New Zealand's Fourth Biennial Report

Under the United Nations Framework Convention on Climate Change

Ministry for the Environment
Manatū Mō Te Taiao

New Zealand Government

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Common tabular format tables

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Abbreviations

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
BR3	Third Biennial Report
BR4	Fourth Biennial Report
BR5	Fifth Biennial Report
CATIE	Centre for Research and Education in Tropical Agriculture
CCAFS	Research Program on Climate Change, Agriculture and Food Security (of the Consultative Group for International Agriculture Research)
CCRA	Climate Change Response Act 2002
CGIAR	Consultative Group for International Agriculture Research
CH_4	methane
CLIFF	Climate Food and Farming Research Network
CO	carbon monoxide
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
COP	Conference of the Parties
CRF	common reporting format
CTF	common tabular format
DAC	Development Assistance Committee
DM	dry matter
EECA	Energy Efficiency and Conservation Authority
EV	electric vehicle
FAO	Food and Agriculture Organization of the United Nations
FFA	Forum Fisheries Agency
FFSR	Fossil Fuel Subsidy Reform
F-gases	fluorinated gases
FONTAGRO	Regional Fund for Agricultural Technology (Inter-American Development Bank)
FRDP	Framework for Resilient Development in the Pacific
GCF	Green Climate Fund
GDP	gross domestic product
GEF	Global Environment Facility
GEM	Generation Expansion Model
GHG	greenhouse gas
GRA	Global Research Alliance on Agricultural Greenhouse Gases
GRADS	Global Research Alliance Development Scholarships

ha	hectare
HFC	hydrofluorocarbon
ICCC	Interim Climate Change Committee
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
IPPU	industrial processes and product use
kg	kilogram
kt CO_2-e	kilotonnes of carbon dioxide equivalent
kW	kilowatt
LAC	Latin America and the Caribbean
LDCs	Least Developed Countries
LEARN	Livestock Emissions Abatement Research Network
LULUCF	land use, land-use change and forestry
MJ	megajoule
MoT	Ministry of Transport
MoU	Memorandum of Understanding
MPI	Ministry for Primary Industries
Mt CO_2-e	million tonnes of carbon dioxide equivalent
MW	megawatt
N_2O	nitrous oxide
NA	not applicable
NDC	Nationally Determined Contribution
NDMOs	National Disaster Management Offices
NE	not estimated
NF_3	nitrogen trifluoride
NIR	National Inventory Report
NIWA	National Institute of Water and Atmospheric Research
NO	not occurring
NO_x	nitrogen oxides
NPS-FM	National Policy Statement for Freshwater Management
NZ ETS	New Zealand Emissions Trading Scheme
NZAGRC	New Zealand Agricultural Greenhouse Gas Research Centre
NZGIF	New Zealand Green Investment Finance
NZSF	New Zealand Super Fund
NZUs	New Zealand units (within the NZ ETS)
ODA	official development assistance
ODS	ozone depleting substances
OECD	Organisation for Economic Co-operation and Development

PFC	perfluorocarbon
PFSI	Permanent Forest Sink Initiative
PIFS	Pacific Islands Forum Secretariat
PIIF	Pacific Islands Investment Forum
PNG	Papua New Guinea
PRIF	Pacific Regional Infrastructure Facility
PSRM	Pastoral Supply Response Model
RMA	Resource Management Act 1991
SADEM	Supply and Demand Energy Model
SEA	Southeast Asia
SF_6	sulphur hexafluoride
SIDS	small island developing state
SPC	The Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
SSIF	Strategic Science Investment Fund
t	tonnes
TAPA	Technical Assistance for Pacific Access
TPL	Tonga Power Limited
TVNUP	Tonga Village Network Upgrade Programme
TWh	Terawatt hour
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VITP	Vanuatu Tourism Infrastructure Project
WAM	with additional measures
WEM	with existing measures
WMF	Waste Minimisation Fund
WOM	without measures
WTO	World Trade Organization
yr	year
ZCA	Climate Change Response (Zero Carbon) Amendment Act 2019

Minister's foreword

Climate change is becoming more and more a part of our everyday lives. Decisions we make about where we live, how we get around, how we work, how we eat, how we relate to one another – in short, everything – will be made, now and in the future, one way or another, within the context of a changing climate.

We have known for decades that rising global temperatures will cause huge problems for all of us. But these problems are not set in stone. We have a choice. It is a simple choice: either act to drive down emissions and improve the lives of everyone around us, or don't.

In making this choice, let's be honest about the severity of the problem and the scale of the challenge ahead, but so too let's remind ourselves of the power we have to change course; to do things differently; to create clean, safe and healthy communities for ourselves, our loved ones and future generations.

This *Fourth Biennial Report* is a crucial part of fulfilling New Zealand's reporting obligations as a Party to the United Nations Framework Convention on Climate Change (UNFCCC). It documents the progress we have made and shows, for the first time, the impact of some of the policies we have introduced in the last couple of years.

Our new Climate Change Response (Zero Carbon) Amendment Act lays the path for where we're heading next.

It was in large part due to the efforts of tens of thousands of New Zealanders that led to the Act being passed through Parliament unopposed in November this year. They told Parliament that they wanted immediate action to find a lasting and long-term solution to climate change.

The Act sets a new domestic greenhouse gas emissions reduction target for New Zealand, and will establish a system of emissions budgets to act as stepping stones towards the long-term target.

It requires this, and all future, governments to develop and implement policies for climate change adaptation and mitigation. The Act also establishes an independent Climate Change Commission to advise the Government of the day on how to achieve that goal across all sectors of the economy.

Together with an improved New Zealand Emissions Trading Scheme (NZ ETS), the Act will become one of our key instruments in the work to solve climate change. The *Fourth Biennial Report* reflects the impact of some of these policies, and I look forward to seeing the full implementation of this work in future reports.

I say this not to suggest that the job is done, but to acknowledge and celebrate what is possible, so we can be confident we have what it takes to carry our progress forward. The projections in this report demand it. Most of all they demand that we do not shy away from what the future holds but work together to shape it.

Biennial Reports under the UNFCCC will soon be superseded by Biennial Transparency Reports once reporting begins under the Paris Agreement.

However, the central purpose will remain the same – to provide transparency on how we are tracking towards our targets.

Transparency sits at the heart of the Paris Agreement – the system by which we hold each other to account – and we look forward to the new transparency framework where all countries fully participate.

Hon James Shaw
Minister for Climate Change, New Zealand

Introduction

New Zealand is pleased to submit its *Fourth Biennial Report* under the United Nations Framework Convention on Climate Change (UNFCCC). The report follows the biennial reporting guidelines for developed country Parties, and is composed of six chapters:

I. Information on greenhouse gas (GHG) emissions and trends

II. Quantified economy-wide emission reduction targets

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

IV. Projections

V. Provision of financial, technological and capacity-building support to developing countries

VI. Other reporting matters.

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

Appendices include:

- emissions data in CTF table 1, presented in appendix A
- supplementary information on projections, contained in appendix B.1 and appendix B.2
- information on updated emissions projections in CTF table 6, presented in appendix C.

Chapter I: Information on greenhouse gas emissions and trends

Key points

- New Zealand's gross emissions have increased 23.1 per cent since 1990 (figure 1.1).
- Methane from dairy cattle digestive systems and carbon dioxide from road transport have contributed the most to this increase.
- Between 2016 and 2017, gross emissions increased by 2.2 per cent, mainly from an increase in emissions from road transport and fossil fuel-generated electricity production.
- Between 1990 and 2017, New Zealand's gross methane emissions increased by 6.2 per cent.
- The agriculture and energy sectors were the two largest contributors to New Zealand's gross emissions, at 48.1 per cent and 40.7 per cent respectively (figure 1.2) in 2017.
- The land use, land-use change and forestry (LULUCF) sector offset 29.6 per cent of New Zealand's gross emissions (figure 1.2) in 2017.
- New Zealand's net emissions increased by 65 per cent between 1990 and 2017 due to the underlying increase in gross emissions and the increased volume of timber harvested from New Zealand's plantation forest estate in 2017 compared with 1990.
- In 2017, Tokelau was included as part of New Zealand's greenhouse gas inventory for the first time, contributing 0.004 per cent to New Zealand's gross emissions.

Introduction

All anthropogenic (human-induced) emissions and removals of greenhouse gases in New Zealand are officially reported in *New Zealand's Greenhouse Gas Inventory* (the inventory). The inventory measures New Zealand's progress against obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.

The reporting of emissions under the UNFCCC covers five sectors: energy; industrial processes and product use (IPPU); agriculture; land use, land-use change and forestry (LULUCF); and waste.

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. Emissions from Tokelau were included in the inventory for the first time in the 2019 submission.

The inventory reports emissions and removals of the direct greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), sulphur hexafluoride (SF_6)[1] and nitrogen trifluoride (NF_3).[2] Only emissions and removals of these direct greenhouse gases are accounted for in total emissions under the UNFCCC and the Kyoto Protocol. Emissions of the indirect greenhouse gases – carbon monoxide (CO), sulphur dioxide (SO_2), oxides of nitrogen (NO_X) and non-methane volatile organic compounds

1 Hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride are referred to collectively as 'F-gases'.

2 Nitrogen trifluoride emissions do not occur in New Zealand.

(NMVOCs) – are also reported in the inventory; however, under the UNFCCC they are not counted towards total national emissions. Similarly, emissions from international bunker fuels are also estimated and reported as part of the inventory but are not included in the national total, in line with international reporting guidelines. New Zealand's most recent inventory report was submitted to the UNFCCC on 11 April 2019. The inventory includes information on emissions and removals of greenhouse gases from 1990 to 2017, and supplementary information required under the Kyoto Protocol.[3]

National trends: emissions by sector and by gas

The information on greenhouse gas emissions presented in this report is the same as the information in the inventory[4] published in April 2019.

Gross emissions

As presented in the inventory submitted in 2019, New Zealand's total (gross) greenhouse gas emissions (excluding the LULUCF sector) were 80,853.5 kilotonnes of carbon dioxide equivalent (kt CO_2-e) in 2017. Between 1990 (the base year) and 2017, New Zealand's total emissions increased by 23.1 per cent. The average annual growth of emissions was approximately 0.8 per cent per year (figure 1.1).

The emission sources that contributed the most to the increase since 1990 were:

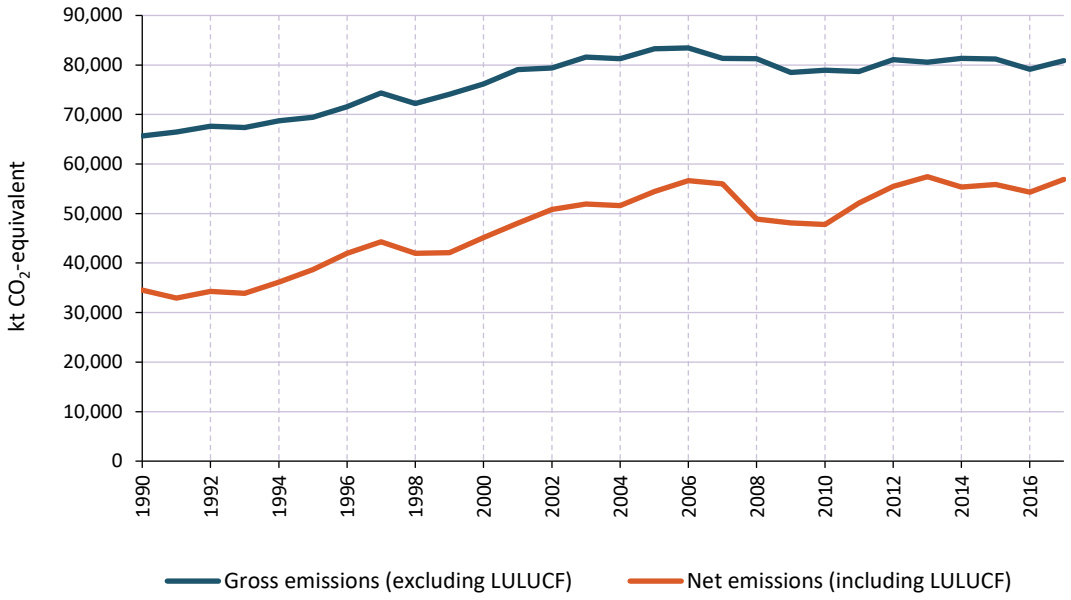
- CH_4 emissions from dairy cattle[5]
- CO_2 from road transportation
- N_2O from agricultural soils
- consumption of HFCs from industrial and household refrigeration, as well as air-conditioning systems
- CO_2 from manufacturing industries and construction (mainly the chemicals category and the food processing, beverages and tobacco category).

[3] After the end of a calendar year there is a 15-month period for data collection and processing before an inventory is submitted for that year. This is in line with international reporting guidelines.

[4] The inventory includes the National Inventory Report (NIR), the common reporting format (CRF) tables (the CRF or the inventory database) and the standard electronic format (SEF) tables (or the registry files). The abbreviation NIR refers to the National Inventory Report only (excluding the CRF and the SEF).

[5] Methane emissions produced from ruminant livestock.

Figure 1.1: New Zealand's gross and net emissions (under the UNFCCC) 1990–2017



Note: kt CO_2-e = 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. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017.* Wellington: Ministry for the Environment.

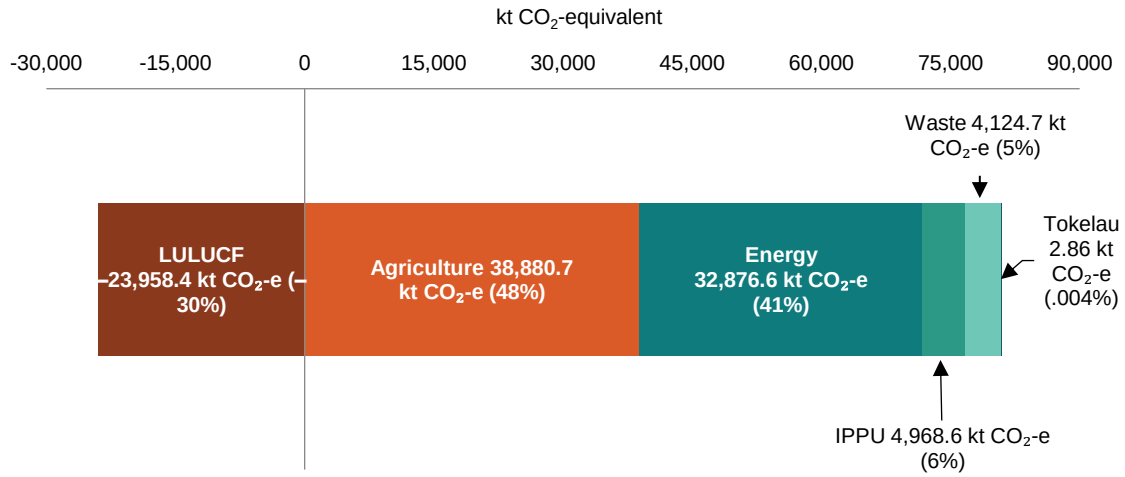
Net emissions

In 2017, New Zealand's net greenhouse gas emissions (including the LULUCF sector under UNFCCC reporting rules) were 56,895.0 kt CO_2-e. This represents an increase of 22,388.5 kt CO_2-e (64.9 per cent) since 1990 (figure 1.1). The reason for the increase is the combined effect of the increase in gross emissions and the increased volume of timber that was harvested from New Zealand's plantation forest estate in 2017 compared with 1990.

Sector trends

The agriculture and energy sectors were the largest contributors to New Zealand's gross greenhouse gas emissions in 2017, contributing 48.1 per cent and 40.7 per cent of gross emissions respectively (figure 1.2). The emissions associated with the IPPU sector and the waste sector were relatively minor, at 6.1 per cent and 5.1 per cent of gross emissions respectively. Removals from the LULUCF sector offset 29.6 per cent of New Zealand's gross emissions in 2017. The total amount of all greenhouse gases from all sources in Tokelau in 2017 was 2.86 kt CO_2-e, contributing approximately 0.004 per cent to New Zealand's gross emissions.

Figure 1.2: New Zealand's greenhouse gas emissions by sector in 2017



Note: IPPU = industrial processes and product use; kt CO_2-e = kilotonnes of carbon dioxide equivalent; LULUCF = land use, land-use change and forestry.

Source: Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017.* Wellington: Ministry for the Environment.

The emissions from each sector, and the changes between 1990 and 2017, are shown in table 1.1.

Table 1.1: New Zealand's emissions of greenhouse gases by sector in 1990 and 2017

Sector	kt CO_2-equivalent		Change from 1990 (kt CO_2-equivalent)	Change from 1990 (%)
	1990	2017		
Energy	23,785.7	32,876.6	9,090.9	38.2
Industrial processes and product use	3,579.9	4,968.6	1,388.7	38.8
Agriculture	34,257.2	38,880.7	4,623.5	13.5
Waste	4,041.9	4,124.7	82.9	2.1
Tokelau	3.6	2.9	–0.8	–21.3
Gross (excluding LULUCF)	**65,668.3**	**80,853.5**	**15,185.2**	**23.1**
LULUCF	–31,161.8	–23,958.4	7,203.3	23.1
Net (including LULUCF)	**34,506.5**	**56,895.0**	**22,388.5**	**64.9**

Note: Net removals from the land use, land-use change and forestry (LULUCF) sector are as reported under the UNFCCC (see chapter 6 of *New Zealand's Greenhouse Gas Inventory 1990–2017*). Columns may not total due to rounding. Percentages presented are calculated from unrounded values. kt CO_2 = kilotonnes of carbon dioxide.

Source: Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment.

The growth in energy sector emissions is primarily from road transportation, manufacturing industries and construction (mainly food processing, beverages and tobacco, and chemicals).

The increase of emissions from the IPPU sector was driven mainly by an increase in HFCs used to replace ozone depleting substances in refrigeration and air conditioning, and secondarily by the increased use of household and commercial air conditioning. Another reason why carbon dioxide emissions have increased is the increased production of metals, lime and cement,

although at a slower rate than the use of air conditioning. Emissions of PFCs have reduced substantially due to improved management of anode effects in aluminium production.

Agricultural emissions growth is mainly due to an 89.6 per cent increase in the size of the national dairy herd since 1990. Additionally, the use of nitrogen-containing synthetic fertiliser increased by approximately 650 per cent over this time. Partially offsetting this increase was a decrease of 52.5 per cent in the sheep flock and a 21.4 per cent decrease in the non-dairy cattle population.

Waste sector emissions have been trending down since 2005, in spite of increasing volumes of solid waste and wastewater associated with the ongoing growth in population and economic activity. The reason for this changing trend is that the management of solid waste disposal at municipal landfills has improved through increasing CH_4 recovery as a result of initiatives to improve practices for both managing solid waste and recovering landfill gas.

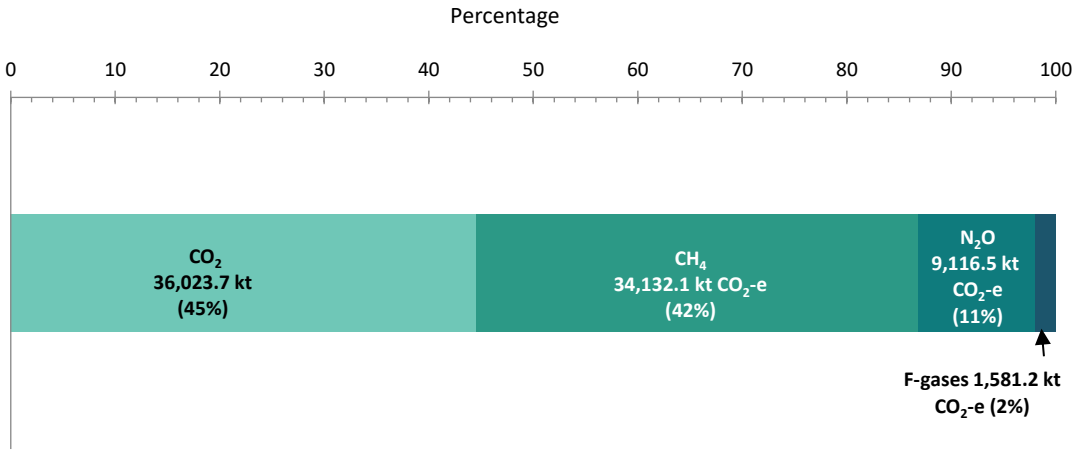
Most of the decrease in emissions from Tokelau has occurred because the territory switched to a solar photovoltaics energy system by the end of 2012.

Between 1990 and 2017, net removals from the LULUCF sector decreased by 23.1 per cent (table 1.1). The reduction occurred because of the cyclical nature of growth and harvest of New Zealand's plantation forests and its impact on carbon stocks, coupled with the uneven age-class distribution of these forests.

Emission trends by gas

In 2017, CO_2 and CH_4 contributed the largest proportion of total emissions (44.6 per cent and 42.2 per cent respectively; see figure 1.3). Nitrous oxide (11.3 per cent) and fluorinated gases (F-gases) (2.0 per cent) made up the balance.

Figure 1.3: New Zealand's gross greenhouse gas emissions by gas in 2017



Note: CH_4 = methane; CO_2 = carbon dioxide; kt CO_2-e = kilotonnes of carbon dioxide equivalent; F-gases (fluorinated gases) are HFCs = hydrofluorocarbons, PFCs = perfluorocarbons and SF_6 = sulphur hexafluoride; N_2O = nitrous oxide.

Source: Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017.* Wellington: Ministry for the Environment.

Table 1.2 shows the change in each direct greenhouse gas between 1990 and 2017. Trends in emissions of CO_2, CH_4, N_2O and F-gases over the period 1990–2017 are shown in figure 1.4, using 1990 emissions as a base level.

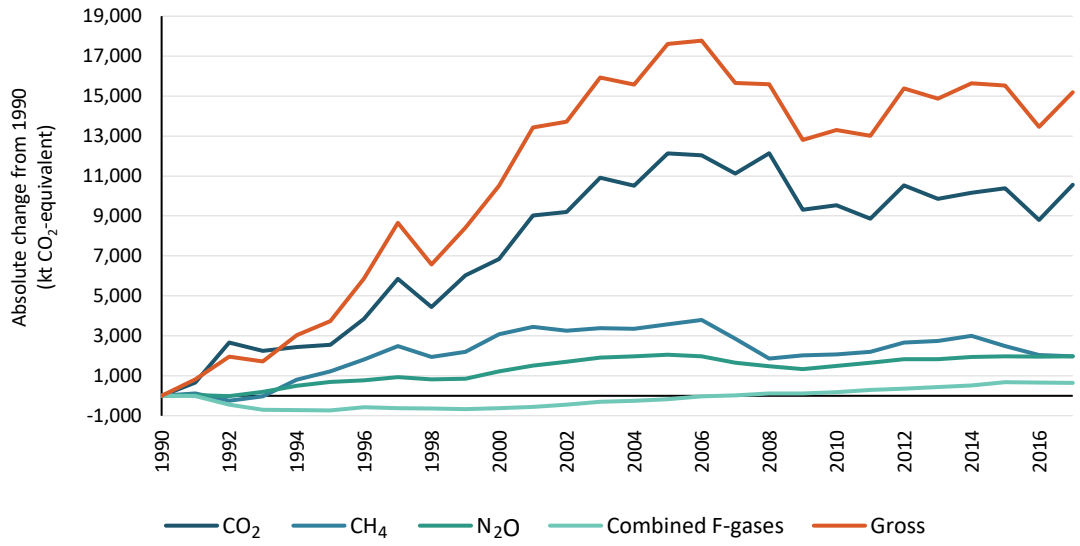
Table 1.2: New Zealand's emissions of greenhouse gases by gas in 1990 and 2017

Direct greenhouse gas emissions	kt CO_2-equivalent 1990	kt CO_2-equivalent 2017	Change from 1990 (kt CO_2-equivalent)	Change from 1990 (%)
CO_2	25,455.2	36,023.7	10,568.6	41.5
CH_4	32,150.0	34,132.1	1,982.1	6.2
N_2O	7,133.2	9,116.5	1,983.3	27.8
HFCs	0.0	1,505.7	1,505.7	NA
PFCs	909.9	60.5	–849.5	–93.4
SF_6	20.0	15.0	–5.0	–24.9
Gross, all gases	**65,668.3**	**80,853.5**	**15,185.2**	**23.1**

Note: The percentage change for hydrofluorocarbons (HFCs) is not applicable (NA) because consumption of HFCs in New Zealand in 1990 was not occurring. CH_4 = methane; CO_2 = carbon dioxide; kt CO_2 = kilotonnes of carbon dioxide; N_2O = nitrous oxide; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride.

Source: Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017.* Wellington: Ministry for the Environment.

Figure 1.4: Change in New Zealand's gross emissions by gas 1990–2017 (using 1990 emissions as a base level)



Note: CH_4 = methane; CO_2 = carbon dioxide; kt CO_2 = kilotonnes of carbon dioxide; N_2O = nitrous oxide; combined F-gases (fluorinated gases) include HFCs (hydrofluorocarbons), PFCs (perfluorocarbons) and SF_6 (sulphur hexafluoride).

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 1990–2017*[6] published in 2019, which is available on both the Ministry for the Environment and UNFCCC websites.

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[7] (the CCRA) was enacted to enable New Zealand to meet its international obligations under the UNFCCC and Kyoto Protocol. A national system for a Party included in Annex 1 of the UNFCCC includes all institutional, legal and procedural arrangements 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.

A ministerial directive for the administration of the CCRA names the Ministry for the Environment as New Zealand's 'central inventory agency'. 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 Article 7.1 of the Kyoto 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. New Zealand's national communication (or periodic report) under Article 7.2 of the Kyoto Protocol and Article 12 of the UNFCCC
    iii. New Zealand's report for the calculation of its initial assigned amount under Article 7.4 of the Kyoto Protocol, including its method of calculation.

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 Part 3 of the CCRA (if any)

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6 Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Available at www.mfe.govt.nz/climate-change/state-of-our-atmosphere-and-climate/new-zealands-greenhouse-gas-inventory.

7 Climate Change Response Act 2002. Available at www.mfe.govt.nz/climate-change/climate-change-acts-and-regulations/climate-change-response-act-2002.

- 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.

Changes to arrangements

Inclusion of Tokelau in New Zealand's inventory system

The changes in New Zealand's inventory system since the *Third Biennial Report* are associated with including greenhouse gas emissions from Tokelau following the extension of ratification of the UNFCCC to Tokelau.

The extension (as of 13 November 2017) of New Zealand's ratification of the UNFCCC and the Paris Agreement requires New Zealand to include Tokelau in the obligatory climate change reporting managed by the Ministry for the Environment. Delivering on this obligation means that New Zealand's inventory shall include estimates of emissions of greenhouse gases for Tokelau.

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.

The Ministry for the Environment 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. The Ministry is also responsible for supporting the emissions estimates prepared by Tokelau, and integrating the emissions estimates with New Zealand's main common reporting format (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, published in 2019 (see also chapter IV of this report).

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 *Third Biennial Report* was submitted.

Aside from the changes in legal and institutional arrangements, several operational changes to improve the quality of New Zealand's inventory reports have occurred during the past two years. This work focused on making the National Inventory System more robust and achieving better transparency, comparability, consistency, completeness and accuracy in the inventory. Since New Zealand's *Third Biennial Report* was submitted, improvements to the inventory have focused on:

- improving the accuracy of estimates for emissions and removals in all sectors
- updating quality control processes and procedures for sectors
- designing and developing computerised quality control tools to ensure better quality of the CRF tables and comparability between data in the NIR and the CRF
- developing the expertise of New Zealand officials involved in the production of the inventory
- inventory officials undertaking reviewer training under the UNFCCC for expert reviews of annual greenhouse gas inventories prepared using the 2006 Intergovernmental Panel on Climate Change (IPCC) guidelines.[8]

For more information on New Zealand's National Inventory System and changes to arrangements since the *Third Biennial Report*, see *New Zealand's Greenhouse Gas Inventory 1990–2017*, submitted in 2019.

[8] IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Hayama, Japan: Institute for Global Environmental Strategies. Retrieved from www.ipcc-nggip.iges.or.jp/public/2006gl/.

Chapter II: Quantified economy-wide emission reduction targets

Key points:

New Zealand has the following international emission reduction targets:

- under the United Nations Framework Convention on Climate Change (UNFCCC), 5 per cent reduction below 1990 gross greenhouse gas (GHG) levels by 2020 for the period 2013 to 2020
- under the Paris Agreement, 30 per cent reduction below 2005 (11 per cent below 1990) gross GHG levels by 2030 for the period 2021 to 2030.

Progress towards and achievement of New Zealand's international targets are measured using target accounting. These include all gross GHG emissions, and a subset of our forestry and land-use emissions.

New Zealand also has the following domestic emission reduction target:

- net zero emissions of all GHGs 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.

Introduction

Climate change is a global issue, and New Zealand is fully committed to playing its part in a global response. To achieve this, New Zealand has set a number of targets for reducing greenhouse gas (GHG) emissions and contributing to the global solution; and in particular, an ambitious first Nationally Determined Contribution (NDC) under the Paris Agreement to meet an emissions budget for 2021–30 (see 'Targets under the Paris Agreement' below). This chapter describes these targets, as well as conditions and assumptions that are relevant to achieving them.

New Zealand's targets

New Zealand has made commitments to the following international and domestic emission reduction targets.

International targets

New Zealand's international targets are:

1. a 5 per cent reduction below 1990 gross GHG levels by 2020 for the period 1 January 2013 to 31 December 2020[9] [10]
2. New Zealand's first NDC under the Paris Agreement to reduce emissions by 30 per cent below 2005 gross GHG levels for the period 1 January 2021 to 31 December 2030.[11]

Domestic targets

New Zealand's domestic targets are:

1. net zero emissions of all greenhouse gases other than biogenic methane by 2050[12]
2. 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.

For the 2020 target, New Zealand uses Kyoto Protocol (target) accounting to measure progress towards, and achievement of, the target. Target accounting includes all our gross emissions, and a subset of our forestry and land-use emissions. The treatment of the subset of forestry and land-use emissions for our first NDC is modified from Kyoto Protocol accounting. This is to ensure that incentives for new forest planting remain but the cyclical emissions from harvesting and replanting in our plantation forests are removed.

In 2015, New Zealand met a previous target under the first Kyoto Protocol commitment period of reducing greenhouse gas emissions to 1990 levels between 2008 and 2012 as shown in its 'True-up report' to the United Nations Framework Convention for Climate Change (UNFCCC).[13]

Figure 2.1 shows New Zealand's emission reduction targets under the Kyoto Protocol for 2008–12 (KP) and the UNFCCC for 2013–2020, NDC under the Paris Agreement for 2021–30, and New Zealand's domestic targets under the Climate Change Response (Zero Carbon) Amendment Act 2019 (ZCA).

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9 New Zealand Government. *Cancun Pledge,* submitted to the UNFCCC 29 August 2013. Retrieved from https://unfccc.int/topics/mitigation/workstreams/pre-2020-ambition/compilation-of-economy-wide-emission-reduction-targets-to-be-implemented-by-parties-included-in-annex-i-to-the-convention.

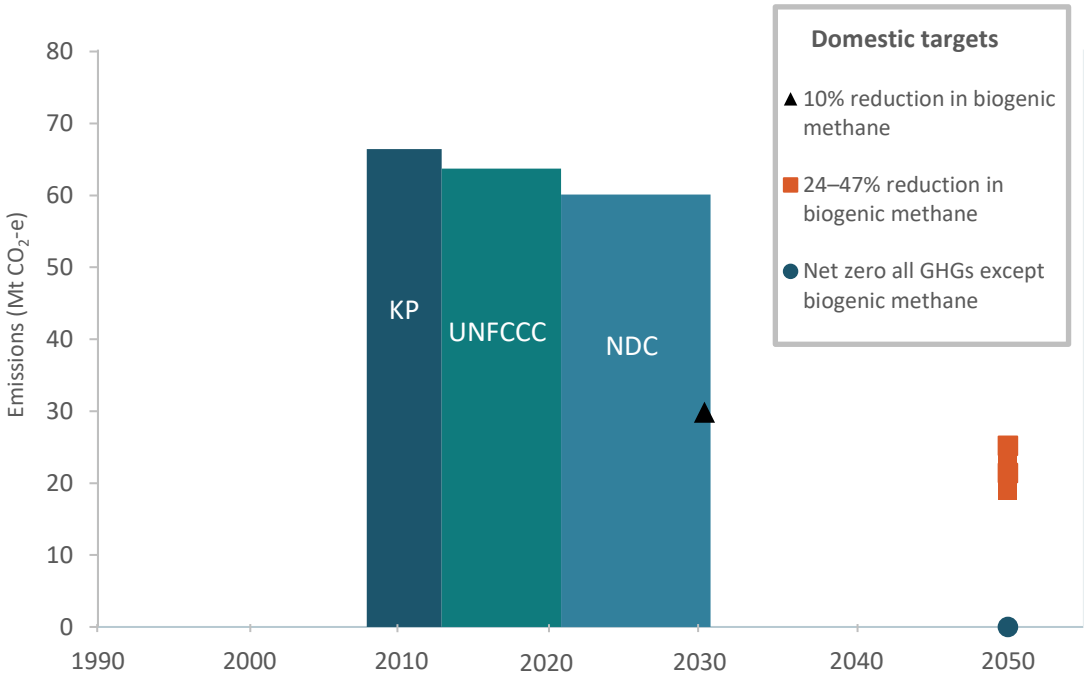
10 The 2013-2020 target under the UNFCCC was prepared before Tokelau was included in New Zealand's international reporting. Since Tokelau makes up about 0.005% of gross emissions, it has not been considered as significant for recalculating the target or for the overall ambition.

11 New Zealand Government. *New Zealand's Nationally Determined Contribution*, submitted to the UNFCCC 4 October 2016. Retrieved from www4.unfccc.int/sites/ndcstaging/PublishedDocuments/New%20Zealand%20First/New%20Zealand%20first%20NDC.pdf (20 September 2019).

12 Climate Change Response (Zero Carbon) Amendment Act 2019. http://legislation.govt.nz/act/public/2019/0061/latest/LMS183736.html (20 November 2019).

13 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 www.mfe.govt.nz/publications/climate-change/report-upon-expiration-additional-period-fulfilling-commitments-new (29 July 2019).

Figure 2.1: New Zealand's emission reduction targets



Note: The Kyoto Protocol (KP), United Nations Framework Convention for Climate Change (UNFCCC) and Nationally Determined Contribution (NDC) targets are multi-year budgets. The domestic targets under the ZCA are point-year targets; however, these targets will be achieved using a system of multi-year emissions budgets.[14] GHGs = greenhouse gases; Mt CO_2-e = million tonnes of carbon dioxide equivalent.

These targets are presented in further detail on the following pages.

Targets under the Paris Agreement

All Parties to the Paris Agreement must communicate their commitment to reduce GHG emissions via an NDC. Parties must also:

- continue to regularly report on their emissions and how they are tracking towards meeting their target
- plan for adaptation.

In addition, developed countries must continue to provide financial support to assist developing countries' mitigation and adaptation efforts.

New Zealand's 2020 targets

New Zealand's quantified economy-wide emission reduction target is a commitment to reduce emissions to 5 per cent below 1990 gross GHG levels for the period 2013–2020. While the target for this period is under the UNFCCC, New Zealand continues to apply the Kyoto Protocol framework of rules in tracking progress towards the target.

Based on UNFCCC methodology, this 5 per cent below 1990 target is equivalent to 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

[14] Emissions budgets for the periods 2022–2025, 2026–2030 and 2031–2035 will be recommended by the Climate Change Commission in early 2021, and set by the Government by the end of 2021.

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,[15] this target corresponds to a commitment to reduce emissions to 509.775 million tonnes of carbon dioxide equivalent for the period 2013–20.[16]

New Zealand is applying 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 to the 5 per cent below 1990 target, including those agreed in Durban in 2011 for land use, land-use change and forestry (see Decision 2/CMP.7). For 2013–20, New Zealand is completing activity-based reporting under Article 3.3 of the Kyoto Protocol for afforestation, reforestation and deforestation, and forest management under Article 3.4 of the Kyoto Protocol.

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

CTF Table 2a: Emission reduction target: base year and target[a]

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

[a] Reporting by a developed country Party on the information specified in the common tabular format (CTF) does not prejudge 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.

CTF Tables 2b and 2c: Description of quantified economy-wide emission reduction target[a]

Gases covered	Base year	Global warming potential
CO_2	1990	IPCC Fourth Assessment Report
CH_4	1990	IPCC Fourth Assessment Report
N_2O	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		

15 Ministry for the Environment. 2016. *New Zealand's Greenhouse Gas Inventory 1990–2014*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/publications/climate-change/new-zealand-greenhouse-gas-inventory-1990-2014 (15 October 2019).

16 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 www.mfe.govt.nz/sites/default/files/media/Climate%20Change/New%20Zealand%27s%20Initial%20Report%20July%202016.pdf (2 October 2019).

Note: CH_4 = methane; CO_2 = carbon dioxide; HFCs = hydrofluorocarbons; IPCC = Intergovernmental Panel on Climate Change; IPPU = industrial processes and product use; LULUCF = land use, land-use change and forestry; NF_3 = nitrogen trifluoride; N_2O = nitrous oxide; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride.

[a] Reporting by a developed country Party on the information specified in the common tabular format (CTF) does not prejudge 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.

CTF Table 2d: Approach to counting emissions and removals from the LULUCF sector[a, b]

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 using an activity-based approach	Using Kyoto Protocol rules (ie, under Article 3.3 of the Kyoto Protocol for afforestation, reforestation and deforestation, and forest management under Article 3.4 of the Kyoto Protocol).

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 prejudge 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.

CTF Table 2e: Possible scale of contributions of market-based mechanisms[a]

CERs	New Zealand will measure progress against its 2020 target as if it had made a commitment under the Kyoto Protocol for the second commitment period, including recognition of the surplus achieved during the first commitment period of the Kyoto Protocol. The scale of contributions of market mechanisms for New Zealand in meeting its 2020 target will not be known until the end of the 2013–2020 accounting period.
ERUs	
AAUs[b]	
Carry-over units[c]	
Other mechanism units under the Convention (specify)[d]	

Note: AAUs = assigned amount units; CERs = certified emission reductions; ERUs = emission reduction units.

[a] Reporting by a developed country Party on the information specified in the common tabular format (CTF) does not prejudge 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. At the time of publication, WEM projections indicate that 27.7 million AAUs may be used as part of meeting New Zealand's 2020 target, see page 44. These projections are subject to considerable uncertainty and revision over time hence the number is not included in the table.

[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 5(e) of the guidelines contained in annex I of Decision 2/CP.17.

CTF Table 2f: Any other information

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.

Other relevant information

In August 2009, the New Zealand Government announced a conditional 2020 target range to signal New Zealand's commitment to comprehensive efforts to address global climate change. New Zealand stated that it was prepared to take on a responsibility target for GHG emission reductions of between 10 and 20 per cent below 1990 levels by 2020, subject to a number of conditions. Most of these conditions have not been met.[17]

New Zealand's first Nationally Determined Contribution

On 7 July 2015, the New Zealand Government submitted its Intended Nationally Determined Contribution to the UNFCCC Secretariat for the period 2021–30, along with accompanying information to facilitate clarity, transparency and understanding.[18] This included an addendum submitted in November 2015 that clarified the approach New Zealand proposed to use to account for forestry and land use.

The Government submitted New Zealand's first NDC under the Paris Agreement in October 2016. New Zealand commits to reduce emissions to 30 per cent below 2005 gross GHG levels by 2030. This target corresponds to a reduction of 11 per cent from 1990 gross GHG levels.

New Zealand's first NDC, including a summary of the methodologies used to account for forestry and other land use, can be found on the UNFCCC Secretariat's interim NDC registry page.[19] The target is expressed as an absolute reduction target managed using an emissions budget for the period 2021–30 inclusive. This equates to a commitment to reduce emissions to approximately 601 million tonnes of carbon dioxide equivalent (CO_2-e) across the period.[20]

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

- reductions in New Zealand's domestic emissions, including all sectors and all GHGs, as reported under Paris Agreement following methodologies from the 2006 IPCC guidelines[21]
- use of market mechanisms and cooperative approaches, while ensuring environmental integrity, avoidance of double counting, and transparency

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17 Ministry for the Environment. 2016. *New Zealand's Conditional 2020 Target*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/climate-change/reducing-greenhouse-gas-emissions/new-zealands-greenhouse-gas-emissions-reduction-2 (12 October 2017).

18 In line with Decisions 1/CP.19 and 1/CP.20.

19 NDC Registry (interim). n.d. *NDC Registry (interim)*. Retrieved from www4.unfccc.int/ndcregistry/Pages/Home.aspx (7 October 2019).

20 New Zealand's NDC will remain as an approximation until the final GHG inventory for the 2013–20 period has been reviewed. This is because the NDC budget is subject to finalisation of 2005 emissions. We anticipate submitting our first biennial transparency report under the Paris Agreement by December 2024 at the latest, which will include a finalised NDC budget.

21 IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Hayama, Japan: Institute for Global Environmental Strategies. Retrieved from www.ipcc.ch/report/2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/ (7 November 2019).

- removal of carbon dioxide by forests, using an accounting approach based on a long-term average carbon stock for plantation forests.

As per the Paris Agreement, New Zealand will continue to regularly review its contributions to international mitigation action. In doing so, it will consider the latest science, development of new technologies, and progress by other countries, as well as the requirement for a five-yearly global stocktake under the Paris Agreement.

New Zealand's 2050 target

In November 2019, the New Zealand Parliament passed an amendment to the Climate Change Response Act 2002. The Climate Change Response (Zero Carbon) Amendment Act 2019 provides a framework for New Zealand to develop and implement clear and stable climate change policies that contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5 degrees Celsius above pre-industrial levels, and allow New Zealand to prepare for, and adapt to, the effects of climate change. The four main achievements of the ZCA are to:

1. set a new domestic GHG emissions reduction target, which is to reduce:
   - net emissions of GHGs other than biogenic methane to zero by 2050
   - emissions of biogenic methane to 24 to 47 per cent below 2017 levels by 2050, including to 10 per cent below 2017 levels by 2030
2. establish a framework for a series of emissions budgets to act as stepping stones towards the long-term target, and plans and policies to achieve them
3. establish regular measures to plan for the impacts of climate change in a coordinated way, including a national climate change risk assessment and a national adaptation plan
4. establish a new, independent Climate Change Commission to provide expert advice and monitoring, with the goal of helping keep successive governments on track to meeting long-term goals.

The 2050 target under the ZCA replaces New Zealand's previous 2050 target, set in 2011, for a 50 per cent reduction in New Zealand greenhouse gas emissions from 1990 levels by 2050.[22] The proposed biogenic methane target of a 10 per cent reduction below 2017 levels by 2030 will complement New Zealand's NDC under the Paris Agreement.

22 Climate Change Response (2050 Emissions Target) Notice 2011, gazetted 31 March 2011.

Chapter III: Progress in achievement of quantified economy-wide emission reduction targets and relevant information

Key developments

New Zealand is on track to meet its 2020 target. Progress has also been made in the Government's three main responses to climate change:

- durable long-term institutional arrangements to 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 emission reductions and ensure the transition is just and inclusive.

Introduction

This chapter outlines New Zealand's progress towards achieving its emission reduction targets. The first section describes the policies and measures in place to reduce emissions, grouped by sector. In addition to the key developments explained above, a number of new climate change policies are in place across all sectors. The second section gives estimates of emission reductions and removals by sector, while the final section explains the progress in achieving New Zealand's 2020 target.

Mitigation actions and their effects

Domestic institutional arrangements

Te Tiriti o Waitangi/the Treaty of Waitangi – New Zealand's founding document

Te Tiriti o Waitangi/the Treaty of Waitangi is an agreement between the British Crown and about 540 Māori rangatira (chiefs) that was signed on 6 February 1840. It has significant implications for climate change policy because it guarantees Māori chieftainship over their land, villages and treasured things. It also establishes the principles of the relationship between Crown and Māori: partnership, participation and protection. The climate change legislation administered by the Ministry for the Environment contains clauses requiring the Crown to take into account the principles of the Treaty.

The Crown

In New Zealand, the meaning of 'the Crown' differs depending on context, but generally refers to the Government as the successor of the British Crown and Queen Victoria, who was party to the Treaty of Waitangi. After New Zealand became a British colony in 1840, it gradually gained independence in later years. While Queen Elizabeth II is New Zealand's current monarch, in practice most of the constitutional and ceremonial duties are carried out by her representative, the Governor-General.

A 'Crown entity' is an organisation that is part of the state sector and operates with some independence from Government. Government Ministers oversee Crown entities within their portfolio, but a board governs a Crown entity's operations.

Administration of climate change policy in New Zealand

The Ministry for the Environment is the Government's primary advisor on matters relating to climate change, the environment and international matters affecting the environment. The Ministry also administers New Zealand's climate change legislation, which is outlined below.

While the Ministry for the Environment leads climate change policy, the response to climate change is an across-government effort, to which other agencies contribute over a range of sectors while advising on or administering climate change policies and measures. These agencies are the:

- Ministry for Primary Industries
- Environmental Protection Authority
- Ministry of Business, Innovation and Employment
- Ministry of Foreign Affairs and Trade
- Energy Efficiency and Conservation Authority
- Ministry of Transport
- New Zealand Transport Agency
- Ministry of Housing and Urban Development.

New Zealand's international climate change obligations

New Zealand ratified the Kyoto Protocol in December 2002 and ratified the second commitment period of the Kyoto Protocol by accepting the Doha Amendment on 30 November 2015. On 4 October 2016, New Zealand ratified the Paris Agreement. These agreements are supported by the Climate Change Response Act 2002.

Climate Change Response Act 2002

The Climate Change Response Act 2002 (CCRA) is New Zealand's main piece of climate change legislation. It provides the legal framework to enable New Zealand to meet its obligations under both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.

The CCRA established an inventory agency[23] to report greenhouse gas emissions, and a registry to record holdings and transfers of emissions units. A ministerial directive for the administration of the CCRA names the Ministry for the Environment as New Zealand's inventory agency, with responsibility for recording and reporting information related to greenhouse gas emissions to meet international requirements. The Environmental Protection Authority manages the New Zealand Emissions Trading Register and ensures its integrity, security and availability.

Climate Change Response (Zero Carbon) Amendment Act 2019

One of the most significant changes since the *Third Biennial Report*[24] has been the passing of the Climate Change Response (Zero Carbon) Amendment Act (ZCA) in November 2019. This Act received considerable public support, particularly from youth organisations.

The ZCA provides a framework to develop and implement clear and stable climate change policies that contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5 degrees Celsius above pre-industrial levels. The ZCA establishes a Climate Change Commission, an independent Crown entity, to hold the Government to account and to provide expert advice on climate change mitigation and adaptation. The ZCA sets a target to reduce New Zealand's emissions of all greenhouse gases, except biogenic methane, to net zero by 2050. It also sets a target of reducing our gross emissions of biogenic methane within the range of 24 to 47 per cent below 2017 levels by 2050.

An Interim Climate Change Committee was established in 2018 to begin the work of the Climate Change Commission ahead of the enactment of the ZCA. Its first task was to produce reports and provide recommendations on two issues:

- how surrender obligations could best be arranged if agricultural methane and nitrous oxide emissions were to enter into the New Zealand Emissions Trading Scheme (NZ ETS)
- how to plan for a transition to 100 per cent renewable electricity by 2035.

Climate Change Response (Emissions Trading Reform) Amendment Bill 2019

The Government has introduced an amendment bill to Parliament that will make a range of improvements to the NZ ETS. This legislation will create a decision-making framework to manage the supply of emission units into the scheme; unit supply decisions will be made and announced annually for the following five years. It enables a cap to be set on emissions in the scheme; for any given year, an overall limit on the number of units will be prescribed, comprising units to be auctioned and units to be freely allocated to emission-intensive and trade-exposed industries. The bill provides for the phase-down of the allocation of units to

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23 Ministry for the Environment. 2017. *New Zealand's Greenhouse Gas Inventory 1990–2015*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/publications/climate-change/new-zealands-greenhouse-gas-inventory-1990%E2%80%932015.

The Climate Change Response Act 2002 describes the responsibilities of the inventory agency as including data collection, reporting and archiving of information. See chapter 13 of Ministry for the Environment (2017) for a description of New Zealand's national system for its greenhouse gas inventory.

24 Ministry for the Environment. 2017. *New Zealand's Third Biennial Report under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/publications/climate-change/new-zealands-third-biennial-report-under-united-nations-framework.

emissions-intensive, trade-exposed industries and introduces a strengthened compliance regime.

Comprehensive review of the Resource Management Act (2019)

The Resource Management Act 1991 (RMA) is the primary legislation governing the use of New Zealand's land, water and air resources, and is also administered by the Ministry for the Environment. The RMA currently requires anyone exercising and functioning powers under it to have regard to the effects of climate change. A comprehensive review of the RMA was begun in 2019, including proposals to further address climate change issues, and to consider how the RMA interacts with the CCRA.

Mitigation actions

The New Zealand Government has a number of different strategies to mitigate climate change. Among the strategies are cross-sector approaches and sector-by-sector strategies. Below is an overview of cross-sector policy, followed by sector-specific policies listed in order of the amount of emissions each sector is responsible for (based on estimates from *New Zealand's Greenhouse Gas Inventory 1990–2017*).[25] A list of all policies is provided in common tabular format (CTF) table 3.

Cross-sector policy

New Zealand Emissions Trading Scheme (NZ ETS)

The NZ ETS is the Government's main tool for reducing greenhouse gas emissions. The scheme was established through the CCRA and came into effect progressively from 2008, with coverage since 2010 of all emissions except agricultural methane and nitrous oxide. The CCRA has been amended several times since 2008.

Sectors under the scheme are required to report on their emissions and surrender units to the Government to cover their emissions. The Government supplies units for emissions removals through forestry and industrial activities. The emissions price is then determined by the market, based on supply and demand of units, and this price creates a financial incentive for businesses that emit greenhouse gases to invest in technologies and practices that reduce emissions. The scheme also encourages forest planting by allowing eligible foresters to earn New Zealand emission units as their trees grow and absorb carbon dioxide.

The NZ ETS creates reporting and surrender obligations on participants within the forestry, industrial processes, stationary energy, liquid fossil fuels and waste sectors. The agriculture sector has also been required to report on its major emissions sources (methane and nitrous oxide from livestock and fertiliser use) since 1 January 2012. Some participants are included voluntarily, and once they are registered all the relevant requirements become mandatory for them to follow. The filing of emissions returns is similar to the 'self-assessment' system under tax legislation. Penalties for not complying with the requirements are set out in the CCRA.

Some types of international emission units, issued under the Kyoto Protocol, could be imported and surrendered to cover obligations to the Government until May 2015. After that date, the NZ ETS transitioned to a domestic-only scheme. The amendment bill introduced to

[25] Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/publications/climate-change/new-zealands-greenhouse-gas-inventory-1990-2017.

Parliament in late 2019 proposes limiting the use of international units if the scheme is opened to international carbon markets.

Until 2016, all non-forestry sectors with surrender obligations were required to surrender only one New Zealand unit for every 2 tonnes of actual emissions reported. This concession was introduced as a transitional measure by a legislative amendment in 2009.

The Environmental Protection Authority is responsible for the operational elements of the NZ ETS. This includes processing and making decisions about industrial allocations, entitlements and non-forestry emission returns. The Authority helps participants meet their obligations and it can take compliance action where necessary.

The NZ ETS was reviewed in two stages between 2015 and 2017, which resulted in the phase-out of the one-for-two transitional measure. A full one-for-one obligation takes effect from 2019. A number of other reforms were announced and included in the Climate Change Response (Emissions Trading Reform) Amendment Bill in late 2019. Among these reforms are the phase-out of free allocation to major industrial emissions, enabling an overall cap on emissions and introducing new forestry accounting settings. These changes are intended to make the NZ ETS an effective tool for driving emissions reductions, encouraging afforestation and achieving our climate change targets.

Productivity Commission report on the path to a low-emissions economy

The Productivity Commission is an independent Crown entity that provides advice to the Government on improving New Zealand's productivity. It is expected to provide this advice in a way that supports the overall wellbeing of New Zealanders and has regard to a wide range of communities of interest and population groups in New Zealand society.

In 2017, the Government asked the Commission to look at how New Zealand can best make the transition to a low-emissions economy, while continuing to grow incomes and wellbeing. It released the *Low-emissions Economy*[26] final report in 2018, an extensive document with 173 findings and 77 recommendations. Among the recommended changes, it emphasised three particular changes that must happen for New Zealand to achieve its low-emission goals:

- transition from fossil fuels to electricity and other low-emission fuels across the economy
- substantial afforestation
- changes to the structure and methods of agricultural production.

The report found that it is necessary to act quickly and that delaying the transition will make it more costly.

- In August 2019 the Government released its climate action plan[27] in response to the Productivity Commission's report. Through the plan, the Government agrees with, or agrees to investigate, the majority of the Commission's recommendations. Policy

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[26] Productivity Commission. 2018. *Low-emissions Economy*. Wellington: Productivity Commission. Retrieved from https://productivity.govt.nz/assets/Documents/4e01d69a83/Productivity-Commission_Low-5emissions-economy_Final-Report.pdf.

[27] Ministry for the Environment. 2019. *Transitioning to a Low-emissions Future: The Government response to the Productivity Commission's Low Emissions Economy report*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/publications/climate-change/transitioning-low-emissions-future-government-response-productivity.

work on the issues addressed in the plan will continue over several years, with most recommendations scheduled to be decided by the end of 2019. Work on many of the recommendations is well under way. For example, the ZCA passed in November 2019, reforms to the NZ ETS have begun and a vehicle fuel efficiency standard and vehicle purchase feebate[28] scheme have been consulted on.

New Zealand Green Investment Finance

New Zealand Green Investment Finance (NZGIF) is a Crown-owned investment vehicle announced in 2018. Established with an initial investment capital of $100 million from the Government, NZGIF has a mandate to invest in business opportunities that accelerate the reduction in domestic greenhouse gas emissions and provide a commercial return on the investment. It will seek to partner with industry, investment houses and other sources of private finance to develop large-scale projects in areas such as transport, industrial process heat, the built environment and agriculture.

Climate implications of policy assessment

From November 2019, it became mandatory for central government agencies to do a greenhouse gas emissions analysis on certain policy proposals. The requirement will enable New Zealand to measure, monitor and report on Cabinet decisions that will impact New Zealand's greenhouse gas emissions.

Agriculture

New Zealand's economy features a strong agricultural export focus, with 62.6 per cent of the total value of merchandise exports coming from agricultural products in 2017.[29] For many developed countries, the agricultural sector constitutes only a small proportion of emissions, on average around 12 per cent, whereas in 2017 agriculture in New Zealand made up 48.1 per cent of total greenhouse gas emissions.[30]

Climate change policy for agriculture in New Zealand is largely based on research, innovation and education. The Ministry for Primary Industries administers or supports five programmes that carry out or fund research, and provide information or training. The purpose of these programmes, among other objectives, is to mitigate agricultural emissions while maintaining a sustainable and productive industry. These policies are detailed in CTF table 3. Landowners – farmers in particular – can apply for grants from the One Billion Trees Programme for planting trees on their land. This programme is described in more detail under 'Land use, land-use change and forestry' below. Since the *Third Biennial Report*,[31] the Biological Emissions

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28 A 'feebate' is a system of charges and rebates in which energy-efficient or environmentally friendly practices are rewarded while failure to adhere to such practices is penalised.

29 Statistics New Zealand. 2018. *Global New Zealand – International trade, investment, and travel profile: Year ended December 2017*. Wellington: Ministry of Foreign Affairs and Trade, and Statistics New Zealand. Retrieved from www.stats.govt.nz/reports/global-new-zealand-year-ended-december-2017.

30 Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/publications/climate-change/new-zealands-greenhouse-gas-inventory-1990-2017.

31 Ministry for the Environment. 2017. *New Zealand's Third Biennial Report under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/publications/climate-change/new-zealands-third-biennial-report-under-united-nations-framework (10 September 2019).

Reference Group has finished its work and published a final report[32] summarising its findings. This group looked at reducing on-farm emissions and found that if all farmers followed current best practice, emissions from agriculture could be reduced by up to 10 per cent.

In early 2019, the Interim Climate Change Committee released a report, *Action on Agricultural Emissions*,[33] looking at how surrender obligations for agricultural methane and nitrous oxide emissions could enter into the NZ ETS. The report recommended that agricultural emissions are priced through a farm-level levy or rebate scheme, integrated with the NZ ETS, with 95 per cent free allocation provided by the Government. In late 2019, the Government announced that it would work with the agricultural sector to develop effective pricing for agricultural emissions by 2025, with the independent Climate Change Commission to review progress in 2022.

Energy

The energy sector (including transport) produces 41 per cent of New Zealand's greenhouse gas emissions. The Ministry of Business, Innovation and Employment is responsible for energy policy development and stewardship, and is doing a wide range of new work towards the transition to a low-emissions economy.

The Government has an aspirational goal of 100 per cent renewable electricity by 2035 in a normal hydrological year, with five-yearly assessments built in to ensure security of supply and affordability. The Interim Climate Change Committee published a report on this topic in July 2019.[34] To accompany its release, the Government announced work to develop policies that will support a Renewable Energy Strategy work programme. This programme focuses on high-level outcomes to ensure that:

- the energy system is inclusive and consumer focused
- increased investment in low-emissions technology is encouraged
- New Zealand's energy system is innovative and creates opportunities for businesses and consumers.

The Government consulted on possible options to address barriers and encourage renewables deployment during 2019.

New Government procurement rules were published in 2019. These require state sector agencies to procure low-emitting heat systems when these systems come up for replacement, and to purchase replacement vehicles with emissions profiles at least 20 per cent lower than their current fleet average.

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32 Biological Emissions Reference Group. 2018. *Report of the Biological Emissions Reference Group (BERG)*. Wellington: Biological Emissions Reference Group. Retrieved from www.mpi.govt.nz/protection-and-response/environment-and-natural-resources/biological-emissions-reference-group/.

33 Interim Climate Change Committee. 2019. *Action on Agricultural Emissions.* Wellington: Interim Climate Change Committee. Retrieved from www.iccc.mfe.govt.nz/what-we-do/agriculture/agriculture-inquiry-final-report/.

34 Interim Climate Change Committee. 2019. *Accelerated Electrification: Evidence, analysis and recommendations.* Wellington: Interim Climate Change Committee. Retrieved from www.iccc.mfe.govt.nz/what-we-do/energy/electricity-inquiry-final-report/accelerated-electrification-evidence-analysis-and-recommendations/.

The Government has established the Just Transitions work programme to ensure that the transition to a low-emissions economy is fair, equitable and inclusive for regions, sectors and communities. (For more information, see the final section of this chapter, 'Economic and social impacts of response measures'.)

The Energy Efficiency and Conservation Authority administers programmes aiming to improve energy efficiency, primarily through providing information or funding to assist large energy users, public sector agencies and small- to medium-sized businesses. Each of these programmes has a residential, business or transport focus.

- Information programmes to help consumers use energy better by providing well-evidenced, accessible advice on energy efficiency, energy conservation and renewable energy, including the Gen Less campaign, which was launched in 2019.
- Insulation and heating grants programmes distribute funding to provide warmer, drier homes through improved thermal performance.
- The Efficient Products Programme aims to help New Zealand households and businesses to purchase and use products that use less energy and save money.
- The Productive and Low-emissions Business Programme promotes efficient energy management in large businesses.
- The NABERSNZ™ uses a rating system to encourage better energy performance in commercial buildings.

Transport

The transport sector is responsible for 19.7 per cent of New Zealand's total greenhouse gas emissions, with road vehicles contributing the majority of carbon dioxide emissions within this sector. This area offers the potential for significant emissions reductions for New Zealand. The NZ ETS is the main tool for reducing greenhouse gas emissions from transport, but a number of other policies encourage fuel efficiency, public transport and uptake of electric vehicles.

The Vehicle Fuel Economy Labelling Scheme, which began in 2008, is run by the Energy Efficiency and Conservation Authority in conjunction with the New Zealand Transport Agency. This scheme makes it compulsory for vehicle traders and online vendors to display information about the fuel economy of their vehicles, allowing consumers to make an informed choice when purchasing their vehicle. The Electric Vehicles Programme, launched in 2016, includes a range of measures that reduce barriers to consumers and businesses choosing electric vehicles. This includes an exemption from paying road user charges for the owners of electric vehicles. The Energy Efficiency and Conservation Authority also administers the Low Emission Vehicles Contestable Fund, to encourage innovation and investment and accelerate the uptake of electric and other low-emission vehicles, which might not otherwise occur.

A new measure aiming to lower transport emissions is the low-emissions vehicle package, another suite of initiatives aiming to transition the New Zealand vehicle fleet to low emissions. As part of the package, the Ministry of Transport consulted on a vehicle fuel efficiency standard (Clean Car Standard) and vehicle purchase feebate scheme (Clean Car Discount) during August 2019. The standard would improve the supply of electric, hybrid and other low-emission vehicles, and the discount would make them more affordable. The proposals apply to light vehicles entering the fleet for the first time.

Industrial processes and product use

Industrial process emissions from the steel, aluminium, cement, lime and glass industries have NZ ETS reporting and surrender obligations. The import of bulk hydrofluorocarbons (HFCs) is also covered by NZ ETS obligations, while imports of HFCs in products (such as refrigerators and air conditioners) and in vehicle air conditioning systems are subject to a levy equivalent to the cost of emissions.

In October 2016, New Zealand joined 196 other countries to adopt the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer. The Kigali Amendment requires Montreal Protocol Parties to gradually phase down HFC production and use. Developed countries are required to phase down HFC production and use by 85 per cent by 2036. New Zealand ratified the Amendment on 3 October 2019, and it will enter into force for New Zealand on 1 January 2020.

If successfully implemented, the Kigali Amendment is anticipated to avoid up to 0.4 degrees Celsius of global warming by 2100. This would represent a significant contribution towards the Paris Agreement's objective of keeping the global temperature rise 'well below' 2 degrees Celsius above pre-industrial levels.

Waste

The waste sector contributes 5.1 per cent of total greenhouse gas emissions. The major legislation governing waste management in New Zealand is the Waste Minimisation Act 2008, which is administered by the Ministry for the Environment. The Act encourages reductions in the amount of waste New Zealand generates and disposes of, which also results in a reduction in greenhouse gas emissions. It places a levy on disposal facilities that accept household waste. In addition, certain landfills are required to surrender units under the NZ ETS.

The Ministry for the Environment also administers a National Environmental Standard for Landfill Methane, which is implemented by local and regional councils. The standard requires landfill sites with a lifetime design capacity of greater than one million tonnes of refuse to collect and destroy methane emissions. This policy has had the largest impact on emissions in the waste sector.

The Waste Minimisation Act also establishes a Waste Minimisation Fund (WMF), which provides co-benefits for emissions reductions. Through this fund, 50 per cent of the total levy on waste disposed of to landfills (minus administration) is allocated to waste minimisation projects. The purpose of the WMF is to support projects that increase resource efficiency, reuse, recovery and recycling, and decrease waste to landfill.

Land use, land-use change and forestry

Forestry is a net sink for greenhouse gas emissions, sequestering an estimated 24.0 million tonnes of carbon dioxide equivalent in 2017. The Ministry for Primary Industries is responsible for forestry policy in New Zealand. The largest new development in forestry policy is the One Billion Trees Programme, established in 2017, which supports planting of permanent trees and plantation forests. The goal is to plant one billion trees by 2028. The Government intends to achieve this through a combination of replanting existing forests, establishing new forests through grants and changing the NZ ETS to better encourage afforestation. The aim is for two-thirds of the forests established through grants to be made up of native species. In aggregate, the One Billion Trees Programme is expected to result in considerable offsetting of greenhouse gas emissions.

Introduced in 2008 before the NZ ETS, the Permanent Forest Sink Initiative is being incorporated into the NZ ETS as a new 'activity', called Permanent Post-1989 Forest. Permanent Post-1989 Forest retains the key design features of the Permanent Forest Sink Initiative, but by integrating it into the NZ ETS, registration will be simpler and less costly for land owners, it will be simpler to administer and it will enable other improvements to be offered to permanent forest owners (for example, addressing unit surrenders as a result of adverse events).

The Afforestation Grant Scheme is being replaced with grants under the One Billion Trees Programme. The One Billion Trees Fund addresses barriers identified in previous schemes, providing a more flexible system to help plant the right trees in the right place, for the right purpose. The fund has more targeted grant rates to encourage afforestation with greater public good, such as plantings with high biodiversity value and afforestation of erosion-prone land. The fund is open for applications year-round, and is focused on partnering with organisations and groups to increase tree planting – whether through research, innovation or sector development.

Two programmes with the aim of controlling soil erosion also encourage afforestation. The Erosion Control Funding Programme provides funding for tree-planting in erosion-prone areas, and the Sustainable Land Management Hill Country Erosion Programme helps protect pastoral hill country from erosion. The Erosion Control Funding Programme has also been superseded by the One Billion Trees Programme.

Since the *Third Biennial Report*, the Climate Change Forestry Reference Group has completed its work and published a final report.[35] This industry group looked at and responded to policies enabling forestry to contribute to New Zealand's emissions targets, and its final report supported the Government's proposals for forestry.

Economic and social impacts of response measures

Fair and equitable transition

One of the main priorities of the New Zealand Government is to make a fair and equitable transition to a low-emissions economy. As a result, work is in progress across government agencies to understand which communities may be more impacted by the changes.

Vulnerability to emissions pricing

A small number of businesses with high emissions and significant competition with businesses in other countries where emissions are not being priced may be affected by NZ ETS costs. These businesses are provided with an allocation of New Zealand units in order to prevent carbon leakage – when the price of emissions results in economic activity moving offshore, and an emissions decrease in New Zealand being offset by an increase elsewhere.

Vulnerable communities

The Productivity Commission's *Low-emissions Economy* report[36] recognised that lower-income households may be disproportionately disadvantaged by mitigation policy. For example, a rise

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35 Climate Change Forestry Reference Group. 2018. *Final Report*. Wellington: Climate Change Forestry Group. Retrieved from www.biosecurity.govt.nz/dmsdocument/33250/direct.

36 Productivity Commission. 2018. *Low-emissions Economy*. Wellington: Productivity Commission. Retrieved from https://productivity.govt.nz/assets/Documents/4e01d69a83/Productivity-Commission_Low-emissions-economy_Final-Report.pdf.

in energy prices as a result of climate change policy would have a larger effect on households who are unable to afford less emissions-intensive consumption, such as installing insulation or purchasing an electric vehicle. The report acknowledged that low-income households are disproportionately Māori.

The Interim Climate Change Committee's report *Action on Agricultural Emissions*[37] examined some of the possible impacts of climate change policy on rural communities. It concluded that further work is needed, including in analysing likely changes in land value and implications for rural employment, and identifying vulnerable communities in order to design programmes to strengthen resilience. Māori are also heavily involved in the land sector, so need to be taken into particular consideration in agriculture and forestry policy.

National Just Transition Summit

New Zealand's first Just Transition Summit was held in Taranaki in May 2019. The aim of the summit was to begin a national conversation about what a just transition to a low carbon economy could look like for New Zealand. It also sought to position Taranaki as a leader in this transition and to inform New Zealand businesses, workers and iwi (tribes) on how they can take practical steps to plan for an effective and inclusive transition.[38] The summit attracted people from businesses, local government, central government, unions, iwi, non-government organisations, and youth and community organisations, who came to hear Government Ministers and international and local speakers talk about the transition. The key themes that emerged from the summit included:

- the need to develop a shared understanding of and approach to the complex and interconnected issues of climate change and the transition to a low-emissions economy
- the need to develop a more planned, integrated and shared approach to economic development, with less emphasis on market solutions
- the particular importance of working closely with Māori groups and developing strong engagement processes
- the need to develop an optimistic approach, despite the enormous challenges.

Another measure to accelerate investor and regional confidence in the transition is the investment of $27 million over four years to set up and operate the National New Energy Development Centre in Taranaki. This is intended to create new jobs and businesses, while helping New Zealand move towards affordable, renewable energy. The centre will work closely with industry and researchers to trial and validate technologies across a range of new energy forms, such as offshore wind, hydrogen, solar, batteries, geothermal and waste-to-energy. In a separate initiative, funding of $20 million over four years has been dedicated toward early-stage research in energy technology.

Scrutiny of legislation

Both primary legislation (laws) and secondary legislation (regulations) go through a Regulatory Impact Assessment, which includes consideration of the economic and social impacts of any measures. Legislative decisions on climate change response measures made by the New

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37 Interim Climate Change Committee. 2019. *Action on agricultural emissions.* Wellington: Interim Climate Change Committee. Retrieved from www.iccc.mfe.govt.nz/what-we-do/agriculture/agriculture-inquiry-final-report/.

38 For the first draft of a sustainable and inclusive economy vision in Taranaki, 'Taranaki 2050 Draft Roadmap', see http://about.taranaki.info/Taranaki2050/Roadmap.aspx.

Zealand Government must have the support of the majority of the Parliament before they can be passed into law. The public consultation phase of the legislative process allows any member of the public, or any organisation, to raise concerns and issues about proposed measures.

The Ministry of Foreign Affairs and Trade provides the Government with advice on international aspects of proposed policies. New Zealand's regular trade, economic and political consultation with other governments, including some non-Annex I Parties, also provides opportunities for those countries to raise any concerns directly. For more detailed information on the implementation of policies and measures that minimise adverse social, environmental and economic impacts on non-Annex 1 Parties, see chapter 15 of *New Zealand's Greenhouse Gas Inventory 1990–2017*.[39]

Estimates of emission reductions and removals from LULUCF activities

Reporting for the period 2013–20

As noted in chapter II, New Zealand is applying the Kyoto Protocol framework of rules in tracking progress towards its target for the period 2013–20.

Table 3.1 presents New Zealand's emissions and removals from land under the Kyoto Protocol for the period 2013–17. This includes not only land reported under Article 3.3 of the Kyoto Protocol (afforestation/reforestation and deforestation), but also land reported under Article 3.4 (forest management), though accounting for this land is against the forest management reference level.[40] Deviations of emissions above or below this reference level are to be included in the target accounting quantity. New Zealand has elected to account for forest management at the end of the 2013-2020 period. Therefore, emissions/removals from forest management is not currently included in the target accounting quantity presented in table 3.1 or table 3.2. However, they will be reported when the next Biennial Report is published following the conclusion of the 2013-2020 period.

Table 3.1: New Zealand's emissions and removals from land under the Kyoto Protocol as reported for the period 2013–17

	2013	2014	2015	2016	2017
A.1 Afforestation and reforestation					
Net cumulative area since 1990 (ha)	670,107	671,838	673,671	675,569	680,086
Area in calendar year (ha)	4,078	2,957	3,397	2,958	4,979
Emissions from afforestation and reforestation in calendar year (kt CO_2-e)	–16,842.2	–16,757.9	–16,866.5	–16,644.3	–16,193.9

[39] Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/publications/climate-change/new-zealands-greenhouse-gas-inventory-1990-2017.

[40] New Zealand Government Submission – Forest Management Reference Level, 12 April 2011. Retrieved from http://unfccc.int/documentation/documents/advanced_search/items/6911.php?priref=600006559#beg (1 October 2019).

		2013	2014	2015	2016	2017
	Emissions from afforestation and reforestation harvested wood products in calendar year (kt CO_2-e)	–563.5	–833.4	–900.2	–1,166.0	–1,416.1
A.2 Deforestation						
	Net cumulative area since 1990 (ha)	179,699	187,350	193,591	197,214	200,161
	Area in calendar year (ha)	15,160	7,651	6,241	3,623	2,947
	Emissions in calendar year (kt CO_2-e)	10,110.8	5,115.8	3,912.9	2,050.5	1,657.0
Target accounting quantity (kt CO_2-e)		–7,294.8	–12,475.6	–13,853.9	–15,759.9	–15,953.0
B.1 Forest management						
	Area included (ha)	9,259,045	9,252,620	9,247,943	9,246,176	9,245,248
	Emissions in calendar year (kt CO_2-e)	–22,258.7	–20,552.2	–18,331.9	–15,731.4	–14,553.9
Total area included (ha)		10,108,851	10,111,808	10,115,205	10,118,960	10,125,495
Emissions in calendar year (kt CO_2-e)		–29,553.5	–33,027.8	–32,185.7	–31,491.3	–30,506.9

Notes: The areas stated are as at 31 December 2017. 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. Forest management emissions include pre-1990 natural and planted forest harvested wood products.

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.

ha = hectares; kt CO_2-e = kilotonnes of carbon dioxide equivalent

Source: Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment.

Progress towards New Zealand's 2020 target

New Zealand tracks its progress towards its 2020 quantified economy-wide reduction target by periodically producing a net position report.[41] The report outlines New Zealand's historical and projected emissions and removals for the target period 2013–20.

The latest net position update produced in December 2019 showed that New Zealand is projected to meet its 2020 emissions reduction target. Table 3.2 gives actual emissions and removals reported up to 2017 (as in *New Zealand's Greenhouse Gas Inventory* submitted in 2019) and projected emissions and removals up to 2020.

41 Ministry for the Environment. 2019. *Latest Update on New Zealand's 2020 Net Position*. Retrieved from www.mfe.govt.nz/climate-change/reporting-greenhouse-gas-emissions/latest-2020-net-position (11 October 2019).

As shown in figure 3.1, New Zealand's emissions budget for the 2013–20 period is 509.8 million tonnes carbon dioxide equivalent.[42] Gross emissions for the 2013–20 period are projected to be 4.5 per cent higher than the carbon budget available, after accounting for forestry emissions and removals using the Kyoto Protocol framework of rules. It is projected that New Zealand will use 27.7 million surplus units[43] carried over from the first commitment period (CP1) of the Kyoto Protocol[44] to meet its 2020 target, leaving a balance of 96.1 million units.

CTF table 4, CTF table 4(a)ii and CTF table 4b provide a further breakdown of historical data as New Zealand tracks towards its 2020 target, including any units from market-based mechanisms.

Table 3.2: Sector breakdown of emissions and removals 2013–20 (million tonnes of carbon dioxide equivalent)

	Historical					Projected			
	2013	2014	2015	2016	2017	2018	2019	2020	Total
Stationary energy	18.0	18.1	17.6	16.1	16.9	16.6	17.2	17.3	137.8
Transport	14.1	14.2	14.8	15.0	15.9	16.2	16.4	16.4	123.0
IPPU	4.8	5.0	5.3	5.0	5.0	5.1	5.2	5.3	40.8
Agriculture	39.3	39.7	39.3	38.9	38.9	38.6	38.1	37.8	310.6
Waste	4.3	4.2	4.2	4.1	4.1	4.1	4.1	4.1	33.2
Tokelau	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.02
Gross emissions	**80.5**	**81.3**	**81.2**	**79.1**	**80.9**	**80.6**	**80.9**	**80.9**	**645.4**
Contribution from LULUCF (target accounting quantity)[45]	–7.3	–12.5	–13.9	–15.8	–16.0	–14.4	–14.5	–13.7	–108.0
Target accounting emissions									537.4

Note: IPPU = industrial processes and product use; LULUCF = land use, land-use change and forestry. Numbers may not add to totals due to rounding.

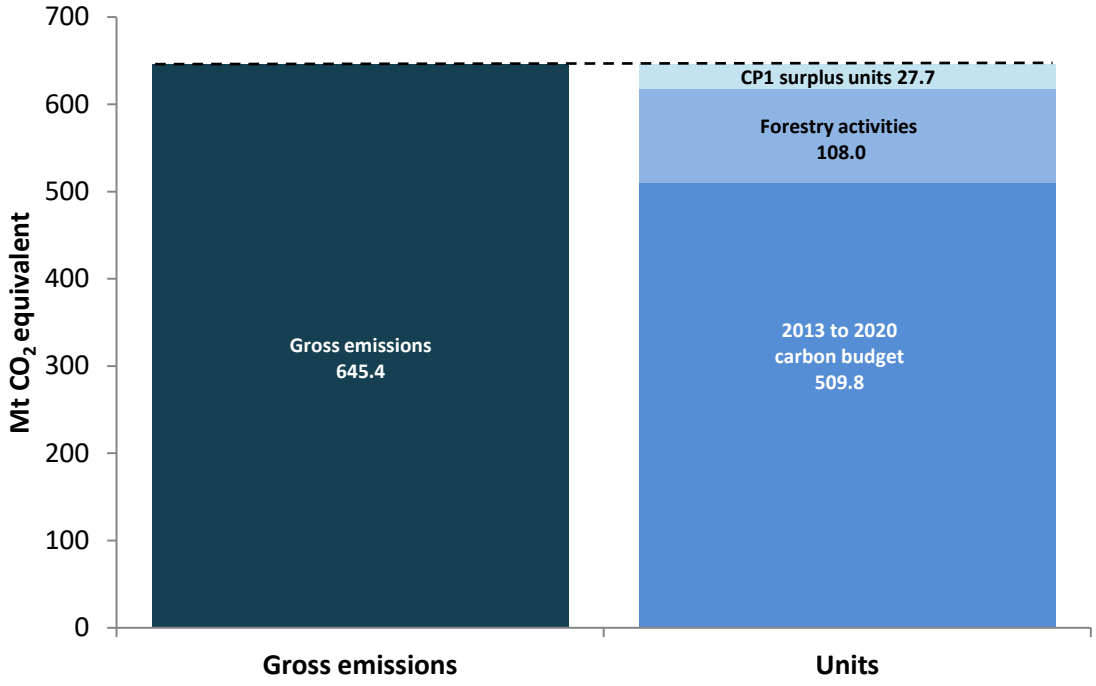
42 Ministry for the Environment. 2016. *New Zealand's report to facilitate the calculation of its emissions budget for the period 2013 to 2020*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/New%20Zealand%27s%20Initial%20Report%20July%202016.pdf.

43 This number is not included in CTF table 2(e)I because these projections are subject to uncertainty and revision over time.

44 United Nations Framework Convention on Climate Change. 2016. *Final compilation and accounting report for New Zealand for the first commitment period of the Kyoto Protocol.* Retrieved from http://unfccc.int/resource/docs/2016/car/nzl.pdf (2 October 2019).

45 This number is not included in CTF table 2(e) because these projections are subject to uncertainty and revision over time.

Figure 3.1: New Zealand's projected gross emissions for the period 2013–2020 and projected 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. CP1 = first commitment period.

CTF Table 3: Progress in achievement of the quantified economy-wide emission reduction target: information on mitigation actions and their effects

Name of mitigation action	Included in 'with measures' GHG projection scenario	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) 2020	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
New Zealand Emissions Trading Scheme (NZ ETS)	Yes	Forestry/LULUCF, Energy, Other (Fishing), Industry/industrial processes, Other (Liquid fossil fuels), Other (Synthetic gases), Waste management/ waste	CO_2, CH_4, N_2O, PFCs, HFCs, SF_6	Aims to reduce emissions by creating a market through which emitters pay for emissions covered by the scheme.	Economic, regulatory	Implemented	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.	2008 (entry has been phased by sector)	Environmental Protection Authority, Ministry for the Environment, Ministry for Primary Industries	2,935	5,641	9,640	12,719
Pricing on agricultural emissions with 95% free allocation	No	Agriculture	CH_4, N_2O	Aims to encourage reduction in agricultural emissions.	Economic, regulatory	Planned	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 will prepare for emissions pricing, including consideration of an alternative pricing mechanism. The Climate Change Commission will carry out a review of progress in 2022.	2020	Ministry for the Environment, Ministry for Primary Industries	NE[a]	14	95	174
Renewable Energy Generation and Process Heat	No	Energy (generation, industry, commercial, public sector)	CO_2	Work programme to support accelerated renewable electricity, energy efficiency and renewable energy in process heat	TBC	Planned	The work programme is focused on: • ensuring the electricity market is delivering fair and affordable prices • accelerating deployment of renewable electricity generation • encouraging energy efficiency and renewable fuels in industry.	TBC	Ministry of Business, Innovation and Employment	NE[b]	NE[b]	NE[b]	NE[b]

Name of mitigation action	Included in 'with measures' GHG projection scenario	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) 2020	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
Green Hydrogen	No	Energy generation, industry, transport.	CO_2	Supporting the development of future fuels to decarbonise sectors of the economy.	TBC	Planned	A work programme supporting the development of future fuels such as hydrogen. A green hydrogen vision paper has been provided that explores the role hydrogen can play in different pathways to decarbonisation and energy resilience. This will be followed by development of a roadmap to guide development of a hydrogen economy in New Zealand.	TBC	Ministry of Business, Innovation and Employment	NE[a]	NE[a]	NE[a]	NE[a]
Engaging hearts and minds	No	Energy (residential)	CO_2	To increase New Zealanders' awareness of the impacts of their energy choices and the connection of those choices to our collective emissions profile.	Information	Implemented	EECA provides consumers with information and tools on energy efficiency and the use of renewable energy via multimedia channels, This includes the recently launched Gen Less campaign.	2009	Energy Efficiency and Conservation Authority	NE[b]	NE[b]	NE[b]	NE[b]
Insulation and heating grants programmes	Yes	Energy (residential)	CO_2	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: • Warm Up New Zealand (running 2009–18), which 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, which replaced Warm Up New Zealand in 2018. 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	8	8	8	9

Name of mitigation action	Included in 'with measures' GHG projection scenario	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) 2020	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
Efficient Products Programme	Yes	Energy	CO_2	Aims to help New Zealand households and businesses to purchase and use products that use less energy and save money.	Regulatory, information	Implemented	A joint Equipment Energy Efficiency (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	240	215	234	301
Productive and Low-emissions Business Programme (formerly the Large Energy User Programme)	Yes	Energy (commercial, industrial, public sector)	CO_2	Promotes best-practice energy management in energy-intensive businesses.	Information, financial and industry support	Implemented	Through this programme, the Energy Efficiency and Conservation Authority works with large energy users across New Zealand to commit to finding long-term energy management and carbon-reduction solutions focusing on efficiency and fuel switching.	2012	Energy Efficiency and Conservation Authority	211	368	391	411
Commercial buildings programmes	No	Energy (commercial, public sector)	CO_2	Improve the energy performance of new and existing commercial buildings.	Information, financial and industry support	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[b]	NE[b]	NE[b]	NE[b]

Name of mitigation action	Included in 'with measures' GHG projection scenario	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) 2020	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
Technology demonstrations	No	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 $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.	2013	Energy Efficiency and Conservation Authority	NE[b]	NE[b]	NE[b]	NE[b]
International technology scans	No	Energy (commercial, industrial, public sector)	CO_2	Enhance information on low-emissions technology in use internationally, and build capability for the low-carbon future	Information	Implemented	These scans look at commercially available technologies that could produce significant energy and cost savings for the industrial sector, but that are currently underused in New Zealand. The first phase of this work is focused on process heat and food processing, with potential for replication across other sectors. The Energy Efficiency and Conservation Authority will continue to resource and plan for technology scans in other areas.	2018	Energy Efficiency and Conservation Authority	NE[c]	NE[c]	NE[c]	NE[c]
Energy Transition Accelerator (ETA) Programme	No	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	Planned	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.	TBC	Energy Efficiency and Conservation Authority	NE[a]	NE[a]	NE[a]	NE[a]

Name of mitigation action	Included in 'with measures' GHG projection scenario	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) 2020	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 Government Procurement and Property	No	Energy	CO_2	The programme aims to make sustainable procurement part of government procurement practice. Rules were updated in 2019.	Fiscal, information	Implemented	The reforms are based on three core elements: policy transformation, capability building and greater use of collaborative contracts. Heat: Agencies will be required to procure low-emitting heat systems when these systems come up for replacement. Fleets: New requirement to purchase replacement vehicles with carbon dioxide emissions profiles at least 20 per cent below their agency's current fleet average.	2009 – updated in 2019	Ministry of Business, Innovation and Employment	NE[b]	NE[b]	NE[b]	NE[b]
National New Energy Development Centre	No	Energy	CO_2	Help transition toward clean, affordable, renewable energy away from fossil fuels, test and trial new technologies, support businesses and jobs.	Research and development	Planned	$27 million over four years to set up and operate the centre in Taranaki. $20 million over four years to establish a new science research fund for cutting edge energy technology such as organic photovoltaics, super conductors, nanotechnologies and inductive power.	2019	Ministry of Business, Innovation and Employment and Venture Taranaki	NE[a]	NE[a]	NE[a]	NE[a]
Vehicle fuel economy labelling	No	Transport	CO_2	A compulsory scheme requiring vehicle traders and online vendors to display information relating to fuel economy.	Regulatory, information	Implemented	Allows consumers to make more informed vehicle purchase choices, and to place an appropriate value on fuel economy.	2008	New Zealand Transport Agency and the Energy Efficiency and Conservation Authority	NE[b]	NE[b]	NE[b]	NE[b]

Name of mitigation action	Included in 'with measures' GHG projection scenario	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) 2020	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
Efficient and Low-emissions Transport Programme	No	Transport	CO_2	A package of initiatives promoting uptake of electric vehicles in New Zealand.	Fiscal, information, education	Implemented	A package of measures to reduce barriers to consumers and businesses choosing electric vehicles. This includes extending the exemption on road user charges for electric vehicles (EVs); a nationwide electric vehicle information and promotion campaign; and a contestable fund of up to NZ$7 million per year to encourage and support innovative low-emissions vehicle projects, including public EV charging infrastructure.	2016 (road user charges exemption began in 2009)	Ministry of Transport, the Energy Efficiency and Conservation Authority and the New Zealand Transport Agency	NE[b]	NE[b]	NE[b]	NE[b]
Low Emissions Vehicle Package (Clean Car Reforms)	No	Transport	CO_2	Two proposed initiatives to address both the supply of and the demand for low-emissions vehicles in New Zealand.	Fiscal, regulatory	Planned	The introduction of a vehicle fuel efficiency standard (Clean Car Standard), and a feebate scheme (Clean Car Discount). Consultation on these proposals closed on 20 August 2019. Final policy proposals subject to progression through Cabinet.	2021	Ministry of Transport and the New Zealand Transport Agency	NE[a]	NE[a]	NE[a]	NE[a]
Low Emissions Vehicle Package (complementary measures)	No	Transport	CO_2	A package of initiatives to complement and improve the Clean Car Reforms.	Fiscal, regulatory, education	Planned	Complementary measures include expanding public EV charging infrastructure and enabling home charging, a voluntary vehicle scrappage scheme, a secondhand EV leasing scheme for low-income households, and strengthening exhaust emissions standards for imported vehicles to improve air quality.	TBC	Ministry of Transport, the New Zealand Transport Agency and the Energy Efficiency and Conservation Authority	NE[b]	NE[b]	NE[b]	NE[b]
Green Freight	No	Transport	CO_2	Reducing emissions from heavy road freight.	Education	Planned	Scoping the potential to reduce emissions from trucks through alternative 'green fuels'. It will look at electrification, hydrogen and biofuels for freight trucks, and the role they could play in reducing emissions over the next 30 years.	2019	Ministry of Transport	NE[a]	NE[a]	NE[a]	NE[a]

Name of mitigation action	Included in 'with measures' GHG projection scenario	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) 2020	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
Government Policy Statement (GPS) on land transport	No	Transport	CO_2	Investment in rail, public transport and active modes of transport to mitigate emissions and avoid further increases.	Regulatory, fiscal	Implemented	Emissions reduction is an ongoing strategic focus in GPS 2018. Through GPS 2018, nearly $4 billion will be invested in public transport, rapid transit and rail over three years, with a further $390 million for walking and cycling. Work on GPS 2021 is under way.	2018	Ministry of Transport	NE[a]	NE[a]	NE[a]	NE[a]
Kigali Amendment to the Montreal Protocol	Yes	IPPU	HFCs	Phase-down of consumption of HFC gases.	Regulatory	Adopted	Staged phase-down on consumption (production, importation and exportation) of bulk HFCs.	2020	Ministry for the Environment	2	63	550	1478
Global Research Alliance on Agricultural Greenhouse Gases	No	Agriculture	CH_4, N_2O, 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	The Global Research Alliance on Agricultural Greenhouse Gases was launched in December 2009 and now has 58 member countries from all regions of the world. For more information, see globalresearchalliance.org.	2009	Secretariat support and co-Chair of the Livestock Research Group provided by New Zealand	NE[b]	NE[b]	NE[b]	NE[b]
Primary Growth Partnership	No	Agriculture	CH_4, N_2O, CO_2	To boost the economic growth and sustainability of New Zealand's primary, forestry and food sectors.	Research, information, training	Implemented	Provides funding for programmes of research and innovation. This fund is no longer taking applications, as it is being replaced by Sustainable Food & Fibre Futures, but current projects will run to completion.	2009–2018	Ministry for Primary Industries	NE[b]	NE[b]	NE[b]	NE[b]
Sustainable Food & Fibre Futures	No	Agriculture	CH_4, N_2O, CO_2	Invests 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[a]	NE[a]	NE[a]	NE[a]

Name of mitigation action	Included in 'with measures' GHG projection scenario	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) 2020	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
New Zealand Agricultural Greenhouse Gas Research Centre	No	Agriculture	CH_4, N_2O, CO_2	Focuses on ways to increase productivity and reduce on-farm methane and nitrous oxide emissions.	Research, information, capability building, education	Implemented	Brings together nine research organisations.	2010	Ministry for Primary Industries	NE[b]	NE[b]	NE[b]	NE[b]
Pastoral Greenhouse Gas Research Consortium	No	Agriculture	CH_4, N_2O	To provide livestock farmers with the information and means to mitigate their greenhouse gas emissions.	Research, information, education	Implemented	A research partnership between the Government and the dairy, sheep, beef, deer, fertiliser and agricultural research sectors.	2002	Ministry of Business, Innovation and Employment	NE[b]	NE[b]	NE[b]	NE[b]
Sustainable Land Management and Climate Change Plan of Action	No	Agriculture	CH_4, N_2O, CO_2	Research programmes in agriculture and forestry sectors.	Research, information, education, capability building	Implemented	Initiatives and programmes in the agricultural and forestry sectors that focus on adaptation to climate change, reducing emissions and enhancing sinks, and new business opportunities.	2007	Ministry for Primary Industries	NE[b]	NE[b]	NE[b]	NE[b]
Permanent Forest Sink Initiative (PFSI)	Yes	Forestry	CO_2	Promote the establishment of permanent forests on previously unforested land.	Fiscal, voluntary agreement	Implemented	The PFSI was introduced prior to the NZ ETS, and is not an efficient means to encourage permanent afforestation. The plan is to discontinue it 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	Ministry for Primary Industries	187	176	165	144
Erosion Control Funding Programme (formerly the East Coast Forestry Project) [46]	Yes	Forestry	CO_2	The main purpose of this project is to reduce erosion by encouraging tree planting on erosion-prone land. The project also enhances the sequestration of carbon in forest sinks.	Fiscal, voluntary agreement	Implemented	Since 1992, the Ministry for Primary Industries has provided funding to landholders to prevent and control erosion. 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.	1992	Ministry for Primary Industries	1,493	12	575	1,091

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

Name of mitigation action	Included in 'with measures' GHG projection scenario	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) 2020	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 Hill Country Erosion Programme	Yes	Forestry	CO_2	The Sustainable Land Management Hill Country Erosion Programme helps protect New Zealand's estimated 1.4 million hectares of pastoral hill country classified as erosion prone.	Fiscal, voluntary agreement	Implemented	The purpose of the programme is to speed up the rate of treatment of erosion-prone land. Projects deliver sustainable land management treatments including wide-spaced poplar and willow planting, small-scale afforestation, reversion to indigenous forest, and retirement of land – treating over 3,500 hectares each year. The fund also supports catchment facilitation work and capability-building initiatives.	2008	Ministry for Primary Industries	244	487	639	633
Afforestation Grant Scheme	Yes	Forestry	CO_2	The scheme offers a contestable fund that aims to increase the area of new forests that meet the afforestation/reforestation definition under the Kyoto Protocol in New Zealand by offering a simpler alternative to the NZ ETS for landowners establishing new forests.	Fiscal, voluntary agreement	Implemented	Landowners who have received a grant have ongoing obligations to maintain their grant forests for a minimum 10-year period.	2008	Ministry for Primary Industries	467	701	712	759
Waste levy under the Waste Minimisation Act 2008	Yes	Waste	CH_4	The purpose is to encourage waste minimisation and decrease waste disposal to protect the environment from harm and provide environmental, social, economic and cultural benefits.	Regulatory	Implemented	In particular, imposes a $10/tonne levy on landfills that take household waste.	2010	Ministry for the Environment	7	10	12	14
National Environmental Standard for Air Quality (landfill methane)	Yes	Waste	CH_4	The objective of the landfill gas standards is to effectively manage discharges to air of greenhouse gases (mainly methane) generated from large landfills.	Regulatory	Implemented	Requires landfill sites with a lifetime design capacity of greater than 1 million tonnes of refuse to collect and destroy methane emissions.	Standard came into effect in 2004, with full compliance required by 2007.	Ministry for the Environment and regional and local councils	687	877	1,040	1,173

Name of mitigation action	Included in 'with measures' GHG projection scenario	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) 2020	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)	No	Waste	CH_4	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). The purpose of the fund is to increase resource efficiency; increase reuse, recovery and recycling; and decrease waste to landfill.	Fiscal	Implemented	The funding comes from a waste disposal levy imposed under the Waste Minimisation Act 2008.	Funding began in 2010.	Ministry for the Environment	NE[b]	NE[b]	NE[b]	NE[b]
Indirect effects of combined agricultural (forestry land-use) policies on waste	Yes	Waste	CH_4, N_2O	Various policies in the agriculture sector have a flow-on effect on the amount of activity that results in emissions from industrial wastewater. This is not an instrument in itself; rather it is to capture the net effects of those policies on the waste sector.	NA	N/A	Refer to policies affecting the agriculture sector.	NA (effects begin from 2018)	Various	0	2	4	4
Tokelau Renewable Energy Project	Yes	Tokelau	CO_2, CH_4	To provide reliable, adequate, and efficient energy for the people of Tokelau through the use of solar photovoltaic power.	Fiscal	Implemented	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	1
Crown Forestry Joint Ventures[47]	Yes	Forestry	CO_2	To help achieve the One Billion Trees goal through commercial joint ventures with landowners to plant commercial radiata pine on their properties.	Fiscal	Implemented	Funding for commercial forestry joint ventures to boost tree planting.	2018	Ministry for Primary Industries	–120	422	634	702

47 A negative estimate of mitigation impact indicates additional GHG emissions resulting from this policy or measure

Name of mitigation action	Included in 'with measures' GHG projection scenario	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) 2020	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
One Billion Trees Programme	Yes	Forestry, agriculture	CO_2, CH_4, N_2O	Aims to facilitate the planting of one billion trees by 2028. The programme will: • create employment and develop the workforce • optimise land use • mitigate climate change • support Māori values and aspirations • protect the environment • support New Zealand's transition to a low-emissions economy.	Research, information, education, capability building, fiscal, regulatory, voluntary agreement	Implemented	The New Zealand Government has developed the One Billion Trees Programme to increase current rates of tree planting to reach at least one billion trees over the next decade. The programme is funded by the Provincial Growth Fund and led by Te Uru Rākau – Forestry New Zealand, in the Ministry for Primary Industries.	2017	Ministry for Primary Industries	41	574	1,316	1,433
National Policy Statement for Freshwater Management (NPS-FM)	Yes	Agriculture	CH_4, N_2O	Aims to improve the quality of fresh water 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	Requires regional councils to establish water quality objectives for catchments in their region. Regional council progress in implementing the NPS-FM varies across the country; many councils have made good progress to identify objectives and set limits. However, and not unexpectedly, no council has implemented the NPS-FM in its entirety.	2011	Regional and local councils	9	196	440	786

Note: The final column specifies the year identified by the Party for estimating impacts (based on the status of the measure and whether an ex-post or ex-ante estimation is available). CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; GHG = greenhouse gas; HFCs = hydrofluorocarbons; IPPU = industrial processes and product use; kt CO_2-e = kilotonnes of carbon dioxide equivalent; NA = not applicable; NE = not estimated; N_2O = nitrous oxide; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride; TBC = to be confirmed.

A negative estimate of mitigation impact indicates additional greenhouse gas emissions resulting from this policy or measure.

[a] Mitigation impact was not estimated because this policy has not yet been implemented or is in the early stages of implementation.

[b] Mitigation impact was not estimated because insufficient data were available.

[c] Mitigation impact was not estimated because the impact is considered negligible.

CTF Table 4: Reporting on progress

Year[c]	Total emissions excluding LULUCF ($kt CO_2$-e)	Contribution from LULUCF[d] ($kt CO_2$-e)	Quantity of units from market-based mechanisms under the Convention (number of units)	Quantity of units from market-based mechanisms under the Convention ($kt CO_2$-e)	Quantity of units from other market-based mechanisms (number of units)	Quantity of units from other market-based mechanisms ($kt CO_2$-e)
Base year/base period	65,668.25	NA	NA	NA	NA	NA
2013	80,540.66	–7,294.86	NA	NA	NA	NA
2014	81,310.14	–12,475.60	NA	NA	NA	NA
2015	81,202.02	–13,853.86	NA	NA	NA	NA
2016	79,136.11	–15,759.92	NA	NA	NA	NA
2017	80,853.47	–15,953.02	NA	NA	NA	NA

Note: kt CO_2-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 prejudge 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.

CTF Table 4(a)ii: 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

Greenhouse gas source and sink activities	Base year	Net emissions/removals[e] (kt CO_2-equivalent)								Total[g]	Accounting parameters[h]	Accounting quantity[i]
		2013	2014	2015	2016	2017	2018	2019	2020			
A. Article 3.3 activities												
A.1. Afforestation/reforestation		–17,405.69	–17,591.36	–17,766.72	–17,810.37	–17,610.00				–88,184.13		–88,184.13
Excluded emissions from natural disturbances (5)		NA	NA	NA	NA	NA				NA		NA
Excluded subsequent removals from land subject to natural disturbances (6)		NA	NA	NA	NA	NA				NA		NA
A.2. Deforestation		10,110.84	5,115.76	3,912.87	2,050.45	1,656.99				22,846.91		22,846.91
B. Article 3.4 activities[m]												
B.1. Forest management										–91,428.07		–91,380.97
Net emissions/removals[e]		–22,258.66	–20,552.23	–18,331.88	–15,731.40	–14,553.91				–91,428.07		
Excluded emissions from natural disturbances (5)		NA	NA	NA	NA	NA				NA		NA
Excluded subsequent removals from land subject to natural disturbances (6)		NA	NA	NA	NA	NA				NA		NA
Any debits from newly established forest (CEF-ne) (7), (8)												
Forest management reference level (FMRL) (9)											11.15	
Technical corrections to FMRL (10)											–20.57	
Forest management cap[l]											2,335.21	–2,335.21
B.2. Cropland management (if elected)		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
B.4. Revegetation (if elected)		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

Note: 1 kt CO_2-eq equals 1 Gg CO_2 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 prejudge 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.] New Zealand has elected to account for forest management at the end of the 2013-2020 period. Therefore, emissions/removals from forest management is not currently included. However, they will be reported when the next Biennial Report is published following the conclusion of the 2013-2020 period.

CTF Table 4(b): Reporting on progress

	Quantity of units	kt CO_2-e
2017		
Kyoto Protocol Units[d]		
AAUs	0.00	0.00
ERUs	0.00	0.00
CERs	0.00	0.00
tCERs	0.00	0.00
lCERs	0.00	0.00
Units from market-based mechanisms under the UNFCCC[e]		
Units from other market-based mechanisms[d, e]		
Total		
2018		
Kyoto Protocol Units[d]		
AAUs	0.00	0.00
ERUs	0.00	0.00
CERs	0.00	0.00
tCERs	0.00	0.00
lCERs	0.00	0.00
Units from market-based mechanisms under the UNFCCC[e]		
Units from other market-based mechanisms[d, e]		
Total		

Note: New Zealand understands 'surrender' to mean retire. New Zealand retired international units in 2015 to fulfil its emissions target for the first commitment period of the Kyoto Protocol. However, no units have been retired or used to meet New Zealand's current (2013–20) economy-wide target. AAUs = assigned amount units; CERs = certified emission reductions; ERUs = emission reduction units; kt CO_2-e = kilotonnes of carbon dioxide equivalent; lCERs = long-term certified emission reductions; tCERs = temporary certified emission reductions.

[a] Reporting by a developed country Party on the information specified in the common tabular format (CTF) does not prejudge 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.

Chapter IV: Projections

Key points:

- 'With existing measures', 'without measures' and 'with additional measures' scenarios of greenhouse gas emissions and removals have been modelled to project the effect of New Zealand's key quantifiable policies and measures out to 2035.
- Under the 'with existing measures' scenario:
  - New Zealand's gross emissions (excluding emissions and removals from the land use, land-use change and forestry (LULUCF) sector) are projected to be 80.9 million tonnes of carbon dioxide equivalent (Mt CO_2-e) in 2020 (23.2 per cent above 1990 levels or 0.1 per cent above 2017 levels). In 2035 gross emissions are projected to be 72.2 Mt CO_2-e (9.9 per cent above 1990 levels or 10.8 per cent below 2017 levels).
  - Gross emissions are projected to be 1.2 per cent higher in 2020 and 2.6 per cent lower in 2030 than they were projected to be in *New Zealand's Third Biennial Report Under the United Nations Framework Convention on Climate Change*[48] (*Third Biennial Report*) published in 2017.
  - New Zealand's net emissions (including emissions and removals from the LULUCF sector) are projected to rise to 66.6 Mt CO_2-e in 2020 (93.0 per cent above 1990 levels or 17.1 per cent above 2017 levels). In 2035 net emissions are projected to be 57.9 Mt CO_2-e (67.7 per cent above 1990 levels or 1.7 per cent above 2017 levels).
  - Net emissions are projected to be 3.6 per cent higher in 2020 and 9.7 per cent lower in 2030 than they were projected to be in the *Third Biennial Report* published in 2017.
  - Projections show the impact of New Zealand's existing policies and measures are estimated to reduce net emissions by 6.4 Mt CO_2-e in 2020 and 21.7 Mt CO_2-e in 2035 relative to the 'without measures' scenario.

Introduction

This chapter presents New Zealand's anticipated future greenhouse gas emissions and removals. These projections are reported under the following three scenarios, plus a high- and low-emissions scenario for the 'with existing measures' scenario.

'With existing measures' (WEM) scenario	Encompasses 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.

48 Ministry for the Environment. 2017. *New Zealand's Third Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/Final%20-Third%20Biennial%20Report.pdf (10 September 2019).

'With additional measures' (WAM) scenario[49]	Includes implemented, adopted and planned 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.

The section 'Projections under the United Nations Framework Convention on Climate Change (UNFCCC)' details New Zealand's total greenhouse gas emissions projected under the WEM, WOM and WAM scenarios from 1990 to 2035, disaggregated by sector and by gas. The projections are presented relative to actual and unadjusted data reported in *New Zealand's Greenhouse Gas Inventory 1990–2017*,[50] and an overview of measures considered under different scenarios is provided alongside the historical and projected key assumptions driving the emission scenarios. The section 'Assessment of the total effect of policies and measures' discusses the combined assessed effect of policies and measures. Changes since New Zealand's last biennial report submission are presented in the section 'Differences from the Third Biennial Report' and within each sector. Last, information on the methodology applied, as well as underlying assumptions specific to each sector and sensitivity analysis, are presented in the section 'Cross-sectoral overview'.

Projections under the United Nations Framework Convention on Climate Change

New Zealand's actual (historical) and projected gross greenhouse gas emissions, excluding emissions and removals from land use, land-use change and forestry (LULUCF), are summarised in figure 4.1. Figure 4.2 summarises New Zealand's actual and projected net greenhouse gas emissions inclusive of emissions and removals from LULUCF. The historical emissions and removals 1990–2017 are consistent with data reported in *New Zealand's Greenhouse Gas Inventory 1990–2017*, while projections are for 2018–35. The WOM scenario starts from 2002 when LULUCF is excluded (1992 when LULUCF is included).[51] The starting year of the WEM and WAM scenario is 2017.

New Zealand's gross greenhouse gas emissions under the WEM scenario are projected to remain steady in the short term, contributing 80.9 Mt CO_2-e in 2020 (23 per cent above 1990 gross emissions) before decreasing to 72.2 Mt CO_2-e in 2035 (10 per cent above 1990 gross emissions). In the short term, this trend is primarily due to the increased emissions in the energy, transport, and industrial processes and product use (IPPU) sectors being offset by decreasing emissions from agriculture and waste. In the long term, decreasing gross emissions are primarily the result of policies and measures introduced by the New Zealand Government.

New Zealand's net greenhouse gas emissions are projected to increase to 72.0 Mt CO_2-e in 2025 (109 per cent above 1990 net emissions) before decreasing to 57.9 Mt CO_2-e (68 per cent above 1990 net emissions) in 2035. The increase in net emissions from 2017 to 2025 is due to a decline in net removals from LULUCF, as plantation forests established in the late 1980s

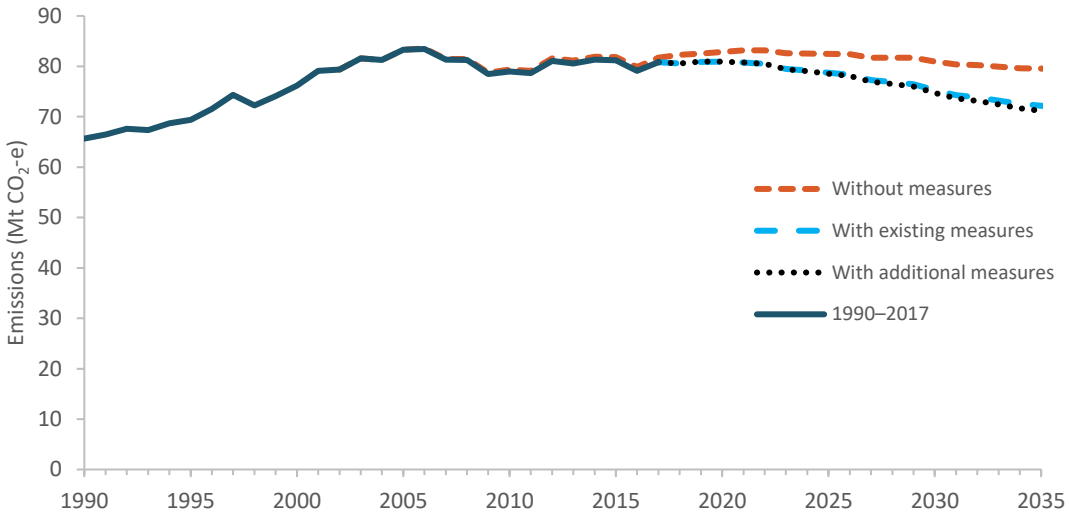
49 See table 4.1 and table 4.9 for the additional policies considered in this scenario.

50 Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

51 The impact of the Erosion Control Funding Programme is calculated from 1992, because the New Zealand Government has provided funding to landholders to prevent and control erosion since 1992.

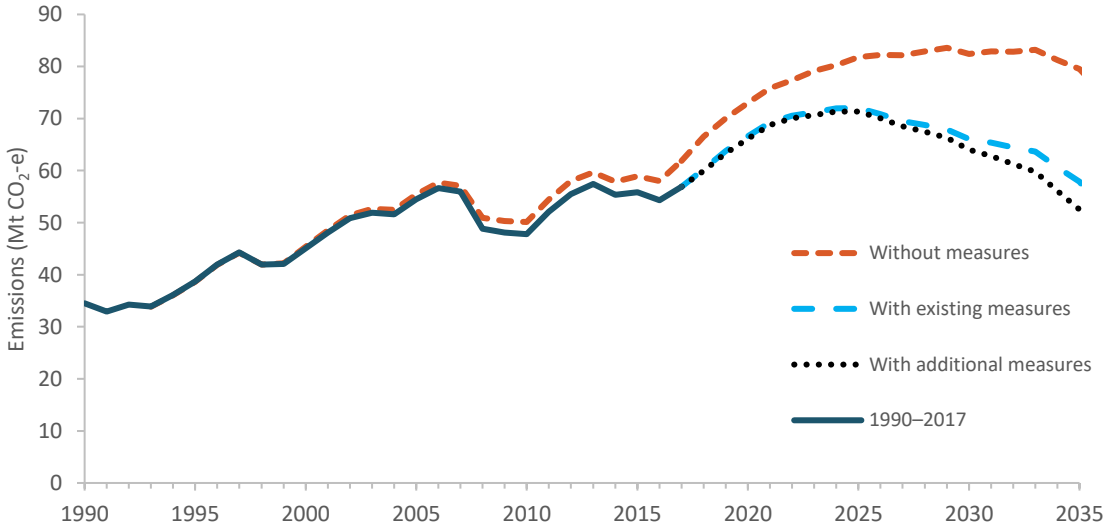
and early 1990s are harvested for timber. However, the LULUCF sector is expected to see an increase in net removals from around 2025 due to the replanting of forests harvested in the early 2020s, and additional sequestration from projected afforestation activities. See the section 'Land use, land-use change and forestry', for more information.

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



Note: LULUCF = land use, land-use change and forestry; WAM = with additional measures; WEM = with existing measures; WOM = without measures.

Figure 4.2: New Zealand's emissions under the WEM, WOM and WAM scenarios, 1990–2035 (including emissions and removals from LULUCF, excluding indirect emissions and emissions from international transport)



Note: LULUCF = land use, land-use change and forestry; WAM = with additional measures; WEM = with existing measures; WOM = without measures.

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. Details regarding each policy and measure are discussed in chapter III.

Table 4.1: Policies and measures included in the WEM, WOM and WAM scenarios Note: Under the WAM scenario, some measures are strengthened compared with the WEM scenario (see remarks)

Policy or measure	Timeframe implemented	Sector	WEM	WOM	WAM	Remarks
New Zealand Emissions Trading Scheme	2008–	Cross-sectoral[52]	✓		✓	Obligations for: forestry from 2008; stationary energy, industrial processes and transport from 2010; fluorinated gases from 2013; waste from 2013. WAM strengthened with higher carbon prices compared with WEM.
Efficient Products Programme	2002–	Energy	✓		✓	
Insulation and heating grants programmes	2009–	Energy	✓		✓	
Productive and Low Emissions Business Programme[53]	2015–	Energy	✓		✓	
Kigali Amendment to the Montreal Protocol	2020–	IPPU	✓		✓	
National Policy Statement for Freshwater Management	2016–	Agriculture	✓		✓	Expected to be fully implemented by all regional councils between 2025 and 2030.
Indirect effects of combined forestry land-use policies on agricultural land use	2016–	Agriculture	✓		✓	WAM strengthened compared with WEM.
Pricing on agricultural emissions with 95% free allocation	2025–	Agriculture			✓	Planned policy and measure.
Afforestation Grant Scheme	2008–18[54]	LULUCF	✓		✓	
Permanent Forest Sink Initiative	2008–21[55]	LULUCF	✓		✓	

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

53 Formerly known as the Large Energy User Programme (EECA Business Programme).

54 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.

55 The PFSI is to be discontinued at the end of 2021 and replaced with a new activity in the NZ ETS.

Policy or measure	Timeframe implemented	Sector	WEM	WOM	WAM	Remarks
Sustainable Land Management Hill Country Erosion Programme	2009–	LULUCF	✓		✓	
Erosion Control Funding Programme	1993–18[56]	LULUCF	✓		✓	
One Billion Trees Programme	2018–	LULUCF	✓		✓	
Crown Forestry Joint Ventures	2018–	LULUCF	✓		✓	
National Environmental Standard for Air Quality (landfill methane)	2005–	Waste	✓		✓	
Waste Disposal Levy	2010–	Waste	✓		✓	
Indirect effects of combined agricultural (forestry land-use) policies on waste	2018–	Waste	✓		✓	
Tokelau Renewable Energy Project	2012–	Tokelau	✓		✓	

Note: 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.

Key assumptions and variables

An overview of the key assumptions used for modelling of the WEM, WOM and WAM scenarios is presented in table 4.2. For further key variables and assumptions used in the projections analysis (CTF table 5), please see appendix B.1, and sector-specific information in the section 'Cross-sectoral overview'.

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 slow to the long-term historical average of 15,000 people per year, 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 $25 in 2022 to $30 in 2030. 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.

[56] 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.

Table 4.2: 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	2017	2020	2025	2030	2035
Population (30 June, million inhabitants)	3.46	3.67	3.86	4.13	4.35	4.59	4.77	5.00	5.29	5.52	5.72
Gross domestic product (real 2009/10 $NZ billion)	112.7	130.5	152.1	184.1	196.7	225.3	241.3	261.9	294.2	323.9	354.0
Net migration (thousand people)	2.0	22.7	–9.8	8.6	16.5	53.4	58.9	33.6	21.0	15.0	15.0
Exchange rate (NZ$/US$)	0.60	0.66	0.46	0.70	0.72	0.70	0.71	0.65	0.65	0.65	0.65
WEM carbon price (real 2017 $NZ tonne CO_2-e)	–	–	–	–	4.91	3.37	11.88	25.00	26.88	30.00	31.88[1]
WOM carbon price (real 2017 $NZ tonne CO_2-e)	–	–	–	–	0	0	0	0	0	0	0
WAM carbon price (real 2017 $NZ tonne CO_2-e)	–	–	–	–	4.91	3.37	11.88	25.00	34.38	50.00	62.50[2]
Labour force (million people)	1.67	1.80	1.92	2.16	2.30	2.48	2.65	2.84	3.03	3.15	3.24

Note: 1. the energy and transport sectors have assumed 'a with existing measures' (WEM) carbon price of $37/tonne CO_2-e in 2035; 2. the energy and transport sectors have assumed a with additional measures (WAM) carbon price of $70/tonne CO_2-e in 2035; WOM = without measures.

Projected greenhouse gas emissions and removals

Table 4.3 and table 4.4 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 information as 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 III. Figure 4.3 and figure 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 (see table 4.2 above).

Table 4.3: New Zealand greenhouse gas emissions by sector, 1990–2035 (Mt CO_2-e)

Sector		Historical							Projected			
		1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
Energy	WEM	15.01	14.77	17.52	20.63	18.01	17.62	16.94	17.31	16.59	15.33	14.08
	WOM	15.01	14.77	17.52	20.65	18.08	17.80	17.21	18.10	17.80	16.61	15.63
	WAM	15.01	14.77	17.52	20.63	18.01	17.62	16.94	17.31	16.45	14.96	13.49
Transport	WEM	8.77	10.96	12.43	13.90	14.16	14.77	15.94	16.40	15.76	14.95	14.11

		Historical							Projected			
Sector		1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
	WOM	8.77	10.96	12.43	13.90	14.16	14.77	15.94	16.40	15.76	14.95	14.11
	WAM	8.77	10.96	12.43	13.90	14.16	14.77	15.94	16.40	15.76	14.95	14.11
IPPU	WEM	3.58	3.17	3.43	4.03	4.54	5.29	4.97	5.33	5.70	5.57	4.99
	WOM	3.58	3.17	3.43	4.03	4.54	5.29	4.97	5.33	5.76	6.12	6.46
	WAM	3.58	3.17	3.43	4.03	4.54	5.29	4.97	5.33	5.70	5.57	4.99
Agriculture	WEM	34.26	36.11	38.06	39.87	37.73	39.34	38.88	37.84	36.67	35.46	35.05
	WOM	34.26	36.11	38.06	39.87	37.73	39.34	38.94	38.13	38.21	38.26	38.25
	WAM	34.26	36.11	38.06	39.87	37.73	39.34	38.88	37.84	36.62	35.26	34.62
Waste	WEM	4.04	4.39	4.74	4.83	4.53	4.18	4.12	4.05	4.00	3.96	3.93
	WOM	4.04	4.39	4.74	4.83	4.82	4.63	4.66	4.75	4.89	5.01	5.12
	WAM	4.04	4.39	4.74	4.83	4.53	4.18	4.12	4.05	4.00	3.96	3.93
Tokelau	WEM	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003
	WOM	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
	WAM	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003
Total (excluding LULUCF)	WEM	65.67	69.41	76.18	83.27	78.96	81.20	80.85	80.93	78.72	75.27	72.16
	WOM	65.67	69.41	76.18	83.29	79.33	81.83	81.73	82.71	82.43	80.95	79.57
	WAM	65.67	69.41	76.18	83.27	78.96	81.20	80.85	80.93	78.53	74.70	71.14
LULUCF	WEM	–31.16	–30.74	–31.06	–28.81	–31.16	–25.32	–23.96	–14.33	–6.68	–9.19	–14.28
	WOM	–31.16	–30.79	–30.78	–27.89	–29.20	–22.93	–19.83	–9.86	–0.71	1.50	0.01
	WAM	–31.16	–30.74	–31.06	–28.81	–31.16	–25.32	–23.96	–14.80	–7.19	–10.69	–18.61
Total (including LULUCF)	WEM	34.51	38.67	45.12	54.47	47.81	55.88	56.90	66.60	72.04	66.07	57.87
	WOM	34.51	38.62	45.40	55.40	50.13	58.90	61.90	72.85	81.72	82.45	79.58
	WAM	34.51	38.67	45.12	54.47	47.81	55.88	56.90	66.13	71.35	64.01	52.53

Note: IPPU = industrial processes and product use; LULUCF = land use, land-use change and forestry; Mt CO_2-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.

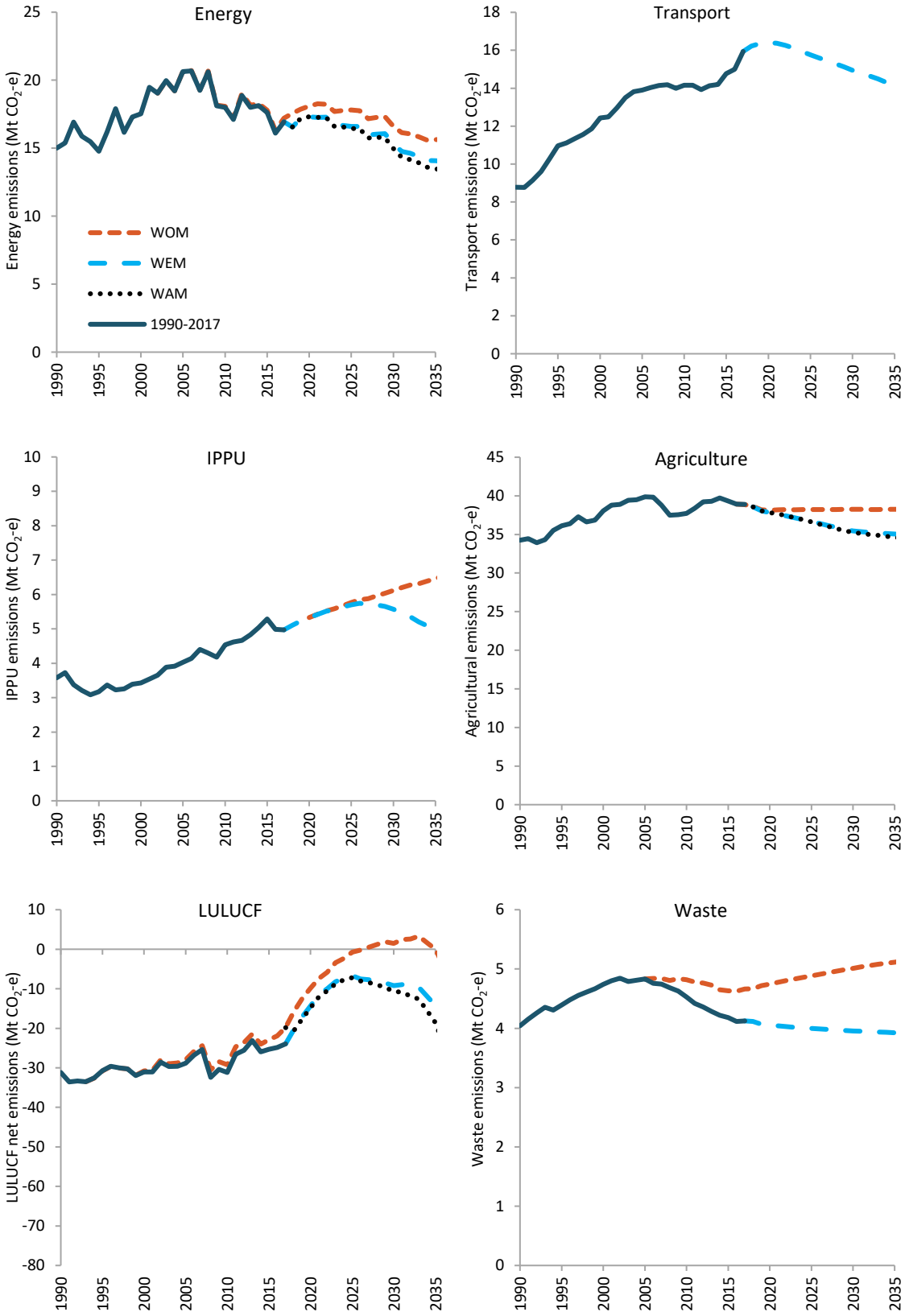
Table 4.4: New Zealand greenhouse gas emissions by gas, 1990–2035 (Mt CO_2-e)

		Historical							Projected			
Gas		1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
CO_2	WEM	25.46	28.01	32.30	37.59	35.00	35.84	36.02	36.92	35.55	33.51	31.47
	WOM	25.46	28.01	32.30	37.61	35.07	36.01	36.30	37.72	36.79	34.83	33.04
	WAM	25.46	28.01	32.30	37.59	35.00	35.84	36.02	36.93	35.41	33.15	30.90
CH_4	WEM	32.15	33.37	35.22	35.73	34.22	34.64	34.13	33.26	32.36	31.37	31.01
	WOM	32.15	33.37	35.22	35.73	34.51	35.09	34.72	34.27	34.46	34.53	34.60

		Historical							Projected			
Gas		**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020**	**2025**	**2030**	**2035**
	WAM	32.15	33.37	35.22	35.73	34.22	34.64	34.13	33.25	32.32	31.21	30.65
N_2O	WEM	7.13	7.84	8.35	9.19	8.63	9.11	9.12	8.87	8.61	8.32	8.21
	WOM	7.13	7.84	8.35	9.19	8.63	9.11	9.13	9.01	8.99	8.96	8.93
	WAM	7.13	7.84	8.35	9.19	8.63	9.11	9.12	8.89	8.60	8.27	8.12
HFCs	WEM	0.00	0.02	0.22	0.66	1.05	1.54	1.51	1.78	2.11	1.98	1.39
	WOM	0.00	0.02	0.22	0.66	1.05	1.54	1.51	1.79	2.18	2.53	2.87
	WAM	0.00	0.02	0.22	0.66	1.05	1.54	1.51	1.78	2.11	1.98	1.39
PFCs	WEM	0.91	0.15	0.07	0.07	0.05	0.06	0.06	0.07	0.07	0.07	0.07
	WOM	0.91	0.15	0.07	0.07	0.05	0.06	0.06	0.07	0.07	0.07	0.07
	WAM	0.91	0.15	0.07	0.07	0.05	0.06	0.06	0.07	0.07	0.07	0.07
SF_6	WEM	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.01
	WOM	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.01
	WAM	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.01
NF_3		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (excluding LULUCF)	**WEM**	65.67	69.41	76.18	83.27	78.96	81.20	80.85	80.93	78.72	75.27	72.16
	WOM	65.67	69.41	76.18	83.29	79.33	81.83	81.73	82.87	82.51	80.93	79.53
	WAM	65.67	69.41	76.18	83.27	78.96	81.20	80.85	80.93	78.53	74.70	71.14
CO_2 (including LULUCF)	WEM	–6.01	–3.06	0.91	8.45	3.54	10.29	11.87	22.38	28.66	24.10	16.97
	WOM	–6.01	–3.11	1.20	9.39	5.57	12.86	16.27	27.64	35.86	36.11	32.84
	WAM	–6.01	–3.06	0.91	8.45	3.54	10.29	11.87	21.91	28.01	22.25	12.07
CH_4 (including LULUCF)	WEM	32.25	33.47	35.31	35.85	34.32	34.71	34.23	33.36	32.45	31.46	31.10
	WOM	32.25	33.47	35.31	35.85	34.61	35.17	34.81	34.36	34.56	34.62	34.70
	WAM	32.25	33.47	35.31	35.85	34.32	34.71	34.23	33.34	32.42	31.30	30.75
N_2O (including LULUCF)	WEM	7.34	8.07	8.59	9.41	8.83	9.26	9.22	8.99	8.73	8.44	8.33
	WOM	7.34	8.07	8.59	9.41	8.83	9.26	9.24	9.13	9.11	9.08	9.05
	WAM	7.34	8.07	8.59	9.41	8.83	9.26	9.22	9.00	8.72	8.39	8.24
Total (including LULUCF)	**WEM**	34.51	38.67	45.12	54.47	47.81	55.88	56.90	66.60	72.04	66.07	57.87
	WOM	34.51	38.62	45.40	55.40	50.13	58.90	61.90	73.01	81.79	82.43	79.53
	WAM	34.51	38.67	45.12	54.47	47.81	55.88	56.90	66.13	71.35	64.01	52.53

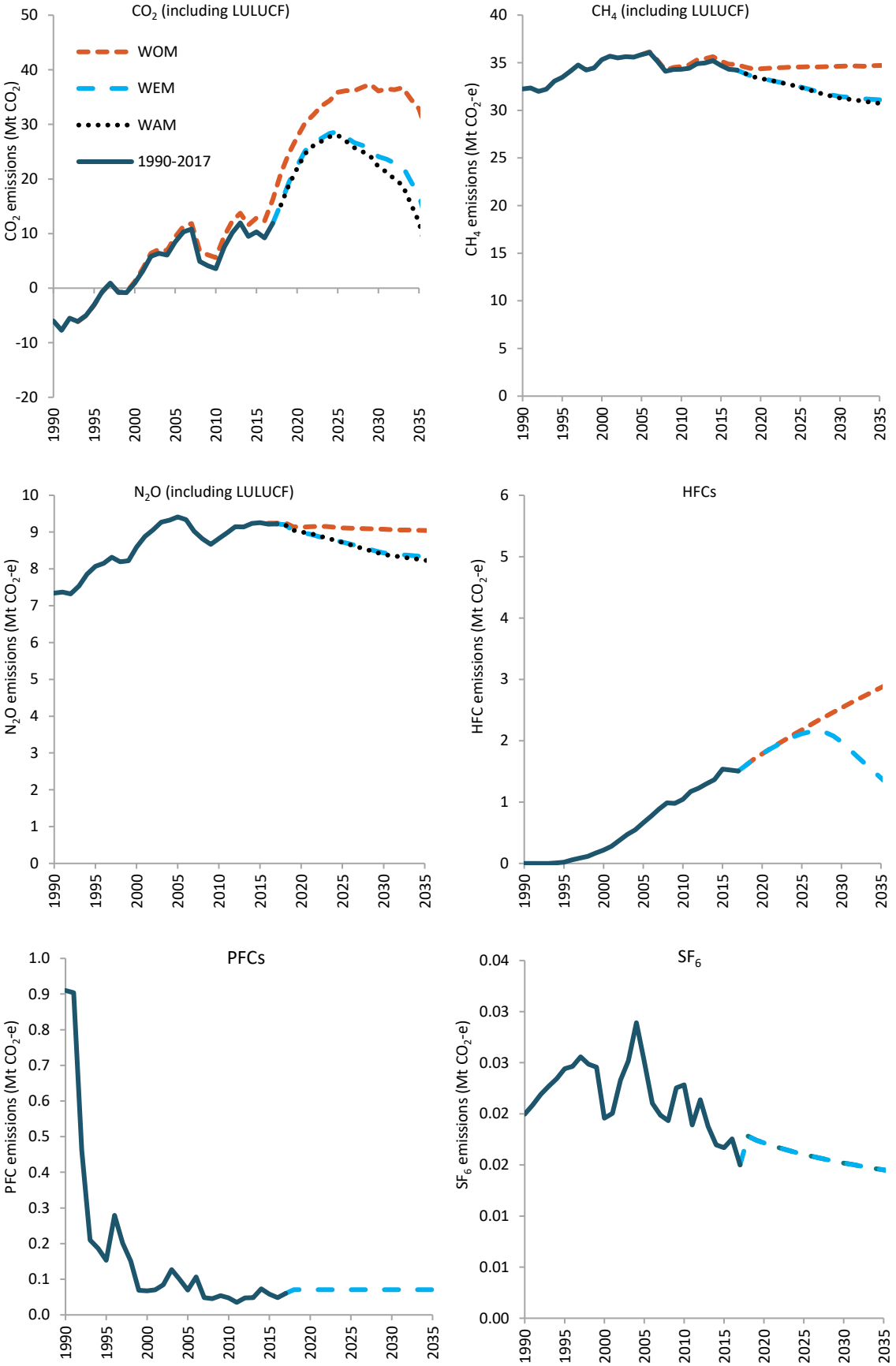
Note: CH_4 = methane; CO_2 = carbon dioxide; HFCs = hydrofluorocarbons; LULUCF = land use, land-use change and forestry; Mt CO_2-e = million tonnes of carbon dioxide equivalent; NF_3 = nitrogen trifluoride; NO = not occurring; N_2O = nitrous oxide; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride; 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: y-axis varies in scale between sectors; IPPU = industrial processes and product use; LULUCF = land use, land-use change and forestry; Mt CO_2-e = million tonnes of carbon dioxide equivalent; WEM = with existing measures; WOM = without measures; WAM = with additional measures.

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 CO_2-e); CH_4 = methane; CO_2 = carbon dioxide; HFCs = hydrofluorocarbons; LULUCF = land use, land-use change and forestry; N_2O = nitrous oxide; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride; WAM = with additional measures; WEM = with existing measures; WOM = without measures.

High- and low-emissions scenario analysis

To understand the potential uncertainty of projected emissions under the WEM scenario, a set of high- and low-emissions scenarios was estimated. These assess the sensitivity of total emission projections to carbon price, population and GDP, alongside other sector-specific considerations.

In summary, the low-emissions scenario assumes:

- the carbon price rises linearly to $37.50 by 2030, then to $40.63 by 2035 ($50 in 2035 for energy and transport)
- population increase is at the low end (10th percentile) of the range projected by Statistics New Zealand
- low GDP growth (0.7 per cent labour productivity growth).

The high-emissions scenario assumes:

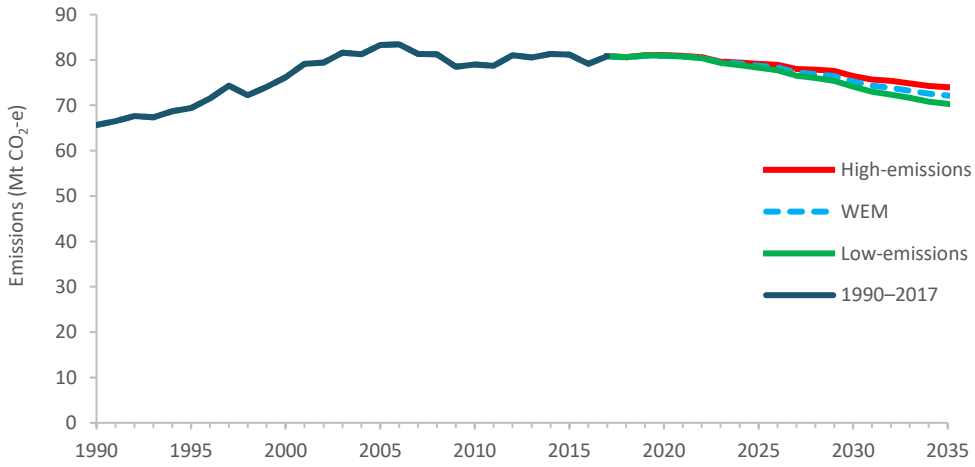
- the carbon price remains at $25 between now and 2035. The carbon price for energy and transport rises from $25 in 2030 to $32 in 2035
- population increase is at the high end (90th percentile) of the range projected by Statistics New Zealand.
- high GDP growth (1.5 per cent labour productivity growth).

Note, the results from the high- and low-emissions scenarios do not account for technological developments and/or new policies and measures, and that the projections for the waste sector and Tokelau in these scenarios are the same as the WEM scenario. For more information on these scenarios, see Key assumptions and variablessectoral information and CTF table 5 in appendix B.1.

Under a low-emissions scenario, emissions are 2.5 per cent lower than 2035 emissions in the WEM scenario (figure 4.5 and table 4.5). Under the high-emissions scenario, emissions are 2.5 per cent higher.

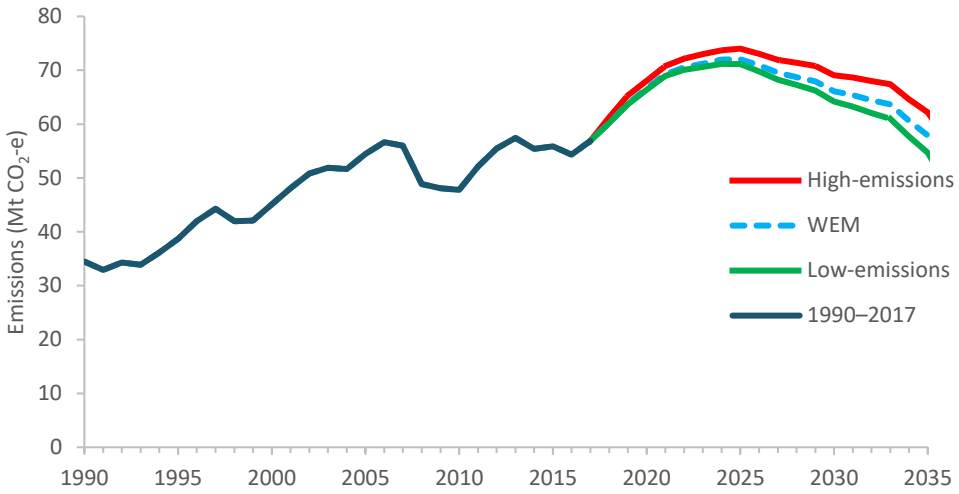
When including LULUCF, emissions under the low-emissions scenario are 5.5 per cent lower than 2035 emissions in the WEM scenario; meanwhile, emissions are 7.4 per cent higher under the high-emissions scenario (figure 4.6).

Figure 4.5: High- and low-emissions scenarios of New Zealand's greenhouse gas emissions (excluding LULUCF) for the 'with existing measures' (WEM) scenario, 1990–2035 (Mt CO_2-e)



Note: High- and low-emissions scenarios were not prepared for Tokelau or the waste sector. LULUCF = land use, land-use change and forestry; Mt CO_2-e = million tonnes of carbon dioxide equivalent.

Figure 4.6: High- and low-emissions scenarios of New Zealand's greenhouse gas emissions (including LULUCF) for the 'with existing measures' (WEM) scenario, 1990–2035 (Mt CO_2-e)



Note: High- and low-emissions scenarios were not prepared for Tokelau or the waste sector. LULUCF = land use, land-use change and forestry; Mt CO_2-e = million tonnes of carbon dioxide equivalent.

Table 4.5: Projected emissions under 'with existing measures', high- and low-emissions scenarios, 1990–2035 (Mt CO_2-e)

Scenario	1990	2017	2020	2025	2030	2035	Change from WEM in 2035 (%)
Emissions (excluding LULUCF)							
High-emissions	65.7	80.9	81.1	79.1	76.4	74.0	2.5
WEM	65.7	80.9	80.9	78.7	75.3	72.2	0
Low-emissions	65.7	80.9	81.0	78.3	74.1	70.3	–2.5
Emissions (including LULUCF)							
High-emissions	34.5	56.9	68.1	74.0	69.1	62.2	7.4
WEM	34.5	56.9	66.6	72.0	66.1	57.9	0
Low-emissions	34.5	56.9	66.4	71.1	64.2	54.7	–5.5

Note: Mt CO_2-e = million tonnes of carbon dioxide equivalent; LULUCF = land use, land-use change and forestry; WEM = with existing measures.

Assessment of the total effect of policies and measures

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 4.6 by policy and measure, table 4.7 by sector and table 4.8 by gas. Where a policy or measure is not in place, the notation NA (not applicable) is used. Where a policy or measure is in place but not quantified, the notation NE (not estimated) is used. For 2020, the total effect of currently implemented and adopted policies and measures excluding LULUCF is estimated to be a reduction of 1.9 Mt CO_2-e (annual reduction, not cumulative). When LULUCF is included, the total effect in 2020 is estimated to be 6.4 Mt CO_2-e. In 2035, the total effect of

currently implemented and adopted policies and measures is estimated to be 7.4 Mt CO_2-e (21.7 Mt CO_2-e including LULUCF).

The combination of government forestry initiatives and the NZ ETS is projected to make an important contribution to increasing net removals in the future. Without the inclusion of government forestry-related policies and measures, projected net LULUCF removals would be around 37 per cent lower in total over the 2018–35 period.

The NZ ETS is estimated to have the greatest effect on net emissions in 2020 and 2035. Under current policies and measures, the contribution is estimated to be –2.9 Mt CO_2-e in 2020 and –12.7 Mt CO_2-e in 2030. Table 4.6 details the estimated impact of the current policies and measures that have been quantified.

Table 4.6: Total effect of currently implemented and adopted policies and measures, 1990–2035 (kt CO_2-e)

	Historical							Projected			
Policy or measure	1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
New Zealand Emissions Trading Scheme	NA	NA	NA	NA	703	513	1,976	2,935	5,641	9,640	12,719
Kigali Amendment to the Montreal Protocol	NA	NA	NA	NA	NA	NA	NA	2	63	550	1,478
One Billion Trees Programme	NA	NA	NA	NA	NA	NA	NA	41	574	1,316	1,433
National Environmental Standard for Air Quality (landfill methane)	NA	NA	NA	NA	293	450	533	687	877	1,040	1,173
Erosion Control Funding Programme	NA	–48	285	919	1,065	1,288	1,410	1,493	12	575	1,091
National Policy Statement for Freshwater Management	NA	NA	NA	NA	NA	NA	NA	9	196	440	786
Afforestation Grant Scheme	NA	NA	NA	NA	-58	235	407	467	701	712	759
Crown Forestry Joint Ventures	NA	NA	NA	NA	NA	NA	NA	–120	422	634	702
Sustainable Land Management Hill Country Erosion Programme	NA	NA	NA	NA	72	172	210	244	487	639	633
Productive and Low Emissions Business Programme	NA	NA	NA	NA	NA	10	79	211	368	391	411
Efficient Products Programme	NA	NA	NA	18	74	155	184	240	215	234	301
Permanent Forest Sink Initiative	NA	NA	NA	NA	174	189	190	187	176	165	144
Waste Disposal Levy	NA	NA	NA	NA	NA	4	5	7	10	12	14

Policy or measure	Historical							Projected			
	1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
Insulation and heating grants programmes	NA	NA	NA	NA	2	8	8	8	8	8	9
Indirect effects of combined agricultural (forestry land-use) policies on waste	NA	NA	NA	NA	NA	NA	NA	0	2	4	4
Tokelau Renewable Energy Project	NA	NA	NA	NA	NA	1	1	1	1	1	1
Total	**NA**	**–48**	**285**	**937**	**2,324**	**3,024**	**5,003**	**6,413**	**9,753**	**16,362**	**21,659**

Note: kt CO_2-e = kilotonnes of carbon dioxide equivalent; NA = not applicable. Estimates attempt to exclude the possibility of double counting. Afforestation and removals estimates are only assigned to the initiative or scheme that was attributed to the forest establishment. 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 4.7: Total effect of current policies and measures by sector, 1990–2035 (kt CO_2-e)

Sector	Historical							Projected			
	1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
Energy	NA	NA	NA	18	76	173	271	796	1,212	1,274	1,542
Transport	NA	NA	NA	NA	NE	NE	NE	NE	NE	NE	NE
IPPU	NA	NA	NA	NA	NA	NE	NE	2	63	550	1,478
Agriculture	NA	NA	NA	NA	NA	NA	63	451	1,621	2,786	3,157
LULUCF	NA	–48	285	919	1,955	2,396	4,130	4,468	5,966	10,695	14,290
Waste	NA	NA	NA	NA	293	454	539	694	889	1,056	1,191
Tokelau	NA	NA	NA	NA	NA	1	1	1	1	1	1
Total	**NA**	**–48**	**285**	**937**	**2,324**	**3,024**	**5,003**	**6,413**	**9,753**	**16,362**	**21,659**

Note: kt CO_2-e = kilotonnes of carbon dioxide equivalent; IPPU = industrial processes and product use; 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 CO_2-e)

Gas	Historical							Projected			
	1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
CO_2	NA	–48	285	937	2,031	2,570	4,401	5,262	7,207	12,010	15,865
CH_4	NA	NA	NA	NA	293	454	583	1,006	2,104	3,161	3,597
N_2O	NA	NA	NA	NA	NA	NE	18	142	379	640	718
HFCs	NA	NA	NA	NA	NA	NE	NE	3	63	550	1,479
PFCs	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE	NE
SF_6	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE	NE
Total	**NA**	**–48**	**285**	**937**	**2,324**	**3,024**	**5,003**	**6,413**	**9,753**	**16,362**	**21,659**

Note: kt CO_2-e = kilotonnes of carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; HFCs = hydrofluorocarbons; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride; 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.

Total effect of additional policies and measures

The quantified effect of additional policies and measures, calculated based on the difference between WEM and WAM scenarios emissions and removals, is presented in table 4.9 by policy and measure, table 4.10 by sector and table 4.11 by gas. For 2020, the total effect of additional policies and measures including LULUCF is estimated to be a reduction of 0.5 Mt CO_2-e (annual reduction, not cumulative). In 2035, the total effect of additional policies and measures is estimated to reduce emissions by 5.3 Mt CO_2-e (1.0 Mt CO_2-e excluding LULUCF).

Table 4.9: Total effect of additional policies and measures, 1990–2035 (kt CO_2-e)

Policy or measure	1990	2017	2020	2025	2030	2035
New Zealand Emissions Trading Scheme with a carbon price of $62.5 in 2035	NA	NA	465	548	1,963	5,173
Price on agricultural emissions with 95% free allocation	NA	NA	NA	14	95	174
Total	**NA**	**NA**	**465**	**562**	**2,058**	**5,347**

Note: kt CO_2-e = kilotonnes of carbon dioxide equivalent. Agriculture is yet to be introduced to the NZ ETS and will receive 95 per cent free allocation on entry; NA = not applicable.

Table 4.10: Total effect of additional policies and measures by sector, 1990–2035 (kt CO_2-e)

Sector	1990	2017	2020	2025	2030	2035
Energy	NA	NA	–7	145	370	591
Transport	NA	NA	NE	NE	NE	NE
IPPU	NA	NA	NE	NE	NE	NE
Agriculture	NA	NA	1	41	194	425
LULUCF	NA	NA	471	507	1,494	4,332
Waste	NA	NA	NE	NE	NE	NE
Total	**NA**	**NA**	**465**	**693**	**2,058**	**5,347**

Note: kt CO_2-e = kilotonnes of carbon dioxide equivalent; IPPU = industrial processes and product use; 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 4.11: Total effect of additional policies and measures by gas, 1990–2035 (kt CO_2-e)

Gas	1990	2017	2020	2025	2030	2035
CO_2	NA	NA	465	648	1,857	4,902
CH_4	NA	NA	12	35	158	353
N_2O	NA	NA	–12	10	43	93
HFCs	NA	NA	NE	NE	NE	NE
PFCs	NA	NA	NE	NE	NE	NE
SF_6	NA	NA	NE	NE	NE	NE
Total	**NA**	**NA**	**465**	**693**	**2,058**	**5,347**

Note: kt CO_2-e = kilotonnes of carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; HFCs = hydrofluorocarbons; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride; NA = not applicable; NE = not estimated.

Differences from the *Third Biennial Report*

Table 4.12 summarises the differences in greenhouse gas emissions projections between this report and *New Zealand's Third Biennial Report Under the United Nations Framework Convention on Climate Change*[57] (*Third Biennial Report*), which was based on projections produced in 2017. The main differences between the two projections include: additional implemented and adopted polices; re-estimations of the impact of policies; the inclusion of a 'with additional measures' scenario, uncertainty analysis scenarios and emissions projections for Tokelau; and revised carbon price, population growth and economic growth assumptions.

Since the *Third Biennial Report*, the assumed 2020 carbon price has been revised up to $25 (27.7 per cent increase) to reflect current NZ ETS market prices, while the 2030 carbon price is 20 per cent higher than assumed in the *Third Biennial Report*. Projections of population and GDP have also been revised up, increasing from the *Third Biennial Report* by 0.4 per cent and 6.1 per cent respectively in 2020, and 0.9 per cent and 9.3 per cent in 2030 (see table 4.12).

Table 4.12: Revision of assumptions since New Zealand's *Third Biennial Report*

	Third Biennial Report			Fourth Biennial Report			Change (%)		
Variable	2020	2025	2030	2020	2025	2030	2020	2025	2030
Population (millions)	4.98	5.25	5.47	5.00	5.29	5.52	0.4	0.8	0.9
GDP (real 2009/10 NZ$ billion)	246.8	271.3	296.3	261.9	294.2	323.9	6.1	8.4	9.3
Exchange rate (NZ$/US$)	0.65	0.66	0.66	0.65	0.65	0.65	0.0	–1.5	–1.5
Effective carbon price (real 2017 $NZ per tonne CO_2-e)	19.57	22.58	25.00	25.00	26.88	30.00	27.7	19.0	20.0

Note: CO_2-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 I.

The net effect of these changes is to increase projected 2020 WEM gross emissions by 1.0 Mt CO_2-e (1.2 per cent) since the *Third Biennial Report*, as shown in table 4.13. The projected increase in gross emissions is mainly due to increased emissions projections for energy (0.9 Mt, 5.4 per cent). Net emissions are also projected to be 2.3 Mt CO_2-e (3.6 per cent) higher than previously forecast.

In 2030, gross emissions are projected to be 2.0 Mt (–2.6 per cent) lower than reported in the *Third Biennial Report*. This reduction is primarily due to reduced emissions from agriculture (–2.3 Mt CO_2-e, –6.0 per cent) and IPPU (–0.6 Mt CO_2-e, –10 per cent). Net emissions are projected to be 7.1 Mt CO_2-e (–9.7 per cent) lower than previously forecast.

[57] Ministry for the Environment. 2017. *New Zealand's Third Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/Final%20-Third%20Biennial%20Report.pdf (10 September 2019).

Table 4.13: Comparison of WEM projections (including LULUCF) with *Third Biennial Report* (Mt CO_2-e)

Gas	Projected emissions 2020				Projected emissions 2030			
	BR3	BR4	Absolute change	Change (%)	BR3	BR4	Absolute change	Change (%)
CO_2	19.6	22.4	2.8	14	28.0	24.1	–3.9	–14
CH_4	34.2	33.4	–0.9	–3	34.0	31.5	–2.5	–7
N_2O	8.5	9.0	0.5	6	8.5	8.4	0.0	0
HFCs	1.9	1.8	–0.1	–7	2.7	2.0	–0.7	–26
PFCs	0.02	0.07	0.05	196	0.01	0.07	0.06	481
SF_6	0.02	0.02	–0.01	–24	0.02	0.02	–0.01	–33
Sector								
Agriculture	37.9	37.8	0.0	–0.1	37.7	35.5	–2.3	–6.0
Energy	16.4	17.3	0.9	5.4	14.3	15.3	1.0	7.0
IPPU	5.5	5.3	–0.2	–2.9	6.2	5.6	–0.6	–10.0
Transport	16.2	16.4	0.2	1.3	15.0	14.9	–0.1	–0.4
Waste	4.0	4.1	0.1	1.9	4.0	4.0	0.0	–0.6
LULUCF	–15.7	–14.3	1.4	8.8	–4.0	–9.2	–5.2	–127.4
Total gross emissions	**80.0**	**80.9**	**1.0**	**1.2**	**77.2**	**75.3**	**–2.0**	**–2.6**
Total net emissions	**64.3**	**66.6**	**2.3**	**3.6**	**73.2**	**66.1**	**–7.1**	**–9.7**

Note: Mt CO_2-e = million tonnes of carbon dioxide equivalent; BR3 = Third Biennial Report; BR4 = Fourth Biennial Report; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; HFCs = hydrofluorocarbons; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride; IPPU = industrial processes and product use; LULUCF = land use, land-use change and forestry. 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. Numbers may not add to totals due to rounding to one decimal place.

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

Cross-sectoral overview

The methodologies applied to calculate 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 4.14 and discussed in the following sections.

Table 4.14: Overview of models and approaches used to project New Zealand's greenhouse gas emissions from different sectors

Sector	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_2O	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 carbon prices and other policies and measures outside of the electricity sector. Limited representation of potential mitigation technologies.	Accounts for anticipated changes in production levels across industries. Does not account for changes in energy demand for land use activities.
Industrial processes and product use (IPPU)	CO_2, CH_4, N_2O, 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_2O	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)		Bottom-up modelling approach, based on actual and projected activity data to determine the impact of polices and measures.	Projection of LULUCF greenhouse gas emissions and removals.	Model allows for scenario building. Activity data and emissions factors either based on *New Zealand's Greenhouse Gas Inventory 1990–2017*[58] or expert external research and analysis.	

[58] Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

Sector	Gases	Type and characteristics of approach or model	Original purpose of approach or model	Strengths and weaknesses	Accounting of overlaps and synergies
Waste		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 emissions factors.	Policies and measures are assumed to target distinct sources of greenhouse gases.
Tokelau	CO_2, CH_4, N_2O, HFCs	Top-down 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_2O	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: CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; HFCs = hydrofluorocarbons; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride; NZ ETS = New Zealand Emissions Trading Scheme; NA = not applicable.

Energy

From 2017, emissions from the energy sector are anticipated to be steady in the short term before declining. Emissions are projected to decrease from 17.3 Mt CO_2-e in 2020 to 14.1 Mt CO_2-e in 2035 (table 4.15).

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 (MW)) in 2023
- Whirinaki Diesel Peaker (155 MW) in 2024
- Huntly Coal Power station (400 MW) 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 4.15: Historical and projected energy sector emissions by gas and subsector under the 'with existing measures' scenario, 1990–2035 (Mt CO_2-e)

	Historical							Projected			
Gas	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020**	**2025**	**2030**	**2035**
CO_2	13.9	13.8	16.3	19.5	16.6	16.6	16.0	16.3	15.6	14.3	13.0
CH_4	0.99	0.92	1.16	0.96	1.26	0.93	0.86	0.85	0.92	0.94	0.97
N_2O	0.09	0.10	0.11	0.14	0.11	0.11	0.11	0.11	0.12	0.11	0.11
Total	**15.0**	**14.8**	**17.5**	**20.6**	**18.0**	**17.6**	**16.9**	**17.3**	**16.6**	**15.3**	**14.1**

Notes: Mt CO_2-e = million tonnes of carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = 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. 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. However, GEM considers large-scale generation that is connected to the grid. GEM requires fuel prices and electricity demand projections from SADEM as inputs.

Differences from the *Third Biennial Report*

Methods, emission factors and activity data have improved since the *Third Biennial Report*.[59]

Electricity intensity in the residential sector is a measure of electricity used per capita. In relation to the *Third Biennial Report*, we have made a substantial change to our methodology and judgement on the projected trend of electricity intensity of the residential sector. In the *Third Biennial Report*, we assumed that electricity intensity would revert to the average of the last decade. In this *Fourth Biennial Report* (BR4), we assume a negative historical trend will continue, with a rate of decline in electricity intensity of around 0.8 per cent per annum 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 BR4, we 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 hour (TWh) of energy is switched from the combustion of fossil fuels to electricity in 2035.

The growing use of distributed solar generation is expected to be one of the major electricity sector trends over the next few decades. As at January 2019, there were 22,000 small-scale (less than 10 kilowatt (kW) capacity) solar panel installations, of which 21,000 installations were residential. The total capacity of those installations was 80 MW, with an average of

[59] Ministry for the Environment. 2017. *New Zealand's Third Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/Final%20-Third%20Biennial%20Report.pdf (10 September 2019).

3.6 kW. The number of installations has grown at around 4,000 per annum in each of the past four years. The outlook for solar installations is positive. We assume that solar installations will grow slowly, reaching 119,000 installations by 2035.

Due to improvements in modelling processes, as well as changes in input assumptions and exogenous forecasts, the base forecast emissions series have changed from the *Third Biennial Report*. Notable differences in outputs are:

- methane emissions have dropped by about 25 per cent to 35 per cent from the *Third Biennial Report*, largely driven by the methane emissions from coal mining
- in the *Third Biennial Report* the projected methane emissions were carrying forward a historical average taken over a period of time when coal mining activity and emissions were much higher than they have been over the past few years; for this report, forecast emissions associated with this activity have dropped significantly, because the historical period averaged over is more recent (2013–17).

For more information, see the *Electricity Demand and Generation Scenarios: Scenario and Results Summary*.[60]

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.

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 the price of oil and carbon and GDP is not included).

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 'with existing measures' scenario) is estimated. The results from these scenarios are displayed in table 4.16 and figure 4.7.

Under a low-emissions scenario, emissions are 8.1 per cent lower than 2035 emissions in the WEM scenario. Under the high-emissions scenario, emissions are 5.9 per cent higher.

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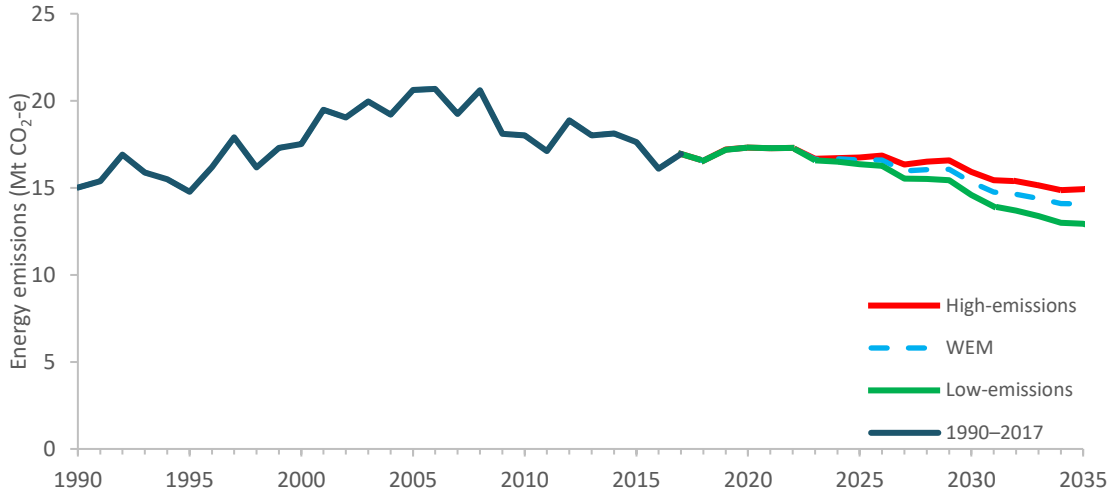
60 Ministry of Business Employment and Innovation. 2019. *Electricity Demand and Generation Scenarios: Scenario and Results Summary*. Wellington: Ministry of Business Employment and Innovation. Retrieved from www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-modelling/electricity-demand-and-generation-scenar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

Figure 4.7: Projected energy emissions under 'with existing measures', high- and low-emissions scenarios (Mt CO_2-e)



Note: Mt CO_2-e = million tonnes of carbon dioxide equivalent; WEM = with existing measures.

Table 4.16: Projected energy emissions under 'with existing measures', high- and low-emissions scenarios, 1990–2035 (Mt CO_2-e)

Scenario	1990	2017	2020	2025	2030	2035	Change from WEM in 2035 (%)
High-emissions			17.3	16.7	15.9	14.9	5.9
WEM	15.0	16.9	17.3	16.6	15.3	14.1	0
Low-emissions			17.3	16.4	14.6	12.9	–8.1

Note: Mt CO_2-e = million tonnes of carbon dioxide equivalent; WEM = with existing measures.

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 16.4 Mt CO_2-e in 2020, 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 14.1 Mt CO_2-e.

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 4.17: Historical and projected transport sector emissions by gas and subsector under the 'with existing measures' scenario, 1990–2035 (Mt CO_2-e)

	Historical							Projected			
Gas	1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
CO_2	8.6	10.7	12.2	13.7	14.0	14.6	15.8	16.3	15.6	14.8	14.0
CH_4	0.08	0.07	0.06	0.05	0.03	0.03	0.02	0.02	0.02	0.02	0.02
N_2O	0.11	0.15	0.18	0.20	0.17	0.14	0.12	0.12	0.11	0.11	0.10
Total	**8.8**	**11.0**	**12.4**	**13.9**	**14.2**	**14.8**	**15.9**	**16.4**	**15.8**	**14.9**	**14.1**

Note: Mt CO_2-e = million tonnes of carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide.

Methodology

The transport sector also incorporates the improvements that were made to the energy projections outlined above. Road transport projections were informed by the latest road transport statistics and vehicle efficiency trends.

EVs have recently gained more attention because many car manufacturers have brought new and improved models to the market, or have announced plans for future models. This change has been reflected in a sharp increase in our EV assumptions for BR4 compared with the *Third Biennial Report*.[61] We assume that EVs comprise 12 per cent of the light vehicle fleet and 3.7 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*.[62]

Sensitivity analysis for transport emissions

The sensitivity of transport emissions to a faster rate of uptake of EVs was modelled by using the fleet data from the Ministry of Transport's *Transport Outlook: Future State*[63] base case scenario. In this analysis, 26 per cent of light vehicles are electric by 2035. To ensure comparability of results, the same models were used as for the other scenarios. The results show a reduction in emissions of 1.4 Mt CO_2-e in 2035, or 11 per cent, compared with the WEM scenario (figure 4.8 and table 4.18). In the short term, the additional demand for electricity can be met by increasing wind-generation capacity. Increasing wind generation could have indirect spill-over effects, reducing stationary energy emissions by 0.2 Mt CO_2-e in 2025. However, as the proportion of wind power increases, the intermittent nature of wind power means other plants, such as geothermal and gas peakers, will be required to meet the additional demand. For more details, see page 28 of *Electricity Demand and Generation Scenarios Scenario and Results Summary*.[64]

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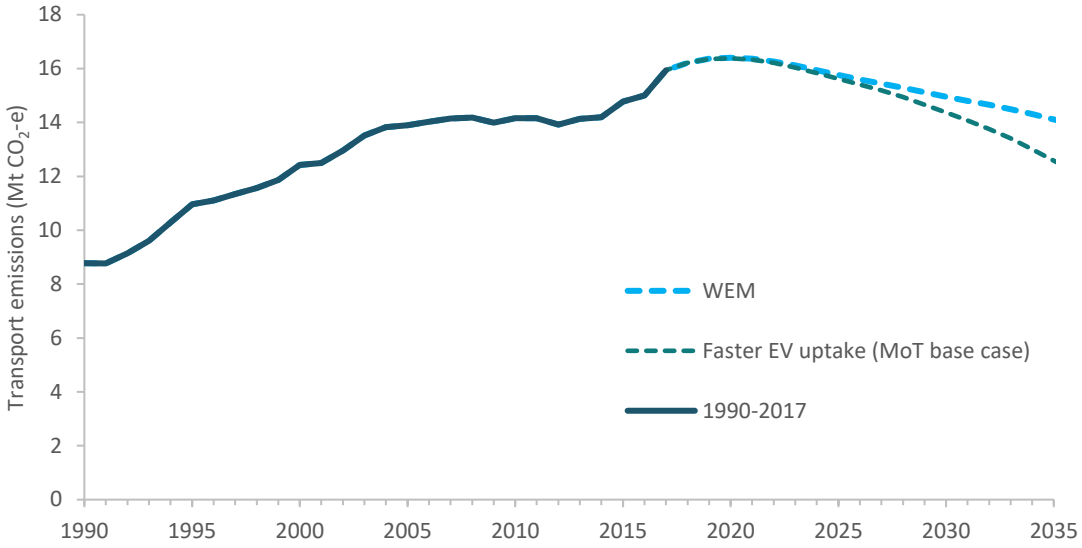
61 Ministry for the Environment. 2017. *New Zealand's Third Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/Final%20-Third%20Biennial%20Report.pdf (10 September 2019).

62 Ministry of Business Employment and Innovation. 2019. *Electricity Demand and Generation Scenarios: Scenario and Results Summary*. Wellington: Ministry of Business Employment and Innovation. 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).

63 Ministry of Transport. 2019. *Transport Outlook: Future State – A starting discussion on the future of transport in New Zealand*. Wellington: Ministry of Transport. Retrieved from www.transport.govt.nz/assets/Uploads/Research/Documents/b41c266676/GOTO-Future-State-A4.pdf (1 November 2019).

64 Ministry of Business Employment and Innovation. 2019. *Electricity Demand and Generation Scenarios: Scenario and Results Summary*. Wellington: Ministry of Business Employment and Innovation. 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).

Figure 4.8: Transport sensitivity analysis – 'with existing measures' scenario with projections using the Ministry of Transport's base case electric vehicle uptake, 1990–2035



Note: Mt CO_2-e = million tonnes of carbon dioxide equivalent; WEM = with existing measures; EV = electric vehicle; MoT = Ministry of Transport.

Table 4.18: Sensitivity of transport emission projections to electric vehicle uptake assumptions, 2017–35 (Mt CO_2-e)

Sensitivity	2017	2020	2025	2030	2035	Change from WEM in 2035 (%)
WEM	15.7	16.4	15.8	14.9	14.1	0
Ministry of Transport's base case with faster EV uptake	15.7	16.4	15.6	14.4	12.6	–10.8
Indirect effects of faster EV uptake on energy sector[65]	0.0	–0.1	–0.2	0.0	+0.1	NA

Note: EV = electric vehicle; NA = not applicable; WEM = with existing measures.

Emissions projections for fuel sold to ships and aircraft engaged in international transport

Emissions from fuel used in international air and sea transport are reported separately and are not included in the historical or projected national totals of transport emissions. These are emissions from bunker fuels sold in New Zealand for the purpose of international transport[66] and are presented in figure 4.9 and table 4.19 and table 4.20.

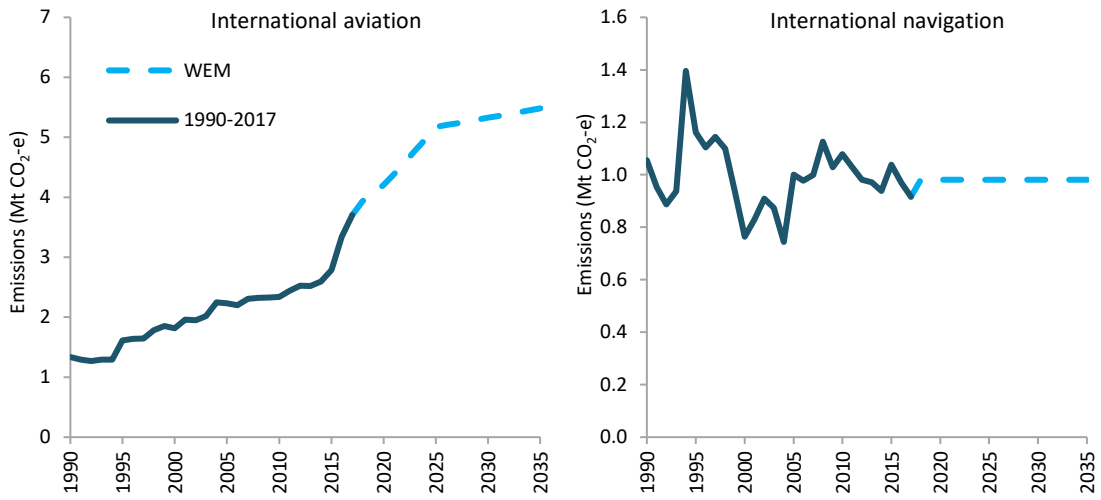
Greenhouse gas emissions from international transport are assumed to be the same under the WEM, WOM and WAM scenarios. Emissions from international aviation are projected to continue to increase out to 2025, in line with the growth of international passenger

65 Negative values represent further emissions reductions in the energy sector associated with faster EV uptake, while positive values represent additional emissions in the energy sector associated with increased EV uptake.

66 As of 2019, Tokelau does not have facilities for the sale of bunker fuels to visiting ships or aircraft engaged in international transport.

movements. The rate of emissions growth is projected to slow from 2025 due to improved efficiencies of aircraft and slower growth in passenger movements. The emissions from international navigation are projected to remain constant, as forecast increases in shipping volumes are offset by improved efficiencies.

Figure 4.9: Historical and projected emissions for international air and international sea transport, 1990–2035



Note: Mt CO_2-e = million tonnes of carbon dioxide equivalent; WEM = with existing measures.

Table 4.19: Historical and projected emissions from international air transport, 1990–2035 (kt CO_2-e)[67]

	Historical							Projected			
Gas	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020**	**2025**	**2030**	**2035**
CO_2	1,322	1,602	1,800	2,211	2,318	2,766	3,672	4,172	5,128	5,281	5,434
CH_4	0.23	0.28	0.31	0.38	0.40	0.48	0.64	0.73	0.89	0.92	0.95
N_2O	11.0	13.3	14.9	18.3	19.1	22.8	30.5	34.6	42.5	43.8	45.1
Total	**1,333**	**1,615**	**1,815**	**2,230**	**2,337**	**2,789**	**3,703**	**4,208**	**5,172**	**5,326**	**5,480**

Note: kt CO_2-e = kilotonnes of carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide.

Table 4.20: Historical and projected emissions from international sea transport, 1990–2035 (kt CO_2-e)[67]

	Historical							Projected			
Gas	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020**	**2025**	**2030**	**2035**
CO_2	1,042	1,147	755	990	1,067	1,027	906	971	971	971	971
CH_4	2.0	2.2	1.6	2.1	2.3	2.2	1.9	2.1	2.1	2.1	2.1
N_2O	11.4	12.2	7.0	8.7	9.0	8.8	8.0	8.4	8.4	8.4	8.4
Total	**1,056**	**1,161**	**764**	**1,001**	**1,078**	**1,038**	**916**	**981**	**981**	**981**	**981**

[67] Columns may not total due to rounding.

Note: kt CO_2-e = kilotonnes of carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide.

Industrial processes and product use

From 2017, emissions for the industrial processes and product use (IPPU) sector are projected to rise in the short term, peaking at 5.7 Mt CO_2-e in 2026. They are then projected to steadily decrease, reaching 5.0 Mt CO_2-e in 2035 as presented below in table 4.21.

Hydrofluorocarbon emissions are expected to increase until 2027. Carbon dioxide emissions are also anticipated to increase through to 2035, primarily due to projected increases in cement and lime production. The emissions of all other gases are assumed to remain at steady levels, or decrease over the same period, in line with historical trends.

In New Zealand, carbon dioxide and methane 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 from 2018 to 2035. All methanol production facilities are anticipated to be closed by 2035.

The non-carbon-dioxide-based components of IPPU include emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) used in electricity transmission and distribution, and methane (CH_4) from the production of methanol, as well as nitrous oxide (N_2O) emissions from the application and use of medical products. Emissions of nitrogen trifluoride (NF_3) 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.

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

The use of hydrofluorocarbons has grown rapidly since the early 1990s when they replaced chlorofluorocarbons, which are being phased out under the Montreal Protocol. The Kigali Amendment to the Montreal Protocol[68] is expected to reduce hydrofluorocarbon emissions in line with the proposed phase down of hydrofluorocarbon consumption. Note that New Zealand's ratification of the Kigali Amendment does not extend to Tokelau.[69]

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68 Ministry for the Environment. (n.d). *Kigali Amendment to the Montreal Protocol*. Retrieved from www.mfe.govt.nz/more/international-agreements-kigali-amendment.

69 United Nations. 3 October 2019. 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).

Table 4.21: Historical and projected IPPU emissions by gas under the 'with existing measures' scenario, 1990–2035 (kt CO_2-e)

	Historical							Projected			
Gas	1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
CO_2	2,520	2,814	2,922	3,209	3,319	3,509	3,214	3,265	3,344	3,415	3,483
CH_4	28	79	139	20	48	107	112	125	98	40	0
N_2O	102	79	61	45	53	60	62	64	58	44	29
HFCs	0	21	216	662	1,046	1,537	1,505	1,784	2,113	1,983	1,388
PFCs	910	153	68	69	48	59	60	71	71	71	71
SF_6	20	24	20	25	23	17	15	17	16	15	15
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total	**3,580**	**3,171**	**3,426**	**4,029**	**4,536**	**5,288**	**4,969**	**5,326**	**5,699**	**5,568**	**4,986**

Note: IPPU = industrial processes and product use; kt CO_2-e = kilotonnes of carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; HFCs = hydrofluorocarbons; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride; NF_3 = nitrogen trifluoride; NO = not occurring.

Methodology

The modelling takes a top-down approach to preparing the WEM projection. Several improvements have been made to the model, including quantifying the impact of the Kigali Amendment phase down for hydrofluorocarbons. This is subtracted from the WOM scenario, to provide an accurate estimate of the WEM scenario. Other improvements include changes to reflect the latest activity data and revised projections of activity data.

The carbon dioxide and methane emissions are also now estimated at the category level, as provided in *New Zealand's Greenhouse Gas Inventory 1990–2017*.[70] This is done by projecting activity data or, where appropriate, holding emissions constant where facilities are at production capacity. The methanol production facilities Waitara, Motinui 1 and Motinui 2 plants are assumed to close in 2023, 2027 and 2033 respectively.

Projected emissions of the fluorinated gases (perfluorocarbons, hydrofluorocarbons and sulphur hexafluoride) and nitrous oxide were modelled from forecast activity informed by historical trends and relationships to population and economic growth.

The impact of the Kigali Amendment phase down on consumption of hydrofluorocarbons is assumed to have a 10-year delay, based on the average product lifespan and leakage rates.[71] The mitigation impact is anticipated to have effect, albeit small, from 2020 when it is implemented, increasing out to 2030 from which point the phase-down steps for consumption take full effect.

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70 Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

71 Appendix B, table 7. Ministry for the Environment. 2017. *Hydrofluorocarbon Consumption in New Zealand*. Prepared for the Ministry for the Environment by ExpertGroup. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/hfc-consumption-in-nz.pdf.

Strengths and weaknesses of models or approach

Projections for non-carbon dioxide IPPU gases are prepared on the basis of historical trends by gas. This avoids the high sensitivity that may otherwise arise from the activity of individual firms. It also simplifies the approach used to quantify the estimated emissions mitigation impact of the Kigali Amendment. However, this approach does not account for gas switching that may occur within the basket of hydrofluorocarbons and/or measures adopted by individual firms to reduce their consumption of fluorinated gases.

The mitigation impact of emissions pricing under the NZ ETS is not quantified for IPPU. 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.

Projected activity data and the anticipated closures of large emitting facilities (ie, methanol production) are aligned with the energy sector during the preparation of projections for carbon dioxide and methane emissions.

Stockpiling of bulk imported fluorinated gases is suspected to have occurred from 2009 to 2013, before the January 2013 introduction of fluorinated gases into the NZ ETS and in response to increasing NZ ETS prices in 2017/18. This is likely to distort year-to-year importation and consumption data that is used to inform historical and projected IPPU emissions.

Projected PFC and SF_6 greenhouse gas emissions are unchanged in the WOM and WAM scenarios relative to the WEM scenario (table 4.4, figure 4.4). This is due to insufficient information about the historical and future impact of carbon price of the emission of these gases.

Differences from the *Third Biennial Report*

Due to improvements in modelling processes, as well as changes in input assumptions, the base forecast emissions have changed from the *Third Biennial Report*. Notable differences in the IPPU projection for 2030 are:

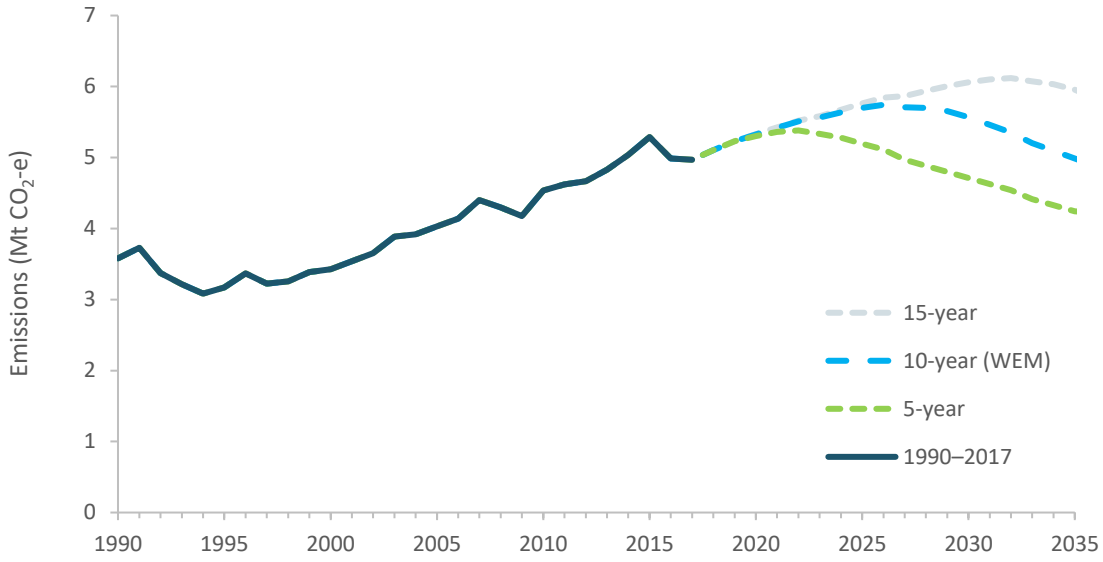
- hydrofluorocarbon emissions have dropped by 26 per cent largely due to the anticipated impact of the Kigali Amendment
- perfluorocarbon emissions have increased by 481 per cent (59 kt CO_2-e) due to the projection methodology now being based on the historical average for 1998–2017
- sulphur hexafluoride emissions have decreased by 33 per cent (8 kt CO_2-e) due to revisions to the modelling
- methane emissions have decreased by 11 per cent due to revised input assumptions.

Sensitivity analysis for IPPU emissions

A sensitivity analysis estimated the effect of both a short and long residence time of hydrofluorocarbons between consumption (ie, importation in line with the Kigali Amendment) and emission. The analysis modelled a 5- and 15-year residence time of hydrofluorocarbons in comparison to the 10-year residence time used for the base scenario. The results of this analysis are presented in figure 4.10 and table 4.22.

The effects of low and high demand for cement, lime, other process uses of carbonates and non-energy products from fuels and solvent use were also modelled. These are based on the combined impact of strong population and economic growth under a high-demand scenario, and a scenario where there is weak population and economic growth called low demand. Other major industrial emitters are assumed to be fixed. In both cases, the response of IPPU emissions was minor.

Figure 4.10: Sensitivity of IPPU emissions to the assumed residence time (5, 10 and 15 years) for hydrofluorocarbons between consumption and emission



Note: IPPU = industrial processes and product use; Mt CO_2-e = million tonnes of carbon dioxide equivalent; WEM = with existing measures.

Table 4.22: Sensitivity of IPPU emissions projections to the assumed residence time of hydrofluorocarbons and high- and low-emissions scenarios (kt CO_2-e)

Sensitivity	1990	2017	2020	2025	2030	2035	Change from WEM in 2035 (%)
5-year residence			5,303	5,040	4,627	4,212	–15.5
WEM scenario (10-year)	3,580	4,969	5,326	5,699	5,568	4,986	0
15-year residence			5,329	5,761	6,060	5,955	19.4
Low-emissions			5,324	5,673	5,553	4,970	–0.3
High-emissions			5,325	5,731	5,621	5,073	1.7

Note: IPPU = industrial processes and product use; kt CO_2-e = kilotonnes of carbon dioxide equivalent; WEM = with existing measures.

The analysis suggests that IPPU emissions are sensitive to the assumed residence time of hydrofluorocarbons. Relative to the WEM scenario, IPPU emissions are 15.5 per cent lower under the 5-year residence scenario and 19.4 per cent higher under the 15-year residence scenario.

IPPU emissions were relatively unresponsive to the high- and low-demand scenarios. Relative to the WEM scenario, IPPU emissions are 1.7 per cent higher under the high-emissions scenario, and less than 1 per cent lower under the low-emissions scenario.

Agriculture

In 2035, greenhouse gas emissions from agriculture are projected to be 35.0 Mt CO_2-e (2.3 per cent above 1990 levels, 12.1 per cent below 2005 levels, and 9.9 per cent below 2017 levels). Table 4.23 presents actual and projected emissions for the agriculture sector.

Agricultural emissions in New Zealand are projected to fall between 2017 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 One Billion Trees Programme and changes to the NZ ETS)
- changes in farm management practices due to improving environmental outcomes and the implementation of the National Policy Statement for Freshwater Management (NPS-FM)
- 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 12.4 per cent and per-lamb carcass weights will increase by 8.8 per cent).

Table 4.23: Historical and projected agriculture sector emissions by gas under the 'with existing measures' scenario, 1990–2035 (Mt CO_2-e)

	Historical							Projected			
Gas	1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
CO_2	0.4	0.7	0.9	1.2	1.1	1.1	1.0	1.0	1.0	1.0	1.0
CH_4	27.1	28.0	29.3	30.0	28.5	29.5	29.2	28.4	27.5	26.6	26.2
N_2O	6.9	7.5	8.0	8.6	8.0	8.6	8.6	8.3	8.0	8.0	7.7
Total	**34.3**	**36.1**	**38.1**	**39.9**	**37.7**	**39.3**	**38.9**	**37.8**	**36.7**	**35.5**	**35.0**

Note: Mt CO_2-e = million tonnes of carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = 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 1990–2017*,[72] sometimes referred to as New Zealand's National Inventory Report (NIR).

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.

[72] Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

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 4.24 summarises the changes in emissions, animal numbers, and production that are projected between 2017 and 2035. In the dairy sector, emissions are projected to decrease by 5.4 per cent, while total milk production is projected to decrease by 1.4 per cent. Sheep emissions are projected to fall by 15.7 per cent by 2035, while total sheep *meat* production is expected to fall by 14.4 per cent over the same period.

Table 4.24: Projected change in emissions, production and animal numbers between 2017 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**
2017	18,199	6,563	10,288
2035	17,215	5,588	8,673
Change 2017–35 (%)	–5.4	–14.8	–15.7
Projected change in total production			
	Total dairy milk production (million litres)	**Total beef meat production (million kg)[1]**	**Total sheep meat production (million kg)[2]**
2017	20,700	416.95	474.65
2035	20,420	378.73	406.19
Change 2017–35 (%)	–1.4	–9.2	–14.4
Projected change in animal numbers (thousands)			
	Dairy cattle	**Beef cattle**	**Sheep**
2017	6,529.8	3,616.1	27,526.5
2035	5,887.2	3,053.9	22,355.8
Change 2017–35 (%)	–9.8	–15.5	–18.8

Note: 1. includes meat from adult beef cattle, heifers, steers and bulls; 2. includes mutton and lamb; kg = kilogram; kt CO_2 e = kilotonnes of carbon dioxide equivalent.

Differences from the *Third Biennial Report*

The differences between the projected emissions and removals in the *Third Biennial Report*[73] and BR4 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 NPS-FM and the effects of forestry policies and schemes on agricultural land use. Some of the more significant changes are summarised below, and more detailed explanations on methodological

[73] Ministry for the Environment. 2017. *New Zealand's Third Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/Final%20-Third%20Biennial%20Report.pdf (10 September 2019).

and emissions factor changes are contained in New Zealand's greenhouse gas inventories from 2018 and 2019.[74]

Changes in methodologies and emissions factors

The following changes to New Zealand's agriculture inventory were implemented after the publication of the *Third Biennial Report*:[75]

- a correction of the methodology used to calculate nitrogen retained in wool from sheep
- minor corrections to the equations for monthly population changes for sheep and deer
- an improvement to the crop-burning area methodology
- updated activity data on the proportion of dairy excreta entering anaerobic lagoons
- an improvement of the methodology and equations used to estimate the proportion of nitrogen excreta partitioned between dung and urine
- a correction to the equations used to estimate metabolisable energy requirements for dairy cattle, non-dairy cattle, sheep and deer.

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. 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, it is now 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 is expected that this measure will act to reduce animal numbers and production.

The new projections also account for the expected indirect effects of government schemes and policies (such as the One Billion Trees Programme and the NZ ETS) that encourage the use of agricultural land for forestry. The WEM projections do *not* assume that agricultural emissions will be priced (ie, that agricultural producers will have to pay for the agricultural emissions generated from farming activity).

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74 Ministry for the Environment. 2018. *New Zealand's Greenhouse Gas Inventory 1990–2016*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/National%20GHG%20Inventory%20Report%201990-2016-final.pdf; Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

75 Ministry for the Environment. 2017. *New Zealand's Third Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/Final%20-Third%20Biennial%20Report.pdf (10 September 2019).

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 between agriculture and LULUCF are based on consistent assumptions.

In contrast, 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 16 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. Historically, the carbon price in the NZ ETS has never exceeded $25 due to the use of a $25 fixed price cap, so any estimates of the effect of the price rising above $25 have to be based on modelling rather than empirical data.

There are also uncertainties over the expected effects of the NPS-FM, and the extent to which this policy will affect animal numbers and fertiliser use.

Sensitivity analysis for agriculture emissions

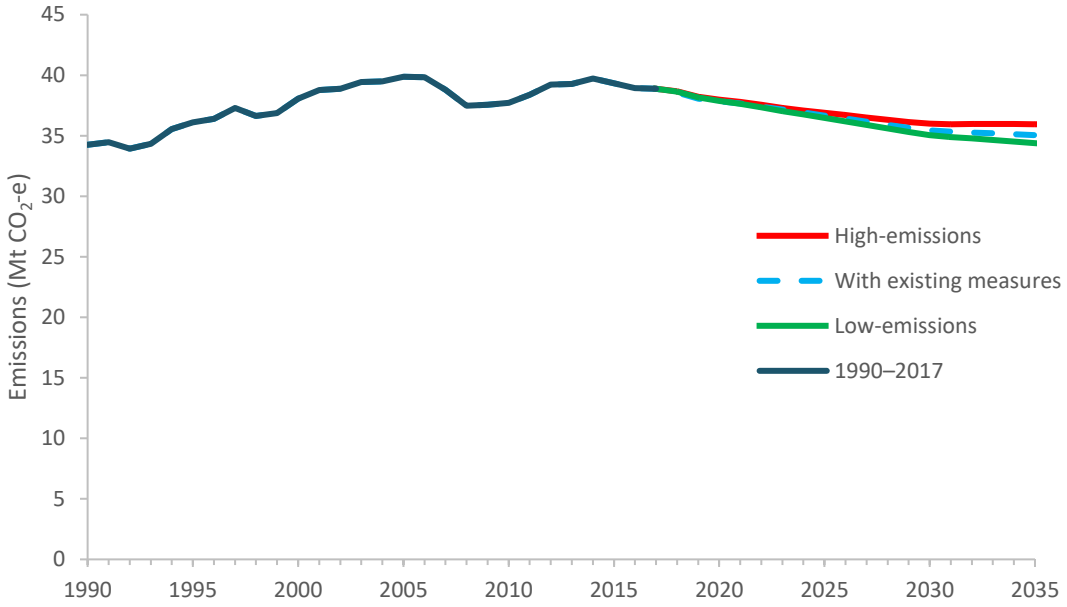
To understand the potential uncertainty range of projected emissions from agriculture, a set of high- and low-emissions scenarios (relative to the 'with existing measures' scenario) was estimated. The scenario results are displayed in table 4.25 and figure 4.11.

Table 4.25: Projected emissions from agriculture, under 'with existing measures', high- and low-emissions scenarios, 1990–2035 (Mt CO_2-e)

Scenario	1990	2017	2020	2025	2030	2035	Change from WEM in 2035 (%)
Low-emissions			37.9	36.5	35.1	34.4	–1.7
WEM	34.3	38.9	37.8	36.7	35.5	35.0	0
High-emissions			38.0	36.9	36.0	36.0	2.9

Note: Mt CO_2-e = million tonnes of carbon dioxide equivalent; WEM = with existing measures.

Figure 4.11: Projected agriculture emissions under 'with existing measures', high- and low-emissions scenarios (Mt CO_2-e)



Note: Mt CO_2-e = million tonnes of carbon dioxide equivalent.

By 2035, emissions under the high-emissions scenario are 2.6 per cent higher than 2035 emissions in the WEM scenario, and emissions under the low-emissions scenario are 1.9 per cent lower.

In the low-emissions scenario:

- productivity gains for dairy, sheep, beef and deer are higher than that forecast under the WEM scenario
- the higher carbon price means that, relative to the WEM scenario, there is a greater incentive to convert pastoral land to forestry.

In the high-emissions scenario:

- productivity gains for dairy, sheep, beef and deer are lower than that forecast under the WEM scenario
- the lower carbon price means that, relative to the WEM scenario, there is a smaller incentive to convert pastoral land to forestry

More details on the productivity assumptions used for this scenario are provided in appendix B.2.

Effect of carbon price on projected emissions

The scenario modelling for agriculture included a sensitivity analysis on the effect of different carbon prices under the current NZ ETS settings. In these scenarios, a higher carbon price will encourage afforestation and discourage deforestation, reducing the amount of land available for livestock farming, leading to reduced agricultural emissions. The following scenarios were analysed:

- the carbon price falls to $0 immediately and remains at this level after 2035. This is equivalent to a hypothetical situation where the NZ ETS is repealed with no replacement legislation

- the carbon price remains at $25 between now and 2035 as used for the high-emissions scenario
- the carbon price rises linearly to $30 by 2030, then rises to $31.88 by 2035. This price level was also used for the WEM scenario
- the carbon price rises linearly to $37.50 by 2030, then rises to $40.63 by 2035 as used for the low-emissions scenario
- the carbon price rises linearly to $50 by 2030, then rises to $62.50 by 2035. This price level was also used for the WAM scenario.

The scenarios assume that agricultural emissions are not priced.

To obtain these projections, the effects of the price changes on forested land area were modelled as part of the LULUCF projections, then used as a set of exogenous inputs modelled by the PSRM.

The results show that agricultural emissions are relatively unresponsive to changes in carbon prices. Relative to the WEM scenario, agriculture emissions are 2.2 per cent higher under the '$0 price' scenario and 0.7 per cent lower under the '$62.50 price' scenario (table 4.26).

Table 4.26: Actual and forecast agricultural emissions under different 2035 carbon price scenarios (kt CO_2-e)

	2035 carbon price				
Year	**$0**	**$25**	**$31.88**	**$40.63**	**$62.50**
1990	34,257				
2017	38,881				
2020	37,848	37,843	37,839	37,842	37,838
2025	36,861	36,672	36,665	36,642	36,638
2030	35,897	35,485	35,456	35,398	35,358
2035	35,833	35,143	35,047	34,896	34,797
2035 difference compared to 'with existing measures' ($31.88) scenario	2.2%	0.3%	0.0%	–0.4%	–0.7%
Absolute change					
1990–2035	1,576	886	790	639	539
2017–35	–3,047	–3,737	–3,833	–3,985	–4,084
Percentage change					
1990–2035	4.6%	2.6%	2.3%	1.9%	1.6%
2017–35	–7.8%	–9.6%	–9.9%	–10.2%	–10.5%

Note: kt CO_2-e = kilotonnes of carbon dioxide equivalent.

Land use, land-use change and forestry

In 2017, New Zealand's land use, land-use change and forestry (LULUCF)[76, 77] sector comprised around 7.8 million hectares of pre-1990 natural forest,[78] and just over 2.1 million hectares of planted forest.[79] Projected LULUCF emissions and removals are significantly influenced by New Zealand's planted forest age-class profile. New Zealand has undergone three periods of significant afforestation;[80] 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 –31.2 Mt CO_2-e net removals, compared with –24.0 Mt CO_2-e in 2017 under UNFCCC reporting rules. The reason for the decline in removals over the 1990 to 2017 period is mainly due to increased harvesting of New Zealand's sustainable plantation forests and an increase in deforestation compared with 1990 levels. See *New Zealand's Greenhouse Gas Inventory 1990–2017* for a more detailed explanation of the change.[81]

Net removals by New Zealand's LULUCF sector are projected to continue to decline in the 2020s under UNFCCC reporting rules 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 from around 2025 due to the replanting of forests harvested in the early 2020s and the additional sequestration from projected afforestation activities.

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76 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 the 2006 IPCC Guidelines. 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.

77 IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Prepared by the National Greenhouse Gas Inventories Programme for the IPCC. Japan: IPCC. Retrieved from www.ipcc-nggip.iges.or.jp/public/2006gl/.

78 Pre-1990 natural forest is the term used in New Zealand's greenhouse gas inventories, and is used to distinguish New Zealand's native and unplanted (self-sown or naturally regenerated) forests that existed before 1990 from pre-1990 planted and post-1989 forests. The land use includes both mature forest and areas of regenerating vegetation that have the potential to return to forest under the management regime that existed in 1990.

79 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 section 6.4, Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

80 Section 6.4. Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

81 Section 6.1. Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

Table 4.27: Historical and projected LULUCF emissions and removals by gas under the 'with existing measures' scenario, 1990–2035 (Mt CO_2-e)

	Historical							Projected			
Gas	1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
CO_2	–31.4	–31.1	–31.4	–29.1	–31.5	–25.5	–24.2	–14.5	–6.9	–9.4	–14.5
CH_4	0.10	0.10	0.08	0.11	0.11	0.08	0.09	0.09	0.10	0.10	0.10
N_2O	0.21	0.23	0.24	0.22	0.19	0.15	0.11	0.12	0.12	0.12	0.12
Total	**–31.2**	**–30.7**	**–31.1**	**–28.8**	**–31.2**	**–25.3**	**–24.0**	**–14.3**	**–6.7**	**–9.2**	**–14.3**

Note: Removals are expressed as negatives (–) and represent net carbon dioxide (CO_2-e) removed from the atmosphere, while emissions are expressed as positives (+) and represent net CO_2-e emissions to the atmosphere; LULUCF = land use, land-use change and forestry; Mt CO_2-e = million tonnes of carbon dioxide equivalent; CH_4 = methane; N_2O = nitrous oxide.

Methodology

Projected emissions and removals from the LULUCF sector are calculated using methodologies consistent with the 2019 greenhouse gas inventory[82] and previous biennial reports, with activity data and emission factors used in the greenhouse gas inventory comprising the historical time series (1990–2017) 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, deforestation, harvesting, pre-1990 natural forest sequestration, harvested wood products, and carbon prices from 2019 to 2035. 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

Activity data and sequestration rates for New Zealand's pre-1990 natural forest from *New Zealand's Greenhouse Gas Inventory 1990–2017*[83]are used for the historical time series 1990–2017. Pre-1990 natural forest projections from 2018 to 2035 are based on research

82 Projections of carbon stock changes have been developed for forest land, grassland and harvested wood products categories only. In New Zealand, the forest land, grassland and harvested wood products categories accounted for most net emissions in the sector (table 6.1.1 in the *Greenhouse Gas Inventory 1990–2017*). Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

83 Section 6.4.3. Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

completed by Scion in 2019.[84] These recent report findings estimated that the regenerating component of the pre-1990 natural forest estate is lower than previously estimated[85] and is now estimated to sequester on average 0.62 tonnes of carbon per hectare per year (tC/ha/yr). When applied to the area of New Zealand's regenerating pre-1990 natural forest (around 1.205 million hectares in 2017), this equates to sequestration rates of around 2,700 kt CO_2 per year over the 2018 to 2035 projection period. The uncertainty in the report's estimate has been applied to the lower (0.38 tC/ha/yr) and upper (0.87 tC/ha/yr) removal scenarios to represent sensitivity in measurement, sampling and model uncertainty.

Pre-1990 planted forest and sustainable forest harvesting

New Zealand's Greenhouse Gas Inventory 1990–2017[86] activity data and emissions factors, combined with projections of harvesting and replanting, are used to determine pre-1990 planted forest emissions and removals from 2018 to 2035. Projections of pre-1990 planted forest harvest are sourced from research and analysis completed by Scion in 2015.[87] Almost all forest harvesting in New Zealand (99.3 per cent) occurs in planted production forests.[88] Planted forest harvesting area, age and emissions from 1990 to 2017 are sourced from *New Zealand's Greenhouse Gas Inventory 1990–2017*. Projections are modelled from historical forest plantings, and assume a target rotation length of around 28 to 30 years.

Afforestation

Historical post-1989 forest activity data and emissions factors are sourced from *New Zealand's Greenhouse Gas Inventory 1990–2017*.[89] Estimated actual post-1989 planted forest age class data from *New Zealand's Greenhouse Gas Inventory 1990–2017* are then combined with projected afforestation scenarios from 2018 (modelled using a forest growth simulation method[90]) to estimate emissions and removals out to 2035. The projected afforestation scenarios factor in government forestry initiatives and commercial planting, afforestation sensitivity analysis based on wood product returns, carbon prices, relative land use

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84 Paul T, Kimberley M, Beets P. 2019. *Carbon stocks and change in New Zealand's natural forests: Estimates from the two complete inventory cycles 2002–07 and 2007–14*. Prepared for the Ministry for the Environment by Scion. Wellington: Ministry for the Environment.

85 Estimated as 1.39 tC/ha/yr. Equating to 6.1 Mt CO_2 per year. Holdaway R, Carswell F, Kimberley M. 2015. *Projections of New Zealand's Natural Forest Estate Final Report*. Prepared for the Ministry for Primary Industries by Landcare Research and Scion. Wellington: Ministry for the Environment.

86 Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

87 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.

88 Consistent with the 2019 *Greenhouse Gas Inventory* (section 6.4) any harvesting that occurs in natural forests is captured within the natural forest carbon stock and stock change estimates. Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

89 Sections 6.4 and 11.3. Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

90 The forest growth simulation model tracks the area planted, harvested and deforested through time and generates annual estimates of carbon stock and change by multiplying the area at a given age by the carbon yields per hectare.

economics, land costs and availability, and were completed by the University of Canterbury for the Ministry for Primary Industries.[91]

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 this period can be found in *New Zealand's Greenhouse Gas Inventory 1990–2017*.[92]

Deforestation

Historical planted and natural forest deforestation activity data and emissions factors are sourced from *New Zealand's Greenhouse Gas Inventory 1990–2017*. Projections of planted production forest deforestation is sourced from the Deforestation Intentions Survey Report.[93] With most of New Zealand's planted forestry estate privately owned, the three deforestation scenarios reflect the impact of land-use economics, carbon emission unit price, and central and local government policies. Projections of pre-1990 natural forest deforestation are based on historical trends.[94] The average over the past five years is assumed to be a valid estimate for the WEM projection scenario, while the lower and upper removal projection scenarios assume a 50 per cent variance that captures variation in recent years.

Biomass burning emissions

Biomass burning projections are based on historical trends in wildfire and controlled burning, and include non-carbon-dioxide emissions from both forest and grassland. Biomass burning is not a significant source of emissions for New Zealand, because the practice of controlled burning is limited, and wildfires are not common due to New Zealand's temperate climate and vegetation.[95]

Effect of policies and measures in the LULUCF sector

The WOM projection excludes the estimated actual and projected effects of the NZ ETS and government forestry initiatives on net LULUCF removals. The methods in determining the carbon impact of each policy are briefly described below.

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91 Manley B. 2019. *Impacts of carbon prices on forest management*. Prepared for the Ministry for Primary Industries by Professor B Manley. Wellington: Ministry for Primary Industries. Retrieved from www.teururakau.govt.nz/dmsdocument/37113/direct.

92 Section 6.10. Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

93 Manley B. 2018. *Deforestation Intentions Survey 2018: Final Report*. Prepared for the Ministry for Primary Industries by Professor B Manley. Wellington: Ministry for Primary Industries. Retrieved from www.mpi.govt.nz/dmsdocument/37110/direct.

94 Table 6.1.6, *New Zealand's Greenhouse Gas Inventory 1990–2017*.

95 For more information, see section 6.11.5, *New Zealand's Greenhouse Gas Inventory 1990–2017*.

New Zealand Emissions Trading Scheme

The NZ ETS estimates in table 4.6 and table 4.9 are a combination of 'additional' afforestation and 'reduced' deforestation that could be attributed to the NZ ETS. The impact the NZ ETS has had on afforestation and deforestation varied between 2008 and 2017 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 any 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.[96] 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 actual 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 is used to estimate the impact of the NZ ETS carbon price on afforestation rates in New Zealand.[97] 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 to actual afforestation rates and carbon prices from 2008 to 2017, and with measures projections from 2018 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 (PFSI), Sustainable Land Management Hill Country Erosion Programme, Erosion Control Funding Programme and the One Billion Trees Programme. See chapter III for further details of these government-funded forestry initiatives. The estimated impact of the various government forestry initiatives is provided in table 4.6 and CTF table 3. Net removal estimates are based on methodologies in *New Zealand's Greenhouse Gas Inventory 1990–2017*,[98] and simulate forest growth using actual forest area, age and species data.

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96 Manley B. 2018. *Deforestation Intentions Survey 2018: Final Report*. Prepared for the Ministry for Primary Industries by Professor B Manley. Wellington: Ministry for Primary Industries. Retrieved from www.mpi.govt.nz/dmsdocument/37110/direct.

97 Manley B. 2019. *Impacts of carbon prices on forest management*. Prepared for the Ministry for Primary Industries by Professor B Manley. Wellington: Ministry for Primary Industries. Retrieved from www.teururakau.govt.nz/dmsdocument/37113/direct.

98 Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

Differences from the *Third Biennial Report*

The differences between LULUCF projections in the BR4, *New Zealand's Seventh National Communication*[99] and the *Third Biennial Report*[100] are mainly due to a combination of new government forestry initiatives, revised carbon price projections, NZ ETS forest accounting changes, and revised estimates of pre-1990 natural forest emission factors. The main contributing factors are summarised below.

The One Billion Trees Programme[101] was launched on 30 November 2018, and is distributed through either a direct landowner or partnerships grant. These two grants are estimated to result in around 14.1 Mt CO_2-e additional removals between 2019 and 2035. For more information, see chapter III.

NZ ETS forest carbon accounting changes announced in March 2019 are projected to increase the economic incentive to plant forests. The introduction of NZ ETS forest averaging accounting means participants no longer need to surrender NZUs upon harvesting. Rather, participants will receive NZUs as their forest grows, up to a determined average level that represents the long-term carbon storage of that forest. This simplified approach to carbon accounting is expected to reduce the scheme's complexity and encourage more landowners to plant trees and join the NZ ETS. See chapter III, for more information.

The *Third Biennial Report* assumed 'with measures' carbon prices from 2016 to 2030 of around $25 per NZU. However, the 'with measures' carbon price assumed in the BR4 was around $25 per NZU up until 2022, then gradually increases to $31.88 by 2035. The 'upper' LULUCF removals scenario assumes carbon prices of around $40.63 per NZU by 2035, while the 'lower' removal scenario assumes $25 per NZU by 2035. The impact of these carbon prices changes the level of afforestation and deforestation over the projection period. For further information on the impact of carbon price on afforestation, refer to *Impacts of carbon prices on forest management*.[102]

Revised pre-1990 natural forest emission factors have resulted in lower removals over the projection period. The amount of removals projected per year is around 3.4 Mt CO_2-e lower than the *Third Biennial Report*, as a result of the improvement to the pre-1990 natural forest emissions factor.[103] LULUCF inventory data has continuously improved, with revised afforestation, deforestation and harvesting area data and emission factors from 1990 to 2017, and updated estimated actual afforestation, deforestation and harvesting activity data in 2018 and 2019.

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99 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 www.mfe.govt.nz/sites/default/files/media/Climate%20Change/21-12-17%20Web%20FINAL%20-%20Seventh%20National%20Communication%202017.pdf.

100 Ministry for the Environment. 2017. *New Zealand's Third Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/Final%20-Third%20Biennial%20Report.pdf (10 September 2019).

101 Beehive.govt.nz. 30 November 2018. *One Billion Trees Fund offers new opportunities*. Retrieved from www.beehive.govt.nz/release/one-billion-trees-fund-offers-new-opportunities.

102 Manley B. 2019. *Impacts of carbon prices on forest management*. Prepared for the Ministry for Primary Industries by Professor B Manley. Wellington: Ministry for Primary Industries. Retrieved from www.teururakau.govt.nz/dmsdocument/37113/direct.

103 The *Third Biennial Report* assumed 6.1 Mt CO_2-e removed per year versus 2.7 Mt CO_2-e removed per year projected in the *Fourth Biennial Report*.

Sensitivity analysis for LULUCF emissions

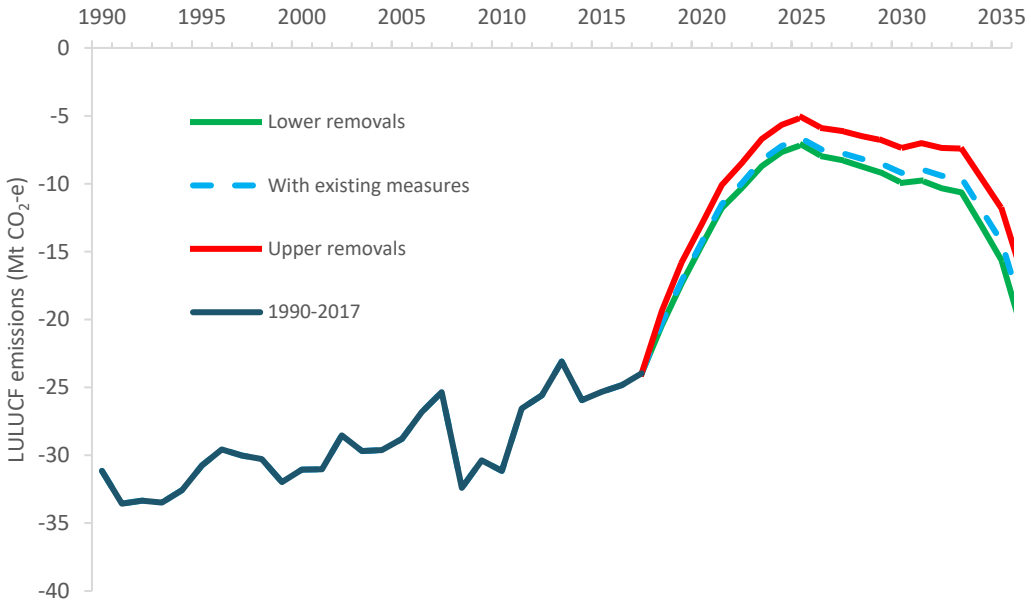
Table 4.28 provides net removals from *New Zealand's Greenhouse Gas Inventory 1990–2017*,[104] and compares LULUCF projections 'with measures' upper removals (low-emissions), base (with existing measures) and lower removals (high-emissions) scenarios.

Table 4.28: Projected net LULUCF removals under 'with existing measures', lower removals and upper removals scenarios, 1990–2035 (Mt CO_2-e)

Scenario	1990	2017	2020	2025	2030	2035	Change from WEM in 2035 (%)
Lower removals (high-emissions scenario)			–13.0	–5.1	–7.4	–11.8	17.5
With existing measures	–31.2	–24.0	–14.3	–6.7	–9.2	–14.3	0
Upper removals (low-emissions scenario)			–14.6	–7.1	–9.9	–15.6	–9.1

Note: LULUCF = land use, land-use change and forestry; Mt CO_2-e = million tonnes of carbon dioxide equivalent. Removals are expressed as negatives (–) and represent net carbon dioxide (CO_2) removed from the atmosphere, while emissions are expressed as positives (+) and represent net CO_2 emissions to the atmosphere. The upper and lower removals scenarios reflect the variability in future rates of afforestation, deforestation, harvesting, pre-1990 natural forest removals, harvested wood products and biomass burning.

Figure 4.12: Projected net LULUCF removals under 'with existing measures', lower removals and upper removals scenarios, 1990–2035 (Mt CO_2-e)



Note: LULUCF = land use, land-use change and forestry; Mt CO_2-e = million tonnes of carbon dioxide equivalent. Removals are expressed as negatives (-) and represent net CO_2 removed from the atmosphere, while emissions are expressed as positives (+) and represent net CO_2 emissions to the atmosphere. The upper and lower removals scenarios reflect the variability in future rates of afforestation, deforestation, harvesting, pre-1990 natural forest removals, harvested wood products and biomass burning.

[104] Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

Waste

From 2017, emissions from waste are projected to decrease to 4,053 kt CO_2-e by 2020 (0.3 per cent above 1990 levels, or 2 per cent below 2017 levels) and to 3,926 kt CO_2-e by 2035 (3 per cent below 1990 levels, or 5 per cent below 2017 levels). Table 4.29 and figure 4.3 present actual greenhouse gas emissions from 1990 to 2017, and projected greenhouse gas emissions from 2018 to 2035 for the waste sector.

Around 90 per cent of waste emissions are methane emissions resulting from disposal of solid waste to land during 1990 to 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 also the waste sector as a whole peaked around 2002. Landfill gas capture is projected to increase, offsetting projected increases in waste volumes, which results in a slightly decreasing trend to 2035.

The remaining 10 per cent of emissions in the waste sector are composed of several gases from the following sources in decreasing order of size: domestic wastewater, industrial wastewater, composting, and incineration and open burning. Carbon dioxide emissions from small amounts of incineration and open burning remain at steady levels from 2018 to 2035, whereas methane 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.

Table 4.29: Historical and projected greenhouse gas emissions from waste by gas, under a 'with existing measures' scenario, 1990–2035 (kt CO_2-e)

	Historical							Projected			
Gas	1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
CO_2	17	16	15	7	4	4	4	4	4	4	4
CH_4	3,938	4,282	4,624	4,722	4,413	4,054	3,992	3,916	3,855	3,809	3,774
N_2O	87	95	103	104	109	122	129	132	139	144	148
Total	**4,042**	**4,392**	**4,742**	**4,834**	**4,526**	**4,179**	**4,125**	**4,053**	**3,998**	**3,956**	**3,926**

Notes: kt CO_2-e = kilotonnes of carbon dioxide equivalent; CH_4 = methane; N_2O = nitrous oxide.

Methodology

All categories but one in the waste sector use a bottom-up approach, estimating emissions at the category level as reported in the greenhouse gas inventory. This is done by projecting activity data and applying the national greenhouse gas inventory models to estimate emissions. The one other category is unmanaged non-municipal landfills, which is projected by extrapolating the historical emissions trend.

The methods for projecting activity data have been revised for the BR4. Three 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 4.30 provides details on the methods used for projecting each category in the waste sector.

Table 4.30: Methods for projecting activity data and or emissions in the waste sector, 2018–35

Category in the waste sector	Gas(es)	Method for projecting activity data or emissions	Strengths	Weaknesses
Managed landfills	CH_4	Waste volumes are projected by analysing historical correlations with proxy variables (eg, GDP) for which projected data are available. Landfill gas recovery rates increase slightly over the time series. A variant of this model is used to measure the impact of the National Environmental Standards for Air Quality, by changing the overall landfill gas collection rate. Another variant of this model is used to measure the impact of the waste levy by changing the volume of waste. Because these two policies and measures change independent parameters, any potential overlap is avoided. The effects of a third, potentially overlapping, policy (the NZ ETS) are not estimated for the waste sector.	Considers changes in numerous statistics.	Relies on the correlations with variables remaining constant over time. Difficult to quantify sensitivity due to large number of input variables.
Unmanaged farm fills	CH_4	Linear extrapolation of farm counts, which are used to drive overall waste volumes 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	Linear extrapolation of historical emissions trend (insufficient information to project activity data).	Plausible projection based on limited data.	Unable to account for changes in industry activity.
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.
Composting	CH_4, N_2O	Constant 5% of projected managed waste volume (in addition to the managed waste volume).	Simple, consistent with the inventory.	Assumes the composting rate is constant.
Incineration	CO_2, CH_4, N_2O	Constant activity assumed since 2007.	Simple, consistent with the inventory.	Assumes the incineration rate is constant.
Open burning	CO_2, CH_4, N_2O	Constant 2% of projected farm waste volume (in addition to the farm waste volume).	Simple, consistent with the inventory.	Assumes the open burning rate is constant.
Domestic wastewater	CH_4, N_2O	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.

Category in the waste sector	Gas(es)	Method for projecting activity data or emissions	Strengths	Weaknesses
Industrial wastewater	CH_4, N_2O	The quantity of industrial wastewater is dependent on industrial production. Projected production for meat and dairy industries are based on projected industry data. The remaining industries are held constant at 2017 levels. A variant of this model is used to measure the impact of indirect agricultural policy impacts by using alternative projected industry data.	Tracks known changes in activity.	Assumes emission factors and some activity is constant.

Note: CH_4 = methane; CO_2 = carbon dioxide; GDP = gross domestic product; N_2O = 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 waste, and is most sensitive to estimated landfill gas capture rates. Table 4.31 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 BR4.

Table 4.31: 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 sensitive to landfill gas capture rates
Unmanaged farm fills	Key driver: projected farm counts Emissions are 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: NA (projected using emissions trend) Emissions are sensitive to historical emissions
Domestic wastewater	Key driver: population Emissions are sensitive to emission factors
Industrial wastewater	Key driver: industry production Emissions are sensitive to emission factors

Differences from the *Third Biennial Report*

The most significant changes to the methodologies for calculating emissions from the waste sector since the *Third Biennial Report*[105] are in the methods for projecting solid waste volumes. Solid waste volumes for managed landfills and unmanaged farm fills are now projected at the category level. Managed waste volumes are projected by analysing historical correlations with

[105] Ministry for the Environment. 2017. *New Zealand's Third Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/Final%20-Third%20Biennial%20Report.pdf (10 September 2019).

proxy variables (eg, GDP) for which projected data are available. Waste disposed in farm fills is projected based on the trend in the number of farms. Previously, these categories were projected based on the trend in the volume of waste only.

Because the waste sector projections use the same models as the *New Zealand's Greenhouse Gas Inventory 1990–2017*,[106] other improvements that have occurred in the inventory since the *Third Biennial Report* are included in the models used for projections in the BR4. The most significant of these improvements are the correction of some errors in the solid waste models and the inclusion of a second survey on farm waste. More details on these improvements can be found in chapter 10 of *New Zealand's Greenhouse Gas Inventory 1990–2016*[107] and *New Zealand's Greenhouse Gas Inventory 1990–2017*.[108]

Tokelau

This is the first biennial report to include emission projections for Tokelau. It follows emission estimates for Tokelau being included for the first time in *New Zealand's Greenhouse Gas Inventory 1990–2017*.[109]

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.

According to *New Zealand's Greenhouse Gas Inventory 1990–2017*,[110] Tokelau's total emissions decreased by 21.3 per cent (0.78 kt CO_2-e) to 2.86 CO_2-e between 1990 and 2017 (figure 4.13, table 4.32). 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 2020 total emissions are projected to be 2.89 kt CO_2-e, and in 2030, 2.97 kt CO_2-e. This is primarily due to growing energy demands and increasing use of hydrofluorocarbons as fridges and freezers become more common.

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106 Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

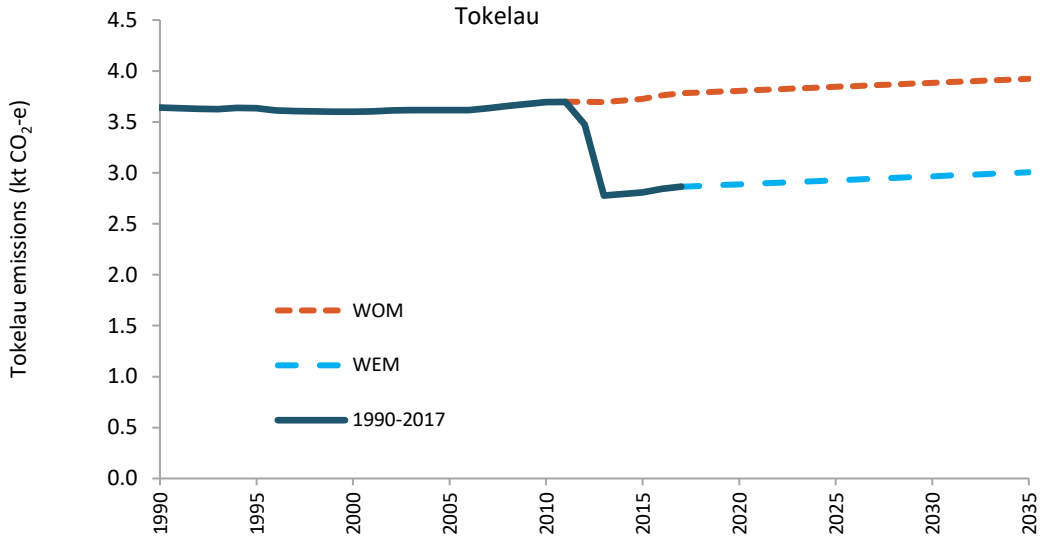
107 Ministry for the Environment. 2018. *New Zealand's Greenhouse Gas Inventory 1990–2016*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/National%20GHG%20Inventory%20Report%201990-2016-final.pdf .

108 Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

109 See chapter 8: Tokelau. Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

110 Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

Figure 4.13: Tokelau's greenhouse gas emissions for the 'with existing measures' and 'without measures' scenarios, 1990–2035



Note: kt CO_2-e = kilotonnes of carbon dioxide equivalent; WEM = with existing measures; WOM = without measures.

Table 4.32: Tokelau's gross greenhouse gas emissions by gas, 1990–2035 (kt CO_2-e)

	Historical							Projected			
Gas	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**	**2020**	**2025**	**2030**	**2035**
CO_2	2.87	2.89	2.88	2.88	2.88	1.93	1.94	1.94	1.94	1.95	1.95
CH_4	0.67	0.65	0.62	0.61	0.60	0.57	0.59	0.58	0.56	0.55	0.53
N_2O	0.10	0.08	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
HFCs	0.00	0.02	0.03	0.06	0.14	0.25	0.28	0.31	0.36	0.41	0.46
PFCs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**3.64**	**3.63**	**3.60**	**3.62**	**3.69**	**2.81**	**2.86**	**2.89**	**2.93**	**2.97**	**3.01**

Note: kt CO_2-e = kilotonnes of carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; HFCs = hydrofluorocarbons; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride; NF_3 = nitrogen trifluoride. 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 top-down approach, based on historical trends in *New Zealand's Greenhouse Gas Inventory 1990–2017*.[111] The emissions mitigation impact of Tokelau's renewable energy project was estimated on the difference in annual emissions before and after project completion.

The projections do not consider the new inter-atoll vessel that, since 2019, provides domestic transport within Tokelau. They also do not account for the expansion and replacement of renewable energy assets that are anticipated to occur in 2020. Finally, they ignore corrections and refinements to Tokelau's greenhouse gas inventory, to be reported in the 2020 Greenhouse Gas Inventory (covering the time series 1990–2018).

[111] Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

Chapter V: Provision of financial, technological and capacity-building support to developing countries

Key developments

Since the *Third Biennial Report*,[112] New Zealand has contributed approximately $259.65 million in climate-related support for developing countries. New Zealand's contribution is an increase of approximately $20.57 million compared with the previous reporting period.

In 2018 we increased our climate finance commitment from $200 million for 2015–19 to $300 million for the period 2019–22.

A significant amount of climate change activity is being delivered through sector components of the New Zealand Aid Programme, including energy, infrastructure, tourism, agriculture, coastal protection and disaster risk reduction. At least two-thirds of our climate-related support will benefit the Pacific region and at least half of this will focus on adaptation.

New Zealand has taken a number of steps to support private sector investments in renewable energy. This includes, for example, providing co-financing to the International Finance Corporation's US$50 million Risk Share Facility, which incentivises private sector investment in projects in the Pacific region through increased availability of commercial finance.
New Zealand has also supported the Asian Development Bank's Pacific Renewable Energy Program, which helps Pacific Island countries increase private sector participation in their energy sectors and achieve their renewable energy targets.

New Zealand has renewed and expanded its core funding to the International Monetary Fund's Pacific Financial Technical Assistance Centre. It is now committing $18 million over 2016–22 to help Pacific Island countries build a stronger public financial management foundation from which to apply for external climate finance.

In 2018 New Zealand announced a contribution of up to $3.5 million towards establishing a Pacific Climate Change Centre in Samoa, building on significant support from Japan. The Centre opened in September 2019 and will provide training, facilitate research and coordinate regional actions on climate change issues.

In 2018 New Zealand also announced it would commit $1.5 million to the Pacific Regional Nationally Determined Contribution (NDC) Hub in support of Pacific efforts to implement and enhance their NDCs.

New Zealand was pleased to support Fiji's COP23 Presidency in 2018. Fiji's Presidency (which marks the first time a small island developing state has held this role) highlighted the challenges of climate change for the Pacific region.

Additionally, New Zealand has undertaken a number of dedicated capacity-building and technology-transfer activities aimed at strengthening the voice of Pacific Island countries in climate change negotiations and providing support to the United Nations Framework Convention on Climate Change.

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112 Ministry for the Environment. 2017. *New Zealand's Third Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/publications/climate-change/new-zealands-third-biennial-report-under-united-nations-framework (10 September 2019).

Introduction

New Zealand remains committed to supporting climate change action in developing countries. Particular areas of focus in 2017/18[113] are the Pacific region, renewable energy, agriculture, water and sanitation, and disaster prevention and preparedness.

This chapter reports on the financial, technological and capacity-building support New Zealand provided to developing countries for climate change action in 2017/18, since the *Third Biennial Report*. It covers support provided through multilateral, regional and bilateral channels, as well as specific resources provided for mitigation, adaptation, technology transfer and capacity building.[114]

New Zealand has made high-level, multi-year climate finance commitments. In 2015, New Zealand committed to deliver up to $200 million in climate-related support for the 2015–19 period.[115] It is well on track to meet this commitment, having provided an average of $52 million per year since 2015 for bilateral support.

In 2018, New Zealand increased its commitment to $300 million for the period 2019–22, demonstrating the importance we place on supporting developing countries to reduce emissions and address the impacts of climate change. Included in this commitment is a dedicated $150 million Pacific- and adaptation-focused climate change programme.

Over 2017 and 2018, New Zealand's climate-related support focused on:

- building stronger and more resilient infrastructure
- strengthening disaster preparedness
- supporting low-carbon economic growth, including through its significant contribution to improving access to affordable, reliable and clean energy.

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

During the reporting period, New Zealand has contributed approximately $259.65 million in financial assistance for climate change outcomes across:

- multilateral climate change funds, such as the Global Environment Facility[116] (an operating entity of the Financial Mechanism of the United Nations Framework Convention on Climate Change (UNFCCC)), and for implementation of the Montreal Protocol – total funding of $10.65 million
- a range of specialised United Nations (UN) and other multilateral organisations and programmes with a strategic focus on climate change, including special funds under the UNFCCC and multilateral financial institutions – total funding of $112.59 million (see CTF table 7a)

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113 The reporting period, as referred to here and throughout this chapter, means the calendar years 2017 and 2018.

114 For clarity, this section uses the definition of capacity building from the Organisation for Economic Co-operation and Development's Development Assistance Committee.

115 All figures in this submission are expressed in New Zealand dollars unless otherwise specified.

116 All multilateral contributions represent the full 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.

- funding to Pacific regional organisations with a strategic focus on climate change – total funding of $35.08 million (see common tabular format (CTF) table 7a)
- support for bilateral climate-related assistance delivered through the New Zealand Aid Programme – total funding of $101.32 million (see CTF table 7b).

Overall, New Zealand's contribution is an increase of approximately $20.56 million compared with the previous reporting period.

We will continue to support low-emissions climate-resilient development into the future, including through our focus on renewable energy, agriculture and disaster risk reduction, as well as through:

- improving access to climate information for decision-making
- supporting greater global action to reduce emissions
- developing innovative financing tools
- improving access to finance
- improving water security in the Pacific region
- building and enhancing ecosystem resilience in the Pacific region
- helping avert, delay and prepare for climate-related human mobility.

More broadly, New Zealand remains committed to the global goal of jointly mobilising US$100 billion per year by 2020 from a variety of sources. This is in the context of meaningful mitigation actions by developing countries and for transparency on implementation.

New Zealand is committed to delivering on 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.

New and additional support

New Zealand's approach to determining how financial resources are new and additional has not changed since its *Third Biennial Report*. New Zealand's practical approach 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.

Our view remains that it is not effective to try to separate climate-related support from other official development assistance (ODA). In practical terms, any climate-related support provided over the reporting period that meets agreed ODA definitions (ie, with a strong concessional element, and a focus on economic development and the welfare of developing countries as its main objective) is included in this report. Furthermore, since climate change is a cross-cutting development issue, there are frequent co-benefits across a range of development outcomes, as is reflected in the integrated approach to climate change and development in the Pacific region.[117] New Zealand's climate-related support remains an important part of its growing aid budget. For the 2017/18 reporting period, it is estimated that approximately 21.1 per cent

[117] 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, Fiji: Pacific Community. Retrieved from http://tep-a.org/wp-content/uploads/2017/05/FRDP_2016_finalResilient_Dev_pacific.pdf.

of the ODA managed by the New Zealand Aid Programme had a climate component. This compares with 22 per cent for 2015/16.

Over time, climate-related support has followed a general upward trajectory in absolute terms, with a $20.57 million increase. We expect this growth to continue and to be bolstered by:

- the increased ODA budgets for 2018–22
- our refreshed climate finance commitment of $300 million for 2019–22
- our strengthened efforts to mainstream climate change across the aid programme.

Tracking and reporting support provided by New Zealand

New Zealand is committed to regular and transparent reporting of its climate-related support, and to finding ways to further improve the tracking of our 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.

The aid programme has policies and systems in place to track, measure and record climate-related assistance provided to developing countries. New Zealand is committed to ongoing improvements in its reporting of climate finance. In 2018 we included a Climate Change Capacity Building marker in our reporting system, to better track the support we provide.

The aid programme's Climate Change Operational Policy outlines how support for climate change is to be delivered, recorded and quantified in internal systems. The policy requires activities and programmes to be assessed for climate change risks, and opportunities explored to support adaptation to and mitigation of climate change. The aid programme uses the Rio markers of the Organisation for Economic Co-operation and Development's (OECD's) Development Assistance Committee (DAC) for tracking development assistance with climate change adaptation and mitigation outcomes.

While the DAC Rio markers capture the thematic objectives of each activity, they do not quantify expenditure towards these objectives. New Zealand has built on the DAC Rio markers to create a system to quantify the climate-related support provided by the aid programme. This system is under review, and any changes made to our approach will be operational from 2020.

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

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.

Classification	Where addressing climate change is…	Financial information recorded in the climate change inventory
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: • a more accurate figure is known • 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 aid 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%
Energy upgrading	Energy upgrading activities, where the outcome of the activity is safer access to energy supplies in the presence of extreme weather events, can potentially be marked significant.	Adaptation: Significant	30%

In this *Fourth Biennial Report*, New Zealand provides information on bilateral, regional and multilateral financial contributions as follows.

- Reporting of bilateral contributions includes funding from the aid programme for activities where addressing climate change is assessed as being the 'principal' or 'significant' outcome of the activity.
- Reporting of regional and multilateral contributions includes core funding provided to:
  - regional organisations with a strategic focus on climate change
  - multilateral agencies for whom climate change is integral to their strategic plans and approaches
  - regional organisations conducting activities in the framework of the GRA.

Except for funding to support GRA activities, core funding provided to regional and multilateral organisations is not monitored by New Zealand to the level of specific climate change allocations and actions. Some of the figures provided in CTF table 7a and CTF table 7b represent total contributions to multilateral and regional organisations that New Zealand "cannot specify as being climate-specific". This approach is in keeping with the UNFCCC Biennial Reporting Guidelines for developed country Parties.[118]

Financial resources

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

New Zealand's reporting period includes part of each of two calendar years, 2017 and 2018, and funds are reported in New Zealand dollars. The methodology used for calculating currency exchange is the annual average exchange rates, as used by the OECD. The rates used are as follows:

- 2017: USD 1 = NZD 1.407
- 2018: USD 1 = NZD 1.445

As required by Conference of Parties (COP) decision 9/CP.21, New Zealand uses the UNFCCC-agreed common tabular format from the Biennial Reporting Guidelines (FCCC/CP/2011/9/Add.1) for this report. This is to ensure transparency in reporting financial data and 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 organisation.

Multilateral support

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

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.

The reporting period falls within both the sixth (2014–18) and seventh (2018–22) replenishment periods of the GEF Trust Fund. CTF table 7a provides details of New Zealand's total contributions to the GEF Trust Fund for the 2017/18 reporting period, which amounted to

[118] UNFCCC. 2011. UNFCCC biennial reporting guidelines for developed country Parties, Annex I, Decision 2/CP.17 (pages 31–35). Retrieved from https://unfccc.int/process/transparency-and-reporting/reporting-and-review-under-the-convention/support-for-developing-countries/modalities--procedures-and-guidelines#eq-1.

$7.59 million.[119] In the seventh GEF replenishment round, New Zealand committed $8 million (equivalent to 4 million Special Drawing Rights, the required denomination for GEF contributions) spread over 2018–22, and made an additional voluntary contribution of $4 million, which we disbursed in 2018.

New Zealand's contribution seeks to recognise the GEF's considerable efforts to increase the support it provides to least developed countries (LDCs) and small island developing states (SIDS), as well as the GEF Trust Fund's responsiveness to the 2030 Agenda for Sustainable Development. We welcome the programming direction for GEF-7, which among other things doubles the target for the mitigation of greenhouse gas (GHG) emissions. We also welcome the GEF-7 Climate Change Focal Area Strategy, which is designed to complement programming by the GCF and other climate funds, based on the GEF's unique role in the global environmental finance architecture.

Green Climate Fund

The GCF is an operating entity of the UNFCCC's Financial Mechanism. The GCF was established in 2010 but only 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-emission and climate-resilient development. The GCF has committed to aim for 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 LDCs, SIDS and African States.

New Zealand's contribution to the initial resource mobilisation of the GCF was disbursed in 2015, and is captured in the *Third Biennial Report*. New Zealand will contribute $15 million to the first replenishment of the GCF (GCF-1). Disbursement of New Zealand's contribution to the first replenishment of the GCF will be outlined in our *Fifth Biennial Report* (BR5).

Other multilateral support

New Zealand continues to support 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 (see CTF table 7a). This includes, for instance, the World Bank, the Asian Development Bank and the United Nations Development Programme (UNDP).

During the reporting period, New Zealand contributed NZ$100,000 to the UNFCCC Trust Fund for Participation, to assist developing countries to participate in UNFCCC meetings.

Acknowledging the importance of adaptation for SIDS and LDCs, New Zealand welcomed the Adaptation Fund serving the Paris Agreement at COP24 in Katowice and committed to providing $3 million to the Fund. Disbursement of these funds will be included in BR5.

Montreal Protocol implementation

In 2018, we made an additional voluntary contribution of $1.5 million to the UNDP to assist with implementation of the Montreal Protocol. The Montreal Protocol will play an important role in tackling climate change, in particular through the Kigali Amendment, which New Zealand ratified in October 2019. This contribution was in addition to our annual assessed contribution.

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[119] 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.

Regional support

Through the New Zealand Aid Programme, we are a major funder of the Pacific regional organisations that have a core focus on climate change, as detailed in CTF table 7a. These organisations include:

- the Secretariat of the Pacific Regional Environment Programme (SPREP), 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
- the Forum Fisheries Agency (FFA, www.ffa.int), 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, www.spc.int), 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, www.forumsec.org), 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 funding to Pacific regional organisations contributes to programmes and projects identified in their strategic plans. However, this is core, untagged funding that goes to regional organisations (as for multilateral core contributions), and is not monitored at a level that tracks specific climate change activities. Therefore, the figures provided in CTF table 7a are total allocations to multilateral and regional agencies, rather than estimates of expenditure on specific climate change actions.

The aid programme is also supporting a range of climate change efforts in the Pacific through several regional initiatives, including the following examples.

- New Zealand is providing $3.72 million in co-financing for the International Finance Corporation's (IFC) US$50 million Risk Share Facility, which incentivises private sector investment in projects in the Pacific through increased availability of commercial finance.
- New Zealand has invested $4.52 million in the Asian Development Bank's (ADB's) Pacific Renewable Energy Program, which will help Pacific Island countries increase private sector participation in their energy sectors, and achieve their renewable energy targets. The programme provides an innovative guarantee structure, consisting of partial risk guarantee, letter of credit and technical assistance products, which directly address a number of known barriers to private sector investment in Pacific renewable energy infrastructure.
- New Zealand has committed $24 million to the World Bank's Pacific Trust Fund to support implementation of World Bank projects in the Pacific, including for climate-related projects.
- The SPREP-led New Zealand Pacific Partnership on Ocean Acidification is helping to raise awareness of and build resilience to ocean acidification in the Pacific region. New Zealand is providing $2.1 million over five years (2015–20) to help address this emerging threat, which is another result of the build-up of carbon dioxide in the atmosphere.
- In partnership with the Pacific Community, New Zealand is supporting a five-year (2014–19), $5 million project to strengthen water security in five Pacific countries with low-lying islands and atolls that are subject to drought and water shortages (Cook Islands,

Kiribati, the Republic of the Marshall Islands, Tokelau and Tuvalu). This partnership is working to improve awareness and understanding of water security issues, develop drought management plans and improve water management practices.

New Zealand recognises that accessing climate finance from multilateral climate funds is a challenge and a priority for developing countries, particularly Pacific SIDS. Through its GCF Board seat constituency, New Zealand works to ensure effective outcomes for the Pacific and other SIDS. We were pleased to see the GCF's Simplified Approval Process adopted in 2017 to streamline the approval of certain small-scale projects.

In addition, and following conversations with partners in the region about their challenges in accessing GCF funding, New Zealand continues to implement our Technical Assistance for Pacific Access (TAPA) programme. TAPA has provided technical support to develop project proposals from the Pacific. For example, the programme provided engineering assistance supporting the Republic of the Marshall Islands' US$18.6 million water security project, approved by the GCF Board in July 2019. The programme also provided readiness support to Niue and Kiribati, and continues to support SPC's and SPREP's efforts to assist Pacific countries to prepare GCF proposals. We are currently preparing a second phase of this programme.

New Zealand has renewed and expanded its core funding to the International Monetary Fund's Pacific Financial Technical Assistance Centre, committing $18 million over the 2016–22 phase of work. Part of this work involves helping Pacific countries build a stronger public financial management foundation from which to apply for external climate finance.

In 2018 New Zealand announced a contribution of up to $3.5 million to establish a Pacific Climate Change Centre in Samoa, building on significant support from Japan. The centre opened in September 2019 and will provide training, facilitate research and coordinate regional actions on climate issues.

In 2018 New Zealand also announced it would commit $1.5 million to the Pacific Regional NDC Hub in support of Pacific efforts to implement and enhance their NDCs.

New Zealand supports our Pacific Island partners' international engagement in climate-related fora to raise the profile of Pacific climate issues internationally and help the region contribute to a global response to climate change. We were pleased to support Fiji's COP23 Presidency with a total of $3.5 million over the financial years ending June 2017 and June 2018. Fiji's presidency – which marks the first time a small island developing state has held this role – highlighted the challenges of climate change for the Pacific region.

In the year to December 2018, New Zealand contributed over $300,000 to support Pacific Island countries to participate in: the 23rd and 24th UNFCCC Conferences of the Parties in Bonn, Germany (2017) and Katowice, Poland (2018); the Fifth Global Platform for Disaster Risk Reduction in Cancun, Mexico (2017); a conference on New Zealand's Response to Climate Change Induced Pacific Displacement (2018) and the Pacific Climate Change Conference in Wellington in 2018. We also contributed $100,000 to the UNFCCC's Trust Fund for Participation in May 2018.

New Zealand has continued to partner with the European Union to mobilise finance at scale for renewable energy across the Pacific region. (See 'Mitigation' in the next section for more details.)

New Zealand supports the development and implementation of regional frameworks, policies and action plans to address climate change and disaster risk management. It does this through its membership of the Pacific Islands Forum, the Pacific region's intergovernmental and

economic policy organisation. New Zealand was actively involved in developing the Framework for Resilient Development in the Pacific 2017–30 (FRDP), which aims to better integrate the agendas of climate change adaptation and disaster risk reduction in the region, and actively participates in the Pacific Resilience Partnership.

Bilateral support

A large proportion of New Zealand's climate-related support is delivered bilaterally through the aid programme as grant funding. New Zealand contributed approximately $101.32 million in climate-related bilateral and multi-country assistance during the 2017/18 reporting period.

Country partnerships are at the heart of New Zealand's approach to bilateral assistance and climate-related support. Joint Commitments for Development and Strategic Partnerships for Development are based on partner countries' national plans and self-identified needs and priorities.

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

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

- a renewable energy initiative in Nauru that will support that Government's goal to increase renewable energy production, reduce reliance on fossil fuels and increase equitable access to affordable energy
- a water security initiative in Vanuatu that supports the Department of Water Resources to work with communities across Vanuatu to identify, map and prioritise water safety and security needs, and to develop water supply improvement projects to address these needs, and mobilise and manage funding to finance them
- a Vietnamese dam safety initiative, which aims to provide dam owners, industry professionals and government agencies with the skills, tools and processes to dramatically reduce the risk and impact (economic and human losses) of extreme dam discharge or failure, by improving risk management across the Ca River Basin in Nghe An and Ha Tinh provinces.

New Zealand's climate-related support will continue to have a strong focus on supporting activities in Pacific SIDS. The region has a great need for climate-related assistance, and New Zealand has the relationships and experience to make a practical difference.

New Zealand also provides climate-related support bilaterally to partner countries in Africa and the Caribbean, and to members of the Association of Southeast Asian Nations with a particular focus on disaster risk reduction, renewable energy and sustainable agriculture.

New Zealand follows a number of development principles when providing climate-related support. These include:

- ownership: encouraging and supporting partner countries to set their own strategies and priorities for responding to climate change to create policy certainty, reducing risk and enabling private sector investment

- alignment: aligning support with countries' own identified priorities for climate mitigation and adaptation
- donor harmonisation: partners working together to maximise the effectiveness of support being provided
- results focus: delivering projects that can be tracked and reported to ensure the project is delivering
- transparency: accounting for every dollar spent in the delivery of aid projects.

New Zealand's approach of integrating environment and climate change objectives as cross-cutting issues in all activities managed by the aid programme, where appropriate, is in keeping with international best practice and reduces the burden of reporting on partner countries. Designing development assistance with environment and climate change co-benefits in mind ensures that the development initiatives funded by our aid programme support sustainable management of natural assets and address climate change.

Further details of support for mitigation, adaptation, technology transfer and capacity-building actions are provided in the relevant sections below, while CTF table 7b contains details of annual financial contributions made in 2017/18 in support of these areas.

Of New Zealand's bilateral support managed and delivered by the aid programme during the reporting period, 44.7 per cent was directed towards supporting adaptation actions and 26 per cent towards mitigation, with 29.9 per cent directed to both adaptation and mitigation actions (all percentages are approximate). This balance between adaptation and mitigation support differs from New Zealand's *Third Biennial Report*,[120] which showed that approximately 39 per cent of New Zealand's bilateral support managed and delivered by the aid programme was directed towards supporting adaptation actions, and approximately 51 per cent towards mitigation, with 9 per cent directed to both adaptation and mitigation actions.

Over 2017/18, 13 per cent of New Zealand's climate-related support ($33.80 million) went towards improving access to affordable, reliable and clean energy. As this renewable energy portfolio matures, New Zealand continues to work to improve the balance between adaptation and mitigation support, with a commitment to ensuring at least 50 per cent of New Zealand's climate-related development assistance over 2019–22 is focused on adaptation initiatives.

Mitigation

New Zealand's main areas of engagement for mitigation support have been in the energy and agriculture sectors.

A priority has been supporting renewable energy initiatives through the aid programme. Support for affordable, reliable and clean energy sources is helping 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 growth in emerging green industries.

In addition, New Zealand's Pacific Partnership with the European Union aimed to mobilise finance flows to drive the uptake of renewable energy in the Pacific region at scale. The June

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120 Ministry for the Environment. 2017. *New Zealand's Third Biennial Report Under the United Nations Framework Convention on Climate Change*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/publications/climate-change/new-zealands-third-biennial-report-under-united-nations-framework (10 September 2019).

2016 Pacific Energy Conference held in Auckland saw donors commit over $1 billion to renewable energy projects in the Pacific region out to 2024, including $100 million from New Zealand.

New Zealand's commitment will be reached in 2022 (or sooner, as further energy work is programmed in 2019–20). Combined with the 2013 Pacific Energy Summit, which saw over $900 million of investments over 70 projects, these efforts have now mobilised over $2 billion for renewable energy projects in the Pacific region.

These outcomes highlight the role that developed country partners, such as New Zealand and the European Union, can play in facilitating such a significant outcome by drawing on expertise and relationships in the field to ensure a coordinated, regional approach to renewable energy and energy efficiency.[121] Delivery of these projects will accelerate progress towards achieving countries' renewable energy targets, which form an important part of their NDCs submitted under the Paris Agreement.

Private sector

New Zealand recognises the importance of private sector investment in contributing to effective climate change outcomes in developing countries. The aid programme's investment in renewable energy offers strong opportunities to increase private sector investment and trade in the Asia–Pacific region.

We support a number of initiatives to incentivise greater private sector investment in the renewable energy sector for the benefit of developing countries. These include initiatives aimed at reducing real or perceived risks that are barriers to investments (such as payment guarantee systems and risk share facilities) and supporting regulatory system improvements.

As noted above, New Zealand has invested $4.52 million in ADB's Pacific Renewable Energy Program, which will assist Pacific Island countries to increase private sector participation in their energy sectors and achieve their renewable energy targets. We have also invested in the IFC's Risk Share Facility to incentivise private sector investment in projects in the Pacific region through increased availability of commercial finance.

New Zealand has also committed $0.48 million over the next three years to support the Pacific Islands Investment Forum (PIIF) to address barriers to greater investment in Pacific infrastructure and to facilitate direct investment deals. The New Zealand Super Fund (NZSF) is a key member of the PIIF and is providing significant in-kind technical assistance to enable PIIF members to increase investment in Pacific infrastructure. We are also undertaking a feasibility study for a new activity to mobilise New Zealand private investment in Pacific development projects, including climate change projects.

Agriculture

The dominance of agriculture in New Zealand's emissions profile has 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. Through the New Zealand Aid Programme, approximately $25.06 million has been invested in climate-related agriculture initiatives over the 2017/18

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[121] New Zealand Ministry of Foreign Affairs and Trade. 2016. *Pacific Energy Country Profiles*. Wellington: Ministry of Foreign Affairs and Trade. Retrieved from www.mfat.govt.nz/assets/Aid-Prog-docs/Renewable-Energy/Country-Energy-Profiles-FINAL-web-version.pdf.

reporting period (9.7 per cent of total climate-related assistance).[122] 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 established the GRA in late 2009, to help decouple emissions from food production, and continues to provide a range of support for these efforts, as outlined elsewhere in this chapter and report.

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. This support is largely delivered through bilateral assistance to partner countries. 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 and regional agencies to help shape and deliver these actions in response to countries' priorities.

SIDS, such as those in the Pacific region, are especially vulnerable to the effects of climate change and extreme weather events. Climate change threatens to reduce resilience and exacerbate existing development and environmental challenges. In response, New Zealand is supporting a range of climate change adaptation projects through the activities of the New Zealand Aid Programme, particularly in the Pacific SIDS.

As summarised in CTF table 7b, examples of key climate change adaptation, disaster risk management and resilience-building initiatives supported through the aid programme include:

- projects to strengthen water security and availability
- building the resilience of communities and the environment to ocean acidification
- the development and maintenance of early warning systems, National Disaster Management Offices (NDMOs) and related capacity building.

New Zealand also continues to support NDMOs in the Cook Islands, Niue, Samoa, Tonga and Tokelau to strengthen their preparedness for and responses to natural disasters, including those relating to climate change.

Adaptation and disaster risk reduction are closely related processes that both aim to reduce risk to short-term acute hazards and longer term chronic hazards. Therefore, New Zealand also supports integration of 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 has been a strong supporter of the FRDP.

Special initiatives

New Zealand's Climate Change Development Fund provides $300,000 annually to assist developing countries to deal with climate change challenges. In 2017 and 2018, the fund:

- assisted developing country participants to attend informal workshops, including on international carbon markets

[122] Through bilateral and multilateral (International Fund for Agricultural Development and Consultative Group for International Agriculture Research) support but excludes GRA support and Pacific Regional Agency support.

- allowed for a contribution to the University of KwaZulu Natal to assist with the funding for a South African branch of the Intergovernmental Panel on Climate Change (IPCC) Working Group II technical support unit (in cooperation with Norway, Germany and South Africa)
- provided supplementary funding to certain UNFCCC work programmes, including the Warsaw International Mechanism on Loss and Damage
- supported developing country capacity building for transparency.

New Zealand has committed $73.5 million to support the GRA from its inception in 2009 until mid-2020. The GRA is a major initiative involving the collaboration of over 50 developed and developing country members, working with partner organisations to reduce agricultural GHG emissions and enhance soil organic carbon without compromising food security.

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

- **Climate Food and Farming Research Network (CLIFF) – Global Research Alliance Development Scholarships (GRADS)**
  CLIFF-GRADS is a joint initiative of the GRA and the Low Emissions Development Flagship of the Consultative Group for International Agricultural Research (CGIAR) Research Program on Climate Change, Agriculture and Food Security (CCAFS). It aims to build the capability of early-career agriculture students in developing countries to conduct applied research on climate change mitigation in agriculture. Funding for CLIFF-GRADS is provided by New Zealand, the United States Agency for International Development, the CGIAR Trust Fund and bilateral agreements in support of CCAFS. Since its inception in 2017, CLIFF-GRADS has offered more than 50 scholarships to PhD students from developing countries.
- **Agricultural GHG inventories**
  Through the GRA, New Zealand has been instrumental in delivering capability-building activities to improve livestock GHG measurement and reporting by developing countries. These are prerequisites for enhanced action on mitigation in the livestock sector in NDCs. Regional inventory improvement programmes are under way in Latin America, Southeast 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.
- **Global Research Project – Hungate 1000**
  New Zealand is making full use of the matured and expansive GRA networks to advance critical research areas. Scientists have developed a global reference set of genome sequences of rumen micro-organisms published in the respected international scientific journal, *Nature Biotechnology*.[123] The project, called the Hungate 1000, brought together nearly 60 scientists from 14 research organisations across nine countries. This global collaboration has generated a reference catalogue of 501 rumen microbial genomes available to the international research community to identify opportunities for livestock methane-emissions reductions. This project shows the power of international collaboration to create a resource that can benefit all countries.

[123] Seshadri R et al. 2018. Cultivation and sequencing of rumen microbiome members from the Hungate1000 Collection. *Nature Biotechnology* 36: 359–367. Retrieved from www.nature.com/articles/nbt.4110.

CTF Table 7: Provision of public financial support: summary information in 2017

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	**70.87**					**70.87**	**50.35**					**50.35**
Multilateral climate change funds	1.85					**1.85**	1.31					**1.31**
Other multilateral climate change funds												
Multilateral financial institutions, including regional development banks	20.32					**20.32**	14.45					**14.45**
Specialised United Nations bodies	15.50					**15.50**	11.02					**11.02**
Other multilateral	33.20					**33.20**	23.57					**23.57**
Total contributions through bilateral, regional and other channels		**10.65**	**19.61**	**8.92**		**39.18**		**7.57**	**13.93**	**6.36**		**27.86**
TOTAL	**70.87**	**10.65**	**19.61**	**8.92**		**110.05**	**50.35**	**7.57**	**13.93**	**6.36**		**78.21**

CTF Table 7: Provision of public financial support: summary information in 2018

	New Zealand dollars (millions) Climate specific						US dollars (millions) Climate specific					
Allocation channel	**Core/ general**	**Mitigation**	**Adaptation**	**Cross-cutting**	**Other**	**Total**	**Core/ general**	**Mitigation**	**Adaptation**	**Cross-cutting**	**Other**	**Total**
Total contributions through multilateral channels	**85.86**	**1.5**		**0.1**		**87.46**	**59.43**	**1.04**		**0.07**		**60.54**
Multilateral climate change funds	7.2	1.5		0.1		**8.80**	4.99	1.04		0.07		**6.10**
Other multilateral climate change funds												
Multilateral financial institutions, including regional development banks	22.73					**22.73**	15.73					**15.73**
Specialised United Nations bodies	15.50					**15.50**	10.73					**10.73**
Other multilateral	40.43					**40.43**	27.98					**27.98**
Total contributions through bilateral, regional and other channels		**15.67**	**25.68**	**20.79**		**62.14**		**10.85**	**17.80**	**14.37**		**43.02**
TOTAL	**85.86**	**17.17**	**25.68**	**20.89**		**149.60**	**59.43**	**11.89**	**17.80**	**14.44**		**103.56**

CTF Table 7a: Provision of public financial support: contributions through multilateral channels in 2017

Donor funding	Total amount Core/general NZD million	Total amount Core/general USD million	Climate specific NZD million	Climate specific USD million	Status	Funding source	Financial instrument	Type of support	Sector
Multilateral climate change funds									
1. Global Environment Facility[124]	1.28	0.91			Disbursed	ODA	Capital subscription	Cross-cutting	General environment
2. Montreal Protocol – UNEP	0.57	0.40			Disbursed	ODA	Grant	Mitigation	General environment
Subtotal	**1.85**	**1.31**							
Multilateral financial institutions, including regional development banks									
1. World Bank IDA 17	8.65	6.15			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. World Bank IDA 18	8.65	6.15			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
3. Asian Development Bank	3.02	2.15			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Subtotal	**20.32**	**14.45**							
Specialised United Nations bodies									
1. United Nations Development Programme	8.00	5.69			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. International Fund for Agricultural Development	1.50	1.07			Disbursed	ODA	Grant	Adaptation	Agriculture
3. World Food Programme	6.00	4.26			Disbursed	ODA	Grant	Adaptation	Cross-cutting
Subtotal	**15.50**	**11.02**							
Other multilateral									

[124] While imputed shares for multilateral agencies are available for 2017 we have not used them here since they are not available for 2018 and would cause inconsistency in reporting approach over the two years. For reference however, see 2017 imputed shares here: www.oecd.org/development/financing-sustainable-development/development-finance-topics/climate-change.htm.

Donor funding	Total amount Core/general NZD million	Total amount Core/general USD million	Climate specific NZD million	Climate specific USD million	Status	Funding source	Financial instrument	Type of support	Sector
1. UNHCR	6.00	4.26			Disbursed	ODA	Grant	Adaptation	Cross-cutting
2. UN Entity for Gender Equality and the Empowerment of Women	2.50	1.78			Disbursed	ODA	Grant	Adaptation	Cross-cutting
3. CGIAR Fund	5.50	3.91			Disbursed	ODA	Grant	Cross-cutting	Agriculture
4. Pacific Islands Forum Secretariat	3.61	2.55			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
5. Pacific Regional Environment Programme	1.56	1.11			Disbursed	ODA	Grant	Cross-cutting	General environment
6. Pacific Community	6.43	4.57			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
7. Forum Fisheries Agency	3.60	2.55			Disbursed	ODA	Grant	Cross-cutting	Fisheries
8. Commonwealth Fund for Technical Cooperation	3.00	2.13			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
9. Global Crop Diversity Trust	1.00	0.71			Disbursed	ODA	Grant	Adaptation	Agriculture
Subtotal	**33.20**	**23.57**							
TOTAL	**70.87**	**50.35**							

Note: CGIAR = Consultative Group for International Agriculture Research; IDA = International Development Association; ODA = official development assistance; UNEP = United Nations Environment Programme; UN = United Nations; UNHCR = United Nations Refugee Agency.

CTF Table 7a: Provision of public financial support: contributions through multilateral channels in 2018

Donor funding	Total amount Core/general NZD million	Total amount Core/general USD million	Climate specific NZD million	Climate specific USD million	Status	Funding source	Financial instrument	Type of support	Sector
Multilateral climate change funds									
1. Global Environment Facility	2.31	1.6			Disbursed	ODA	Capital subscription	Cross-cutting	General environment
2. Global Environment Facility	4.0	2.77			Disbursed	ODA	Grant	Cross-cutting	General environment
3. United Nations Framework Convention on Climate Change Trust Fund for Participation			0.10	0.07	Disbursed	ODA	Grant	Cross-cutting	General environment
4. UNEP – Montreal Protocol	0.89	0.62			Disbursed	ODA	Grant	Mitigation	General environment
5. UNDP – Montreal Protocol			1.50	1.04	Disbursed	ODA	Grant	Mitigation	General environment
Subtotal	**7.20**	**4.99**	**1.6**	**1.11**					
Multilateral financial institutions, including regional development banks									
1. World Bank IDA 18	17.29	11.97			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. Asian Development Bank ADF 12	5.44	3.76			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Subtotal	**22.73**	**15.73**							
Specialised United Nations bodies									
1. United Nations Development Programme	8.00	5.54			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. International Fund for Agricultural Development	1.5	1.04			Disbursed	ODA	Grant	Adaptation	Agriculture
3. World Food Programme	6.00	4.15			Disbursed	ODA	Grant	Adaptation	Cross-cutting
Subtotal	**15.50**	**10.73**							
Other multilateral									
1. UNHCR	6.00	4.15			Disbursed	ODA	Grant	Adaptation	Cross-cutting

Donor funding	Total amount Core/general NZD million	Total amount Core/general USD million	Climate specific NZD million	Climate specific USD million	Status	Funding source	Financial instrument	Type of support	Sector
2. UN Entity for Gender Equality and the Empowerment of Women	2.50	1.73			Disbursed	ODA	Grant	Adaptation	Cross-cutting
3. CGIAR Fund	5.50	3.81			Disbursed	ODA	Grant	Cross-cutting	Agriculture
4. Pacific Islands Forum Secretariat	3.36	2.33			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
5. Pacific Regional Environment Programme	1.53	1.06			Disbursed	ODA	Grant	Cross-cutting	General environment
6. Pacific Community	13.19	9.13			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
7. Forum Fisheries Agency	1.80	1.24			Disbursed	ODA	Grant	Cross-cutting	Fisheries
8. Commonwealth Fund for Technical Cooperation	6.00	4.15			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
9. Commonwealth Small States Office	0.55	0.38			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Subtotal	**40.43**	**27.98**							
TOTAL	**85.86**	**59.43**	**1.60**	**1.11**					

Note: ADF = Asian Development Fund; CGIAR = Consultative Group for International Agriculture Research; IDA = International Development Association; ODA = official development assistance; UNDP = United Nations Development Programme; UNEP = United Nations Environment Programme; UNHCR = United Nations Refugee Agency.

CTF Table 7b: Provision of public financial support: contributions through bilateral, regional and other channels in 2017

Recipient country, programme or activity[125] [126]	Total amount Climate specific NZD million	USD million	Status	Funding source	Financial instrument	Type of support	Sector
Cook Islands / Wastewater Activity	0.38	0.27	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Cook Islands / Water Partnership	0.66	0.47	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Fiji / Dairy Industry Development Initiative	0.91	0.65	Disbursed	ODA	Grant	Adaptation	Agriculture
Fiji / Evacuation Centres Upgrade Project	0.31	0.22	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Fiji / Child-focused Disaster Risk Reduction in Fiji	0.16	0.12	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Fiji / Enhanced water security in rural communities through improved water and sanitation management	0.23	0.16	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Fiji / United Nations Climate Change Conference in Suva, 2017	1.00	0.71	Disbursed	ODA	Grant	Cross-cutting	Government and Civil Society
Fiji / Tropical Cyclone Winston Recovery Package	3.80	2.70	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Kiribati / Kiritimati Energy Sector Project	1.24	0.88	Disbursed	ODA	Grant	Mitigation	Energy
Kiribati / Temaiku Land and Urban Development	0.59	0.42	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Kiribati / Water 2015–20	0.19	0.14	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Kiribati / Water and sanitation, including rainwater harvesting	0.20	0.14	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Nauru / Renewable Energy Initiative	0.10	0.07	Disbursed	ODA	Grant	Mitigation	Energy
Niue / Niue Renewable Energy Activity	0.94	0.67	Disbursed	ODA	Grant	Mitigation	Energy
Niue / Upgrade of the Niue Wharf	1.00	0.71	Disbursed	ODA	Grant	Adaptation	Transport
Papua New Guinea / Enga Hydro	1.04	0.74	Disbursed	ODA	Grant	Mitigation	Energy

[125] Bilateral activities with a moderated 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.

[126] New Zealand does not provide funding to Annex 1 countries through any activities listed in Table 7b.

Recipient country, programme or activity[125] [126]	Total amount Climate specific NZD million	USD million	Status	Funding source	Financial instrument	Type of support	Sector
Papua New Guinea / Increasing access to renewable energy for remote Papua New Guinea (PNG) communities	1.59	1.13	Disbursed	ODA	Grant	Cross-cutting	Energy
Papua New Guinea / Improved livelihoods and well-being for women and their families	0.21	0.15	Disbursed	ODA	Grant	Adaptation	Agriculture
Papua New Guinea / Private Sector Development: PNG Partnership (IFC)	0.15	0.11	Disbursed	ODA	Grant	Cross-cutting	Financial services
Samoa / Incentivising Economic Reform Phase Two	1.05	0.75	Disbursed	ODA	Grant	Mitigation	Government and civil society
Samoa / Samoa Renewable Energy Partnership	0.89	0.63	Disbursed	ODA	Grant	Mitigation	Energy
Samoa / Tourism Infrastructure – Apia Waterfront Development	0.66	0.47	Disbursed	ODA	Grant	Adaptation	Tourism
Solomon Islands / Fisheries Development	0.52	0.37	Disbursed	ODA	Grant	Adaptation	Fishing
Tokelau / Reducing risks of coastal inundation in Tokelau	0.20	0.14	Disbursed	ODA	Grant	Adaptation	Multi-sector
Tokelau / Wharf and Reef Channel Rehabilitation	0.58	0.41	Disbursed	ODA	Grant	Adaptation	Transport
Tonga / Energy: Renewable Energy Solar Project	0.33	0.24	Disbursed	ODA	Grant	Mitigation	Energy
Tonga / Village Network Upgrade Programme Stages 2 and 3	0.32	0.23	Disbursed	ODA	Grant	Mitigation	Energy
Tuvalu / Tuvalu Renewable Energy Projects	0.28	0.20	Disbursed	ODA	Grant	Mitigation	Energy
Tuvalu / Tuvalu Fisheries Building	0.71	0.51	Disbursed	ODA	Grant	Cross-cutting	Fishing
Vanuatu / Inter-island Shipping Programme	0.14	0.10	Disbursed	ODA	Grant	Adaptation	Transport
Vanuatu / Support to Wan Smolbag	0.30	0.21	Disbursed	ODA	Grant	Adaptation	Government and civil society
Vanuatu / Vanuatu Rural Electrification Project	1.50	1.07	Disbursed	ODA	Grant	Cross-cutting	Energy
Vanuatu / Vanuatu Tourism Infrastructure Project	0.23	0.16	Disbursed	ODA	Grant	Adaptation	Tourism
Vanuatu / Water Sector Partnership 2017–21	0.41	0.29	Disbursed	ODA	Grant	Adaptation	Water and sanitation

Recipient country, programme or activity[125] [126]	Total amount Climate specific NZD million	USD million	Status	Funding source	Financial instrument	Type of support	Sector
Pacific Regional / Strengthening Water Security in Selected Pacific Island Countries	1.10	0.78	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Pacific Regional / Improving Pacific Access to the Green Climate Fund	1.29	0.92	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / North West Pacific Renewable Energy	0.43	0.30	Disbursed	ODA	Grant	Mitigation	Energy
Pacific Regional / Ocean Acidification	0.60	0.43	Disbursed	ODA	Grant	Adaptation	Multi-sector
Pacific Regional / Pacific Energy Conference 2016	0.29	0.20	Disbursed	ODA	Grant	Mitigation	Energy
Pacific Regional / Pacific Islands Emergency Management Association	0.18	0.13	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Pacific Regional / Pacific Regional Infrastructure Facility Technical Assistance	0.30	0.21	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Pacific Regional / Pacific Risk Tool for Resilience (pilot)	0.39	0.28	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Pacific Regional / Pacific Community Water and Sanitation Programme	0.15	0.11	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Pacific Regional / Regional Seasonal Employer Worker Training Programme	0.24	0.17	Disbursed	ODA	Grant	Adaptation	Education
Pacific Regional / World Bank Pacific Facility 4	0.26	0.19	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Afghanistan / Capability Building and Technical Assistance for the Afghan Energy Utility Company	0.23	0.16	Disbursed	ODA	Grant	Mitigation	Energy
Africa Regional / New Zealand East Africa Geothermal Assistance Facility	0.77	0.55	Disbursed	ODA	Grant	Mitigation	Energy
Asia Regional / Renewable Energy Short-term Training Scholarships	0.79	0.56	Disbursed	ODA	Grant	Mitigation	Energy
Cambodia / Cambodia Quality Horticulture	0.52	0.37	Disbursed	ODA	Grant	Adaptation	Agriculture

Recipient country, programme or activity[125] [126]	Total amount Climate specific NZD million	USD million	Status	Funding source	Financial instrument	Type of support	Sector
Colombia / Development of Commercial Horticulture	0.30	0.21	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Colombia / Dairy Value Chain Initiative	0.20	0.14	Disbursed	ODA	Grant	Adaptation	Agriculture
Indonesia / Community Resilience and Economic Development	0.13	0.09	Disbursed	ODA	Grant	Cross-cutting	Disaster prevention and preparedness
Indonesia / Geothermal Well Control Training Initiative	0.25	0.18	Disbursed	ODA	Grant	Mitigation	Energy
Indonesia / Innovative Farm Systems and Capability for Agribusiness	0.33	0.24	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Indonesia / National Disaster Management Framework	0.37	0.26	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Indonesia / New Zealand-Maluku Access to Energy Support	0.11	0.08	Disbursed	ODA	Grant	Mitigation	Energy
Indonesia / New Zealand support for accelerating geothermal development in Indonesia	0.80	0.57	Disbursed	ODA	Grant	Mitigation	Energy
Indonesia / Strengthened Indonesian Resilience: Reducing Risk from Disasters	0.53	0.37	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Kenya / Strengthened Avocado Value Chain	0.16	0.11	Disbursed	ODA	Grant	Adaptation	Agriculture
Lao PDR / Beef industry training	0.16	0.11	Disbursed	ODA	Grant	Adaptation	Agriculture
Lao PDR / Community Resilience through Education and Communication Action	0.55	0.39	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Myanmar / Dairy Excellence Project	0.35	0.25	Disbursed	ODA	Grant	Adaptation	Agriculture
Myanmar / Winter Crops Production in Rakhine, Myanmar	0.69	0.49	Disbursed	ODA	Grant	Adaptation	Agriculture
Peru / Peru Dairy Support	0.34	0.24	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Sri Lanka / Sri Lanka Dairy Excellence Training Initiative	0.25	0.18	Disbursed	ODA	Grant	Mitigation	Agriculture
Uruguay / Family Farm Improvement Project	0.32	0.23	Disbursed	ODA	Grant	Adaptation	Agriculture
Viet Nam / Dam and Downstream Community Safety	0.35	0.25	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness

Recipient country, programme or activity[125] [126]	Total amount Climate specific NZD million	USD million	Status	Funding source	Financial instrument	Type of support	Sector
Viet Nam / Disaster Risk Management, Education and Prevention	0.41	0.29	Disbursed	ODA	Grant	Adaptation	Multi-sector
Viet Nam / Dragon Fruit Economic Development	0.32	0.23	Disbursed	ODA	Grant	Adaptation	Agriculture
West Indies Regional / Caribbean Geothermal Technical Assistance Activity	0.33	0.23	Disbursed	ODA	Grant	Mitigation	Energy
Other / Adaptation	0.93	0.66	Disbursed	ODA	Grant	Adaptation	Cross-cutting
Other / Mitigation	0.21	0.15	Disbursed	ODA	Grant	Mitigation	Cross-cutting
Other / Cross-cutting	0.43	0.31	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
TOTAL	**39.18**	**27.86**					

Note: IFC = International Finance Corporation; ODA = official development assistance.

CTF Table 7b: Provision of public financial support: contributions through bilateral, regional and other channels in 2018

Recipient country, programme or activity[127] [128]	Total amount: Climate specific NZD million	Total amount: Climate specific USD million	Status	Funding source	Financial instrument	Type of support	Sector
Cook Islands / Wastewater Activity	1.04	0.72	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Cook Islands / Budget Contribution to Asset Management 2018/19	3.90	2.70	Disbursed	ODA	Grant	Adaptation	Government and civil society
Cook Islands / Water Partnership	1.44	1.00	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Fiji / Tropical Cyclone Winston Recovery Package	1.44	1.00	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Fiji / Dairy Industry Development Initiative	0.64	0.45	Disbursed	ODA	Grant	Adaptation	Agriculture
Fiji / Biosecurity Activity	0.14	0.10	Disbursed	ODA	Grant	Adaptation	Agriculture
Fiji / Enhanced water security in rural communities through improved water supply and sanitation management	0.15	0.10	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Fiji / Developing sustainable and responsible tuna longline fisheries	0.25	0.17	Disbursed	ODA	Grant	Adaptation	Fishing
Fiji / Habitat Training for Disaster Risk Reduction in Fiji	0.24	0.17	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Fiji / United Nations Climate Change Conference	2.50	1.73	Disbursed	ODA	Grant	Cross-cutting	Government and civil society
Kiribati / Kiritimati Energy Sector Project	1.77	1.23	Disbursed	ODA	Grant	Mitigation	Energy
Kiribati / Temaiku Land and Urban Development	2.65	1.83	Disbursed	ODA	Grant	Cross-cutting	General environment
Kiribati / Water – 2015–20	0.59	0.41	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Republic of the Marshall Islands / Energy Initiative	0.78	0.54	Disbursed	ODA	Grant	Mitigation	Energy

[127] Bilateral activities with a moderated 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.

[128] New Zealand does not provide funding to Annex 1 countries through any activities listed in Table 7b.

Recipient country, programme or activity[127] [128]	Total amount Climate specific NZD million	USD million	Status	Funding source	Financial instrument	Type of support	Sector
Federated States of Micronesia / Energy Initiative	0.38	0.26	Disbursed	ODA	Grant	Mitigation	Energy
Nauru / Renewable Energy Initiative	1.41	0.98	Disbursed	ODA	Grant	Mitigation	Energy
Niue / Niue Renewable Energy Activity	3.01	2.08	Disbursed	ODA	Grant	Mitigation	Energy
Niue / Upgrade of the Niue Wharf	0.62	0.43	Disbursed	ODA	Grant	Adaptation	Transport
Papua New Guinea / Enga Electrification	0.73	0.51	Disbursed	ODA	Grant	Mitigation	Energy
Papua New Guinea / Increasing access to renewable energy	0.47	0.32	Disbursed	ODA	Grant	Cross-cutting	Energy
Papua New Guinea / Improved livelihoods and well-being for women and their families	0.20	0.14	Disbursed	ODA	Grant	Adaptation	Agriculture
Papua New Guinea / Private Sector Development	0.15	0.10	Disbursed	ODA	Grant	Cross-cutting	Energy
Samoa / Cocoa Industry Development Initiative	0.20	0.14	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Samoa / Apia Waterfront Development	1.18	0.82	Disbursed	ODA	Grant	Adaptation	Tourism
Samoa / Tropical Cyclone Gita Resilience Package	0.90	0.62	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Solomon Islands / Coconut Rhinoceros Beetle Response	0.15	0.10	Disbursed	ODA	Grant	Adaptation	Agriculture
Solomon Islands / Hybrid electricity systems	1.83	1.26	Disbursed	ODA	Grant	Cross-cutting	Energy
Solomon Islands / Provincial Airfield Upgrades	0.12	0.08	Disbursed	ODA	Grant	Adaptation	Transport
Solomon Islands / Fisheries Development	0.58	0.40	Disbursed	ODA	Grant	Adaptation	Fishing
Tokelau / Comprehensive Tokelau Coastal Risk Study and Risk Mitigation Plan	0.14	0.10	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Tokelau / Wharf and Reef Channel Rehabilitation	1.56	1.08	Disbursed	ODA	Grant	Adaptation	Transport
Tonga / Nukualofa Network Upgrade Project	1.50	1.04	Disbursed	ODA	Grant	Mitigation	Energy

Recipient country, programme or activity[127] [128]	Total amount Climate specific NZD million	USD million	Status	Funding source	Financial instrument	Type of support	Sector
Tonga / Village Network Upgrade Programme	1.76	1.22	Disbursed	ODA	Grant	Mitigation	Energy
Tuvalu / Direct Budget Support to the Government of Tuvalu	0.30	0.21	Disbursed	ODA	Grant	Cross-cutting	Government and civil society
Vanuatu / Fred Hollows Infrastructure	0.17	0.11	Disbursed	ODA	Grant	Adaptation	Health
Vanuatu / Inter-island Shipping Programme	0.14	0.10	Disbursed	ODA	Grant	Adaptation	Transport
Vanuatu / Growing Market Opportunities for Tanna Farmers	0.23	0.16	Disbursed	ODA	Grant	Adaptation	Agriculture
Vanuatu / Support to Wan Smolbag	0.22	0.15	Disbursed	ODA	Grant	Adaptation	Government and civil society
Vanuatu / Takara Geothermal Support	0.10	0.07	Disbursed	ODA	Grant	Cross-cutting	Energy
Vanuatu / Vanuatu Rural Electrification Project	0.42	0.29	Disbursed	ODA	Grant	Cross-cutting	Energy
Vanuatu / Water Sector Partnership 2017–21	0.18	0.13	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Pacific Regional / Agriculture and climate mitigation review	0.22	0.15	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Pacific Regional / Strengthening water security in selected Pacific Island countries	0.65	0.45	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Pacific Regional / Labour Mobility Worker Training Initiative	0.19	0.13	Disbursed	ODA	Grant	Adaptation	Government and civil society
Pacific Regional / North West Pacific Renewable Energy	0.24	0.16	Disbursed	ODA	Grant	Mitigation	Energy
Pacific Regional / Ocean Acidification	0.30	0.21	Disbursed	ODA	Grant	Adaptation	Multi-sector
Pacific Regional / Pacific Energy Conference 2016	0.11	0.07	Disbursed	ODA	Grant	Mitigation	Energy
Pacific Regional / Pacific Risk Share Facility	3.72	2.57	Disbursed	ODA	Grant	Cross-cutting	Energy

Recipient country, programme or activity[127] [128]	Total amount Climate specific NZD million	USD million	Status	Funding source	Financial instrument	Type of support	Sector
Pacific Regional / Improving Pest Management of Coconut Rhinoceros Beetles in Solomon Islands and PNG	0.20	0.14	Disbursed	ODA	Grant	Adaptation	Agriculture
Pacific Regional / Pacific Regional Infrastructure Facility Technical Assistance	0.30	0.21	Disbursed	ODA	Grant	Cross-cutting	Transport
Pacific Regional / RiskScape drought module	0.30	0.20	Disbursed	ODA	Grant	Adaptation	Water and sanitation
Pacific Regional / Samoa and Vanuatu – Pacific Risk Tool for Resilience (pilot)	0.14	0.10	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Pacific Regional / Pacific Health Security Coordination Plan	0.36	0.25	Disbursed	ODA	Grant	Adaptation	Health
Pacific Regional / Pacific Facility Trust Fund	5.88	4.07	Disbursed	ODA	Grant	Cross-cutting	Multi-sector
Africa Regional / New Zealand East Africa Geothermal Assistance Facility	0.50	0.35	Disbursed	ODA	Grant	Mitigation	Energy
Asia Regional / Renewable Energy Short-term Training Scholarships	0.65	0.45	Disbursed	ODA	Grant	Mitigation	Energy
Cambodia / Cambodia Quality Horticulture	0.45	0.31	Disbursed	ODA	Grant	Adaptation	Agriculture
Cambodia / Promoting Security, Resilience and Economic Development for Indigenous Communities	0.12	0.08	Disbursed	ODA	Grant	Adaptation	Agriculture
Cambodia / Cambodia Development of Commercial Horticulture	0.14	0.10	Disbursed	ODA	Grant	Adaptation	Agriculture
Cambodia / Improving sustainable management of Angkor Wat Park	0.14	0.10	Disbursed	ODA	Grant	Adaptation	Tourism
Colombia / Dairy Value Chain Initiative	0.23	0.16	Disbursed	ODA	Grant	Adaptation	Agriculture

Recipient country, programme or activity[127] [128]	Total amount Climate specific NZD million	USD million	Status	Funding source	Financial instrument	Type of support	Sector
Indonesia / Community Resilience and Economic Development	0.16	0.11	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Indonesia / Better Warehousing and Logistics Management Initiative	0.15	0.10	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Indonesia / Innovative Farm Systems and Capability for Agribusiness	0.32	0.22	Disbursed	ODA	Grant	Adaptation	Agriculture
Indonesia / National Disaster Management Framework	0.17	0.12	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Indonesia / Support for Training in the Indonesia Geothermal Sector	0.30	0.21	Disbursed	ODA	Grant	Mitigation	Energy
Indonesia / New Zealand-Maluku Access to Energy Support	0.20	0.14	Disbursed	ODA	Grant	Mitigation	Energy
Indonesia / Support for accelerating geothermal development in Indonesia	0.87	0.60	Disbursed	ODA	Grant	Mitigation	Energy
Indonesia / Strengthened Indonesian Resilience: Reducing Risk from Disasters	0.33	0.23	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Kenya / Strengthened Avocado Value Chain	0.26	0.18	Disbursed	ODA	Grant	Adaptation	Agriculture
Kenya / Agriculture, Dairy and Economic Development in Emali, Kenya	0.13	0.09	Disbursed	ODA	Grant	Adaptation	Agriculture
Lao PDR / Beef industry training in Lao PDR	0.33	0.23	Disbursed	ODA	Grant	Adaptation	Agriculture
Lao PDR / Community Resilience through Education and Communication Action	0.43	0.30	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Myanmar / Dairy Excellence Project	0.46	0.32	Disbursed	ODA	Grant	Adaptation	Agriculture
Myanmar / Dairy Industry/Vet training	0.23	0.16	Disbursed	ODA	Grant	Adaptation	Agriculture

Recipient country, programme or activity[127] [128]	Total amount Climate specific NZD million	USD million	Status	Funding source	Financial instrument	Type of support	Sector
Myanmar / Renewable Energy Programme	0.67	0.46	Disbursed	ODA	Grant	Mitigation	Energy
Myanmar / Winter Crops Production in Rakhine, Myanmar	0.66	0.46	Disbursed	ODA	Grant	Adaptation	Agriculture
Myanmar / Matupi Sustainable Rural Economic Development	0.18	0.13	Disbursed	ODA	Grant	Adaptation	Agriculture
Peru / Dairy Support	0.26	0.18	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Philippines / Restoring Agricultural Livelihoods Mindanao	1.12	0.78	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Sri Lanka / Sri Lanka Dry Zone Smallholder Dairy Expansion Programme	0.22	0.15	Disbursed	ODA	Grant	Cross-cutting	Agriculture
Sri Lanka / Dairy Excellence Training Initiative	0.18	0.13	Disbursed	ODA	Grant	Mitigation	Agriculture
Viet Nam / Dam and Downstream Community Safety	0.89	0.62	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Viet Nam / Dragon Fruit Economic Development	0.11	0.07	Disbursed	ODA	Grant	Adaptation	Agriculture
West Indies Regional / Caribbean Geothermal Technical Assistance Activity	0.39	0.27	Disbursed	ODA	Grant	Mitigation	Energy
Worldwide / New Zealand Red Cross Partnership 2018–23	0.64	0.44	Disbursed	ODA	Grant	Adaptation	Disaster prevention and preparedness
Other / Adaptation	0.79	0.55	Disbursed	ODA	Grant	Adaptation	Cross-cutting
Other / Mitigation	0.22	0.15	Disbursed	ODA	Grant	Mitigation	Cross-cutting
Other / Cross-cutting	0.45	0.31	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
TOTAL	**62.14**	**43.02**					

Note: ODA = official development assistance; PDR = People's Democratic Republic.

Technology 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. 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 is a win-win, helping 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 is, therefore, a priority for New Zealand. During the reporting period, New Zealand delivered on these commitments through the New Zealand Aid Programme and the GRA. This section reports on these commitments in text and tables, while referencing other relevant sections of this chapter.

Technology transfer delivered through the New Zealand Aid Programme

As detailed in the 'Bilateral support' section, 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. The New Zealand Aid Programme is committed to supporting climate change action in developing countries; particular areas of focus are the Pacific region, renewable energy and agriculture. These focus areas are reflected in the sectors most strongly represented in CTF table 8. In addition, New Zealand has supported a number of technology transfer activities in Southeast Asia, Africa and South America, through both the aid programme and the GRA, as outlined in CTF table 8.

As detailed in the 'Mitigation' section, a priority for the aid programme has been supporting renewable energy initiatives to enable access to affordable, reliable and clean-energy sources, reducing carbon emissions, improving energy efficiency and creating low-carbon development pathways. CTF table 7b in the 'Bilateral supportBilateral support' section details several examples of renewable energy projects that promoted, facilitated and financed technology transfer for the benefit of non-Annex 1 Parties, and the majority of mitigation activities detailed in CTF table 8 are renewable energy activities.

Another priority in the aid 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 CTF table 8 aim to help communities better meet the challenges of more intense extreme weather events, the increasing risk of drought, sea-level rise, and changes in fisheries resources. The 'Adaptation' section details a number of these projects, including those focused on water and sanitation, agriculture and disaster-resilient infrastructure.

Lessons learnt

Tonga Village Network Upgrade Programme

For several years New Zealand has been helping upgrade Tonga's electricity network on the main island, Tongatapu, through the Tonga Village Network Upgrade Programme (TVNUP). Prior to the project, the electricity distribution network on Tongatapu covered only around 80 per cent of the population, and line losses were over 20 per cent in some villages; system reliability was low, with regular network faults causing blackouts, and the system was not built to withstand the tropical cyclones encountered in the Pacific region. Without reliable and affordable electricity on the island, economic and human development was being severely hampered.

Typically, development partners have funded external suppliers to build new infrastructure, then demonstrate to local staff how to operate and maintain it during very short training periods. This has often resulted in new infrastructure that is not well maintained, severely shortening its useful life. However, under TVNUP, New Zealand and Tonga took a new approach that focused primarily on building local capability within the utility Tonga Power Limited (TPL).

Training was conducted in New Zealand and Tonga, using the New Zealand Line Mechanic Pathway, which is recognised internationally. A purpose-built training ground was established at the Tonga Institute of Science & Technology, allowing the training to be carried out locally. The New Zealand company, NorthPower provided further on-the-ground training to the newly graduated line mechanics as they were constructing the lines as part of TVNUP.

During the programme, 16 new line mechanics (15 males and one female) were trained and qualified to a Level 4 New Zealand Qualifications Authority standard; in total, TPL now has eight female line mechanics and two technical designer/planners. The programme has been a trailblazer for women gaining employment in non-traditional roles in the Pacific region. Several line mechanics have been able to secure roles in companies in New Zealand.

With the knowledge and experience gained during TVNUP, TPL is now in the best position to operate and maintain its system, as well as to rebuild further parts if needed. TPL was able to restore power to all of Tongatapu after Tropical Cyclone Gita in February 2018 in half the expected time, requiring relatively little foreign assistance. It has also assisted other Pacific countries after natural disasters, such as in helping Fiji rehabilitate its network after Tropical Cyclone Winston in early 2016. TPL has since started to upgrade the remaining old network on Tongatapu that supplies the capital, Nuku'alofa, only requiring funding for materials now that it has a fully trained workforce.

Global Research Alliance on Agricultural Greenhouse Gases

In addition to technology transfer delivered through the New Zealand Aid Programme, under 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 support enables developing countries to implement their commitments, in particular by:

- developing national agricultural 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 CTF table 8)
- providing training to Southeast Asian countries to improve agricultural development strategies that aim for low GHG emissions, and reduce vulnerability or increase resilience to climate change (see CTF table 8).

Explanation of information in CTF table 8

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 New Zealand's 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. CTF table 8 includes examples of both hard- and soft-technology transfer, with the majority of activities identified comprising a combination of both.

Similarly, most of the activities identified in CTF table 8 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, CTF table 8 does not differentiate between endogenous and non-endogenous technology transfer unless specified.

As detailed in the 'Bilateral support' section, New Zealand follows a number of development principles when providing climate-related support through the New Zealand Aid 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 success' in CTF table 8 identifies these criteria.

The GRA applies a different funding criterion. Where possible, therefore, 'CTF table 8: Technology transfer delivered through the GRA' identifies factors that led to a project's success in a different way from 'CTF table 8: Technology transfer delivered through the New Zealand Aid Programme'. These factors are not always recorded for GRA activities, and so some of the activities in 'CTF table 8: Technology transfer delivered through the GRA' do not include factors that led to a project's success.

CTF Table 8: Technology transfer delivered through the New Zealand Aid Programme

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
Solomon Islands hybrid electricity systems	Expanded access to reliable and clean energy in rural Solomon Islands.	Solomon Islands	Energy	Mitigation	This activity will inform the expansion of the energy sector in Solomon Islands in the next five years.	2017–20	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Design of four solar-diesel-battery hybrid mini-grid systems.	Public	Refer to CTF table 7b
Niue Renewable Energy Activity	The activity will support Niue's goal to increase renewable energy production and reduce reliance on fossil fuels.	Niue	Energy	Mitigation	This activity will resolve technical issues regarding the current generation and network distribution, and increase renewable energy supply to meet 40% of electricity from renewable energy by 2018.	2016–19	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency	Provision of grid-connected photovoltaic panels and battery storage.	Public	Refer to CTF table 7b

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
Vanuatu Rural Electrification Project	To increase access to sustainable and reliable energy in rural Vanuatu communities.	Vanuatu	Energy	Mitigation	The activity supports the Department of Energy to establish a robust private-sector business model that meets demand, and strengthens government capacity for planning and regulating product/vendor supply standards.	2015–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Stand-alone home solar systems through the private sector.	Public and private	Refer to CTF table 7b
North West Pacific Renewable Energy	This activity will expand access to affordable, reliable and clean energy in Micronesia.	Nauru, Palau, Republic of the Marshall Islands, Federated States of Micronesia	Energy	Mitigation	This activity will identify how New Zealand can most effectively contribute to achieving the energy priorities of Micronesian countries by providing technical assistance and support for renewable energy generation.	2018–20	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Grid-connected solar photovoltaic panels a standalone solar-diesel-battery hybrid mini-grid system in Palau for an outer island community.	Public	Refer to CTF table 7b
Renewable Energy Initiative	This activity is aimed at supporting the Government of Nauru's goal to increase	Nauru	Energy	Mitigation	This activity is assisting the Nauru Utilities Corporation to develop a least-cost plan for increasing Nauru's	2017–20	Country ownership, alignment with country strategies and priorities, donor	Provision of a grid-connected 1 megawatt-peak solar photovoltaic system.	Public	Refer to CTF table 7b

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 production, reduce reliance on fossil fuels and increase equitable access to affordable energy.				renewable energy production.		harmonisation, results focused, transparency.			
New Zealand East Africa Geothermal Assistance Facility	Reduce reliance on fossil fuels and expand access to affordable, reliable and clean energy in East Africa, through the provision of targeted technical assistance for geothermal energy development and distribution.	Africa Regional/ multi-country	Energy	Mitigation	This activity supports the development of the Government of Comoros' geothermal resource, working closely with the United Nations Development Programme and the African Union-managed Geothermal Risk Mitigation Facility. The activity will also establish an East Africa Geothermal Support Facility to provide a flexible and responsive mechanism to support development of the geothermal sector in East Africa.	2016–22	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Assisting with technical studies and applications for funding for a programme of drilling for geothermal energy.	Public	Refer to CTF table 7b

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
Water Partnership (Te Mato Vai)	To deliver a reliable source of potable water to the population of Rarotonga.	Cook Islands	Water supply and sanitation	Adaptation	Ongoing activity to upgrade Rarotonga's reticulation system to increase storage capacity, building resilience to more frequent dry spells.	2013–20	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Water storage tanks, filtration systems and pipes.	Public	Refer to CTF table 7b
Enhanced water security in rural communities through improved water and sanitation management	To address the water and sanitation infrastructure needs of 20 vulnerable communities and 10 schools in rural Cakaudrove and Naitasiri.	Fiji	Water supply and sanitation	Adaptation	This activity will improve water and sanitation needs of 20 communities through the rehabilitation of water systems, introduction of water quality treatment technologies and piloting of sanitation schemes.	2016–20	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Water systems rehabilitated or constructed; water quality treatment technologies introduced; pilot sanitation schemes.	Public	Refer to CTF table 7b
Coconut Rhinoceros Beetle Bio-control	To support the Pacific region to respond to the invasion of a new strain of coconut rhinoceros beetle that threatens economic resilience and	Pacific Regional, Solomon Islands, Papua New Guinea	Agriculture	Adaptation	This activity will provide the tools and strategies that are required to effectively manage the coconut rhinoceros beetle.	2016–18	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	An Integrated Pest Management approach, designed to bring together scientifically proven control methods in a single package that can be effectively implemented by	Public	Refer to CTF table 7b

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
	food security across the Pacific.							Pacific Island countries and territories to protect their coconut and oil palms.		
Water 2015–20	To improve potable water supply, sewerage and sanitation in South Tarawa.	Kiribati	Water supply and sanitation	Adaptation	The activity will improve water and sanitation in South Tarawa through the provision of rainwater harvesting for public buildings and private households; installation of a desalination plant; extension of current sewerage systems within South Tarawa; provision of on-site sanitation for public buildings and private households; and provision of a new reticulated sewerage system.	2015–20	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Rainwater harvesting for public buildings and private households; desalination plant installed; extended sewerage systems within South Tarawa; on-site sanitation for public buildings and private households.	Public	Refer to CTF table 7b

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	To strengthen water availability in five Pacific countries with low-lying islands that are subject to drought and water shortages.	Tuvalu, Tokelau, Kiribati, Cook Islands, Republic of the Marshall Islands	Water and sanitation	Adaptation	Funding the appointment, training and operation of five water security officers, who are placed in government departments to provide technical support for water security planning and implementation.	2015–19	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Groundwater monitoring systems and effective management of water supply to withstand more frequent drought events.	Public	Refer to CTF table 7b
Water and sanitation, including rainwater harvesting	To increase Kiribati's resilience to drought events as a result of climate change.	Kiribati	Water supply and sanitation	Adaptation	This activity will provide rainwater harvesting systems in South Tarawa's community buildings; refurbishing water and sanitation systems in two hospitals, as well as improved water resource management and testing.	2013–16	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Rainwater harvesting systems, sanitation systems, information and knowledge sharing on better waste management.	Public	Refer to CTF table 7b
Cocoa Industry Development	The activity aims to encourage cocoa farmers in Western Savai'i to produce larger volumes of cocoa	Samoa	Agriculture	Adaptation	This activity aims to increase the value and volume of Samoan cocoa export and increase financial returns for smallholder	2017–22	Country ownership, alignment with country strategies and priorities, donor	New methods of seedling planting by providing appropriate seedling bags to ensure trees will be able to withstand	Public	Refer to CTF table 7b

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
	by increasing capabilities in on-farm and post-harvest practices.				cocoa growers through increased investment and sustainable production and quality management.		harmonisation, results focused, transparency.	harsh conditions such as cyclones and strong winds.		
Development of Commercial Horticulture	To sustainably increase small-scale farmer incomes through commercial horticulture, primarily in the northwest provinces of Cambodia.	Cambodia	Agriculture	Adaptation	The activity aims to significantly and sustainably increase small-scale farmer income in the northwest provinces of Cambodia via commercial horticulture and high-value horticultural cash crop agribusinesses.	2014–19	Country ownership, alignment with country strategies and priorities, donor harmonisation, results-focused, transparency.	The activity introduces new practices and inputs, such as improved seeds, drip irrigation and trellising nets, as well as new higher-value crops.	Public	Refer to CTF table 7b
Winter Crops Production in Rakhine	To improve food security and generate more sustainable farming systems in Rakhine State, Myanmar.	Myanmar	Agriculture	Adaptation	The activity aims to improve agriculture farm systems so they are more resilient to changing weather patterns through better water management and crop diversification.	2015–20	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Improving soil management; better water harvesting, storage and irrigation systems; new agriculture techniques, seed varieties (resistant to harsh weather conditions) and tools.	Public	Refer to CTF table 7b

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 Economic Development	To improve the capability and capacity in Viet Nam for the development and commercialisation of new varieties of dragon fruit.	Viet Nam	Agriculture	Adaptation	This activity develops and commercialises new dragon fruit varieties, which will earn premium prices on international markets and have increased resistance to disease.	2013–20	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Sustainable production and canker disease control, resulting in increased productivity for farmers who adopt the new systems and practices.	Public	Refer to CTF table 7b
Vanuatu Inter-island Shipping Project	To promote economic development through strengthened transportation modes and agencies/public sector.	Vanuatu	Transport	Adaptation	This activity will build wharves and landing ramps to withstand projected sea-level rise and storm surges.	2015–19	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Engineering technical expertise to design climate-resilient wharves and ramps.	Public	Refer to CTF table 7b
Vanuatu Tourism Infrastructure Project	To strengthen areas of the Port Vila Seafront Precinct to withstand storm surges and sea-level rise.	Vanuatu	Transport	Adaptation	This activity will strengthen areas of the Port Vila Seafront Precinct to withstand storm surges and sea-level rise.	2017–19	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Engineering technical expertise to design climate resilient seafront able to withstand projections of climate-related cyclones, sea-level rise and rainfall.	Public	Refer to CTF table 7b

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
Downstream Dam Safety	To improve dam safety in Viet Nam to reduce the risk and impact (economic and human losses) of dam failures in Viet Nam, specifically the Ca River Basin.	Viet Nam	Disaster preparedness and prevention	Adaptation	This activity aims to provide Vietnamese dam owners, industry professionals and government agencies with the skills, tools and processes to dramatically reduce the risk and impact of extreme dam discharge or failure by improving risk management across the Ca River Basin in Nghe An and Ha Tinh provinces.	2016–20	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Tools and training in dam safety methodologies including the Dam Remediation Rapid Assessment Prioritisation Tool to be used by dam owners and operators.	Public	Refer to CTF table 7b
Fiji Evacuation Centres Upgrade Project	To provide greater access to safe emergency centres during disasters.	Fiji	Disaster prevention and preparedness	Adaptation	This activity aims to strengthen disaster evacuation centres to withstand increased disaster events.	2015–17	Country ownership, alignment with country strategies and priorities, donor harmonisation, results focused, transparency.	Buildings constructed in line with Fiji building codes to withstand cyclones and other natural hazards compounded by climate change.	Public	Refer to CTF table 7b

CTF Table 8: Technology transfer delivered through the Global Research Alliance on Agricultural Greenhouse Gases 2017 and 2018

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	To assist Southeast Asian (SEA) 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 SEA 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 (CH_4) emissions.	Public	$239,000
Database and Inventory Refinement for GHG emissions associated with manure	To consolidate and unify CH_4 and nitrous oxide (N_2O) emissions data sets associated with manure from several regions of the world.	Chile	Agriculture	Mitigation	Establishment of a central database. Analysis of the data to generate Emissions Factors (EFs) and provide a global resource for upgrading national inventories.	2018–20	Coordination across agencies responsible, government and researchers.	Coordination and analysis of regional data from Latin America, understanding of the requirements for GHG inventories and development of regionally specific EFs.	Public	$140,000

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$)
Climate Change and Livestock Development in Latin America and the Caribbean (LAC): action needed on knowledge, policies and projects for investment	Addressing regional challenges and identifying collaborative activities with policy-makers, researchers and agribusiness representatives.	Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Honduras, Nicaragua, México, Panamá, Paraguay, Uruguay	Agriculture	Mitigation	Jointly organised with New Zealand, the World Bank, Food and Agriculture Organisation of the UN (FAO), Centre for Research and Education in Tropical Agriculture (CATIE), and Fontagro.	2018	Identifying the key actors in LAC to develop low-emissions livestock development activities, including governments, research institutes, regional organisations and donors.	Demonstrate how science underpins this work, including helping to support countries' NDCs. Identify ways to build regional and national capacity through future activities.	Public	$65,000
Construction and use of respiration chambers for small ruminant studies	Establish and maintain the equipment required to measure GHG emissions from small ruminants.	Viet Nam, Sri Lanka, Thailand, Indonesia, Philippines, China, Malaysia	Agriculture	Mitigation	Four-day 'hands-on' regional workshop covering the design, construction and operation of low-cost respiration chambers for small ruminants.	2018	Builds on ongoing activities in SEA to improve livestock GHG inventories.	Construction, calibration and maintaining respiration chambers in their own countries. Also animal handling, quality assurance and quality control procedures, data calculation and interpretation, and the costs, benefits, limitations and options for further improvements to the chamber methodology.	Public	$70,500

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$)
Manure GHG inventory development in Thailand	Bilateral technical training with Government officials in Thailand to improve the national agriculture GHG inventory.	Thailand	Agriculture	Mitigation	Three-day technical training workshop designed to enhance the national GHG inventory as it relates to emissions from manure management.	2018	Coordination across agencies responsible, government and researchers.	Review of the existing inventory, identification of data gaps, and needs to account for emissions and improved manure management practices.	Public	$48,100
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	Built on existing work with Kenya via the joint GRA–FAO–CCAC project, 'Reducing enteric methane for improving food security and livelihoods'.	Development of a higher-tier GHG inventory for the dairy sector to account for mitigation practices and technologies.	Public	$68,856
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	Coordination across agencies responsible, government, researchers and regional organisations.	Demonstrate how science underpins this work, including helping to support countries' NDCs. Identify ways to build regional and national capacity through future activities.	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$)
Evaluating soil carbon benefits from grazed systems in LAC	Ensure that management practices to mitigate GHGs are considered in existing regional activities.	Argentina, Brazil, Chile, Dominican Republic, Ecuador, Nicaragua, Paraguay, Uruguay	Agriculture	Mitigation	Expansion of an existing regional project in the Latin America and Caribbean region, with GRA partner Fontagro and regional organisation PROCISUR, to evaluate the impact on soil carbon sequestration of inclusion of legumes in pasture systems.	2018	Standardisation of measurements for results and outcomes comparison.	Training and measurements required to evaluate additional benefits from soil carbon sequestration.	Public	$100,000
Discovery of new nitrification inhibitors: Phase II	Identification of novel compounds to nitrification and mitigate N_2O emissions.	China	Agriculture	Mitigation	Identification of novel compounds to nitrification and mitigate N_2O 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. Sharing the high-throughput screening mechanisms for novel inhibitors developed in New Zealand.	Public	$50,000
Antibody binding to antigenic targets in the rumen	To improve the effectiveness of anti-methanogen vaccines.	Argentina	Agriculture	Mitigation	Successful anti-methanogen vaccines require antibodies to enter the rumen and	2017–20	New Zealand's International Research Fund 'Global	Involving international partners from Argentina and Australia.		$120,000

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$)
					bind strongly to antigens on the surface of methane-producing methanogens.		Partnerships in Livestock Emissions Research' supports the participation of developing country researchers.			
Inventory Development in South and Southeast Asian countries	Improve livestock GHG inventories and data sharing within the region.	Sri Lanka, Malaysia, Viet Nam, Thailand, Philippines, Indonesia	Agriculture	Mitigation	A workshop to develop enteric methane projects based on country needs that supported specific development goals and focus areas.	2017	Third regional workshop on inventory development in South and Southeast Asia.	Created enabling environment for climate-friendly agriculture methods and technologies by developing ways to consolidate and merge productivity, mitigation and inventory activities into a coherent regional network of countries.	Public	$94,000
Using naturally produced lovastatin to reduce methane emissions.	Demonstrating the use of locally produced lovastatin is a viable mitigation technique to reduce enteric methane emission.	Malaysia	Agriculture	Mitigation	Study the reduction in methane emissions from small ruminants and the effects of lovastatin on animal health and safety of the products.	2015–17	Collaboration between researchers in New Zealand and Malaysia to develop protocols.	Training provided to develop and calibrate equipment as well as to measure CH_4 emissions during the experiment.	Public	$150,000

Note: CCAC = Climate and Clean Air Coalition; CCAFS = Research Program on Climate Change, Agriculture and Food Security; GHG = greenhouse gas; NDC = Nationally Determined Contribution; NZAGRC = New Zealand Agricultural Greenhouse Gas Research Centre.

Capacity building[129]

Countries must have the capacity to be able to mitigate and adapt to climate change. New Zealand recognises the important role that enhancing the capacity and ability of developing countries to take effective climate change action must play in responding to climate change. New Zealand provides capacity-building support that responds to the existing and emerging capacity needs identified by developing country Parties in the areas of mitigation, adaptation, and technology development and transfer. This occurs through a number of mechanisms, including the New Zealand Aid Programme, the GRA, the UNFCCC and regional organisations, such as SPREP.

New Zealand's capacity-building activities are targeted to areas where it has expertise, such as agriculture, renewable energy generation and disaster risk resilience building, and where countries have identified specific needs and capacity gaps. A large portion of New Zealand's capacity-building activity has been aimed at the Pacific region, aligning with the Ministry of Foreign Affairs and Trade's objectives of maximising the impact of New Zealand's engagement in improving the prosperity, stability and resilience of the Pacific region and its people. This also means New Zealand's capacity-building support is focused on developing the needs of those with the least capacity – SIDS, many of whom are also those most vulnerable to climate change. Other capacity-building activities where New Zealand has expertise have been delivered to the benefit of developing countries in Africa, Southeast Asia and Latin America and the Caribbean.

Capacity building supported through the New Zealand Aid Programme

Capacity building is an integral part of most New Zealand Aid Programme activities. New Zealand's capacity-building support in the context of climate change is described in CTF table 9. Examples include:

- disaster risk management and resilience building
- renewable energy
- ocean acidification
- drought resilience
- agriculture
- support to developing countries to better access the finance needed for climate action, such as the TAPA programme (described under 'Regional support' in the first section), which provides rapid deployment of technical support to develop project proposals from the Pacific region.

As noted above, in 2018 we included a climate change capacity-building marker in our reporting system to enable us to better track the support we provide for climate change capacity building and to provide more detailed reporting in the future.

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129 Capacity building is the means by which skills, experience, technical and management capacity are developed within an organisational structure (contractors, consultants or contracting agencies), often through the provision of technical assistance, short- and/or long-term training, and specialist inputs (eg, computer systems). The process may involve the development of human, material and financial resources.

Other capacity-building support

New Zealand has also provided support to capacity-building initiatives from other government funding sources. Some of this has been channelled through the GRA, the UNFCCC, other New Zealand government agencies and regional organisations, such as SPREP. As detailed in CTF table 9, during the reporting period, New Zealand:

- provided training to four Pacific Island countries (Vanuatu, Solomon Islands, Fiji and Tuvalu) to build capacity in relation to the monitoring, reporting and verification requirements for the Carbon Off-setting and Reduction Scheme for International Aviation (New Zealand Ministry of Transport)
- contributed, as detailed in the 'Multilateral support' section, $100,000 to the UNFCCC's Trust Fund for Participation
- supported the Centre for Research and Education in Tropical Agriculture (CATIE) in establishing the Latin America and Caribbean Platform for the sustainable intensification of livestock production, providing $60,000 in 2017; this initiative contributes to the implementation of GRA activities and facilitates workshops with key stakeholders and other actors in the region to develop a coordinated research agenda
- hosted inventory practitioner training ($18,267); national inventory compilers attended from Argentina, Costa Rica, Kenya, and Namibia to learn about New Zealand's national GHG inventory structure and systems
- provided $833,922 to the Livestock Emissions Abatement Research Network (LEARN),[130] to support technicians, doctoral students and postdoctoral fellows from developing countries to build international capability in livestock emissions research
- provided $50,000 for the World Farmers' Organisation and GRA study tour held in Rome, Italy, 13–18 October 2017, to support participants from Colombia, Egypt, South Africa and Uruguay (see chapter 9 of New Zealand's Seventh National Communication to the UNFCCC)[131]
- provided $77,395 to support officials and researchers from developing countries to attend GRA events and activities, including the first international conference on agricultural GHG emission and food security alongside the 8th GRA Council meeting, 10–12 October 2018.

Fossil fuel subsidy reform

New Zealand has been a long-standing leader and advocate for Fossil Fuel Subsidy Reform (FFSR), including by working in the Friends of FFSR group. At COP24, the Friends launched a Friends' Network – that is, an ongoing virtual dialogue around the phase-out of fossil fuel subsidies that encourage the wasteful consumption of fossil fuels, and contribute towards climate change – along with a 'how to' brochure. We also made FFSR a dominant thread in our Talanoa Dialogue process.

New Zealand led a Ministerial statement on FFSR at the World Trade Organization's (WTO's) 11th Ministerial conference in December 2017, with 12 WTO members endorsing it. The statement seeks to advance discussion in the WTO aimed at achieving ambitious and effective

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130 See www.livestockemissions.net for further information.

131 Ministry for the Environment. 2017. *New Zealand's Seventh National Communication Under the United Nations Framework Convention on Climate Change and the Kyoto Protocol*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/publications/climate-change/new-zealands-seventh-national-communication-under-united-nations.

disciplines on inefficient fossil fuel subsidies that encourage wasteful consumption, including through enhanced WTO transparency and reporting that will enable the evaluation of the trade and resource effects of fossil fuel subsidies programmes.

CTF Table 9: Activities managed by the New Zealand Aid Programme that address capacity building

Recipient country or countries	Target area	Project title	Description
Pacific Regional/multi-country	Mitigation	Pacific Regional Infrastructure Facility (PRIF) Technical Assistance Phase Three	PRIF assists various Pacific Island countries to develop National Infrastructure Investment Plans, and to embed good asset management procedures and practice.
Fiji, Cook Islands, Tonga, Samoa	Mitigation	Pacific Energy Initiatives	Pacific Island countries were assisted to develop and negotiate power purchase agreements with independent power producers.
Tuvalu	Mitigation	Tuvalu Renewable Energy Projects	Financial management and accountancy support to the electricity utility
Samoa	Mitigation	Samoa Renewable Energy Partnership	Direct support to utility board and senior management on an on-call basis.
Palau, Republic of the Marshall Islands, Federated States of Micronesia	Mitigation	North West Pacific Renewable Energy	Assistance to develop the Republic of the Marshall Islands' electricity roadmap.
Indonesia	Mitigation	New Zealand Support for Training in the Indonesia Geothermal Sector	Working with Ministry of Energy training institution and other parties to improve training practices and targeting trades training for geothermal industry growth.
Indonesia	Mitigation	New Zealand support for accelerating geothermal development in Indonesia	Direct geothermal training and capacity building, particularly addressing good science practice and broadening knowledge of regulators and developing some model documentation.
Indonesia	Mitigation	Geothermal Well Control Training Initiative	Training of relevant people on specifics of geothermal well control.
Laos, Cambodia	Mitigation	Renewable Energy Technical Assistance	Training of regulators and industry on dam safety aspects, English language training.
Kiribati	Mitigation	Kiritimati Energy Sector Project	Training of technical staff to operate and maintain their new electricity system.
Nauru	Mitigation	Renewable Energy Initiative	Provision of budget for training of utility staff – fund managed by utility.
Africa Regional/multi-country	Mitigation	New Zealand East Africa Geothermal Assistance Facility	Training to African Union Commission countries focused on exploring the potential of geothermal reservoirs.
West Indies Regional/multi-country	Mitigation	Caribbean Geothermal Technical Assistance Activity	Casual mentoring, guidance on good industry structures and practice to take projects to the next stage.
Papua New Guinea (PNG)	Mitigation	Private Sector Development: PNG Partnership (IFC)	Assistance to the private sector in PNG to provide and maintain solar household systems.
Federated States of Micronesia	Mitigation	Energy Initiative	Support to the utility in developing a grid model.

Recipient country or countries	Target area	Project title	Description
Vanuatu	Mitigation	Takara Geothermal Support	Assistance to the government to increase its ability to assess the potential of Vanuatu's geothermal resources.
West Bank and Gaza Strip	Mitigation	Office of the Quartet Renewable Energy	Training local staff to assess opportunities for solar photovoltaic generation.
Tonga	Mitigation	Support for Tonga Power Limited	Direct support and mentoring of the new (and first Tongan) Chief Executive Officer of the utility.
Fiji	Adaptation	Dairy Industry Development	Support for the development of a Fiji Dairy Industry Strategy.
Fiji	Adaptation	Child-Focused Disaster Risk Reduction in Fiji	This is a programme of institutional strengthening, capacity building, technical support and community-based initiatives to reduce the impacts for children of slow and sudden onset disasters.
Fiji	Adaptation	Habitat Training for Disaster Risk	Building and training on resilient building methods for disaster risk reduction and sustainability in Fiji.
Kiribati	Adaptation	Water– 2015–20	Improving potable water supply resilience in South Tarawa through providing safe water sewerage and on-site sanitation systems. This involved raising awareness among government and community about water, sanitation and hygiene and environmental issues and improving service delivery.
Samoa	Adaptation	Cocoa Industry Development Initiative	This activity aims to encourage cocoa farmers in Western Savai'i to produce larger volumes of quality cocoa by increasing capabilities in on-farm and post-harvest best practice.
Solomon Islands	Adaptation	Fisheries Development	A five-year programme of grant funding and technical assistance to the Ministry of Fisheries and Marine Resources.
Tokelau	Adaptation	Reducing risks of coastal inundation in Tokelau	The activity will enhance resilience to coastal hazards on Tokelau's atolls and support Tokelau's Climate Change Unit to facilitate Tokelau engagement in the design and use of new data for village planning.
Vanuatu	Adaptation	Water Sector Partnership 2017–21	This supports the Department of Water Resources to work with communities across Vanuatu to identify, map and prioritise water safety and security needs, to develop water supply improvement projects to address these needs, and to mobilise and manage funding to finance them.
Vanuatu	Adaptation	Growing Market Opportunities for Farmers on Tanna Island	The goal is to strengthen household economic resilience through developing the sustainable agricultural sector in Tanna, Vanuatu.
Pacific Regional/ multi-country	Adaptation	Strengthening Water Security in Selected Pacific Island Countries	The activity aims to build the capacity of selected Pacific Island countries to anticipate, prepare for and respond to drought; and improve their ability to effectively and efficiently use and maintain existing infrastructure.

Recipient country or countries	Target area	Project title	Description
Pacific Regional/ multi-country	Cross-cutting	Improving Pacific Access to the Green Climate Fund (GCF)	This activity aims to support governments (and other regional stakeholders) to gain financing for selected projects through capacity-building initiatives and the provision of specialist technical advice.
Pacific Regional/ multi-country	Adaptation	Ocean Acidification	This activity aims to build community and environmental capacity to respond to increasing ocean acidification.
Pacific Regional/ multi-country	Adaptation	Pacific Risk Tool for Resilience (pilot)	This activity will expand the applicability of New Zealand's National Institute for Water and Atmospheric Research (NIWA) multi-hazard risk assessment and vulnerability mapping tool, making it significantly more relevant to the Pacific.
Pacific Regional	Cross-cutting	SPREP Programme Support	This activity aims to build the capacity of SPREP, the regional organisation charged with the protection and sustainable development of the region's environment.
Asia Regional/multi-country	Mitigation	Renewable Energy Short-term Training Scholarships	The skills, knowledge and overall capacity of renewable energy practitioners are improved, enabling them to better contribute to their country's development needs, through the delivery of 30 short-term training awards per year.
Colombia	Adaptation	Dairy Value Chain Initiative	This aims to improve the productivity and net incomes of small- and medium-sized dairy farmers in the Colombian high tropics. This will adapt relevant New Zealand farm management practices and systems, and increase the capacity of Colombia's extension and vocational training.
Indonesia	Mitigation	Geothermal Well Control Training Initiative	New Zealand support for training in the Indonesia geothermal sector.
Indonesia	Adaptation	Better Warehousing and Logistics Management Initiative	This activity builds the relief response capacity and capability of the Indonesian Red Cross National Society.
Indonesia	Adaptation	Innovative Farm Systems and Capability for Agribusiness	This uses innovation and capability building, and enhanced farming systems and agribusiness capability to create economic opportunities from sustainable agriculture in Nusa Tenggara Barat, Eastern Indonesia.
Indonesia	Adaptation	Strengthened Indonesian Resilience: Reducing Risk from Disasters	Training and capability building are provided to increase the disaster risk management skills of local governments, to 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.
Lao PDR	Adaptation	Community Resilience through Education and Communication Action	Improved risk and disaster recovery preparedness in seven districts in Luang Prabang and Sayaboury provinces of Lao PDR.

Recipient country or countries	Target area	Project title	Description
Myanmar	Adaptation	Winter Crops Production in Rakhine, Myanmar	This activity provides water infrastructure and related training to enable farmers to crop into the dry season; assists with new agricultural techniques, seed varieties and tools; builds capacity in the Agriculture Ministry to support farmers to use the new techniques; and works with the local development bank to improve farmers' access to credit.
Uruguay	Adaptation	Family Farm Improvement Project	This activity aims to improve the profitability and viability of family farms in Uruguay, using environmentally sound farming practices and technologies; developing informed policy; and achieving effective technology transfer and extension, particularly in new monitoring systems for farm performance and environmental impacts and new pasture technologies. The project facilitated the learning process, including farmer-to-farmer learning and 'train the trainer' programmes, and strengthened rural support networks to create a platform of people, tools and practice to lay the foundation for ongoing development.
Viet Nam	Adaptation	Dam and Downstream Community Safety	This activity provides Vietnamese dam owners, industry professionals and government agencies with the skills, tools and processes to dramatically reduce the risk and impact (economic and human losses) of extreme dam discharge or failure by improving risk management across the Ca River Basin in Nghe An and Ha Tinh provinces.
Viet Nam	Adaptation	Disaster Risk Management, Education & Prevention	This activity introduces activities at the commune level, focused on disaster risk management, water sanitation and hygiene, and livelihoods adaptation through the Ben Tre Department of Agriculture and Rural Development.
Viet Nam	Adaptation	Dragon Fruit Economic Development	Support to improve the capability and capacity in Viet Nam for the development and commercialisation of new varieties of dragon fruit, contributing to sustainable and equitable economic development for the agriculture sector.
Asia regional	Adaptation	Association of Southeast Asian Nations (ASEAN) Humanitarian Assistance Centre	Practical-level training and technical support to the ASEAN Humanitarian Assistance Centre in disaster risk management and risk identification. Practical-level Critical Incident Leadership training to ASEAN government agencies through the ASEAN Humanitarian Assistance Centre in order to improve knowledge, and enhance skills and capability for disaster response.

Note: IFC = International Finance Corporation; PDR = People's Democratic Republic; SPREP = Secretariat of the Pacific Regional Environment Programme.

CTF Table 9: Capacity-building activities funded from other sources

Recipient countries	Target area	Programme/project title	Description
Chile, Paraguay, Senegal, Bangladesh, Argentina, Brazil, Ethiopia, Pakistan, Sri Lanka, China, Viet Nam, Pakistan	Mitigation	Livestock Emissions Abatement Research Network	Support for technicians, doctoral students and postdoctoral fellows from developing countries to build international capability in livestock emissions research.
Nigeria, Argentina, Tunisia, Ethiopia, Colombia	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.
Colombia, Egypt, South Africa, Uruguay	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.
Latin America and Caribbean	Cross-cutting	Centre for Research and Education in Tropical Agriculture (CATIE)	Supported CATIE in establishing the Latin America and Caribbean Platform for the sustainable intensification of Livestock Production. This initiative contributes to the implementation of GRA activities and facilitates workshops with key stakeholders and other actors in the region to develop a coordinated research agenda.
Argentina, Costa Rica, Kenya, and Namibia	Mitigation	Agricultural Greenhouse Gas Inventory Training	Inventory practitioner training hosted by New Zealand. National inventory compilers attended from Argentina, Costa Rica, Kenya and Namibia to learn about New Zealand's national GHG inventory structure and systems.
Argentina, Colombia, Egypt, Ghana, India, Indonesia, Kenya, Namibia, Senegal, Tanzania, Tunisia, Uganda, Viet Nam, Zimbabwe	Mitigation	Financial support	Provided support to officials and researchers from developing countries to attend GRA events and activities, including the first international conference on agricultural GHG emission and food security alongside the 8th GRA Council meeting.

Note: GRA = Global Research Alliance on Agricultural Greenhouse Gases; GHG = greenhouse gas.

Chapter VI: Other reporting matters

Net position report

New Zealand regularly publishes a domestic net position report,[132] which tracks New Zealand's progress towards its 2020 emissions reduction target. The report includes emissions and removals, projections of emissions and removals to 2020, and units held by the Government.

Measuring Emissions Guide

The Measuring Emissions Guide[133] provides guidance for 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 1990–2017*)[134] so that organisations can input their activity data and produce their own inventory (figure 4.14).

Figure 4.14: Steps for New Zealand organisations to measure and report their emissions

132 The report is available at www.mfe.govt.nz/climate-change/reporting-greenhouse-gas-emissions/latest-2020-net-position.

133 Ministry for the Environment. 2019. *Measuring Emissions: A Guide for Organisations – 2019 Detailed Guide*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/climate-change/guidance-measuring-emissions.

134 Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

Offsetting guidance

In September 2019 the Government released the report *Guidance for voluntary emissions offsetting until 31 December 2020*, to support New Zealand businesses with voluntary emissions offsetting.[135] This is the first time the Government has released such guidance.

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.

The guidance provides good practice guidelines on:

- what a voluntary emissions offset is
- what constitutes a voluntary offset
- examples of how voluntary emissions offsetting can be applied in the New Zealand context.

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. Only then can any remaining emissions be offset. Other principles that should be met in order for an offset to be credible include:

- transparency
- real, measurable and verified
- additional
- not double counted
- addresses leakage
- permanence.

[135] Ministry for the Environment. 2019. *Guidance for voluntary emissions offsetting until 31 December 2020*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/guidance-for-voluntary-emissions-offsetting-until-31-December-2020_0.pdf.

Appendix A: CTF table 1 emissions trends 1990–2017

CTF Table 1: Emission trends (CO_2 – Part 1 of 3)

Greenhouse gas source and sink categories	Base year (1990) (kt CO_2)	1991 (kt CO_2)	1992 (kt CO_2)	1993 (kt CO_2)	1994 (kt CO_2)	1995 (kt CO_2)	1996 (kt CO_2)	1997 (kt CO_2)	1998 (kt CO_2)	1999 (kt CO_2)
1. Energy	22,516.01	22,999.63	24,868.02	24,318.47	24,556.22	24,499.83	25,833.86	27,888.08	26,337.59	27,669.88
A. Fuel combustion (sectoral approach)	22,055.92	22,444.71	24,327.67	23,799.91	24,015.38	23,999.47	25,167.27	27,158.46	25,629.88	27,053.73
1. Energy industries	5,996.09	6,096.54	7,584.85	6,647.85	5,534.52	4,805.04	5,553.98	7,159.94	5,575.58	6,794.44
2. Manufacturing industries and construction	4,686.81	5,161.12	5,012.94	5,282.06	5,599.58	5,692.70	6,043.72	6,133.25	5,873.54	5,728.96
3. Transport	8,582.52	8,575.86	8,946.42	9,406.43	10,074.11	10,745.83	10,889.97	11,120.76	11,339.49	11,633.64
4. Other sectors	2,790.51	2,611.19	2,783.46	2,463.57	2,807.17	2,755.90	2,679.59	2,744.51	2,841.27	2,896.69
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	460.09	554.92	540.35	518.56	540.83	500.36	666.59	729.62	707.71	616.15
1. Solid fuels	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA
2. Oil and natural gas and other emissions from energy production	460.09	554.92	540.35	518.56	540.83	500.36	666.59	729.62	707.71	616.15
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial processes	2,519.90	2,659.43	2,757.54	2,847.51	2,725.55	2,813.76	2,826.01	2,732.12	2,792.12	2,944.21
A. Mineral industry	561.87	572.41	648.54	646.71	625.40	674.60	646.19	695.08	650.96	728.35
B. Chemical industry	175.40	189.82	181.80	179.40	196.23	171.54	190.79	190.39	195.43	196.71
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	1,985.89
D. Non-energy products from fuels and solvent use	25.12	25.05	26.04	27.24	29.05	30.80	31.17	31.87	32.46	33.25
E. Electronic industry										
F. Product uses as ODS substitutes										

Greenhouse gas source and sink categories	Base year (1990) ($kt CO_2$)	1991 ($kt CO_2$)	1992 ($kt CO_2$)	1993 ($kt CO_2$)	1994 ($kt CO_2$)	1995 ($kt CO_2$)	1996 ($kt CO_2$)	1997 ($kt CO_2$)	1998 ($kt CO_2$)	1999 ($kt CO_2$)
G. Other product manufacture and use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
H. Other										
3. Agriculture	399.26	440.54	468.46	522.45	588.09	677.93	627.06	662.41	747.90	855.03
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	360.06	388.70	417.33	451.95	496.55	541.15	485.22	534.62	584.01	633.41
H. Urea application	39.19	51.84	51.13	70.49	91.54	136.78	141.84	127.79	163.89	221.62
I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
J. Other										
4. Land use, land-use change and forestry[2]	–31,466.82	–33,849.26	–33,637.26	–33,802.76	–32,889.15	–31,075.45	–29,943.09	–30,383.95	–30,661.92	–32,300.82
A. Forest land	–30,048.01	–31,213.71	–30,180.33	–30,311.47	–29,388.03	–27,604.88	–26,720.02	–27,118.17	–28,898.94	–29,284.01
B. Cropland	469.42	471.68	473.93	476.19	478.44	480.70	482.95	487.11	489.53	491.94
C. Grassland	108.49	183.25	253.09	377.95	503.71	619.60	729.62	862.93	964.99	1,070.39
D. Wetlands	–9.96	–8.22	–10.08	–8.37	–5.70	–3.74	–5.80	–1.65	–1.35	–2.23
E. Settlements	72.65	74.22	75.79	77.66	80.21	83.44	85.72	88.15	90.38	91.70
F. Other land	13.50	14.77	16.03	17.29	18.55	19.81	21.07	24.30	26.12	27.94
G. Harvested wood products	–2,072.91	–3,371.25	–4,265.70	–4,432.01	–4,576.33	–4,670.38	–4,536.63	–4,726.62	–3,332.65	–4,696.55
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Greenhouse gas source and sink categories	Base year (1990) ($kt CO_2$)	1991 ($kt CO_2$)	1992 ($kt CO_2$)	1993 ($kt CO_2$)	1994 ($kt CO_2$)	1995 ($kt CO_2$)	1996 ($kt CO_2$)	1997 ($kt CO_2$)	1998 ($kt CO_2$)	1999 ($kt CO_2$)
5. Waste	17.12	17.09	17.03	17.00	16.42	16.22	15.71	15.95	16.00	15.60
A. Solid waste disposal	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	17.12	17.09	17.03	17.00	16.42	16.22	15.71	15.95	16.00	17.12
D. Waste water treatment and discharge										
E. Other										
6. Other *(as specified in summary 1.A)*	2.87	2.89	2.89	2.89	2.89	2.89	2.88	2.88	2.88	2.88
6. Tokelau_1. Energy	2.82	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84
6. Tokelau_2. Industrial Processes and Product Use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Tokelau_3. Agriculture	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Tokelau_5. Waste	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04
Total CO_2 equivalent emissions without land use, land-use change and forestry	25,455.16	26,119.58	28,113.94	27,708.31	27,889.17	28,010.63	29,305.53	31,301.44	29,896.49	31,487.61
Total CO_2 equivalent emissions with land use, land-use change and forestry	–6,011.67	–7,729.68	–5,523.32	–6,094.45	–4,999.99	–3,064.82	–637.55	917.49	–765.43	–813.21
Memo items:										
International bunkers	2,364.07	2,222.17	2,134.61	2,210.24	2,660.07	2,748.56	2,718.81	2,759.39	2,857.03	2,762.58
Aviation	1,321.65	1,282.16	1,258.35	1,284.21	1,281.41	1,601.89	1,627.38	1,628.90	1,770.21	1,836.55
Navigation	1,042.42	940.01	876.27	926.03	1,378.66	1,146.66	1,091.43	1,130.49	1,086.82	926.03
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	3,516.11	3,592.45	3,592.72	3,785.48	3,973.81	4,089.94	3,925.44	4,123.00	4,377.11	4,856.84
CO_2 captured	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA

Greenhouse gas source and sink categories	Base year (1990) (kt CO_2)	1991 (kt CO_2)	1992 (kt CO_2)	1993 (kt CO_2)	1994 (kt CO_2)	1995 (kt CO_2)	1996 (kt CO_2)	1997 (kt CO_2)	1998 (kt CO_2)	1999 (kt CO_2)
Long-term storage of C in waste disposal sites	2,942.62	3,103.20	3,267.10	3,442.67	3,622.97	3,806.59	3,990.72	4,170.79	4,345.20	4,525.95
Indirect N_2O										
Indirect CO_2[3]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CTF Table 1: Emission trends (CO_2 – Part 2 of 3)

Greenhouse gas source and sink categories	2000 (kt CO_2)	2001 (kt CO_2)	2002 (kt CO_2)	2003 (kt CO_2)	2004 (kt CO_2)	2005 (kt CO_2)	2006 (kt CO_2)	2007 (kt CO_2)	2008 (kt CO_2)	2009 (kt CO_2)
1. Energy	28,446.92	30,445.56	30,489.81	32,087.96	31,693.25	33,180.30	33,257.64	32,081.38	33,376.05	30,649.42
A. Fuel combustion (sectoral approach)	27,853.66	29,824.04	29,895.68	31,476.72	30,829.93	32,265.06	32,297.23	31,059.98	32,133.83	29,281.50
1. Energy industries	6,452.15	7,955.39	7,179.33	8,511.52	8,134.87	10,200.04	10,096.30	8,456.80	9,624.93	7,443.84
2. Manufacturing industries and construction	6,247.81	6,623.28	6,882.43	6,328.95	5,800.68	4,989.51	5,043.19	5,479.46	5,484.40	5,180.73
3. Transport	12,187.70	12,259.32	12,722.64	13,267.19	13,569.70	13,656.16	13,795.05	13,915.79	13,960.35	13,781.68
4. Other sectors	2,966.00	2,986.05	3,111.28	3,369.06	3,324.68	3,419.35	3,362.69	3,207.93	3,064.15	2,875.25
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	593.25	621.52	594.13	611.24	863.32	915.24	960.40	1,021.40	1,242.22	1,367.92
1. Solid fuels	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA
2. Oil and natural gas and other emissions from energy production	593.25	621.52	594.13	611.24	863.32	915.24	960.40	1,021.40	1,242.22	1,367.92
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Greenhouse gas source and sink categories	2000 (kt CO_2)	2001 (kt CO_2)	2002 (kt CO_2)	2003 (kt CO_2)	2004 (kt CO_2)	2005 (kt CO_2)	2006 (kt CO_2)	2007 (kt CO_2)	2008 (kt CO_2)	2009 (kt CO_2)
2. Industrial processes	2,922.40	2,986.81	2,984.72	3,152.87	3,131.40	3,208.54	3,180.79	3,376.77	3,158.90	3,022.29
A. Mineral industry	718.54	716.89	706.97	697.26	666.68	756.18	719.14	861.50	807.03	752.17
B. Chemical industry	198.26	206.31	213.07	201.42	194.29	229.12	243.05	249.96	265.66	261.66
C. Metal industry	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	34.65	34.93	36.14	37.52	38.34	38.58	38.97	39.27	39.54	39.34
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
H. Other										
3. Agriculture	911.35	1,031.04	1,171.91	1,123.45	1,125.25	1,194.38	1,038.67	1,111.52	1,051.17	1,093.61
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	682.80	732.20	781.59	689.34	670.21	737.78	616.41	655.22	610.84	719.70
H. Urea application	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
J. Other										
4. Land use, land-use change and forestry[2]	–31,384.58	–31,346.24	–28,852.86	–29,998.65	–29,923.14	–29,144.01	–27,154.41	–25,765.28	–32,700.26	–30,679.21
A. Forest land	–30,107.39	–29,415.27	–25,964.29	–29,231.18	–33,039.59	–37,156.34	–37,733.71	–41,017.38	–33,406.31	–33,430.93
B. Cropland	509.34	511.16	508.48	524.92	553.91	606.50	633.45	681.29	496.39	476.02

Greenhouse gas source and sink categories	2000 (kt CO_2)	2001 (kt CO_2)	2002 (kt CO_2)	2003 (kt CO_2)	2004 (kt CO_2)	2005 (kt CO_2)	2006 (kt CO_2)	2007 (kt CO_2)	2008 (kt CO_2)	2009 (kt CO_2)
C. Grassland	3,320.75	3,365.63	3,131.66	4,643.36	7,355.06	11,703.06	14,125.76	18,750.98	4,247.50	7,007.71
D. Wetlands	1.86	2.13	3.35	- 1.92	0.82	11.48	18.63	24.14	24.58	21.70
E. Settlements	108.65	109.21	106.83	124.15	154.50	209.98	238.10	289.21	97.56	105.42
F. Other land	45.12	46.92	45.17	55.85	73.80	98.68	115.25	145.69	58.10	129.50
G. Harvested wood products	–5,262.91	–5,966.02	–6,684.08	–6,113.83	–5,021.63	–4,617.36	–4,551.89	–4,639.20	–4,218.08	–4,988.62
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	14.78	9.74	8.99	8.24	8.20	7.03	5.82	4.28	4.15	4.09
A. Solid waste disposal	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	14.78	9.74	8.99	8.24	8.20	7.03	5.82	4.28	4.15	4.09
D. Waste water treatment and discharge										
E. Other										
6. Other *(as specified in summary 1.A)*	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88
6. Tokelau_1. Energy	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84
6. Tokelau_2. Industrial Processes and Product Use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Tokelau_3. Agriculture	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Tokelau_5. Waste	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Total CO_2 equivalent emissions without land use, land-use change and forestry	32,298.33	34,476.04	34,658.32	36,375.40	35,960.98	37,593.13	37,485.80	36,576.84	37,593.15	34,772.29
Total CO_2 equivalent emissions with land use, land-use change and forestry	913.75	3,129.80	5,805.45	6,376.75	6,037.84	8,449.12	10,331.39	10,811.56	4,892.89	4,093.08

Greenhouse gas source and sink categories	2000 (kt CO_2)	2001 (kt CO_2)	2002 (kt CO_2)	2003 (kt CO_2)	2004 (kt CO_2)	2005 (kt CO_2)	2006 (kt CO_2)	2007 (kt CO_2)	2008 (kt CO_2)	2009 (kt CO_2)
Memo items:										
International bunkers	2,555.31	2,762.57	2,832.51	2,865.86	2,964.04	3,200.74	3,146.78	3,276.34	3,418.70	3,325.51
Aviation	1,800.08	1,943.22	1,933.98	2,002.37	2,228.09	2,210.89	2,180.08	2,287.52	2,304.12	2,308.01
Navigation	755.24	819.35	898.53	863.49	735.95	989.85	966.70	988.82	1,114.58	1,017.50
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	5,303.07	5,250.51	5,642.14	5,681.85	6,106.15	6,085.54	6,052.98	5,800.00	5,407.94	5,016.68
CO_2 captured	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA		NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA
Long-term storage of C in waste disposal sites	4,713.24	4,912.76	5,119.07	5,327.72	5,544.09	5,761.10	5,986.23	6,190.31	6,377.27	6,558.81
Indirect N_2O										
Indirect CO_2[3]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CTF Table 1: Emission trends (CO_2 – Part 3 of 3)

Greenhouse gas source and sink categories	2010 (kt CO_2)	2011 (kt CO_2)	2012 (kt CO_2)	2013 (kt CO_2)	2014 (kt CO_2)	2015 (kt CO_2)	2016 (kt CO_2)	2017 (kt CO_2)	Change from base to latest reported year (%)
1. Energy	30,601.38	29,881.37	31,547.62	30,924.74	31,117.61	31,179.19	29,951.77	31,756.30	41.04
A. Fuel combustion (sectoral approach)	29,095.58	28,423.83	30,270.78	29,838.71	29,866.33	29,808.03	28,709.42	30,556.94	38.54
1. Energy industries	6,796.27	6,299.87	7,692.16	6,389.47	5,426.94	5,269.20	4,163.25	4,741.49	-20.92
2. Manufacturing industries and construction	5,448.88	5,176.27	5,580.97	6,357.24	7,131.17	6,700.20	6,646.45	6,866.13	46.50
3. Transport	13,958.28	13,962.45	13,733.85	13,949.99	14,018.25	14,600.31	14,837.72	15,789.78	83.98
4. Other sectors	2,892.16	2,985.25	3,263.80	3,142.01	3,289.96	3,238.32	3,062.01	3,159.54	13.22
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
B. Fugitive emissions from fuels	1,505.81	1,457.53	1,276.84	1,086.03	1,251.28	1,371.16	1,242.34	1,199.35	160.68
1. Solid fuels	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	NO, NE, NA	0.00
2. Oil and natural gas and other emissions from energy production	1,505.81	1,457.53	1,276.84	1,086.03	1,251.28	1,371.16	1,242.34	1,199.35	160.68
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Industrial processes	3,318.58	3,293.97	3,254.58	3,319.49	3,396.02	3,509.38	3,213.58	3,213.88	27.54
A. Mineral industry	740.23	713.26	751.88	774.42	830.50	876.33	726.79	669.67	19.19
B. Chemical industry	265.10	281.55	275.21	260.53	253.57	282.35	191.34	193.09	10.08
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	31.12
D. Non-energy products from fuels and solvent use	40.02	40.29	39.91	40.77	41.19	42.96	43.97	46.67	85.82
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	NA	NA	NA	NA	NA	NA	NA	NA	0.00
H. Other									

Greenhouse gas source and sink categories	2010 (kt CO_2)	2011 (kt CO_2)	2012 (kt CO_2)	2013 (kt CO_2)	2014 (kt CO_2)	2015 (kt CO_2)	2016 (kt CO_2)	2017 (kt CO_2)	Change from base to latest reported year (%)
3. Agriculture	1,069.83	1,131.49	1,176.95	1,060.25	1,102.69	1,144.50	1,088.80	1,047.86	162.45
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	620.47	634.49	682.71	540.07	591.98	536.27	514.41	459.60	27.64
H. Urea application	449.36	497.00	494.24	520.18	510.71	608.23	574.39	588.26	1400.86
I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	0.00
J. Other									
4. Land use, land-use change and forestry[(2)]	–31,454.73	–26,827.47	–25,855.52	–23,354.03	–26,158.11	–25,547.91	–25,065.49	–24,158.29	–23.23
A. Forest land	–33,719.68	–27,024.86	–27,212.14	–26,606.03	–24,989.53	–25,091.78	–22,969.28	–21,839.53	–27.32
B. Cropland	477.58	465.32	455.80	510.38	439.90	410.50	405.89	387.40	–17.47
C. Grassland	7,901.32	6,429.89	8,124.51	11,019.48	6,168.69	5,241.81	4,015.59	3,652.15	3266.49
D. Wetlands	46.52	26.06	21.02	49.97	45.23	15.01	106.62	13.89	–239.37
E. Settlements	108.82	117.26	116.28	105.59	102.74	113.68	137.88	100.69	38.60
F. Other land	154.37	206.25	208.62	194.11	187.84	239.21	174.75	45.64	237.93
G. Harvested wood products	–6,423.66	–7,047.39	–7,569.60	–8,627.54	–8,112.99	–6,476.35	–6,936.94	–6,518.52	214.46
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	0.00

Greenhouse gas source and sink categories	2010 (kt CO_2)	2011 (kt CO_2)	2012 (kt CO_2)	2013 (kt CO_2)	2014 (kt CO_2)	2015 (kt CO_2)	2016 (kt CO_2)	2017 (kt CO_2)	Change from base to latest reported year (%)
5. Waste	4.12	4.02	4.03	3.96	3.96	3.89	3.90	3.75	–78.08
A. Solid waste disposal	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
B. Biological treatment of solid waste									
C. Incineration and open burning of waste	4.12	4.02	4.03	3.96	3.96	3.89	3.90	3.75	–78.08
D. Waste water treatment and discharge									
E. Other									
6. Other *(as specified in summary 1.A)*	2.88	2.88	2.64	1.93	1.93	1.93	1.94	1.94	–32.64
6. Tokelau_1. Energy	2.84	2.84	2.60	1.89	1.89	1.89	1.89	1.89	–33.02
6. Tokelau_2. Industrial Processes and Product Use	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Tokelau_3. Agriculture	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Tokelau_5. Waste	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	–11.76
Total CO_2 equivalent emissions without land use, land-use change and forestry	34,996.79	34,313.73	35,985.82	35,310.37	35,622.22	35,838.89	34,259.98	36,023.73	41.52
Total CO_2 equivalent emissions with land use, land-use change and forestry	3,542.07	7,486.26	10,130.30	11,956.34	9,464.11	10,290.98	9,194.49	11,865.43	–297.37
Memo items:									
International bunkers	3,384.93	3,435.59	3,474.44	3,461.36	3,502.90	3,792.92	4,271.52	4,578.04	93.65
Aviation	2,317.90	2,417.84	2,504.37	2,500.95	2,575.42	2,765.83	3,312.54	3,671.58	177.80
Navigation	1,067.03	1,017.75	970.07	960.40	927.48	1,027.09	958.98	906.46	–13.04
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO_2 emissions from biomass	5,618.64	5,685.13	5,652.49	5,363.78	5,418.67	5,480.08	5,443.75	5,717.53	62.61
CO_2 captured	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	0.00

Greenhouse gas source and sink categories	2010 (kt CO_2)	2011 (kt CO_2)	2012 (kt CO_2)	2013 (kt CO_2)	2014 (kt CO_2)	2015 (kt CO_2)	2016 (kt CO_2)	2017 (kt CO_2)	Change from base to latest reported year (%)
Long-term storage of C in waste disposal sites	6,741.30	6,922.51	7,109.70	7,310.88	7,531.51	7,773.36	8,030.64	8,295.93	181.92
Indirect N_2O									
Indirect CO_2 (3)	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	0.00
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	0.00

CTF Table 1: Emission trends (CH_4 – Part 1 of 3)

Greenhouse gas source and sink categories	Base year (1990) (kt CH_4)	1991 (kt CH_4)	1992 (kt CH_4)	1993 (kt CH_4)	1994 (kt CH_4)	1995 (kt CH_4)	1996 (kt CH_4)	1997 (kt CH_4)	1998 (kt CH_4)	1999 (kt CH_4)
1. Energy	42.87	38.11	38.89	37.92	39.19	39.75	48.95	44.44	45.53	48.76
A. Fuel combustion (sectoral approach)	7.79	7.36	7.04	6.85	7.03	7.01	6.82	6.81	6.73	6.66
1. Energy industries	0.10	0.10	0.13	0.11	0.09	0.08	0.09	0.12	0.09	0.11
2. Manufacturing industries and construction	1.06	1.08	1.10	1.15	1.19	1.20	1.17	1.21	1.25	1.35
3. Transport	3.17	3.07	3.00	2.92	2.87	2.82	2.70	2.62	2.51	2.41
4. Other sectors	3.46	3.10	2.81	2.67	2.88	2.90	2.86	2.87	2.87	2.78
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	35.08	30.76	31.85	31.07	32.16	32.74	42.13	37.62	38.80	42.10
1. Solid fuels	13.13	8.80	8.99	8.72	10.27	12.97	19.17	13.52	15.58	17.16
2. Oil and natural gas and other emissions from energy production	21.95	21.95	22.86	22.35	21.89	19.77	22.97	24.10	23.21	24.95
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	4.74
A. Mineral industry										
B. Chemical industry	1.10	1.89	1.60	1.79	2.25	3.16	4.25	4.38	4.12	4.74
C. Metal industry	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
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
H. Other										

Greenhouse gas source and sink categories	Base year (1990) (kt CH_4)	1991 (kt CH_4)	1992 (kt CH_4)	1993 (kt CH_4)	1994 (kt CH_4)	1995 (kt CH_4)	1996 (kt CH_4)	1997 (kt CH_4)	1998 (kt CH_4)	1999 (kt CH_4)
3. Agriculture	1,084.49	1,089.15	1,069.68	1,075.05	1,109.14	1,120.47	1,130.75	1,159.25	1,134.31	1,138.19
A. Enteric fermentation	1,056.83	1,061.01	1,041.46	1,046.13	1,078.82	1,089.28	1,098.43	1,125.77	1,101.39	1,105.30
B. Manure management	26.75	27.33	27.46	28.05	29.40	30.39	31.40	32.43	31.98	31.95
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Prescribed burning of savannas	IE	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	0.94
G. Liming										
H. Urea application										
I. Other carbon-containing fertilizers										
J. Other										
4. Land use, land-use change and forestry[2]	3.92	3.26	3.40	4.15	4.24	4.13	4.86	4.43	5.46	3.64
A. Forest land	0.82	0.60	0.69	0.82	1.11	1.37	1.67	1.64	1.12	0.74
B. Cropland	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE
C. Grassland	3.09	2.67	2.71	3.32	3.13	2.77	3.18	2.79	4.35	2.91
D. Wetlands	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
F. Other land	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

Greenhouse gas source and sink categories	Base year (1990) (kt CH_4)	1991 (kt CH_4)	1992 (kt CH_4)	1993 (kt CH_4)	1994 (kt CH_4)	1995 (kt CH_4)	1996 (kt CH_4)	1997 (kt CH_4)	1998 (kt CH_4)	1999 (kt CH_4)
5. Waste	157.51	161.83	165.99	169.91	167.91	171.26	174.79	177.69	179.85	182.05
A. Solid waste disposal	148.45	152.39	156.33	160.37	158.13	161.27	164.65	167.46	169.74	172.44
B. Biological treatment of solid waste	0.11	0.11	0.12	0.12	0.12	0.13	0.12	0.12	0.11	0.11
C. Incineration and open burning of waste	0.20	0.19	0.19	0.20	0.17	0.17	0.16	0.17	0.18	0.19
D. Waste water treatment and discharge	8.75	9.13	9.35	9.22	9.49	9.69	9.86	9.95	9.81	9.29
E. Other										
6. Other *(as specified in summary 1.A)*	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02
6. Tokelau_1. Energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Tokelau_2. Industrial Processes and Product Use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Tokelau_3. Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Tokelau_5. Waste	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02
Total CH_4 emissions without CH_4 from LULUCF	1,286.00	1,291.00	1,276.19	1,284.70	1,318.51	1,334.67	1,358.77	1,385.78	1,363.83	1,373.76
Total CH_4 emissions with CH_4 from LULUCF	1,289.91	1,294.26	1,279.60	1,288.84	1,322.75	1,338.80	1,363.62	1,390.22	1,369.30	1,377.41
Memo items:										
International bunkers	0.09	0.08	0.08	0.08	0.12	0.10	0.10	0.10	0.10	0.09
Aviation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Navigation	0.08	0.07	0.07	0.07	0.11	0.09	0.09	0.09	0.09	0.08
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass										
CO_2 captured										
Long-term storage of C in waste disposal sites										
Indirect N_2O										
Indirect CO_2[(3)]										

CTF Table 1: Emission trends (CH_4 – Part 2 of 3)

Greenhouse gas source and sink categories	2000 (kt CH_4)	2001 (kt CH_4)	2002 (kt CH_4)	2003 (kt CH_4)	2004 (kt CH_4)	2005 (kt CH_4)	2006 (kt CH_4)	2007 (kt CH_4)	2008 (kt CH_4)	2009 (kt CH_4)
1. Energy	48.59	49.63	48.17	42.64	40.09	40.44	45.00	39.68	44.19	46.63
A. Fuel combustion (sectoral approach)	6.70	6.57	6.59	6.63	6.60	6.68	6.69	6.36	6.15	5.75
1. Energy industries	0.11	0.13	0.12	0.13	0.12	0.15	0.14	0.13	0.14	0.11
2. Manufacturing industries and construction	1.49	1.52	1.63	1.66	1.72	1.69	1.68	1.64	1.55	1.39
3. Transport	2.28	2.18	2.12	2.04	1.96	1.84	1.71	1.64	1.52	1.44
4. Other sectors	2.82	2.75	2.73	2.79	2.81	3.00	3.15	2.95	2.95	2.80
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	41.89	43.06	41.58	36.01	33.49	33.76	38.31	33.32	38.03	40.88
1. Solid fuels	16.86	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	25.03	25.98	24.60	20.04	18.49	17.89	18.12	20.39	21.74	21.36
C. CO_2 transport and storage										
2. Industrial processes	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	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
D. Non-energy products from fuels and solvent use	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
H. Other										

Greenhouse gas source and sink categories	2000 (kt CH_4)	2001 (kt CH_4)	2002 (kt CH_4)	2003 (kt CH_4)	2004 (kt CH_4)	2005 (kt CH_4)	2006 (kt CH_4)	2007 (kt CH_4)	2008 (kt CH_4)	2009 (kt CH_4)
3. Agriculture	1,169.81	1,182.25	1,173.74	1,189.66	1,189.79	1,199.09	1,206.01	1,174.44	1,131.72	1,138.08
A. Enteric fermentation	1,135.11	1,146.04	1,136.84	1,151.42	1,151.07	1,159.84	1,165.85	1,133.82	1,090.45	1,094.32
B. Manure management	33.77	35.16	35.87	37.26	37.98	38.38	39.33	39.59	40.42	42.93
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Prescribed burning of savannas	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
F. Field burning of agricultural residues	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[(2)]	3.36	3.36	3.42	3.59	3.23	4.62	4.75	6.41	3.59	4.12
A. Forest land	0.79	0.65	0.61	0.51	0.47	0.44	0.49	0.82	0.64	0.88
B. Cropland	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE
C. Grassland	2.57	2.71	2.81	3.08	2.76	4.18	4.26	5.59	2.94	3.24
D. Wetlands	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
F. Other land	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

Greenhouse gas source and sink categories	2000 (kt CH_4)	2001 (kt CH_4)	2002 (kt CH_4)	2003 (kt CH_4)	2004 (kt CH_4)	2005 (kt CH_4)	2006 (kt CH_4)	2007 (kt CH_4)	2008 (kt CH_4)	2009 (kt CH_4)
5. Waste	184.96	187.49	189.37	187.12	188.00	188.90	185.86	185.35	183.06	180.65
A. Solid waste disposal	175.37	178.03	180.08	177.72	178.54	179.48	176.55	176.00	173.63	171.36
B. Biological treatment of solid waste	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.12	0.11	0.11
C. Incineration and open burning of waste	0.19	0.18	0.17	0.16	0.16	0.16	0.16	0.15	0.15	0.14
D. Waste water treatment and discharge	9.29	9.17	9.00	9.11	9.18	9.14	9.03	9.08	9.17	9.04
E. Other										
6. Other *(as specified in summary 1.A)*	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
6. Tokelau_1. Energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Tokelau_2. Industrial Processes and Product Use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Tokelau_3. Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Tokelau_5. Waste	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total CH_4 emissions without CH_4 from LULUCF	1,408.94	1,424.30	1,416.55	1,421.67	1,420.40	1,429.24	1,437.82	1,400.50	1,360.30	1,367.27
Total CH_4 emissions with CH_4 from LULUCF	1,412.30	1,427.66	1,419.97	1,425.25	1,423.62	1,433.87	1,442.57	1,406.91	1,363.88	1,371.39
Memo items:										
International bunkers	0.08	0.08	0.09	0.09	0.08	0.10	0.10	0.10	0.11	0.10
Aviation	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Navigation	0.06	0.07	0.08	0.07	0.06	0.09	0.08	0.09	0.10	0.09
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass										
CO_2 captured										
Long-term storage of C in waste disposal sites										
Indirect N_2O										
Indirect CO_2[(3)]										

CTF Table 1: Emission trends (CH_4 – Part 3 of 3)

Greenhouse gas source and sink categories	2010 (kt CH_4)	2011 (kt CH_4)	2012 (kt CH_4)	2013 (kt CH_4)	2014 (kt CH_4)	2015 (kt CH_4)	2016 (kt CH_4)	2017 (kt CH_4)	Change from base to latest reported year (%)
1. Energy	51.61	44.18	39.17	37.77	37.64	38.49	36.20	35.46	–17.29
A. Fuel combustion (sectoral approach)	6.06	6.08	6.32	6.09	5.70	5.78	5.45	5.83	–25.18
1. Energy industries	0.11	0.10	0.12	0.10	0.09	0.09	0.07	0.08	–20.37
2. Manufacturing industries and construction	1.56	1.56	1.56	1.53	1.56	1.56	1.53	1.63	54.32
3. Transport	1.37	1.29	1.22	1.19	1.15	1.11	1.07	0.90	–71.60
4. Other sectors	3.02	3.13	3.42	3.27	2.91	3.02	2.77	3.22	–7.08
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	–
B. Fugitive emissions from fuels	45.55	38.10	32.85	31.68	31.94	32.71	30.75	29.63	–15.53
1. Solid fuels	23.65	16.52	11.52	10.83	9.01	7.61	6.87	5.28	–59.77
2. Oil and natural gas and other emissions from energy production	21.91	21.58	21.34	20.85	22.93	25.10	23.88	24.35	10.93
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	305.86
A. Mineral industry									
B. Chemical industry	1.91	1.92	2.55	3.27	5.06	4.27	5.01	4.48	305.86
C. Metal industry	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	–
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	NA	NA	NA	NA	NA	NA	NA	NA	–
H. Other									

Greenhouse gas source and sink categories	2010 (kt CH_4)	2011 (kt CH_4)	2012 (kt CH_4)	2013 (kt CH_4)	2014 (kt CH_4)	2015 (kt CH_4)	2016 (kt CH_4)	2017 (kt CH_4)	Change from base to latest reported year (%)
3. Agriculture	1,138.77	1,155.67	1,180.95	1,188.25	1,199.38	1,180.52	1,167.13	1,165.64	7.48
A. Enteric fermentation	1,092.36	1,105.95	1,127.18	1,130.57	1,138.70	1,120.57	1,107.28	1,105.86	4.64
B. Manure management	45.44	49.07	52.73	56.60	59.79	59.34	59.05	59.01	120.55
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	–
D. Agricultural soils	NO	NO	NO	NO	NO	NO	NO	NO	–
E. Prescribed burning of savannas	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	–14.47
G. Liming									
H. Urea application									
I. Other carbon-containing fertilizers									
J. Other									
4. Land use, land-use change and forestry(2)	4.02	2.91	3.21	3.19	2.68	3.13	4.23	3.72	–5.08
A. Forest land	0.73	0.67	0.63	0.49	0.59	1.33	1.12	0.58	–29.98
B. Cropland	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	–
C. Grassland	3.30	2.24	2.58	2.70	2.10	1.80	3.11	3.14	1.53
D. Wetlands	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NO, NE	NO, NE	–
E. Settlements	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	–
G. Harvested wood products									
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	–
5. Waste	176.53	172.15	169.78	166.68	163.90	162.14	159.48	159.68	1.38
A. Solid waste disposal	167.18	162.69	160.29	157.02	154.05	151.99	148.96	148.98	0.35

Greenhouse gas source and sink categories	2010 (kt CH_4)	2011 (kt CH_4)	2012 (kt CH_4)	2013 (kt CH_4)	2014 (kt CH_4)	2015 (kt CH_4)	2016 (kt CH_4)	2017 (kt CH_4)	Change from base to latest reported year (%)
B. Biological treatment of solid waste	0.15	0.20	0.25	0.32	0.41	0.51	0.61	0.70	538.24
C. Incineration and open burning of waste	0.14	0.14	0.14	0.14	0.14	0.13	0.13	0.13	–35.60
D. Waste water treatment and discharge	9.06	9.12	9.10	9.20	9.30	9.50	9.77	9.88	12.83
E. Other									
6. Other *(as specified in summary 1.A)*	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	–12.54
6. Tokelau_1. Energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–14.16
6. Tokelau_2. Industrial Processes and Product Use	NO	NO	NO	NO	NO	NO	NO	NO	–
6. Tokelau_3. Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–67.92
6. Tokelau_5. Waste	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	–12.19
Total CH_4 emissions without CH_4 from LULUCF	1,368.84	1,373.95	1,392.47	1,395.99	1,406.01	1,385.44	1,367.85	1,365.28	6.17
Total CH_4 emissions with CH_4 from LULUCF	1,372.86	1,376.85	1,395.68	1,399.18	1,408.69	1,388.57	1,372.08	1,369.00	6.13
Memo items:									
International bunkers	0.11	0.11	0.10	0.10	0.10	0.11	0.10	0.10	15.92
Aviation	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	176.48
Navigation	0.09	0.09	0.09	0.08	0.08	0.09	0.08	0.08	–2.73
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	0
CO_2 emissions from biomass									
CO_2 captured									
Long-term storage of C in waste disposal sites									
Indirect N_2O									
Indirect CO_2[(3)]									

CTF Table 1: Emission trends (N_2O – Part 1 of 3)

Greenhouse gas source and sink categories	Base year (1990) (kt N_2O)	1991 (kt N_2O)	1992 (kt N_2O)	1993 (kt N_2O)	1994 (kt N_2O)	1995 (kt N_2O)	1996 (kt N_2O)	1997 (kt N_2O)	1998 (kt N_2O)	1999 (kt N_2O)
1. Energy	0.66	0.67	0.72	0.73	0.79	0.81	0.81	0.85	0.86	0.91
A. Fuel combustion (sectoral approach)	0.66	0.67	0.72	0.73	0.79	0.81	0.81	0.85	0.86	0.91
1. Energy industries	0.02	0.01	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.03
2. Manufacturing industries and construction	0.16	0.16	0.17	0.17	0.18	0.18	0.17	0.18	0.18	0.20
3. Transport	0.37	0.39	0.41	0.43	0.46	0.49	0.50	0.52	0.54	0.56
4. Other sectors	0.12	0.11	0.12	0.11	0.13	0.12	0.11	0.11	0.12	0.12
5. Other	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
1. Solid fuels	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	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	0.34	0.33	0.31	0.29	0.28	0.27	0.25	0.24	0.23	0.22
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
C. Metal industry										
D. Non-energy products from fuels and solvent use	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	0.34	0.33	0.31	0.29	0.28	0.27	0.25	0.24	0.23	0.22
H. Other										

Greenhouse gas source and sink categories	Base year (1990) ($kt N_2O$)	1991 ($kt N_2O$)	1992 ($kt N_2O$)	1993 ($kt N_2O$)	1994 ($kt N_2O$)	1995 ($kt N_2O$)	1996 ($kt N_2O$)	1997 ($kt N_2O$)	1998 ($kt N_2O$)	1999 ($kt N_2O$)
3. Agriculture	22.64	22.77	22.55	23.24	24.23	24.90	25.15	25.67	25.27	25.35
A. Enteric fermentation										
B. Manure management	0.17	0.18	0.18	0.19	0.20	0.21	0.22	0.22	0.22	0.22
C. Rice cultivation										
D. Agricultural soils	22.45	22.58	22.35	23.04	24.02	24.67	24.92	25.43	25.03	25.12
E. Prescribed burning of savannas	IE	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	0.02
G. Liming										
H. Urea application										
I. Other carbon-containing fertilizers										
J. Other										
4. Land use, land-use change and forestry[2]	0.70	0.68	0.68	0.71	0.75	0.78	0.82	0.83	0.81	0.78
A. Forest land	0.46	0.45	0.48	0.51	0.57	0.60	0.64	0.65	0.63	0.60
B. Cropland	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
C. Grassland	0.21	0.20	0.17	0.17	0.15	0.14	0.14	0.14	0.15	0.14
D. Wetlands	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
F. Other land	0.00	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	NA
5. Waste	0.29	0.30	0.30	0.31	0.31	0.32	0.32	0.33	0.33	0.34
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

Greenhouse gas source and sink categories	Base year (1990) ($kt N_2O$)	1991 ($kt N_2O$)	1992 ($kt N_2O$)	1993 ($kt N_2O$)	1994 ($kt N_2O$)	1995 ($kt N_2O$)	1996 ($kt N_2O$)	1997 ($kt N_2O$)	1998 ($kt N_2O$)	1999 ($kt N_2O$)
C. Incineration and open burning of waste	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
D. Waste water treatment and discharge	0.28	0.29	0.29	0.29	0.30	0.30	0.31	0.31	0.32	0.32
E. Other										
6. Other *(as specified in summary 1.A)*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Tokelau_1. Energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Tokelau_2. Industrial Processes and Product Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Tokelau_3. Agriculture	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Tokelau_5. Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total N_2O emissions without N_2O from LULUCF	23.94	24.07	23.89	24.58	25.61	26.29	26.54	27.08	26.69	26.81
Total N_2O emissions with N_2O from LULUCF	24.63	24.74	24.57	25.29	26.36	27.07	27.35	27.91	27.50	27.59
Memo items:										
International bunkers	0.08	0.07	0.07	0.07	0.09	0.09	0.08	0.08	0.08	0.08
Aviation	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05
Navigation	0.04	0.04	0.03	0.03	0.05	0.04	0.04	0.04	0.04	0.03
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass										
CO_2 captured										
Long-term storage of C in waste disposal sites										
Indirect N_2O	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
Indirect CO_2[(3)]										

CTF Table 1: Emission trends (N_2O – Part 2 of 3)

Greenhouse gas source and sink categories	2000 ($kt\ N_2O$)	2001 ($kt\ N_2O$)	2002 ($kt\ N_2O$)	2003 ($kt\ N_2O$)	2004 ($kt\ N_2O$)	2005 ($kt\ N_2O$)	2006 ($kt\ N_2O$)	2007 ($kt\ N_2O$)	2008 ($kt\ N_2O$)	2009 ($kt\ N_2O$)
1. Energy	0.96	0.97	1.01	1.08	1.12	1.14	1.11	1.06	1.04	0.97
A. Fuel combustion (sectoral approach)	0.96	0.97	1.01	1.08	1.12	1.14	1.11	1.06	1.04	0.97
1. Energy industries	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	0.21	0.22	0.24	0.24	0.25	0.25	0.25	0.24	0.23	0.21
3. Transport	0.61	0.60	0.62	0.65	0.67	0.67	0.65	0.64	0.61	0.60
4. Other sectors	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.12	0.11
5. Other	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
1. Solid fuels	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	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	0.21	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
C. Metal industry										
D. Non-energy products from fuels and solvent use	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	0.21	0.20	0.19	0.18	0.16	0.15	0.14	0.15	0.18	0.18
H. Other										

Greenhouse gas source and sink categories	2000 (kt N_2O)	2001 (kt N_2O)	2002 (kt N_2O)	2003 (kt N_2O)	2004 (kt N_2O)	2005 (kt N_2O)	2006 (kt N_2O)	2007 (kt N_2O)	2008 (kt N_2O)	2009 (kt N_2O)
3. Agriculture	26.52	27.50	28.10	28.77	28.92	29.20	28.98	27.91	27.34	26.91
A. Enteric fermentation										
B. Manure management	0.23	0.24	0.24	0.26	0.27	0.26	0.27	0.28	0.28	0.30
C. Rice cultivation										
D. Agricultural soils	26.28	27.25	27.84	28.49	28.64	28.92	28.70	27.61	27.04	26.60
E. Prescribed burning of savannas	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
F. Field burning of agricultural residues	0.02	0.02	0.02	0.02	0.01	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(2)	0.79	0.78	0.76	0.75	0.74	0.75	0.75	0.82	0.67	0.67
A. Forest land	0.60	0.58	0.56	0.54	0.51	0.48	0.46	0.47	0.45	0.45
B. Cropland	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05
C. Grassland	0.15	0.15	0.15	0.16	0.17	0.21	0.23	0.29	0.17	0.16
D. Wetlands	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
F. Other land	0.00	0.00	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
5. Waste	0.35	0.36	0.34	0.35	0.35	0.35	0.35	0.35	0.36	0.36
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

Greenhouse gas source and sink categories	2000 (kt N_2O)	2001 (kt N_2O)	2002 (kt N_2O)	2003 (kt N_2O)	2004 (kt N_2O)	2005 (kt N_2O)	2006 (kt N_2O)	2007 (kt N_2O)	2008 (kt N_2O)	2009 (kt N_2O)
C. Incineration and open burning of waste	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
D. Waste water treatment and discharge	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 1.A)*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Tokelau_1. Energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Tokelau_2. Industrial Processes and Product Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Tokelau_3. Agriculture	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Tokelau_5. Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total N_2O emissions without N_2O from LULUCF	28.04	29.02	29.64	30.36	30.55	30.84	30.58	29.47	28.91	28.42
Total N_2O emissions with N_2O from LULUCF	28.83	29.80	30.40	31.11	31.29	31.59	31.33	30.29	29.58	29.09
Memo items:										
International bunkers	0.07	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.10	0.09
Aviation	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Navigation	0.02	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass										
CO_2 captured										
Long-term storage of C in waste disposal sites										
Indirect N_2O	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
Indirect CO_2[(3)]										

CTF Table 1: Emission trends (N_2O – Part 3 of 3)

Greenhouse gas source and sink categories	2010 (kt N_2O)	2011 (kt N_2O)	2012 (kt N_2O)	2013 (kt N_2O)	2014 (kt N_2O)	2015 (kt N_2O)	2016 (kt N_2O)	2017 (kt N_2O)	Change from base to latest reported year (%)
1. Energy	0.94	0.92	0.92	0.89	0.87	0.85	0.83	0.78	18.12
A. Fuel combustion (sectoral approach)	0.93	0.92	0.92	0.89	0.87	0.85	0.83	0.78	18.08
1. Energy industries	0.03	0.03	0.05	0.03	0.03	0.02	0.01	0.02	–10.33
2. Manufacturing industries and construction	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.24	55.11
3. Transport	0.57	0.55	0.52	0.51	0.49	0.48	0.47	0.41	11.73
4. Other sectors	0.10	0.11	0.11	0.11	0.12	0.11	0.11	0.11	–7.27
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
B. Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	150.62
1. Solid fuels	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
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	150.62
C. CO_2 transport and storage									
2. Industrial processes	0.18	0.18	0.19	0.20	0.20	0.20	0.20	0.21	–39.68
A. Mineral industry									
B. Chemical industry	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
C. Metal industry									
D. Non-energy products from fuels and solvent use	NA	NA	NA	NA	NA	NA	NA	NA	0.00
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	0.18	0.18	0.19	0.20	0.20	0.20	0.20	0.21	–39.68
H. Other									

Greenhouse gas source and sink categories	2010 (kt N_2O)	2011 (kt N_2O)	2012 (kt N_2O)	2013 (kt N_2O)	2014 (kt N_2O)	2015 (kt N_2O)	2016 (kt N_2O)	2017 (kt N_2O)	Change from base to latest reported year (%)
3. Agriculture	27.48	28.03	28.60	28.61	29.02	29.12	29.06	29.17	28.85
A. Enteric fermentation									
B. Manure management	0.32	0.34	0.37	0.40	0.41	0.41	0.40	0.41	134.39
C. Rice cultivation									
D. Agricultural soils	27.15	27.68	28.21	28.19	28.59	28.70	28.64	28.75	28.06
E. Prescribed burning of savannas	IE	IE	IE	IE	IE	IE	IE	IE	0.00
F. Field burning of agricultural residues	0.02	0.01	0.02	0.02	0.02	0.01	0.01	0.01	–16.02
G. Liming									
H. Urea application									
I. Other carbon-containing fertilizers									
J. Other									
4. Land use, land-use change and forestry[(2)]	0.65	0.63	0.62	0.59	0.51	0.49	0.43	0.36	–48.39
A. Forest land	0.43	0.43	0.41	0.37	0.33	0.33	0.28	0.22	–52.74
B. Cropland	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.03	18.53
C. Grassland	0.16	0.15	0.16	0.17	0.13	0.11	0.11	0.10	–52.60
D. Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,297.80
E. Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	905.85
F. Other land	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	3,444.44
G. Harvested wood products									
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	0.00
5. Waste	0.36	0.37	0.37	0.38	0.39	0.41	0.42	0.43	48.39
A. Solid waste disposal									

Greenhouse gas source and sink categories	2010 (kt N_2O)	2011 (kt N_2O)	2012 (kt N_2O)	2013 (kt N_2O)	2014 (kt N_2O)	2015 (kt N_2O)	2016 (kt N_2O)	2017 (kt N_2O)	Change from base to latest reported year (%)
B. Biological treatment of solid waste	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.04	538.24
C. Incineration and open burning of waste	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	–27.21
D. Waste water treatment and discharge	0.35	0.35	0.35	0.36	0.36	0.37	0.38	0.38	39.13
E. Other									
6. Other *(as specified in summary 1.A)*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–35.91
6. Tokelau_1. Energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–14.59
6. Tokelau_2. Industrial Processes and Product Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–60.49
6. Tokelau_3. Agriculture	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Tokelau_5. Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–11.76
Total N_2O emissions without N_2O from LULUCF	28.96	29.50	30.08	30.08	30.48	30.59	30.50	30.59	27.80
Total N_2O emissions with N_2O from LULUCF	29.61	30.13	30.70	30.67	30.99	31.07	30.93	30.95	25.65
Memo items:									
International bunkers	0.09	0.10	0.10	0.10	0.10	0.11	0.12	0.13	70.91
Aviation	0.06	0.07	0.07	0.07	0.07	0.08	0.09	0.10	176.48
Navigation	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	–30.49
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO_2 emissions from biomass									
CO_2 captured									
Long-term storage of C in waste disposal sites									
Indirect N_2O	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	0.00
Indirect CO_2[3]									

CTF Table 1: Emission trends (HFCs, PFCs, SF_6 and NF_3 – 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)	1999 (kt)
Emissions of HFCs and PFCs – (kt CO_2-equivalent)	909.95	903.79	461.92	210.55	194.53	174.73	334.24	285.22	266.83	235.75
Emissions of HFCs – (kt CO_2-equivalent)	NO, NA	NO, NA	0.04	0.39	8.35	21.45	55.26	84.11	115.45	167.08
HFC-23	NO, NA	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	0.00
HFC-41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-43-10mee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-125	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.01	0.00	0.00
HFC-134	NA	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	0.04	0.05	0.07
HFC-143	NA	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	0.01
HFC-152	NA	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	0.00
HFC-161	NA	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	0.00
HFC-236cb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-236ea	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-236fa	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-245ca	NA	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	NO, NA
HFC-365mfc	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Unspecified mix of HFCs[4] – (kt CO_2-equivalent)	NA	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)	1999 (kt)
Emissions of PFCs – (kt CO_2-equivalent)	909.95	903.79	461.88	210.16	186.18	153.28	278.98	201.11	151.38	68.67
CF_4	0.11	0.10	0.05	0.02	0.02	0.02	0.03	0.02	0.01	0.01
C_2F_6	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_3F_8	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.01	NO, NA
C_4F_{10}	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
c-C_4F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C_5F_{12}	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C_6F_{14}	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
$C_{10}F_{18}$	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
c-C_3F_6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of PFCs[4] – (kt CO_2-equivalent)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs – (kt CO_2-equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
	19.97	20.86	21.91	22.69	23.43	24.42	24.65	25.58	24.86	24.56
Emissions of SF_6 – (kt CO_2-equivalent)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SF_6	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Emissions of NF_3 – (kt CO_2-equivalent)	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

CTF Table 1: Emission trends (HFCs, PFCs, SF_6 and NF_3 – Part 2 of 3)

Greenhouse gas source and sink categories	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 CO_2-equivalent)	283.68	351.45	459.91	599.82	647.12	731.49	875.78	933.18	1,033.12	1,032.02
Emissions of HFCs – (kt CO_2-equivalent)	216.08	280.84	375.43	473.01	548.01	662.11	769.05	884.78	987.65	978.16
HFC-23	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	0.01	0.01	0.01	0.01	0.02	0.02
HFC-41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-43-10mee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-125	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.07	0.08	0.08
HFC-134	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-134a	0.10	0.12	0.15	0.18	0.19	0.21	0.23	0.25	0.28	0.27
HFC-143	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-143a	0.01	0.01	0.02	0.03	0.03	0.04	0.05	0.06	0.07	0.07
HFC-152	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-152a	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
HFC-227ea	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
HFC-236ea	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-236fa	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-245ca	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-245fa	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	0.00	0.00	0.00	0.00	0.00	0.00
Unspecified mix of HFCs[4] – (kt CO_2-equivalent)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Greenhouse gas source and sink categories	2000 (kt)	2001 (kt)	2002 (kt)	2003 (kt)	2004 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)
Emissions of PFCs – (kt CO_2-equivalent)	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	0.00	0.01
C_2F_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_3F_8	NO, NA	NO, NA	0.00	0.00	0.00	NO, NA	0.00	0.00	0.00	0.00
C_4F_{10}	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
c-C_4F_8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C_5F_{12}	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C_6F_{14}	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
$C_{10}F_{18}$	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
c-C_3F_6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of PFCs[4] – (kt CO_2-equivalent)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs – (kt CO_2-equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Emissions of SF_6 – (kt CO_2-equivalent)	19.56	20.04	23.32	25.19	28.92	25.13	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
Emissions of NF_3 – (kt CO_2-equivalent)	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

CTF Table 1: Emission trends (HFCs, PFCs, SF_6 and NF_3 – 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)	Change from base to latest reported year (%)
Emissions of HFCs and PFCs – (kt CO_2-equivalent)	1,093.59	1,206.36	1,271.78	1,348.59	1,437.41	1,595.74	1,571.99	1,566.15	72.11
Emissions of HFCs – (kt CO_2-equivalent)	1,046.03	1,171.21	1,224.32	1,300.47	1,364.00	1,537.16	1,523.30	1,505.70	100.00
HFC-23	0.00	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	100.00
HFC-32	0.02	0.04	0.04	0.04	0.05	0.06	0.08	0.10	100.00
HFC-41	NA	NA	NA	NA	NA	NA	NA	NA	0.00
HFC-43-10mee	NA	NA	NA	NA	NA	NA	NA	NA	0.00
HFC-125	0.09	0.10	0.11	0.12	0.12	0.15	0.16	0.17	100.00
HFC-134	NA	NA	NA	NA	NA	NA	NA	NA	0.00
HFC-134a	0.28	0.31	0.32	0.33	0.34	0.37	0.33	0.34	100.00
HFC-143	NA	NA	NA	NA	NA	NA	NA	NA	0.00
HFC-143a	0.07	0.07	0.08	0.08	0.09	0.10	0.09	0.07	100.00
HFC-152	NA	NA	NA	NA	NA	NA	NA	NA	0.00
HFC-152a	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
HFC-161	NA	NA	NA	NA	NA	NA	NA	NA	0
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-236cb	NA	NA	NA	NA	NA	NA	NA	NA	0.00
HFC-236ea	NA	NA	NA	NA	NA	NA	NA	NA	0.00
HFC-236fa	NA	NA	NA	NA	NA	NA	NA	NA	0.00
HFC-245ca	NA	NA	NA	NA	NA	NA	NA	NA	0.00
HFC-245fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	100.00
HFC-365mfc	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Unspecified mix of HFCs[4] – (kt CO_2-equivalent)	NA	NA	NA	NA	NA	NA	NA	NA	0.00

Greenhouse gas source and sink categories	2010 (kt)	2011 (kt)	2012 (kt)	2013 (kt)	2014 (kt)	2015 (kt)	2016 (kt)	2017 (kt)	Change from base to latest reported year (%)
Emissions of PFCs – (kt CO_2-equivalent)	47.56	35.15	47.46	48.13	73.41	58.59	48.69	60.46	–93.36
CF_4	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	–93.55
C_2F_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–92.22
C_3F_8	NO, NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
C_4F_{10}	NA	NA	NA	NA	NA	NA	NA	NA	0.00
c-C_4F_8	NA	NA	NA	NA	NA	NA	NA	NA	0.00
C_5F_{12}	NA	NA	NA	NA	NA	NA	NA	NA	0.00
C_6F_{14}	NA	NA	NA	NA	NA	NA	NA	NA	0.00
$C_{10}F_{18}$	NA	NA	NA	NA	NA	NA	NA	NA	0.00
c-C_3F_6	NA	NA	NA	NA	NA	NA	NA	NA	0.00
Unspecified mix of PFCs[4] – (kt CO_2-equivalent)	NA	NA	NA	NA	NA	NA	NA	NA	0.00
Unspecified mix of HFCs and PFCs – (kt CO_2-equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
Emissions of SF_6 – (kt CO_2-equivalent)	22.84	18.92	21.38	18.75	16.95	16.68	17.56	15.00	–24.91
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–24.91
Emissions of NF_3 – (kt CO_2-equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
NF_3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00

CTF Table 1: Emissions trends summary (Part 1 of 3)

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)	1999 (kt CO_2-equivalent)
CO_2 emissions without net CO_2 from LULUCF	25,455.16	26,119.58	28,113.94	27,708.31	27,889.17	28,010.63	29,305.53	31,301.44	29,896.49	31,487.61
CO_2 emissions with net CO_2 from LULUCF	–6,011.67	–7,729.68	–5,523.32	–6,094.45	–4,999.99	–3,064.82	–637.55	917.49	–765.43	–813.21
CH_4 emissions without CH_4 from LULUCF	32,149.96	32,274.99	31,904.77	32,117.44	32,962.87	33,366.70	33,969.16	34,644.62	34,095.85	34,344.11
CH_4 emissions with CH_4 from LULUCF	32,247.87	32,356.58	31,989.88	32,221.10	33,068.80	33,470.02	34,090.56	34,755.38	34,232.42	34,435.17
N_2O emissions without N_2O from LULUCF	7,133.21	7,171.66	7,118.08	7,324.43	7,632.65	7,835.29	7,907.47	8,070.19	7,952.38	7,990.58
N_2O emissions with N_2O from LULUCF	7,340.35	7,373.52	7,321.49	7,535.85	7,854.87	8,066.86	8,151.11	8,316.24	8,194.53	8,222.34
HFCs	NO, NA	NO, NA	0.04	0.39	8.35	21.45	55.26	84.11	115.45	167.08
PFCs	909.95	903.79	461.88	210.16	186.18	153.28	278.98	201.11	151.38	68.67
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
SF_6	19.97	20.86	21.91	22.69	23.43	24.42	24.65	25.58	24.86	24.56
NF_3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Total (without LULUCF)	65,668.25	66,490.88	67,620.61	67,383.42	68,702.64	69,411.76	71,541.05	74,327.06	72,236.40	74,082.61
Total (with LULUCF)	34,506.48	32,925.07	34,271.88	33,895.75	36,141.64	38,671.20	41,963.01	44,299.91	41,953.21	42,104.61
Total (without LULUCF, with indirect)	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
1. Energy	23,785.67	24,151.53	26,055.67	25,485.25	25,771.39	25,735.69	27,298.06	29,251.40	27,730.81	29,158.82
2. Industrial processes and product use	3,579.87	3,728.55	3,373.79	3,213.44	3,083.17	3,171.28	3,366.37	3,223.97	3,254.86	3,387.66
3. Agriculture	34,257.22	34,454.65	33,929.78	34,324.75	35,537.32	36,108.81	36,391.67	37,292.87	36,635.75	36,864.96
4. Land use, land-use change and forestry[5]	–31,161.77	–33,565.80	–33,348.74	–33,487.67	–32,561.00	–30,740.56	–29,578.04	–30,027.14	–30,283.19	–31,978.00
5. Waste	4,041.86	4,152.51	4,257.74	4,356.35	4,307.13	4,392.35	4,481.34	4,555.21	4,611.37	4,667.57
6. Other	3.64	3.63	3.63	3.62	3.64	3.63	3.61	3.61	3.60	3.60
Total (including LULUCF)[5]	34,506.48	32,925.07	34,271.88	33,895.75	36,141.64	38,671.20	41,963.01	44,299.91	41,953.21	42,104.61

CTF Table 1: Emissions trends summary (Part 2 of 3)

Greenhouse gas source and sink categories	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	32,298.33	34,476.04	34,658.32	36,375.40	35,960.98	37,593.13	37,485.80	36,576.84	37,593.15	34,772.29
CO_2 emissions with net CO_2 from LULUCF	913.75	3,129.80	5,805.45	6,376.75	6,037.84	8,449.12	10,331.39	10,811.56	4,892.89	4,093.08
CH_4 emissions without CH_4 from LULUCF	35,223.39	35,607.39	35,413.70	35,541.72	35,509.91	35,731.10	35,945.58	35,012.46	34,007.38	34,181.83
CH_4 emissions with CH_4 from LULUCF	35,307.39	35,691.47	35,499.30	35,631.36	35,590.62	35,846.67	36,064.32	35,172.83	34,097.05	34,284.87
N_2O emissions without N_2O from LULUCF	8,354.55	8,648.04	8,831.75	9,048.40	9,104.05	9,189.38	9,114.07	8,783.05	8,613.89	8,468.59
N_2O emissions with N_2O from LULUCF	8,590.78	8,879.60	9,057.94	9,271.14	9,323.21	9,412.73	9,337.73	9,026.32	8,814.54	8,667.70
HFCs	216.08	280.84	375.43	473.01	548.01	662.11	769.05	884.78	987.65	978.16
PFCs	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
SF_6	19.56	20.04	23.32	25.19	28.92	25.13	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
Total (without LULUCF)	76,179.52	79,102.96	79,386.99	81,590.53	81,250.99	83,270.23	83,442.28	81,325.40	81,266.89	78,477.27
Total (with LULUCF)	45,115.16	48,072.36	50,845.92	51,904.25	51,627.71	54,465.14	56,630.26	55,963.77	48,856.94	48,100.21
Total (without LULUCF, with indirect)	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
1. Energy	29,947.83	31,974.43	31,994.59	33,475.23	33,029.97	34,529.59	34,714.54	33,389.32	34,789.32	32,103.26
2. Industrial processes and product use	3,425.57	3,539.15	3,654.44	3,885.62	3,918.35	4,029.38	4,141.47	4,398.85	4,296.80	4,177.20
3. Agriculture	38,060.44	38,782.88	38,889.83	39,437.10	39,486.99	39,873.80	39,825.34	38,789.83	37,490.37	37,565.82
4. Land use, land-use change and forestry(5)	–31,064.35	–31,030.60	–28,541.07	–29,686.27	–29,623.28	–28,805.08	–26,812.02	–25,361.64	–32,409.95	–30,377.06
5. Waste	4,742.08	4,802.90	4,844.53	4,788.97	4,812.06	4,833.84	4,757.33	4,743.78	4,686.75	4,627.32
6. Other	3.60	3.60	3.61	3.62	3.62	3.62	3.61	3.63	3.66	3.67
Total (including LULUCF)(5)	45,115.16	48,072.36	50,845.92	51,904.25	51,627.71	54,465.14	56,630.26	55,963.77	48,856.94	48,100.21

CTF Table 1: Emissions trends summary (Part 3 of 3)

Greenhouse gas source and sink categories	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)	Change from base to latest reported year (%)
CO_2 emissions without net CO_2 from LULUCF	34,996.79	34,313.73	35,985.82	35,310.37	35,622.22	35,838.89	34,259.98	36,023.73	41.52
CO_2 emissions with net CO_2 from LULUCF	3,542.07	7,486.26	10,130.30	11,956.34	9,464.11	10,290.98	9,194.49	11,865.43	–297.37
CH_4 emissions without CH_4 from LULUCF	34,220.98	34,348.67	34,811.75	34,899.78	35,150.21	34,636.07	34,196.16	34,132.10	6.17
CH_4 emissions with CH_4 from LULUCF	34,321.54	34,421.36	34,892.02	34,979.54	35,217.27	34,714.34	34,301.96	34,225.03	6.13
N_2O emissions without N_2O from LULUCF	8,630.70	8,791.43	8,963.93	8,963.16	9,083.34	9,114.64	9,090.43	9,116.49	27.80
N_2O emissions with N_2O from LULUCF	8,825.02	8,980.05	9,149.86	9,139.35	9,234.89	9,259.53	9,218.54	9,223.40	25.65
HFCs	1,046.03	1,171.21	1,224.32	1,300.47	1,364.00	1,537.16	1,523.30	1,505.70	100.00
PFCs	47.56	35.15	47.46	48.13	73.41	58.59	48.69	60.46	–93.36
Unspecified mix of HFCs and PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
SF_6	22.84	18.92	21.38	18.75	16.95	16.68	17.56	15.00	–24.91
NF_3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
Total (without LULUCF)	78,964.90	78,679.12	81,054.66	80,540.66	81,310.14	81,202.02	79,136.11	80,853.47	23.12
Total (with LULUCF)	47,805.05	52,112.95	55,465.34	57,442.57	55,370.64	55,877.27	54,304.54	56,895.02	64.88
Total (without LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	0.00
Total (with LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	0.00
1. Energy	32,170.44	31,260.08	32,801.56	32,133.70	32,318.91	32,395.89	31,103.81	32,876.58	38.22
2. Industrial processes and product use	4,536.01	4,620.32	4,666.82	4,828.03	5,035.05	5,288.36	4,987.13	4,968.56	38.79
3. Agriculture	37,728.70	38,377.16	39,222.46	39,290.96	39,734.27	39,335.92	38,925.85	38,880.72	13.50
4. Land use, land-use change and forestry[5]	–31,159.85	–26,566.17	–25,589.32	–23,098.09	–25,939.50	–25,324.75	–24,831.57	–23,958.45	–23.12
5. Waste	4,526.05	4,417.86	4,360.36	4,285.19	4,219.11	4,179.04	4,116.48	4,124.75	2.05
6. Other	3.69	3.70	3.48	2.78	2.79	2.81	2.84	2.86	–21.33
Total (including LULUCF)[5]	47,805.05	52,112.95	55,465.34	57,442.57	55,370.64	55,877.27	54,304.54	56,895.02	64.88

Note: C = carbon; CH_4 =methane; CO_2 = carbon dioxide; HFCs = hydrofluorocarbons; IE = included elsewhere; kt CO_2-equivalent = kilotonnes of carbon dioxide equivalent; LULUCF = land use, land-use change and forestry; N_2O = nitrous oxide; NA = not applicable; NE = not estimated; NF_3 = nitrogen trifluoride; NO = not occurring; ODS = ozone depleting substances; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride.

(1) The column 'Base year' should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

(2) Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (–) and for emissions positive (+).

(3) In accordance with the UNFCCC reporting guidelines, for Parties that decide to report indirect CO_2 the national totals shall be provided with and without indirect CO_2.

(4) In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (ie, mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is kt of CO_2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

(5) Includes net CO_2, CH_4 and N_2O from LULUCF.

Appendix B: Supplementary information on projections

B.1: Key variables and assumptions

CTF Table 5: Summary of key variables and assumptions used in the projections analysis

Key underlying assumptions	Unit	Scenarios	Historical							Projected			
			1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
Population	million	WOM/WEM/WAM	3.46	3.67	3.86	4.13	4.35	4.59	4.77	5.00	5.29	5.52	5.72
		Low emissions	3.46	3.67	3.86	4.13	4.35	4.59	4.77	5.00	5.24	5.36	5.43
		High emissions	3.46	3.67	3.86	4.13	4.35	4.59	4.77	5.00	5.34	5.69	6.01
GDP	real 2009/10 $NZ billion	WOM/WEM/WAM	112.7	130.5	152.1	184.1	196.7	225.3	241.3	261.9	294.2	323.9	354.0
		Low emissions	112.7	130.5	152.1	184.1	196.7	225.3	241.3	261.9	288.6	304.6	317.6
		High emissions	112.7	130.5	152.1	184.1	196.7	225.3	241.3	261.9	298.5	340.9	385.7
Effective carbon price[136]	real 2017 $NZ per tonne CO_2-e	WOM	NA	NA	NA	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		WEM	NA	NA	NA	NA	4.91	3.37	11.88	25.00	26.88	30.00	31.88
		WAM	NA	NA	NA	NA	4.91	3.37	11.88	25.00	34.38	50.00	62.50
		Low emissions	NA	NA	NA	NA	4.91	3.37	11.88	25.00	29.69	37.50	40.63
		High emissions	NA	NA	NA	NA	4.91	3.37	11.88	25.00	25.00	25.00	25.00
Net migration	thousand people	WOM/WEM/WAM/High/Low	2.0	22.7	-9.8	8.6	16.5	53.4	58.9	33.6	21.0	15.0	15.0
Exchange rate	NZ$/US$	WOM/WEM/WAM/High/Low	0.60	0.66	0.46	0.70	0.72	0.70	0.71	0.65	0.65	0.65	0.65

[136] The assumed carbon price in the energy and transport sectors diverges from those stated here after 2030. In 2035 the 'with existing measures' price used by these sectors is $37 per tonne of carbon dioxide equivalent.

Key underlying assumptions	Unit	Scenarios	Historical							Projected			
			1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
Labour force	million people	WOM/WEM/WAM/High/Low	1.67	1.80	1.92	2.16	2.30	2.48	2.65	2.84	3.03	3.15	3.24
Afforestation	hectares	WEM	14,740	66,117	32,188	9,328	9,382	3,397	6,536	21,696	23,774	25,852	27,930
		WAM	14,740	66,117	32,188	9,328	9,382	3,397	6,536	22,509	33,728	46,216	49,816
		Low emissions	14,740	66,117	32,188	9,328	9,382	3,397	6,536	22,112	26,268	30,424	34,580
		High emissions	14,740	66,117	32,188	9,328	9,382	3,397	6,536	21,280	21,280	21,280	21,280
Deforestation	hectares	WEM	1,908	1,908	4,602	17,027	11,193	6,635	4,007	1,538	1,270	1,270	1,270
		WAM	1,908	1,908	4,602	17,027	11,193	6,635	4,007	1,323	789	789	789
		Low emissions	1,908	1,908	4,602	17,027	11,193	6,635	4,007	1,323	789	789	789
		High emissions	1,908	1,908	4,602	17,027	11,193	6,635	4,007	1,752	1,752	1,752	1,752
Upper limit on importation of HFCs	kilotonnes CO_2-e	WEM/WAM/High/Low	NA	NA	NA	NA	NA	NA	NA	1,338	857	535	348
New Zealand baseline for HFC importation	percent	WEM/WAM/High/Low	NA	NA	NA	NA	NA	NA	NA	100	64	40	26
Managed waste volumes	kilotonnes	WOM/WEM/WAM/High/Low	2,607	3,033	2,806	3,081	2,511	3,208	3,495	3,533	3,645	3,777	3,864
Total number of farms	number	WOM/WEM/WAM/High/Low	80,904	68,776	77,029	64,488	59,907	55,263	52,295	58,849	57,108	55,366	53,625
Dairy area	thousand hectares	WEM	1,024	1,208	1,329	1,399	1,639	1,752	1,755	1,750	1,771	1,790	1,796
		WOM	1,024	1,208	1,329	1,399	1,639	1,752	1,755	1,749	1,773	1,795	1,814
		WAM	1,024	1,208	1,329	1,399	1,639	1,752	1,755	1,748	1,769	1,782	1,784
		Low emissions	1,024	1,208	1,329	1,399	1,639	1,752	1,755	1,748	1,768	1,784	1,792
		High emissions	1,024	1,208	1,329	1,399	1,639	1,752	1,755	1,747	1,769	1,787	1,795
	thousand hectares	WEM	12,054	11,610	10,587	9,825	9,200	8,415	8,331	8,041	7,621	7,275	6,971
		WOM	12,054	11,610	10,587	9,825	9,200	8,415	8,331	8,040	7,687	7,426	7,212

Key underlying assumptions	Unit	Scenarios	Historical							Projected			
			1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
Sheep beef deer area (includes sheep-beef-deer crop land)		WAM	12,054	11,610	10,587	9,825	9,200	8,415	8,331	8,040	7,617	7,238	6,873
		Low emissions	12,054	11,610	10,587	9,825	9,200	8,415	8,331	8,043	7,621	7,268	6,931
		High emissions	12,054	11,610	10,587	9,825	9,200	8,415	8,331	8,045	7,632	7,298	7,010
Horticulture area	thousand hectares	WEM/WOM/WAM/Low/High	72	94	93	97	105	104	111	113	116	119	122
Arable land	thousand hectares	WEM/WOM/WAM/Low/High	191	161	161	149	171	161	138	150	150	134	134
Exotic forest	thousand hectares	WEM	1,333	1,617	1,805	1,832	1,816	1,814	1,820	1,875	2,034	2,158	2,283
		WOM	1,321	1,593	1,767	1,775	1,743	1,742	1,747	1,852	1,893	1,888	1,874
		WAM	1,333	1,617	1,805	1,832	1,816	1,814	1,820	1,876	2,056	2,235	2,438
		Low emissions	1,333	1,617	1,805	1,832	1,816	1,814	1,820	1,876	2,048	2,195	2,353
		High emissions	1,333	1,617	1,805	1,832	1,816	1,814	1,820	1,873	2,020	2,121	2,213
Other land	thousand hectares	WEM	2,816	1,888	1,934	2,003	1,649	1,683	1,746	1,619	1,627	1,663	1,678
		WOM	2,674	1,730	1,768	1,815	1,466	1,476	1,535	1,617	1,527	1,451	1,318
		WAM	2,816	1,888	1,934	2,003	1,649	1,683	1,746	1,625	1,635	1,716	1,784
		Low emissions	2,816	1,888	1,934	2,003	1,649	1,683	1,746	1,619	1,619	1,692	1,736
		High emissions	2,816	1,888	1,934	2,003	1,649	1,683	1,746	1,621	1,620	1,649	1,627
Total agriculture land use	thousand hectares	WEM	17,489	16,578	15,909	15,306	14,580	13,929	13,900	13,548	13,318	13,138	12,983
		WOM	17,489	16,578	15,909	15,306	14,580	13,929	13,900	13,522	13,146	12,811	12,473
		WAM	17,489	16,578	15,909	15,306	14,580	13,929	13,900	13,553	13,343	13,223	13,134
		Low emissions	17,489	16,578	15,909	15,306	14,580	13,929	13,900	13,548	13,322	13,191	13,067
		High emissions	17,489	16,578	15,909	15,306	14,580	13,929	13,900	13,549	13,307	13,107	12,900

Key underlying assumptions	Unit	Scenarios	Historical							Projected			
			1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
Total nitrogen fertiliser	thousand tonnes per year	WEM	59	151	189	350	333	429	443	436	419	402	399
		WOM	59	151	189	350	333	429	443	439	439	439	439
		WAM	59	151	189	350	333	429	443	436	419	401	396
		Low emissions	59	151	189	350	333	429	443	436	419	401	398
		High emissions	59	151	189	350	333	429	443	436	419	402	399
Total annual milk production	million litres per year	WEM	7,199	8,957	11,630	14,103	16,483	21,253	20,702	20,753	20,441	20,223	20,419
		WOM	7,199	8,957	11,630	14,103	16,483	21,253	20,702	20,380	21,212	21,733	22,273
		WAM	7,199	8,957	11,630	14,103	16,483	21,253	20,702	20,329	20,426	20,120	20,217
		Low emissions	7,199	8,957	11,630	14,103	16,483	21,253	20,702	20,753	20,156	19,704	19,674
		High emissions	7,199	8,957	11,630	14,103	16,483	21,253	20,702	20,683	20,728	20,686	21,149
Light passenger vehicles – Internal Combustion Engine[137]	thousands	WOM/WEM/WAM/High/Low	NA	NA	2,147.7	2,578.6	2,705.3	2,979.0	3,214.5	3,504.4	3,628.2	3,588.9	3,330.9
Light passenger vehicles – Electric vehicle	thousands	WOM/WEM/WAM/High/Low	NA	NA	0.05	0.05	0.06	0.98	6.14	17.91	66.85	222.50	581.70
Light commercial vehicles – Internal Combustion Engine	thousands	WOM/WEM/WAM/High/Low	NA	NA	347.20	388.21	416.72	503.20	580.05	565.46	591.09	595.71	569.21
Light commercial vehicles – Electric vehicle	thousands	WOM/WEM/WAM/High/Low	NA	NA	NA	NA	NA	NA	NA	10.03	43.46	95.06	156.15

[137] For historical vehicles numbers, see Ministry of Transport. 2017. *New Zealand 2017 Vehicle Fleet: Data Spreadsheet*. Wellington: Ministry of Transport. Retrieved from www.transport.govt.nz/assets/Uploads/Research/Documents/Fleet-reports/b19d737497/NZ-Vehicle-Fleet-Graphs-2017-WEB.xlsx.

Key underlying assumptions	Unit	Scenarios	Historical							Projected			
			1990	1995	2000	2005	2010	2015	2017	2020	2025	2030	2035
Heavy commercial vehicles – Internal Combustion Engine	thousands	WOM/WEM/WAM/High/Low	NA	NA	95.58	119.56	128.49	136.13	144.14	158.48	167.12	171.11	170.24
Motorcycles	thousands	WOM/WEM/WAM/High/Low	NA	NA	77.94	96.55	139.32	157.64	170.55	176.42	188.14	199.09	207.57
Buses – Internal Combustion Engine	thousands	WOM/WEM/WAM/High/Low	NA	NA	4.57	6.62	8.47	9.45	10.64	11.22	11.37	11.38	11.33
Trucks and buses – Electric vehicles and plug-in hybrids	thousands	WOM/WEM/WAM/High/Low	NA	NA	0.07	0.08	0.08	0.07	0.07	0.22	0.86	3.00	7.00

Note: CO_2-e = carbon dioxide equivalent; GDP = gross domestic product; HFCs = hydrofluorocarbons; NA = not applicable; WAM = with additional measures; WEM = with existing measures; WOM = without measures.

B.2: Agriculture methodologies

This section describes the modelling approach used to generate estimates of future activity data and emissions for agriculture.

Emissions from 1990 to 2017 in the 'with measures' and 'with additional measures' scenarios are identical to those reported in *New Zealand's Greenhouse Gas Inventory 1990–2017*.[138]

Dairy, beef, sheep and deer emissions

Emissions from dairy cattle, beef cattle, sheep and deer made up 91.7 per cent of New Zealand's total agriculture emissions in 2017. For these four animal categories, projections of agricultural greenhouse gas emissions have been created as follows:

1. forecasts of activity data, such as animal production and animal population numbers, from the Ministry for Primary Industries' (MPI's) Pastoral Supply Response Model (PSRM); estimates of future afforestation and deforestation expected on agricultural land from the land use, land-use change and forestry (LULUCF) sector projections, which were used as an exogenous input into the PSRM
2. the assumed effects of the National Policy Statement for Freshwater Management (NPS-FM) to modify the forecast activity data from the PSRM
3. the forecast activity data, which was put into MPI's agricultural greenhouse gas inventory model to estimate future emissions.

The PSRM, NPS-FM and the modelling of forestry policy on agriculture emissions are explained in more detail below.

Pastoral Supply Response Model

MPI projects New Zealand's future agricultural activity by using economic analysis and bottom-up modelling. The PSRM forecasts agricultural production and animal productivity using:

- historical agriculture production, animal numbers and prices
- land-use forecasts
- historical and forecast commodity prices.

Agriculture land-use forecasts are based on historical national-level interactions between competing land classes, farm prices, commodity export prices, and farm profitability. The PSRM is also used by MPI to inform the *Situation and Outlook for Primary Industries* quarterly report. The 'with existing measures'[139] scenario assumptions for forest harvesting, replanting and deforestation rates are used as an exogenous input to ensure that the agriculture projections are consistent with LULUCF projections.

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138 Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

139 For more information on the 'with existing measures' scenario used in LULUCF projections, see the key assumptions under the Land use, land-use change and forestry section in this chapter.

The projection scenarios were calculated by modifying the PSRM output to account for the assumed effects of freshwater management reform (see 'Effects of the National Policy Statement for Freshwater Management' below) and expected rates of afforestation and deforestation on agricultural land, which were estimated as part of the LULUCF sector projections.

Effect of forestry policy, New Zealand Emissions Trading Scheme and New Zealand Unit price

The New Zealand Emissions Trading Scheme (NZ ETS) and government-funded afforestation initiatives are expected to increase the conversion of agricultural land to forestry and, therefore, reduce the amount of emissions from livestock, because the area of land available for livestock farming is lower compared with the situation where there are no government incentives to plant forests.

The NZ ETS provides NZUs for new forests as they grow, to encourage afforestation. In these projections, it was assumed the carbon price under the NZ ETS would gradually rise to $31.88 (per tonne of CO_2-e) by 2035. In 2019 the New Zealand Unit price was around $25.

It is expected that recent changes to the NZ ETS (announced in 2019) will further incentivise afforestation and ensure the NZ ETS is better aligned to meet New Zealand's climate change targets. The agriculture projections have accounted for the expected effects of these changes.

Other government-funded afforestation initiatives, such as the Sustainable Land Management Hill Country Erosion Programme, Erosion Control Funding Programme and the One Billion Trees Programme, also aim to increase the area of forested land to provide a range of social, economic and environmental benefits. These initiatives are also included in the 'with measures' projections for agriculture and LULUCF.

As stated earlier, estimates of afforestation and deforestation from these policies (estimated as part of the LULUCF projections) are used as an input into the modelling of agricultural land and the PSRM, which is used to help estimate activity data for dairy cattle, beef cattle, sheep and deer.

A more detailed description of the NZ ETS and government-funded forestry programmes is provided in chapter III, and table 4.6 estimates the expected effect of these policies on projected agricultural emissions.

Effects of the National Policy Statement for Freshwater Management

The NPS-FM aims to improve the quality of fresh water in New Zealand, and requires regional councils to establish water quality objectives for catchments in their region.

The NPS-FM was first introduced in 2011 and updated in 2014 to provide more detailed instruction on how regional councils should manage water resources to maintain and improve freshwater quality. The 2014 NPS-FM also established that two measurements for water quality (relating to *ecosystem health* and *human health for recreation*) must be managed at or above minimum 'bottom line' values.

Research undertaken by Motu Economic and Public Policy Research[140] modelled the effects of implementing the NPS-FM on future agricultural activity and emissions. The results showed that its implementation is likely to slow the growth of livestock populations, production and agricultural emissions, due to:

- the introduction of nutrient discharge caps, which could require reductions in the application of fertiliser and restrictions on the stocking of animals near water bodies
- restrictions on land use intensification
- requirements for farmers to demonstrate good farm management practices (such as the establishment of riparian buffers near streams, and manure and fertiliser management – application area, timing and amount)
- regulated requirement to use nutrient management tools (such as OVERSEER[141] or on-farm emission calculators) to improve decision-making and optimise profit, productivity and reduce environmental impacts.

It is estimated that these requirements and restrictions began affecting agricultural emissions in 2016. The NPS-FM is expected to be fully implemented by all regional councils between 2025 and 2030.

Emissions from other animals, fertiliser, lime and cropping

Agricultural emissions from activities other than dairy cattle, beef cattle, sheep and deer made up 8.3 per cent of New Zealand's total agriculture emissions in 2017. These activities include:

- use of nitrogen fertiliser, including urea (5.8 per cent of agricultural emissions)
- use of lime (1.2 per cent)
- decay of crop residues following harvest (0.7 per cent)
- crop burning (0.1 per cent)
- histosols and nitrogen mineralisation (0.1 per cent)
- swine (0.2 per cent)
- goats (0.1 per cent)
- horses, llama and alpacas, mules and asses, and poultry (0.2 per cent).

For the projections, the use of nitrogen fertiliser is assumed to decline by around 10 per cent between 2017 and 2035 due to a decline in the area of total agricultural land (excluding forestry) and NPS-FM regulation. It was assumed that the proportion of urea coated with urease inhibitor would increase from 28 per cent in 2017 to 50 per cent by 2030.

Emissions from crop burning and residues are assumed to fall slightly (3 per cent between 2017 and 2035) in line with a decline in the area of arable land, forecast by the PSRM. Goat numbers are forecast to rise from around 100,000 to 120,000 by 2035.

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[140] Daigneault A, Elliot S, Greenhalgh S, Kerr S, Lou E, Murphy L, Timar L, Wadhwa S. 2016. *Modelling the Potential Impact of New Zealand's Freshwater Reforms on Land-Based Greenhouse Gas Emissions*. Report to the Ministry for Primary Industries. Wellington: Ministry for Primary Industries.

[141] OVERSEER is an online tool that allows farmers to examine the impact of nutrient use and flows within a farm, and off-farm losses of nutrients and greenhouse gases; for more information, see www.overseer.org.nz.

For the remaining minor agriculture emissions categories (including lime, histosols, nitrogen mineralisation, swine, horses, llama, alpacas, mules, asses and poultry) there was not enough evidence to suggest that these activities will increase or decrease significantly. The activity data and emissions for these categories were projected to remain identical to the 2017 emissions level between 2018 and 2035.

Estimating greenhouse gas emissions

New Zealand uses a range of methods, appropriate to the size of the different emissions categories, to calculate agricultural emissions. In 2017, 91.7 per cent of New Zealand's agriculture emissions were generated by the four major grazed livestock categories: dairy cattle, non-dairy cattle, sheep and deer. New Zealand uses detailed livestock population and production data, and a complex ruminant animal nutritional and energy model to calculate emissions from these livestock. This includes methane and nitrous oxide emissions from enteric fermentation and manure management.

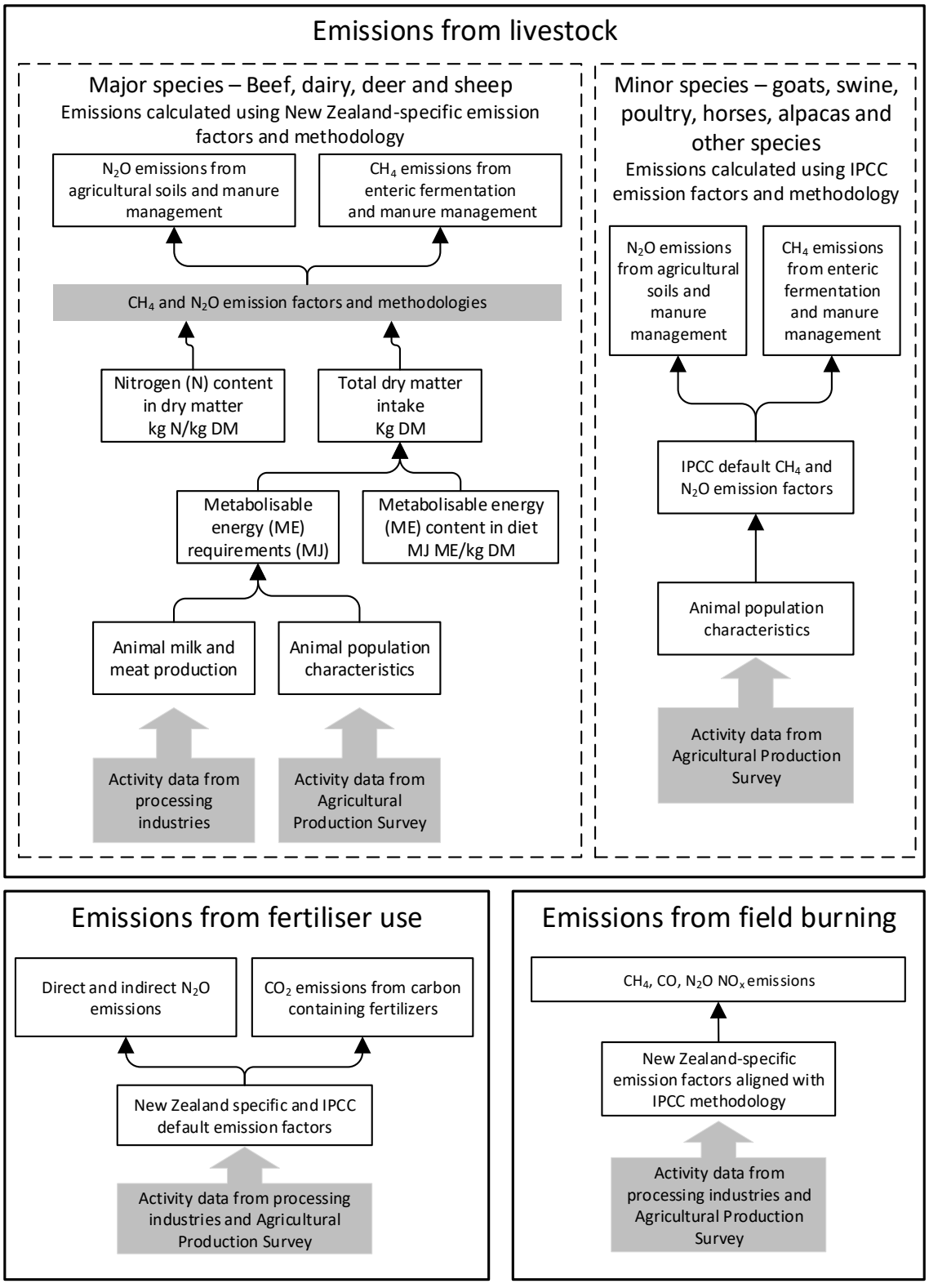
Other livestock species (swine, goats, horses, llama and alpacas, mules and asses, and poultry – referred to as 'minor' livestock categories) account for only 0.5 per cent of New Zealand's agriculture emissions and are estimated primarily using Tier 1 methods. Where possible, New Zealand has used country-specific methods and emission factors to estimate emissions for these minor livestock species.

Direct and indirect nitrous oxide emissions from synthetic fertiliser account for 4.3 per cent of New Zealand's agricultural emissions, and are calculated using country-specific emission factors. Carbon dioxide emissions from liming and urea contributed 2.7 per cent of New Zealand's total agricultural emissions in 2017.

The remaining 0.8 per cent of New Zealand's agriculture emissions is due to organic fertiliser, crop residue returned to the soil, cropland cultivation (histosols and nitrogen mineralisation) and cropland burning. Emissions from crop residues and the burning of agriculture residues are calculated using a Tier 2 method.

Figure 4.15 outlines how the greenhouse gas inventory calculates different emission categories.

Figure 4.15: How New Zealand's agriculture emissions are calculated



Note: CO = carbon monoxide; CO_2 = carbon dioxide; CH_4 = methane; DM = dry matter; IPCC = Intergovernmental Panel on Climate Change; kg = kilogram; MJ = megajoule; N_2O = nitrous oxide; NO_x = nitrogen oxides.

New Zealand's greenhouse gas methodology is based on the 2006 IPCC guidelines.[142] A further explanation of the methodology can be found in *New Zealand's Greenhouse Gas Inventory 1990–2017*,[143] and full details are given in the report *Methodology for calculation of New Zealand's agricultural greenhouse gas emissions*.[144]

Assumptions on future mitigation technologies

The potential effect of new mitigation technologies, such as vaccines, inhibitors and low-emission feeds, are not yet included in the 'with existing measures', 'without measures' or 'with additional measures' projections. This decision was made because research into these technologies is not yet advanced enough to enable an accurate calculation of the likely impact of uptake of these technologies.

A review of the literature determined that, while inhibitors and vaccines are the on-farm mitigation technologies with the largest potential in terms of absolute agricultural emission reductions, these technologies are not yet commercially available, and require further development to reach their potential on farm and at scale with sustained reduction through time.[145, 146, 147] The ability of all future mitigation practices to reduce emissions in practice depends on their actual adoption by farmers, which is variable across farmers and farm types.[148] Issues of adoption and efficacy of mitigation technologies are compounded further by the potential failure to reach the market due to market or regulatory barriers.

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142 IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Prepared by the National Greenhouse Gas Inventories Programme for the IPCC. Japan: IPCC. Retrieved from www.ipcc-nggip.iges.or.jp/public/2006gl/.

143 Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment. Retrieved from www.mfe.govt.nz/sites/default/files/media/Climate%20Change/nz-greenhouse-gas-inventory-2019.pdf (19 June 2019).

144 Pickering A, Gibbs J. 2018. *Methodology for calculation of New Zealand's agricultural greenhouse gas emissions*. Wellington: Ministry for Primary Industries. Retrieved from www.mpi.govt.nz/dmsdocument/13906-detailed-methodologies-for-agricultural-greenhouse-gas-emission-calculation.

145 Reisinger A, Clark H, Abercrombie R, Aspin M, Ettema P, Harris M, Hoggard A, Newman M, Sneath G. 2019. *Future options to reduce biological GHG emissions on-farm: Critical assumptions and national scale impact*. Wellington: Biological Emissions Reference Group.

146 Biological Emissions Reference Group. 2018. *Report of the Biological Emissions Reference Group*. Wellington: Biological Emissions Reference Group.

147 New Zealand Agriculture and Greenhouse Gas Research Centre. 2016. *Modelling agriculture's contribution to New Zealand's contribution to the post-2020 agreement*. Wellington: MPI.

148 Reisinger A, Clark H, Abercrombie R, Aspin M, Ettema P, Harris M, Hoggard A, Newman M, Sneath G. 2019. *Future options to reduce biological GHG emissions on-farm: Critical assumptions and national scale impact*. Wellington: Biological Emissions Reference Group.

Appendix C: CTF table 6 Information on updated emissions projections

CTF Table 6a: Information on updated greenhouse gas projections (with measures) [1] [2] [3]

GHG emissions projections	GHG emissions and removals						With measures		
	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)	2017 (kt CO_2-e)	2020 (kt CO_2-e)	2030 (kt CO_2-e)
Sector									
Energy	15,013.41	14,772.13	17,522.70	20,628.11	18,007.99	17,624.38	16,940.86	17,306.34	15,333.31
Transport	8,772.25	10,963.56	12,425.13	13,901.48	14,162.45	14,771.51	15,935.72	16,401.20	14,948.75
Industry/industrial processes	3,579.87	3,171.28	3,425.57	4,029.38	4,536.01	5,288.36	4,968.56	5,326.24	5,568.11
Agriculture	34,257.22	36,108.81	38,060.44	39,873.80	37,728.70	39,335.92	38,880.72	37,839.15	35,456.48
Forestry/LULUCF[4][5]	–31,161.77	–30,740.56	–31,064.35	–28,805.08	–31,159.85	–25,324.75	–23,958.45	–14,331.46	–9,192.71
Waste management/waste	4,041.86	4,392.35	4,742.08	4,833.84	4,526.05	4,179.04	4,124.75	4,052.78	3,956.11
Other Sectors									
Tokelau	3.64	3.63	3.60	3.62	3.69	2.81	2.86	2.89	2.97
Gases[6]									
CO_2 emissions including net CO_2 from LULUCF	–6,011.67	–3,064.82	913.75	8,449.12	3,542.07	10,290.98	11,865.43	22,377.22	24,104.33
CO_2 emissions excluding net CO_2 from LULUCF	25,455.16	28,010.63	32,298.33	37,593.13	34,996.79	35,838.89	36,023.73	36,920.80	33,512.14
CH_4 emissions including CH_4 from LULUCF	32,247.87	33,470.02	35,307.39	35,846.67	34,321.54	34,714.34	34,225.03	33,356.95	31,462.84
CH_4 emissions excluding CH_4 from LULUCF	32,149.96	33,366.70	35,223.39	35,731.10	34,220.98	34,636.07	34,132.10	33,262.85	31,368.05
N_2O emissions including N_2O from LULUCF	7,340.35	8,066.86	8,590.78	9,412.73	8,825.02	9,259.53	9,223.40	8,991.17	8,436.34

GHG emissions projections	Base year (1990) (kt CO_2-e)	GHG emissions and removals 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)	With measures 2017 (kt CO_2-e)	2020 (kt CO_2-e)	2030 (kt CO_2-e)
N_2O emissions excluding N_2O from LULUCF	7,133.21	7,835.29	8,354.55	9,189.38	8,630.70	9,114.64	9,116.49	8,873.13	8,316.02
HFCs	0.00	21.45	216.08	662.11	1,046.03	1,537.16	1,505.70	1,783.93	1,983.61
PFCs	909.95	153.28	67.61	69.38	47.56	58.59	60.46	70.72	70.72
SF_6	19.97	24.42	19.56	25.13	22.84	16.68	15.00	17.15	15.19
NF_3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Other gases									
Total with LULUCF[(5)]	34,506.48	38,671.20	45,115.16	54,465.14	47,805.05	55,877.27	56,895.02	66,597.14	66,073.03
Total without LULUCF	65,668.25	69,411.76	76,179.52	83,270.23	78,964.90	81,202.02	80,853.47	80,928.58	75,265.73

CTF Table 6b: Information on updated greenhouse gas projections (without measures) [(1) (2) (3)]

GHG emissions projections	Base year (1990) (kt CO_2-e)	GHG emissions and removals 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)	Without measures 2017 (kt CO_2-e)	2020 (kt CO_2-e)	2030 (kt CO_2-e)
Sector									
Energy	15,013.41	14,772.13	17,522.70	20,645.89	18,084.14	17,797.08	17,211.73	18,101.91	16,607.22
Transport	8,772.25	10,963.56	12,425.13	13,901.48	14,162.45	14,771.51	15,935.72	16,401.20	14,948.75
Industry/industrial processes	3,579.87	3,171.28	3,425.57	4,029.38	4,536.01	5,288.36	4,968.56	5,328.74	6,118.47
Agriculture	34,257.22	36,108.81	38,060.44	39,873.80	37,728.70	39,335.92	38,943.85	38,127.62	38,259.17
Forestry/LULUCF[(4)(5)]	–31,161.77	–30,788.76	–30,779.16	–27,885.92	–29,204.94	–22,928.30	–19,828.92	–9,863.32	1,502.21

GHG emissions projections	GHG emissions and removals						Without measures		
	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)	2017 (kt CO_2-e)	2020 (kt CO_2-e)	2030 (kt CO_2-e)
Waste management/waste	4,041.86	4,392.35	4,742.08	4,833.84	4,818.87	4,632.61	4,663.27	4,747.25	5,011.78
Other Sectors									
Tokelau	3.64	3.63	3.60	3.62	3.69	3.73	3.78	3.80	3.88
Gases[6]									
CO_2 emissions including net CO_2 from LULUCF[4]	–6,011.67	–3,113.02	1,198.94	9,386.06	5,573.13	12,861.05	16,266.76	27,639.59	36,114.60
CO_2 emissions excluding net CO_2 from LULUCF	25,455.16	28,010.63	32,298.33	37,610.91	35,072.95	36,012.51	36,295.52	37,715.04	34,827.49
CH_4 emissions including CH_4 from LULUCF	32,247.87	33,470.01	35,307.39	35,846.68	34,614.35	35,167.90	34,808.52	34,363.27	34,623.64
CH_4 emissions excluding CH_4 from LULUCF	32,149.96	33,366.70	35,223.39	35,731.10	34,513.80	35,089.63	34,715.59	34,269.18	34,528.85
N_2O emissions including N_2O from LULUCF	7,340.35	8,066.87	8,590.77	9,412.73	8,825.03	9,259.53	9,241.57	9,132.76	9,076.83
N_2O emissions excluding N_2O from LULUCF	7,133.21	7,835.29	8,354.55	9,189.38	8,630.70	9,114.64	9,134.66	9,014.72	8,956.51
HFCs	0.00	21.45	216.08	662.11	1,046.03	1,537.16	1,505.70	1,786.42	2,533.96
PFCs[149]	909.95	153.28	67.61	69.38	47.56	58.59	60.46	70.72	70.72
SF_6[150]	19.97	24.42	19.56	25.13	22.84	16.68	15.00	17.15	15.19
NF_3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Other gases									
Total with LULUCF[5]	34,506.48	38,623.00	45,400.35	55,402.09	50,128.93	58,900.90	61,897.99	73,009.92	82,434.94
Total without LULUCF	65,668.25	69,411.76	76,179.52	83,288.00	79,333.87	81,829.20	81,726.91	82,873.23	80,932.73

149 Emissions of PFCs in the WOM scenario are unchanged relative to the WEM scenario. This is due to insufficient information about the historical and future impact of existing policies and measures on these gases.

150 SF_6 emissions in the WOM scenario are unchanged relative to the WEM scenario. This is due to insufficient information about the historical and future impact of existing policies and measures on this gas.

CTF Table 6c: Information on updated greenhouse gas projections (with additional measures) [1] [2] [3]

GHG emissions projections	GHG emissions and removals						With additional measures		
	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)	2017 (kt CO_2-e)	2020 (kt CO_2-e)	2030 (kt CO_2-e)
Sector									
Energy	15,013.41	14,772.13	17,522.70	20,628.11	18,007.99	17,624.38	16,940.86	17,313.45	14,963.19
Transport	8,772.25	10,963.56	12,425.13	13,901.48	14,162.45	14,771.51	15,935.72	16,401.20	14,948.75
Industry/industrial processes	3,579.87	3,171.28	3,425.57	4,029.38	4,536.01	5,288.36	4,968.56	5,326.24	5,568.11
Agriculture	34,257.22	36,108.81	38,060.44	39,873.80	37,728.70	39,335.92	38,880.72	37,838.39	35,262.67
Forestry/LULUCF[4][5]	–31,161.77	–30,740.56	–31,064.35	–28,805.08	–31,159.85	–25,324.75	–23,958.45	–14,802.86	–10,686.95
Waste management/waste	4,041.86	4,392.35	4,742.08	4,833.84	4,526.05	4,179.04	4,124.75	4,052.78	3,956.11
Other Sectors									
Tokelau	3.64	3.63	3.60	3.62	3.69	2.81	2.86	2.89	2.97
Gases[6]									
CO_2 emissions including net CO_2 from LULUCF[4]	–6,011.66	–3,064.83	913.75	8,449.12	3,542.06	10,290.98	11,865.44	21,912.56	22,247.57
CO_2 emissions excluding net CO_2 from LULUCF	25,455.16	28,010.63	32,298.33	37,593.13	34,996.79	35,838.89	36,023.73	36,927.55	33,149.61
CH_4 emissions including CH_4 from LULUCF	32,247.87	33,470.01	35,307.39	35,846.68	34,321.53	34,714.34	34,225.03	33,344.68	31,304.83
CH_4 emissions excluding CH_4 from LULUCF	32,149.96	33,366.70	35,223.39	35,731.10	34,220.98	34,636.07	34,132.10	33,250.59	31,210.04
N_2O emissions including N_2O from LULUCF	7,340.35	8,066.87	8,590.77	9,412.73	8,825.03	9,259.53	9,223.40	9,003.04	8,392.94
N_2O emissions excluding N_2O from LULUCF	7,133.21	7,835.29	8,354.55	9,189.38	8,630.70	9,114.64	9,116.49	8,885.00	8,272.62
HFCs	0.00	21.45	216.08	662.11	1,046.03	1,537.16	1,505.70	1,783.93	1,983.61

GHG emissions projections	GHG emissions and removals						With additional measures		
	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)	2017 (kt CO_2-e)	2020 (kt CO_2-e)	2030 (kt CO_2-e)
PFCs[151]	909.95	153.28	67.61	69.38	47.56	58.59	60.46	70.72	70.72
SF_6[152]	19.97	24.42	19.56	25.13	22.84	16.68	15.00	17.15	15.19
NF_3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Other gases									
Total with LULUCF(5)	34,506.48	38,671.20	45,115.16	54,465.14	47,805.05	55,877.27	56,895.02	66,132.08	64,014.86
Total without LULUCF	65,668.25	69,411.76	76,179.52	83,270.23	78,964.90	81,202.02	80,853.47	80,934.93	74,701.80

Note: CO_2 = carbon dioxide; CH_4 =methane; HFCs = hydrofluorocarbons; kt CO_2-equivalent = kilotonnes of carbon dioxide equivalent; LULUCF = land use, land-use change and forestry; N_2O = nitrous oxide; NA = not applicable; NO = not occurring; NF_3 = nitrogen trifluoride; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride.

(1) In accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", at a minimum Parties shall report a 'with measures' scenario, and may report 'without measures' and 'with additional measures' scenarios. If a Party chooses to report 'without measures' and/or 'with additional measures' scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report 'without measures' or 'with additional measures' scenarios then it should not include tables 6(b) or 6(c) in the biennial report.

(2) Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.

(3) In accordance with paragraph 34 of the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.

(4) For the purposes of reporting, the signs for removals are always negative (–) and for emissions positive (+).

151 Emissions of PFCs in the WAM scenario are unchanged relative to the WEM scenario. This is due to insufficient information to quantify the impact of additional policies and measures on these gases.

152 SF_6 emissions in the WAM scenario are unchanged relative to the WEM scenario. This is due to insufficient information to quantify the impact of additional policies and measures on these gases.

(5) Includes net CO_2, CH_4 and N_2O from LULUCF.

(6) In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (ie, mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is kt of CO_2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.