expected to occur. The methanol production facilities Motunui 1 and Motunui 2 plants are assumed to close in 2030 and 2040 respectively, while the Waitara Valley Plant (idled in 2021) is assumed to stay closed.

Projected emissions of SF₆ and N₂O were modelled from forecast activity informed by historical trends and relationships to population and economic growth.

Projections of HFC emissions were prepared through an assessment of the volume and composition of the stockpile of HFC gases in New Zealand and estimates on New Zealand's projected drawdown, reuse, destruction and emissions of those gases. This assessment considered historical trends and analysis on the impact of the Kigali Amendment phase-down, international equipment changes resulting from European Union fluorinated gas regulations, emissions pricing, stakeholder transition plans and likely new technology shifts.

For HFC emissions, the WOM scenario does not include any impact from the Kigali Amendment phase-down and assumes no NZ ETS price, as well as negligible recycled imports, and only includes internationally driven technology shifts. The WAM scenario includes additional estimated impacts of proposals to prohibit imports of pre-charged equipment containing high global warming potential HFCs and increased recovery rates resulting from competition to be included in regulations for the refrigerant recovery sector.

The key assumptions for each HFC emissions scenario are outlined in table 4.18.

Table 4.18: Summary of IPPU key assumptions applied to the scenarios

Key underlying assumptions	Unit	Scenarios	2025	2030	2035
Upper limit in importation of new HFCs	Percentage of 1,796 kt CO ₂ -e baseline*	WEM/WAM/High/Low	47.7%	29.8%	19.4%
GWP limits on new pre-charged equipment		WEM/High/Low	NA	NA	NA
		WAM	Yes	Yes	Yes
Refrigerants recovery rate	Percentage of retired volumes	WEM	9%	10%	12%
		High	9%	12%	14%
		Low	9%	10%	11%
		WAM	12%	12%	18%

Note: *Ozone Layer Protection Act 1996 regulations as at 10 December 2018, Schedules 6+1AA, relating to a High Court amendment. GWP = global warming potential; HFCs = hydrofluorocarbons; IPPU = industrial processes and product use; kt CO₂-e = kilotonnes of carbon dioxide equivalent; WAM = with additional measures; WEM = with existing measures.

Estimated impact of 'additional measures' on HFC emissions

Two significant policy changes are planned to reduce HFC emissions as part of New Zealand's first emissions reduction plan, although the details and timing have yet to be confirmed. The WAM scenario shows a major impact in the timing of stocks and emissions because of the sharp global warming potential deadlines for new equipment as currently proposed and also a smaller impact from competition in the refrigerant recovery sector. The combined impact of these WAM policies would reduce 2035 HFC emissions in the WEM scenario by 24.0 per cent, but more significantly they would reduce 2050 HFC emissions by 83.0 per cent.

Strengths and weaknesses of models or approach

The compilation of HFC emissions includes a highly detailed assessment process for different sectors and uses of HFCs. The approach used is a considerable revision and improvement from previously prepared projections. However, there is still a high level of uncertainty as there are many interacting factors, limited domestic and international evidence, and a significant ongoing policy programme to address HFC emissions.

The mitigation impact of emissions pricing under the NZ ETS is not quantified for non-HFC IPPU emissions beyond the extent that a rising NZ ETS price may be a contributing factor to anticipated specific site closures. This includes the estimated mitigation impact of the phase-down of free allocation of units to large trade-exposed industrial emitters within the NZ ETS.

The assumption around the anticipated closure of New Zealand's sole aluminium smelter is consistent with the assumptions made in the preparation of the energy sector projections.

Historically, imports and exports of bulk HFCs and equipment containing HFCs have fluctuated significantly year to year. For example, stockpiling of bulk imported F-gases is suspected to have occurred from 2010 to 2012, before the January 2013 introduction of F-gases into the NZ ETS, and around 2016 to 2017 in response to increasing NZ ETS prices and the prospect of a Kigali Amendment phase-down permit system. These types of fluctuations distort year-to-year importation and consumption data that are used to inform historical and projected IPPU emissions.

The impact of a rising NZ ETS price for the WEM and WAM scenarios has been assessed for different refrigeration sectors for HFCs. However, these impacts are highly uncertain as there is a limited evidence base for the elasticity of refrigerant usage with respect to an emissions price.

Projected PFC, SF₆, CH₄, N₂O and CO₂ greenhouse gas emissions are unchanged in the WOM and WAM scenarios relative to the WEM scenario. This is due to insufficient information about the historical and future impact of carbon price on the emissions of these gases.

Differences from the *Fourth Biennial Report*

Several improvements and updated assumptions have been made to the model for HFC emissions, including updated NZ ETS price pathway assumptions and quantification of the impact that NZ ETS pricing has on HFC emissions. Other improvements include changes to reflect the latest activity data and revised projections of activity data such as adjustments to the level of refrigerant reuse in some sectors, which has been observed to be increasing. This better understanding has resulted in a 39 per cent drop in emissions in the HFC projection for 2030 compared with the *Fourth Biennial Report*.

Updated assumptions of anticipated specific industrial site closures have been included in these IPPU projections. This improved understanding has significantly impacted projected emissions from aluminium production (largely CO₂ and PFCs) and impacted the projected pathway for methanol production emissions (largely CH₄).

Sensitivity analysis for IPPU emissions

To understand the potential uncertainty range of projected emissions from hydrofluorocarbons, a set of high and low emissions scenarios (relative to the WEM scenario) is estimated for HFC emissions. The low- and high-emissions scenarios estimate the impacts of respectively high

and low NZ ETS price pathways on technology shifts and maintenance (leakage rates) for each sector compared with the WEM scenario. In contrast to the scenarios developed for the *Fourth Biennial Report*, these scenarios do not include impacts from low and high GDP growth. No additional scenarios have been projected for emissions from other IPPU gases.

Under a low-emissions scenario, HFC emissions are 5.4 per cent lower than 2035 emissions in the WEM scenario. Under the high-emissions scenario, emissions are 4.9 per cent higher. For the total IPPU sector, these estimates are respectively 1.5 per cent lower and 1.3 per cent higher.

Sensitivity analysis has been carried out to highlight the importance of the average 15-year residence time of HFCs in most refrigeration and air-conditioning equipment. A 10-year residence time, representing a faster transition to lower global warming potential technologies, would reduce 2035 HFC emissions in the WEM scenario by 26.1 per cent. A 20-year residence time, perhaps representing a slower transition where equipment operators extend the useful lifetime because of the high capital cost of shifting to lower global warming potential technologies, would increase 2035 HFC emissions in the WEM scenario by 11.7 per cent.

4.5.4 Agriculture

In 2035, greenhouse gas emissions from agriculture are projected to be 35.3 Mt CO₂-e (4.3 per cent above 1990 levels, 10.7 per cent below 2005 levels and 10.4 per cent below 2020 levels). Table 4.19 presents historical and projected emissions for the agriculture sector.

Agricultural emissions in New Zealand are projected to fall between 2020 and 2035 due to:

- a continued decline in the amount of land used for agriculture, including a decrease in the dairy cow population and a continued decline in the sheep and beef populations
- an increased focus on afforestation and reduced incentive to deforest, as a result of government schemes and policies such as the NZ ETS
- changes in farm management practices due to improving environmental outcomes and the implementation of the Essential Freshwater package,³⁸ a cap on synthetic nitrogen fertiliser use³⁹ and the introduction of pricing on agricultural emissions through He Waka Eke Noa – Primary Sector Climate Action Partnership⁴⁰
- continued reductions in emissions intensity (emissions per unit of product) as a result of ongoing improvements in animal productivity and on-farm efficiency. (Based on past performance trends, it is projected that per-dairy cow milk production will increase by 10.3 per cent and per-lamb carcass weights will increase by 8.4 per cent.)

³⁸ Ministry for Primary Industries. Protecting freshwater health. Retrieved from www.mpi.govt.nz/agriculture/farm-management-the-environment-and-land-use/protecting-freshwater-health/ (22 November 2022).

³⁹ Ministry for the Environment. Synthetic nitrogen fertiliser cap. Retrieved from environment.govt.nz/acts-and-regulations/freshwater-implementation-guidance/agriculture-and-horticulture/synthetic-nitrogen-fertiliser-cap-in-place-from-1-july/ (22 November 2022).

⁴⁰ He Waka Eke Noa. Retrieved from hewakaekenoa.nz/ (22 November 2022).

Table 4.19: Historical and projected agriculture sector emissions by gas under the ‘with existing measures’ scenario, 1990–2035 (Mt CO₂-e)

Gas	Historical						Projected			
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
CO ₂	0.34	0.58	0.79	1.06	0.96	1.05	0.95	0.97	0.94	0.91
CH ₄	28.10	29.04	30.32	31.10	29.55	30.66	30.47	28.86	28.00	27.28
N ₂ O	5.36	6.11	6.51	7.41	7.20	7.70	8.00	7.59	7.35	7.14
Total	33.79	35.73	37.61	39.57	37.71	39.42	39.43	37.43	36.30	35.33

Note: CH₄ = methane; CO₂ = carbon dioxide; Mt CO₂-e = million tonnes of carbon dioxide equivalent; N₂O = nitrous oxide.

Methodology

Forecasts of future agricultural activity were estimated using a number of modelling tools and assumptions, then inserted into the agricultural greenhouse gas inventory model to obtain emissions projections out to 2035. Emission projections use the same methodology and country-specific emission factors used in the compilation of *New Zealand’s Greenhouse Gas Inventory 1990–2020*,⁴¹ sometimes referred to as New Zealand’s National Inventory Report.

Assumptions for productivity, animal population, land use and crop production for the WEM scenario have been informed through consultation with literature, experts and representatives from the major industry bodies.

Productivity inputs for the four major livestock categories (dairy, sheep, beef and deer) are modelled by an internal projections model, the Pastoral Supply Response Model (PSRM), which is also used for the *Situation and Outlook for Primary Industries* quarterly reports. For more information, see appendix B.2.

Table 4.20 summarises the changes in emissions, animal numbers, and production that are projected between 2020 and 2035. In the dairy sector, emissions are projected to decrease by 6.0 per cent, while total milk production is projected to decrease by 4.7 per cent. Sheep emissions are projected to fall by 15.1 per cent by 2035, while total sheep *meat* production is expected to fall by 14.4 per cent over the same period.

⁴¹ Ministry for the Environment. 2022. *New Zealand’s Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/publications/GhG-Inventory/New-Zealand-Greenhouse-Gas-Inventory-1990-2020-Chapters-1-15.pdf (26 July 2022).

Table 4.20: Projected change in emissions, production and animal numbers between 2020 and 2035 under a 'with existing measures' scenario for dairy, sheep and beef sectors

Projected change in emissions by activity (kt CO ₂ -e)			
	Dairy	Beef	Sheep
2020	18,481.78	7,101.98	9,308.17
2035	17,371.52	6,055.07	7,906.29
Change 2020–35 (%)	–6.0 %	–14.7 %	–15.1 %
Projected change in total production			
	Total dairy milk production (million litres)	Total beef meat production (million kg)*	Total sheep meat production (million kg)**
2020	21,148.49	207.12	92.83
2035	20,149.28	188.00	75.68
Change 2020–35 (%)	–4.7 %	–9.2 %	–18.5 %
Projected change in animal numbers (thousands)			
	Dairy cattle	Beef cattle	Sheep
2020	6,361.40	3,889.99	26,821.85
2035	5,708.64	3,272.62	21,074.85
Change 2020–35 (%)	–10.3 %	–15.9 %	–21.4 %

Note: * Includes meat from adult beef cattle, heifers, steers and bulls. ** Includes mutton and lamb. kg = kilogram; kt CO₂-e = kilotonnes of carbon dioxide equivalent.

Differences from the *Fourth Biennial Report*

The differences between the projected emissions and removals in the *Fourth Biennial Report*⁴² and the *Fifth Biennial Report* for the agriculture sector are due to improvements in methodologies, emission factors and projections of future agricultural activity.

The new WEM projections have altered the expected effects of implementing the National Policy Statement for Freshwater Management (NPS-FM)⁴³ and the effects of forestry policies and schemes on agricultural land use. Some of the more significant changes are summarised below. More detailed explanations on methodological and emission factor changes are contained in New Zealand's greenhouse gas inventories from 2020 to 2022.⁴⁴

⁴² Ministry for the Environment. 2019. *New Zealand's Fourth Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/Publications/Files/fourth-biennial-report.pdf (26 July 2020).

⁴³ New Zealand Government. 2020. *National Policy Statement for Freshwater Management 2020*. Wellington: New Zealand Government.

⁴⁴ Ministry for the Environment. 2020. *New Zealand's Greenhouse Gas Inventory 1990–2018*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/Publications/Files/new-zealands-greenhouse-gas-inventory-1990-2018-vol-1.pdf (22 November 2022). Ministry for the Environment. 2021. *New Zealand's Greenhouse Gas Inventory 1990–2019*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/Publications/New-Zealands-Greenhouse-Gas-Inventory-1990-2019-Volume-1-Chapters-1-15.pdf (22 November 2022). Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/publications/GhG-Inventory/New-Zealand-Greenhouse-Gas-Inventory-1990-2020-Chapters-1-15.pdf (26 July 2022).

Changes in methodologies and emission factors

The following changes to New Zealand's agriculture inventory were implemented after the publication of the *Fourth Biennial Report*.⁴⁵

- use of revised activity data for the proportion of dairy goats in the overall farmed goat population
- improvements to the equations used to estimate energy efficiency for maintenance for cattle, sheep and deer
- revised N₂O emission factors for livestock excreta, as well as an updated methodology for allocating excreta to different hill slopes
- a minor correction to the sheep nitrogen excretion calculations
- updated values for pasture quality for Tier 2 livestock categories
- updating the activity data for organic soils
- refining estimates of nitrogen leaching for cropping systems
- updating the assumptions regarding the purity of agricultural lime.

Projections of future agricultural activity

Differences in emissions projections are also due to recent improvements in the PSRM (eg, new data, equations and assumptions), which is used to provide projections of agricultural activity data. This also includes more recent afforestation data, which are assumed to displace agricultural livestock. Recent projections from this model now have a small decrease for future dairy production, compared with projections used in previous national communications and biennial reports.

By combining PSRM projections with assumptions on the effect of the NPS-FM, agricultural pricing and the cap on synthetic nitrogen fertilisers, it is projected that dairy cattle populations will decline due to constraints on land availability and the introduction of water quality objectives. Sheep and beef populations will also continue to decline.

Effect of policy measures

The new WEM projection in this report has updated the expected effects of the NPS-FM based on discussions with subject matter experts. It also included an analysis on the expected impact of the cap on synthetic nitrogen fertiliser, based on farm-level data across New Zealand. It is expected that the combinations of these measures will act to reduce animal numbers and subsequently reduce production.

⁴⁵ Ministry for the Environment. 2019. *New Zealand's Fourth Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/Publications/Files/fourth-biennial-report.pdf (26 July 2020).

The new projections also account for the expected indirect effects of government schemes and policies that encourage afforestation. The WEM projections also assume that agricultural emissions will be priced via the NZ ETS backstop option at a discount rate of 95 per cent. This is based on previous modelling carried out by Manaaki Whenua Landcare Research⁴⁶ and has been extrapolated to take into consideration the carbon price pathway.

Strengths and weaknesses of models or approach

The main strength of this modelling approach for agriculture emissions projections is the use of both economic modelling and expert opinion to generate activity data inputs. Outputs from the PSRM have been sense-checked and combined with insights and opinions from subject matter experts to estimate the expected effect of the NPS-FM. Another strength is the use of projection data from the LULUCF sector to help inform assumptions on agricultural land use. This ensures that the emissions projections for agriculture and LULUCF are based on consistent assumptions.

Conversely, the weaknesses of the modelling approach mostly arise due to the timeframe of the projections. The PSRM was originally designed to estimate animal numbers and production five years into the future, while agriculture projections described in this section partially use the PSRM to estimate emissions up to 15 years into the future. Over this period, there are a number of long-term economic trends (such as commodity prices) that are extremely difficult to model. Further, there are uncertainties over long-term climate variables and how these will affect agricultural production and emissions.

Another weakness results from the difficulty in modelling the expected effect of carbon prices on agricultural land use (versus forestry) and resulting emissions. The carbon price in the NZ ETS has risen rapidly in recent years as demand for NZUs has increased. Historically, the carbon prices being seen today (NZ\$72.55 spot price as at 26 July 2022) have never been experienced before, so the effect of the price continuing to rise has to be based on modelling rather than empirical data.

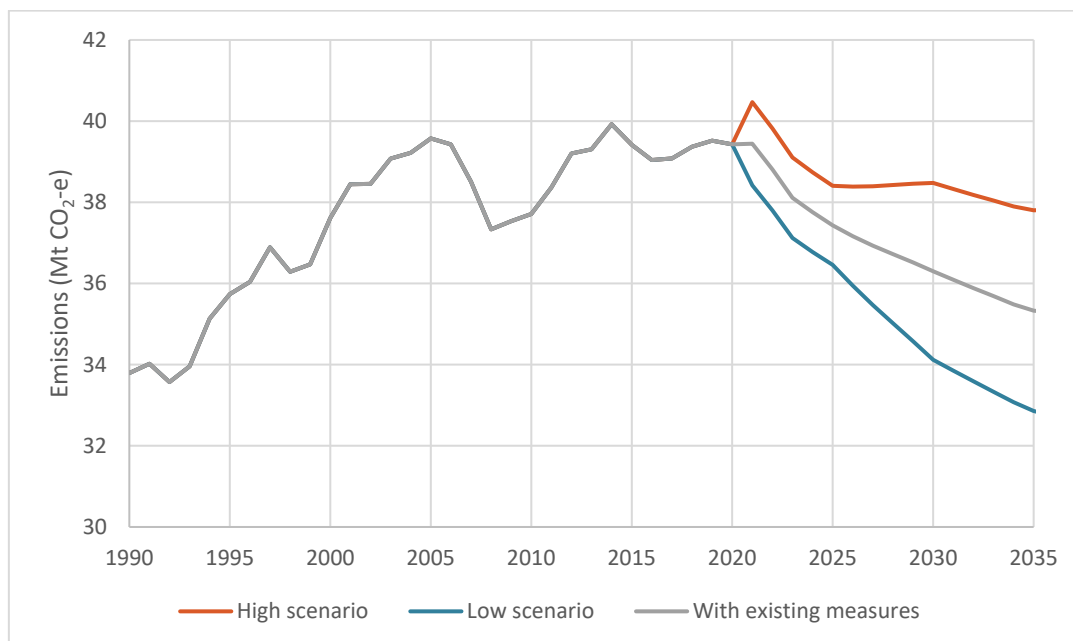
There are also uncertainties over the expected effects of the NPS-FM, cap on synthetic nitrogen fertiliser and agricultural emissions pricing and the extent to which these policies will affect animal numbers and fertiliser use.

Sensitivity analysis for agriculture emissions

To understand the potential uncertainty range of projected emissions from agriculture, emissions from the 2022 *Greenhouse Gas Inventory* were compared with past projections. The uncertainty in this year's projection model has been designed to reflect the previous performance of the model. The results are displayed in table 4.21 and figure 4.6.

⁴⁶ Djanibekov U, Samarasinghe O, Greenhalgh S. 2019. *Modelling of Agricultural Climate Change Mitigation Policy Scenarios*. Prepared for the Ministry for Primary Industries by Manaaki Whenua Landcare Research. Retrieved from www.mpi.govt.nz/dmsdocument/39095/direct (22 November 2022).

Figure 4.6: Projected emissions from agriculture, under ‘with existing measures’, with uncertainty envelope, 1990–2035 (Mt CO₂-e)



Note: Mt CO₂-e = million tonnes of carbon dioxide equivalent.

Table 4.21: Projected emissions from agriculture, under ‘with existing measures’, high- and low-emissions scenarios, 1990–2035 (Mt CO₂-e)

Scenario	1990	2020	2025	2030	2035	Change from WEM in 2035 (%)
Low emissions	33.79	39.42	36.46	34.12	32.86	-7.0 %
WEM	33.79	39.42	37.43	36.30	35.33	0 %
High emissions	33.79	39.42	38.41	38.48	37.80	7.0 %

Note: Mt CO₂-e = million tonnes of carbon dioxide equivalent; WEM = with existing measures.

By 2035, emissions under the high-emissions scenario are 7.0 per cent higher than 2035 emissions in the WEM scenario, and emissions under the low-emissions scenario are 7.0 per cent lower.

More details on the estimated uncertainty are provided in appendix B.2.

4.5.5 Land use, land-use change and forestry

In 2020, New Zealand’s LULUCF⁴⁷ sector comprised around 7.845 million hectares of natural forest and just over 2.1 million hectares of planted forest.⁴⁸ Projected LULUCF emissions and

⁴⁷ The term LULUCF is used to refer to the forestry and other land use categories of the ‘Agriculture, forestry and other land use’ chapter of: International Panel on Climate Change (IPCC). 2006. HS Eggleston, L Buendia, K Miwa, T Ngara, K Tanabe (eds). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Prepared by the National Greenhouse Gas Inventories Programme for the IPCC. Hayama: Institute for Global Environmental Strategies. Retrieved from www.ipcc-nggip.iges.or.jp/public/2006gl/ (22 November 2022). These are used for *reporting* to the UNFCCC and are distinct from the *accounting* guidelines used to determine forestry’s contribution towards meeting emissions reduction targets.

⁴⁸ The area of planted forest is based on New Zealand greenhouse gas inventory gross stocked area standard, which includes forest tracks, skid sites and unstocked areas. For more detail, see Ministry for the Environment. 2022. *New Zealand’s Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry

removals are significantly influenced by New Zealand’s planted forest age-class profile and harvesting rates. New Zealand has undergone three periods of significant afforestation and reforestation; the subsequent growth, harvest and replanting cycles of these plantation forests will continue to affect New Zealand’s emissions and removals well into the future.

New Zealand’s LULUCF sector is currently a net sink of carbon dioxide. In 1990, the LULUCF sector contributed –21.2 Mt CO₂-e net emissions (table 4.22), compared with –23.3 Mt CO₂-e in 2020. The main reason for the decline in removals from 2010 is an increase in forest harvesting of New Zealand’s sustainable plantation forests. See *New Zealand’s Greenhouse Gas Inventory 1990–2020* for a more detailed explanation of the change.⁴⁹

Net emissions in New Zealand’s LULUCF sector are projected to continue to decline in the 2020s as plantation forests established in the late 1980s and early 1990s are harvested for timber. However, the LULUCF sector is expected to see an increase in net removals in the late 2020s due to the growth from the replanted forests following harvest and the additional sequestration from projected afforestation activities.

Table 4.22: Historical and projected LULUCF emissions and removals by gas under the ‘with existing measures’ scenario, 1990–2035 (Mt CO₂-e)

Gas	Historical						Projected			
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
CO ₂	–21.6	–22.9	–27.4	–25.9	–29.8	–27.0	–23.7	–9.9	–12.4	–25.8
CH ₄	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N ₂ O	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3
Total	–21.2	–22.4	–26.9	–25.4	–29.3	–26.6	–23.3	–9.5	–12.0	–25.5

Note: Removals are expressed as negatives (–) and represent net carbon dioxide (CO₂-e) removed from the atmosphere, while emissions are expressed as positives (+) and represent net CO₂-e emissions to the atmosphere. CH₄ = methane; LULUCF = land use, land-use change and forestry; Mt CO₂-e = million tonnes of carbon dioxide equivalent; N₂O = nitrous oxide.

Methodology

Projected emissions and removals from the LULUCF sector are calculated using methodologies consistent with those used within *New Zealand’s Greenhouse Gas Inventory 1990–2020*⁵⁰ (the Inventory). Activity data and emission factors used in the Inventory comprise the historical time series (1990–2020) used in this report. The modelling takes a bottom-up approach to projecting the WEM projections. Each LULUCF policy and measure is calculated on an individual basis using a bottom-up approach, with the total for each policy and measure subtracted from the WEM scenario to provide an accurate estimate of the WOM scenario.

As with projections of emissions for any sector, the LULUCF sector is sensitive to the underlying assumptions used. It is challenging to arrive at absolute values of future rates of afforestation,

for the Environment, section 6.4. Retrieved from environment.govt.nz/assets/publications/GhG-Inventory/New-Zealand-Greenhouse-Gas-Inventory-1990-2020-Chapters-1-15.pdf (26 July 2022).

⁴⁹ Ministry for the Environment. 2022. *New Zealand’s Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment, section 6.1. Retrieved from environment.govt.nz/assets/publications/GhG-Inventory/New-Zealand-Greenhouse-Gas-Inventory-1990-2020-Chapters-1-15.pdf (26 July 2022).

⁵⁰ Ministry for the Environment. 2022. *New Zealand’s Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/publications/new-zealands-greenhouse-gas-inventory-1990-2020 (18 August 2022).

deforestation, harvesting, pre-1990 natural forest sequestration and harvested wood products. Projections of activity data and emission factors are based on external research and analysis, with a range of upper and lower removals to reflect the variability in predictions.

Main assumptions

The main drivers and assumptions used in the LULUCF projections are detailed below.

Pre-1990 natural forests

New Zealand's pre-1990 natural forest is separated into two sub-categories: pre-1990 regenerating forest and pre-1990 tall forest. Carbon stock changes of these forest categories are reported in the Inventory. In 2020 the pre-1990 natural forest estate was a net sink, sequestering around -1.4 Mt CO_2 . The regenerating component of the pre-1990 forest estate was a net sink whereas the tall forest component was a net source of emissions.

Activity data and emission factors for New Zealand's pre-1990 natural forest from the Inventory are used for the historical time series 1990–2020. Pre-1990 natural forest projections from 2021 to 2035 assume the continued rate of change for pre-1990 tall and regenerating natural forests.⁵¹

The rate of carbon stock change in pre-1990 tall forest is $-0.01 \pm 0.19 \text{ t C ha}^{-1}\text{yr}^{-1}$, while for pre-1990 regenerating forest the rate of change is $0.43 \pm 0.51 \text{ t C ha}^{-1}\text{yr}^{-1}$. The uncertainty in the report's estimate has been applied to the lower and upper removal scenarios to represent sensitivity in measurement, sampling and model uncertainty.

Pre-1990 planted forest and sustainable forest harvesting

In 1990, pre-1990 planted forests were a net sink, sequestering around -19.1 Mt CO_2 . This has decreased to around -7.7 Mt CO_2 in 2020, due to an increase in rates of harvesting. The activity data and emission factors from *New Zealand's Greenhouse Gas Inventory 1990–2020*,⁵² combined with projections of harvesting and replanting, are used to determine pre-1990 planted forest emissions and removals from 2021 to 2035.

Projections of pre-1990 planted forest harvest are sourced from the *Wood Availability Forecast – New Zealand 2021 to 2060* (the Wood Availability Forecast).⁵³ Almost all forest harvesting in

⁵¹ Carbon stocks in tall pre-1990 natural forest have previously been reported as being in steady state because the annual net change is not statistically significant (Paul T, Kimberley MO, Beets PN. 2021. Natural forests in New Zealand – a large terrestrial carbon pool in a national state of equilibrium. *Forest Ecosystems* 8(34). URL: link.springer.com/article/10.1186/s40663-021-00312-0). New Zealand received a recommendation from the expert review team (L.18, UNFCCC. 2020. FCCC/ARR/2019/NZL. Report on the individual review of the annual submission of New Zealand submitted in 2019. In-country Review. URL: unfccc.int/sites/default/files/resource/NewZealand_complete.pdf) to review this position and to report the losses and associated uncertainty occurring in this forest class regardless of the statistical significance. Therefore, the pre-1990 natural forest carbon stock change per hectare estimate has been revised for the 2022 submission to report carbon stock changes occurring in the tall forest category.

⁵² Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment, section 6.3. Retrieved from environment.govt.nz/assets/publications/GhG-Inventory/New-Zealand-Greenhouse-Gas-Inventory-1990-2020-Chapters-1-15.pdf (26 July 2022).

⁵³ Ministry for Primary Industries. 2021. *Wood Availability Forecast – New Zealand 2021 to 2060*. Wellington: Ministry for Primary Industries. URL: www.mpi.govt.nz/dmsdocument/47671-Wood-Availability-Forecast-New-Zealand-2021-to-2060 (22 November 2022).

New Zealand (99.9 per cent) occurs in planted production forests.⁵⁴ Planted forest harvesting area, age and net emissions from 1990 to 2020 are sourced from the Inventory. Projections are modelled from historical forest plantings and assume a target rotation length of 28–30 years.

Afforestation and sustainable forest harvesting

Historical post-1989 forest activity data and emission factors are sourced from the Inventory. Estimated post-1989 planted forest age-class data from the Inventory are combined with projected afforestation scenarios from 2021, and the 2021 Wood Availability Forecast to estimate emissions and removals out to 2035. The 2021 Wood Availability Forecast indicates that harvest levels will increase over the 2020s, which is reflected in the LULUCF projections with lower net removals over this period.

Projected afforestation scenarios from 2021 onwards are based on the University of Canterbury's School of Forestry report, *Afforestation and Deforestation Intentions Survey 2021*.⁵⁵ The report shows exotic afforestation intentions estimated at 41,500 hectares in 2021 and intentions to establish 63,300 hectares in 2022 (47,900 hectares was confirmed at the time of the survey), with exotic afforestation intentions ranging between 31,355 and 46,500 hectares per year from 2023 to 2030. The survey also reported native forest afforestation estimated at 7,000 hectares in 2021, and intentions of 5,300 hectares in 2022 which then decreased to around 2,000 hectares per year by 2030.

Harvested wood products

New Zealand's planted forests are dominated by radiata pine. Its wood is used in a wide range of applications including timber-frame construction, packaging, plywood, medium-density fibreboard, posts and poles, and mechanical and chemical pulping. The methodology used to estimate net removals from harvested wood products over the projected period can be found in the Inventory.

Deforestation

Historical planted and natural forest deforestation activity data and emission factors are sourced from the Inventory. Projections of planted production forest deforestation are sourced from the *Afforestation and Deforestation Intentions Survey 2021*.⁵⁶ With most of New Zealand's planted forestry estate privately owned, the three deforestation scenarios reflect the impact of land-use economics, carbon emissions unit price, and central and local government policies. Projections of pre-1990 natural forest deforestation are based on historical trends.⁵⁷

⁵⁴ Consistent with the 2020 *Greenhouse Gas Inventory* (section 6.3), any harvesting that occurs in natural forests is captured within the natural forest carbon stock and stock change estimates. Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/publications/GhG-Inventory/New-Zealand-Greenhouse-Gas-Inventory-1990-2020-Chapters-1-15.pdf (26 July 2022).

⁵⁵ Manley B. 2021. *Afforestation and Deforestation Intentions Survey 2021: Final report*. Prepared for the Ministry for Primary Industries by Professor B Manley, School of Forestry, University of Canterbury. Wellington: Ministry for Primary Industries. Retrieved from www.mpi.govt.nz/dmsdocument/52405-Afforestation-and-Deforestation-Intentions-Survey-2021 (22 November 2022).

⁵⁶ Ibid.

⁵⁷ Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment, table 6.3.7. Retrieved from environment.govt.nz/assets/publications/GhG-Inventory/New-Zealand-Greenhouse-Gas-Inventory-1990-2020-Chapters-1-15.pdf (26 July 2022).

Non-CO₂ emissions

Historical non-CO₂ emissions are sourced from the Inventory. Non-CO₂ emissions are not a significant source of emissions for New Zealand's LULUCF sector, with projections based on historical trends.

Effect of policies and measures in the LULUCF sector

The WOM projection excludes the estimated historical and projected effects of the NZ ETS and government forestry initiatives on net LULUCF removals (see table 4.23 and figure 4.7). The methods in determining the carbon impact of each policy are briefly described below.

New Zealand Emissions Trading Scheme

The NZ ETS estimates in CTF table 3 (see appendix B) are a combination of 'additional' afforestation and 'avoided' deforestation that could be attributed to the NZ ETS. The impact the NZ ETS has had on afforestation and deforestation varied between 2008 and 2020 depending on the carbon price at the time. The WOM scenario excludes the estimated impact of the NZ ETS on levels of afforestation and on pre-1990 planted forest deforestation.

The assessment of the historical and projected impact is primarily based on annual evaluation surveys, research and modelling conducted by the University of Canterbury's School of Forestry.⁵⁸ Surveys conducted by the university are used to estimate the amount of deforestation that would occur 'with' and then 'without' the existence of the NZ ETS. The deforestation estimates 'without the NZ ETS' were correlated with historical and projected deforestation rates to determine the impact of the NZ ETS at that time.

In calculating the impact of the NZ ETS on afforestation, only afforestation since the establishment of the NZ ETS in 2008 is considered as being attributable. This creates a distinction between forests that were established before and after the NZ ETS came into effect, and ensures only forests established as a direct result of that initiative are included. Research and analysis conducted by the University of Canterbury are used to estimate the impact of the NZ ETS carbon price on afforestation rates in New Zealand.⁵⁹ The research findings provide estimated afforestation 'with' and 'without' carbon prices and are used as a measure of the 'additional' afforestation since 2008 that can be attributed to the establishment of the NZ ETS. The results of this research were then correlated with afforestation rates and carbon prices from 2008 to 2020, and 'with existing measures' projections from 2021 to 2035, to determine the impact that carbon price has had on afforestation.

Government-funded forestry initiatives

The WOM scenario also assumes the exclusion of afforestation as a direct result of government forestry initiatives, such as the Afforestation Grant Scheme, Permanent Forest Sink Initiative, Sustainable Land Management Hill Country Erosion Programme, Erosion Control Funding Programme and the One Billion Trees Programme. See *New Zealand's Eighth*

⁵⁸ Manley B. 2021. *Afforestation and Deforestation Intentions Survey 2021: Final report*. Prepared for the Ministry for Primary Industries by Professor B Manley, School of Forestry, University of Canterbury. Wellington: Ministry for Primary Industries. Retrieved from www.mpi.govt.nz/dmsdocument/52405-Afforestation-and-Deforestation-Intentions-Survey-2021 (22 November 2022).

⁵⁹ Manley B. 2019. *Impacts of Carbon Prices on Forest Management*. Prepared for the Ministry for Primary Industries by Professor B Manley, School of Forestry, University of Canterbury. Wellington: Ministry for Primary Industries. Retrieved from www.teurakau.govt.nz/dmsdocument/37113/direct (22 November 2022).

National Communication, chapter 4, for further details of these government-funded forestry initiatives. The estimated impact of the various government forestry initiatives is provided in CTF table 3 (see appendix B). Net removal estimates are based on methodologies in the Inventory, and simulate forest growth using activity data on forest area, age and species.

Effect of additional measures

The WAM scenario includes measures already implemented (WEM) and those planned, but currently not implemented (see table 4.23 and figure 4.7). The WAM scenario includes three initiatives that have been funded through the newly established Climate Emergency Response Fund.⁶⁰ The three additional forestry initiatives are:

- a) Establishing Native Forests at Scale to Develop Long-term Carbon Sinks and Improve Biodiversity
- b) Increasing Woody Biomass Supply to Replace Coal and other Carbon Intensive Fuels and Materials
- c) Maximising Carbon Storage: Increasing Natural Sequestration to Achieve New Zealand’s Future Carbon Goals.

For more information on the WAM initiatives refer to *Aotearoa New Zealand's first emissions reduction plan: Technical information annex*.⁶¹ Compared with the WEM scenario, these three WAM initiatives are estimated to sequester around –2.6 Mt CO₂-e⁶² of additional LULUCF removals in the year 2035.

Table 4.23: Net LULUCF removals under ‘with existing measures’ and ‘without measures’ scenario, and with ‘additional measures’ 1990–2035 (Mt CO₂-e)

LULUCF scenario	1990	2020	2025	2030	2035
With existing measures (WEM)	–21.2	–23.3	–9.5	–12.0	–25.5
Without measures (WOM)	–21.2	–17.0	–2.4	1.5	–4.9
With additional measures (WAM)	–21.2	–23.3	–9.6	–13.4	–28.0

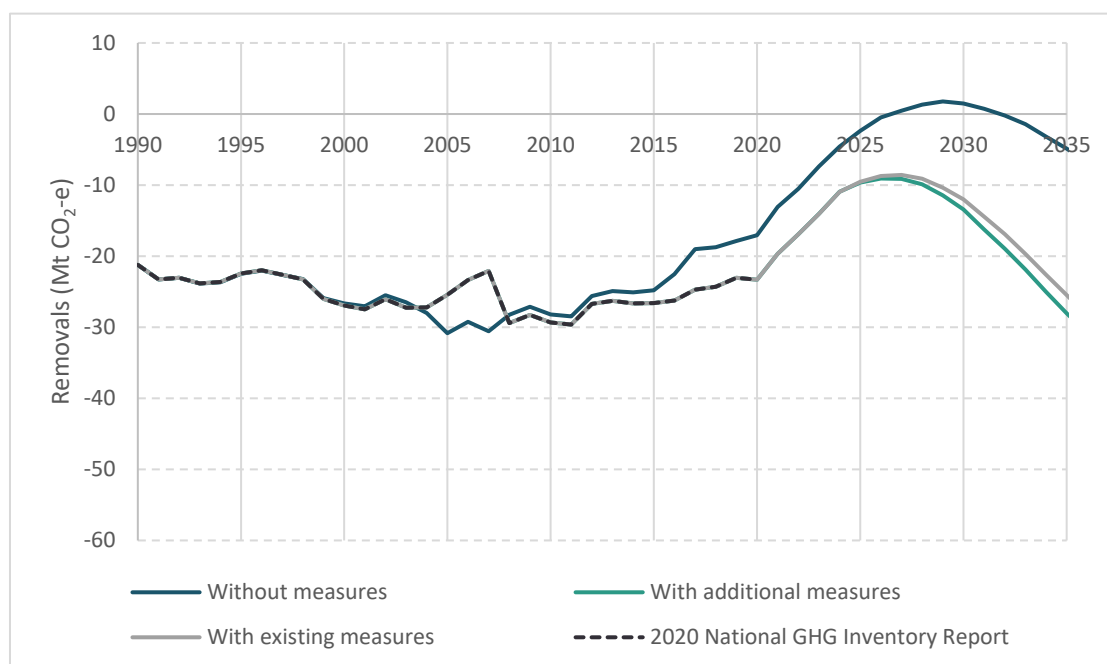
Note: LULUCF = land use, land-use change and forestry; Mt CO₂-e = million tonnes of carbon dioxide equivalent.

⁶⁰ New Zealand Government. 2022. Climate Change Emergency Fund, pp 12–13. Retrieved from www.beehive.govt.nz/sites/default/files/2022-05/CERF%20investments.pdf (22 November 2022).

⁶¹ Ministry for the Environment. 2022. *Aotearoa New Zealand's first emissions reduction plan: Technical information annex*, pp 34–35. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/publications/Files/Aotearoa-New-Zealands-first-emissions-reduction-plan-Technical-information-annex.pdf (22 November 2022).

⁶² This figure differs to that derived from table 4.23 due to rounding.

Figure 4.7: Net LULUCF removals under 'with existing measures' and 'without measures' scenarios, and with 'additional measures' 1990–2035 (Mt CO₂-e)



Note: GHG = greenhouse gas; LULUCF = land use, land-use change and forestry; Mt CO₂-e = million tonnes of carbon dioxide equivalent.

Differences from the *Fourth Biennial Report* and *Seventh National Communication*

The differences between LULUCF projections in this report and those in the *Fourth Biennial Report* and *Seventh National Communication*⁶³ are mainly due to general improvements to *New Zealand's Greenhouse Gas Inventory* activity data and emission factors, revised afforestation projections due to the inclusion of the *Afforestation and Deforestation Intentions Survey 2021*, updated harvesting data sourced from the *Wood Availability Forecast* and revised estimates of pre-1990 natural forest sequestration. The main contributing factors are summarised below.

LULUCF inventory emission factors have improved continuously for the forest land category, with activity data improvements across all land use categories. As an example, the continuous improvement between the 2015 and 2020 LULUCF inventories has resulted in a 12 per cent increase in removals for 2015 and a 30 per cent decrease in removals in 1990.

The findings from the *2021 Afforestation and Deforestation intentions Survey 2021*⁶⁴ show an increase in intended exotic afforestation over the projection period, with exotic afforestation

⁶³ Ministry for the Environment. 2017. *New Zealand's Seventh National Communication: Fulfilling reporting requirements under the United Nations Framework Convention on Climate Change and the Kyoto Protocol*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/publications/new-zealands-seventh-national-communication-under-the-united-nations-framework-convention-on-climate-change-and-the-kyoto-protocol/ (22 November 2022).

⁶⁴ Manley B. 2021. *Afforestation and Deforestation Intentions Survey 2021: Final report*. Prepared for the Ministry for Primary Industries by Professor B Manley, School of Forestry, University of Canterbury. Wellington: Ministry for Primary Industries. Retrieved from www.mpi.govt.nz/dmsdocument/52405-Afforestation-and-Deforestation-Intentions-Survey-2021 (22 November 2022).

around 36,000 hectares in 2030, compared with around 15,000 hectares per year projected in the *Seventh National Communication* and 26,000 hectares per year projected in the *Fourth Biennial Report*. The increase in projected afforestation can be largely attributed to a significant rise in the New Zealand unit carbon price that post-1989 forest owners receive within the NZ ETS.⁶⁵

The *Fourth Biennial Report* and *Seventh National Communication* projected production planted forest harvesting from research and analysis completed by *Scion* in 2015.⁶⁶ Harvesting projections have been updated based on the most recent research and analysis completed in 2021. The *Wood Availability Forecast* shows slightly higher harvest levels over the 2020s than previously assumed. For example, total forest harvesting in the *Fourth Biennial Report* was projected to be around 591,000 hectares over 2021–2030, compared with around 668,000 hectares harvested over the same period in the *Wood Availability Forecast*.

Revised pre-1990 natural forest emission factors have resulted in lower removals over inventory reporting and projection periods. In this report, projected removals from pre-1990 natural forests are around –1.4 Mt CO₂-e per year compared with around –6.1 Mt CO₂-e per year as reported in the *Seventh National Communication*⁶⁷ and 2.7 Mt CO₂-e per year as reported in the *Fourth Biennial Report*.

Table 4.24 and figure 4.8 provides net removals from the inventory for 1990 and 2020, and projected net removals ‘with existing measures’ upper removals (low-emissions), base (WEM) and lower removals (high-emissions) scenarios. The upper and lower removals scenarios reflect the variability in future rates of afforestation, deforestation, harvesting, pre-1990 forests and harvested wood products.

Table 4.24: Projected net LULUCF removals under ‘with existing measures’, lower removals and upper removals scenarios, 1990–2035 (Mt CO₂-e)

Scenario	1990	2020	2025	2030	2035
Lower removals (high-emissions scenario)	–21.2	–23.3	–2.7	–4.6	–16.7
With existing measures	–21.2	–23.3	–9.5	–12.0	–25.5
Upper removals (low-emissions scenario)	–21.2	–23.3	–15.9	–18.9	–33.8

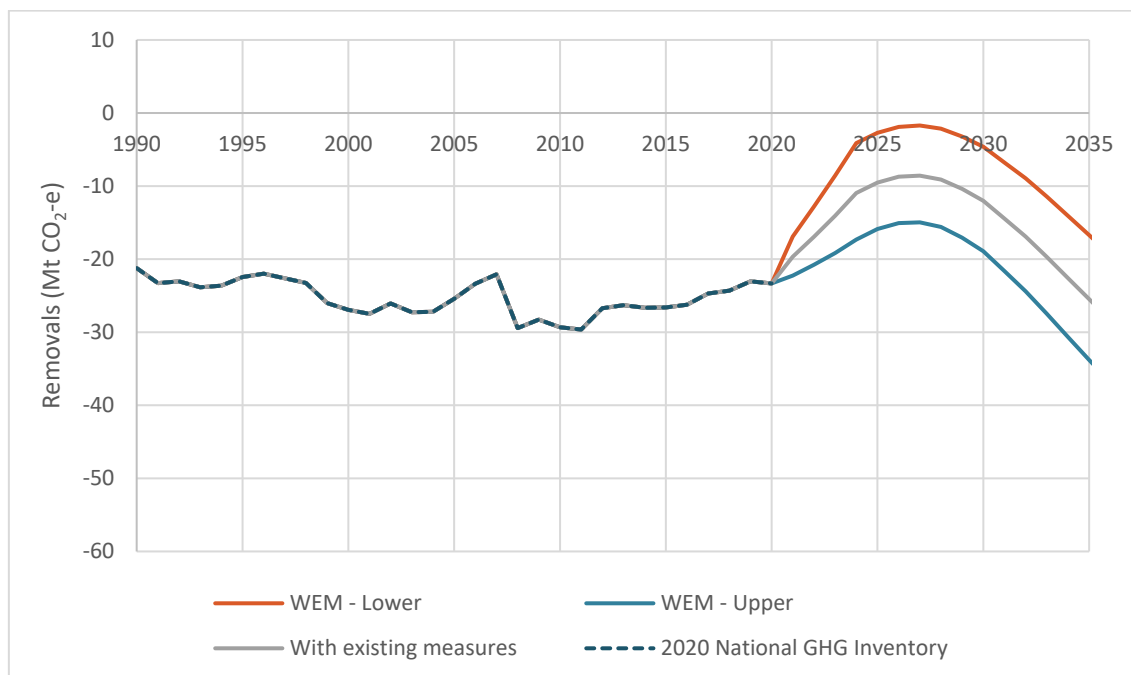
Note: Removals are expressed as negatives (–) and represent net carbon dioxide (CO₂) removed from the atmosphere, while emissions are expressed as positives (+) and represent net CO₂ emissions to the atmosphere. LULUCF = land use, land-use change and forestry; Mt CO₂-e = million tonnes of carbon dioxide equivalent.

⁶⁵ Ministry for Primary Industries. Forestry in the Emissions Trading Scheme. Retrieved from www.mpi.govt.nz/forestry/forestry-in-the-emissions-trading-scheme/ (22 November 2022).

⁶⁶ Scion. 2014. *Post-2020 LULUCF Projections: Greenhouse gas emissions and removals under alternative accounting scenarios*. Prepared for the Ministry for Primary Industries by Scion. Wellington: Ministry for the Environment.

⁶⁷ The *Seventh National Communication* assumed 6.1 Mt CO₂-e removed per year versus 2.7 Mt CO₂-e removed per year projected in the *Fourth Biennial Report*.

Figure 4.8: Projected net LULUCF removals under ‘with existing measures’, lower removals and upper removals scenarios, 1990–2035 (Mt CO₂-e)



Note: Removals are expressed as negatives (–) and represent net CO₂ removed from the atmosphere, while emissions are expressed as positives (+) and represent net CO₂ emissions to the atmosphere. GHG = greenhouse gas; LULUCF = land use, land-use change and forestry; Mt CO₂-e = million tonnes of carbon dioxide equivalent; WEM = with existing measures.

4.5.6 Waste

From 2020, emissions from waste are projected to decrease to 2982 kt CO₂-e by 2030 (24.4 per cent below 1990 levels, or 8.8 per cent below 2020 levels) and to 2884 kt CO₂-e by 2035 (26.9 per cent below 1990 levels, or 11.8 per cent below 2020 levels). Table 4.25 presents historical greenhouse gas emissions from 1990 to 2020, and projected greenhouse gas emissions from 2021 to 2035 for the waste sector.

Around 82.2 per cent of waste emissions are CH₄ emissions resulting from disposal of solid waste to land during 1990–2035. Due to the increasing use of landfill gas capture, particularly since this became mandatory for certain landfills under the National Environmental Standard for Air Quality, net emissions from landfills and the waste sector as a whole peaked around 2002. Changing composition of waste, notably a reduction in the proportion of food and paper waste to landfill offsets projected increases in waste volumes, which results in a slightly decreasing trend to 2035.

The remaining 17.8 per cent of emissions in the waste sector are composed of several gases from the following sources in decreasing order of size: domestic wastewater, open burning, industrial wastewater, composting, incineration and anaerobic digestion. Carbon dioxide emissions mainly from open burning remain at steady levels from 2021 to 2035, whereas CH₄ emissions are expected to decrease during this period. Nitrous oxide emissions increase during the same timeframe, largely due to the increased wastewater emissions from an increasing population and also a contribution from increased composting.

Table 4.25: Historical and projected greenhouse gas emissions from waste by gas, under a ‘with existing measures’ scenario, 1990–2035 (kt CO₂-e)

Gas	Historical						Projected			
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
CO ₂	159	136	150	119	109	100	90	96	94	92
CH ₄	3,671	3,981	4,156	4,133	3,632	3,240	3,012	2,862	2,698	2,596
N ₂ O	113	117	129	126	131	147	167	180	191	196
Total	3,943	4,235	4,435	4,378	3,872	3,488	3,269	3,138	2,982	2,884

Note: CH₄ = methane; CO₂ = carbon dioxide; kt CO₂-e = kilotonnes of carbon dioxide equivalent; N₂O = nitrous oxide.

Methodology

All categories in the waste sector use a bottom-up approach, estimating emissions at the category level as reported in the Inventory. This is done by projecting activity data and applying the national greenhouse gas inventory models to estimate emissions.

Some methods for projecting activity data have been revised for the *Fifth Biennial Report*. Several policies and measures have been quantified in the waste sector and use a variant of the model used for existing measures that incorporates the alternative activity data and/or emission factors. Table 4.26 provides details on the methods used for projecting each category in the waste sector.

Table 4.26: Methods for projecting activity data and or emissions in the waste sector, 2021–35

Category in the waste sector	Gas(es)	Method for projecting activity data or emissions	Strengths	Weaknesses
Managed landfills	CH ₄	Waste tonnage is projected by correlating historical GDP with total waste disposed and extending the correlation into the future. Other parameters are held constant Variants of this model using modified activity data and/or parameters are used to estimate the effects of some existing and additional measures	Models projected waste amounts using a robust mathematical model drawing mainly on recent historical trends, the impact of an increasing waste levy and current policy direction	Projection of activity data is sensitive to the latest historical waste tonnages which have been impacted by COVID-19 and could distort the longer-term projection
Unmanaged farm fills	CH ₄	Logarithmic extrapolation of farm counts from 2002 to 2017, which in turn drives overall waste tonnages on farms as per the greenhouse gas inventory	Based on plausible long-term trend in farm counts	Assumes that waste volume per farm is constant
Unmanaged non-municipal fills	CH ₄	Waste tonnages are held constant into the future at 2015 levels, which is based on the available historical data	Plausible projection based on limited available data	Does not account for potential changes in industry activity into the future
Uncategorised landfills	CH ₄	Activity data ended in 2010, however, emissions continue to occur and are projected using the first order decay model in the greenhouse gas inventory	Uses first order decay model from the inventory	Relies on historical activity data being accurate

Category in the waste sector	Gas(es)	Method for projecting activity data or emissions	Strengths	Weaknesses
Composting	CH ₄ , N ₂ O	The activity data are modelled from 1990 based on an assumed growth curve, consistent with limited actual data where available and assumed changes into the future Variants of this model using modified activity data and or parameters are used to estimate the effects of some existing and additional measures	Assumptions are tied to actual data	Limited actual data results in heavy reliance on assumed growth curve
Anaerobic digestion	CH ₄	A model based on inventory tier 1 methods is used to estimate projected emissions for anaerobic digestion based on assumed waste tonnages A variant of this model using modified activity data is used to estimate the effects of additional measures	Applies inventory methods	No activity data are available as this is solely a future activity as at the time of reporting
Incineration	CO ₂ , CH ₄ , N ₂ O	Constant activity assumed since 2007	Simple, consistent with the inventory	Assumes the incineration rate is constant
Open burning	CO ₂ , CH ₄ , N ₂ O	Uses activity data modelled for farm fills, noting that half of the activity data are landfilled and half are burned	Simple, consistent with the inventory	Assumes the same amounts of waste are burned and buried
Domestic wastewater	CH ₄ , N ₂ O	The quantity of domestic wastewater is dependent on the national population, using the latest emission factor as calculated in the greenhouse gas inventory, which is held constant for projections	Uses inventory methods and reflects projected population changes	Assumes no changes in wastewater treatment processes
Industrial wastewater	CH ₄ , N ₂ O	The quantity of industrial wastewater is dependent on industrial production. Projected production for meat and dairy industries is based on projected industry data. The remaining industries are held constant at 2020 levels	Tracks known changes in activity in accordance with the inventory	Assumes emission factors and some activity data are constant

Note: CH₄ = methane; CO₂ = carbon dioxide; GDP = gross domestic product; N₂O = nitrous oxide; NZ ETS = New Zealand Emissions Trading Scheme.

Sensitivity analysis for waste emissions

The projected emissions in the waste sector are predominantly driven by volumes of managed and unmanaged solid waste. Table 4.27 describes the key drivers and sensitivities for the main categories in the waste sector. No quantitative sensitivities were produced for the waste sector for the *Eighth National Communication* or *Fifth Biennial Report*.

Table 4.27: Qualitative analysis of key drivers of projected emissions in the waste sector

Major category in the waste sector	Key drivers of emissions and sensitivities
Managed landfills	Key driver: projected waste volumes Emissions are most sensitive to landfill gas capture rates and historical activity data
Farm waste (both open burning and unmanaged landfills)	Key driver: projected farm counts Emissions are most sensitive to composition and quantity of waste per farm, as well as the degree of aerobic versus anaerobic decomposition
Unmanaged non-municipal fills	Key driver: assumption that waste tonnages remain constant since 2015 Emissions are most sensitive to historical waste tonnages and assumed composition of waste, as well as the degree of aerobic versus anaerobic decomposition
Domestic wastewater	Key driver: population Emissions are most sensitive to emission factors
Industrial wastewater	Key driver: industry production Emissions are most sensitive to emission factors

Differences from the *Fourth Biennial Report*

The most significant changes to the methodologies for calculating emissions from the waste sector since the *Fourth Biennial Report*⁶⁸ are in the methods for projecting solid waste volumes. Managed solid waste projections are revised using the latest historical data, resulting in a decrease for that category due to the slowing in growth of waste disposal. Farm waste is now divided in half between open burning and landfilling, whereas previous projections assumed the overwhelming majority was buried. Further, non-municipal landfills (a type of unmanaged landfill) are now estimated from projected activity data rather than extrapolated emissions.

Because the waste sector projections use the same models as *New Zealand's Greenhouse Gas Inventory 1990–2020*,⁶⁹ other improvements that have occurred in the Inventory since the *Fourth Biennial Report* are included in the models used for projections in the *Eighth National Communication* and *Fifth Biennial Report*. The most significant of these improvements are the changes to farm waste disposal (mentioned above) and also the revisions to composting activity data based on evidence. More details on these improvements can be found in chapter 10 of the following three versions of *New Zealand's Greenhouse Gas Inventory for 1990–2018*,⁷⁰ *1990–2019*⁷¹ and *1990–2020*.⁷²

⁶⁸ Ministry for the Environment. 2019. *New Zealand's Fourth Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/Publications/Files/fourth-biennial-report.pdf (6 October 2022).

⁶⁹ Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/publications/new-zealands-greenhouse-gas-inventory-1990-2020/ (6 October 2022).

⁷⁰ Ministry for the Environment. 2020. *New Zealand's Greenhouse Gas Inventory 1990–2018*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/publications/new-zealands-greenhouse-gas-inventory-1990-2018/ (6 October 2022).

⁷¹ Ministry for the Environment. 2021. *New Zealand's Greenhouse Gas Inventory 1990–2019*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/publications/new-zealands-greenhouse-gas-inventory-1990-2019/ (6 October 2022).

⁷² Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/publications/new-zealands-greenhouse-gas-inventory-1990-2020/ (6 October 2022).

4.5.7 Tokelau

This is the second biennial report to include emission projections for Tokelau. On 13 November 2017 New Zealand extended its ratification of the UNFCCC and the Paris Agreement to include Tokelau. Emissions estimates for Tokelau have been included in *New Zealand's Greenhouse Gas Inventory* since 2019.

Including and refining Tokelau's emissions calculations for New Zealand's biennial reporting is a gradual process. As with inventory reporting, this requires building expert capacity in the various small government departments and organisations in Tokelau that participate in decision-making, data collection and processing.

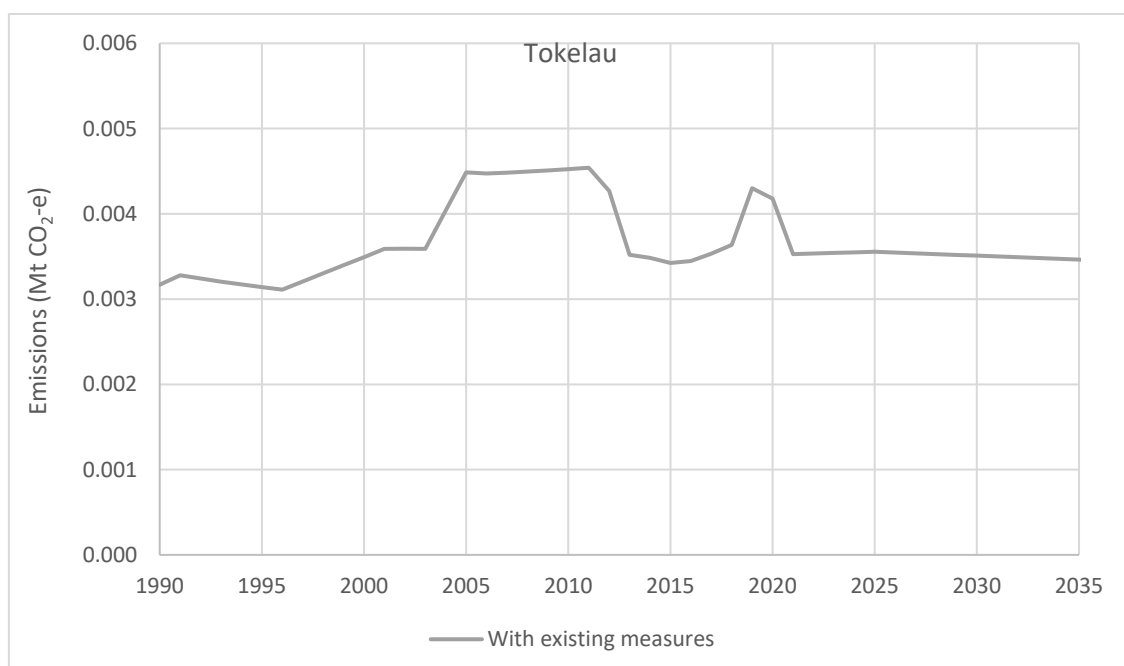
Between 1990 and 2020, Tokelau's total emissions increased by 31.9 per cent, from 3.17 kt CO₂-e to 4.18 kt CO₂-e. The main contributors to this increase were domestic navigation and electricity generation. The changes in domestic navigation are a result of Tokelau gaining ownership and use of the ferry *Mataliki* in 2016, cargo vessel *Kalopaga* in 2018 and *Fetu o te Moana* in 2019, leading to an increasing number of sea voyages between the atolls, which increased transport emissions.

Further changes in Tokelau's energy sector emissions are a significant rise and then drop (by nearly 400 per cent and 82.5 per cent respectively) in consumption of imported petroleum products used for electricity production in Tokelau. The main driver underpinning this reported change was switching to a 100 per cent solar photovoltaics energy system by the end of 2012; a significant drop (nearly 82 per cent) in consumption of imported petroleum products for electricity production resulted.

Emissions of perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride are not occurring in Tokelau.

In 2030 total emissions from Tokelau are projected to be 3.51 kt CO₂-e, and in 2035, 3.46 kt CO₂-e. Table 4.28 and figure 4.9 present historical and projected emissions for Tokelau.

Figure 4.9: Tokelau's greenhouse gas emissions for the 'with existing measures' scenario, 1990–2035



Note: Mt CO₂-e = megatonnes of carbon dioxide equivalent. Tokelau does not have WOM and WAM scenarios.

Table 4.28: Tokelau’s gross greenhouse gas emissions by gas, 1990–2035 (kt CO₂-e)

Gas	Historical							Projected		
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
CO ₂	1.30	1.38	1.45	2.45	2.52	1.63	2.42	2.42	2.00	2.17
CH ₄	1.78	1.69	1.95	1.93	1.81	1.53	1.48	1.28	1.15	1.01
N ₂ O	0.09	0.07	0.05	0.04	0.04	0.04	0.05	0.04	0.04	0,04
HFCs	0.00	0.01	0.03	0.08	0.15	0.22	0.23	0.23	0.23	0.23
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF ₆	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total	3.17	3.14	3.49	4.49	4.52	3.42	4.18	3.56	3.51	3.46

Note: CH₄ = methane; CO₂ = carbon dioxide; HFCs = hydrofluorocarbons; kt CO₂-e = kilotonnes of carbon dioxide equivalent; N₂O = nitrous oxide; NO = not occurring; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride. Gross emissions exclude net removals from the land use, land-use change and forestry sector, which, however, are minimal in Tokelau.

Methodology

Tokelau’s emissions were projected using a hybrid of a top-down and bottom-up approach. The emissions estimates for Tokelau are as prepared for the October 2020 projections round. This includes no change to the assumptions used since October 2020, and the projections are based off the 2020 Inventory (data 1990–2018). There has been an update to reflect the 2022 Inventory (data 1990–2020); however, the update only changes years 2019 and 2020.

Differences from the *Fourth Biennial Report*

The most significant change to the projections methodologies for calculating emissions from Tokelau since the *Fourth Biennial Report* has been the shift from a purely top-down approach to a hybrid of a top-down and bottom-up approach. The projections methodology now includes the use of time series activity data and sector-specific assumptions, rather than the previous solely linear interpolation based on Tokelau’s historical greenhouse gas emissions.

5 Financial, technological and capacity-building support

Key developments since the Seventh National Communication

- Since the *Fourth Biennial Report*,⁷³ Aotearoa New Zealand has contributed approximately NZ\$285.78 million in climate-specific support for developing countries during 2019 and 2020. This contribution is an increase of approximately NZ\$26.13 million compared with the previous reporting period.
- In 2018 New Zealand increased its climate finance for the period 2019–22 to NZ\$300 million. It met this commitment early, in July 2021. Of this commitment, two-thirds was for the Pacific and half to adaptation (although these were not mutually exclusive targets). New Zealand continues to increase its provision of international climate finance to developing countries.
- New Zealand delivers its international climate finance primarily through activities in its International Development Cooperation programme, focusing on agriculture, food security, disaster prevention and preparedness, ecosystem strengthening, renewable energy, infrastructure and water security.
- New Zealand has continued to support multilateral climate funds, providing NZ\$22.16 million in total. This included an NZ\$15 million contribution to the first replenishment of the Green Climate Fund and an NZ\$3 million contribution to the Adaptation Fund.
- New Zealand has also undertaken dedicated capacity-building and technology-transfer activities. This is aimed at strengthening the capability and capacity of Pacific Island countries to respond to the impacts of climate change.
- This reporting period includes the first year of the COVID-19 pandemic. The impacts of the pandemic on New Zealand’s financial, technology transfer and capacity-building support will be more evident in the next report.

5.1 Introduction

Aotearoa New Zealand is committed to delivering its international obligations, and to providing information about how we will do this, including for our climate finance obligations. New Zealand’s policy is to share indicative finance flows with partner countries at least two years ahead of time, in an effort to enhance transparency and predictability.

This chapter reports on the financial, technological and capacity-building support New Zealand provided to developing countries for climate change action for the previous two calendar years, 2019 and 2020. It covers support provided through multilateral, regional and bilateral channels, as well as specific resources provided for mitigation, adaptation, technology transfer and capacity building.⁷⁴

⁷³ Ministry for the Environment. 2019. *New Zealand’s Fourth Biennial Report under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from environment.govt.nz/assets/Publications/Files/fourth-biennial-report.pdf (22 April 2022).

⁷⁴ For clarity, this chapter uses the definition of capacity building from the Organisation for Economic Co-operation and Development’s Development Assistance Committee.

In 2018, New Zealand made a new high-level, multi-year climate finance commitment of NZ\$300 million for the period 2019–22. This commitment demonstrated the importance New Zealand placed on supporting developing countries to reduce emissions and adapt to the impacts of climate change. This commitment included a dedicated NZ\$150 million for a Pacific- and adaptation-focused Climate Change Programme.

Over 2019–20, New Zealand’s climate-related support focused on:

- strengthening capacity for effective low-emissions, climate-resilient planning
- supporting low-carbon economic growth, including through a significant contribution to improving access to renewable energy
- supporting Pacific countries to access the climate-related support they need from regional and multilateral agencies
- ensuring decision-makers have access to the science and information they need and use it to make informed decisions
- supporting greater global action to reduce greenhouse gas emissions
- strengthening disaster prevention and preparedness
- improving Pacific resilience through on-the-ground adaptation activities, including in areas such as agriculture, ecosystem strengthening, infrastructure and water security.

New Zealand also supported low-emissions agricultural development, primarily through support for, and participation in, the Global Research Alliance on Agricultural Greenhouse Gases (GRA), which was founded in late 2009.

During the reporting period, New Zealand contributed approximately NZ\$285.78 million in total financial assistance (NZ\$217.12 million in climate-specific support⁷⁵) for climate change outcomes across:

- multilateral climate change funds, such as the Global Environment Facility,⁷⁶ the Green Climate Fund and the Adaptation Fund – total funding of NZ\$22.16 million (climate-specific NZ\$21.48 million) (table 5.4)
- a range of specialised United Nations bodies – total funding of NZ\$40.94 million (climate-specific NZ\$13.84 million) (table 5.4)
- a range of multilateral financial institutions including regional development banks – total funding NZ\$68.46 million (climate-specific NZ\$27.58 million) (table 5.4)
- bilateral, regional and other channels – total funding of NZ\$154.22 million (table 5.5).

Looking ahead

New Zealand remains committed to the global goal of jointly mobilising US\$100 billion per year from a variety of sources through to 2025. This is in the context of developing countries taking meaningful mitigation actions and providing transparency on implementation.

⁷⁵ Climate-specific support represents the total of the climate-related support in table 5.3 (NZ\$285.78 million) minus the amount that is tagged as ‘core/general’ (NZ\$68.66 million). Due to the availability of the relevant imputed shares, the climate-specific figure is more accurate for 2019–20 than for previous reporting periods.

⁷⁶ Multilateral contributions represent the total amounts provided to the organisations for the full range of activities covered by their programmes, which include climate change mitigation and adaptation, unless imputed shares are available.

In October 2021, New Zealand committed to spend NZ\$1.3 billion in grant-based climate finance between 2022 and 2025. The allocation of this funding will be guided by the *Aotearoa New Zealand International Climate Finance Strategy – Tuia te Waka a Kiwa*.⁷⁷ The strategy will ensure that New Zealand’s climate finance supports developing countries and communities to build resilience in a world on a pathway to keeping global warming within 1.5°C. To do this, the strategy will work towards four key goals:

1. enhance resilience and adaptation
2. promote quicker action on mitigation
3. improve information to allow evidence-based decisions
4. leverage our investments to make greater impact.

5.1.1 New and additional support

New Zealand’s approach to determining new and additional financial resources, for the period 2019–20, has been to report all climate-related assistance provided during the reporting period. This is the most transparent and appropriate way of communicating new resources provided.

This report includes any climate-related support provided over the reporting period that meets agreed Official Development Assistance (ODA) definitions (ie, with a strong concessional element and with economic development and the welfare of developing countries as its main objective). Because climate change is a cross-cutting development issue, this support frequently has co-benefits across a range of development outcomes. This is reflected in the integrated approach to climate change and development in the Pacific region.⁷⁸ For the 2019–20 reporting period, it is estimated that approximately 20 per cent of New Zealand’s IDC Programme had a climate-related component.

Overall, New Zealand is committed to increasing its climate-related support. Future growth will be bolstered by:

- the increased IDC Programme budgets for 2021–23
- New Zealand’s increased climate finance commitment of NZ\$1.3 billion for 2022–25
- increased efforts to mobilise private finance
- continued efforts to mainstream climate change across New Zealand’s IDC Programme.

5.1.2 Approach to tracking and reporting provision of support

New Zealand is committed to regular and transparent reporting of its climate-related support, and to improving the tracking of its climate-related financial flows. Tracking and monitoring climate finance enables both donor and recipient countries to direct support to areas or sectors that offer the greatest mitigation and adaptation potential, achieving the most effective outcomes and facilitating further climate finance and investment flows.

⁷⁷ Retrieved from www.mfat.govt.nz/en/aid-and-development/climate-change-support.

⁷⁸ Pacific Community (SPC). 2017. *Framework for Resilient Development in the Pacific: An Integrated Approach to Address Climate Change and Disaster Risk Management (FRDP) 2017–2030*. Suva: Pacific Community. Retrieved from <http://gsd.spc.int/frdp/> (30 September 2022).

The IDC Programme uses the Rio markers of the Organisation for Economic Co-operation and Development's (OECD's) Development Assistance Committee for tracking development assistance with climate change adaptation and mitigation outcomes. While the Development Assistance Committee's Rio markers capture the thematic objectives of each activity, they do not quantify expenditure towards these objectives. New Zealand has built on the Rio markers to create a system to quantify the climate-related support provided by the IDC Programme.

In 2018, New Zealand added a marker for capacity building. This marker is a binary indication of whether or not projects support climate change capacity building. New Zealand does not track financial resources towards this marker.

The IDC tracking system allows climate-related expenditure to be quantified and recorded in the IDC Programme's climate change inventory, according to specific classifications and moderation weightings, as table 5.1 shows.

Table 5.1: Classifications and moderation weightings for quantifying and recording climate-related expenditure

Classification	Where addressing climate change is...	Financial information recorded in the climate change inventory
Principal	...one of the main outcomes of the activity Addressing climate change risks or opportunities is fundamental to the design of the activity. The activity includes climate change as an important outcome. Climate change is explicitly addressed through specific outputs	100% of the activity value for the financial year
Significant	...one of the outcomes of the activity Addressing climate change risks or opportunities is an important but not the principal reason for undertaking the activity. Climate change is explicitly addressed as part of outputs in the activity design – these do more than simply avoid a potential negative impact	30% of the activity value for the financial year unless either: 1. a more accurate figure is known or 2. a different default figure is specified for the particular activity type
Not targeted	...not an outcome of the activity Climate change opportunities and risks have been assessed but will not be significantly addressed through any of the outputs in the Results Framework	0% of the activity value for the financial year

In addition to the criteria in table 5.1, some specific types of activities supported by the IDC Programme have specific weightings. Table 5.2 provides further guidance on the application of the climate change markers for those activities.

Table 5.2: Guidance on the application of the climate change markers

Activity	Description	Marker and classification	Weighting
Disaster risk reduction and management	The activity is driven by a prime concern for extreme weather events	Adaptation: Principal	100%
	The activity is driven by a prime concern for seismic events (earthquakes, tsunamis) but where extreme weather events occur	Adaptation: Significant	50%
Renewable energy and energy efficiency	Any activity dealing with renewable energy and/or energy efficiency, whether the prime concern is energy security, economic growth, climate change or any combination of these	Mitigation: Principal	100%

Activity	Description	Marker and classification	Weighting
Energy upgrading	Energy upgrading activities, where the outcome of the activity is safer access to energy supplies during extreme weather events, can potentially be marked significant	Adaptation: Significant	30%

In this *Fifth National Communication*, New Zealand provides information on:

- bilateral financial contributions, including funding from the IDC Programme for activities where addressing climate change is assessed as being the ‘principal’ or ‘significant’ outcome of the activity
- financial contributions to regional organisations with a strategic focus on climate change
- financial contributions to multilateral agencies that have climate change as an integral part of their strategic plans and approaches.

Except for funding to support GRA activities, New Zealand does not monitor its core funding to regional and multilateral organisations to the level of specific climate change allocations and actions. Some of the figures provided in table 5.4 and table 5.5 represent total contributions to multilateral and regional organisations that New Zealand “cannot specify as being climate-specific”. This approach is in keeping with the United Nations Framework Convention on Climate Change (UNFCCC) Biennial Reporting Guidelines for developed country Parties.⁷⁹

5.1.3 New Zealand’s IDC Programme principles

New Zealand’s IDC Programme pursues impactful development outcomes through four principles when providing climate-related support, as outlined in *New Zealand’s International Cooperation for Effective Sustainable Development (ICESD)*.⁸⁰ These principles are that:

- **effective development** is values driven, partnership focused, adaptive, outcomes focused and evidence based
- **inclusive development** addresses exclusions and inequality created across all dimensions of social identity, while promoting human rights and equitable participation in the benefits of development
- **resilient development** strengthens the environment, economy and societies to withstand shocks and manage crises while protecting future wellbeing
- **sustained development** enables lasting progress and is locally owned to uphold results in the long term.

New Zealand aims to, where appropriate, integrate environment and climate change objectives as cross-cutting issues in all activities managed by its IDC Programme. This is in keeping with international best practice and reduces the reporting burden for partner countries. Designing development assistance with environment and climate change co-benefits in mind ensures the development initiatives funded by the IDC Programme support sustainable management of natural assets and address climate change.

⁷⁹ UNFCCC. 2011. UNFCCC biennial reporting guidelines for developed country Parties, Annex I, Decision 2/CP.17 (pages 31–35). Retrieved from unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf#page=4 (30 September 2022).

⁸⁰ Retrieved from www.mfat.govt.nz/assets/Aid-Prog-docs/Policy/Policy-Statement-New-Zealand-International-Cooperation-for-Effective-Sustainable-Development-ICESD.pdf (30 September 2022).

5.2 Financial resources

This report outlines all climate-related financial support New Zealand provided since its Fourth Biennial Report, for the purpose of assisting developing countries' climate change mitigation and adaptation efforts.⁸¹ This report also highlights some of the key initiatives Aotearoa New Zealand has supported.

New Zealand's reporting period includes two calendar years, 2019 and 2020. Funds are reported in New Zealand dollars (NZ\$). The methodology used for calculating currency exchange is the annual average exchange rates, as used by the OECD. The rates used are:

- 2019: US\$ 1 = NZ\$ 1.518
- 2020: US\$ 1 = NZ\$ 1.542.

As Conference of Parties decision 9/CP.21 requires, this report uses the UNFCCC-agreed common tabular format (CTF) from the Biennial Reporting Guidelines (FCCC/CP/2011/9/Add.1). This is to ensure transparency in reporting financial data and to promote consistency across all financial contributors.

For the purposes of this report, 'provided' means funds that have been transferred from the New Zealand Government to a recipient, including any multilateral or regional organisation.

Table 5.3 summarises the public financial support New Zealand has provided in 2019–20. The tables that follow provide more detail on how it provided that support through multilateral channels (table 5.4) and bilateral, regional and other channels (table 5.5) in each of the reporting years.

5.2.1 Multilateral support

New Zealand provides support to multilateral funds with a strategic focus on climate change, including the Adaptation Fund, the Global Environment Facility (GEF) and the Green Climate Fund (GCF).

Adaptation Fund

The Adaptation Fund was established in 2001 to finance concrete adaptation projects and programmes in developing country Parties to the Kyoto Protocol that are particularly vulnerable to the adverse effects of climate change.

In 2019, New Zealand contributed NZ\$3 million to the Adaptation Fund. This contribution responds to the calls from Pacific countries for a greater focus on finance for climate change adaptation.

Global Environment Facility

The GEF is an operating entity of the UNFCCC's Financial Mechanism. It distributes financial assistance associated with the major multilateral agreements on climate change, biodiversity, persistent organic pollutants, ozone-depleting substances and desertification. It also supports activities relating to land degradation and international waters.

⁸¹ New Zealand respects the choice of countries to differentiate finance given to them for the purposes of loss and damage. However, in this report this support is counted as 'adaptation' finance.

The reporting period falls within the seventh (2018–22) replenishment period of the GEF Trust Fund. Table 5.4 provides details of New Zealand’s total contributions to the GEF Trust Fund for the 2019–20 reporting period, which amounted to NZ\$4.16 million.⁸²

New Zealand’s contribution recognises the GEF’s considerable efforts to increase the support it provides to least developed countries and small island developing states, as well as the GEF Trust Fund’s responsiveness to the 2030 Agenda for Sustainable Development.

Green Climate Fund

The GCF is an operating entity of the UNFCCC’s Financial Mechanism. The GCF was established in 2010 and became fully operational in 2015. It aims to support a paradigm shift in the global response to climate change, by mobilising funding at scale (including via its Private Sector Facility) to invest in low-emissions and climate-resilient development. The GCF has committed to achieving a 50:50 balance between mitigation and adaptation investments, with at least 50 per cent of adaptation funding to go to the most vulnerable countries, including least developed countries, small island developing states and African states.

In 2019, New Zealand contributed NZ\$15 million to the first replenishment of the GCF. This contribution complements New Zealand’s existing support for climate action and supports climate action in areas where it does not have the expertise or scale to make a difference.

Other multilateral support

New Zealand supports a range of multilateral organisations and programmes with a strategic focus on climate change, including those with specific programmes related to the implementation of the UNFCCC (table 5.4). This includes, for instance, the World Bank, the Asian Development Bank and the United Nations Development Programme.

Montreal Protocol implementation

The Montreal Protocol plays an important role in tackling climate change, in particular through the Kigali Amendment, which New Zealand ratified in October 2019. For the 2019–20 reporting period, New Zealand’s total contributions to the Montreal Protocol amounted to NZ\$1.92 million.

5.2.2 Regional support

New Zealand is a major funder of the Pacific regional organisations that have a strategic focus on climate change, as detailed in table 5.5. These organisations include:

- the Secretariat of the Pacific Regional Environment Programme (SPREP),⁸³ which coordinates the region’s response to climate change; it provides policy and technical support to its Pacific Island members to meet their commitments under the UNFCCC and to support climate change adaptation actions

⁸² Annual contributions represent the combined total of New Zealand’s payments to the GEF Trust Fund in the financial year (July to June). GEF projects address six global environmental issues, or focal areas, of which climate change is one.

⁸³ www.sprep.org

- the Pacific Islands Forum Fisheries Agency (FFA),⁸⁴ which provides expertise, technical assistance and other support to its members to assist them with decisions on tuna and other fisheries management, including managing for the impacts of climate change on fisheries
- the Pacific Community (SPC),⁸⁵ which assists members in a number of climate-affected sectors, such as health, geoscience, agriculture, forestry, water resources, disaster management and energy
- the Pacific Islands Forum Secretariat (PIFS),⁸⁶ which, under the guidance of Forum leaders, ministers and officials, conducts high-level advocacy and develops policy guidance on climate change and access to climate finance.

New Zealand's core funding to Pacific regional organisations contributes to programmes and projects identified in their strategic plans. However, as core, untagged funding it is not monitored at a level that tracks specific climate change activities. Therefore, the figures for regional agencies provided in table 5.5 are moderated based on the policies outlined in table 5.1.

The IDC Programme also supports climate change efforts in the Pacific through several regional initiatives. The following are examples of these initiatives.

- An SPC-led activity to reduce the risk of water scarcity through improved sustainable water resources will provide at-risk Pacific communities with improvements to their water infrastructure and infrastructure maintenance. It will also provide training and tools to enable these communities to adapt to the impacts of climate change through effectively managing water resources, managing water demand and supply, and mitigating risks.
- An activity started in 2019 to support management of invasive species for climate change adaptation involved SPREP, along with New Zealand's Department of Conservation and Manaaki Whenua Landcare Research in its delivery. This will support the Pacific to adapt to the increasing impact of invasive species with climate change and to increase its resilience by supporting healthy ecosystems, improving information and management of invasive species, improving food security and reducing disaster risk.
- At the 2019 United Nations Climate Change Conference (COP25), in partnership with the Climate Change Resilience team at SPREP, New Zealand co-hosted the Moana Blue Pacific Pavilion with Fiji, as well as a full programme of side events. The Moana Blue Pacific Pavilion was a place for discussion, debate and knowledge transfer on issues related to the ocean and climate change that are important to the Pacific. New Zealand also supported regional delegates to attend COP25 through this partnership.

New Zealand continues to partner with other development partners, such as the Asian Development Bank and World Bank Group, to mobilise finance at scale for renewable energy across the Pacific region. (See section 5.2.3 under 'Mitigation' for more details.)

⁸⁴ www.ffa.int

⁸⁵ www.spc.int

⁸⁶ www.forumsec.org

5.2.3 Bilateral support

A large proportion of New Zealand's climate-related support is delivered bilaterally through its IDC Programme as grant funding. New Zealand contributed approximately NZ\$138.79 million in climate-related bilateral and multi-country assistance during 2019–20.

Country partnerships are at the heart of New Zealand's approach to bilateral assistance and climate-related support. Bilateral Statements of Partnership and four-year plans are based on partner countries' national plans and self-identified needs and priorities.

New Zealand primarily delivered its climate-related support as part of activities designed to achieve sustainable, inclusive and resilient development outcomes that meet the aspirations and needs that partner countries identified, consistent with international best practice.

New Zealand's climate-related support builds stronger and more resilient infrastructure, strengthens disaster preparedness and supports low-emissions economic growth, including through its significant contribution to improving access to affordable, reliable and clean energy. Examples include:

- New Zealand provided NZ\$1.43 million, over 2019–20, towards the Niue Renewable Energy activity. This activity helped to resolve issues with the current electricity network in Niue, increasing the country's renewable energy supply and reduce its dependence on imported fuels.
- From 2019, New Zealand has been involved in revitalising informal settlements and their environments in Fiji. This activity aims to integrate ecologically and environmentally sustainable water infrastructure into the housing and landscapes of 12 informal settlements in the greater Suva area. The programme combines community engagement with the instalment and monitoring of decentralised water infrastructure to achieve health outcomes and improve climate change and nature disaster resilience.
- In 2019, New Zealand began implementing the Cambodia Climate-smart Commercial Horticulture activity. Building on the successful Commercial Development and Strengthening of Horticulture in Cambodia activity, this new activity introduced climate-smart agricultural techniques and technologies. It will also sustainably increase climate-change resilience, farm and food safety, profitability and market system support for small-scale commercial and semi-commercial horticulture farmers.

The Pacific region has a great need for climate-related assistance. New Zealand has the relationships and experience to make a practical difference, and will strive to be a partner of preference for the Pacific on climate issues.

Climate-related support is also provided bilaterally to partner countries in Africa, Latin America and the Caribbean, and to members of the Association of Southeast Asian Nations (ASEAN) with a particular focus on disaster risk reduction, renewable energy and sustainable agriculture.

The following sections give further details of how New Zealand is supporting mitigation, adaptation, technology transfer and capacity-building actions. Table 5.5 details the country's financial contributions in 2019 and 2020 to these areas.

Adaptation

New Zealand's support for climate change adaptation efforts is primarily designed to reduce the vulnerability of human or natural systems to the impacts of climate change, by increasing community resilience and adaptive capacity. It delivers this support to other countries through

a range of approaches to bilateral, regional and multilateral assistance. Regional, national and community-level resilience and adaptation actions are implemented within the context of national and regional plans, strategies and frameworks. New Zealand works with partner countries, regional agencies and multilateral funds to help shape and deliver these actions in response to the priorities of individual countries.

As already noted, at least 50 per cent of New Zealand's future climate finance will go towards adaptation to the impacts of climate change and building resilience to climate change-related loss and damage (see 'Loss and damage' below). Over 2019–20, 47 per cent of its support for bilateral, regional and other channels was for supporting adaptation actions and 14 per cent was for mitigation. The other 39 per cent is directed to both adaptation and mitigation actions (all percentages are approximate).

As table 5.5 sets out, the IDC Programme supports key initiatives for climate change adaptation, disaster risk management and resilience building such as the following.

- Reduce the risk of water scarcity in atoll countries by enabling water-scarce communities to actively manage resources to improve resilience.
- Mainstream risk-based analysis into government planning by incorporating climate change into governance systems for planning, budgeting and programme management purposes. Interventions are targeted at national and subnational levels in several Pacific Island countries.
- Improve ecosystem resilience, through contributions to the Pacific regional 'Kiwa Initiative: Nature-based Solutions for Climate Resilience'. This initiative aims to strengthen Pacific Island ecosystems, economies and communities to become more resilient to the impacts of climate change. Funding is provided for nature-based solutions to local and national authorities, regional and civil society organisations.

Adaptation and disaster risk reduction are closely related processes in that both aim to reduce vulnerability to short-term acute hazards and longer-term chronic hazards. New Zealand supports the Pacific's approach, as stated in the *Framework for Resilient Development in the Pacific* (FRDP), of integrating disaster risk reduction and climate adaptation. New Zealand participates in the annual United Nations Office for Disaster Risk Reduction Global Platform on Disaster Risk Reduction, and is an active supporter of the FRDP as a member on the Pacific Resilience Partnership Taskforce, which facilitates the implementation of the FRDP's goals.

Agriculture

The dominance of agriculture in New Zealand's emissions profile and its vulnerability to the impacts of climate change have motivated New Zealand to use its expertise to help address the 10–12 per cent of global emissions that come from the agriculture sector worldwide. New Zealand has invested approximately NZ\$14.95 million in climate-related agriculture initiatives over the 2019–20 reporting period.⁸⁷ These initiatives have included a focus on supporting communities to increase their resilience to natural disasters and climate-related weather events, including by introducing new drought-tolerant irrigation technologies. In addition, New Zealand is a leading member of the GRA, which brings countries together to find ways to grow more food without increasing greenhouse gas emissions, and supports these efforts in a range of ways, as outlined elsewhere in this chapter and report.

⁸⁷ This includes bilateral and multilateral (International Fund for Agricultural Development and Consultative Group for International Agricultural Research) support but excludes GRA support and Pacific regional agency support.

Climate mobility

Displacement related to climate change is a real and pressing concern in the Pacific. In 2018, New Zealand developed a plan to take early and collaborative action on climate mobility. This plan recognises the importance of the perspectives of Pacific peoples, including their desire to live in their own country, where possible.

As part of that plan, New Zealand is supporting activities to avert and delay climate-related displacement, and preparing people for climate migration where that may be necessary. Its initiatives include:

- conducting a comprehensive scoping study in 2020 to inform the procurement of research to better understand future climate migration trends and the social and economic impacts on New Zealand and Pacific Island countries. Lack of reliable data impedes the ability of New Zealand and Pacific Island countries to adequately prepare for and respond to climate mobility
- supporting a peace-building non-government organisation to help communities in Fiji to prevent and manage conflicts that may result from displacement and relocations related to climate change
- supporting the Government of Fiji to establish the Fiji Relocation Trust Fund to provide internal relocation assistance to Fijian communities
- funding a consortium of United Nations and international organisations, led by the International Organization for Migration, to strengthen the capacity and coordination of Pacific governments and non-government actors in their approach to climate mobility.

COVID-19

As countries set out their economic recovery strategies from COVID-19, there are opportunities to accelerate climate action. New Zealand is aware of the need to guard against the risk of recovery spending that locks in high-emissions pathways.

COVID-19 has affected most activities that provide financial, technological and capacity-building support to developing countries. The true impact of COVID-19 on the delivery of climate change initiatives will only be realised in future reporting periods.

Long-term low-emissions development strategies

A low-emissions, climate-resilient development approach represents an important opportunity for Pacific Island countries to anticipate, plan for and counter some of the impacts of climate change and to transition their economies to a low-carbon future. This is also an opportunity for sustainable development.

Pacific Island countries rely on imported fossil fuels for energy generation and transport, and a small number of climate-sensitive industries that underpin their economies (mainly tourism, fisheries and agriculture). New Zealand is supporting them to develop low-emissions, climate resilient development strategies, sector roadmaps, and associated policies and legislation to reduce emissions and increase their resilience to the impacts of climate change.

New Zealand supported a NZ\$590,000 project led by the Department of Climate Change in Tonga's Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications. The resulting long-term, low-emissions development

strategy articulates a long-term vision and direction for the future of Tonga across all sectors in a low-carbon world and in a changing climate.

In 2020, New Zealand committed NZ\$150,000 to support the Fiji Government to review and update its 2014 Draft National Energy Policy with a view to developing a new policy for 2020–30.

New Zealand is also partnering with the Global Green Growth Institute to deliver a multi-country programme of work. The programme will support Pacific Island countries to develop the policy, legislation, regulations, strategies and roadmaps they need to transition to low-emissions, climate-resilient economies and societies.

Mainstreaming low-carbon, climate-resilient development decision-making into governance is critical for sustainable development and for adapting to climate change.

Loss and damage

New Zealand recognises Pacific Island countries are some of the most exposed in the world to the impacts of climate change. There are indications that some locations have exceeded their adaptation limits already. Economic and non-economic costs are becoming increasingly apparent. New Zealand is currently scoping potential activities that could avert, minimise and address loss and damage.

Most of New Zealand's adaptation work in the Pacific region supports the resilience of communities, livelihoods and ecosystems and helps to minimise the loss and damage associated with climate change (see 'Adaptation' below). It also supports work on early warning systems to prepare for hazards, and financial preparedness and resilience, as the following examples illustrate.

- The Averting Water-related Emergencies activity will create effective early warning systems by supporting Pacific Island countries to anticipate and prepare for water-related emergencies through understanding their vulnerability.
- In 2020, New Zealand provided funding to SPC to establish the Pacific Community Centre for Ocean Science. The centre brings together scientific data and expertise and makes them more readily available to decision-makers in the region. It also provides a platform to coordinate and integrate ocean science activities with international and regional partners.
- New Zealand supports the Pacific Insurance and Climate Adaptation Programme, which will improve the financial preparedness and resilience of Pacific peoples in the face of climate change and natural hazards.

Mitigation

New Zealand's main areas of engagement for mitigation support have been in the energy and agriculture sectors. A priority has been to support renewable energy initiatives through the IDC Programme.

Through its support for affordable, reliable and clean energy sources, New Zealand continues to help partner countries reduce their carbon emissions, improve energy efficiency and pursue low-carbon development pathways. These measures have co-benefits such as increasing energy security, reducing reliance on costly diesel imports and encouraging emerging green industries to grow.

As the cost of renewable energy generation has decreased, New Zealand has worked with other development partners to encourage the private sector to fund and develop commercially viable renewable energy generation projects, particularly in the Pacific region (see 'Private sector' below for more details).

New Zealand continues to champion a coordinated approach among development partners, particularly in the Pacific region. It is a key funder and member of the Pacific Regional Infrastructure Facility (PRIF),⁸⁸ which coordinates the Pacific efforts of eight large development partners. The PRIF has an active and effective Energy Sector Working Group, in which development partners coordinate their work and share opportunities for working together in the energy sector. By taking a coordinated, regional approach to renewable energy and energy efficiency projects, PRIF partners will accelerate progress towards achieving Pacific Island countries' renewable energy targets, which form an important part of their Nationally Determined Contributions (NDCs) submitted under the Paris Agreement.

Private sector

New Zealand continues to value private sector expertise and actively seek to crowd in private sector climate finance. The private sector plays an important role in contributing to positive climate change outcomes through knowledge and innovation, investment and responsible business conduct.

New Zealand's IDC Programme supports the private sector to transition to a green economy by strengthening the enabling policy environment, catalysing investment and providing technical assistance across industry sectors.

New Zealand's support for the Asian Development Bank's Pacific Private Sector Development Initiative has enabled the development of policy recommendations for sustainable tourism in the Pacific as part of a post-COVID recovery strategy. New Zealand and the Private Sector Development Initiative also cooperate closely on sustainable tourism programme delivery through the lead regional tourism body, the Pacific Tourism Organisation.

Investment in initiatives to catalyse greater private investment in the green economy is important. In 2020, New Zealand completed the design for InvestPacific, an NZ\$50 million impact investment fund based in New Zealand that will mobilise private investment in the Pacific for inclusive and climate-resilient development. The fund is expected to launch in 2023.

In 2019, New Zealand committed NZ\$4 million to the Pacific Infrastructure Technical Assistance Fund, which provides technical assistance grants to support Pacific Island countries to attract high-quality infrastructure finance. The fund has helped to progress a number of renewable energy and resilient infrastructure projects across the region.

New Zealand supports the Pacific private sector to build more sustainable, climate-resilient businesses through access to business advisory services and concessional finance. In 2020, it committed NZ\$6.94 million to the Pacific Small and Medium Enterprise Finance Facility pilot to enable Pacific small and medium enterprises to adapt to the economic impacts of COVID-19 and build back better by investing in climate mitigation and adaptation, education and green technology.

⁸⁸ <https://theprif.org>

Special initiatives

New Zealand's Climate Change Development Fund provides NZ\$300,000 each year to help developing countries to deal with climate change challenges. In 2019–20, the fund:

- helped developing country experts to participate in informal workshops relevant to the international negotiations agenda, including on international carbon markets
- provided supplementary funding to some UNFCCC work programmes, including the Warsaw International Mechanism on Loss and Damage, and for enhancing the capacity of developing countries to participate in the transparency arrangements under the Paris Agreement and the UNFCCC.

Global Research Alliance on Agricultural Greenhouse Gases

New Zealand has provided NZ\$73.5 million to support the GRA's work since it began in 2009. New funding has been agreed to support further international collaboration, build developing countries' capacity through training and awards, and continue New Zealand's leadership in the GRA. The GRA is a major initiative involving the collaboration of 66 developed and developing country members, working with 27 partner organisations to reduce agricultural greenhouse gas (GHG) emissions, enhance soil organic carbon and improve food security.

The following are some of the GRA's projects that have benefited developing countries.

- **Climate, Food and Farming Research Network – Global Research Alliance Development Scholarship (CLIFF-GRADS).** CLIFF-GRADS is a joint initiative of the GRA and the Consultative Group for International Agricultural Research (CGIAR). It aims to build the capability of early-career agriculture students from developing countries to conduct applied research on climate change mitigation in agriculture. The New Zealand Government, the United States Agency for International Development and CGIAR fund CLIFF-GRADS. Since it began in 2017, CLIFF-GRADS has offered more than 120 scholarships to PhD students from developing countries.
- **Agricultural GHG inventory development.** In support of the GRA, New Zealand has delivered capability-building activities to improve livestock GHG measurement and reporting by developing countries. Effective measurement and reporting in this area are prerequisites for enhanced action on mitigation in the livestock sector in NDCs and enable robust domestic policy action. Regional inventory improvement programmes are under way in Latin America, South East Asia and East Africa, building local networks of experts who employ similar systems and can learn from each other. Participants have built their capacity and understanding of improving inventories for livestock systems and the steps needed for developing them in line with national circumstances and priorities.
- **Supporting developing country participation in research.** This work includes participation in European Union funding calls and region-specific projects such as the sustainable intensification of legume-based livestock systems. New Zealand is supporting a Latin American regional project to establish a regional platform of cooperation to strengthen livestock systems based on the use of forage legumes. This work benefits more than 2,500 farmers, technicians, researchers and students in eight countries. It will reduce fertiliser requirements, lead to more resilient and climate-friendly beef production, and develop human resources in a regionally supportive manner.

Table 5.3: Provision of public financial support – summary information, 2019 and 2020 (CTF Table 7)

Table 5.3a: Provision of public financial support – summary information, 2019

Allocation channel	New Zealand dollars (millions) Climate-specific						US dollars (millions) Climate-specific					
	Core/ general	Mitigation	Adaptation	Cross- cutting	Other	Total	Core/ general	Mitigation	Adaptation	Cross- cutting	Other	Total
Total contributions through multilateral channels	30.65	0.94	3.75	34.35		69.69	20.19	0.62	2.47	22.64		45.92
Multilateral climate change funds	0.28		3.00	16.38		19.66	0.19		1.98	10.79		12.96
Multilateral financial institutions, including regional development banks	17.87			13.21		31.08	11.77			8.71		20.48
Specialised United Nations bodies	12.50	0.94	0.75	4.76		18.95	8.23	0.62	0.49	3.14		12.48
Total contributions through bilateral, regional and other channels		11.58	32.39	32.84		76.81		7.63	21.37	21.65		50.65
TOTAL	30.65	12.52	36.14	67.19		146.50	20.19	8.25	23.84	44.29		96.57

Table 5.3b: Provision of public financial support – summary information, 2020

Allocation channel	New Zealand dollars (millions)						US dollars (millions)					
	Climate-specific						Climate-specific					
	Core/ general	Mitigation	Adaptation	Cross- cutting	Other	Total	Core/ general	Mitigation	Adaptation	Cross- cutting	Other	Total
Total contributions through multilateral channels	38.01	0.98	1.65	21.23		61.87	24.66	0.64	1.07	13.77		40.14
Multilateral climate change funds	0.40			2.10		2.50	0.26			1.36		1.62
Multilateral financial institutions, including regional development banks	23.01			14.37		37.38	14.93			9.32		24.25
Specialised United Nations bodies	14.60	0.98	1.65	4.76		21.99	9.47	0.64	1.07	3.09		14.27
Total contributions through bilateral, regional and other channels		9.09	41.36	26.96		77.41		5.90	26.87	17.48		50.25
TOTAL	38.01	10.07	43.01	48.19		139.28	24.66	6.54	27.94	31.25		90.39

Table 5.4: Provision of public financial support – contributions through multilateral channels, 2019 and 2020 (CTF Table 7a)

Table 5.4a: Provision of public financial support – contributions through multilateral channels, 2019

Donor funding	Core/general		Climate-specific*		Status	Funding source	Financial instrument	Type of support	Sector
	NZ\$ million	US\$ million	NZ\$ million	US\$ million					
Multilateral climate change funds									
Global Environment Facility	0.28	0.19	1.38	0.91	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Adaptation Fund	0.00	0.00	3.00	1.98	Disbursed	ODA	Grant	Adaptation	Multi-sector
Green Climate Fund	0.00	0.00	15.00	9.88	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Subtotal	0.28	0.19	19.38	12.77					

Donor funding	Core/general		Climate-specific*		Status	Funding source	Financial instrument	Type of support	Sector
	NZ\$ million	US\$ million	NZ\$ million	US\$ million					
Multilateral financial institutions, including regional development banks									
World Bank – IDA 18	11.93	7.86	5.36	3.53	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Asian Development Bank – ADF 12	4.79	3.15	1.86	1.23	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Subtotal	16.72	11.01	7.22	4.76					
Specialised United Nations bodies									
United Nations Development Programme	5.60	3.69	2.40	1.58	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
United Nations Environment Programme Montreal Protocol	0.00	0.00	0.94	0.62	Disbursed	ODA	Grant	Mitigation	Multi-sector
United Nations Women	1.75	1.15	0.75	0.49	Disbursed	ODA	Grant	Adaptation	Government and civil society
World Food Programme	4.20	2.77	1.80	1.19	Disbursed	ODA	Grant	Cross-cutting	Humanitarian
International Fund for Agricultural Development	0.95	0.62	0.56	0.37	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Subtotal	12.50	8.23	6.45	4.25					
Other multilateral									
CGIAR – Climate Change, Agriculture and Food Security Programme	0.00	0.00	5.50	3.62	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Association of Small Island States	0.10	0.07	0.04	0.03	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Commonwealth Small States Office	1.05	0.69	0.45	0.30	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Subtotal	1.15	0.76	5.99	3.95					
TOTAL	30.65	20.19	39.04	25.73					

Note: * OECD's imputed shares for 2019 have been applied for those organisations on the OECD list (Asian Development Bank, Green Climate Fund, Global Environment Facility, International Fund for Agricultural Development and World Bank). For those multilateral organisations not on the OECD list or where imputed shares are not available, New Zealand has applied its standard weighting of 30% (Rio Marker 1) and 100% (Rio Marker 2). CGIAR = Consultative Group for International Agricultural Research; ODA = Official Development Assistance.

Table 5.4b: Provision of public financial support – contributions through multilateral channels, 2020

Donor funding	Core/general		Climate-specific*		Status	Funding source	Financial instrument	Type of support	Sector
	NZ\$ million	US\$ million	NZ\$ million	US\$ million					
Multilateral climate change funds									
Global Environment Facility	0.40	0.26	2.10	1.36	Disbursed	ODA	Grant	Cross-cutting	
Subtotal	0.40	0.26	2.10	1.36					
Multilateral financial institutions, including regional development banks									
World Bank – IDA 18	5.88	3.82	2.77	1.80	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
World Bank – IDA 19	11.76	7.63	5.53	3.59	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Asian Development Bank – ADF12	2.63	1.71	0.39	0.25	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Subtotal	20.27	13.15	8.69	5.64					
Specialised United Nations bodies									
United Nations Development Programme	5.60	3.63	2.40	1.56	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
United Nations Environment Programme Montreal Protocol	0.00	0.00	0.98	0.64	Disbursed	ODA	Grant	Mitigation	Multi-sector
United Nations Women	1.75	1.14	0.75	0.49	Disbursed	ODA	Grant	Adaptation	Governance and civil society
World Food Programme	4.20	2.73	1.80	1.17	Disbursed	ODA	Grant	Cross-cutting	Humanitarian
International Fund for Agricultural Development	0.95	0.61	0.56	0.36	Disbursed	ODA	Grant	Cross-cutting	Agriculture
United Nations Peacebuilding Fund	2.10	1.36	0.90	0.58	Disbursed	ODA	Grant	Adaptation	Governance and civil society
Subtotal	14.60	9.47	7.39	4.79					
Other multilateral									
CGIAR – Climate Change, Agriculture and Food Security Programme	0.00	0.00	4.50	2.92	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Association of Small Island States	0.11	0.07	0.05	0.03	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Commonwealth Small States Office	0.53	0.34	0.23	0.15	Disbursed	ODA	Grant	Cross-cutting	Multi-sector

Donor funding	Core/general		Climate-specific*		Status	Funding source	Financial instrument	Type of support	Sector
	NZ\$ million	US\$ million	NZ\$ million	US\$ million					
Commonwealth Fund for Technical Cooperation	2.10	1.36	0.90	0.58	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Subtotal	2.74	1.77	5.68	3.68					
TOTAL	38.01	24.66	23.85	15.47					

Note: * OECD's imputed shares for 2020 have been applied for those organisations on the OECD list (Asian Development Bank, Global Environment Facility, International Fund for Agricultural Development and World Bank). For those multilateral organisations not on the OECD list or where imputed shares are not available, New Zealand has applied its standard weighting of 30% (Rio Marker 1) and 100% (Rio Marker 2). CGIAR = Consultative Group for International Agricultural Research; ODA = Official Development Assistance.

Table 5.5: Provision of public financial support – contributions through bilateral, regional and other channels, 2019 and 2020 (CTF Table 7b)

Table 5.5a: Provision of public financial support – contributions through bilateral, regional and other channels, 2019

Recipient country/programme/activity*	Total amount climate-specific NZ\$ million	Total amount climate-specific US\$ million	Status	Funding source	Financial instrument	Type of support	Sector
Pacific Regional / Climate and Oceans Support Program in the Pacific (COSPPAC)	3.00	1.98	Disbursed	ODA	Grant	Adaptation	Multi-sector
Pacific Regional / World Bank Pacific Facility Trust Fund	1.50	0.99	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Asian Development Bank Pacific Partnership Facility	3.15	2.08	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Cook Islands / Core Sector Support: Bridging Funding 2018–19	2.73	1.80	Disbursed	ODA	Grant	Adaptation	Multi-sector
Cook Islands / Infrastructure Trust Fund	3.60	2.37	Disbursed	ODA	Grant	Adaptation	Multi-sector
Cook Islands / Wastewater Activity	0.33	0.22	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Pacific Regional / Information for Decision-making	0.27	0.18	Disbursed	ODA	Grant	Adaptation	Multi-sector
Pacific Regional / Strengthening Water Security in Selected Pacific Island Countries	0.51	0.34	Disbursed	ODA	Grant	Adaptation	Water and sanitation

Recipient country/programme/activity*	Total amount climate-specific NZ\$ million	Total amount climate-specific US\$ million	Status	Funding source	Financial instrument	Type of support	Sector
Fiji / Social Housing	0.34	0.22	Disbursed	ODA	Grant	Adaptation	Other social infrastructure and services
Fiji / Ease of Doing Business – International Finance Corporation contribution	0.60	0.40	Disbursed	ODA	Grant	Adaptation	Business and other services
Fiji / Dairy Industry Development Initiative	0.45	0.30	Disbursed	ODA	Grant	Adaptation	Agriculture
Fiji / Child-focused Disaster Risk Reduction	0.34	0.23	Disbursed	ODA	Grant	Adaptation	Humanitarian
Fiji / Disaster Risk Management – Tropical Cyclone Winston: Recovery Package	0.20	0.13	Disbursed	ODA	Grant	Adaptation	Humanitarian
Fiji / Ministry for Primary Industries – Biosecurity Authority of Fiji Biosecurity Activity	0.13	0.09	Disbursed	ODA	Grant	Mitigation	Agriculture
Fiji / Tuna Longline Fisheries	0.14	0.09	Disbursed	ODA	Grant	Mitigation	Fishing
Fiji / Habitat Training for Disaster Risk Reduction in Fiji	0.19	0.12	Disbursed	ODA	Grant	Adaptation	Humanitarian
Pacific Regional / Ocean Acidification Partnership	0.26	0.17	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Pacific Islands Emergency Management Alliance	0.31	0.21	Disbursed	ODA	Grant	Adaptation	Humanitarian
Worldwide / New Zealand Red Cross Partnership 2018–23	0.64	0.42	Disbursed	ODA	Grant	Cross-cutting	Humanitarian
Kiribati / Energy and Public Utility Reform	0.13	0.08	Disbursed	ODA	Grant	Mitigation	Energy
Kiribati / Improved Sanitation	0.22	0.15	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Kiribati / Energy Project (Kiritimati)	0.16	0.10	Disbursed	ODA	Grant	Mitigation	Energy
Kiribati / Water	0.18	0.12	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Caribbean / Caribbean Geothermal Technical Assistance Phase II	2.33	1.54	Disbursed	ODA	Grant	Mitigation	Energy
Colombia / Dairy Value Chain Project	0.10	0.07	Disbursed	ODA	Grant	Adaptation	Agriculture
Peru / Dairy Initiative	0.26	0.17	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Pacific Regional / Strengthening Pacific Monitoring, Evaluation and Learning (MEL) Capacity	0.11	0.07	Disbursed	ODA	Grant	Cross-cutting	Multi-sector

Recipient country/programme/activity*	Total amount climate-specific NZ\$ million	Total amount climate-specific US\$ million	Status	Funding source	Financial instrument	Type of support	Sector
Nauru / Energy Efficiency	0.34	0.23	Disbursed	ODA	Grant	Cross-cutting	Energy
Nauru / Renewable Energy Initiative	1.95	1.29	Disbursed	ODA	Grant	Mitigation	Energy
Pacific Regional / Energy: North West Pacific Design	0.26	0.17	Disbursed	ODA	Grant	Mitigation	Energy
Niue / Strengthen Governance: Infrastructure	0.90	0.59	Disbursed	ODA	Grant	Adaptation	Government and civil society
Niue / Niue Renewable Energy Activity	1.21	0.80	Disbursed	ODA	Grant	Cross-cutting	Energy
Federated States of Micronesia / Energy Initiative	0.92	0.61	Disbursed	ODA	Grant	Mitigation	Energy
Republic of Marshall Islands / Energy Initiative	0.64	0.42	Disbursed	ODA	Grant	Mitigation	Energy
Palau / Energy Initiatives	0.17	0.11	Disbursed	ODA	Grant	Mitigation	Energy
Sri Lanka / Dairy Excellence Training	0.17	0.11	Disbursed	ODA	Grant	Adaptation	Agriculture
Sri Lanka / Dairy Expansion in Dry Zone	0.28	0.19	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Pacific Regional / Support: Office of the Pacific Ocean Commissioner	0.43	0.28	Disbursed	ODA	Grant	Adaptation	Multi-sector
Pacific Regional / Pacific Islands Forum Secretariat 2018–20	2.02	1.33	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Climate Change Programme Design	0.67	0.44	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Support to the Pacific Climate Change Centre	1.17	0.77	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Asian Development Bank Pacific Renewable Energy Program	4.52	2.98	Disbursed	ODA	Grant	Cross-cutting	Energy
Pacific Regional / Pacific Regional Infrastructure Facility – Phase Four	1.35	0.89	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Improve Decision-making through Ocean Knowledge	1.23	0.81	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Pacific Voice	0.77	0.51	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Forum Fisheries Agency 2015–21 core funding	1.62	1.07	Disbursed	ODA	Grant	Adaptation	Fishing
Pacific Regional / Secretariat of the Pacific Regional Environment Programme (SPREP) Programme Support 2016–19	1.53	1.01	Disbursed	ODA	Grant	Cross-cutting	Multi-sector

Recipient country/programme/activity*	Total amount climate-specific NZ\$ million	Total amount climate-specific US\$ million	Status	Funding source	Financial instrument	Type of support	Sector
Pacific Regional / Recognised Seasonal Employer Worker Training Programme II (RSE WTP II)	0.32	0.21	Disbursed	ODA	Grant	Adaptation	Education
Pacific Regional / Pacific Community (SPC) 2017–19	0.69	0.45	Disbursed	ODA	Grant	Adaptation	Multi-sector
Pacific Regional / Local Government Technical Assistance Facility 2017–22	0.24	0.16	Disbursed	ODA	Grant	Adaptation	Government and civil society
Pacific Regional / Improving Pacific Access to Climate Finance	0.89	0.59	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Papua New Guinea / Private Sector Development: PNG Partnership (International Finance Corporation)	2.25	1.48	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Papua New Guinea / Water, Sanitation and Hygiene	0.20	0.13	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Pacific Regional / Pacific Response to Coconut Rhinoceros Beetle	0.73	0.48	Disbursed	ODA	Grant	Adaptation	Agriculture
Pacific Regional / Rhinoceros Beetle Biocontrol	0.12	0.08	Disbursed	ODA	Grant	Adaptation	Agriculture
Worldwide / Volunteer Service Abroad 2018–23	2.74	1.81	Disbursed	ODA	Grant	Adaptation	Multi-sector
Worldwide / Negotiated Partnerships: Design and Due Diligence	0.19	0.12	Disbursed	ODA	Grant	Adaptation	Multi-sector
Samoa / Habitat Disaster Risk Reduction	0.60	0.39	Disbursed	ODA	Grant	Adaptation	Humanitarian
Samoa / Renewable Energy Partnership	0.88	0.58	Disbursed	ODA	Grant	Cross-cutting	Energy
Samoa / Tourism Infrastructure – Apia Waterfront Development	0.51	0.34	Disbursed	ODA	Grant	Adaptation	Multi-sector
Samoa / Cocoa Industry Development Initiative	0.45	0.30	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Solomon Islands / Provincial Airfield Upgrades	0.15	0.10	Disbursed	ODA	Grant	Adaptation	Transport and storage
Solomon Islands / Coconut Rhinoceros Beetle Response	0.15	0.10	Disbursed	ODA	Grant	Adaptation	Agriculture
Solomon Islands / Building Ecotourism in the Arnavons	0.30	0.20	Disbursed	ODA	Grant	Adaptation	Multi-sector
Solomon Islands / Fisheries Development	0.63	0.42	Disbursed	ODA	Grant	Adaptation	Fishing
Solomon Islands / Renewable Energy Scoping Study	1.83	1.20	Disbursed	ODA	Grant	Cross-cutting	Energy
Tokelau / Coastal Risk Mitigation	0.45	0.30	Disbursed	ODA	Grant	Cross-cutting	Multi-sector

Recipient country/programme/activity*	Total amount climate-specific NZ\$ million	Total amount climate-specific US\$ million	Status	Funding source	Financial instrument	Type of support	Sector
Tokelau / Renewable Energy Expansion and Renewal	2.50	1.65	Disbursed	ODA	Grant	Mitigation	Energy
Tokelau / Wharf and Reef Channel Rehabilitation	0.38	0.25	Disbursed	ODA	Grant	Adaptation	Transport and storage
Tonga / Energy: Nuku'alofa Network Upgrade Project	1.05	0.69	Disbursed	ODA	Grant	Cross-cutting	Energy
Tuvalu / Tuvalu Trust Fund Contributions	0.90	0.59	Disbursed	ODA	Grant	Adaptation	Government and civil society
Tuvalu / Budget Support (Policy Reform Matrix)	0.30	0.20	Disbursed	ODA	Grant	Adaptation	Government and civil society
Vanuatu / Growing Market Opportunities for Tanna Farmers	0.13	0.09	Disbursed	ODA	Grant	Adaptation	Agriculture
Vanuatu / Inter-island Shipping Support Project Additional Support – South Paray	0.14	0.09	Disbursed	ODA	Grant	Adaptation	Transport and storage
Vanuatu / Support to Wan Smolbag 2015–19	0.28	0.19	Disbursed	ODA	Grant	Adaptation	Government and civil society
Vanuatu / Water Sector Partnership 2017–21	0.62	0.41	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Myanmar / Renewable Energy Programme	0.41	0.27	Disbursed	ODA	Grant	Mitigation	Energy
Indonesia / Livelihood Support in Eastern Indonesia	0.38	0.25	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Myanmar / Dairy Inclusive Growth and Investment	0.20	0.13	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Cambodia / Climate-smart Commercial Horticulture	0.56	0.37	Disbursed	ODA	Grant	Adaptation	Agriculture
Indonesia / Strengthening Disaster Resilience	0.29	0.19	Disbursed	ODA	Grant	Adaptation	Multi-sector
Myanmar / Rakhine Winter Cropping Activity	0.84	0.55	Disbursed	ODA	Grant	Adaptation	Agriculture
Indonesia / Innovative Agribusiness	0.21	0.14	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Viet Nam / Dam Safety Project	0.44	0.29	Disbursed	ODA	Grant	Adaptation	Humanitarian
Indonesia / Accelerating Geothermal Development	0.41	0.27	Disbursed	ODA	Grant	Mitigation	Energy
Indonesia / Improving Energy Access in Maluku	0.42	0.28	Disbursed	ODA	Grant	Mitigation	Energy
Myanmar / Matupi Sustainable Rural Economic Development (SURE)	0.19	0.12	Disbursed	ODA	Grant	Adaptation	Multi-sector
Indonesia / Supporting Geothermal Sector Training	0.69	0.46	Disbursed	ODA	Grant	Mitigation	Energy

Recipient country/programme/activity*	Total amount climate-specific NZ\$ million	Total amount climate-specific US\$ million	Status	Funding source	Financial instrument	Type of support	Sector
Indonesia / Better Warehousing	0.39	0.26	Disbursed	ODA	Grant	Adaptation	Humanitarian
Myanmar / Dairy Industry and Veterinary Training	0.27	0.18	Disbursed	ODA	Grant	Adaptation	Agriculture
Asia Regional / Lao PDR and Cambodia Renewable Energy Facility	1.58	1.04	Disbursed	ODA	Grant	Cross-cutting	Energy
Lao PDR / Quality Beef Initiative	0.35	0.23	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Cambodia / Quality Horticulture Initiative	0.37	0.24	Disbursed	ODA	Grant	Adaptation	Agriculture
Myanmar / Better Warehousing and Logistics	0.15	0.10	Disbursed	ODA	Grant	Adaptation	Multi-sector
Viet Nam / Dragon Fruit Development	0.21	0.14	Disbursed	ODA	Grant	Adaptation	Agriculture
Kenya / Strengthened Avocado Value Chain	0.20	0.13	Disbursed	ODA	Grant	Adaptation	Agriculture
Comoros / Support for Realisation of Geothermal Potential	0.22	0.14	Disbursed	ODA	Grant	Mitigation	Energy
Zambia / Dairy Transformation Programme	0.41	0.27	Disbursed	ODA	Grant	Adaptation	Agriculture
Africa Regional / Africa Geothermal Assistance Facility	0.51	0.34	Disbursed	ODA	Grant	Cross-cutting	Energy
Other / Adaptation	1.26	0.83	Disbursed	ODA	Grant	Adaptation	Multi-sector
Other / Mitigation	0.10	0.06	Disbursed	ODA	Grant	Mitigation	Multi-sector
Other / Cross-cutting	0.80	0.52	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
TOTAL	76.81	50.65					

Note: * Bilateral activities with a moderated (climate-specific) value of less than NZ\$100,000 have been grouped together and are listed at the end of this table as 'Other' in the 'Country' column. Lao PDR = Lao People's Democratic Republic; ODA = Official Development Assistance.

Table 5.5b: Provision of public financial support – contributions through bilateral, regional and other channels, 2020

Recipient country/programme/activity*	Total amount climate-specific NZ\$ million	Total amount climate-specific US\$ million	Status	Funding source	Financial instrument	Type of support	Sector
Pacific Regional / Invasive Species Management	2.09	1.35	Disbursed	ODA	Grant	Adaptation	Multi-sector
Pacific Regional / Climate Mobility	2.00	1.30	Disbursed	ODA	Grant	Adaptation	Multi-sector
Pacific Regional / Averting Water-related Emergencies	0.25	0.16	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Pacific Regional / Reduce Risk of Water Scarcity	3.33	2.16	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Cook Islands / Wastewater Activity	0.24	0.16	Disbursed	OOF	Grant	Adaptation	Water and sanitation
Pacific Regional / Design and Delivery	1.00	0.65	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Low-emissions, Climate-resilient Planning	0.55	0.35	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Fiji / Disaster Risk Management	0.46	0.30	Disbursed	ODA	Grant	Adaptation	Multi-sector
Fiji / Ease of Doing Business – International Finance Corporation contribution	0.60	0.39	Disbursed	ODA	Grant	Adaptation	Business and other services
Fiji / RISE – Upgrades for Informal Settlements	2.00	1.30	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Fiji / Fiji Relocation Trust Fund	0.50	0.32	Disbursed	ODA	Grant	Adaptation	Other social infrastructure and services
Fiji / Dairy Industry Development Initiative	0.40	0.26	Disbursed	ODA	Grant	Adaptation	Agriculture
Fiji / Habitat Training for Disaster Risk Reduction in Fiji	0.21	0.13	Disbursed	ODA	Grant	Adaptation	Humanitarian
Pacific Regional / Mainstreaming Climate Change in Governance	3.75	2.43	Disbursed	ODA	Grant	Cross-cutting	Governance and civil society
Pacific Regional / Pacific Islands Emergency Management Alliance	0.30	0.19	Disbursed	ODA	Grant	Adaptation	Humanitarian
Worldwide / Disability-inclusive Humanitarian Action	0.13	0.09	Disbursed	ODA	Grant	Adaptation	Humanitarian
Pacific Regional / New Zealand Red Cross Partnership	0.64	0.42	Disbursed	ODA	Grant	Cross-cutting	Humanitarian
Caribbean Regional / Agriculture and Tourism Support	0.17	0.11	Disbursed	ODA	Grant	Adaptation	Agriculture
Caribbean Regional / Caribbean Geothermal Technical Assistance Phase II	1.31	0.85	Disbursed	ODA	Grant	Mitigation	Energy

Recipient country/programme/activity*	Total amount climate-specific NZ\$ million	Total amount climate-specific US\$ million	Status	Funding source	Financial instrument	Type of support	Sector
Peru / Dairy Initiative	0.13	0.08	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Pacific Regional / Strengthening Pacific Monitoring, Evaluation and Learning (MEL) Capacity	0.14	0.09	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Pacific Climate Change Mobility Scoping Study	0.13	0.09	Disbursed	ODA	Grant	Adaptation	Multi-sector
Nauru / Energy Efficiency	0.15	0.10	Disbursed	ODA	Grant	Cross-cutting	Energy
Nauru / Renewable Energy Initiative	0.77	0.50	Disbursed	ODA	Grant	Mitigation	Energy
Niue / Strengthen Governance: Infrastructure	0.61	0.40	Disbursed	ODA	Grant	Adaptation	Government and civil society
Niue / Renewable Energy Activity	0.22	0.15	Disbursed	ODA	Grant	Cross-cutting	Energy
Federated States of Micronesia / Energy Initiative	0.20	0.13	Disbursed	ODA	Grant	Mitigation	Energy
Republic of Marshall Islands / Energy Initiative	0.15	0.10	Disbursed	ODA	Grant	Mitigation	Energy
Palau / Energy Initiatives	0.31	0.20	Disbursed	ODA	Grant	Mitigation	Energy
Palau / Support to Our Ocean 2020	0.20	0.13	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Palestine / Renewable Energy (Office of the Quartet)	0.19	0.12	Disbursed	ODA	Grant	Cross-cutting	Energy
Sri Lanka / Dairy Excellence Training	0.14	0.09	Disbursed	ODA	Grant	Adaptation	Agriculture
Sri Lanka / Dairy Expansion in Dry Zone	0.19	0.12	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Pacific Regional / Support: Office of the Pacific Ocean Commissioner	0.15	0.09	Disbursed	ODA	Grant	Adaptation	Multi-sector
Pacific Regional / Climate Change Programme Design	0.30	0.19	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Pacific Community (SPC) Core Funding 2020–24	5.39	3.50	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / University of the South Pacific Partnership	1.50	0.97	Disbursed	ODA	Grant	Cross-cutting	Education
Pacific Regional / Improving Ecosystem Resilience: Kiwa Initiative	1.00	0.65	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / InvestPacific	0.13	0.09	Disbursed	ODA	Grant	Cross-cutting	Financial services

Recipient country/programme/activity*	Total amount climate-specific NZ\$ million	Total amount climate-specific US\$ million	Status	Funding source	Financial instrument	Type of support	Sector
Pacific Regional / Pacific Public Sector Strengthening	1.43	0.93	Disbursed	ODA	Grant	Adaptation	Governance and civil society
Pacific Regional / Pacific Regional Nationally Determined Contribution (NDC) Hub	0.55	0.36	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Pacific Infrastructure Technical Assistance Facility	0.17	0.11	Disbursed	ODA	Grant	Cross-cutting	Construction
Pacific Regional / Pacific Voice	0.11	0.07	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Secretariat of the Pacific Regional Environment Programme (SPREP) 2020–25	2.08	1.35	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Forum Fisheries Agency 2015–21 core funding	1.38	0.90	Disbursed	ODA	Grant	Adaptation	Fishing
Pacific Regional / Recognised Seasonal Employer Worker Training Programme II (RSE WTP II)	0.23	0.15	Disbursed	ODA	Grant	Adaptation	Education
Pacific Regional / Local Government Technical Assistance Facility 2017–22	0.27	0.17	Disbursed	ODA	Grant	Adaptation	Government and civil society
Papua New Guinea / Private Sector Development: PNG Partnership (International Finance Corporation)	1.05	0.68	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Papua New Guinea / Farming Livelihoods (HARVEST)	0.10	0.07	Disbursed	ODA	Grant	Adaptation	Agriculture
Pacific Regional / Pacific Response to Coconut Rhinoceros Beetle	0.51	0.33	Disbursed	ODA	Grant	Adaptation	Agriculture
Worldwide / Volunteer Service Abroad 2018–23	2.07	1.34	Disbursed	ODA	Grant	Adaptation	Multi-sector
Pacific Regional / Pacific Seeds for Life (PS4L)	0.39	0.25	Disbursed	ODA	Grant	Adaptation	Agriculture
Worldwide / Negotiated Partnerships: Design and Due Diligence	0.11	0.07	Disbursed	ODA	Grant	Adaptation	Multi-sector
Samoa / Habitat Disaster Risk Reduction	0.39	0.25	Disbursed	ODA	Grant	Adaptation	Humanitarian
Samoa / Improved Livelihoods Cocoa	0.14	0.09	Disbursed	ODA	Grant	Adaptation	Agriculture
Samoa / Incentivising Economic Reform 2018–21	2.50	1.62	Disbursed	ODA	Grant	Cross-cutting	General programme assistance
Samoa / Tourism Infrastructure – Apia Waterfront Development	0.30	0.20	Disbursed	ODA	Grant	Adaptation	Tourism

Recipient country/programme/activity*	Total amount climate-specific NZ\$ million	Total amount climate-specific US\$ million	Status	Funding source	Financial instrument	Type of support	Sector
Samoa / Cocoa Industry Development Initiative	0.24	0.15	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Solomon Islands / Forest Conservation	0.21	0.14	Disbursed	ODA	Grant	Adaptation	Multi-sector
Solomon Islands / Building Ecotourism in the Arnavons	0.26	0.17	Disbursed	ODA	Grant	Adaptation	Multi-sector
Solomon Islands / Fisheries New Phase 2020–24	0.88	0.57	Disbursed	ODA	Grant	Adaptation	Fishing
Timor Leste / Crop Diversification	1.43	0.93	Disbursed	ODA	Grant	Mitigation	Agriculture
Tokelau / Coastal Risk Mitigation	0.14	0.09	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Tokelau / Budget Support 2020/21	2.25	1.46	Disbursed	ODA	Grant	Adaptation	General programme assistance
Tokelau / Renewable Energy Expansion and Renewal	2.50	1.62	Disbursed	ODA	Grant	Mitigation	Energy
Tonga / Energy: Nuku'alofa Network Upgrade Project	0.75	0.49	Disbursed	ODA	Grant	Cross-cutting	Energy
Tonga / Parliament Buildings Project	0.22	0.15	Disbursed	ODA	Grant	Adaptation	Multi-sector
Tonga / Incentivising Public Sector Reform 2019–21	2.50	1.62	Disbursed	ODA	Grant	Adaptation	General programme assistance
Tonga / Community Shelter Resilience	1.16	0.76	Disbursed	ODA	Grant	Adaptation	Multi-sector
Tuvalu / Vaitupu Water Security	0.30	0.19	Disbursed	ODA	Grant	Adaptation	Multi-sector
Tuvalu / Budget Support (Policy Reform Matrix)	0.60	0.39	Disbursed	ODA	Grant	Adaptation	Governance and civil society
Tuvalu / Fisheries Support Programme 2020–25	0.44	0.29	Disbursed	ODA	Grant	Adaptation	Multi-sector
Vanuatu / Inter-island Shipping Support Project Additional Support – South Paray	0.38	0.25	Disbursed	ODA	Grant	Adaptation	Transport and storage
Vanuatu / Santo WASH Project in Vanuatu	0.11	0.07	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Vanuatu / Support to Wan Smolbag 2015–19	0.34	0.22	Disbursed	ODA	Grant	Adaptation	Government and civil society
Vanuatu / Water Sector Partnership 2017–21	1.10	0.71	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Myanmar / Renewable Energy Programme	-0.18	-0.12	Disbursed	ODA	Grant	Mitigation	Energy
Indonesia / Palu Earthquake Recovery	0.12	0.08	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Myanmar / Dairy Inclusive Growth and Investment	0.14	0.09	Disbursed	ODA	Grant	Cross-cutting	Agriculture

Recipient country/programme/activity*	Total amount climate-specific NZ\$ million	Total amount climate-specific US\$ million	Status	Funding source	Financial instrument	Type of support	Sector
Cambodia / Climate-smart Commercial Horticulture	0.48	0.31	Disbursed	ODA	Grant	Adaptation	Agriculture
Asia Regional / ASEAN Climate-smart Agriculture Initiative	1.25	0.81	Disbursed	ODA	Grant	Mitigation	Agriculture
Asia Regional / Support to the Mekong River Commission	0.30	0.19	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Myanmar / Promoting Rural Electrification	1.38	0.90	Disbursed	ODA	Grant	Mitigation	Energy
Myanmar / Livelihoods and Food Security Fund	0.75	0.49	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Cambodia / Angkor Governance Support	0.12	0.08	Disbursed	ODA	Grant	Mitigation	Government and civil society
Indonesia / Strengthening Disaster Resilience	0.15	0.10	Disbursed	ODA	Grant	Adaptation	Multi-sector
Myanmar / Rakhine Winter Cropping Activity	0.21	0.14	Disbursed	ODA	Grant	Adaptation	Agriculture
Indonesia / Innovative Agribusiness	0.16	0.10	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Viet Nam / Dam Safety Project	0.33	0.22	Disbursed	ODA	Grant	Adaptation	Humanitarian
Indonesia / Accelerating Geothermal Development	0.17	0.11	Disbursed	ODA	Grant	Mitigation	Energy
Indonesia / Improving Energy Access in Maluku	0.35	0.22	Disbursed	ODA	Grant	Mitigation	Energy
Myanmar / Matupi Sustainable Rural Economic Development (SURE)	0.17	0.11	Disbursed	ODA	Grant	Adaptation	Multi-sector
Indonesia / Supporting Geothermal Sector Training	0.26	0.17	Disbursed	ODA	Grant	Mitigation	Energy
Indonesia / Better Warehousing	0.28	0.18	Disbursed	ODA	Grant	Adaptation	Humanitarian
Myanmar / Dairy Industry and Veterinary Training	0.21	0.14	Disbursed	ODA	Grant	Adaptation	Agriculture
ASEAN / Lao PDR and Cambodia Renewable Energy Facility	1.39	0.90	Disbursed	ODA	Grant	Cross-cutting	Energy
Lao PDR / Quality Beef Initiative	0.20	0.13	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Cambodia / Quality Horticulture Initiative	0.22	0.14	Disbursed	ODA	Grant	Adaptation	Agriculture
Myanmar / Better Warehousing and Logistics	0.32	0.22	Disbursed	ODA	Grant	Adaptation	Multi-sector
Myanmar / Resilient Horticulture	0.21	0.14	Disbursed	ODA	Grant	Adaptation	Agriculture
Viet Nam / Dragon Fruit Development	0.20	0.13	Disbursed	ODA	Grant	Adaptation	Agriculture

Recipient country/programme/activity*	Total amount climate-specific NZ\$ million	Total amount climate-specific US\$ million	Status	Funding source	Financial instrument	Type of support	Sector
Worldwide / Save the Children New Zealand Implementation	0.74	0.48	Disbursed	ODA	Grant	Adaptation	Multi-sector
Worldwide / World Vision New Zealand Implementation	1.31	0.85	Disbursed	ODA	Grant	Adaptation	Multi-sector
Worldwide / ChildFund New Zealand Implementation	0.75	0.49	Disbursed	ODA	Grant	Adaptation	Multi-sector
Africa Regional / African Climate-smart Agriculture Initiative	0.40	0.26	Disbursed	ODA	Grant	Mitigation	Agriculture
Africa Regional / East Africa: Farm to Market Alliance	0.42	0.27	Disbursed	ODA	Grant	Adaptation	Agriculture
Zambia / Dairy Transformation Programme	0.42	0.27	Disbursed	ODA	Grant	Adaptation	Agriculture
Africa Geothermal / Africa Geothermal Assistance Facility	0.57	0.37	Disbursed	ODA	Grant	Cross-cutting	Energy
Other / Adaptation	1.51	0.98	Disbursed	ODA	Grant	Adaptation	Multi-sector
Other / Mitigation	0.10	0.07	Disbursed	ODA	Grant	Mitigation	Multi-sector
Other / Cross-cutting	0.56	0.36	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
TOTAL	77.46	50.25					

Note: * Bilateral activities with a moderated (climate-specific) value of less than NZ\$100,000 have been grouped together and are listed at the end of this table as 'Other' in the 'Country' column. ASEAN = Association of Southeast Asian Nations; Lao PDR = Lao People's Democratic Republic; ODA = Official Development Assistance; RISE = Revitalising Informal Settlements and their Environments.

5.3 Technology development and transfer

The development and transfer of climate-friendly technologies is critical for reducing GHG emissions and adapting to the impacts of climate change, including achieving the goals of the Paris Agreement. Aotearoa New Zealand is committed to promoting, facilitating and financing the transfer of, access to and deployment of climate-friendly technologies for the benefit of developing countries.

Technology transfer helps both developed and developing countries reduce the cost of tackling climate change, while also stimulating opportunities for sustainable development. Practical assistance and cooperative action to accelerate technology development and transfer to help developing country Parties are, therefore, priorities for New Zealand. During the reporting period, New Zealand delivered on these commitments through the New Zealand IDC Programme and the GRA. This section reports on these commitments in text and tables, which also reference other sections of this chapter where relevant.

5.3.1 Technology transfer delivered through the New Zealand IDC Programme

As detailed in section 5.2.3, country partnerships are at the heart of New Zealand's climate-related support, and countries' identified priorities are central to the development support New Zealand provides. Its IDC Programme is committed to supporting climate change action in developing countries. Particular areas of focus are the Pacific region, renewable energy and agriculture; these areas are reflected in the sectors most strongly represented in table 5.6. In addition, New Zealand has supported a number of technology transfer activities in South East Asia, Africa, the Caribbean and Latin America, through both the IDC Programme and the GRA, as outlined in table 5.6 and table 5.7.

As detailed under 'Mitigation' in section 5.2.3, a priority for the IDC Programme has been supporting energy initiatives to enable access to affordable, reliable and clean energy sources, reducing carbon emissions, improving energy efficiency and creating low-carbon development pathways. Table 5.5 in section 5.2.3 gives several examples of energy projects that promoted, facilitated and financed technology transfer for the benefit of developing country Parties, and the majority of mitigation activities listed in table 5.6 are energy activities.

Another priority in the IDC Programme has been supporting adaptation projects that reduce the vulnerability of human and natural systems to the impacts of climate change by increasing community and infrastructure resilience. Many of the activities identified in table 5.6 aim to help communities better meet the challenges of more extreme weather events, the increasing risk of drought, sea-level rise, and changes in fisheries resources. Section 5.2.3, under 'Adaptation', details a number of these projects, including those focused on water and sanitation, agriculture and disaster-resilient infrastructure.

Success stories

Tonga Village Network Upgrade Programme and Nuku'alofa Network Upgrade Project

This activity built and embedded capability in the Tongan electricity utility to undertake all of its own network upgrades and repairs. It involved training a large group of Tongans to New Zealand line mechanic standards, while completely upgrading the electricity network on the main island of Tongatapu.

In 2020, Tropical Cyclone Harold hit Tonga, causing widespread damage. On Tongatapu, where lines had previously been upgraded, damage was relatively minor and power cables were reinstated relatively easily. The Tonga Power team were able to assess damage across all island groups quickly and came up with a plan to rehabilitate damaged lines. They had the necessary materials held in stock on Tongatapu for the network upgrade programmes, meaning they required no materials from overseas. They also had a large number of well-trained and experienced line mechanics to undertake the repairs. Power was restored quickly to all islands without the need to send overseas line crews in to help, as has been the normal practice following cyclone damage in Pacific countries. Being able to complete the repairs independently was particularly beneficial as Tonga had effectively closed its borders to keep out the COVID-19 pandemic.

The extended length of the programme with continued support from New Zealand and more recently other development partners has meant that line mechanics who were first trained have been able to build and maintain their skills, and then pass them on to new groups of line mechanics.

The original approach involved partnering the local utility with a line company and training organisation both based in New Zealand, which built an enduring partnership. A crucial element of the programme's success was that Tongan line mechanics spent considerable time in New Zealand working with line mechanics there and undertaking training. Some line mechanics have chosen to stay in New Zealand or move to Australia, which has resulted in high remittances back to Tonga from well-paid, skilled work. Because the programme trained twice the number of line mechanics needed for the work in Tonga, the choice of some line mechanics to work in other countries has not disrupted the upgrading work on Tonga.

This activity had a life span of 10 years, 2012–21, and a total funding package of NZ\$42.1 million.

Lessons learnt

Nauru Energy Efficiency

The activity's aim is to increase Nauru's economic resilience by increasing energy efficiency and therefore reducing the amount of imported fossil fuel. It involves scoping all potential energy efficiency opportunities and then implementing the most impactful and cost-effective. This is the first project in Nauru to address energy efficiency and uses New Zealand's wealth of experience and capability in this often overlooked energy subsector.

Within this activity, the transferred technologies include:

- monitoring equipment for disaggregating electricity use in buildings
- energy-efficient appliances, lighting and equipment.

The lesson learnt in this activity is that the energy sector has a lot of interconnected parts and, for best results, a holistic approach that covers the entire energy sector is needed. While energy efficiency is often overlooked, work to improve it is much cheaper than building more renewable energy generation. Within this holistic approach, the activity includes scoping the potential efficiencies by reducing transport energy and associated emissions.

This activity has a life span of five years, 2019–24, and a total funding package of NZ\$4.9 million.

Activity Evaluations for the International Development Cooperation Programme

Evaluations are critical to running a successful and credible IDC Programme. Any completed activity that was high risk or had high strategic value is independently evaluated. These evaluations identify what worked, how it worked, for who, what did not work, why it did not work and ways to make sure it works in the future. Evaluations of IDC Programme activities are carried out by external evaluators and they complement our internal monitoring and review processes. These evaluations are publicly available at www.mfat.govt.nz/en/aid-and-development/our-approach-to-aid/evaluation-and-research.

Global Research Alliance on Agricultural Greenhouse Gases

In addition to delivering technology transfer through its IDC Programme, through its support of the GRA New Zealand promotes and facilitates the development of agriculture-specific endogenous and non-endogenous capacities and technologies of developing country Parties. New Zealand's support enables developing countries to implement their commitments, in particular by:

- developing national agricultural GHG inventories
- developing, applying and diffusing – including transferring – technologies, practices and processes that control, reduce or prevent GHGs in the agriculture sector
- conserving and enhancing GHG sinks and reservoirs in terrestrial ecosystems.

These outcomes are achieved through a range of research, education, training and public awareness activities, focused mainly on mitigation but with some adaptation components. Activities include:

- assisting countries to develop and/or improve their agriculture GHG inventories in ways that are consistent with their national circumstances, priorities and capacities (see table 5.6)
- providing training to South East Asian, African and Latin American countries to improve agricultural development strategies that aim for low GHG emissions and reduce vulnerability or increase resilience to climate change (see table 5.6)
- investing in the establishment of measurement hubs in ASEAN and Africa by providing training on the use of equipment and installing required equipment to measure GHG emissions (see table 5.6).

Explanation of information in tables 5.6 and 5.7

During the reporting period, New Zealand's support for technology transfer included 'hard' technology – tangible components – and 'soft' technology, which includes information and knowledge sharing, training and research. Much of this support is a combination of both hard and soft technology, to help ensure that the management and development of climate-friendly technologies are country relevant, sustainable and long-lasting. Table 5.6 includes examples of both hard- and soft-technology transfer, with many of the activities identified combining both.

Similarly, most of the activities identified in table 5.6 are a combination of endogenous and non-endogenous technology transfer. This helps to ensure that technology transfer is implemented in country-specific ways, building on existing knowledge and practices, and using local governance structures. In recognition of this dual approach, table 5.6 does not differentiate between endogenous and non-endogenous technology transfer unless specified.

As detailed in section 5.2.3, New Zealand follows several development principles when providing climate-related support through its IDC Programme, including ownership, alignment, donor harmonisation, results focus and transparency. Because these principles are applied in the delivery of all development support, the column 'Factors that led to the project's success' in table 5.6 identifies these criteria.

The GRA applies a different funding criterion. Where possible, therefore, table 5.7, which focuses on technology transfer delivered through the GRA, identifies factors that led to a project's success in a different way from table 5.6, with its focus on the New Zealand IDC Programme. These factors are not always recorded for GRA activities, and so some of the activities in table 5.7 do not include factors that led to a project's success.

Table 5.6: Technology transfer delivered through the New Zealand IDC Programme (CTF Table 8)

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Agriculture and Tourism Support	Increasing climate resilience, reducing <i>Sargassum</i> on the beaches of the Caribbean and increasing regional food security	Caribbean	Agriculture	Adaptation	Supporting the Caribbean's goal of addressing <i>Sargassum</i> arrival on local beaches, by investigating potential uses for <i>Sargassum</i> and causes of arrival	2019–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Creating technology or value chains from the floating <i>Sargassum</i>	Public	Refer to table 5.5
Dairy Value Chain Project	Increasing the productivity and incomes of small- to medium-scale dairy farmers in the Colombian high tropics	Colombia	Agriculture	Adaptation	Improving productivity and incomes of small- to medium-scale dairy farmers, by adapting farm management practices and systems, and increasing the capacity of Colombia's training	2018–22	Establishing a coalition of agricultural technology companies that work together to service the demand for dairy technology in Colombia	Adapted New Zealand dairy farming systems and industry knowledge to the Colombian context	Public	Refer to table 5.5a
Dairy Initiative	Increasing the productivity and incomes of small- to medium-scale dairy farmers in the Peruvian Sierra	Peru	Agriculture	Cross-cutting	Increasing the adoption of improved milk and cheese production, handling and processing practices. Supported by effective research and extension systems	2017–21	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Established processing plants to trial and demonstrated best practices in improving raw milk and cheese quality assurance practices	Public	Refer to table 5.5

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Dairy Excellence Training	Improving dairy-related incomes and standard of living in Sri Lanka, and contributing to an increased supply of local milk, through improved knowledge and skills from extension training	Sri Lanka	Agriculture	Adaptation	Supporting Sri Lanka's Ministry of Rural Economic Affairs to develop and roll out in-service training that enables livestock development staff to act as dairy advisors	2017–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Improved knowledge and skills from extension training	Public	Refer to table 5.5
Pacific Response to Coconut Rhinoceros Beetle	Supporting the Pacific to respond to the invasion of a new strain of coconut rhinoceros beetle	Pacific	Agriculture	Adaptation	Providing tools and strategies required to effectively manage the coconut rhinoceros beetle	2019–29	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	An integrated pest management approach that brings together scientifically proven control methods in a single package, allowing effective implantation	Public	Refer to table 5.5
Pacific Seeds for Life	Achieving food-secure and resilient communities across the Pacific	Vanuatu, Fiji, Tonga, Samoa, Tuvalu, Kiribati	Agriculture	Adaptation	Supporting the development of an enabling national-level environment through research, regulations, training, and awareness raising and improving seed and planting material production	2020–24	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Upgrading facilities and equipment for Centre for Pacific Crops and Trees molecular lab, technical support to improve the quality of collection, and sourcing new seeds and planting varieties for the region	Public	Refer to table 5.5b

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Cocoa Industry Development Initiative	Encouraging smallholder cocoa growers to produce larger volumes of cocoa by increasing their capabilities in on-farm and post-harvest practices	Samoa	Agriculture	Cross-cutting	Increasing the value and volume of Samoan cocoa export and financial returns through increased investment and sustainable production and quality management	2017–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	New methods of seedling planting by providing appropriate seedling bags to ensure trees can withstand harsh conditions such as cyclones	Public	Refer to table 5.5
ASEAN Climate-smart Agriculture Initiative	Supporting ASEAN countries to shift to low-emissions agriculture and improving agricultural productivity and returns	Asia	Agriculture	Mitigation	Enabling ASEAN countries to increase their engagement with the GRA in order to develop and implement effective technologies/practices to mitigate agricultural greenhouse gas emissions, and to build regional capability in agricultural emissions measurement	2020–25	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Identifying low-emissions agriculture systems, technologies and practices	Public	Refer to table 5.5b
Rakhine Winter Cropping Activity	Improving food security and generating more sustainable farming systems in Rakhine State	Myanmar	Agriculture	Cross-cutting	Improving agriculture farm systems to be more resilient through better water management and crop diversification	2017–20	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Better water harvesting, storage and irrigation systems. New agriculture techniques, seed varieties and tools	Public	Refer to table 5.5

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Dairy Industry and Veterinary Training	Livestock educational institutions and vocational training systems provide more qualified people	Myanmar	Agriculture	Adaptation	Supporting dairy and beef farmers to increase output and achieve higher income through new knowledge, skills and technologies	2017–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Improved knowledge and skills from new training	Public	Refer to table 5.5
Quality Beef Initiative	An expanded and viable beef industry and value chain producing high-quality, safe meat for consumers	Lao PDR	Agriculture	Cross-cutting	Providing farm demonstrations and training in profitable beef production systems to smallholder farmers, and delivering training that enhances food safety for consumers	2017–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Improved knowledge and skills from new training	Public	Refer to table 5.5
Quality Horticulture Initiative	Sector growth through delivering on market demand for high-quality, safe produce	Cambodia	Agriculture	Adaptation	Working with select vegetable supply chains to improve sustainable production systems for vegetables, post harvest systems, food quality assurance and market linkages	2017–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Improved knowledge and skills from new training	Public	Refer to table 5.5

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Dragon Fruit Development	Improving capability and capacity for the development and commercialisation of new varieties of dragon fruit	Viet Nam	Agriculture	Adaptation	Developing and commercialising new dragon fruit varieties that earn premium prices on international markets and have increased resistance to disease	2017–21	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	New systems and practices in sustainable production and disease control	Public	Refer to table 5.5
African Climate-smart Agriculture Initiative	Supporting eastern and southern African countries to shift to low-emissions agriculture	Africa	Agriculture	Adaptation	Enabling countries to increase their engagement with the GRA in order to develop and implement effective technologies/practices to mitigate agricultural greenhouse gas emissions, and build regional capability in agricultural emissions measurement	2020–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Identified low-emissions agriculture systems, technologies and practices	Public	Refer to table 5.5b
Strengthened Avocado Value Chain	Improving smallholder farmer economic opportunities by strengthening and sharing lessons with the avocado industry in Kenya	Kenya	Agriculture	Adaptation	Improving the quality of services and access to these services, as well as improving the efficiency of the activity by improving the value for money	2018–23	Builds on the previous and successful activity, the Kenya Avocado Programme	Improved knowledge and skills from new training	Public	Refer to table 5.5a

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Dairy Transformation Programme	Improving the productivity and profitability of smallholder dairy farmers by strengthening emerging dairy value chains and improving access to and quality of extension support in Zambia	Zambia	Agriculture	Adaptation	Supporting smallholder farmers to improve their productivity, milk quality and linkage to urban markets	2017–20	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Improved knowledge and skills from new training	Public	Refer to table 5.5
Caribbean Geothermal Technical Assistance Phase II	Supporting the development of geothermal energy in the Caribbean	Caribbean	Energy	Mitigation	A flexible, demand-driven technical assistance facility supporting the development of geothermal energy across eastern Caribbean island states	2018–22	Builds on previous technical assistance towards the development of renewable energy across the region	Assisting with technical studies and applications for funding for a programme of drilling for geothermal energy	Public	Refer to table 5.5
Energy Efficiency	Supporting Nauru's economic resilience	Nauru	Energy	Mitigation	Increasing energy efficiency and therefore reducing the amount of imported fossil fuel	2019–24	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Established a fund to enable the replacement of inefficient household appliances with efficient appliances	Public	Refer to table 5.5

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Renewable Energy Initiative	Increasing renewable energy production, reducing reliance on fossil fuels and increasing equitable access to affordable energy	Nauru	Energy	Mitigation	Assisting the Nauru Utilities Corporation to develop a least-cost plan for increasing Nauru's renewable energy production	2017–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Provided a grid-connected 1-megawatt-peak solar photovoltaic system	Public	Refer to table 5.5
Niue Renewable Energy Activity	Supporting Niue's goal to increase renewable energy production and reduce reliance on fossil fuels	Niue	Energy	Mitigation	Resolving technical issues with the current generation and network distribution, and increasing renewable energy supply	2017–21	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Provided grid-connected photovoltaic panels and battery storage	Public	Refer to table 5.5
Energy Initiative	Expanding access to affordable, reliable and clean energy	Federated States of Micronesia	Energy	Mitigation	Expanding access to affordable, reliable and clean energy	2018–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Provided grid-connected photovoltaic panels	Public	Refer to table 5.5

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Energy Initiative	Supporting the goal of the Government of the Republic of Marshall Islands to expand access to affordable, reliable and clean energy	Republic of Marshall Islands	Energy	Mitigation	Supporting the goal of the Government of the Republic of Marshall Islands to expand access to affordable, reliable and clean energy	2018–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Provided grid-connected photovoltaic panels	Public	Refer to table 5.5
Energy Initiatives	Supporting the Government of Palau's goal to increase renewable energy production, reduce reliance on fossil fuels and increase equitable access to affordable, clean energy	Palau	Energy	Mitigation	Installing and rehabilitating renewable energy generation systems, and delivering technical assistance and training to integrate renewable generation into the grid	2018–21	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Provided grid-connected photovoltaic panels and battery storage	Public	Refer to table 5.5
Renewable Energy Partnership	Supporting efficient, reliable, safe, affordable and sustainable electricity supply for Samoa	Samoa	Energy	Mitigation	Developing large-scale photovoltaics, small hydro power plant rehabilitation (post-cyclone) and construction, and technical assistance to develop a least-cost investment plan and asset management	2017–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Provided grid-connected photovoltaic panels	Public	Refer to table 5.5a

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Renewable Energy Expansion and Renewal	Increasing access to reliable clean energy by expanding each village's solar photovoltaic capacity and improving renewable energy asset management processes	Tokelau	Energy	Mitigation	Providing co-financing and technical assistance to expand renewable energy infrastructure and replace components at end of life	2019–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Provided grid-connected photovoltaic panels	Public	Refer to table 5.5
Nuku'alofa Network Upgrade Project	Facilitating economic and social development through the delivery of reliable, resilient and safe electricity	Tonga	Energy	Mitigation	Improving the performance and management of the network and reducing the diesel consumption in electricity generation through increased network efficiency	2018–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Upgraded electricity network materials, equipment and tools	Public	Refer to table 5.5
Renewable Energy Programme	Increasing beneficial and sustainable use of renewable energy resources to support economic and social development	Myanmar	Energy	Mitigation	Supporting ethnic communities and rural areas to increase renewable energy production and connectivity by undertaking best-practice development of renewable energy resources	2018–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Providing technical assistance and capacity building, as well as assisting with technical studies and applications for funding	Public	Refer to table 5.5

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Promoting Rural Electrification	Enhancing living conditions of the population in rural areas by improving access to clean, affordable and reliable electricity	Myanmar	Energy	Mitigation	Promoting and encouraging private sector participation and investment in renewable energy mini-grids in rural Myanmar	2019–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Provided technical assistance and capacity building to support the implantation of mini-grid projects	Public	Refer to table 5.5b
Accelerating Geothermal Development	Accelerating geothermal development that supports economic and social development, while increasing human capacity and advancing gender, environment and human rights in the sector	Indonesia	Energy	Mitigation	Supporting geothermal energy development and access to energy by providing technical assistance and capacity building to three partner agencies focused on geothermal development	2018–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Enabled geothermal electricity generation by providing technical assistance and capacity building	Public	Refer to table 5.5
Improving Energy Access in Maluku	Supporting the uptake of affordable, reliable and renewable energy	Indonesia	Energy	Mitigation	Supporting the uptake of affordable, reliable and renewable energy in off-grid and grid-connected areas in Seram and surrounding islands in eastern Indonesia	2017–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Enabled electricity mini-grids by providing technical assistance and capacity building	Public	Refer to table 5.5

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Supporting Geothermal Sector Training	Increasing workforce skills and capability in geothermal energy	Indonesia	Energy	Mitigation	Increasing workforce skills and capability in geothermal energy through targeted support covering training for geothermal trades, technicians and plant operators	2017–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Enabled geothermal energy generation through capacity building	Public	Refer to table 5.5
Lao PDR and Cambodia Renewable Energy Facility	Increasing the use of renewable energy resources to support economic and social development	Cambodia, Lao PDR	Energy	Mitigation	Providing technical assistance to increase the use of renewable energy resources to support economic and social development in Lao PDR	2019–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Transferred technology through technical assistance and capacity building	Public	Refer to table 5.5
Support for Realisation of Geothermal Potential	Undertaking technical studies allowing the Government of Comoros to attract funding for the next stages of realising its geothermal potential	Comoros	Energy	Mitigation	Assisting the development of the potential geothermal resource on Comoros for electric power generation	2017–20	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Provided technical assistance and capacity building	Public	Refer to table 5.5a

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Africa Geothermal Assistance Facility	Reducing reliance on fossil fuels and expanding access to affordable, reliable and clean energy in East Africa through technical assistance for geothermal energy development and distribution	Africa	Energy	Mitigation	Establishing a Geothermal Facility to support the development of the geothermal sector in 11 East African countries	2017–24	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Assisted with technical studies and applications for funding for a programme of drilling for geothermal energy	Public	Refer to table 5.5
Infrastructure Trust Fund	Supporting the Cook Islands to resource construction of resilient public infrastructure and strengthen infrastructure sector capability	Cook Islands	Multi-sector	Adaptation	Financing the construction of high-quality public infrastructure in the Cook Islands and supporting infrastructure sector capacity building, by contributing to an Infrastructure Trust Fund	2019–34	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Assisting with technical studies and the procurement of appliances that will enable slab replacement at Rarotonga International Airport	Public	Refer to table 5.5a

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Strengthening Water Security in Selected Pacific Island Countries	Supporting vulnerable and isolated communities in drought-prone Pacific atolls to gain sustained access to safe and reliable drinking water, including during periods of drought	Pacific	Water and sanitation	Adaptation	Building resilience by helping vulnerable Pacific Island countries to access safe and reliable drinking water supplies, and reduce their risk of water shortage	2017–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Developing practical tools and procedures to improve awareness, build capacity, reduce vulnerability and maximise use of available water resources	Public	Refer to table 5.5a
Tropical Cyclone Winston: Recovery Package	Providing a package of recovery support to Fiji following Tropical Cyclone Winston	Fiji	Humanitarian	Adaptation	Providing a recovery package for Fiji in response to Tropical Cyclone Winston, which destroyed housing and crucial infrastructure	2017–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Delivered training programmes and construction techniques that improve resilience to cyclones	Public	Refer to table 5.5a
Habitat Training for Disaster Risk Reduction in Fiji	Increasing resilience to disasters of vulnerable Fijian communities through shelter-specific training in disaster risk reduction using community-led safe shelter awareness	Fiji	Humanitarian	Adaptation	Building on Habitat for Humanity New Zealand training in resilient building methods for disaster risk reduction and sustainability	2017–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Building using and training in resilient building methods for disaster risk reduction and sustainability	Public	Refer to table 5.5

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Local Government Technical Assistance Facility 2017–22	Improving service delivery and infrastructure at the local level	Pacific	Adaptation	Government and civil society	Supporting New Zealand local government employees to work with their equivalents in Pacific Island countries to share technical knowledge and capability	2017–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Sharing technical knowledge and capability focusing on urban planning, asset management and governance	Public	Refer to table 5.5
Wharf and Reef Channel Rehabilitation	Increasing the safety and efficiency of ship-to-shore transfers of passengers and cargo at Tokelau's atolls	Tokelau	Adaptation	Transport and storage	Reconstructing wharfs and reef channels in four locations on Tokelau	2017–20	Engagement of local decision-makers and labourers has increased the sense of local ownership for the rehabilitated wharfs	Upgraded and resilient wharfs and reef channels	Public	Refer to table 5.5a
Water Sector Partnership 2017–21	Increasing sustainable and equitable access to improved, safe water, leading to a healthier and more economically productive and resilient ni-Vanuatu population	Vanuatu	Adaptation	Water and sanitation	Supporting the Department of Water Resources to operationalise its National Implementation Plan	2017–21	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Assisting with technical studies to assess risks to the water system and work with the community to address them	Public	Refer to table 5.5

Project title	Purpose of the project	Recipient country or countries	Sector	Targeted area	Description of the project	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector – was private-sector activity encouraged?	Total funding
Strengthening Disaster Resilience	Improving skills and knowledge for disaster risk reduction planning and implementation	Indonesia	Adaptation	Multi-sector	Providing training and capability building to increase the disaster risk management skills of local governments. Action plans for 10 districts will be developed and effectively implemented	2017–20	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Improved knowledge and skills from training	Public	Refer to table 5.5
Better Warehousing	Improving relief response capabilities of the Indonesian Red Cross National Society, as a result of better warehousing and logistics, resulting in reduced losses from disasters	Indonesia	Adaptation	Humanitarian	Providing funding and technical assistance to improve infrastructure, knowledge and relief response capabilities in an emergency	2017–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Technology was transferred through technical assistance and capacity building	Public	Refer to table 5.5
Myanmar Better Warehousing and Logistics	Increasing the sustainable recovery from emergencies for vulnerable disaster-affected communities through more efficient provision of relief supplies in Myanmar	Myanmar	Adaptation	Multi-sector	Providing funding and technical assistance to improve warehousing infrastructure, knowledge and relief response capabilities in Myanmar	2017–23	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Technology was transferred through technical assistance and capacity building	Public	Refer to table 5.5

Note: Lao PDR = Lao People's Democratic Republic.

Table 5.7: Technology transfer delivered through the Global Research Alliance on Agricultural Greenhouse Gases

Project title	Purpose	Recipient country or countries	Sector	Targeted area	Description	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector	Total funding (NZ\$)
Institutional Strengthening in Indonesia for Mitigating Livestock Methane Emissions	Assisting South East Asian countries to develop higher-tier agricultural inventories	Indonesia, Malaysia	Agriculture	Mitigation	Developing Tier 2 inventories to measure the impacts of mitigation technologies and practices	2018–20	Builds on existing activities in South East Asia to improve livestock GHG inventories	Training in undertaking measurements and understanding how these are linked to higher-tier livestock GHG accounting methodologies. Understanding the impacts of specific mitigation technologies to reduce livestock methane emissions	Public	\$563,220
Database and Inventory Refinement for GHG Emissions Associated with Manure	Consolidating and unifying methane and nitrous oxide emissions datasets associated with manure from several regions of the world	Chile	Agriculture	Mitigation	Establishing a central database. Analysing the data to generate emissions factors and provide a global resource for upgrading national inventories	2018–21	Coordination across responsible agencies, government and researchers	Coordinated and analysed regional data from Latin America; developed understanding of the requirements for GHG inventories and developed regionally specific emissions factors	Public	\$140,000
Bovine Productivity in the South American Chaco Region	Generating socio-economic and environmental benefits for the region by improving the efficiency, stability and resilience of family livestock system	Argentina, Bolivia, Uruguay	Agriculture	Mitigation	Generating an extension network and a virtual collaborative site with specialised livestock technicians that efficiently disseminate and transfer technology to producers	2020–24	Partnership with FONTAGRO	Network of pilot sites (livestock farms) where the proposed technologies are adapted and demonstrated, together with a technical assistance and training plan on livestock	Public	\$310,599

Project title	Purpose	Recipient country or countries	Sector	Targeted area	Description	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector	Total funding (NZ\$)
								innovation for extension agents, advisors and producers		
Agritech for Climate-smart Dairy	Generating digital tools to implement climate-smart dairy in the targeted region	Argentina, Costa Rica, Dominican Republic, Honduras, Uruguay	Agriculture	Mitigation	Creating a digital platform to monitor real-time productive, climate and management aspects that allow the implementation of climate-smart dairy establishments in the region	2020–24	Partnership with FONTAGRO	Creating reliable data for farmers and technicians for the sustainable management of milk establishments	Public	\$279,503
Innovation in Pasture Management	Improving self-sufficiency and sustainability of livestock production	Argentina, Costa Rica, Uruguay	Agriculture	Mitigation	Improving grass harvest produced on family farms, through the use of drones and decision support platform	2020–24	Partnership with FONTAGRO	Developing new technologies to help farmers increase their harvest and facilitate management decisions	Public	\$310,559
Organic-Carbon Sequestration in Latin American and Caribbean (LAC) Soils	Contributing to the design of land uses management with potential for sequestration of soil carbon in the agricultural system	Uruguay, Argentina, Chile, Colombia, Costa Rica	Agriculture	Mitigation	Generating capacities in LAC to quantify and monitor soil carbon stock	2020–24	Partnership with FONTAGRO	Identifying and evaluating strategies for intensification of agricultural production systems in LAC with potential for mitigation and adaptation to climate change	Public	\$397,331
Regional and Technical Engagement in South and East Africa	Improving the livestock GHG inventory of Kenya	Tanzania, Kenya, Botswana, Zambia, Malawi, South Africa	Agriculture	Mitigation	In partnership with FAO and local institutes, a three-day technical workshop to develop a Tier 2 inventory for Kenya's dairy sector	2018–19	Built on existing work with Kenya via the joint GRA–FAO–CCAC project, 'Reducing enteric methane for improving food security and livelihoods'	Developed a higher-tier GHG inventory for the dairy sector to account for mitigation practices and technologies	Public	\$68,856

Project title	Purpose	Recipient country or countries	Sector	Targeted area	Description	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector	Total funding (NZ\$)
Regional and Technical Engagement in South and East Africa	Regional GRA engagement with East African countries	Ethiopia, Ivory Coast, Kenya, Tanzania, Uganda	Agriculture	Mitigation	On behalf of the GRA and working in partnership with CCAFS, FAO, the World Bank and the African Climate Policy Centre, NZAGRC	2018–19	Coordination across responsible agencies, government, researchers and regional organisations	Demonstrated how science underpins this work, including helping to support countries' NDCs. Identified ways to build regional and national capacity through future activities	Public	\$68,856
The Effect of Feed and Nutrition on Methane Emissions from Cattle in South East Asia and South America	Improving the quantification of the effects of feed and nutrition on enteric methane emissions from cattle	Malaysia, Colombia, Argentina, Brazil, Chile, Costa Rica, Mexico, Peru, Uruguay, Indonesia, Thailand, Viet Nam, China, Philippines, Cambodia, Lao PDR	Agriculture	Mitigation	Generating more data for production systems in South East Asia and South America to develop specific methane yield values for the region	2019–21	Expanded animal feed databases to represent production systems in South East Asia and South America	Creating more reliable and precise databases to improve animal feed and reduce methane emissions efficiently	Public	\$328,497
Enteric Fermentation: Rumen Microbiomes to Predict Methane	Sequencing microbiome profiles of ruminant species from multiple countries	Brazil, Peru, Uruguay	Agriculture	Mitigation	Developing a rapid sequencing technology to generate low-cost profiling of rumen microbiome that can be used to predict methane emissions	2018–22	Global collaboration to understand how the rumen adapts to different production system	Generated a method of profiling the rumen microbiome with low cost and in live animals at any stage of production	Public	\$367,024

Project title	Purpose	Recipient country or countries	Sector	Targeted area	Description	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector	Total funding (NZ\$)
MRV of Livestock Emissions at the Provincial Level in China	Developing methods and systems for advanced (Tier 2) measurement, reporting and verification (MRV)	China	Agriculture	Mitigation	Delivering improved guidance for provincial-level implementation of Tier 2 inventories	2018–20	Collaboration with international research centres	Sharing improved guidance for provincial-level implementation of MRV – Tier 2 for compilers, and sharing project's outcomes with policy-makers	Public	\$193,118
Discovery of new nitrification inhibitors: Phase II	Identifying novel compounds to nitrification and mitigate nitrous oxide emissions	China	Agriculture	Mitigation	Identifying novel compounds to nitrification and mitigating nitrous oxide emissions	2017–20	New Zealand's International Research Fund 'Global Partnerships in Livestock Emissions Research' supports the participation of developing country researchers	Involving international partners from China and the United Kingdom. Shared the high-throughput screening mechanisms for novel inhibitors developed in New Zealand	Public	\$50,000
Antibody Binding to Antigenic Targets in the Rumen	Improving the effectiveness of anti-methanogen vaccines	Argentina	Agriculture	Mitigation	Optimise antigen production and improve the effectiveness of anti-methanogen vaccines	2017–20	New Zealand's International Research Fund 'Global Partnerships in Livestock Emissions Research' supports the participation of developing country researchers	Involving international partners from Argentina and Australia	Public	\$120,000
Emissions Avoidance of Soil Carbon from Lands Undergoing Practice Change	Understanding the possible options in soil management that may prevent or reduce the rapid initial loss of soil carbon	Indonesia	Agriculture	Mitigation	Using the latest information in published and grey literature, along with professional expertise to understand how to reduce soil carbon losses	2019–20	Partnership with ACIAR	Identifying ways to build regional and national capacity through future activities	Public	\$100,000

Project title	Purpose	Recipient country or countries	Sector	Targeted area	Description	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector	Total funding (NZ\$)
Evaluation of Climate Risks to Farming Systems in the Pacific	Improving understanding of the risks of the long-term impact of climate change in the Pacific	Solomon Islands	Agriculture	Mitigation	Studying the impact of climate change on agricultural livelihoods and food security in the Pacific	2019–21	Partnership with ACIAR	Delivering key industry report to develop larger programme	Public	\$88,456
UNIQUE – GRA Engagement Activities in Selected Countries in Sub-Saharan Africa and Asia	Supporting countries' capacity to identify concrete mitigation actions and policies, including robust assessment of possible reductions	Sub-Saharan countries	Agriculture	Mitigation	Collaborating with international experts to develop national and regional capacity to advance locally appropriate GHG inventories, NDCs and MRV systems	2019–20	Partnership with UNIQUE and international experts	Developing access to infrastructure and material for developing countries. It will support the targeted countries into reaching their NDCs	Public	\$150,000
Livestock Sector Activity Data Collection- Sub-Saharan Africa	Improving national livestock GHG emissions to Tier 2.	39 countries across Sub-Saharan Africa.	Agriculture	Mitigation	Data collection and analysis of technics to produce a report GHG emission capability for each selected country	2020	Partnership with FANRPAN	Developing higher-tier GHG inventory for livestock	Public	\$179,402
Development of Regional Methane Emissions Factors for Livestock Categories for Sub-Saharan Africa	Improving livestock GHG emissions to higher-tier level and supporting countries in achieving their NDCs	Central, East, West and Southern African countries (39 in total)	Agriculture	Mitigation	Improving livestock GHG emissions to higher-tier level and supporting countries in achieving their NDCs	2020–21	Inventory of measurement results and outcomes comparisons	Resulting data will generate regionally relevant methane emissions factors for livestock in Sub-Saharan Africa	Public	\$71,720
Stocktake of Selected ASEAN Countries' Inventory Capability Needs	Gathering information on livestock GHG inventories to be developed	Cambodia, Lao PDR, Myanmar, Philippines	Agriculture	Mitigation	Collecting information on livestock GHG inventories	2020	Collaboration with regional expert to gather information and report to New Zealand	Sharing knowledge to move to higher-tier inventory	Public	\$16,000

Project title	Purpose	Recipient country or countries	Sector	Targeted area	Description	Year(s)	Factors that led to the project's success	Technology transferred	Activities undertaken by public or private sector	Total funding (NZ\$)
Tier 2 Inventory Development and Implementation in Kenya	Helping targeted country to move to higher-tier inventory	Kenya	Agriculture	Mitigation	Providing technical support and expertise to Kenya to move to Tier 2 inventory for its dairy sector	2018–19	Collaboration with FAO, CCAFS and Kenya's State Department for Livestock	Improved national capability in inventory development	Public	\$100,860

Note: ACIAR = Australian Centre for International Agricultural Research; CCAC = Climate and Clean Air Coalition; CCAFS = Research Program on Climate Change, Agriculture and Food Security; FANRPAN = Food, Agriculture and Natural Resources Policy Analysis Network; FAO = Food and Agriculture Organization; FONTAGRO= Regional Fund for Agricultural Technology of Latin America; GHG = greenhouse gas; GRA = Global Research Alliance on Agricultural Greenhouse Gases; Lao PDR = Lao People's Democratic Republic; MRV = measurement, reporting and verification; NDC = Nationally Determined Contribution; NZAGRC = New Zealand Agricultural Greenhouse Gas Research Centre.

5.4 Capacity building

Aotearoa New Zealand recognises that enhancing the capacity and capability of developing countries to take effective climate change action must play an important role in responding to climate change. It provides capacity-building support that responds to the existing and emerging capacity needs developing country Parties identify in the areas of mitigation, adaptation, and technology development and transfer. This occurs through a number of mechanisms, including the New Zealand IDC Programme, the GRA, the UNFCCC and regional organisations such as SPREP, SPC and the University of the South Pacific.

New Zealand's capacity-building activities are targeted to areas where it has expertise, such as weather and climate data analysis and forecasting, agriculture, renewable energy generation and disaster risk resilience building, and where countries have identified specific needs and capacity gaps. A large portion of this capacity-building activity has been aimed at the Pacific region. This means the capacity-building support is focused on responding to the needs of those with the least capacity – small island developing states, many of which are also the countries most vulnerable to climate change. Other capacity-building activities New Zealand has delivered where it has expertise have been to the benefit of developing countries in Africa, South East Asia, Latin America and the Caribbean.

5.4.1 Capacity building supported through the New Zealand IDC Programme

Capacity building is an integral part of most activities in the New Zealand IDC Programme. As noted in section 5.1.2, we introduced a climate change capacity-building marker into our reporting system in 2018. This is enabling us to better track the support we provide for climate change capacity building and to provide more detailed reporting in the future. Table 5.8 describes New Zealand's capacity-building support in the context of climate change. The following examples illustrate the range of areas to which this support has contributed.

- **Improving climate research, data and analysis to support better evidence-based decision making.** New Zealand provided funding to establish a Pacific Community Centre for Ocean Science (see section 5.2.3).
- **Disaster risk management and resilience building.** The Disaster Risk Management in Fiji activity was designed to increase the capacity of the National Disaster Management Office to manage disaster awareness and response in Fiji. It involves: (a) providing technical assistance to the office; (b) upgrading tsunami and flood protection systems; and (c) constructing warehouses and evacuation centres.
- **Renewable energy.** Alongside the many renewable energy activities that are aimed at technology transfer, New Zealand aims to strengthen these with capacity-building support to ensure countries and communities have the ability to operate and maintain these technologies into the future, especially in the face of the impacts of climate change (see section 5.3.1 under 'Success stories').
- **Ocean acidification.** The New Zealand Pacific Partnership on Ocean Acidification activity has supported communities in Fiji, Kiribati and Tokelau to better adapt to the impacts of ocean acidification through support for research and community-based adaptation and awareness-raising actions.
- **Drought resilience.** The Averting Water-related Emergencies activity builds early warning systems in the Pacific region (see section 5.2.3 under 'Loss and damage').

- **Agriculture.** The Myanmar Dairy Inclusive Growth and Investment activity supports continued development of an inclusive, vibrant and sustainable dairy sector, leading to higher incomes for smallholder farmers and safe food for consumers.
- **Fisheries.** The Solomon Islands fisheries support activity will contribute to sustainable fisheries management, food security and improved government revenue.

Data and information

Having access to climate data and analysis, along with suitable information products and services, is critical for improving the effectiveness of climate action. New Zealand is providing a wide range of support to increase the quality and quantity of weather and climate data and forecasting; improve impact analysis of natural disasters exacerbated by climate change; and undertake an extensive research project into the current and predicted impacts of climate change in the Pacific region. It is also creating information products and services to better respond to the demands of government, business and communities to improve climate-resilient decision-making.

5.4.2 Other capacity-building support

New Zealand has provided support to capacity-building initiatives from other government funding sources. It has channelled some of this support through the GRA, the UNFCCC, other New Zealand government agencies and regional organisations, such as SPREP. As detailed in table 5.9, during the reporting period New Zealand provided:

- NZ\$1,004,009 to the Livestock Emissions Abatement Research Network (LEARN),⁸⁹ to support technicians, PhD students and postdoctoral fellows from developing countries to build international capability in livestock emissions research
- NZ\$589,668 for Climate, Food and Farming Network students from developing countries, who are currently enrolled in PhD programmes, to undertake short-term research in association with advanced research institutes on topics related to measurement and mitigation of GHG emissions, or carbon storage in agricultural systems and quantification of GHG emissions
- NZ\$35,126 to support participants to attend advanced online courses hosted by the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) on agricultural GHG assessment of emissions, mitigation options and adaptation strategies
- NZ\$167,580 to support GRA members from developing countries to attend a GRA council meeting and Climate Smart Conference.

⁸⁹ See www.livestockemissions.net for further information.

Table 5.8: Activities managed by the New Zealand IDC Programme that address capacity building (CTF Table 9)

Recipient country or countries	Target area	Project title	Description
Pacific Regional	Adaptation	Pacific Islands Emergency Management Alliance	Funds SPC to deliver regional and national training exercises and technical assistance for Pacific Island countries' emergency services
Palestine	Cross-cutting	Palestine Renewable Energy (Office of the Quartet)	Supports the development of renewable energy initiatives in Occupied Palestinian Territories through the funding of a senior energy expert, and contributes to an economic development associate and multiple detailed feasibility studies for proposed solar power generation sites in Gaza
Solomon Islands	Adaptation	Forest Conservation	Supports the protection of forests and the ecosystem services they provide, through delivery of alternative source of revenue for landowners
Philippines	Adaptation	Agricultural Livelihoods in Mindanao	Targets households that are food insecure, many of which are returning home after being displaced by conflict
Pacific Regional	Cross-cutting	Climate and Oceans Support Program in the Pacific	Provides funding for the Climate Data for the Environment component, which will include funding for NIWA-led activities
Pacific Regional	Cross-cutting	PICTicipate (from 2018/19)	Supports the attendance of Pacific Island citizens at regional and international events, which strengthens ownership of regional and international development processes, and provides capacity building and knowledge transfer
Samoa	Adaptation	Habitat Disaster Risk Reduction Samoa	Supports disaster risk reduction in Samoa through training in safer building techniques, disaster preparation and financial literacy
Tuvalu	Cross-cutting	Vaitupu Energy Extension	Scopes the work required on the current renewable energy infrastructure, in order to determine the scale of additional work required
Tuvalu	Adaptation	Vaitupu Water Security	Supports the generation of knowledge for evidence-based decision-making, the establishment of local capacity to manage, operate, maintain and govern the system, and the empowerment of the community to maintain safe drinking water in all conditions
Tokelau	Cross-cutting	Coastal Risk Mitigation	Enhances the resilience of communities by preparing designs and inputs for strengthening coastal defences, constructing emergency shelters and repairing or replacing Nukunonu bridge

Recipient country or countries	Target area	Project title	Description
Fiji	Cross-cutting	Disaster Risk Management in Fiji	Supports improved disaster preparedness and response, and climate resilience by increasing the capacity of the National Disaster Management Office to manage disaster awareness and response in Fiji
Fiji	Adaptation	Fiji Ease of Doing Business – International Finance Corporation contribution	Promotes private sector development and growth by promoting policy and providing tools and opportunities for businesses, investors and government departments
Worldwide	Cross-cutting	Commonwealth Fund for Technical Cooperation 2019–21	Contributes to the Commonwealth Fund for Technical Cooperation, which supports the Commonwealth Secretariat work programme to deliver assistance to developing Commonwealth member countries, mostly in the form of technical assistance
Worldwide	Cross-cutting	CGIAR – Research on Climate Change, Agriculture and Food Security 2018–21	Supports international agricultural research focused specifically on climate change, agriculture and food security programmes
Pacific Regional	Cross-cutting	Improving Ecosystem Resilience: Kiwa Initiative	Supports the implementation of the ‘Kiwa Initiative: Nature-based Solutions for Climate Resilience’, which will increase the resilience of Pacific Islands ecosystems, economies and communities
Pacific Regional	Cross-cutting	Support to the Pacific Climate Change Centre	Supports the Pacific Climate Change Centre and will focus on human resources and capacity development
Pacific Regional	Cross-cutting	Strengthening Pacific Monitoring, Evaluation and Learning (MEL) capacity	Improves governance and decision-making by strengthening capacity for contextually and culturally appropriate monitoring, evaluation and learning
Pacific Regional	Cross-cutting	Pacific Regional Infrastructure Facility (PRIF) Phase Four (November 2019 – November 2023)	Improves the delivery of development assistance to the infrastructure sector in the Pacific. PRIF supports infrastructure development and maintenance in Pacific Island countries through investment coordination, research and technical assistance
Myanmar	Cross-cutting	Myanmar Dairy Inclusive Growth and Investment	Supports continued development of an inclusive, vibrant and sustainable dairy sector in Myanmar, which leads to higher incomes for smallholder farmers and safe food for consumers
Worldwide	Cross-cutting	Alliance of Small Island States, Grant for Assistance	Enhances capacity for advocacy on climate change and oceans issues in international fora
Pacific Regional	Adaptation	Pacific Public Sector Strengthening	Supports public sector reform initiatives, development of Pacific-specific solutions and supports the Pacific Public Service Commissioners’ Conference to share knowledge and experience
Kiribati	Mitigation	Energy and Public Utility Reform	Supports the Public Utilities Board to build institutional capability and capacity

Recipient country or countries	Target area	Project title	Description
Pacific Regional	Cross-cutting	Improve Decision-making through Ocean Knowledge	Supports the establishment of the Pacific Community Centre for Ocean Science, which will support and strengthen regional oceans governance and management for Council of Regional Organisations of the Pacific processes
Pacific Regional	Cross-cutting	Pacific Regional NDC Hub	Supports the Pacific Regional NDC Hub, which has been established to help Pacific Island countries enhance and implement their NDCs under the Paris Agreement
Fiji	Adaptation	RISE – Upgrades for Informal Settlements	Integrates ecologically and environmentally sustainable water infrastructure into the housing and landscapes of 12 informal settlements in the greater Suva area
Niue	Cross-cutting	Strengthen Governance: Capability	Contributes to good governance, management and improved service delivery within Niue's public sector through building the capability of government institutions to deliver their functions effectively and efficiently and adhere to accountability requirements
Pacific	Cross-cutting	Pacific Participation at Global Evaluation Fora	Supports Pacific attendance at Global Evaluation Fora to strengthen Pacific voice and participation on the international stage
Pacific Regional	Cross-cutting	Pacific Voice	Focuses on amplifying the Pacific voice, enabling the Pacific to tell its story and influencing global negotiations with greater impact
Pacific Regional	Adaptation	Climate Mobility	Enhances Pacific resilience to climate change by enabling Pacific peoples to remain in situ and minimise harm from potential climate-related mobility
Tuvalu	Cross-cutting	Integrated Water Resources Management – Tuvalu	Supports a diagnostic of current water collection and storage on the outer atolls that will strengthen drought management plans, water and sanitation policy, and drought modelling
Kiribati	Cross-cutting	Climate Change Resilience	Supports Kiribati to plan for and respond to climate change impacts effectively
Pacific Regional	Cross-cutting	Ecosystems Resilience	Supports Pacific countries to maintain and restore ecosystem services for food security, coastal protection and disaster risk reduction
Pacific Regional	Adaptation	Information for Decision-making	Supports the incorporation of climate change information into all forms of government decision-making and planning
Kiribati	Cross-cutting	Uananginang Ununiki Group	Provides a source of fresh drinking water for home-grown vegetables and root crops to sustain and nourish the community

Recipient country or countries	Target area	Project title	Description
Pacific Regional	Adaptation	Disaster Risk Management in the Pacific 2019–24	Provides a programme of technical and advisory support to the Cook Islands, Niue, Samoa, Tokelau and Tonga to strengthen domestic disaster risk management capabilities
Africa	Adaptation	East Africa: Farm to Market Alliance	Contributes to the Farm to Market Alliance in East Africa, which works to sustainably improve farmer livelihoods while fostering commercial viability of value chain stakeholders
Pacific Regional	Adaptation	Enhanced Pacific Biosecurity Programme	Supports the Cook Islands, Fiji, Niue, Samoa, Tonga and Vanuatu to improve Pacific biosecurity
Pacific Regional	Adaptation	Reduce Risk of Water Scarcity	Provides at-risk communities with improvements to their water infrastructure, infrastructure maintenance, training and tools
Pacific Regional	Adaptation	Averting Water-related Emergencies	Supports Pacific Island countries to understand their vulnerability to water-related hazards and informs vulnerable communities so they can anticipate and respond
Pacific Regional	Adaptation	Building Resilient Water Management Systems	Integrates water resource management approaches into local, national and regional systems to improve water security
Pacific Regional	Cross-cutting	Low-emissions, Climate-resilient Planning	Supports the transition to low-emissions and climate-resilient futures through supporting long-term, climate-responsive planning and decision-making
Cambodia	Mitigation	Angkor Governance Support	Supports the development of the Angkor Park Landscape Management Strategy for this World Heritage site and its indigenous communities
Tuvalu	Mitigation	Maritime Transport – Maintenance and Safety Systems	Improves maritime safety aboard Tuvalu Government vessels by addressing known mechanical faults and establishing maintenance plans and safety systems to keep the vessels up to a minimum international standard
Africa	Cross-cutting	Building Resilience of Smallholder Farmers	Targets food-insecure households in rural areas of Zimbabwe by providing capacity-strengthening activities to build resilience to climate shocks
Kiribati	Adaptation	Activity Capacity Support – Urban Development	Provides funding for the management of urban development initiatives in water and sanitation, solid waste management and urban housing
Indonesia	Adaptation	Strengthening Disaster Resilience	Provides training and capability building to increase the disaster risk management skills of local governments, provide specialist advice and technical support to local governments, and increase participation of the private sector, non-government organisations and communities in disaster risk management

Recipient country or countries	Target area	Project title	Description
Indonesia	Adaptation	National Disaster Response Framework	Supports the development of an all-of-government framework for disaster preparedness and response that clarifies roles, accountabilities and mechanisms for coordinating disaster preparedness and response work
Tuvalu	Mitigation	Tuvalu Renewable Energy Projects	Includes the installation of hybrid photovoltaics on the three outer islands of Nanumea, Nanumanga and Niutao as well as on Vaitupu, and hybrid photovoltaics on selected buildings in Funafuti
Samoa	Cross-cutting	Samoa Renewable Energy Partnership	Includes the development of large-scale photovoltaics, small hydro power plant rehabilitation and construction, and technical assistance to develop a least-cost investment plan and asset management
Kiribati	Adaptation	Kiribati Water	Aims to improve communities' access to reliable, safe water in Kiribati through investing in infrastructure and strengthening capacity and management
Pacific Regional	Adaptation	Strengthening Water Security in Selected Pacific Island Countries	Supports vulnerable Pacific Island countries to access safe and reliable drinking water supplies, and reduce their risk of water shortage
Pacific Regional	Cross-cutting	Ocean Acidification Partnership	Supports communities in Fiji, Kiribati and Tokelau to better adapt to the impacts of climate change-induced ocean acidification through support for research- and community-based adaptation actions
Fiji	Mitigation	MPI–BAF Biosecurity Activity	Supports Pacific capacity development to improve invasive species identification, management and response
Vanuatu	Adaptation	Water Sector Partnership 2017–21	Supports the Department of Water Resources to operationalise its National Implementation Plan
Pacific Regional	Adaptation	Improving Pacific Access to Climate Finance	Involves contracting for technical assistance and providing direct funding to help Pacific Island countries access climate finance

Note: BAF = Biosecurity Authority of Fiji; CGIAR = Consultative Group for International Agricultural Research; MPI = Ministry for Primary Industries; NDC = Nationally Determined Contribution; NIWA = National Institute of Water and Atmospheric Research; RISE = Revitalising Informal Settlements and their Environments; SPC = Pacific Community.

Table 5.9: Capacity-building activities funded from other sources

Recipient countries	Target area	Programme/project title	Description
Argentina, Bangladesh, Brazil, Chile, Costa Rica, Ethiopia, Nigeria, Pakistan, Paraguay, Senegal, Uruguay	Mitigation	Livestock Emissions Abatement Research Network	Supports technicians, doctoral students and postdoctoral fellows from developing countries to build international capability in livestock emissions research
Algeria, Argentina, Benin, Brazil, Burkina Faso, Cameroon, China, Colombia, Cuba, Ecuador, Ethiopia, India, Iran, Kenya, Mexico, Nepal, Nigeria, Pakistan, South Africa, Tanzania, Togo, Uganda, Viet Nam, Zimbabwe	Mitigation	Climate, Food and Farming Network – GRA Development Scholarships (CLIFF-GRADS)	The CLIFF-GRADS programme provides grants for students from developing countries, who are currently enrolled in PhD programmes, to undertake short-term research in association with advanced research institutes. Topics are related to measurement and mitigation of GHG emissions, or carbon storage in agricultural systems and quantification of GHG emissions
Democratic Republic of the Congo, Uganda, Benin, Kenya, South Africa	Mitigation	African Regional Universities Forum for Capability Building in Agriculture (RUFORUM)	Supports capability in Africa by offering grants to students and research from RUFORUM-associated universities, working on innovative responses to support smallholder farmers
CLIFF-GRADS Alumni	Mitigation	Financial Support	Financial support for CLIFF-GRADS alumni to participate in workshops and connect with each other. It also provided a platform for alumni to present their work
Ethiopia, Indonesia, Kenya, South Africa, Uganda	Cross-cutting	World Farmers' Organisation – GRA Study Tours	Young farmer and early-career agricultural scientist study tour to raise awareness between the international farming and science communities of the issue of GHGs from agriculture, to provide a way to share experiences and to be informed of, and inform, the global research agenda
Ghana, Senegal, Uganda, Cameroon, Côte d'Ivoire, Nigeria, Zambia, Zimbabwe, South Africa, Thailand, Tunisia, Costa Rica	Mitigation	Financial Support	Provided financial support for countries to attend a Livestock Research Group meeting and an associated GHG Animal Agriculture Conference
Pacific	Mitigation	Pacific Climate Change Conference	Hosted an interactive session at the Pacific Climate Change Conference. This event offered an occasion to enhance dialogue and cooperation with Pacific countries. Twenty-two delegates from Pacific countries attended thanks to GRA's financial support

Recipient countries	Target area	Programme/project title	Description
Ethiopia, Ghana, Argentina, Eswatini, Senegal, Uruguay, Zimbabwe, Malawi, Tunisia, Paraguay, Mongolia, Sri Lanka, Egypt, Panama, Viet Nam, Ecuador, Cambodia	Mitigation	Financial Support	Provided financial support to GRA members from developing countries to attend a GRA council meeting and Climate Smart Conference
Peru, Namibia, Botswana, Bhutan, Senegal, Rwanda, Ecuador	Mitigation	Training Course Hosted by CIHEAM	Funding for participants to attend an advanced online course in GHG assessment and mitigation in agriculture
Nigeria, Ghana, Egypt, Turkey, Argentina, South Africa	Mitigation	Training Course Hosted by CIHEAM	Funding for participants to attend an advanced online course in livestock and climate change (assessment of emissions, mitigation options and adaptation strategies)
Uganda, Malawi, Mexico, Colombia, Uruguay, Indonesia	Mitigation	Inventory Training	Training workshop for GHG inventory experts in developing countries
Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Côte d'Ivoire, Gambia, Ghana, Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Togo	Mitigation	Regional and Technical Engagement in Africa	Developing technical knowledge and engagement in African countries
Kenya, Indonesia, Costa Rica	Mitigation	The Role of Modelling in National Estimation of Livestock Emissions	Training workshop to improve the estimation and reporting of livestock GHG emissions
African and ASEAN countries	Mitigation	Development of Online Resources on Methodological and Emissions Factor Improvements to Countries' Agricultural GHG Inventories	Sharing practices, allowing compilers to improve current methodologies for NDC report

Note: ASEAN = Association of Southeast Asian Nations; CIHEAM = International Centre for Advanced Mediterranean Agronomic Studies; GHG = greenhouse gas; GRA = Global Research Alliance on Agricultural Greenhouse Gases.

6 Other reporting matters

6.1 Net position report

Aotearoa New Zealand regularly publishes a domestic net position report,⁹⁰ which tracks New Zealand's progress towards its targets. New Zealand will meet its 2020 emissions reduction target by applying the Kyoto Protocol accounting framework. The target will be met through contributions from forestry activities and international units.

6.2 Climate Change Commission and Climate Change Chief Executives Board

Amendments to the Climate Change Response Act 2002 in 2019 included the establishment of the He Pou a Rangi – Climate Change Commission (the Commission) to:

- provide independent advice to the Government on climate change mitigation and adaptation
- monitor and review the Government's progress towards meeting the emissions budgets and 2050 target, as well as the implementation of emissions reduction and national adaptation plans.

On 31 May 2021, the Commission delivered advice to the Government in its report *Ināia tonu nei: A low emissions future for Aotearoa*.⁹¹ The Commission's report provided recommendations on the first three emissions budgets, policy direction for the first emissions reduction plan, Aotearoa New Zealand's 2030 Nationally Determined Contribution, and reductions required for biogenic methane.

The Climate Change Chief Executives Board (the Board) has been established as an interdepartmental executive board under the Public Service Act 2020. The Board is responsible to the Prime Minister and is made up of the chief executives of government agencies with significant roles in mitigating and/or adapting to climate change. The Board provides cross-government oversight of the emissions reduction plan, and will also oversee the national adaptation plan, with focus on adaptation set to increase over time.

⁹⁰ The report is available at environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/emissions-reduction-targets/latest-update-on-new-zealands-2020-net-position/

⁹¹ Climate Change Commission. 2021. *Ināia tonu nei: A low emissions future for Aotearoa*. Wellington: Climate Change Commission.

6.3 Measuring emissions guidance

The measuring emissions guide⁹² provides guidance for Aotearoa New Zealand organisations of all sizes and levels of expertise to estimate their emissions and track reductions over time. This includes those measuring their emissions for the first time and those producing their latest greenhouse gas emissions report. The latest emissions factors are provided for common sources of emissions in New Zealand (based on *New Zealand's Greenhouse Gas Inventory 1990–2020*)⁹³ so organisations can input their activity data and produce their own inventory.

6.4 Carbon Neutral Government Programme

The Carbon Neutral Government Programme (CNGP) was set up by the Government to accelerate the reduction of emissions within the public sector. The programme's aim is to make several organisations within the public sector carbon neutral from 2025. It was launched in December 2020.⁹⁴ The CNGP has published guidance for CNGP organisations on measuring and reporting their greenhouse gas emissions.⁹⁵ It includes information on what sources of greenhouse gas emissions organisations need to collect data for, standards to follow, methods for calculating emissions, the required information to report, who to report to, and by when.

6.5 Voluntary climate change mitigation guidance

The Ministry for the Environment provides principle-based guidance for organisations to follow when making claims for voluntary action taken to reduce or remove greenhouse gas emissions outside the boundary of their organisation.

In February 2022, the Government published the report *Interim guidance for voluntary climate change mitigation*, to support New Zealand businesses with voluntary emissions mitigation efforts, such as offsetting.⁹⁶

The best practice for voluntary carbon markets internationally is evolving with the transition into the Paris Agreement era. As such, the guidance is interim and will be reviewed to ensure it remains relevant for organisations in Aotearoa New Zealand undertaking voluntary climate change mitigation.

Voluntary offsetting allows an organisation or individual to buy or use certified greenhouse gas emissions reductions or removals that have been achieved through actions that reduce emissions. These emissions reductions or removals can be used to offset an organisation's carbon footprint.

⁹² Ministry for the Environment. 2022. *Measuring emissions: A guide for organisations: 2022 detailed guide*. Wellington: Ministry for the Environment.

⁹³ Ministry for the Environment. 2022. *New Zealand's Greenhouse Gas Inventory 1990–2020*. Wellington: Ministry for the Environment.

⁹⁴ Information about the Carbon Neutral Government Programme is available on the Ministry for the Environment's website at environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/carbon-neutral-government-programme/

⁹⁵ Ministry for the Environment. 2021. *Carbon Neutral Government Programme: A guide to measuring and reporting greenhouse gas emissions*. Wellington: Ministry for the Environment.

⁹⁶ Ministry for the Environment. 2022. *Interim guidance for voluntary climate change mitigation*. Wellington: Ministry for the Environment

The guidance provides examples of how voluntary emissions offsetting can be applied in the New Zealand context as well as good practice guidelines on:

- what a voluntary emissions offset is
- what constitutes a voluntary offset.

An important message is that voluntary emissions offsetting should take place only after the organisation's or individual's emissions have been measured and subsequent emissions reductions made to the best of their ability. Only then should any remaining emissions be offset. Other principles that should be met for an offset to be credible include:

- the need for transparency
- being real, measurable and verified
- being additional
- not being double counted
- addressing leakage
- the need for permanence.

Appendix A: Summary of emissions and removals from New Zealand's 2022 Greenhouse Gas Inventory

Table A.1: Emissions trends summary (CTF Table 1) (three parts)

Table A.1: Emissions trends summary (CTF Table 1) (part 1 of 3)

Greenhouse gas emissions	Base year 1990 (kt CO ₂ - equivalent)	1991 (kt CO ₂ - equivalent)	1992 (kt CO ₂ - equivalent)	1993 (kt CO ₂ - equivalent)	1994 (kt CO ₂ - equivalent)	1995 (kt CO ₂ - equivalent)	1996 (kt CO ₂ - equivalent)	1997 (kt CO ₂ - equivalent)	1998 (kt CO ₂ - equivalent)
CO ₂ emissions without net CO ₂ from LULUCF	25,502.51	26,182.59	28,166.92	27,761.18	27,900.04	28,003.49	29,304.54	31,278.67	29,858.54
CO ₂ emissions with net CO ₂ from LULUCF	3,878.45	2,537.68	4,736.30	3,503.99	3,819.14	5,102.66	6,837.28	8,160.84	6,067.45
CH ₄ emissions without CH ₄ from LULUCF	32,972.51	33,208.11	32,793.87	33,091.81	33,991.44	34,237.19	34,881.11	35,676.09	35,023.70
CH ₄ emissions with CH ₄ from LULUCF	33,041.22	33,256.37	32,850.72	33,165.14	34,071.64	34,314.43	34,969.32	35,762.95	35,145.18
N ₂ O emissions without N ₂ O from LULUCF	5,792.05	5,860.17	5,887.35	6,108.18	6,334.50	6,570.02	6,647.84	6,732.60	6,666.35
N ₂ O emissions with N ₂ O from LULUCF	6,118.17	6,180.19	6,216.66	6,450.51	6,701.33	6,947.71	7,042.40	7,139.94	7,076.75
HFCs	NO, NA	NO, NA	0.29	0.36	7.91	24.52	54.36	113.42	97.52
PFCs	909.95	903.79	461.88	210.16	186.18	153.28	278.98	201.11	151.38
Unspecified mix of HFCs and PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
SF ₆	19.97	20.86	21.91	22.69	23.43	24.42	24.65	25.58	24.86
NF ₃	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Total (without LULUCF)	65,196.98	66,175.53	67,332.21	67,194.37	68,443.50	69,012.91	71,191.49	74,027.48	71,822.35
Total (with LULUCF)	43,967.76	42,898.90	44,287.76	43,352.84	44,809.62	46,567.01	49,206.99	51,403.84	48,563.14
Total (without LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (with LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA

Greenhouse gas source and sink categories	Base year 1990 (kt CO ₂ - equivalent)	1991 (kt CO ₂ - equivalent)	1992 (kt CO ₂ - equivalent)	1993 (kt CO ₂ - equivalent)	1994 (kt CO ₂ - equivalent)	1995 (kt CO ₂ - equivalent)	1996 (kt CO ₂ - equivalent)	1997 (kt CO ₂ - equivalent)	1998 (kt CO ₂ - equivalent)
1. Energy	23,877.89	24,367.64	26,228.40	25,762.94	26,081.68	25,866.12	27,462.16	29,493.97	27,912.15
2. Industrial processes and product use	3,579.92	3,728.61	3,374.09	3,213.46	3,082.80	3,174.43	3,365.55	3,253.36	3,237.01
3. Agriculture	33,792.88	34,022.51	33,570.98	33,956.39	35,133.36	35,734.70	36,038.26	36,893.06	36,287.58
4. Land Use, Land-Use Change and Forestry	-21,229.22	-23,276.63	-23,044.46	-23,841.53	-23,633.88	-22,445.90	-21,984.50	-22,623.64	-23,259.21
5. Waste	3,943.11	4,053.49	4,155.50	4,258.37	4,142.48	4,234.51	4,322.41	4,383.88	4,382.31
6. Other	3.17	3.28	3.24	3.21	3.17	3.14	3.11	3.21	3.30
Total (including LULUCF)	43,967.76	42,898.90	44,287.76	43,352.84	44,809.62	46,567.01	49,206.99	51,403.84	48,563.14

Table A.1: Emissions trends summary (CTF Table 1) (part 2 of 3)

Greenhouse gas emissions	1999 (kt CO ₂ - equivalent)	2000 (kt CO ₂ - equivalent)	2001 (kt CO ₂ - equivalent)	2002 (kt CO ₂ - equivalent)	2003 (kt CO ₂ - equivalent)	2004 (kt CO ₂ - equivalent)	2005 (kt CO ₂ - equivalent)	2006 (kt CO ₂ - equivalent)	2007 (kt CO ₂ - equivalent)	2008 (kt CO ₂ - equivalent)	2009 (kt CO ₂ - equivalent)
CO ₂ emissions without net CO ₂ from LULUCF	31,465.59	32,246.01	34,379.21	34,542.29	36,241.47	35,836.30	37,424.07	37,330.16	36,410.66	37,509.26	34,620.67
CO ₂ emissions with net CO ₂ from LULUCF	4,962.54	4,831.02	6,416.75	7,991.84	8,501.47	8,165.39	11,490.90	13,458.24	13,772.75	7,645.31	5,893.12
CH ₄ emissions without CH ₄ from LULUCF	35,127.95	35,951.60	36,370.66	36,079.86	36,160.67	36,215.13	36,522.93	36,850.14	35,794.38	34,369.57	34,522.16
CH ₄ emissions with CH ₄ from LULUCF	35,207.39	36,021.62	36,445.11	36,156.64	36,242.71	36,290.72	36,633.80	36,963.59	35,944.48	34,446.58	34,620.16
N ₂ O emissions without N ₂ O from LULUCF	6,697.21	6,996.74	7,363.34	7,463.59	7,726.31	7,859.35	7,930.30	7,725.79	7,537.10	7,537.22	7,539.78
N ₂ O emissions with N ₂ O from LULUCF	7,101.17	7,406.82	7,772.22	7,867.80	8,126.58	8,254.91	8,328.06	8,121.28	7,947.78	7,901.20	7,902.83

Greenhouse gas emissions	1999 (kt CO ₂ - equivalent)	2000 (kt CO ₂ - equivalent)	2001 (kt CO ₂ - equivalent)	2002 (kt CO ₂ - equivalent)	2003 (kt CO ₂ - equivalent)	2004 (kt CO ₂ - equivalent)	2005 (kt CO ₂ - equivalent)	2006 (kt CO ₂ - equivalent)	2007 (kt CO ₂ - equivalent)	2008 (kt CO ₂ - equivalent)	2009 (kt CO ₂ - equivalent)
HFCs	192.28	233.65	300.10	401.36	503.85	582.58	694.01	798.68	917.09	1,013.31	1,075.61
PFCs	68.67	67.61	70.61	84.48	126.81	99.12	69.38	106.73	48.41	45.47	53.86
Unspecified mix of HFCs and PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
SF ₆	24.56	19.56	20.04	23.32	25.19	28.92	25.41	21.05	19.87	19.34	22.54
NF ₃	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Total (without LULUCF)	73,576.26	75,515.17	78,503.95	78,594.91	80,784.30	80,621.38	82,666.10	82,832.55	80,727.52	80,494.16	77,834.61
Total (with LULUCF)	47,556.61	48,580.27	51,024.83	52,525.44	53,526.60	53,421.62	57,241.57	59,469.58	58,650.37	51,071.20	49,568.11
Total (without LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (with LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Greenhouse gas emissions	1999 (kt CO ₂ - equivalent)	2000 (kt CO ₂ - equivalent)	2001 (kt CO ₂ - equivalent)	2002 (kt CO ₂ - equivalent)	2003 (kt CO ₂ - equivalent)	2004 (kt CO ₂ - equivalent)	2005 (kt CO ₂ - equivalent)	2006 (kt CO ₂ - equivalent)	2007 (kt CO ₂ - equivalent)	2008 (kt CO ₂ - equivalent)	2009 (kt CO ₂ - equivalent)
1. Energy	29,283.48	30,019.02	32,039.08	31,989.04	33,413.74	33,056.30	34,649.77	35,047.74	33,639.79	34,775.53	32,091.90
2. Industrial processes and product use	3,412.94	3,443.22	3,558.48	3,680.46	3,916.54	3,953.00	4,061.65	4,171.18	4,431.19	4,322.44	4,274.59
3. Agriculture	36,468.19	37,614.88	38,445.14	38,452.90	39,075.43	39,219.07	39,571.90	39,427.40	38,508.10	37,332.25	37,535.96
4. Land Use, Land-Use Change and Forestry	-26,019.65	-26,934.90	-27,479.12	-26,069.47	-27,257.70	-27,199.76	-25,424.54	-23,362.98	-22,077.15	-29,422.96	-28,266.50
5. Waste	4,408.25	4,434.56	4,457.67	4,468.91	4,375.01	4,388.98	4,378.30	4,181.76	4,143.96	4,059.45	3,927.65
6. Other	3.40	3.49	3.59	3.59	3.59	4.04	4.49	4.47	4.48	4.50	4.51
Total (including LULUCF)	47,556.61	48,580.27	51,024.83	52,525.44	53,526.60	53,421.62	57,241.57	59,469.58	58,650.37	51,071.20	49,568.11

Table A.1: Emissions trends summary (CTF Table 1) (part 3 of 3)

Greenhouse gas emissions	2010 (kt CO ₂ - equivalent)	2011 (kt CO ₂ - equivalent)	2012 (kt CO ₂ - equivalent)	2013 (kt CO ₂ - equivalent)	2014 (kt CO ₂ - equivalent)	2015 (kt CO ₂ - equivalent)	2016 (kt CO ₂ - equivalent)	2017 (kt CO ₂ - equivalent)	2018 (kt CO ₂ - equivalent)	2019 (kt CO ₂ - equivalent)	2020 (kt CO ₂ - equivalent)
CO ₂ emissions without net CO ₂ from LULUCF	34,811.08	34,265.85	35,945.09	35,241.00	35,438.93	35,813.11	34,152.64	35,688.13	35,704.54	37,121.03	34,456.75
CO ₂ emissions with net CO ₂ from LULUCF	5,035.98	4,219.69	8,794.23	8,533.86	8,410.44	8,826.78	7,525.91	10,635.80	11,091.04	13,736.29	10,790.52
CH ₄ emissions without CH ₄ from LULUCF	34,764.35	34,932.72	35,238.02	35,186.88	35,486.17	34,989.09	34,538.48	34,415.85	34,445.83	34,510.42	34,272.94
CH ₄ emissions with CH ₄ from LULUCF	34,856.74	34,997.35	35,314.42	35,262.48	35,554.94	35,066.39	34,646.16	34,507.58	34,512.51	34,594.17	34,354.60
N ₂ O emissions without N ₂ O from LULUCF	7,679.68	7,859.78	7,968.75	8,000.41	8,267.30	8,186.65	8,214.77	8,244.40	8,363.08	8,399.49	8,463.78
N ₂ O emissions with N ₂ O from LULUCF	8,036.12	8,211.11	8,318.08	8,336.69	8,577.65	8,485.51	8,495.85	8,501.19	8,607.59	8,665.57	8,735.10
HFCs	1,100.81	1,177.84	1,262.35	1,311.05	1,335.79	1,386.17	1,419.55	1,465.97	1,479.03	1,481.00	1,480.29
PFCs	47.56	35.15	47.46	48.13	73.41	58.59	48.69	60.46	72.40	89.13	87.92
Unspecified mix of HFCs and PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
SF ₆	22.84	18.94	20.90	18.18	16.80	16.46	17.36	14.79	14.71	15.98	16.69
NF ₃	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Total (without LULUCF)	78,426.32	78,290.28	80,482.57	79,805.66	80,618.40	80,450.06	78,391.48	79,889.59	80,079.58	81,617.06	78,778.37
Total (with LULUCF)	49,100.05	48,660.08	53,757.43	53,510.39	53,969.03	53,839.90	52,153.51	55,185.79	55,777.28	58,582.14	55,465.11
Total (without LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (with LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Greenhouse gas emissions	2010 (kt CO ₂ - equivalent)	2011 (kt CO ₂ - equivalent)	2012 (kt CO ₂ - equivalent)	2013 (kt CO ₂ - equivalent)	2014 (kt CO ₂ - equivalent)	2015 (kt CO ₂ - equivalent)	2016 (kt CO ₂ - equivalent)	2017 (kt CO ₂ - equivalent)	2018 (kt CO ₂ - equivalent)	2019 (kt CO ₂ - equivalent)	2020 (kt CO ₂ - equivalent)
1. Energy	32,247.49	31,571.43	32,953.12	32,089.37	32,159.28	32,405.70	31,001.33	32,452.95	32,524.23	33,920.37	31,461.42
2. Industrial processes and product use	4,591.13	4,627.39	4,703.19	4,836.35	5,006.98	5,137.32	4,883.07	4,928.44	4,825.07	4,861.05	4,618.35
3. Agriculture	37,711.50	38,362.27	39,203.36	39,306.76	39,922.77	39,415.79	39,042.96	39,082.39	39,368.29	39,518.64	39,425.54
4. Land Use, Land-Use Change and Forestry	-29,326.27	-29,630.20	-26,725.14	-26,295.26	-26,649.37	-26,610.16	-26,237.97	-24,703.80	-24,302.31	-23,034.92	-23,313.25
5. Waste	3,871.67	3,724.65	3,618.63	3,569.66	3,525.88	3,487.83	3,460.68	3,422.28	3,358.36	3,312.70	3,268.87
6. Other	4.52	4.54	4.27	3.52	3.48	3.42	3.45	3.53	3.64	4.30	4.18
Total (including LULUCF)	49,100.05	48,660.08	53,757.43	53,510.39	53,969.03	53,839.90	52,153.51	55,185.79	55,777.28	58,582.14	55,465.11

Note: CO₂ = carbon dioxide; CH₄ = methane; HFCs = hydrofluorocarbons; kt CO₂-equivalent = kilotonnes of carbon dioxide equivalent; LULUCF = land, land-use change and forestry; N₂O = nitrous oxide; NA = not applicable; NF₃ = nitrogen trifluoride; NO = not occurring; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride.

Table A.2: Emissions trends (CO₂) (CTF Table 1(a)) (three parts)

Table A.2: Emissions trends (CO₂) (CTF Table 1(a)) (part 1 of 3)

Greenhouse gas source and sink categories	Base year 1990 (kt)	1991 (kt)	1992 (kt)	1993 (kt)	1994 (kt)	1995 (kt)	1996 (kt)	1997 (kt)	1998 (kt)
1. Energy	22,486.66	22,992.05	24,857.07	24,310.71	24,535.02	24,469.65	25,804.65	27,837.20	26,271.64
A. Fuel combustion (sectoral approach)	22,026.93	22,437.43	24,316.72	23,792.14	23,994.18	23,969.28	25,138.05	27,123.36	25,566.61
1. Energy industries	5,979.07	6,089.88	7,577.04	6,639.27	5,512.76	4,775.29	5,524.41	7,125.46	5,514.30
2. Manufacturing industries and construction	4,676.53	5,160.36	5,012.94	5,282.32	5,599.81	5,693.44	6,043.97	6,132.86	5,871.92
3. Transport	7,936.45	7,915.24	8,271.97	8,720.40	9,373.66	10,029.86	10,161.48	10,383.51	10,587.78
4. Other sectors	3,434.88	3,271.95	3,454.78	3,150.14	3,507.96	3,470.69	3,408.19	3,481.53	3,592.62
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	459.73	554.61	540.35	518.56	540.84	500.37	666.61	713.84	705.02
1. Solid fuels	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
2. Oil and natural gas and other emissions from energy production	459.73	554.61	540.35	518.56	540.84	500.37	666.61	713.84	705.02
C. CO ₂ transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial processes	2,519.96	2,659.49	2,757.60	2,847.57	2,725.62	2,813.83	2,826.09	2,732.19	2,792.19
A. Mineral industry	561.87	572.41	648.54	646.71	625.40	674.60	646.19	695.08	650.96
B. Chemical industry	175.40	189.82	181.80	179.40	196.23	171.54	190.79	190.39	195.43
C. Metal industry	1,757.51	1,872.16	1,901.17	1,994.16	1,874.88	1,936.83	1,957.86	1,814.77	1,913.27
D. Non-energy products from fuels and solvent use	25.17	25.10	26.10	27.30	29.12	30.87	31.25	31.95	32.54
E. Electronic industry									
F. Product uses as ODS substitutes									

Greenhouse gas source and sink categories	Base year 1990 (kt)	1991 (kt)	1992 (kt)	1993 (kt)	1994 (kt)	1995 (kt)	1996 (kt)	1997 (kt)	1998 (kt)
G. Other product manufacture and use	NA	NA	NA	NA	NA	NA	NA	NA	NA
H. Other									
3. Agriculture	335.68	371.91	394.77	442.64	500.41	582.38	541.38	568.01	644.78
A. Enteric fermentation									
B. Manure management									
C. Rice cultivation									
D. Agricultural soils									
E. Prescribed burning of savannas									
F. Field burning of agricultural residues									
G. Liming	296.48	320.06	343.64	372.15	408.87	445.60	399.54	440.22	480.89
H. Urea application	39.19	51.84	51.13	70.49	91.54	136.78	141.84	127.79	163.89
I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE
J. Other									
4. Land Use, Land-Use Change and Forestry	-21,624.05	-23,644.92	-23,430.62	-24,257.20	-24,080.90	-22,900.84	-22,467.27	-23,117.84	-23,791.09
A. Forest land	-20,299.82	-21,343.38	-20,968.13	-21,545.49	-21,189.00	-19,852.84	-19,550.85	-20,151.52	-22,243.66
B. Cropland	468.69	470.94	473.20	475.46	477.72	479.97	482.23	486.39	488.81
C. Grassland	609.84	713.08	809.36	903.63	996.05	1,019.31	1,046.28	1,077.75	1,102.97
D. Wetlands	-10.47	-8.75	-10.65	-8.97	-6.34	-4.42	-6.50	-2.38	-2.11
E. Settlements	75.42	76.96	78.50	80.25	82.76	85.96	88.21	90.69	92.88
F. Other land	13.50	14.74	15.99	17.24	18.48	19.73	20.97	24.25	26.06
G. Harvested wood products	-2,481.21	-3,568.51	-3,828.89	-4,179.31	-4,460.58	-4,648.55	-4,547.61	-4,643.02	-3,256.04

Greenhouse gas source and sink categories	Base year 1990 (kt)	1991 (kt)	1992 (kt)	1993 (kt)	1994 (kt)	1995 (kt)	1996 (kt)	1997 (kt)	1998 (kt)
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	158.91	157.84	156.15	158.92	137.63	136.26	131.03	139.87	148.51
A. Solid waste disposal	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
B. Biological treatment of solid waste									
C. Incineration and open burning of waste	158.91	157.84	156.15	158.92	137.63	136.26	131.03	139.87	148.51
D. Waste water treatment and discharge									
E. Other									
6. Other (as specified in summary table A.1)	1.30	1.31	1.33	1.34	1.36	1.38	1.39	1.41	1.42

Table A.2: Emissions trends (CO₂) (CTF Table 1(a)) (part 2 of 3)

Greenhouse gas source and sink categories	1999 (kt)	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
1. Energy	27,619.96	28,381.57	30,350.58	30,390.50	31,961.87	31,571.68	33,029.43	33,098.46	31,920.63	33,295.23	30,522.36
A. Fuel combustion (sectoral approach)	27,003.80	27,788.31	29,737.66	29,803.51	31,350.65	30,708.36	32,120.18	32,139.58	30,899.30	32,053.05	29,155.62
1. Energy industries	6,743.71	6,385.09	7,871.10	7,088.55	8,408.32	8,015.66	10,055.84	9,942.64	8,295.52	9,565.39	7,342.61
2. Manufacturing industries and construction	5,729.20	6,248.83	6,621.50	6,880.90	6,325.45	5,798.39	4,988.20	5,038.67	5,478.82	5,471.96	5,166.17
3. Transport	10,868.59	11,410.88	11,473.86	11,925.66	12,453.65	12,742.48	12,817.90	12,944.51	13,053.26	13,073.80	12,887.11
4. Other sectors	3,662.30	3,743.51	3,771.20	3,908.39	4,163.23	4,151.83	4,258.23	4,213.76	4,071.70	3,941.90	3,759.73
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	616.16	593.26	612.92	586.99	611.22	863.32	909.25	958.88	1,021.33	1,242.18	1,366.74
1. Solid fuels	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA

Greenhouse gas source and sink categories	1999 (kt)	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
2. Oil and natural gas and other emissions from energy production	616.16	593.26	612.92	586.99	611.22	863.32	909.25	958.88	1,021.33	1,242.18	1,366.74
C. CO ₂ transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial processes	2,944.29	2,922.48	2,986.90	2,984.81	3,152.96	3,131.49	3,208.64	3,180.88	3,376.87	3,158.99	3,022.38
A. Mineral industry	728.35	718.54	716.89	706.97	697.26	666.68	756.18	719.14	861.50	807.03	752.17
B. Chemical industry	196.71	198.26	206.31	213.07	201.42	194.29	229.12	243.05	249.96	265.66	261.66
C. Metal industry	1,985.89	1,970.95	2,028.69	2,028.55	2,216.67	2,232.09	2,184.66	2,179.63	2,226.05	2,046.67	1,969.13
D. Non-energy products from fuels and solvent use	33.33	34.74	35.01	36.23	37.60	38.43	38.67	39.06	39.36	39.64	39.43
E. Electronic industry											
F. Product uses as ODS substitutes											
G. Other product manufacture and use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
H. Other											
3. Agriculture	743.18	790.78	901.75	1,033.90	1,001.73	1,006.91	1,064.10	929.82	995.82	942.64	965.77
A. Enteric fermentation											
B. Manure management											
C. Rice cultivation											
D. Agricultural soils											
E. Prescribed burning of savannas											
F. Field burning of agricultural residues											
G. Liming	521.56	562.24	602.91	643.58	567.62	551.86	607.51	507.57	539.53	502.31	591.86
H. Urea application	221.62	228.54	298.84	390.32	434.11	455.04	456.60	422.26	456.29	440.33	373.91
I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
J. Other											

Greenhouse gas source and sink categories	1999 (kt)	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
4. Land Use, Land-Use Change and Forestry	-26,503.05	-27,414.99	-27,962.46	-26,550.45	-27,740.01	-27,670.91	-25,933.17	-23,871.92	-22,637.92	-29,863.95	-28,727.55
A. Forest land	-23,598.32	-25,961.60	-25,777.53	-23,302.28	-26,515.86	-29,911.62	-32,965.13	-33,460.20	-36,728.82	-30,634.70	-30,973.26
B. Cropland	491.24	506.77	508.71	506.73	522.26	548.46	597.33	623.13	668.83	493.87	476.43
C. Grassland	1,132.51	3,108.33	3,081.02	2,844.45	4,206.36	6,673.21	10,805.29	13,206.41	17,588.20	4,295.18	6,615.04
D. Wetlands	-3.02	3.03	3.19	4.17	-0.06	4.60	18.25	27.67	36.53	23.82	31.42
E. Settlements	94.16	109.22	109.61	107.82	123.73	150.74	203.37	230.52	279.18	99.87	109.04
F. Other land	27.87	46.27	47.91	46.24	56.18	73.04	96.45	113.42	143.35	75.98	129.22
G. Harvested wood products	-4,647.48	-5,227.01	-5,935.37	-6,757.59	-6,132.63	-5,209.33	-4,688.74	-4,612.88	-4,625.19	-4,217.97	-5,115.44
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	156.72	149.73	138.52	131.60	123.42	124.25	119.46	118.53	114.88	109.91	107.65
A. Solid waste disposal	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
B. Biological treatment of solid waste											
C. Incineration and open burning of waste	156.72	149.73	138.52	131.60	123.42	124.25	119.46	118.53	114.88	109.91	107.65
D. Waste water treatment and discharge											
E. Other											
6. Other (as specified in summary table A.1)	1.44	1.45	1.47	1.48	1.50	1.97	2.45	2.46	2.48	2.49	2.51

Table A.2: Emissions trends (CO₂) (CTF Table 1(a)) (part 3 of 3)

Greenhouse gas source and sink categories	2010 (kt)	2011 (kt)	2012 (kt)	2013 (kt)	2014 (kt)	2015 (kt)	2016 (kt)	2017 (kt)	2018 (kt)	2019 (kt)	2020 (kt)
1. Energy	30,419.70	29,843.88	31,525.50	30,851.17	30,939.01	31,151.21	29,838.40	31,410.15	31,508.64	32,922.21	30,549.36
A. Fuel combustion (sectoral approach)	28,913.87	28,383.95	30,246.58	29,758.62	29,714.90	29,803.32	28,686.14	30,321.02	30,516.48	32,009.30	29,768.63
1. Energy industries	6,693.13	6,271.34	7,725.32	6,412.07	5,474.20	5,289.75	4,192.90	4,780.07	4,644.22	5,437.40	5,561.66
2. Manufacturing industries and construction	5,420.40	5,209.58	5,604.21	6,268.62	6,970.91	6,729.44	6,730.58	6,774.10	6,819.92	7,432.13	6,595.24
3. Transport	13,145.47	13,137.15	12,820.73	12,899.39	13,163.62	13,634.17	13,739.72	14,658.43	14,985.90	14,517.60	13,078.68
4. Other sectors	3,654.86	3,765.89	4,096.33	4,178.55	4,106.16	4,149.96	4,022.95	4,108.42	4,066.44	4,622.16	4,533.05
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	1,505.82	1,459.93	1,278.92	1,092.55	1,224.11	1,347.89	1,152.26	1,089.13	992.16	912.91	780.73
1. Solid fuels	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
2. Oil and natural gas and other emissions from energy production	1,505.82	1,459.93	1,278.92	1,092.55	1,224.11	1,347.89	1,152.26	1,089.13	992.16	912.91	780.73
C. CO ₂ transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial processes	3,319.00	3,294.41	3,254.92	3,319.36	3,396.54	3,509.69	3,213.60	3,213.88	3,085.45	3,085.52	2,863.67
A. Mineral industry	740.23	713.26	751.88	774.42	830.50	876.33	726.79	669.67	620.54	618.07	537.43
B. Chemical industry	265.10	281.55	275.21	260.53	253.57	282.35	191.34	193.09	167.78	183.30	154.38
C. Metal industry	2,273.23	2,258.88	2,187.58	2,243.77	2,270.77	2,307.74	2,251.47	2,304.45	2,249.34	2,236.11	2,127.78
D. Non-energy products from fuels and solvent use	40.44	40.73	40.26	40.64	41.70	43.27	44.00	46.67	47.79	48.04	44.08
E. Electronic industry											
F. Product uses as ODS substitutes											

Greenhouse gas source and sink categories	2010 (kt)	2011 (kt)	2012 (kt)	2013 (kt)	2014 (kt)	2015 (kt)	2016 (kt)	2017 (kt)	2018 (kt)	2019 (kt)	2020 (kt)
G. Other product manufacture and use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
H. Other											
3. Agriculture	961.20	1,019.71	1,056.78	965.93	998.76	1,050.24	998.15	967.09	1,016.14	1,020.50	951.51
A. Enteric fermentation											
B. Manure management											
C. Rice cultivation											
D. Agricultural soils											
E. Prescribed burning of savannas											
F. Field burning of agricultural residues											
G. Liming	511.84	522.70	562.54	445.75	488.05	442.01	423.75	378.83	407.95	449.78	409.48
H. Urea application	449.36	497.00	494.24	520.18	510.71	608.23	574.39	588.26	608.19	570.72	542.03
I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
J. Other											
4. Land Use, Land-Use Change and Forestry	-29,775.10	-30,046.17	-27,150.86	-26,707.14	-27,028.48	-26,986.32	-26,626.73	-25,052.32	-24,613.50	-23,384.74	-23,666.23
A. Forest land	-30,968.84	-29,616.70	-27,961.26	-28,714.20	-27,704.90	-27,275.84	-26,103.40	-22,181.94	-19,858.04	-19,335.04	-19,983.31
B. Cropland	474.96	469.25	453.40	510.28	449.36	408.76	412.01	386.70	382.99	379.27	375.55
C. Grassland	7,122.63	6,045.79	7,593.73	9,836.17	7,671.00	6,367.33	6,567.89	5,150.46	3,916.57	4,319.09	2,524.46
D. Wetlands	27.97	34.66	19.92	50.09	49.62	22.40	34.98	13.60	13.31	13.29	13.31
E. Settlements	111.46	123.64	119.74	111.70	123.43	122.08	144.69	123.52	123.07	127.78	124.05
F. Other land	158.47	216.36	204.07	188.24	172.75	242.70	213.86	129.88	132.15	148.71	114.28
G. Harvested wood products	-6,701.76	-7,319.15	-7,580.45	-8,689.41	-7,789.74	-6,873.75	-7,896.76	-8,674.53	-9,323.54	-9,037.85	-6,834.58

Greenhouse gas source and sink categories	2010 (kt)	2011 (kt)	2012 (kt)	2013 (kt)	2014 (kt)	2015 (kt)	2016 (kt)	2017 (kt)	2018 (kt)	2019 (kt)	2020 (kt)
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	108.66	105.31	105.57	102.91	102.98	100.34	100.78	95.22	92.42	90.26	89.80
A. Solid waste disposal	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
B. Biological treatment of solid waste											
C. Incineration and open burning of waste	108.66	105.31	105.57	102.91	102.98	100.34	100.78	95.22	92.42	90.26	89.80
D. Waste water treatment and discharge											
E. Other											
6. Other (as specified in summary table A.1)	2.52	2.54	2.32	1.62	1.64	1.63	1.71	1.79	1.89	2.54	2.42

Note: CO₂ = carbon dioxide; kt = kilotonnes; NA = not applicable; NE = not estimated; NO = not occurring; ODS = ozone-depleting substance.

Table A.3: Emissions trends (CH₄) (CTF Table 1(b) (three parts))

Table A.3: Emissions trends (CH₄) (CTF Table 1(b) (part 1 of 3))

Greenhouse gas source and sink categories	Base year 1990 (kt)	1991 (kt)	1992 (kt)	1993 (kt)	1994 (kt)	1995 (kt)	1996 (kt)	1997 (kt)	1998 (kt)
1. Energy	46.86	46.20	45.37	48.41	51.51	45.21	55.67	55.35	54.73
A. Fuel combustion (sectoral approach)	8.09	7.65	7.34	7.17	7.35	7.34	7.17	6.96	6.78
1. Energy industries	0.10	0.10	0.13	0.11	0.09	0.08	0.09	0.12	0.09
2. Manufacturing industries and construction	1.17	1.17	1.19	1.25	1.28	1.29	1.28	1.11	1.04
3. Transport	3.17	3.07	3.00	2.92	2.87	2.82	2.70	2.62	2.51
4. Other sectors	3.66	3.31	3.02	2.89	3.11	3.14	3.10	3.12	3.13
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	38.77	38.55	38.03	41.24	44.16	37.87	48.50	48.38	47.95
1. Solid fuels	13.12	8.81	9.03	8.94	10.27	13.11	18.98	13.89	15.47
2. Oil and natural gas and other emissions from energy production	25.64	29.75	29.00	32.30	33.89	24.76	29.52	34.49	32.47
C. CO ₂ transport and storage									
2. Industrial processes	1.10	1.89	1.60	1.79	2.25	3.16	4.25	4.38	4.12
A. Mineral industry									
B. Chemical industry	1.10	1.89	1.60	1.79	2.25	3.16	4.25	4.38	4.12
C. Metal industry	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
D. Non-energy products from fuels and solvent use	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	NA	NA	NA	NA	NA	NA	NA	NA	NA
H. Other									

Greenhouse gas source and sink categories	Base year 1990 (kt)	1991 (kt)	1992 (kt)	1993 (kt)	1994 (kt)	1995 (kt)	1996 (kt)	1997 (kt)	1998 (kt)
3. Agriculture	1,124.03	1,128.97	1,109.41	1,114.15	1,150.26	1,161.79	1,172.31	1,202.30	1,177.65
A. Enteric fermentation	1,094.01	1,098.49	1,078.75	1,082.83	1,117.34	1,127.96	1,137.25	1,165.94	1,141.74
B. Manure management	29.11	29.68	29.90	30.45	31.99	33.04	34.14	35.30	34.96
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed burning of savannas	IE	IE	IE	IE	IE	IE	IE	IE	IE
F. Field burning of agricultural residues	0.90	0.80	0.76	0.87	0.92	0.80	0.92	1.05	0.94
G. Liming									
H. Urea application									
I. Other carbon-containing fertilizers									
J. Other									
4. Land Use, Land-Use Change and Forestry	2.75	1.93	2.27	2.93	3.21	3.09	3.53	3.47	4.86
A. Forest land	0.71	0.52	0.50	0.53	0.73	0.73	0.89	1.18	0.77
B. Cropland	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE
C. Grassland	2.03	1.41	1.78	2.40	2.48	2.36	2.64	2.29	4.08
D. Wetlands	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
E. Settlements	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA
F. Other land	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA
G. Harvested wood products									
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	146.83	151.19	155.30	159.25	155.57	159.25	162.95	164.95	164.38
A. Solid waste disposal	132.73	136.74	140.70	144.68	141.49	145.01	148.71	150.32	149.58
B. Biological treatment of solid waste	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.13
C. Incineration and open burning of waste	5.09	5.06	5.00	5.10	4.35	4.31	4.14	4.45	4.76

Greenhouse gas source and sink categories	Base year 1990 (kt)	1991 (kt)	1992 (kt)	1993 (kt)	1994 (kt)	1995 (kt)	1996 (kt)	1997 (kt)	1998 (kt)
D. Waste water treatment and discharge	8.90	9.27	9.49	9.35	9.61	9.81	9.97	10.05	9.91
E. Other									
6. Other (as specified in summary table A.1)	0.07	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07

Table A.3: Emissions trends (CH₄) (CTF Table 1(b) (part 2 of 3))

Greenhouse gas source and sink categories	1999 (kt)	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
1. Energy	55.05	53.45	55.39	51.34	44.67	45.45	50.69	64.07	55.40	46.08	50.38
A. Fuel combustion (sectoral approach)	6.69	6.68	6.58	6.56	6.59	6.52	6.60	6.63	6.38	6.20	5.84
1. Energy industries	0.11	0.11	0.13	0.12	0.13	0.12	0.14	0.14	0.13	0.14	0.11
2. Manufacturing industries and construction	1.12	1.19	1.24	1.30	1.32	1.33	1.29	1.31	1.33	1.26	1.14
3. Transport	2.41	2.28	2.18	2.12	2.04	1.96	1.84	1.71	1.64	1.52	1.44
4. Other sectors	3.05	3.10	3.03	3.02	3.09	3.12	3.32	3.47	3.28	3.29	3.15
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	48.36	46.77	48.81	44.78	38.08	38.94	44.08	57.44	49.02	39.88	44.54
1. Solid fuels	17.14	16.72	17.08	16.98	15.98	15.00	15.87	20.19	12.93	16.29	19.52
2. Oil and natural gas and other emissions from energy production	31.22	30.05	31.73	27.80	22.11	23.93	28.21	37.24	36.08	23.59	25.02
C. CO ₂ transport and storage											
2. Industrial processes	4.74	5.54	4.90	5.25	2.23	2.50	0.79	0.93	1.00	1.31	1.89
A. Mineral industry											
B. Chemical industry	4.74	5.54	4.90	5.25	2.23	2.50	0.79	0.93	1.00	1.31	1.89
C. Metal industry	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA

Greenhouse gas source and sink categories	1999 (kt)	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
D. Non-energy products from fuels and solvent use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Electronic industry											
F. Product uses as ODS substitutes											
G. Other product manufacture and use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
H. Other											
3. Agriculture	1,180.30	1,212.76	1,226.91	1,218.02	1,234.38	1,235.03	1,244.05	1,251.47	1,219.22	1,174.42	1,180.87
A. Enteric fermentation	1,144.58	1,175.14	1,187.55	1,177.89	1,192.83	1,192.84	1,201.34	1,207.76	1,174.99	1,129.56	1,133.28
B. Manure management	34.77	36.69	38.32	39.11	40.57	41.46	41.84	42.89	43.20	44.01	46.76
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed burning of savannas	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
F. Field burning of agricultural residues	0.94	0.94	1.04	1.03	0.98	0.73	0.88	0.83	1.03	0.85	0.84
G. Liming											
H. Urea application											
I. Other carbon-containing fertilizers											
J. Other											
4. Land Use, Land-Use Change and Forestry	3.18	2.80	2.98	3.07	3.28	3.02	4.44	4.54	6.00	3.08	3.92
A. Forest land	0.50	0.58	0.52	0.58	0.47	0.45	0.43	0.48	0.78	0.59	0.82
B. Cropland	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE
C. Grassland	2.68	2.22	2.45	2.49	2.81	2.57	4.00	4.06	5.22	2.49	3.10
D. Wetlands	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
E. Settlements	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA

Greenhouse gas source and sink categories	1999 (kt)	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
F. Other land	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA
G. Harvested wood products											
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	164.95	166.23	167.54	168.50	165.07	165.55	165.31	157.46	156.08	152.90	147.67
A. Solid waste disposal	150.37	151.88	153.55	154.90	151.62	152.01	151.95	144.23	142.85	139.76	134.69
B. Biological treatment of solid waste	0.13	0.13	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.16	0.20
C. Incineration and open burning of waste	5.07	4.85	4.63	4.40	4.14	4.17	4.04	4.05	3.97	3.80	3.72
D. Waste water treatment and discharge	9.38	9.36	9.23	9.06	9.16	9.22	9.18	9.03	9.11	9.19	9.05
E. Other											
6. Other (as specified in summary table A.1)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07

Table A.3: Emissions trends (CH₄) (CTF Table 1(b) (part 3 of 3))

Greenhouse gas source and sink categories	2010 (kt)	2011 (kt)	2012 (kt)	2013 (kt)	2014 (kt)	2015 (kt)	2016 (kt)	2017 (kt)	2018 (kt)	2019 (kt)	2020 (kt)
1. Energy	61.23	57.36	45.29	37.89	37.61	39.11	35.64	31.59	30.53	29.45	27.66
A. Fuel combustion (sectoral approach)	6.07	6.06	6.38	6.22	5.66	5.76	5.42	5.61	5.34	5.35	4.99
1. Energy industries	0.11	0.10	0.12	0.10	0.09	0.09	0.07	0.08	0.08	0.09	0.09
2. Manufacturing industries and construction	1.24	1.22	1.24	1.24	1.25	1.28	1.28	1.24	1.24	1.23	1.09
3. Transport	1.37	1.29	1.22	1.19	1.15	1.11	1.07	0.90	0.83	0.77	0.62
4. Other sectors	3.35	3.46	3.81	3.69	3.17	3.29	3.00	3.39	3.20	3.26	3.19
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	55.16	51.30	38.91	31.67	31.95	33.34	30.21	25.98	25.18	24.10	22.67
1. Solid fuels	23.65	16.52	11.52	10.83	9.01	7.61	6.96	2.54	2.81	2.64	2.46

Greenhouse gas source and sink categories	2010 (kt)	2011 (kt)	2012 (kt)	2013 (kt)	2014 (kt)	2015 (kt)	2016 (kt)	2017 (kt)	2018 (kt)	2019 (kt)	2020 (kt)
2. Oil and natural gas and other emissions from energy production	31.51	34.78	27.39	20.84	22.94	25.73	23.25	23.44	22.37	21.46	20.21
C. CO ₂ transport and storage											
2. Industrial processes	1.91	1.92	2.55	3.27	5.06	4.27	5.01	4.48	3.69	4.29	3.85
A. Mineral industry											
B. Chemical industry	1.91	1.92	2.55	3.27	5.06	4.27	5.01	4.48	3.69	4.29	3.85
C. Metal industry	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
D. Non-energy products from fuels and solvent use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Electronic industry											
F. Product uses as ODS substitutes											
G. Other product manufacture and use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
H. Other											
3. Agriculture	1,182.08	1,198.51	1,226.50	1,233.12	1,245.51	1,226.51	1,212.53	1,213.68	1,219.31	1,224.30	1,218.88
A. Enteric fermentation	1,131.59	1,144.55	1,167.90	1,170.50	1,179.24	1,160.90	1,147.10	1,148.26	1,153.69	1,158.60	1,153.26
B. Manure management	49.53	53.31	57.56	61.54	65.37	65.00	64.63	64.65	64.99	64.89	64.82
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed burning of savannas	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
F. Field burning of agricultural residues	0.96	0.65	1.04	1.08	0.90	0.61	0.80	0.77	0.63	0.80	0.80
G. Liming											
H. Urea application											
I. Other carbon-containing fertilizers											
J. Other											

Greenhouse gas source and sink categories	2010 (kt)	2011 (kt)	2012 (kt)	2013 (kt)	2014 (kt)	2015 (kt)	2016 (kt)	2017 (kt)	2018 (kt)	2019 (kt)	2020 (kt)
4. Land Use, Land-Use Change and Forestry	3.70	2.59	3.06	3.02	2.75	3.09	4.31	3.67	2.67	3.35	3.27
A. Forest land	0.67	0.57	0.56	0.44	0.54	1.27	1.08	0.55	0.67	2.19	2.37
B. Cropland	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE
C. Grassland	3.02	2.01	2.49	2.59	2.21	1.82	3.23	3.12	2.00	1.16	0.90
D. Wetlands	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
E. Settlements	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA
F. Other land	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA	NE, NA
G. Harvested wood products											
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	145.28	139.46	135.11	133.13	131.21	129.62	128.30	126.83	124.24	122.32	120.48
A. Solid waste disposal	132.18	126.30	121.85	119.73	117.56	115.70	114.11	112.50	109.71	107.55	105.51
B. Biological treatment of solid waste	0.28	0.40	0.50	0.62	0.75	0.90	1.08	1.24	1.36	1.52	1.60
C. Incineration and open burning of waste	3.76	3.64	3.65	3.55	3.56	3.46	3.48	3.29	3.19	3.11	3.10
D. Waste water treatment and discharge	9.06	9.12	9.12	9.23	9.35	9.56	9.63	9.81	9.99	10.14	10.28
E. Other											
6. Other (as specified in summary table A.1)	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06

Note: CO₂ = carbon dioxide; CH₄ = methane; IE = included elsewhere; kt = kilotonnes; NA = not applicable; NE = not estimated; NO = not occurring; ODS = ozone-depleting substances.

Table A.4: Emissions trends (N₂O) (CTF Table 1(c)) (three parts)

Table A.4: Emissions trends (N₂O) (CTF Table 1(c)) (part 1 of 3)

Greenhouse gas source and sink categories	Base year 1990 (kt)	1991 (kt)	1992 (kt)	1993 (kt)	1994 (kt)	1995 (kt)	1996 (kt)	1997 (kt)	1998 (kt)
1. Energy	0.74	0.74	0.80	0.81	0.87	0.89	0.89	0.92	0.91
A. Fuel combustion (sectoral approach)	0.74	0.74	0.80	0.81	0.87	0.89	0.89	0.92	0.91
1. Energy industries	0.02	0.01	0.03	0.02	0.02	0.02	0.02	0.03	0.02
2. Manufacturing industries and construction	0.17	0.17	0.18	0.19	0.19	0.19	0.19	0.18	0.17
3. Transport	0.37	0.39	0.41	0.43	0.46	0.49	0.50	0.52	0.54
4. Other sectors	0.17	0.17	0.18	0.17	0.20	0.19	0.18	0.18	0.19
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. CO ₂ transport and storage									
2. Industrial processes	0.34	0.33	0.31	0.29	0.28	0.27	0.25	0.24	0.23
A. Mineral industry									
B. Chemical industry	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C. Metal industry									
D. Non-energy products from fuels and solvent use	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	0.34	0.33	0.31	0.29	0.28	0.27	0.25	0.24	0.23
H. Other									

Greenhouse gas source and sink categories	Base year 1990 (kt)	1991 (kt)	1992 (kt)	1993 (kt)	1994 (kt)	1995 (kt)	1996 (kt)	1997 (kt)	1998 (kt)
3. Agriculture	17.97	18.21	18.26	18.99	19.72	20.49	20.77	21.03	20.81
A. Enteric fermentation									
B. Manure management	0.17	0.18	0.18	0.18	0.19	0.20	0.21	0.22	0.22
C. Rice cultivation									
D. Agricultural soils	17.79	18.02	18.06	18.79	19.51	20.28	20.54	20.80	20.58
E. Prescribed burning of savannas	IE	IE	IE	IE	IE	IE	IE	IE	IE
F. Field burning of agricultural residues	0.02	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02
G. Liming									
H. Urea application									
I. Other carbon-containing fertilizers									
J. Other									
4. Land Use, Land-Use Change and Forestry	1.09	1.07	1.11	1.15	1.23	1.27	1.32	1.37	1.38
A. Forest land	0.72	0.72	0.76	0.81	0.90	0.93	0.98	1.03	1.02
B. Cropland	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04
C. Grassland	0.21	0.19	0.18	0.17	0.15	0.15	0.15	0.14	0.16
D. Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Other land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Harvested wood products									
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	0.38	0.39	0.39	0.40	0.39	0.39	0.39	0.40	0.42
A. Solid waste disposal									
B. Biological treatment of solid waste	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. Incineration and open burning of waste	0.10	0.10	0.10	0.10	0.09	0.08	0.08	0.09	0.09

Greenhouse gas source and sink categories	Base year 1990 (kt)	1991 (kt)	1992 (kt)	1993 (kt)	1994 (kt)	1995 (kt)	1996 (kt)	1997 (kt)	1998 (kt)
D. Waste water treatment and discharge	0.28	0.28	0.29	0.29	0.30	0.30	0.31	0.31	0.32
E. Other									
6. Other (as specified in summary table A.1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.4: Emissions trends (N₂O) (CTF Table 1(c)) (part 2 of 3)

Greenhouse gas source and sink categories	1999 (kt)	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
1. Energy	0.96	1.01	1.02	1.06	1.12	1.17	1.19	1.17	1.12	1.10	1.04
A. Fuel combustion (sectoral approach)	0.96	1.01	1.02	1.06	1.12	1.17	1.19	1.17	1.12	1.10	1.04
1. Energy industries	0.03	0.02	0.03	0.03	0.06	0.07	0.09	0.08	0.05	0.07	0.05
2. Manufacturing industries and construction	0.18	0.19	0.20	0.21	0.21	0.22	0.22	0.22	0.22	0.21	0.20
3. Transport	0.56	0.61	0.60	0.62	0.65	0.67	0.67	0.65	0.64	0.61	0.60
4. Other sectors	0.19	0.19	0.19	0.20	0.21	0.21	0.21	0.21	0.21	0.20	0.20
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. CO ₂ transport and storage											
2. Industrial processes	0.22	0.21	0.20	0.19	0.18	0.16	0.15	0.14	0.15	0.18	0.18
A. Mineral industry											
B. Chemical industry	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C. Metal industry											
D. Non-energy products from fuels and solvent use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Greenhouse gas source and sink categories	1999 (kt)	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
E. Electronic industry											
F. Product uses as ODS substitutes											
G. Other product manufacture and use	0.22	0.21	0.20	0.19	0.18	0.16	0.15	0.14	0.15	0.18	0.18
H. Other											
3. Agriculture	20.86	21.83	23.06	23.38	24.21	24.62	24.85	24.20	23.60	23.59	23.65
A. Enteric fermentation											
B. Manure management	0.21	0.22	0.23	0.23	0.25	0.26	0.26	0.26	0.27	0.27	0.29
C. Rice cultivation											
D. Agricultural soils	20.64	21.59	22.81	23.13	23.94	24.35	24.58	23.92	23.31	23.30	23.35
E. Prescribed burning of savannas	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
F. Field burning of agricultural residues	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.01
G. Liming											
H. Urea application											
I. Other carbon-containing fertilizers											
J. Other											
4. Land Use, Land-Use Change and Forestry	1.36	1.38	1.37	1.36	1.34	1.33	1.33	1.33	1.38	1.22	1.22
A. Forest land	1.01	1.02	1.01	1.00	0.98	0.95	0.92	0.90	0.89	0.87	0.87
B. Cropland	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05
C. Grassland	0.14	0.16	0.16	0.15	0.17	0.18	0.22	0.24	0.30	0.17	0.17
D. Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Other land	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
G. Harvested wood products											
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Greenhouse gas source and sink categories	1999 (kt)	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
5. Waste	0.43	0.43	0.44	0.42	0.42	0.42	0.42	0.43	0.43	0.43	0.43
A. Solid waste disposal											
B. Biological treatment of solid waste	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. Incineration and open burning of waste	0.10	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.07	0.07
D. Waste water treatment and discharge	0.32	0.33	0.34	0.33	0.33	0.33	0.34	0.34	0.34	0.34	0.35
E. Other											
6. Other (as specified in summary table A.1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.4: Emissions trends (N₂O) (CTF Table 1(c)) (part 3 of 3)

Greenhouse gas source and sink categories	2010 (kt)	2011 (kt)	2012 (kt)	2013 (kt)	2014 (kt)	2015 (kt)	2016 (kt)	2017 (kt)	2018 (kt)	2019 (kt)	2020 (kt)
1. Energy	1.00	0.99	0.99	0.98	0.94	0.93	0.91	0.85	0.85	0.88	0.74
A. Fuel combustion (sectoral approach)	1.00	0.98	0.99	0.98	0.94	0.93	0.91	0.85	0.85	0.88	0.74
1. Energy industries	0.03	0.03	0.05	0.03	0.03	0.03	0.01	0.02	0.02	0.03	0.04
2. Manufacturing industries and construction	0.21	0.21	0.21	0.21	0.21	0.21	0.22	0.21	0.22	0.22	0.20
3. Transport	0.57	0.55	0.52	0.51	0.50	0.48	0.47	0.41	0.40	0.40	0.28
4. Other sectors	0.19	0.20	0.21	0.22	0.21	0.21	0.21	0.21	0.21	0.23	0.23
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. CO ₂ transport and storage											

Greenhouse gas source and sink categories	2010 (kt)	2011 (kt)	2012 (kt)	2013 (kt)	2014 (kt)	2015 (kt)	2016 (kt)	2017 (kt)	2018 (kt)	2019 (kt)	2020 (kt)
2. Industrial processes	0.18	0.18	0.18	0.20	0.20	0.20	0.20	0.21	0.27	0.28	0.25
A. Mineral industry											
B. Chemical industry	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C. Metal industry											
D. Non-energy products from fuels and solvent use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Electronic industry											
F. Product uses as ODS substitutes											
G. Other product manufacture and use	0.18	0.18	0.18	0.20	0.20	0.20	0.20	0.21	0.27	0.28	0.25
H. Other											
3. Agriculture	24.16	24.76	25.11	25.21	26.13	25.85	25.94	26.09	26.41	26.48	26.85
A. Enteric fermentation											
B. Manure management	0.31	0.33	0.36	0.38	0.39	0.39	0.39	0.39	0.40	0.39	0.39
C. Rice cultivation											
D. Agricultural soils	23.83	24.42	24.74	24.81	25.72	25.45	25.54	25.68	26.00	26.07	26.45
E. Prescribed burning of savannas	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
F. Field burning of agricultural residues	0.02	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
G. Liming											
H. Urea application											
I. Other carbon-containing fertilizers											
J. Other											
4. Land Use, Land-Use Change and Forestry	1.20	1.18	1.17	1.13	1.04	1.00	0.94	0.86	0.82	0.89	0.91
A. Forest land	0.86	0.86	0.84	0.80	0.75	0.75	0.70	0.64	0.63	0.71	0.74
B. Cropland	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.02
C. Grassland	0.16	0.15	0.17	0.17	0.15	0.12	0.13	0.11	0.09	0.08	0.08

Greenhouse gas source and sink categories	2010 (kt)	2011 (kt)	2012 (kt)	2013 (kt)	2014 (kt)	2015 (kt)	2016 (kt)	2017 (kt)	2018 (kt)	2019 (kt)	2020 (kt)
D. Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Other land	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
G. Harvested wood products											
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	0.44	0.45	0.45	0.46	0.48	0.49	0.51	0.52	0.54	0.55	0.56
A. Solid waste disposal											
B. Biological treatment of solid waste	0.02	0.02	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.09	0.10
C. Incineration and open burning of waste	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06
D. Waste water treatment and discharge	0.35	0.35	0.35	0.36	0.36	0.37	0.38	0.39	0.39	0.40	0.40
E. Other											
6. Other (as specified in summary table A.1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: CO₂ = carbon dioxide; CH₄ = methane; IE = included elsewhere; kt = kilotonnes; N₂O = nitrous oxide; NA = not applicable; NO = not occurring; ODS = ozone-depleting substances.

Table A.5: Emissions trends (HFCs, PFCs and SF₆) (CTF Table 1(d)) (three parts)

Table A.5: Emissions trends (HFCs, PFCs and SF₆) (CTF Table 1(d)) (part 1 of 3)

Greenhouse gas source and sink categories	Base year 1990 (kt)	1991 (kt)	1992 (kt)	1993 (kt)	1994 (kt)	1995 (kt)	1996 (kt)	1997 (kt)	1998 (kt)
Emissions of HFCs and PFCs (kt CO₂-equivalent)	909.95	903.79	462.17	210.51	194.08	177.80	333.34	314.53	248.90
Emissions of HFCs (kt CO₂-equivalent)	NO, NA	NO, NA	0.29	0.36	7.91	24.52	54.36	113.42	97.52
HFC-23	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-32	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.00
HFC-41	NA	NA	NA	NA	NA	NA	NA	NA	NA

Greenhouse gas source and sink categories	Base year 1990 (kt)	1991 (kt)	1992 (kt)	1993 (kt)	1994 (kt)	1995 (kt)	1996 (kt)	1997 (kt)	1998 (kt)
HFC-43-10mee	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-125	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.01	0.00
HFC-134	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-134a	NO, NA	NO, NA	0.00	0.00	0.00	0.01	0.02	0.06	0.04
HFC-143	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-143a	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.00	0.01
HFC-152	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-152a	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.00	0.00
HFC-161	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-227ea	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.00	0.00
HFC-236cb	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-236ea	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-236fa	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-245ca	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-245fa	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-365mfc	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Unspecified mix of HFCs (kt CO ₂ -equivalent)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emissions of PFCs (kt CO₂-equivalent)	909.95	903.79	461.88	210.16	186.18	153.28	278.98	201.11	151.38
CF ₄	0.11	0.10	0.05	0.02	0.02	0.02	0.03	0.02	0.01
C ₂ F ₆	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
C ₃ F ₈	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.01
C ₄ F ₁₀	NA	NA	NA	NA	NA	NA	NA	NA	NA
c-C ₄ F ₈	NA	NA	NA	NA	NA	NA	NA	NA	NA
C ₅ F ₁₂	NA	NA	NA	NA	NA	NA	NA	NA	NA

Greenhouse gas source and sink categories	Base year 1990 (kt)	1991 (kt)	1992 (kt)	1993 (kt)	1994 (kt)	1995 (kt)	1996 (kt)	1997 (kt)	1998 (kt)
C ₆ F ₁₄	NA	NA	NA	NA	NA	NA	NA	NA	NA
C ₁₀ F ₁₈	NA	NA	NA	NA	NA	NA	NA	NA	NA
c-C ₃ F ₆	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of PFCs (kt CO ₂ -equivalent)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs (kt CO₂-equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Emissions of SF₆ (kt CO₂-equivalent)	19.97	20.86	21.91	22.69	23.43	24.42	24.65	25.58	24.86
SF ₆	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions of NF₃ (kt CO₂-equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
NF ₃	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA

Table A.5: Emissions trends (HFCs, PFCs and SF₆) (CTF Table 1(d)) (part 2 of 3)

Greenhouse gas source and sink categories	1999 (kt)	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
Emissions of HFCs and PFCs (kt CO₂-equivalent)	260.95	301.26	370.71	485.85	630.66	681.69	763.39	905.41	965.49	1,058.77	1,129.46
Emissions of HFCs (kt CO₂-equivalent)	192.28	233.65	300.10	401.36	503.85	582.58	694.01	798.68	917.09	1,013.31	1,075.61
HFC-23	NO, NA	NO, NA	NO, NA	0.00	0.00	NO, NA	NO, NA	0.00	NO, NA	NO, NA	NO, NA
HFC-32	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02
HFC-41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-43-10mee	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-125	0.00	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.07	0.08	0.09
HFC-134	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-134a	0.09	0.11	0.13	0.17	0.20	0.21	0.24	0.26	0.26	0.29	0.27
HFC-143	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Greenhouse gas source and sink categories	1999 (kt)	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
HFC-143a	0.01	0.01	0.01	0.02	0.03	0.03	0.04	0.05	0.06	0.07	0.08
HFC-152	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-152a	0.00	NO, NA	0.00	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-161	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-236cb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-236ea	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-236fa	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-245ca	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-245fa	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.00	0.00	0.00
HFC-365mfc	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.00	0.00	0.00
Unspecified mix of HFCs (kt CO ₂ -equivalent)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emissions of PFCs (kt CO₂-equivalent)	68.67	67.61	70.61	84.48	126.81	99.12	69.38	106.73	48.41	45.47	53.86
CF ₄	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
C ₂ F ₆	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C ₃ F ₈	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	NO, NA	0.00	0.00	0.00	0.00
C ₄ F ₁₀	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
c-C ₄ F ₈	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C ₅ F ₁₂	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C ₆ F ₁₄	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C ₁₀ F ₁₈	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
c-C ₃ F ₆	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of PFCs (kt CO ₂ -equivalent)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs (kt CO₂-equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA

Greenhouse gas source and sink categories	1999 (kt)	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
Emissions of SF₆ (kt CO₂-equivalent)	24.56	19.56	20.04	23.32	25.19	28.92	25.41	21.05	19.87	19.34	22.54
SF ₆	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions of NF₃ (kt CO₂-equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
NF ₃	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA

Table A.5: Emissions trends (HFCs, PFCs and SF₆) (CTF Table 1(d)) (part 3 of 3)

Greenhouse gas source and sink categories	2010 (kt)	2011 (kt)	2012 (kt)	2013 (kt)	2014 (kt)	2015 (kt)	2016 (kt)	2017 (kt)	2018 (kt)	2019 (kt)	2020 (kt)
Emissions of HFCs and PFCs (kt CO₂-equivalent)	1,148.37	1,212.99	1,309.81	1,359.18	1,409.20	1,444.76	1,468.24	1,526.43	1,551.43	1,570.13	1,568.21
Emissions of HFCs (kt CO₂-equivalent)	1,100.81	1,177.84	1,262.35	1,311.05	1,335.79	1,386.17	1,419.55	1,465.97	1,479.03	1,481.00	1,480.29
HFC-23	0.00	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	NO, NA	NO, NA
HFC-32	0.02	0.04	0.04	0.04	0.04	0.05	0.07	0.08	0.10	0.12	0.10
HFC-41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-43-10mee	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
HFC-125	0.09	0.10	0.11	0.12	0.11	0.13	0.15	0.15	0.16	0.17	0.16
HFC-134	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-134a	0.31	0.31	0.34	0.34	0.36	0.36	0.33	0.34	0.37	0.34	0.36
HFC-143	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-143a	0.07	0.07	0.08	0.08	0.09	0.08	0.08	0.08	0.07	0.07	0.07
HFC-152	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-152a	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.00	0.00	0.00
HFC-161	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-236cb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Greenhouse gas source and sink categories	2010 (kt)	2011 (kt)	2012 (kt)	2013 (kt)	2014 (kt)	2015 (kt)	2016 (kt)	2017 (kt)	2018 (kt)	2019 (kt)	2020 (kt)
HFC-236ea	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-236fa	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-245ca	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-245fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-365mfc	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unspecified mix of HFCs (kt CO ₂ -equivalent)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emissions of PFCs (kt CO₂-equivalent)	47.56	35.15	47.46	48.13	73.41	58.59	48.69	60.46	72.40	89.13	87.92
CF ₄	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C ₂ F ₆	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C ₃ F ₈	NO, NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C ₄ F ₁₀	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
c-C ₄ F ₈	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C ₅ F ₁₂	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C ₆ F ₁₄	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C ₁₀ F ₁₈	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
c-C ₃ F ₆	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of PFCs (kt CO ₂ -equivalent)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs (kt CO₂-equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Emissions of SF₆ (kt CO₂-equivalent)	22.84	18.94	20.90	18.18	16.80	16.46	17.36	14.79	14.71	15.98	16.69
SF ₆	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions of NF₃ (kt CO₂-equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
NF ₃	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA

Note: HFCs = hydrofluorocarbons; kt = kilotonnes; kt CO₂-equivalent = kilotonnes of carbon dioxide equivalent; NA = not applicable; NF₃ = nitrogen trifluoride; NO = not occurring; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride.

Appendix B: Progress in achievement of the quantified economy-wide emissions reduction target: information on mitigation actions and their effects (CTF table 3)

Note: CCRA = Climate Change Response Act 2002; CH₄ = methane; CO₂ = carbon dioxide; CO₂-e = carbon dioxide equivalent; GHGs = greenhouse gases; HFCs = hydrofluorocarbons; IPPU = industrial processes and product use; kt = kilotonnes; LULUCF = land use, land-use change and forestry; N₂O = nitrous oxide; NA = not applicable; NE = not estimated; NZU = New Zealand Unit; PFCs = perfluorocarbons; SF₆ = sulphur hexafluoride; TBC = to be confirmed; WAM = with additional measures; WEM = with existing measures.

Estimate of mitigation impact: Mitigation impacts were not estimated (NE) for some policies because the policy is not implemented or is in the early stages of implementation, insufficient data were available, there were model design constraints or the impact is considered negligible.

Status of implementation: Policies with a status described as WEM (with existing measures) or WAM (with additional measures) have mitigation impacts estimated from emissions projections scenarios described in chapter 5. Mitigation impacts for all other policies have been developed at policy level using other methods and have not been integrated into sector-level modelling. This also means that the estimated total mitigation impacts of policies and measures do not align with the change in emissions between the 'without measures' scenario and the 'with measures' scenario from chapter 5.

A negative estimate of mitigation impact indicates additional GHG emissions resulting from this policy or measure for this particular year.

Name of mitigation action	Sectors affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative) 2025 (kt CO ₂ -e)	Estimate of mitigation impact (not cumulative) 2030 (kt CO ₂ -e)	Estimate of mitigation impact (not cumulative) 2035 (kt CO ₂ -e)
Cross-cutting policies and measures: New Zealand's emissions reduction plan and the New Zealand Emissions Trading Scheme											
Emissions reduction plan	Energy, transport, agriculture, waste, IPPU, LULUCF	CO ₂ , CH ₄ , N ₂ O, PFCs, HFCs, SF ₆	Sets out over 300 actions, policies and strategies for meeting New Zealand's first emissions budget.	Economic, fiscal, voluntary agreement, regulatory, information, education, research	Adopted	The policies and strategies in the emissions reduction plan form a coherent, strategic package with a mutually supportive and balanced mix of emissions pricing, well-targeted regulations, tailored sectoral policies, direct investment (public and private), innovation and mechanisms to meet our climate targets and support an equitable transition to a low-emissions economy.	2022	Ministry for the Environment, Ministry for Primary Industries, Te Manatū Waka – Ministry of Transport, Ministry of Business, Innovation and Employment, The Treasury New Zealand, Ministry of Foreign Affairs and Trade, Ministry of Social	See the first emissions reduction plan for further details	NA	NA

Name of mitigation action	Sectors affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2025	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2030	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2035
								Development, Ministry of Housing and Urban Development, Department of Conservation, Energy Efficiency & Conversation Authority, Waka Kotahi, Kāinga Ora, Te Arawhiti, Te Puni Kōkiri, Te Waihanga, Department of Internal Affairs			
New Zealand Emissions Trading Scheme (NZ ETS)	Forestry/LULUCF, energy, other (fishing), industry/ industrial processes, other (liquid fossil fuels), other (synthetic gases), waste management/ waste, agriculture	CO ₂ , CH ₄ , N ₂ O, PFCs, HFCs, SF ₆	Reduce emissions by creating a market through which emitters pay for emissions covered by the scheme.	Economic, regulatory	Implemented (WEM, WAM)	The NZ ETS requires upstream entities, such as fuel suppliers and large emitters, to pay emissions units (NZUs) to the Government for their activities that result in emissions. It also rewards entities that remove carbon from the atmosphere – which for New Zealand is predominantly through forestry sequestration. A reducing cap on emissions, and the expectation of a rising NZU price shapes future economic development by encouraging alignment of investment decisions with a low-carbon economy and influencing technology choices towards low-emissions alternatives. The NZ ETS places a price signal on the stationary energy, liquid fossil fuel, industrial process, synthetic greenhouse gas, waste and forestry sectors. There has been a phased entry of sectors since 2008.	2008	Environmental Protection Authority, Ministry for the Environment, Ministry for Primary Industries	2,520.4	4,419.1	5,638.6 ⁹⁷

⁹⁷ The mitigation impact reported here is for energy and transport only.

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Cross-cutting policies and measures: dedicated funding and finance initiatives											
Climate Emergency Response Fund (CERF)	Transport, energy, agriculture, forestry	CO ₂ , CH ₄ , N ₂ O	The CERF is a dedicated funding source for public investment on climate-related initiatives.	Fiscal	Implemented	<p>The CERF is a Budget funding mechanism to support the Government's climate spending.</p> <p>The abatement impact of the policies and measures in the emissions reduction plan has been quantified as 95–228 Mt across the first, second and third emissions budget periods, reflecting a range of low to high impacts of policies and measures. The investments made through the CERF in Budget 2022 are estimated to drive 52–70% of this abatement.</p> <p>In the first emissions budget period, emissions reduction plan policies and measures have been quantified to drive 5.4–11.9Mt of abatement, of which funding from the CERF in Budget 2022 is estimated to support 21–34%.</p>	2021	The Treasury	NE	NE	NE
New Zealand's Sovereign Green Bond Programme	Energy, transport, agriculture, forestry, waste	CO ₂ , CH ₄ , N ₂ O, PFCs, HFCs, SF ₆	Finance or re-finance specific government projects with positive climate and environmental government impacts.	Fiscal	Implemented	<p>Green Bonds provide financing for existing expenditures with positive climate and environmental outcomes. Design of the Green Bond Programme has been informed by international best practice and incorporates New Zealand-specific elements. Alongside Nominal Bonds and Inflation-Indexed Bonds, Green Bonds are expected to be an important and enduring part of the New Zealand Government Bond portfolio. Green Bonds will help ensure high-quality government projects with robust environmental outcomes are financed, delivered, monitored and reported on.</p>	2022	The Treasury	NE	NE	NE

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New Zealand Green Investment Finance Limited (NZGIF)	Various	CO ₂ , CH ₄ , N ₂ O, PFCs, HFCs, SF ₆	Invest in climate mitigating technologies. <ul style="list-style-type: none"> Invest to reduce emissions. Invest on a commercial basis. Crowd-in private capital. Show market leadership. 	Fiscal	Implemented	This government-owned entity has the objective of accelerating emissions reduction in New Zealand by investing in climate-mitigating technologies. NZGIF's emissions mitigation impact is estimated as emissions reduction, ⁹⁸ crowding-in private capital, and demonstrating the benefits of low-carbon investment to the market. As at 30 June 2022, the total estimated lifetime emissions reduction of its capital committed is 580–710 kilotonnes of CO ₂ (or equivalents).	2019	New Zealand Green Investment Finance Limited	NE	NE	NE
State Sector Decarbonisation Fund (SSDF)	Energy	CO ₂	Government agencies demonstrate the action required to decarbonise.	Financial support	Implemented	The NZ\$219.437 million SSDF provides co-funding to state sector agencies to replace coal boilers with low-emissions alternatives and for other energy efficiency or renewable energy projects, including efficient lighting and electric vehicles. Three-quarters of the funding is targeted for hospitals, schools and universities, which are the biggest emitters.	2020	Energy Efficiency and Conservation Authority, Ministry of Business, Innovation and Employment, The Treasury	46.0	115.6	110.8
Cross-cutting policies and measures: public sector leadership											
Sustainable Government Procurement	Energy	CO ₂	Make sustainable procurement part of government procurement practice.	Other (System Leadership), information	Implemented	The Government Procurement Rules were updated in 2019 to include a focus on the achievement of wider social, economic, cultural and environmental outcomes that go beyond the immediate purchase of goods and services. New Government Procurement Rule introduced. Rule 20: Transitioning to a net zero emissions economy and designing waste out of the system. This directs agencies to:	2019	Ministry of Business, Innovation and Employment	NE	NE	NE

⁹⁸ Future emissions reductions associated with a project or company over the life of the investment.

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						1) support the procurement of low-emissions and low-waste goods, services and works 2) encourage innovation to significantly reduce emissions and waste impacts from goods and services.					
Sustainable building rating systems	Energy, construction	CO ₂	Reduce greenhouse gas emissions and construction and demolition waste associated with the construction of new non-residential government owned buildings. Support agencies to meet the requirements of the Carbon Neutral Government Programme.	Other (system leadership), information	Partially implemented	When constructing a new non-residential government-owned building, agencies are required to use an approved sustainable building rating system and achieve minimum requirements around reducing embodied and operational greenhouse gas emissions as well as building and construction waste.	2022	Ministry of Business, Innovation and Employment	NE	NE	NE
Energy-efficient government office accommodation	Energy	CO ₂	Improve the energy performance of government office accommodation. Support agencies to meet the requirements of the Carbon Neutral Government Programme.	Other (system leadership), information	Implemented	Agencies that are subject to the Property System Lead mandate and have office accommodation over 2,000 m ² are required to begin a National Australian Built Environment Rating System New Zealand (NABERSNZ™) assessment at the next available opportunity (such as a lease renewal). Agencies entering a new lease or renewing an existing lease should target the building achieving a minimum of a 4-star rating. Agencies planning a new build project need to achieve a minimum of a 5-star rating.	2021	Ministry of Business, Innovation and Employment	NE	NE	NE
Cross-cutting policies and measures: climate innovation platforms											
Climate innovation platforms	Energy, transport, agriculture, waste, IPPU, LULUCF	CO ₂ , CH ₄ , N ₂ O, PFCs, HFCs, SF ₆	Coordinate action on key challenges and take opportunities in our shift to a low-emissions future	Other	Adopted	This all-of-government approach will use a wide range of tools and approaches including proactive policy, regulatory settings and innovation tools to ensure that ideas from here and around the world can be implemented quickly.	TBC	Ministry of Business, Innovation and Employment	NE	NE	NE

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Energy: strategic approaches to manage the phase-out of fossil fuels											
Aotearoa New Zealand Energy Strategy	Energy	CO ₂ , CH ₄	Support the transition to a low-carbon economy, address strategic challenges in the energy sector and signal pathways away from fossil fuels.	Research, regulatory	Planned	The Energy Strategy will help set the pathways to navigate through the energy trilemma and to provide certainty for the sector, industry and consumers. It will set the direction for New Zealand's pathway away from fossil fuels and towards greater levels of renewable electricity and other low-emissions alternatives.	2022	Ministry of Business, Innovation and Employment	NE	NE	NE
New Zealand Energy Efficiency and Conservation Strategy (NZECS) 2017–2022	Energy	CO ₂	Develop a new New Zealand Energy Efficiency and Conservation Strategy to better align with current energy efficiency, conservation and climate change priorities.	Research, regulatory	Planned	The new strategy will better align with the Government's climate change and energy system priorities. It is intended that the new NZECS will complement, and integrate with, the broader Government-led national energy strategy.	2022	Ministry of Business, Innovation and Employment	NE	NE	NE
Hydrogen Roadmap	Energy, industry, transport	CO ₂	Support the development of future fuels to decarbonise sectors of the economy.	Research, regulatory	Planned	The Government will develop a hydrogen roadmap for New Zealand by 2023. This roadmap will build on the Vision for Hydrogen in New Zealand, published in September 2019, to set a strategy guiding investment in hydrogen, and maximising economic benefits and emissions reductions.	2022	Ministry of Business, Innovation and Employment	NE	NE	NE
Gas Transition Plan	Energy	CO ₂ , CH ₄	Set a pathway to reduce reliance on fossil gas through a gas transition plan.	Research, regulatory	Planned	The Gas Transition Plan will set out a transition pathway for the fossil gas industry, explore opportunities for renewable gases and contribute to an equitable transition as we reduce our reliance on fossil gas.	2022	Ministry of Business, Innovation and Employment	NE	NE	NE

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Energy: programmes regulating energy efficiency											
Equipment Energy Efficiency (E3) programme	Energy	CO ₂	Help households and businesses to purchase and use products that use less energy and save money.	Regulatory, information	Implemented	A joint E3 Programme has been developed with Australia. Energy efficiency measures, including energy rating labelling for a range of residential, commercial and industrial products, along with mandatory performance standards, allow both countries to set consistent standards and measures for energy efficiency.	2002	Energy Efficiency and Conservation Authority	214.6	234.0	301.4
Publicly Available Specifications (PAS)	Energy	CO ₂	Provide best-practice specifications for non-regulated products.	Voluntary documents	Implemented	EECA has worked with Standards New Zealand since 2020 to develop five PAS. This includes guidance for biomass boilers, high-temperature heat pumps, and residential and commercial electric vehicle chargers.	2020	Energy Efficiency and Conservation Authority	NE	NE	NE
Energy: reduce emissions and energy use in industry											
Government Investment in Decarbonising Industry (GIDI) Fund	Energy	CO ₂	Accelerate the decarbonisation of industrial process heat.	Financial support	Implemented	Assists private sector businesses with the upfront capital costs of energy efficiency initiatives as well as switching from fossil fuels to renewables to accelerate their decarbonisation goals. The combined emissions reduction across the three rounds of GIDI 1.0 is 7.46 million tonnes of CO ₂ -e, equivalent to taking 134,800 cars off the road.	2020	Energy Efficiency and Conservation Authority	179.0	330.6	198.2
Expansion of GIDI Fund	Energy	CO ₂	Decarbonise businesses through a number of workstreams, including industrial process heat, commercial space and water heating, and efficient industrial equipment replacements.	Financial support	Adopted (WAM)	The expanded fund significantly increases the funding for the original GIDI Fund, and will go to market through multiple channels, including the original contestable process heat fund, as well partnerships with large energy users, equipment subsidies and infrastructure enablement.	2022	Energy Efficiency and Conservation Authority	1,080.7	2,543.1	1,709.5

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Energy Transition Accelerator (ETA) Programme	Energy (commercial, industrial sector)	CO ₂	Develop long-term plans for businesses to transition to lowering emissions as much as possible.	Information, financial and industry support	Implemented	The Energy Efficiency and Conservation Authority is working with large energy users to help them develop tailored and practical low-carbon transition pathways. The goal is to facilitate long-term thinking by drafting a practical map for transition, showing what the technically and economically feasible opportunities are, including innovative technologies, energy efficiency and fuel switching.	2019	Energy Efficiency and Conservation Authority	NE	NE	NE
Technology demonstration programme	Energy (commercial, industrial)	CO ₂	Promote technology that is commercially proven, but underused in New Zealand.	Information	Implemented	The Technology demonstration programme will offer up to NZ\$2 million in the coming year (spread across several projects) to co-fund and reduce risk for underused energy-saving technology for wider market deployment. Since 2018/19, the programme has included a specific investment focus to demonstrate innovative electric heat pump technologies. Since 2013, the expected total annual emissions savings from completed and commissioned projects was 94.232 kt CO ₂ -e per annum. A further total annual emissions saving of 31.641 kt CO ₂ -e per annum is expected from projects in the pipeline.	2013	Energy Efficiency and Conservation Authority	NE	NE	NE
Energy: energy efficient communities											
Gen Less	Energy	CO ₂	Educate people and businesses about their energy choices and support the Government's wider move towards a net zero carbon New Zealand by 2050.	Information	Implemented	The Gen Less website, social media channels and direct mailing lists provide information about climate change and how to reduce energy-related emissions at household, business and national levels.	2019	Energy Efficiency and Conservation Authority	NE	NE	NE

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Support for Energy Education in Communities Programme	Energy	CO ₂	Lift people out of energy hardship.	Fiscal	Implemented	Funding to build and expand the network of services to support people experiencing energy hardship to achieve warmer, more energy-efficient homes and lower their energy bills.	2020	Ministry of Business, Innovation and Employment	NE	NE	NE
Energy: further programmes to improve the energy system											
Māori and Public Housing Renewable Energy Fund and Community Energy Fund	Energy	CO ₂	Support renewable and affordable energy in communities.	Fiscal	Implemented	This fund trials community-scale renewable technologies such as modern geothermal, solar panels and batteries. The most recent round made funding available for larger, more complex, renewable energy technologies, such as small-scale hydro, wind energy generation and projects integrating remote distribution and retail solutions. The Community Energy Fund builds on and expands this.	2020	Ministry of Business, Innovation and Employment	NE	NE	NE
NZ Battery Project	Energy	CO ₂	Investigate solutions to the 'dry year problem' when hydro catchments are low and fossil fuels are used to generate electricity to cover the shortfall.	Research	Implemented	The NZ Battery Project will provide comprehensive advice on the technical, environmental and commercial feasibility of pumped hydro and other potential energy storage projects to mitigate the dry year problem.	2020	Ministry of Business, Innovation and Employment	NE	NE	NE
Electricity Market Measures	Energy	CO ₂	Support the electricity market to transition to 100 per cent renewable generation.	Research, regulatory	Planned	Investigation of the need for and implementation of additional market mechanisms and regulation to support affordable and reliable electricity supply, while accelerating the transition to a highly renewable electricity system.	2022	Ministry of Business, Innovation and Employment	NE	NE	NE
Develop offshore energy regulatory framework	Energy	CO ₂	Enable investment in offshore renewable energy.	Regulatory	Planned	Develop regulatory settings to enable investment in offshore renewable energy (such as offshore wind farms) and innovation.	2022	Ministry of Business, Innovation and Employment	NE	NE	NE

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Review national direction tools for new renewable generation and electricity infrastructure	Energy	CO ₂	Determine whether – and how – resource consent processes could be improved.	Regulatory	Planned	Review of national direction tools for enabling investment in new renewable electricity generation and infrastructure, including small-scale generation. Determine whether, and how, resource consenting processes could be improved.	2022	Ministry of Business, Innovation and Employment	NE	NE	NE
Building and construction											
National Australian Built Environment Rating System – New Zealand (NABERSNZ™)	Energy (commercial, public sector)	CO ₂	Improve the energy performance of new and existing commercial buildings.	Information	Implemented	NABERSNZ™ is a system for rating the energy efficiency of existing office buildings and identifies opportunities for implementing building energy performance improvements. Other work includes: financial grants and loans for energy audits; energy plans; monitoring and verification systems; systems optimisation; and new and emerging technologies.	2013	Energy Efficiency and Conservation Authority	NE	NE	NE
Insulation and heating grants programmes	Energy (residential)	CO ₂	Provide warmer, drier homes through improved thermal performance.	Financial and industry support	Implemented	To date, the Energy Efficiency and Conservation Authority has administered two major insulation and heating programmes. <ul style="list-style-type: none"> • Warm Up New Zealand (running 2009–18) offered insulation retrofits to low-income and/or high-health-need households, as well as to general homeowners in its early years. • Warmer Kiwi Homes replaced Warm Up New Zealand in 2018 and added grants for heat pumps and woodburners. The Energy Efficiency and Conservation Authority has taken a partnership approach by working with third-party funders in the community to leverage government grants.	2009	Energy Efficiency and Conservation Authority	NE	NE	NE

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Transport: reducing reliance on vehicles and supporting people to walk, cycle and use public transport											
Urban Cycleways programme	Transport	CO ₂	Accelerate investment in and uptake of cycling.	Fiscal	Implemented	This Programme optimises co-investment from central government through the Urban Cycleways Fund with funding from the National Land Transport Fund and other local funding.	2014	Waka Kotahi	NE	NE	NE
Community Connect public transport concession	Transport	CO ₂	Improve affordability of public transport for low-income New Zealanders.	Economic, fiscal	Planned	The Community Connect public transport concession will provide half-price fares for Community Service Cardholders. The Government is providing approximately \$25 million a year for this concession.	2023	Waka Kotahi, public transport authorities	5	6	0
Public transport bus decarbonisation	Transport	CO ₂	Accelerate decarbonisation of the public transport bus fleet.	Economic, fiscal, regulatory	Partially implemented	The Government will require only zero-emission public transport buses to be purchased by 1 July 2025 and is targeting full decarbonisation of the bus fleet by 2035. The Government is providing \$137 million over 12 years to support bus decarbonisation initiatives. Funding provided in 2022 for bus decarbonisation is expected to result in an emissions reduction of approximately 290,000 tonnes of CO ₂ -e over 2022–45.	2023	Te Manatū Waka – Ministry of Transport, Waka Kotahi	23	78	177
Transport: rapidly adopting low-emissions vehicles											
Road User Charges exemptions for electric vehicles	Transport	CO ₂	Encourage electric vehicle uptake in both the light and heavy fleets.	Fiscal	Implemented (WEM)	A Road User Charges exemption on light electric vehicles commenced in 2012 and will run until 31 March 2024. A new Road User Charges exemption for heavy electric vehicles was introduced in 2017 and will run until 31 December 2025.	2012	Te Manatū Waka – Ministry of Transport, Waka Kotahi	9	9	8

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Clean Vehicle Discount Scheme and Clean Vehicle Standard	Transport	CO ₂	Address both the supply of and the demand for low-emissions vehicles in New Zealand.	Fiscal, regulatory	Implemented	The Clean Vehicle Discount encourages buyer demand for low-emission vehicles by providing rebates for zero- and low-emission light vehicles, and requiring a fee be paid for high-emission vehicles registered in New Zealand for the first time. The Clean Vehicle Standard requires vehicle importers to achieve annually stricter CO ₂ targets from 2023 or otherwise face financial charges. Scenario modelling using assumed demand response to price changes suggests emissions reduction benefits between 2022 and 2050 from the Clean Vehicle Discount and the Clean Vehicle Standard policies could range between 3.8 and 15.3 million tonnes.	2021	Te Manatū Waka – Ministry of Transport, Waka Kotahi	NE	NE	NE
Low Emissions Transport Fund	Transport	CO ₂	Support the demonstration and adoption of low-emission transport technology, innovation and infrastructure to accelerate the decarbonisation of New Zealand's transport sector.	Financial support	Implemented	The Government increased the funding contribution from \$6–7 million per year to \$25 million per year by 2023/24.	2021	Energy Efficiency and Conservation Authority	NE	NE	NE
Electric vehicle charging infrastructure	Transport	CO ₂	Provide a long-term strategic direction as New Zealand's electric vehicle infrastructure expands.	Other	Planned	This strategy (a discussion document for it is due at the end of 2022) will set out the Government's vision and policy objectives around electric vehicle charging.	TBC	Te Manatū Waka – Ministry of Transport	NE	NE	NE

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Vehicle Fuel Economy Labelling	Transport	CO ₂	Allow consumers to make more informed vehicle purchase choices, and to place an appropriate value on fuel economy.	Regulatory, information	Implemented	This compulsory programme requires vehicle traders and online vendors to display information relating to fuel economy. Updated 2022 to better show CO ₂ emissions, a stricter star rating scheme, and any rebate/charge under the Clean Vehicle Discount scheme. The Energy Efficiency and Conservation Authority estimates that the Vehicle Fuel Economy Labelling programme will encourage CO ₂ savings of 41 kt CO ₂ -e per year by 2020.	2008	Energy Efficiency and Conservation Authority	NE	NE	NE
Transport: begin work now to decarbonise heavy transport and freight											
Freight and Supply Chain Strategy	Transport	CO ₂	Reduce emissions from heavy road freight.	Education	Planned	Developing a Freight and Supply Chain Strategy in collaboration with iwi/Māori, local government and industry. It will set out system-wide actions that need to happen across the sector to achieve our decarbonisation, resilience, productivity and wellbeing outcomes.	2023	Te Manatū Waka – Ministry of Transport	NE	NE	NE
Sustainable Biofuels Obligation	Transport	CO ₂	Help overcome the cost and risk barriers to sustainable biofuels uptake.	Regulatory	Planned	The Sustainable Biofuels Obligation will require fuel suppliers that purchase or import fuel for use in Aotearoa to reduce the total emissions of the fuels they sell by a set percentage each year through the deployment of sustainable biofuels.	2024	Te Manatū Waka – Ministry of Transport and Ministry of Business, Innovation and Employment; Environmental Protection Agency as regulatory agency	513	659	1,001
Transport: Cross-cutting measures to contribute to the delivery of a low-emissions transport system											
Government Policy Statement (GPS) on Land Transport 2021	Transport	CO ₂	Invest in rail, public transport and active modes of transport to mitigate emissions and avoid further increases.	Regulatory, fiscal	Implemented	The GPS on land transport sets the Government's priorities for land transport investment over a 10-year period. It also sets out how money from the National Land Transport Fund is spent on activities such as public transport, state highway improvements, local roads and road safety.	2021	Te Manatū Waka – Ministry of Transport, Waka Kotahi	NE	NE	NE

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Industry											
Kigali Amendment to the Montreal Protocol	IPPU	HFCs	Phase-down of consumption of HFC gases.	Regulatory	Implemented (WEM)	Staged phase-down on consumption (production, importation and exportation) of bulk HFCs.	2020	Ministry for the Environment	NE	NE	NE
Proposals to prohibit import and sale of pre-charged equipment containing HFCs	IPPU	HFCs	Reduce HFCs emissions by prohibiting their use where alternatives are available.	Regulatory	Planned (WAM)	Prohibiting the import and sale of pre-charged equipment containing HFCs in cases where alternatives are available.	TBC	Ministry for the Environment	NE	NE	NE
Action plan for decarbonising industry	Energy	CO ₂	Decarbonise industry.	Research, regulatory	Planned	The Government will set an action plan for decarbonising industry by the end of 2024. The plan will support existing industries to decarbonise and innovative low-emissions industries to grow. The plan will sit within the energy strategy to align with the broader approach for decarbonising the energy sector, including ensuring competitive energy prices and security of supply.	2022	Ministry of Business, Innovation and Employment	NE	NE	NE
Agriculture											
New Zealand Emissions Trading Scheme (NZ ETS)	Agriculture	CO ₂ , CH ₄ , N ₂ O, PFCs, HFCs, SF ₆	Reduce emissions by creating a market through which emitters pay for emissions covered by the scheme.	Economic, regulatory	Implemented (WEM)	The NZ ETS covers all sectors and all gases with reporting and/or surrender obligations – that is, all emissions except for biological emissions from agriculture. The 2012 amendments to the CCRA removed the date for biological emissions from agriculture to assume surrender obligations. The mitigation impacts noted here relate to land-use change. There has been a phased entry of sectors since 2008.	2008	Environmental Protection Authority, Ministry for the Environment, Ministry for Primary Industries	589.4	903.2	1,215.3

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Pricing on agricultural emissions with 95% free allocation	Agriculture	CH ₄ , N ₂ O	Encourage reduction in agricultural emissions.	Economic, regulatory	Planned (WEM)	The Climate Change Response (Emissions Trading Reform) Amendment Bill will put a price on agricultural emissions from 2025, with free allocation set at 95%. In the meantime, a formal sector–Government partnership is helping to prepare for emissions pricing, including by enabling on-farm emissions reporting while considering an alternative pricing mechanism. The Climate Change Commission has carried out a review of progress in 2022.	2020	Ministry for the Environment, Ministry for Primary Industries	123.5	649.8	1,136.0
Centre for Climate Action on Agricultural Emissions	Agriculture	CH ₄ , N ₂ O, CO ₂	Accelerate the development of greenhouse gas mitigations	Research, commercialisation, information, capability building	Planned	The Centre will include a new public–private joint venture with a focus on product development and commercialisation to drive research and development activity.	TBC	Ministry for Primary Industries	NE	NE	NE
Global Research Alliance on Agricultural Greenhouse Gases (GRA)	Agriculture	CH ₄ , N ₂ O, CO ₂	Increase international collaboration on and investment in research on increasing agricultural and food production, without growing greenhouse gas emissions.	Research, information, training, education	Implemented	New Zealand plays an active role in supporting the GRA through funding and delivery of education, training and public awareness, funding of mitigation research projects and funding of regional and international collaboration in addition to co-chairing the GRA's Livestock Research Group and hosting the GRA Secretariat and Special Representative.	2009	Secretariat support and co-Chair of the Livestock Research Group provided by New Zealand Ministry for Primary Industries	NE	NE	NE
New Zealand Agricultural Greenhouse Gas Research Centre	Agriculture	CH ₄ , N ₂ O, CO ₂	Focus on ways to reduce on-farm CH ₄ and N ₂ O emissions and enhance soil carbon.	Research, information, capability building, education	Implemented	Brings together nine primary sector research organisations.	2009	Ministry for Primary Industries	NE	NE	NE
Sustainable Food and Fibre Futures	Agriculture	CH ₄ , N ₂ O, CO ₂	Invest in innovative projects to grow New Zealand's food and fibre industries sustainably.	Research, information, training	Implemented	Provides funding for programmes of research and innovation.	2018	Ministry for Primary Industries	NE	NE	NE

Name of mitigation action	Sectors affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2025	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2030	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2035
Sustainable Land Management and Climate Change Research Programme	Agriculture	CH ₄ , N ₂ O, CO ₂	Research programmes in agriculture and forestry sectors.	Research, information, education, capability building, extension	Implemented	Initiatives and programmes in the agricultural and forestry sectors that focus on adaptation to climate change.	2007	Ministry for Primary Industries	NE	NE	NE
Synthetic nitrogen fertiliser cap (N-cap)	Agriculture	N ₂ O	Limit the impacts of synthetic nitrogen fertiliser on freshwater ecosystems following application to land. The synthetic fertiliser cap will have the co-benefit of a reduction in synthetic nitrogen fertiliser applied to land, and modelled reduction in N ₂ O emissions.	Regulatory	Implemented (WEM)	From 1 July 2021, a cap on the use of synthetic nitrogen fertiliser applies on any contiguous parcel of pastoral land. The cap has been set at 190 kg per hectare per year.	2021	Ministry for the Environment and regional and local councils	0.0	71.7	149.8
Essential Freshwater Package (excluding the impact of the N-cap)	Agriculture	CH ₄ , N ₂ O	Improve the quality of freshwater in New Zealand. Its implementation will have a co-benefit of more streamside planting (to reduce rural runoff), retention of more natural wetlands, and potentially less intensive stocking. These actions will contribute to carbon capture and reduce emissions.	Regulatory	Implemented (WEM)	The National Policy Statement for Freshwater Management provides national policy direction to regional councils on freshwater management. These measures will impact emissions from agriculture through their influence on animal numbers.	2020	Regional and local councils	82.2	424.5	767.5
Land use, land-use change and forestry (LULUCF): principal measures											
NZ ETS	LULUCF	CO ₂	Promote afforestation and disincentivise planted forest deforestation.	Fiscal	Implemented (WEM)	The NZ ETS is a key tool for meeting domestic and international climate change targets. Owners of post-1989 eligible forest can earn NZUs for carbon sequestered. There are also liabilities for forest carbon loss, via harvesting or deforestation.	2008	Ministry for Primary Industries	4,569.7	10,109.0	16,394.3

Name of mitigation action	Sectors affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative) 2025 (kt CO ₂ -e)	Estimate of mitigation impact (not cumulative) 2030 (kt CO ₂ -e)	Estimate of mitigation impact (not cumulative) 2035 (kt CO ₂ -e)
Afforestation Grant Scheme	LULUCF	CO ₂	Promote the establishment of production and permanent forests on previously unforested land. Reduce erosion by encouraging tree planting on erosion-prone land. Enhance the sequestration of carbon in forest sinks. Increase the area of new forests that meet the afforestation/ reforestation definition under the Kyoto Protocol in New Zealand.	Fiscal	Implemented (WEM)	Under the Afforestation Grant Scheme, landowners who have received a grant have ongoing obligations to maintain their grant forests for a minimum 10-year period.	2008–18	Ministry for Primary Industries	713.4	703.6	774.5
One Billion Trees Programme	LULUCF	CO ₂	Increase tree planting across New Zealand. The goal is to double the current planting rate to reach one billion trees planted by 2028.	Fiscal	Implemented (WEM)	This \$176.8 million fund ran for three years from August 2018 until its closure on 30 June 2021. Existing funding agreements extend into the future and will receive continued support and relationship management as these projects progress to completion.	2018–21	Ministry for Primary Industries	932.9	1,111.8	1,283.4
Sustainable Land Management Hill Country Erosion Programme	LULUCF	CO ₂	Protect New Zealand's estimated 1.4 million hectares of pastoral hill country that is classified as erosion-prone.	Fiscal	Implemented (WEM)	It provides up to NZ\$10 million of targeted funding support annually to regional and unitary councils. The purpose of the Programme is to speed up the rate of treatment of erosion-prone land.	2009	Ministry for Primary Industries	485.0	694.2	724.1
Erosion Control Funding Programme	LULUCF	CO ₂	Provide funding to land owners to prevent and control erosion.	Fiscal	Implemented (WEM)	The grant can be used to control erosion on the worst eroding or erosion-prone land in the district, by providing effective tree cover through planting or encouraging natural reversion to native bush.	1993–2018	Ministry for Primary Industries	246.8	698.8	1,273.3
Permanent Forest Sink Initiative (PFSI)	LULUCF	CO ₂	Enable land owners to receive New Zealand Units for permanent forest sinks.	Fiscal	Implemented (WEM)	Discontinue the PFSI at the end of 2021 and replace it with a new activity in the NZ ETS that encourages the establishment of permanent post-1989 forests.	2008–22	Ministry for Primary Industries	214.4	178.5	166.0

Name of mitigation action	Sectors affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2025	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2030	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2035
LULUCF: other measures											
Woody biomass	LULUCF	CO ₂	Directly increase biomass supply and stimulate private sector investment to create further supply.	Fiscal	Planned (WAM)	Investment in commercial planting to increase the supply of biomass; and research into alternative biomass crops, and effective forest waste recovery for biomass.	2023	Ministry for Primary Industries	-75.4	288.6	309.8
Native afforestation initiative	LULUCF	CO ₂	Increase the supply of native seedlings and reducing the barriers and cost for planting. It is the first stage of a multi-phase project to support establishing native forests at scale to develop long-term carbon sinks.	Fiscal	Planned (WAM)	Deployment and uptake of technology; development of a long-term strategy and actions plan with partners and stakeholders; research and innovation; and increased knowledge and advice to support nursery sector growth.	2025	Ministry for Primary Industries	31.1	282.3	740.1
Maximising carbon storage	LULUCF	CO ₂	Support the increased sequestration of carbon.	Fiscal	Planned (WAM)	Stimulate investment in domestic wood processing to increase value from exports and maximise carbon stored in manufactured wood products; fund research and expand look-up tables to more accurately reflect carbon stock changes.	2024	Ministry for Primary Industries	149.1	843.0	1,507.0
National Environmental Standards	LULUCF	CO ₂	Ensure the environmental effects of all exotic afforestation are managed; improve wildfire risk management planning; better enable foresters and councils to manage the environmental effects of forestry; and consult on options for extending regulatory controls to control the location of plantation and exotic carbon afforestation.	Regulatory	Planned	Proposals and options for managing plantation and exotic carbon forestry under the resource management system. Consultation commenced October 2022.	TBC	Ministry for the Environment, Ministry for Primary Industries	NE	NE	NE

Name of mitigation action	Sectors affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative) 2025 (kt CO ₂ -e)	Estimate of mitigation impact (not cumulative) 2030 (kt CO ₂ -e)	Estimate of mitigation impact (not cumulative) 2035 (kt CO ₂ -e)
Develop forestry and wood processing industry transformation plan (ITP)	Forestry	CO ₂	Proposes a vision and actions to transform the forestry and wood processing sector so that the sector generates more value for New Zealand, is a key pillar of our regional communities, and underpins New Zealand's low-emissions economy.	Fiscal	Adopted	The ITP is being developed in partnership with Māori, industry and workers to deliver more value from our existing and future forest estate, stimulate production of new cost-effective low-emissions products and wood-based biofuels and provide sustainable jobs across the regions.	TBC	Ministry for Primary Industries	NE	NE	NE
Waste											
Emissions reduction plan – existing waste sector policies	Waste	CH ₄ , N ₂ O	This represents the set of policies that are already adopted under the emissions reduction plan for the waste sector, covering various waste reduction programmes.	Regulatory, fiscal voluntary agreement, information, education, research	Adopted (WEM)	<ul style="list-style-type: none"> Implement organic waste reduction behaviour change programmes. Standardise residential kerbside collection – provision of food scraps collections. Require businesses to separate food waste. Invest in organic waste processing and resource recovery infrastructure to support an increase in food, garden, paper/cardboard and wood waste diversion from landfill. Improve landfill gas capture systems. Implementation year varies by policy. 	2023	Ministry for the Environment, regional and local councils	27.4	96.9	139.2
Emissions reduction plan – additional waste sector policies	Waste	CH ₄ , N ₂ O	This represents several planned policies under the emissions reduction plan for the waste sector, focusing on landfill gas capture.	Regulatory	Planned (WAM)	<ul style="list-style-type: none"> Limits and bans organic waste to landfill by 2030. Expands landfill gas capture systems to more landfills. Implementation year varies by policy.	2023	Ministry for the Environment, regional and local councils	0	176.5	258.2
Waste Disposal Levy under the Waste Minimisation Act 2008	Waste	CO ₂ , CH ₄ , N ₂ O	Encourage waste minimisation and decrease waste disposal to protect the environment from harm and provide environmental, social, economic and cultural benefits.	Regulatory	Implemented (WEM)	The Waste Disposal Levy rate for landfills that take household waste is progressively increasing over four years from \$10 per tonne, set in 2009, to \$60 per tonne as of July 2024.	2010	Ministry for the Environment	32.3	64.5	79.8

Name of mitigation action	Sectors affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2025	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2030	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2035
Waste Minimisation Fund (WMF)	Waste	CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆	Increase resource efficiency; increase reuse, recovery and recycling; and decrease waste to landfill.	Fiscal	Implemented	A levy is imposed on waste disposed to landfill and generates funds for waste minimisation activities. These funds are distributed to territorial authorities and waste minimisation projects (via the WMF). Additional funding from the Climate Emergency Response Fund is available for infrastructure projects to reduce emissions from waste in 2022–24.	2010	Ministry for the Environment	NE	NE	NE
Regulated Product Stewardship	Waste, IPPU	CO ₂ , CH ₄ , HFCs, SF ₆	Implement regulations to increase circular economy and place responsibilities for managing end-of-life products on producers, importers and retailers rather than on communities, councils, neighbours and nature.	Regulatory	Adopted	The Ministry for the Environment is working with stakeholders to co-design product stewardship schemes for six priority products: plastic packing, tyres, electrical and electronic products, agrichemicals and their containers, refrigerants, farm plastics. Co-design of the schemes for tyres and refrigerants is currently under way. Of particular interest from an emissions perspective is product stewardship for refrigerants (found in heating and cooling devices). Product stewardship of electric vehicle batteries is also important to assist with uptake and sustainability of electric vehicles.	2020	Ministry for the Environment	NE	NE	NE

Name of mitigation action	Sectors affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2025	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2030	Estimate of mitigation impact (not cumulative) (kt CO ₂ -e) 2035
National Environmental Standard for Air Quality	Waste	CH ₄	Effectively manage discharges to air of greenhouse gases (mainly CH ₄) generated from large landfills.	Regulatory	Implemented (WEM)	The landfill gas standards currently require landfill sites with a lifetime design capacity of greater than 1 million tonnes of refuse to collect and destroy CH ₄ emissions. Amendments proposed under the emissions reduction plan will require all municipal landfills to capture gas, including sites with less than 1 million tonnes capacity. Standard came into effect in 2004, with full compliance required by 2007.	2004	Ministry for the Environment, regional and local councils	605.3	657.2	691.6
Tokelau											
Tokelau Renewable Energy Project	Tokelau	CO ₂ , CH ₄	Provide reliable, adequate, and efficient energy for the people of Tokelau through the use of solar photovoltaic power.	Fiscal	Implemented (WEM)	In 2012, the installation of about 4,000 solar panels across Tokelau's three atolls was completed. Each of the three Tokelau atolls now has a significant array of solar panels that cater for almost all local electric power requirements.	2012	Ministry of Foreign Affairs and Trade	1	1	1

Appendix C: Supplementary material for emissions projections

C.1: Key variables and assumptions

Table C.1: Summary of key variables and assumptions used in the projections analysis (CTF Table 5)

Key underlying assumptions	Unit	Scenarios	Historical							Projected		
			1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Population	million inhabitants	WEM/WOM/WAM/ Low/high	3.46	3.67	3.86	4.13	4.35	4.59	5.09	5.32	5.55	5.72
GDP	billion (real 2009/10 \$NZ)	WEM/WOM/WAM/ Low/high	112.68	130.49	152.13	184.13	196.70	225.26	261.95	294.16	323.90	354.02
Effective carbon price	\$NZ tonne CO ₂ -e	WEM/WAM	NA	NA	NA	NA	NA	NA	NA	\$64	\$97	\$115
		WOM	NA	NA	NA	NA	NA	NA	NA	\$0	\$0	\$0
		Low	NA	NA	NA	NA	NA	NA	NA	\$93	\$150	\$174
		High	NA	NA	NA	NA	NA	NA	NA	\$35	\$44	\$57
Population (Energy & Transport sectors)	million inhabitants	WEM/WOM/WAM	3.46	3.67	3.86	4.13	4.35	4.60	5.09	5.28	5.58	5.80
		Low	3.46	3.67	3.86	4.13	4.35	4.60	5.09	5.28	5.46	5.53
		High	3.46	3.67	3.86	4.13	4.35	4.60	5.09	5.28	5.71	6.08
GDP (Energy & Transport sectors)	billion (real 2009/10 \$NZ billion)	WEM/WOM/WAM	112.71	130.5	152.2	184.2	196.8	225.9	253.3	291.4	325.3	351.7
		Low	112.71	130.5	152.2	184.2	196.8	225.9	253.3	291.4	316.1	332.4
		High	112.71	130.5	152.2	184.2	196.8	225.9	253.3	291.4	335.4	375.8
Effective carbon price (Energy & Transport sectors)	(\$NZ tonne CO ₂ -e)	WEM/WAM/Low/ High	NA	NA	NA	NA	NA	NA	NA	82	140	168

Key underlying assumptions	Unit	Scenarios	Historical							Projected		
			1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Light vehicles – Internal Combustion Engine	thousands	WEM/WOM/WAM/ Low/High	NA	NA	NA	2967.41	3122.80	3482.11	4034.12	4342.35	4382.24	4126.12
Light vehicles – Electric vehicle	thousands	WEM/WOM/WAM/ Low/High	NA	NA	NA	0.06	0.07	0.96	23.93	841.73	240.10	633.89
Heavy commercial vehicles – Internal Combustion Engine	thousands	WEM/WOM/WAM/ Low/High	NA	NA	NA	126.20	137.01	145.63	167.73	182.23	185.69	185.68
Motorcycles	thousands	WEM/WOM/WAM/ Low/High	NA	NA	NA	97.17	140.04	158.48	188.24	202.38	206.37	207.71
Trucks and buses – Electric vehicles and plug-in hybrids	thousands	WEM/WOM/WAM/ Low/High	NA	NA	NA	0.07	0.07	0.07	0.19	0.86	2.99	7.65
Vehicle kilometres travelled	vehicle thousand KM	WEM/WOM/WAM/ Low/High	NA	NA	NA	40398.75	40394.56	43173.49	46262.99	52700.17	56060.74	58979.55
Total energy demand	Gross PJ	WEM/WOM/WAM/ Low/High	389.3	438.8	481.3	512.4	520.0	555.4	540.0	549.5	540.7	533.9
Aviation	Gross PJ	WEM/WOM/WAM/ Low/High	13.87	16.34	17.18	17.41	13.98	12.41	10.31	15.64	15.64	15.64
Rail transport	Gross PJ	WEM/WOM/WAM/ Low/High	1.34	2.44	3.76	2.46	2.25	2.27	1.86	1.85	1.85	1.85
Navigation	Gross PJ	WEM/WOM/WAM/ Low/High	3.28	4.10	5.17	5.45	3.76	5.73	3.72	2.75	2.75	2.75
Labour Force	millions	WEM/WOM/WAM/ Low/High	NA	NA	NA	NA	NA	NA	2.84	3.02	3.21	3.34
Net migration	thousands	WEM/WOM/WAM/ Low/High	NA	NA	NA	NA	NA	NA	NA	35.1	32.8	25
Exchange rate	(NZ\$/US\$)	WEM/WOM/WAM/ Low/High	NA	NA	NA	NA	NA	NA	0.64	0.65	0.65	0.65

Key underlying assumptions	Unit	Scenarios	Historical							Projected			
			1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	
Upper limit in importation of new HFCs	Percent of 1796 kt CO ₂ -e baseline*	WEM/WAM/High/Low	NA	NA	NA	NA	NA	NA	NA	NA	47.7%	29.8%	19.4%
GWP limits on new pre-charged equipment		WEM/High/Low	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		WAM	NA	NA	NA	NA	NA	NA	NA	NA	Yes	Yes	Yes
Refrigerants recovery rate	Percent of retired volumes	WEM	NA	NA	NA	NA	NA	NA	NA	NA	9%	10%	12%
		High	NA	NA	NA	NA	NA	NA	NA	NA	9%	12%	14%
		Low	NA	NA	NA	NA	NA	NA	NA	NA	9%	10%	11%
		WAM	NA	NA	NA	NA	NA	NA	NA	NA	12%	12%	18%
Effective carbon price (discounted carbon price for pricing) (Agriculture)	\$NZ	WEM/WOM/WAM	NA	NA	NA	NA	NA	NA	NA	NA	\$64 (\$3.20)	\$97 (\$9.72)	\$115 (\$23.05)
Dairy area	thousand hectares	WEM/WAM	1,024	1,208	1,329	1,399	1,639	1,752	1,714	1,714	1,705	1,699	1,695
		WOM	1,024	1,209	1,330	1,401	1,641	1,756	1,721	1,721	1,723	1,726	1,731
Sheep beef deer area	thousand hectares	WEM	12,054	11,610	10,587	9,825	9,200	8,415	7,839	7,839	7,334	7,141	6,954
		WOM	12,054	11,618	10,612	9,855	9,246	8,500	7,989	7,989	7,689	7,660	7,635
		WAM	12,054	11,610	10,587	9,825	9,200	8,415	7,839	7,839	7,317	7,062	6,813
Horticulture area	thousand hectares	WEM/WOM/WAM	72	94	93	97	105	104	109	109	116	120	124
Arable land	thousand hectares	WEM/WOM/WAM	191	161	161	149	171	161	144	144	161	166	160
Exotic forest	thousand hectares	WEM/WAM	1,315	1,541	1,744	1,776	1,733	1,731	1,789	1,789	2,039	2,232	2,419
		WOM	1,315	1,533	1,717	1,745	1,684	1,642	1,632	1,632	1,665	1,685	1,702
Other land	thousand hectares	WEM/WOM	2,681	1,782	1,791	1,815	1,476	1,487	1,473	1,473	1,410	1,369	1,324
		WAM^	2,681	1,782	1,791	1,815	1,476	1,487	1,473	1,473	1,426	1,448	1,465

Key underlying assumptions	Unit	Scenarios	Historical								Projected	
			1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Total agriculture land use	thousand hectares	WEM/WOM/WAM	17,489	16,578	15,909	15,306	14,580	13,929	13,344	13,037	12,992	12,940
Total nitrogen fertiliser	thousand tonnes per year	WEM/WAM	59	151	189	355	341	429	470	450	424	398
		WOM	59	151	189	355	341	429	470	455	456	456
Total annual milk production	million litres per year	WEM/WAM	7,199	8,957	11,630	14,103	16,483	21,253	21,148	20,734	20,935	21,058
		WOM	7,199	8,959	11,638	14,114	16,500	21,290	21,217	20,893	21,639	22,461
Total Dairy Cows	thousand head	WEM/WAM	3,302	3,839	4,316	5,152	5,861	6,698	6,361	6,055	5,875	5,709
		WOM	3,302	3,840	4,319	5,156	5,867	6,710	6,382	6,101	6,072	6,089
Total Beef Cows	thousand head	WEM	4,526	5,048	4,644	4,447	4,101	3,670	3,890	3,710	3,448	3,273
		WOM	4,526	5,050	4,651	4,457	4,115	3,695	3,941	3,830	3,704	3,660
		WAM	4,526	5,048	4,644	4,447	4,101	3,670	3,890	3,704	3,421	3,226
Total Sheep	thousand head	WEM	60,569	49,466	45,680	39,271	32,384	29,803	26,822	23,918	22,428	21,075
		WOM	60,569	49,488	45,755	39,353	32,497	30,010	27,173	24,692	24,095	23,569
		WAM	60,569	49,466	45,680	39,271	32,384	29,803	26,822	23,881	22,255	20,775
Total Lambs	thousand head	WEM	39,997	37,018	34,840	33,226	28,152	25,833	23,172	21,466	20,537	19,683
		WOM	39,997	37,034	34,897	33,296	28,250	26,012	23,476	22,160	22,064	22,012
		WAM	39,997	37,034	34,897	33,296	28,250	26,012	23,476	21,432	20,379	19,403
Total Deer	thousand head	WEM	780	1,231	1,677	1,757	1,146	958	810	756	676	618
		WOM	780	1,232	1,680	1,761	1,150	965	821	780	726	691
		WAM	780	1,232	1,680	1,761	1,150	965	821	755	671	609
Afforestation	hectares	WEM	14,512	64,101	32,863	12,010	10,513	5,937	41,111	43,476	38,067	38,067
		WAM	14,512	64,101	32,863	12,010	10,513	5,937	41,111	55,226	50,519	50,519
		Low	14,512	64,101	32,863	12,010	10,513	5,937	41,111	51,867	46,287	46,287
		High	14,512	64,101	32,863	12,010	10,513	5,937	41,111	35,123	29,885	29,885

Key underlying assumptions	Unit	Scenarios	Historical							Projected		
			1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Deforestation	hectares	WEM/WAM	1,844	1,844	4,591	16,668	10,069	8,523	2,506	1,933	1,933	1,933
		Low	1,844	1,844	4,591	16,668	10,069	8,523	2,506	1,067	1,067	1,067
		High	1,844	1,844	4,591	16,668	10,069	8,523	2,506	3,244	3,244	3,244
Managed waste tonnage	kilotonnes	WEM	2,607	3,033	2,806	3,081	2,511	3,208	3,495	3,533	3,645	3,777
managed LFG sites only waste	kilotonnes	WEM	1,433	1,688	1,575	1,881	2,308	3,017	3,248	3,192	3,342	3,449
managed non-LFG sites only waste	kilotonnes	WEM	1,175	1,345	1,231	1,200	225	205	135	142	94	67
non-MSW landfills waste	kilotonnes	WEM	2,604	2,917	3,433	4,161	4,500	5,093	5,093	5,093	5,093	5,093
farm waste (buried)	kilotonnes	WEM	784	663	746	621	578	533	476	510	499	490
farm waste (burned)	kilotonnes	WEM	784	663	746	621	578	533	476	510	499	490
composted waste tonnage	kilotonnes	WEM	27	30	33	37	71	224	399	472	506	526
AD waste tonnage	kilotonnes	WEM	0	0	0	0	0	0	0	60	75	90
Total number of farms	number	WEM	80,904	68,776	NE	64,488	59,907	55,263	49,288	52,858	51,716	50,755
Combined Population & GDP scaling factor from 2020 projections (Waste sector)	factor	Low	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.95	0.91
Combined Population & GDP scaling factor from 2020 projections (Waste sector)	factor	High	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.05	1.09

Note: CO₂-e = carbon dioxide equivalent; GDP = gross domestic product; HFCs = hydrofluorocarbons; NA = not applicable; WAM = with additional measures; WEM = with existing measures; WOM = without measures; Low = Low emissions variation of the WEM scenario, High = High emissions variation of the WEM scenario. *Ozone Layer Protection Act 1996 regulations as at 10 December 2018, Schedules 6+1AA, relating to a High Court amendment. ^This includes numbers on native afforestation from the modelled CERF forestry initiatives.

C.2: Information on updated emissions projections

Table C.2.1: Information on updated greenhouse gas emissions (with measures) (CTF Table 6a)

GHG emissions projections	GHG emissions and removals							GHG emissions projections		
	Base year 1990 (kt CO ₂ -e)	1995 (kt CO ₂ -e)	2000 (kt CO ₂ -e)	2005 (kt CO ₂ -e)	2010 (kt CO ₂ -e)	2015 (kt CO ₂ -e)	2020 (kt CO ₂ -e)	2025 (kt CO ₂ -e)	2030 (kt CO ₂ -e)	2035 (kt CO ₂ -e)
Sector										
Energy	15,751.70	15,618.56	18,370.71	21,586.33	18,898.06	18,600.46	18,285.00	13,589.80	12,050.37	10,990.54
Transport	8,126.19	10,247.56	11,648.31	13,063.44	13,349.43	13,805.24	13,176.42	15,111.28	14,798.50	13,754.28
Industry/industrial processes	3,579.92	3,174.43	3,443.22	4,061.65	4,591.13	5,137.32	4,618.35	4,019.60	3,910.28	3,717.95
Agriculture	33,792.88	35,734.70	37,614.88	39,571.90	37,711.50	39,415.79	39,425.54	37,432.57	36,298.76	35,329.96
Forestry/LULUCF	-21,229.22	-22,445.90	-26,934.90	-25,424.54	-29,326.27	-26,610.16	-23,313.25	-9,532.97	-12,013.71	-25,476.16
Waste management/waste	3,943.11	4,234.51	4,434.56	4,378.30	3,871.67	3,487.83	3,268.87	3,137.90	2,982.49	2,884.33
Tokelau (Other)	3.17	3.14	3.49	4.49	4.52	3.42	4.18	3.56	3.51	3.46
Gas										
CO ₂ emissions including net CO ₂ from LULUCF	3,878.45	5,102.66	4,831.02	11,490.90	5,035.98	8,826.78	10,790.52	21,401.44	17,051.54	1,466.04
CO ₂ emissions excluding net CO ₂ from LULUCF	25,502.51	28,003.49	32,246.01	37,424.07	34,811.08	35,813.11	34,456.75	31,284.66	29,415.51	27,292.45
CH ₄ emissions including CH ₄ from LULUCF	33,041.22	34,314.43	36,021.62	36,633.80	34,856.74	35,066.39	34,354.60	32,657.63	31,592.07	30,762.47
CH ₄ emissions excluding CH ₄ from LULUCF	32,972.51	34,237.19	35,951.60	36,522.93	34,764.35	34,989.09	34,272.94	32,571.33	31,505.77	30,676.17
N ₂ O emissions including N ₂ O from LULUCF	6,118.17	6,947.71	7,406.82	8,328.06	8,036.12	8,485.51	8,735.10	8,381.61	8,157.57	7,948.45

GHG emissions projections	GHG emissions and removals						GHG emissions projections			
	Base year 1990 (kt CO ₂ -e)	1995 (kt CO ₂ -e)	2000 (kt CO ₂ -e)	2005 (kt CO ₂ -e)	2010 (kt CO ₂ -e)	2015 (kt CO ₂ -e)	2020 (kt CO ₂ -e)	2025 (kt CO ₂ -e)	2030 (kt CO ₂ -e)	2035 (kt CO ₂ -e)
N ₂ O emissions excluding N ₂ O from LULUCF	5,792.05	6,570.02	6,996.74	7,930.30	7,679.68	8,186.65	8,463.78	8,117.66	7,893.62	7,684.50
HFCs	0.00	24.52	233.65	694.01	1,100.81	1,386.17	1,480.29	1,302.98	1,209.46	1,006.70
PFCs	909.95	153.28	67.61	69.38	47.56	58.59	87.92	0.00	0.00	0.00
SF ₆	19.97	24.42	19.56	25.41	22.84	16.46	16.69	18.08	19.55	20.70
NF ₃										
Other gases										
Total with LULUCF	43,967.76	46,567.01	48,580.27	57,241.57	49,100.05	53,839.90	55,465.11	63,761.75	58,030.20	41,204.35
Total without LULUCF	65,196.98	69,012.91	75,515.17	82,666.10	78,426.32	80,450.06	78,778.37	73,294.72	70,043.91	66,680.52

Table C.2.2: Information on updated greenhouse gas emissions (without measures) (CTF Table 6b)

GHG emissions projections	GHG emissions and removals						GHG emissions projections			
	Base year 1990 (kt CO ₂ -e)	1995 (kt CO ₂ -e)	2000 (kt CO ₂ -e)	2005 (kt CO ₂ -e)	2010 (kt CO ₂ -e)	2015 (kt CO ₂ -e)	2020 (kt CO ₂ -e)	2025 (kt CO ₂ -e)	2030 (kt CO ₂ -e)	2035 (kt CO ₂ -e)
Sector										
Energy	15,751.70	15,618.56	18,370.71	21,586.33	18,898.06	18,600.46	18,285.00	15,912.53	16,052.42	15,986.22
Transport	8,126.19	10,247.56	11,648.31	13,063.44	13,349.43	13,805.24	13,176.42	15,328.82	15,232.69	14,411.54
Industry/industrial processes	3,579.92	3,181.18	3,453.29	4,043.88	4,557.14	5,127.74	4,609.13	4,246.68	4,220.83	4,100.84
Agriculture	33,792.88	35,734.70	37,614.88	39,571.90	37,711.50	39,561.83	39,821.96	38,225.91	38,346.42	38,597.10
Forestry/LULUCF	-21,229.22	-22,474.82	-26,648.51	-30,839.55	-28,206.15	-24,800.91	-17,043.47	-2,370.87	1,482.20	-4,860.59

GHG emissions projections	GHG emissions and removals						GHG emissions projections			
	Base year 1990 (kt CO ₂ -e)	1995 (kt CO ₂ -e)	2000 (kt CO ₂ -e)	2005 (kt CO ₂ -e)	2010 (kt CO ₂ -e)	2015 (kt CO ₂ -e)	2020 (kt CO ₂ -e)	2025 (kt CO ₂ -e)	2030 (kt CO ₂ -e)	2035 (kt CO ₂ -e)
Waste management/waste	3,943.11	4,234.51	4,434.56	4,378.30	4,298.26	4,090.63	3,846.43	3,777.36	3,707.31	3,660.03
Tokelau (Other)	3.17	3.14	3.49	4.49	4.52	3.42	4.18	3.56	3.51	3.46
Gas										
CO ₂ emissions including net CO ₂ from LULUCF	3,878.45	5,073.74	5,117.40	6,075.88	6,156.10	10,636.04	17,060.31	31,085.54	34,992.06	27,777.47
CO ₂ emissions excluding net CO ₂ from LULUCF	25,502.51	28,003.49	32,246.01	37,424.07	34,811.08	35,813.11	34,456.75	33,806.67	33,860.11	32,988.32
CH ₄ emissions including CH ₄ from LULUCF	33,041.22	34,314.43	36,021.62	36,633.80	35,283.33	35,797.05	35,274.02	33,974.84	33,962.43	34,114.87
CH ₄ emissions excluding CH ₄ from LULUCF	32,972.51	34,237.19	35,951.60	36,522.93	35,190.94	35,719.75	35,192.36	33,888.54	33,876.13	34,028.57
N ₂ O emissions including N ₂ O from LULUCF	6,118.17	6,947.71	7,406.82	8,328.06	8,036.12	8,503.68	8,789.66	8,515.45	8,551.33	8,595.97
N ₂ O emissions excluding N ₂ O from LULUCF	5,792.05	6,570.02	6,996.74	7,930.30	7,679.68	8,204.82	8,518.34	8,251.50	8,287.37	8,332.01
HFCs	0.00	31.27	243.72	676.24	1,066.82	1,376.59	1,471.07	1,530.06	1,520.01	1,389.59
PFCs	909.95	153.28	67.61	69.38	47.56	58.59	87.92	0.00	0.00	0.00
SF ₆	19.97	24.42	19.56	25.41	22.84	16.46	16.69	18.08	19.55	20.70
NF ₃										
Other gases										
Total with LULUCF	43,967.76	46,544.84	48,876.73	51,808.78	50,612.77	56,388.41	62,699.65	75,123.98	79,045.38	71,898.60
Total without LULUCF	65,196.98	69,019.65	75,525.24	82,648.34	78,818.92	81,189.32	79,743.12	77,494.85	77,563.18	76,759.19

Table C.2.3: Information on updated greenhouse gas emissions (with additional measures) (CTF Table 6c)

GHG emissions projections	GHG emissions and removals							GHG emissions projections		
	Base year 1990 (kt CO ₂ -e)	1995 (kt CO ₂ -e)	2000 (kt CO ₂ -e)	2005 (kt CO ₂ -e)	2010 (kt CO ₂ -e)	2015 (kt CO ₂ -e)	2020 (kt CO ₂ -e)	2025 (kt CO ₂ -e)	2030 (kt CO ₂ -e)	2035 (kt CO ₂ -e)
Sector										
Energy	15,751.70	15,618.56	18,370.71	21,586.33	18,898.06	18,600.46	18,285.00	13,588.01	11,337.69	10,487.54
Transport	8,126.19	10,247.56	11,648.31	13,063.44	13,349.43	13,805.24	13,176.42	15,111.28	14,798.50	13,754.28
Industry/industrial processes	3,579.92	3,174.43	3,443.22	4,061.65	4,591.13	5,137.32	4,618.35	3,940.12	3,810.65	3,475.91
Agriculture	33,792.88	35,734.70	37,614.88	39,571.90	37,711.50	39,415.79	39,425.54	37,390.57	36,165.29	35,107.74
Forestry/LULUCF	-21,229.22	-22,445.90	-26,934.90	-25,424.54	-29,326.27	-26,610.16	-23,313.25	-9,637.74	-13,427.64	-28,033.03
Waste management/waste	3,943.11	4,234.51	4,434.56	4,378.30	3,871.67	3,487.83	3,268.87	3,137.78	2,840.35	2,661.09
Tokelau (Other)	3.17	3.14	3.49	4.49	4.52	3.42	4.18	3.56	3.51	3.46
Gas										
CO ₂ emissions including net CO ₂ from LULUCF	3,878.45	5,102.66	4,831.02	11,490.90	5,035.98	8,826.78	10,790.52	21,294.87	14,924.93	-1,593.83
CO ₂ emissions excluding net CO ₂ from LULUCF	25,502.51	28,003.49	32,246.01	37,424.07	34,811.08	35,813.11	34,456.75	31,282.87	28,702.83	26,789.45
CH ₄ emissions including CH ₄ from LULUCF	33,041.22	34,314.43	36,021.62	36,633.80	34,856.74	35,066.39	34,354.60	32,620.78	31,319.35	30,330.58
CH ₄ emissions excluding CH ₄ from LULUCF	32,972.51	34,237.19	35,951.60	36,522.93	34,764.35	34,989.09	34,272.94	32,534.48	31,233.05	30,244.28
N ₂ O emissions including N ₂ O from LULUCF	6,118.17	6,947.71	7,406.82	8,328.06	8,036.12	8,485.51	8,735.10	8,376.34	8,154.69	7,934.89
N ₂ O emissions excluding N ₂ O from LULUCF	5,792.05	6,570.02	6,996.74	7,930.30	7,679.68	8,186.65	8,463.78	8,112.38	7,890.73	7,670.93
HFCs	0.00	24.52	233.65	694.01	1,100.81	1,386.17	1,480.29	1,223.50	1,109.83	764.66

GHG emissions projections	GHG emissions and removals						GHG emissions projections			
	Base year 1990 (kt CO ₂ -e)	1995 (kt CO ₂ -e)	2000 (kt CO ₂ -e)	2005 (kt CO ₂ -e)	2010 (kt CO ₂ -e)	2015 (kt CO ₂ -e)	2020 (kt CO ₂ -e)	2025 (kt CO ₂ -e)	2030 (kt CO ₂ -e)	2035 (kt CO ₂ -e)
PFCs	909.95	153.28	67.61	69.38	47.56	58.59	87.92	0.00	0.00	0.00
SF ₆	19.97	24.42	19.56	25.41	22.84	16.46	16.69	18.08	19.55	20.70
NF ₃										
Other gases										
Total with LULUCF	43,967.76	46,567.01	48,580.27	57,241.57	49,100.05	53,839.90	55,465.11	63,533.58	55,528.35	37,457.00
Total without LULUCF	65,196.98	69,012.91	75,515.17	82,666.10	78,426.32	80,450.06	78,778.37	73,171.32	68,955.99	65,490.02