Ministry for the Environment
Manatū Mō Te Taiao

New Zealand's Greenhouse Gas Inventory

1990–2019

Volume 2, Annexes

Fulfilling reporting requirements under the
United Nations Framework Convention on
Climate Change and the Kyoto Protocol

New Zealand Government

Contents

See volume 1, chapters 1–15, for the National Inventory Report, which is presented separately.

Tables

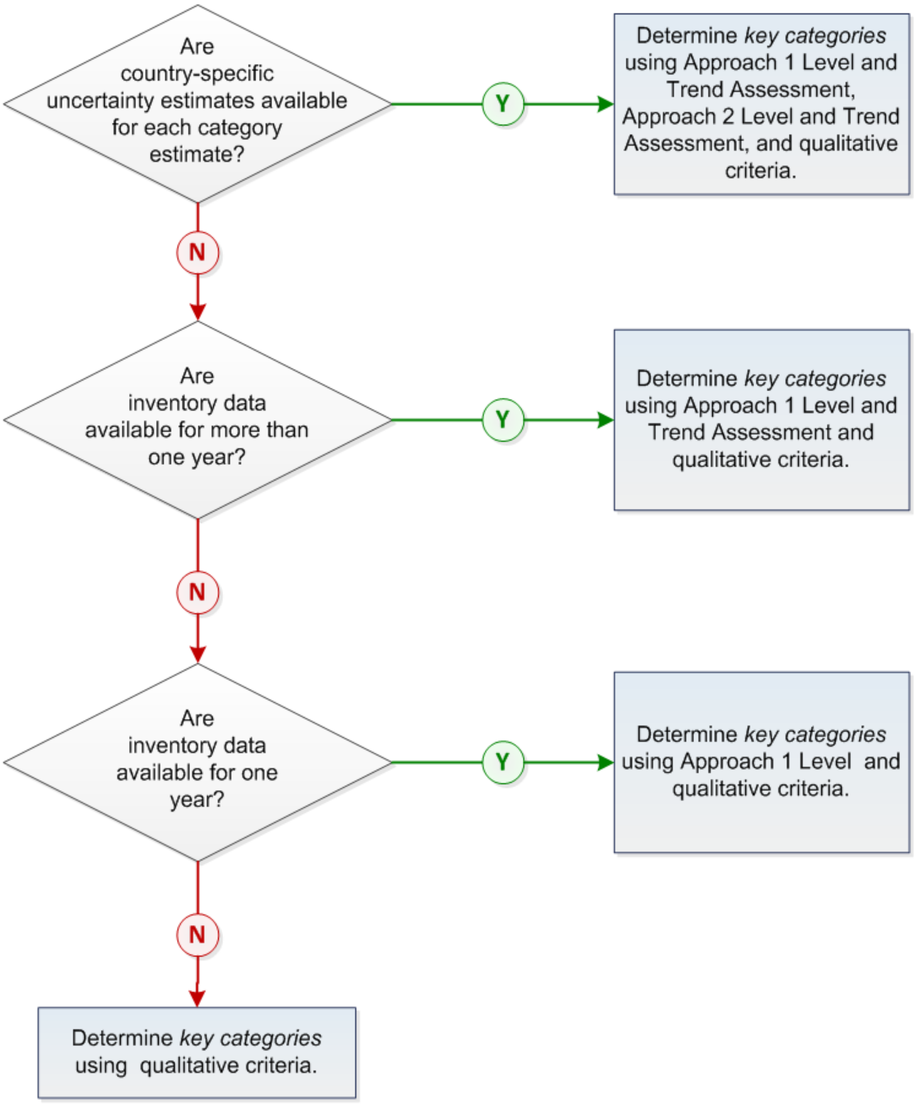
Figures

Annex 1: Key categories

A1.1 Methodology used for identifying key categories

The key categories in the inventory have been assessed using the Approach 1 level and trend methodologies from the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC, 2006). The methodology applied was determined using the decision tree shown in figure A1.1.1. Because some categories in the inventory apply default uncertainties values for emission estimates, and developing country-specific uncertainty values is resource prohibitive, Approach 1 level and trend methodologies are used.

Figure A1.1.1 Decision tree to identify key source categories (figure 4.2, IPCC, 2006)



For this inventory submission, the Approach 1 level and trend assessments were applied, including and excluding the Land Use, Land-Use Change and Forestry (LULUCF) sector (IPCC, 2006).

The level and trend assessments are calculated as per equations 4.1, 4.2 and 4.3 of the IPCC 2006 Guidelines (IPCC, 2006). Key categories are defined as those categories whose cumulative percentages, when summed in decreasing order of magnitude, contributed 95 per cent of the total level or trend.

A minor error in the formulas used to calculate trend key categories was identified after the 2020 submission and corrected for the 2021 submission. The formulas are now consistent with equations 4.2 and 4.3, volume 1 of the IPCC 2006 guidelines (IPCC, 2006). This correction made only small changes to the categories identified as trend key categories.

A1.2 Disaggregation

The classification of categories follows the classification of the common reporting format (CRF) tables by:

- identifying categories using carbon dioxide equivalent emissions and considering each greenhouse gas from each category separately
- either including or excluding LULUCF categories at the level shown in the IPCC 2006 guidelines table 4.1 (IPCC, 2006).

The level of aggregation used for the key category analysis is similar to the default aggregation used for the key category analysis within the CRF tables, with adjustments to better reflect New Zealand's emissions profile. Specifically, a large proportion of emissions from the Energy and Agriculture sectors are disaggregated further than the key category analysis generated in the CRF tables, to allow for a more evenly proportioned analysis of categories.

A1.3 Tables 4.2–4.3 of the IPCC 2006 Guidelines (General Guidance and Reporting)

The following tables specify the level analyses for 2019 and 1990, and trend analyses, each including and excluding LULUCF. The tables show the categories that comprise 99 per cent of emissions for each analysis. Only the categories that comprise the top 95 per cent of emissions for the 2019 level analysis and the trend analysis are key categories. The 1990 level analysis tables are included for information only.

Table A1.3.1(a) Results of the key category level analysis for 99 per cent of the net emissions and removals for New Zealand in 2019

IPCC Tier 1 category level assessment – including LULUCF (net emissions): 2019					
CRF category code	IPCC category	Gas	2019 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
4.A.1	Forest Land – Forest Land Remaining Forest Land	CO_2	–17,544.5	14.7	14.7
1.A.3.b	Transport – Road Transportation Liquid Fuels	CO_2	14,559.4	12.2	26.8
3.A.1	Option A – Dairy Cattle	CH_4	14,013.6	11.7	38.6
4.G	Land Use, Land-Use Change and Forestry – Harvested Wood Products	CO_2	–10,067.3	8.4	47.0
3.A.2	Other (please specify) – Sheep	CH_4	8,527.2	7.1	54.1
3.A.1	Option A – Non-Dairy *(Beef)* Cattle	CH_4	5,893.7	4.9	59.0
4.A.2	Forest Land – Land Converted to Forest Land	CO_2	–4,736.0	4.0	63.0

CRF category code	IPCC category	Gas	2019 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
3.D.1.3	Direct N_2O Emissions From Managed Soils – Urine and Dung Deposited by Grazing Animals	N_2O	3,899.3	3.3	66.3
4.C.2	Grassland – Land Converted to Grassland	CO_2	2,953.0	2.5	68.7
5.A	Waste – Solid Waste Disposal	CH_4	2,692.9	2.3	71.0
1.A.1.a	Energy Industries – Public Electricity and Heat Production Gaseous Fuels	CO_2	2,533.5	2.1	73.1
1.A.2.c	Manufacturing Industries and Construction – Chemicals Gaseous Fuels	CO_2	1,859.2	1.6	74.6
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Solid Fuels	CO_2	1,751.6	1.5	76.1
2.C.1	Metal Industry – Iron and Steel Production	CO_2	1,661.6	1.4	77.5
2.F.1	Product Uses as Substitutes for ODS – Refrigeration and Air conditioning	HFCs	1,637.7	1.4	78.9
1.A.1.a	Energy Industries – Public Electricity and Heat Production Solid Fuels	CO_2	1,634.8	1.4	80.2
3.D.1.1	Direct N_2O Emissions from Managed Soils – Inorganic N Fertilizers	N_2O	1,429.3	1.2	81.4
3.B.1.1	Option A – Dairy Cattle	CH_4	1,384.2	1.2	82.6
4.C.1	Grassland – Grassland Remaining Grassland	CO_2	1,228.2	1.0	83.6
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Gaseous Fuels	CO_2	1,197.6	1.0	84.6
1.A.4.c	Other Sectors – Agriculture/Forestry/Fishing Liquid Fuels	CO_2	1,154.3	1.0	85.6
1.A.3.a	Domestic Aviation – Jet Kerosene	CO_2	989.6	0.8	86.4
3.D.2.1	Indirect N_2O Emissions From Managed Soils – Atmospheric Deposition	N_2O	925.3	0.8	87.2
1.A.2.g.iii	Other (please specify) – Mining (excluding fuels) and quarrying Liquid Fuels	CO_2	834.6	0.7	87.9
1.A.1.b	Energy Industries – Petroleum Refining Liquid Fuels	CO_2	663.7	0.6	88.4
3.D.1.6	Direct N_2O Emissions from Managed Soils – Cultivation of Organic Soils	N_2O	653.0	0.5	89.0
1.A.4.a	Other Sectors – Commercial/Institutional Liquid Fuels	CO_2	587.4	0.5	89.5
1.B.2.d	Other (please specify) – Geothermal	CO_2	585.1	0.5	90.0
2.C.3	Metal Industry – Aluminium Production	CO_2	574.5	0.5	90.4
3.H	Agriculture – Urea Application	CO_2	570.7	0.5	90.9
3.G	Agriculture – Liming	CO_2	546.1	0.5	91.4
3.D.2.2	Indirect N_2O Emissions From Managed Soils – Nitrogen Leaching and Run-off	N_2O	513.8	0.4	91.8
3.A.4	Other livestock – Deer	CH_4	492.9	0.4	92.2
1.A.4.a	Other Sectors – Commercial/Institutional Gaseous Fuels	CO_2	461.7	0.4	92.6
2.A.1	Mineral Industry – Cement Production	CO_2	410.9	0.3	93.0
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Solid Fuels	CO_2	383.7	0.3	93.3
1.A.4.b	Other Sectors – Residential Gaseous Fuels	CO_2	369.6	0.3	93.6

CRF category code	IPCC category	Gas	2019 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
IPCC Tier 1 category level assessment – including LULUCF (net emissions): 2019					
1.A.1.c	Energy Industries – Manufacture of Solid Fuels and Other Energy Industries Gaseous Fuels	CO_2	354.0	0.3	93.9
1.A.3.d	Domestic Navigation – Residual Fuel Oil	CO_2	329.1	0.3	94.2
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Gaseous Fuels	CO_2	315.7	0.3	94.4
4.B.1	Cropland – Cropland Remaining Cropland	CO_2	315.6	0.3	94.7
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Liquid Fuels	CO_2	287.7	0.2	94.9
1.B.2.c.1.ii	Venting – Gas	CO_2	283.0	0.2	95.2
3.D.1.4	Direct N_2O Emissions from Managed Soils – Crop Residues	N_2O	265.4	0.2	95.4
5.D	Waste – Wastewater Treatment and Discharge	CH_4	253.6	0.2	95.6
1.A.4.b	Other Sectors – Residential Liquid Fuels	CO_2	234.3	0.2	95.8
1.A.2.g.viii	Other (please specify) – Other (please specify) Liquid Fuels	CO_2	222.4	0.2	96.0
1.A.1.b	Energy Industries – Petroleum Refining Gaseous Fuels	CO_2	217.9	0.2	96.2
1.B.2.b.5	Natural Gas – Distribution	CH_4	210.9	0.2	96.3
1.A.4.c	Other Sectors – Agriculture/Forestry/Fishing Solid Fuels	CO_2	202.8	0.2	96.5
2.B.10	Chemical Industry – Other (please specify)	CO_2	159.0	0.1	96.6
1.B.2.d	Other (please specify) – Geothermal	CH_4	156.9	0.1	96.8
1.B.2.c.2.iii	Flaring – Combined	CO_2	147.5	0.1	96.9
1.B.2.b.2	Natural Gas – Production	CH_4	135.0	0.1	97.0
1.A.2.a	Manufacturing Industries and Construction – Iron and Steel Gaseous Fuels	CO_2	134.4	0.1	97.1
1.A.3.c	Transport – Railways Liquid Fuels	CO_2	126.4	0.1	97.2
5.D	Waste – Wastewater Treatment and Discharge	N_2O	118.9	0.1	97.3
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Gaseous Fuels	CO_2	115.2	0.1	97.4
2.A.2	Mineral Industry – Lime Production	CO_2	108.0	0.1	97.5
2.B.8	Chemical Industry – Petrochemical and Carbon Black Production	CH_4	107.2	0.1	97.6
3.B.2.5	N_2O and NMVOC Emissions – Indirect N_2O Emissions	N_2O	101.2	0.1	97.7
2.A.4	Mineral Industry – Other Process Uses of Carbonates	CO_2	99.1	0.1	97.8
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Liquid Fuels	CO_2	96.8	0.1	97.8
3.B.1.2	CH_4 Emissions – Sheep	CH_4	95.2	0.1	97.9
1.A.3.b	Transport – Road Transportation Liquid Fuels	N_2O	92.2	0.1	98.0
5.C	Waste – Incineration and Open Burning of Waste	CO_2	90.2	0.1	98.1
2.C.3	Metal Industry – Aluminium Production	PFCs	89.1	0.1	98.2
2.F.4	Product Uses as Substitutes for ODS – Aerosols	HFCs	87.2	0.1	98.2
2.G.3	Other Product Manufacture and Use – N_2O from Product Uses	N_2O	84.5	0.1	98.3
3.B.1.1	Option A – Non-Dairy *(Beef)* Cattle	CH_4	81.4	0.1	98.4

IPCC Tier 1 category level assessment – including LULUCF (net emissions): 2019					
CRF category code	IPCC category	Gas	2019 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
1.A.4.a	Other Sectors – Commercial/Institutional Solid Fuels	CO_2	80.7	0.1	98.4
5.C	Waste – Incineration and Open Burning of Waste	CH_4	77.8	0.1	98.5
3.D.1.2	Direct N_2O Emissions from Managed Soils – Organic N Fertilizers	N_2O	76.9	0.1	98.6
4.E.1	Settlements – Settlements Remaining Settlements	CO_2	75.7	0.1	98.6
1.A.4.c	Other Sectors – Agriculture/Forestry/Fishing Gaseous Fuels	CO_2	73.0	0.1	98.7
1.B.1.a.1	Coal Mining and Handling – Underground Mines	CH_4	72.7	0.1	98.7
4.B.2	Cropland – Land Converted to Cropland	CO_2	63.8	0.1	98.8
1.B.1.a.2	Coal Mining and Handling – Surface Mines	CH_4	62.6	0.1	98.8
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Liquid Fuels	CO_2	58.2	0.0	98.9
4.A.2	Forest Land – Land Converted to Forest Land	N_2O	58.0	0.0	98.9
4.F.2	Other Land – Land Converted to Other Land	CO_2	48.6	0.0	99.0
2.D	Industrial Processes and Product Use – Non-energy Products from Fuels and Solvent Use	CO_2	48.0	0.0	99.0

Note: Key categories are those that comprise 95 per cent of the total. Removals from the LULUCF sector are shown as negatives in this table. The absolute values for those removals were used for the calculations.

Table A1.3.1(b) Results of the key category level analysis for 99 per cent of the gross emissions and removals for New Zealand in 2019

IPCC Tier 1 category level assessment – gross emissions (excluding LULUCF): 2019					
CRF category code	IPCC Category	Gas	2019 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
1.A.3.b	Transport – Road Transportation Liquid Fuels	CO_2	14,559.4	17.7	17.7
3.A.1	Option A – Dairy Cattle	CH_4	14,013.6	17.0	34.7
3.A.2	Other (please specify) – Sheep	CH_4	8,527.2	10.4	45.1
3.A.1	Option A – Non-Dairy *(Beef)* Cattle	CH_4	5,893.7	7.2	52.2
3.D.1.3	Direct N_2O Emissions from Managed Soils – Urine and Dung Deposited by Grazing Animals	N_2O	3,899.3	4.7	57.0
5.A	Waste – Solid Waste Disposal	CH_4	2,692.9	3.3	60.2
1.A.1.a	Energy Industries – Public Electricity and Heat Production Gaseous Fuels	CO_2	2,533.5	3.1	63.3
1.A.2.c	Manufacturing Industries and Construction – Chemicals Gaseous Fuels	CO_2	1,859.2	2.3	65.6
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Solid Fuels	CO_2	1,751.6	2.1	67.7
2.C.1	Metal Industry – Iron and Steel Production	CO_2	1,661.6	2.0	69.7
2.F.1	Product Uses as Substitutes for ODS – Refrigeration and Air conditioning	HFCs	1,637.7	2.0	71.7
1.A.1.a	Energy Industries – Public Electricity and Heat Production Solid Fuels	CO_2	1,634.8	2.0	73.7
3.D.1.1	Direct N_2O Emissions from Managed Soils – Inorganic N Fertilizers	N_2O	1,429.3	1.7	75.4

IPCC Tier 1 category level assessment – gross emissions (excluding LULUCF): 2019					
CRF category code	IPCC Category	Gas	2019 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
3.B.1.1	Option A – Dairy Cattle	CH_4	1,384.2	1.7	77.1
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Gaseous Fuels	CO_2	1,197.6	1.5	78.6
1.A.4.c	Other Sectors – Agriculture/Forestry/Fishing Liquid Fuels	CO_2	1,154.3	1.4	80.0
1.A.3.a	Domestic Aviation – Jet Kerosene	CO_2	989.6	1.2	81.2
3.D.2.1	Indirect N_2O Emissions from Managed Soils – Atmospheric Deposition	N_2O	925.3	1.1	82.3
1.A.2.g.iii	Other (please specify) – Mining (excluding fuels) and quarrying Liquid Fuels	CO_2	834.6	1.0	83.3
1.A.1.b	Energy Industries – Petroleum Refining Liquid Fuels	CO_2	663.7	0.8	84.1
3.D.1.6	Direct N_2O Emissions from Managed Soils – Cultivation of Organic Soils	N_2O	653.0	0.8	84.9
1.A.4.a	Other Sectors – Commercial/Institutional Liquid Fuels	CO_2	587.4	0.7	85.6
1.B.2.d	Other (please specify) – Geothermal	CO_2	585.1	0.7	86.3
2.C.3	Metal Industry – Aluminium Production	CO_2	574.5	0.7	87.0
3.H	Agriculture – Urea Application	CO_2	570.7	0.7	87.7
3.G	Agriculture – Liming	CO_2	546.1	0.7	88.4
3.D.2.2	Indirect N_2O Emissions from Managed Soils – Nitrogen Leaching and Run-off	N_2O	513.8	0.6	89.0
3.A.4	Other livestock – Deer	CH_4	492.9	0.6	89.6
1.A.4.a	Other Sectors – Commercial/Institutional Gaseous Fuels	CO_2	461.7	0.6	90.2
2.A.1	Mineral Industry – Cement Production	CO_2	410.9	0.5	90.7
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Solid Fuels	CO_2	383.7	0.5	91.1
1.A.4.b	Other Sectors – Residential Gaseous Fuels	CO_2	369.6	0.4	91.6
1.A.1.c	Energy Industries – Manufacture of Solid Fuels and Other Energy Industries Gaseous Fuels	CO_2	354.0	0.4	92.0
1.A.3.d	Domestic Navigation – Residual Fuel Oil	CO_2	329.1	0.4	92.4
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Gaseous Fuels	CO_2	315.7	0.4	92.8
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Liquid Fuels	CO_2	287.7	0.3	93.2
1.B.2.c.1.ii	Venting – Gas	CO_2	283.0	0.3	93.5
3.D.1.4	Direct N_2O Emissions from Managed Soils – Crop Residues	N_2O	265.4	0.3	93.8
5.D	Waste – Wastewater Treatment and Discharge	CH_4	253.6	0.3	94.1
1.A.4.b	Other Sectors – Residential Liquid Fuels	CO_2	234.3	0.3	94.4
1.A.2.g.viii	Other (please specify) – Other (please specify) Liquid Fuels	CO_2	222.4	0.3	94.7
1.A.1.b	Energy Industries – Petroleum Refining Gaseous Fuels	CO_2	217.9	0.3	94.9
1.B.2.b.5	Natural Gas – Distribution	CH_4	210.9	0.3	95.2
1.A.4.c	Other Sectors – Agriculture/Forestry/Fishing Solid Fuels	CO_2	202.8	0.2	95.4
2.B.10	Chemical Industry – Other (please specify)	CO_2	159.0	0.2	95.6
1.B.2.d	Other (please specify) – Geothermal	CH_4	156.9	0.2	95.8
1.B.2.c.2.iii	Flaring – Combined	CO_2	147.5	0.2	96.0

IPCC Tier 1 category level assessment – gross emissions (excluding LULUCF): 2019					
CRF category code	IPCC Category	Gas	2019 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
1.B.2.b.2	Natural Gas – Production	CH_4	135.0	0.2	96.2
1.A.2.a	Manufacturing Industries and Construction – Iron and Steel Gaseous Fuels	CO_2	134.4	0.2	96.3
1.A.3.c	Transport – Railways Liquid Fuels	CO_2	126.4	0.2	96.5
5.D	Waste – Wastewater Treatment and Discharge	N_2O	118.9	0.1	96.6
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Gaseous Fuels	CO_2	115.2	0.1	96.8
2.A.2	Mineral Industry – Lime Production	CO_2	108.0	0.1	96.9
2.B.8	Chemical Industry – Petrochemical and Carbon Black Production	CH_4	107.2	0.1	97.0
3.B.2.5	N_2O and NMVOC Emissions – Indirect N_2O Emissions	N_2O	101.2	0.1	97.2
2.A.4	Mineral Industry – Other Process Uses of Carbonates	CO_2	99.1	0.1	97.3
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Liquid Fuels	CO_2	96.8	0.1	97.4
3.B.1.2	CH_4 Emissions – Sheep	CH_4	95.2	0.1	97.5
1.A.3.b	Transport – Road Transportation Liquid Fuels	N_2O	92.2	0.1	97.6
5.C	Waste – Incineration and Open Burning of Waste	CO_2	90.2	0.1	97.7
2.C.3	Metal Industry – Aluminium Production	PFCs	89.1	0.1	97.8
2.F.4	Product Uses as Substitutes for ODS – Aerosols	HFCs	87.2	0.1	97.9
2.G.3	Other Product Manufacture and Use – N_2O from Product Uses	N_2O	84.5	0.1	98.1
3.B.1.1	Option A – Non-Dairy *(Beef)* Cattle	CH_4	81.4	0.1	98.2
1.A.4.a	Other Sectors – Commercial/Institutional Solid Fuels	CO_2	80.7	0.1	98.2
5.C	Waste – Incineration and Open Burning of Waste	CH_4	77.8	0.1	98.3
3.D.1.2	Direct N_2O Emissions from Managed Soils – Organic N Fertilizers	N_2O	76.9	0.1	98.4
1.A.4.c	Other Sectors – Agriculture/Forestry/Fishing Gaseous Fuels	CO_2	73.0	0.1	98.5
1.B.1.a.1	Coal Mining and Handling – Underground Mines	CH_4	72.7	0.1	98.6
1.B.1.a.2	Coal Mining and Handling – Surface Mines	CH_4	62.6	0.1	98.7
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Liquid Fuels	CO_2	58.2	0.1	98.8
2.D	Industrial Processes and Product Use – Non-energy Products from Fuels and Solvent Use	CO_2	48.0	0.1	98.8
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Solid Fuels	CO_2	47.2	0.1	98.9
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Biomass	N_2O	45.9	0.1	98.9
1.A.4.b	Other Sectors – Residential Biomass	CH_4	45.2	0.1	99.0
1.A.3.e	Transport – Other Transportation (please specify) Gaseous Fuels	CO_2	39.8	0.0	99.0

Note: Key categories are those that comprise 95 per cent of the total.

Table A1.3.2(a) Results of the level analysis for 99 per cent of the net emissions and removals for New Zealand in 1990 included for reference only

IPCC Tier 1 category level assessment – including LULUCF (net emissions): 1990					
CRF category code	IPCC category	Gas	1990 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
4.A.2	Forest Land – Land Converted to Forest Land	CO_2	–18,516.4	20.1	20.1
3.A.2	Other (please specify) – Sheep	CH_4	14,557.9	15.8	36.0
1.A.3.b	Transport – Road Transportation Liquid Fuels	CO_2	7,164.6	7.8	43.8
3.A.1	Option A – Dairy Cattle	CH_4	6,147.3	6.7	50.4
3.A.1	Option A – Non-Dairy *(Beef)* Cattle	CH_4	5,950.0	6.5	56.9
4.A.1	Forest Land – Forest Land Remaining Forest Land	CO_2	–4,808.9	5.2	62.1
5.A	Waste – Solid Waste Disposal	CH_4	3,337.8	3.6	65.8
3.D.1.3	Direct N_2O Emissions from Managed Soils – Urine and Dung Deposited by Grazing Animals	N_2O	3,068.6	3.3	69.1
1.A.1.a	Energy Industries – Public Electricity and Heat Production Gaseous Fuels	CO_2	3,011.8	3.3	72.4
4.G	Land Use, Land-Use Change and Forestry – Harvested Wood Products	CO_2	–2,072.9	2.3	74.6
1.A.1.c	Energy Industries – Manufacture of Solid Fuels and Other Energy Industries Gaseous Fuels	CO_2	1,761.0	1.9	76.6
2.C.1	Metal Industry – Iron and Steel Production	CO_2	1,306.7	1.4	78.0
1.A.4.c	Other Sectors – Agriculture/Forestry/Fishing Liquid Fuels	CO_2	1,072.3	1.2	79.1
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Solid Fuels	CO_2	938.6	1.0	80.2
2.C.3	Metal Industry – Aluminium Production	PFCs	909.9	1.0	81.2
1.A.3.a	Domestic Aviation – Jet Kerosene	CO_2	892.6	1.0	82.1
1.A.1.b	Energy Industries – Petroleum Refining Liquid Fuels	CO_2	778.9	0.8	83.0
3.D.2.1	Indirect N_2O Emissions from Managed Soils – Atmospheric Deposition	N_2O	735.1	0.8	83.8
1.A.2.g.viii	Other (please specify) – Other (please specify) Solid Fuels	CO_2	731.1	0.8	84.6
3.D.1.6	Direct N_2O Emissions from Managed Soils – Cultivation of Organic Soils	N_2O	643.8	0.7	85.3
1.A.2.c	Manufacturing Industries and Construction – Chemicals Gaseous Fuels	CO_2	528.7	0.6	85.8
1.A.4.a	Other Sectors – Commercial/Institutional Liquid Fuels	CO_2	500.6	0.5	86.4
1.A.1.a	Energy Industries – Public Electricity and Heat Production Solid Fuels	CO_2	474.8	0.5	86.9
2.C.3	Metal Industry – Aluminium Production	CO_2	449.0	0.5	87.4
2.A.1	Mineral Industry – Cement Production	CO_2	448.7	0.5	87.9
3.A.4	Other livestock – Deer	CH_4	445.5	0.5	88.4
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Gaseous Fuels	CO_2	445.1	0.5	88.8
3.B.1.1	Option A – Dairy Cattle	CH_4	416.6	0.5	89.3
3.D.2.2	Indirect N_2O Emissions from Managed Soils – Nitrogen Leaching and Run-off	N_2O	395.2	0.4	89.7
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Solid Fuels	CO_2	382.9	0.4	90.1
3.G	Agriculture – Liming	CO_2	360.1	0.4	90.5
4.B.1	Cropland – Cropland Remaining Cropland	CO_2	351.1	0.4	90.9
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Gaseous Fuels	CO_2	348.9	0.4	91.3

IPCC Tier 1 category level assessment – including LULUCF (net emissions): 1990					
CRF category code	IPCC category	Gas	1990 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
1.A.4.b	Other Sectors – Residential Solid Fuels	CO_2	344.9	0.4	91.7
1.A.2.g.iii	Other (please specify) – Mining (excluding fuels) and quarrying Liquid Fuels	CO_2	331.5	0.4	92.0
4.C.2	Grassland – Land Converted to Grassland	CO_2	311.5	0.3	92.4
1.B.1.a.1	Coal Mining and Handling – Underground Mines	CH_4	289.6	0.3	92.7
1.B.2.b.5	Natural Gas – Distribution	CH_4	277.5	0.3	93.0
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Liquid Fuels	CO_2	269.4	0.3	93.3
1.A.4.a	Other Sectors – Commercial/Institutional Gaseous Fuels	CO_2	236.1	0.3	93.5
1.A.3.d	Domestic Navigation – Residual Fuel Oil	CO_2	232.9	0.3	93.8
3.D.1.1	Direct N_2O Emissions from Managed Soils – Inorganic N Fertilizers	N_2O	230.3	0.3	94.0
1.B.2.d	Other (please specify) – Geothermal	CO_2	228.6	0.2	94.3
5.D	Waste – Wastewater Treatment and Discharge	CH_4	221.2	0.2	94.5
4.C.1	Grassland – Grassland Remaining Grassland	CO_2	219.9	0.2	94.8
3.A.4	Other Livestock – Goats	CH_4	196.6	0.2	95.0
1.A.4.b	Other Sectors – Residential Gaseous Fuels	CO_2	185.6	0.2	95.2
3.D.1.4	Direct N_2O Emissions from Managed Soils – Crop Residues	N_2O	175.5	0.2	95.4
1.A.4.b	Other Sectors – Residential Liquid Fuels	CO_2	167.4	0.2	95.6
5.C	Waste – Incineration and Open Burning of Waste	CO_2	158.8	0.2	95.7
2.B.10	Chemical Industry – Other (please specify)	CO_2	152.3	0.2	95.9
3.B.1.2	CH_4 Emissions – Sheep	CH_4	148.8	0.2	96.1
1.A.4.a	Other Sectors – Commercial/Institutional Solid Fuels	CO_2	142.2	0.2	96.2
1.A.3.b	Transport – Road Transportation Gaseous Fuels	CO_2	140.8	0.2	96.4
5.C	Waste – Incineration and Open Burning of Waste	CH_4	127.3	0.1	96.5
4.A.2	Forest Land – Land Converted to Forest Land	N_2O	124.3	0.1	96.6
4.B.2	Cropland – Land Converted to Cropland	CO_2	117.3	0.1	96.8
1.A.2.a	Manufacturing Industries and Construction – Iron and Steel Gaseous Fuels	CO_2	116.6	0.1	96.9
1.B.2.c.2.iii	Flaring – Combined	CO_2	114.4	0.1	97.0
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Solid Fuels	CO_2	109.5	0.1	97.1
1.B.2.c.1.ii	Venting – Gas	CO_2	109.3	0.1	97.3
1.A.4.c	Other Sectors – Agriculture/Forestry/Fishing Gaseous Fuels	CO_2	106.2	0.1	97.4
2.G.3	Other Product Manufacture and Use – N_2O from Product Uses	N_2O	102.4	0.1	97.5
1.A.3.b	Transport – Road Transportation Liquid Fuels	N_2O	89.3	0.1	97.6
2.A.2	Mineral Industry – Lime Production	CO_2	82.6	0.1	97.7
5.D	Waste – Wastewater Treatment and Discharge	N_2O	82.1	0.1	97.8
3.B.1.1	Option A – Non-Dairy *(Beef)* Cattle	CH_4	82.0	0.1	97.9
1.A.3.c	Transport – Railways Liquid Fuels	CO_2	78.4	0.1	97.9
4.C.1	Grassland – Grassland Remaining Grassland	CH_4	74.2	0.1	98.0
1.A.3.b	Transport – Road Transportation Liquid Fuels	CH_4	72.9	0.1	98.1
4.E.1	Settlements – Settlements Remaining Settlements	CO_2	67.2	0.1	98.2
1.B.2.c.2.iii	Flaring – Combined	CH_4	64.6	0.1	98.2

IPCC Tier 1 category level assessment – including LULUCF (net emissions): 1990					
CRF category code	IPCC category	Gas	1990 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Gaseous Fuels	CO_2	64.3	0.1	98.3
1.A.2.g.vi	Other (please specify) – Textile and leather Gaseous Fuels	CO_2	59.2	0.1	98.4
3.B.1.3	CH_4 Emissions – Swine	CH_4	58.6	0.1	98.4
1.B.2.d	Other (please specify) – Geothermal	CH_4	54.8	0.1	98.5
1.A.2.g.viii	Other (please specify) – Other (please specify) Liquid Fuels	CO_2	51.7	0.1	98.6
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Liquid Fuels	CO_2	49.1	0.1	98.6
1.A.4.b	Other Sectors – Residential Biomass	CH_4	48.4	0.1	98.7
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Liquid Fuels	CO_2	48.4	0.1	98.7
1.A.3.a	Domestic Aviation – Aviation Gasoline	CO_2	47.7	0.1	98.8
1.B.2.b.2	Natural Gas – Production	CH_4	47.7	0.1	98.8
4.C.1	Grassland – Grassland Remaining Grassland	N_2O	43.2	0.0	98.9
3.A.4	Other Livestock – Horses	CH_4	42.3	0.0	98.9
1.A.2.g.i	Other (please specify) – Manufacturing of machinery Gaseous Fuels	CO_2	41.9	0.0	99.0
3.H	Agriculture – Urea Application	CO_2	39.2	0.0	99.0
1.B.1.a.2	Coal Mining and Handling – Surface Mines	CH_4	38.7	0.0	99.0

Note: Removals from the LULUCF sector are shown as negatives in this table. The absolute values for those removals were used for the calculations.

Table A1.3.2(b) Results of the level analysis for 99 per cent of the gross emissions for New Zealand in 1990 included for reference only

IPCC Tier 1 category level assessment – gross emissions (excluding LULUCF): 1990					
CRF category code	IPCC category	Gas	1990 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
3.A.2	Other (please specify) – Sheep	CH_4	14,557.9	22.4	22.4
1.A.3.b	Transport – Road Transportation Liquid Fuels	CO_2	7,164.6	11.0	33.4
3.A.1	Option A – Dairy Cattle	CH_4	6,147.3	9.4	42.8
3.A.1	Option A – Non-Dairy *(Beef)* Cattle	CH_4	5,950.0	9.1	51.9
5.A	Waste – Solid Waste Disposal	CH_4	3,337.8	5.1	57.1
3.D.1.3	Direct N_2O Emissions from Managed Soils – Urine and Dung Deposited by Grazing Animals	N_2O	3,068.6	4.7	61.8
1.A.1.a	Energy Industries – Public Electricity and Heat Production Gaseous Fuels	CO_2	3,011.8	4.6	66.4
1.A.1.c	Energy Industries – Manufacture of Solid Fuels and Other Energy Industries Gaseous Fuels	CO_2	1,761.0	2.7	69.1
2.C.1	Metal Industry – Iron and Steel Production	CO_2	1,306.7	2.0	71.1
1.A.4.c	Other Sectors – Agriculture/Forestry/Fishing Liquid Fuels	CO_2	1,072.3	1.6	72.7
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Solid Fuels	CO_2	938.6	1.4	74.2
2.C.3	Metal Industry – Aluminium Production	PFCs	909.9	1.4	75.6
1.A.3.a	Domestic Aviation – Jet Kerosene	CO_2	892.6	1.4	77.0
1.A.1.b	Energy Industries – Petroleum Refining Liquid Fuels	CO_2	778.9	1.2	78.1
3.D.2.1	Indirect N_2O Emissions from Managed Soils – Atmospheric Deposition	N_2O	735.1	1.1	79.3

IPCC Tier 1 category level assessment – gross emissions (excluding LULUCF): 1990					
CRF category code	IPCC category	Gas	1990 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
1.A.2.g.viii	Other (please specify) – Other (please specify) Solid Fuels	CO_2	731.1	1.1	80.4
3.D.1.6	Direct N_2O Emissions from Managed Soils – Cultivation of Organic Soils	N_2O	643.8	1.0	81.4
1.A.2.c	Manufacturing Industries and Construction – Chemicals Gaseous Fuels	CO_2	528.7	0.8	82.2
1.A.4.a	Other Sectors – Commercial/Institutional Liquid Fuels	CO_2	500.6	0.8	83.0
1.A.1.a	Energy Industries – Public Electricity and Heat Production Solid Fuels	CO_2	474.8	0.7	83.7
2.C.3	Metal Industry – Aluminium Production	CO_2	449.0	0.7	84.4
2.A.1	Mineral Industry – Cement Production	CO_2	448.7	0.7	85.1
3.A.4	Other Livestock – Deer	CH_4	445.5	0.7	85.8
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Gaseous Fuels	CO_2	445.1	0.7	86.4
3.B.1.1	Option A – Dairy Cattle	CH_4	416.6	0.6	87.1
3.D.2.2	Indirect N_2O Emissions from Managed Soils – Nitrogen Leaching and Run-off	N_2O	395.2	0.6	87.7
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Solid Fuels	CO_2	382.9	0.6	88.3
3.G	Agriculture – Liming	CO_2	360.1	0.6	88.8
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Gaseous Fuels	CO_2	348.9	0.5	89.4
1.A.4.b	Other Sectors – Residential Solid Fuels	CO_2	344.9	0.5	89.9
1.A.2.g.iii	Other (please specify) – Mining (excluding fuels) and quarrying Liquid Fuels	CO_2	331.5	0.5	90.4
1.B.1.a.1	Coal Mining and Handling – Underground Mines	CH_4	289.6	0.4	90.9
1.B.2.b.5	Natural Gas – Distribution	CH_4	277.5	0.4	91.3
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Liquid Fuels	CO_2	269.4	0.4	91.7
1.A.4.a	Other Sectors – Commercial/Institutional Gaseous Fuels	CO_2	236.1	0.4	92.1
1.A.3.d	Domestic Navigation – Residual Fuel Oil	CO_2	232.9	0.4	92.4
3.D.1.1	Direct N_2O Emissions from Managed Soils – Inorganic N Fertilizers	N_2O	230.3	0.4	92.8
1.B.2.d	Other (please specify) – Geothermal	CO_2	228.6	0.4	93.1
5.D	Waste – Wastewater Treatment and Discharge	CH_4	221.2	0.3	93.5
3.A.4	Other livestock – Goats	CH_4	196.6	0.3	93.8
1.A.4.b	Other Sectors – Residential Gaseous Fuels	CO_2	185.6	0.3	94.0
3.D.1.4	Direct N_2O Emissions from Managed Soils – Crop Residues	N_2O	175.5	0.3	94.3
1.A.4.b	Other Sectors – Residential Liquid Fuels	CO_2	167.4	0.3	94.6
5.C	Waste – Incineration and Open Burning of Waste	CO_2	158.8	0.2	94.8
2.B.10	Chemical Industry – Other (please specify)	CO_2	152.3	0.2	95.0
3.B.1.2	CH_4 Emissions – Sheep	CH_4	148.8	0.2	95.3
1.A.4.a	Other Sectors – Commercial/Institutional Solid Fuels	CO_2	142.2	0.2	95.5
1.A.3.b	Transport – Road Transportation Gaseous Fuels	CO_2	140.8	0.2	95.7
5.C	Waste – Incineration and Open Burning of Waste	CH_4	127.3	0.2	95.9
1.A.2.a	Manufacturing Industries and Construction – Iron and Steel Gaseous Fuels	CO_2	116.6	0.2	96.1
1.B.2.c.2.iii	Flaring – Combined	CO_2	114.4	0.2	96.3

IPCC Tier 1 category level assessment – gross emissions (excluding LULUCF): 1990					
CRF category code	IPCC category	Gas	1990 estimate (kt CO_2-e)	Level assessment (%)	Cumulative total (%)
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Solid Fuels	CO_2	109.5	0.2	96.4
1.B.2.c.1.ii	Venting – Gas	CO_2	109.3	0.2	96.6
1.A.4.c	Other Sectors – Agriculture/Forestry/Fishing Gaseous Fuels	CO_2	106.2	0.2	96.8
2.G.3	Other Product Manufacture and Use – N_2O from Product Uses	N_2O	102.4	0.2	96.9
1.A.3.b	Transport – Road Transportation Liquid Fuels	N_2O	89.3	0.1	97.1
2.A.2	Mineral Industry – Lime Production	CO_2	82.6	0.1	97.2
5.D	Waste – Wastewater Treatment and Discharge	N_2O	82.1	0.1	97.3
3.B.1.1	Option A – Non-Dairy *(Beef)* Cattle	CH_4	82.0	0.1	97.4
1.A.3.c	Transport – Railways Liquid Fuels	CO_2	78.4	0.1	97.6
1.A.3.b	Transport – Road Transportation Liquid Fuels	CH_4	72.9	0.1	97.7
1.B.2.c.2.iii	Flaring – Combined	CH_4	64.6	0.1	97.8
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Gaseous Fuels	CO_2	64.3	0.1	97.9
1.A.2.g.vi	Other (please specify) – Textile and leather Gaseous Fuels	CO_2	59.2	0.1	98.0
3.B.1.3	CH_4 Emissions – Swine	CH_4	58.6	0.1	98.0
1.B.2.d	Other (please specify) – Geothermal	CH_4	54.8	0.1	98.1
1.A.2.g.viii	Other (please specify) – Other (please specify) Liquid Fuels	CO_2	51.7	0.1	98.2
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Liquid Fuels	CO_2	49.1	0.1	98.3
1.A.4.b	Other Sectors – Residential Biomass	CH_4	48.4	0.1	98.4
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Liquid Fuels	CO_2	48.4	0.1	98.4
1.A.3.a	Domestic Aviation – Aviation Gasoline	CO_2	47.7	0.1	98.5
1.B.2.b.2	Natural Gas – Production	CH_4	47.7	0.1	98.6
3.A.4	Other livestock – Horses	CH_4	42.3	0.1	98.6
1.A.2.g.i	Other (please specify) – Manufacturing of machinery Gaseous Fuels	CO_2	41.9	0.1	98.7
3.H	Agriculture – Urea Application	CO_2	39.2	0.1	98.8
1.B.1.a.2	Coal Mining and Handling – Surface Mines	CH_4	38.7	0.1	98.8
3.D.1.2	Direct N_2O Emissions from Managed Soils – Organic N Fertilizers	N_2O	36.3	0.1	98.9
1.A.4.c	Other Sectors – Agriculture/Forestry/Fishing Solid Fuels	CO_2	35.1	0.1	98.9
3.B.2.5	N_2O and NMVOC Emissions – Indirect N_2O Emissions	N_2O	34.7	0.1	99.0
1.A.2.b	Manufacturing Industries and Construction – Non-Ferrous Metals Liquid Fuels	CO_2	32.5	0.0	99.0

Table A1.3.3(a) Results of the key category trend analysis for 99 per cent of the net emissions and removals for New Zealand in 1990–2019

IPCC Tier 1 category trend assessment – including LULUCF (net emissions)							
CRF category code	IPCC category	Gas	1990 estimate (kt CO_2-e)	2019 estimate (kt CO_2-e)	Trend assessment	Contribution to trend (%)	Cumulative total (%)
4.A.1	Forest Land – Forest Land Remaining Forest Land	CO_2	–4,808.9	–17,544.5	0.156	17.8	17.8
3.A.2	Other (please specify) – Sheep	CH_4	14,557.9	8,527.2	0.119	13.5	31.3
4.G	Land Use, Land-Use Change and Forestry – Harvested Wood Products	CO_2	–2,072.9	–10,067.3	0.094	10.8	42.1
4.A.2	Forest Land – Land Converted to Forest Land	CO_2	–18,516.4	–4,736.0	0.082	9.4	51.5
3.A.1	Option A – Dairy Cattle	CH_4	6,147.3	14,013.6	0.063	7.2	58.7
1.A.3.b	Transport – Road Transportation Liquid Fuels	CO_2	7,164.6	14,559.4	0.054	6.2	64.9
4.C.2	Grassland – Land Converted to Grassland	CO_2	311.5	2,953.0	0.028	3.1	68.0
3.A.1	Option A – Non-Dairy *(Beef)* Cattle	CH_4	5,950.0	5,893.7	0.022	2.5	70.6
1.A.1.c	Energy Industries – Manufacture of Solid Fuels and Other Energy Industries Gaseous Fuels	CO_2	1,761.0	354.0	0.022	2.5	73.0
5.A	Waste – Solid Waste Disposal	CH_4	3,337.8	2,692.9	0.019	2.2	75.2
2.F.1	Product Uses as Substitutes for ODS – Refrigeration and Air conditioning	HFCs	0.0	1,637.7	0.018	2.0	77.2
1.A.1.a	Energy Industries – Public Electricity and Heat Production Gaseous Fuels	CO_2	3,011.8	2,533.5	0.016	1.8	79.1
1.A.2.c	Manufacturing Industries and Construction – Chemicals Gaseous Fuels	CO_2	528.7	1,859.2	0.013	1.4	80.5
2.C.3	Metal Industry – Aluminium Production	PFCs	909.9	89.1	0.012	1.4	81.9
3.D.1.1	Direct N_2O Emissions from Managed Soils – Inorganic N Fertilizers	N_2O	230.3	1,429.3	0.012	1.4	83.3
1.A.1.a	Energy Industries – Public Electricity and Heat Production Solid Fuels	CO_2	474.8	1,634.8	0.011	1.2	84.6
1.A.2.g.viii	Other (please specify) – Other (please specify) Solid Fuels	CO_2	731.1	9.5	0.011	1.2	85.7
4.C.1	Grassland – Grassland Remaining Grassland	CO_2	219.9	1,228.2	0.010	1.2	86.9
3.B.1.1	Option A – Dairy Cattle	CH_4	416.6	1,384.2	0.009	1.0	87.9
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Gaseous Fuels	CO_2	445.1	1,197.6	0.007	0.7	88.7
3.H	Agriculture – Urea Application	CO_2	39.2	570.7	0.006	0.6	89.3
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Solid Fuels	CO_2	938.6	1,751.6	0.005	0.6	89.9
1.A.4.b	Other Sectors – Residential Solid Fuels	CO_2	344.9	24.6	0.005	0.5	90.5
1.A.2.g.iii	Other (please specify) – Mining (excluding fuels) and quarrying Liquid Fuels	CO_2	331.5	834.6	0.004	0.5	91.0

IPCC Tier 1 category trend assessment – including LULUCF (net emissions)							
CRF category code	IPCC category	Gas	1990 estimate (kt CO_2-e)	2019 estimate (kt CO_2-e)	Trend assessment	Contribution to trend (%)	Cumulative total (%)
1.A.1.b	Energy Industries – Petroleum Refining Liquid Fuels	CO_2	778.9	663.7	0.004	0.5	91.4
1.B.1.a.1	Coal Mining and Handling – Underground Mines	CH_4	289.6	72.7	0.003	0.4	91.8
1.B.2.d	Other (please specify) – Geothermal	CO_2	228.6	585.1	0.003	0.3	92.2
1.A.4.c	Other Sectors – Agriculture/ Forestry/Fishing Liquid Fuels	CO_2	1,072.3	1,154.3	0.003	0.3	92.5
3.A.4	Other livestock – Goats	CH_4	196.6	21.0	0.003	0.3	92.8
1.A.1.b	Energy Industries – Petroleum Refining Gaseous Fuels	CO_2	0.0	217.9	0.002	0.3	93.1
3.D.1.6	Direct N_2O Emissions from Managed Soils – Cultivation of Organic Soils	N_2O	643.8	653.0	0.002	0.3	93.3
1.A.3.a	Domestic Aviation – Jet Kerosene	CO_2	892.6	989.6	0.002	0.3	93.6
3.D.1.3	Direct N_2O Emissions from Managed Soils – Urine and Dung Deposited by Grazing Animals	N_2O	3,068.6	3,899.3	0.002	0.2	93.8
2.A.1	Mineral Industry – Cement Production	CO_2	448.7	410.9	0.002	0.2	94.1
1.A.3.b	Transport – Road Transportation Gaseous Fuels	CO_2	140.8	0.0	0.002	0.2	94.3
1.B.2.b.5	Natural Gas – Distribution	CH_4	277.5	210.9	0.002	0.2	94.5
1.A.4.c	Other Sectors – Agriculture/ Forestry/Fishing Solid Fuels	CO_2	35.1	202.8	0.002	0.2	94.7
1.A.2.g.viii	Other (please specify) – Other (please specify) Liquid Fuels	CO_2	51.7	222.4	0.002	0.2	94.9
4.B.1	Cropland – Cropland Remaining Cropland	CO_2	351.1	315.6	0.002	0.2	95.1
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Gaseous Fuels	CO_2	348.9	315.7	0.002	0.2	95.3
1.A.4.a	Other Sectors – Commercial/ Institutional Gaseous Fuels	CO_2	236.1	461.7	0.002	0.2	95.4
1.B.2.c.1.ii	Venting – Gas	CO_2	109.3	283.0	0.001	0.2	95.6
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Solid Fuels	CO_2	382.9	383.7	0.001	0.2	95.8
1.A.4.b	Other Sectors – Residential Gaseous Fuels	CO_2	185.6	369.6	0.001	0.2	95.9
5.C	Waste – Incineration and Open Burning of Waste	CO_2	158.8	90.2	0.001	0.2	96.1
1.A.4.a	Other Sectors – Commercial/ Institutional Solid Fuels	CO_2	142.2	80.7	0.001	0.1	96.2
4.A.2	Forest Land – Land Converted to Forest Land	N_2O	124.3	58.0	0.001	0.1	96.3
3.B.1.2	CH_4 Emissions – Sheep	CH_4	148.8	95.2	0.001	0.1	96.5
3.A.4	Other livestock – Deer	CH_4	445.5	492.9	0.001	0.1	96.6
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Solid Fuels	CO_2	109.5	47.2	0.001	0.1	96.7
4.B.2	Cropland – Land Converted to Cropland	CO_2	117.3	63.8	0.001	0.1	96.8

IPCC Tier 1 category trend assessment – including LULUCF (net emissions)							
CRF category code	IPCC category	Gas	1990 estimate (kt CO_2-e)	2019 estimate (kt CO_2-e)	Trend assessment	Contribution to trend (%)	Cumulative total (%)
5.C	Waste – Incineration and Open Burning of Waste	CH_4	127.3	77.8	0.001	0.1	96.9
2.F.4	Product Uses as Substitutes for ODS – Aerosols	HFCs	0.0	87.2	0.001	0.1	97.1
1.B.2.d	Other (please specify) – Geothermal	CH_4	54.8	156.9	0.001	0.1	97.2
2.C.1	Metal Industry – Iron and Steel Production	CO_2	1,306.7	1,661.6	0.001	0.1	97.3
1.A.4.a	Other Sectors – Commercial/ Institutional Liquid Fuels	CO_2	500.6	587.4	0.001	0.1	97.4
1.A.3.b	Transport – Road Transportation Liquid Fuels	CH_4	72.9	18.2	0.001	0.1	97.5
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Liquid Fuels	CO_2	269.4	287.7	0.001	0.1	97.6
1.B.2.b.2	Natural Gas – Production	CH_4	47.7	135.0	0.001	0.1	97.6
2.B.8	Chemical Industry – Petrochemical and Carbon Black Production	CH_4	27.6	107.2	0.001	0.1	97.7
1.A.4.c	Other Sectors – Agriculture/ Forestry/Fishing Gaseous Fuels	CO_2	106.2	73.0	0.001	0.1	97.8
3.G	Agriculture – Liming	CO_2	360.1	546.1	0.001	0.1	97.9
4.C.1	Grassland – Grassland Remaining Grassland	CH_4	74.2	35.5	0.001	0.1	98.0
2.A.4	Mineral Industry – Other Process Uses of Carbonates	CO_2	30.5	99.1	0.001	0.1	98.0
1.B.2.c.2.iii	Flaring – Combined	CH_4	64.6	29.6	0.001	0.1	98.1
3.D.2.1	Indirect N_2O Emissions from Managed Soils – Atmospheric Deposition	N_2O	735.1	925.3	0.001	0.1	98.2
3.B.2.5	N_2O and NMVOC Emissions – Indirect N_2O Emissions	N_2O	34.7	101.2	0.001	0.1	98.3
2.G.3	Other Product Manufacture and Use – N_2O from Product Uses	N_2O	102.4	84.5	0.001	0.1	98.3
2.B.10	Chemical Industry – Other (please specify)	CO_2	152.3	159.0	0.000	0.1	98.4
1.A.2.g.i	Other (please specify) – Manufacturing of machinery Gaseous Fuels	CO_2	41.9	13.5	0.000	0.1	98.4
1.A.2.g.vi	Other (please specify) – Textile and leather Gaseous Fuels	CO_2	59.2	37.1	0.000	0.1	98.5
5.D	Waste – Wastewater Treatment and Discharge	CH_4	221.2	253.6	0.000	0.1	98.5
3.B.1.3	CH_4 Emissions – Swine	CH_4	58.6	38.0	0.000	0.0	98.6
4.C.1	Grassland – Grassland Remaining Grassland	N_2O	43.2	17.7	0.000	0.0	98.6
3.A.4	Other livestock – Horses	CH_4	42.3	17.3	0.000	0.0	98.7
1.A.3.a	Domestic Aviation – Aviation Gasoline	CO_2	47.7	25.6	0.000	0.0	98.7
1.A.4.b	Other Sectors – Residential Solid Fuels	CH_4	27.3	1.9	0.000	0.0	98.8
5.B	Waste – Biological Treatment of Solid Waste	CH_4	2.7	38.0	0.000	0.0	98.8

IPCC Tier 1 category trend assessment – including LULUCF (net emissions)							
CRF category code	IPCC category	Gas	1990 estimate (kt CO_2-e)	2019 estimate (kt CO_2-e)	Trend assessment	Contribution to trend (%)	Cumulative total (%)
1.A.3.e	Transport – Other Transportation (please specify) Gaseous Fuels	CO_2	5.5	39.8	0.000	0.0	98.8
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Liquid Fuels	CO_2	48.4	96.8	0.000	0.0	98.9
4.F.2	Other Land – Land Converted to Other Land	CO_2	12.6	48.6	0.000	0.0	98.9
3.D.1.4	Direct N_2O Emissions from Managed Soils – Crop Residues	N_2O	175.5	265.4	0.000	0.0	99.0
4.C.2	Grassland – Land Converted to Grassland	N_2O	28.5	8.4	0.000	0.0	99.0

Note: Key categories are those that comprise 95 per cent of the total. Removals from the LULUCF sector are shown as negatives in this table. The absolute values for those removals were used for the calculations.

Table A1.3.3(b) Results of the key category trend analysis for 99 per cent of the gross emissions for New Zealand in 1990–2019

IPCC Tier 1 category trend assessment – gross emissions (excluding LULUCF)							
CRF Category code	IPCC Category	Gas	1990 estimate (kt CO_2-e)	2019 estimate (kt CO_2-e)	Trend assessment	Contribution to trend (%)	Cumulative total (%)
3.A.2	Other (please specify) – Sheep	CH_4	14,557.9	8,527.2	0.152	22.3	22.3
3.A.1	Option A – Dairy Cattle	CH_4	6,147.3	14,013.6	0.096	14.1	36.5
1.A.3.b	Transport – Road Transportation Liquid Fuels	CO_2	7,164.6	14,559.4	0.085	12.5	48.9
1.A.1.c	Energy Industries – Manufacture of Solid Fuels and Other Energy Industries Gaseous Fuels	CO_2	1,761.0	354.0	0.029	4.2	53.2
2.F.1	Product Uses as Substitutes for ODS – Refrigeration and Air conditioning	HFCs	0.0	1,637.7	0.025	3.7	56.9
3.A.1	Option A – Non-Dairy *(Beef)* Cattle	CH_4	5,950.0	5,893.7	0.025	3.7	60.6
5.A	Waste – Solid Waste Disposal	CH_4	3,337.8	2,692.9	0.023	3.5	64.0
1.A.1.a	Energy Industries – Public Electricity and Heat Production Gaseous Fuels	CO_2	3,011.8	2,533.5	0.020	2.9	66.9
1.A.2.c	Manufacturing Industries and Construction – Chemicals Gaseous Fuels	CO_2	528.7	1,859.2	0.018	2.7	69.6
3.D.1.1	Direct N_2O Emissions from Managed Soils – Inorganic N Fertilizers	N_2O	230.3	1,429.3	0.017	2.6	72.2
2.C.3	Metal Industry – Aluminium Production	PFCs	909.9	89.1	0.016	2.4	74.6
1.A.1.a	Energy Industries – Public Electricity and Heat Production Solid Fuels	CO_2	474.8	1,634.8	0.016	2.3	76.9
1.A.2.g.viii	Other (please specify) – Other (please specify) Solid Fuels	CO_2	731.1	9.5	0.014	2.1	79.0
3.B.1.1	Option A – Dairy Cattle	CH_4	416.6	1,384.2	0.013	1.9	80.9
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Gaseous Fuels	CO_2	445.1	1,197.6	0.010	1.4	82.3
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Solid Fuels	CO_2	938.6	1,751.6	0.009	1.3	83.6

IPCC Tier 1 category trend assessment – gross emissions (excluding LULUCF)							
CRF Category code	IPCC Category	Gas	1990 estimate (kt CO_2-e)	2019 estimate (kt CO_2-e)	Trend assessment	Contribution to trend (%)	Cumulative total (%)
3.H	Agriculture – Urea Application	CO_2	39.2	570.7	0.008	1.2	84.8
1.A.2.g.iii	Other (please specify) – Mining (excluding fuels) and Quarrying Liquid Fuels	CO_2	331.5	834.6	0.006	0.9	85.7
1.A.4.b	Other Sectors – Residential Solid Fuels	CO_2	344.9	24.6	0.006	0.9	86.7
1.A.1.b	Energy Industries – Petroleum Refining Liquid Fuels	CO_2	778.9	663.7	0.005	0.7	87.4
1.B.2.d	Other (please specify) – Geothermal	CO_2	228.6	585.1	0.005	0.7	88.1
1.B.1.a.1	Coal Mining and Handling – Underground Mines	CH_4	289.6	72.7	0.005	0.7	88.7
3.A.4	Other livestock – Goats	CH_4	196.6	21.0	0.003	0.5	89.3
1.A.1.b	Energy Industries – Petroleum Refining Gaseous Fuels	CO_2	0.0	217.9	0.003	0.5	89.7
1.A.4.c	Other Sectors – Agriculture/ Forestry/Fishing Liquid Fuels	CO_2	1,072.3	1,154.3	0.003	0.5	90.2
1.A.3.b	Transport – Road Transportation Gaseous Fuels	CO_2	140.8	0.0	0.003	0.4	90.6
1.A.4.a	Other Sectors – Commercial/ Institutional Gaseous Fuels	CO_2	236.1	461.7	0.003	0.4	91.0
3.D.1.6	Direct N_2O Emissions from Managed Soils – Cultivation of Organic Soils	N_2O	643.8	653.0	0.002	0.4	91.3
1.A.4.c	Other Sectors – Agriculture/ Forestry/Fishing Solid Fuels	CO_2	35.1	202.8	0.002	0.4	91.7
1.A.2.g.viii	Other (please specify) – Other (please specify) Liquid Fuels	CO_2	51.7	222.4	0.002	0.4	92.1
2.A.1	Mineral Industry – Cement Production	CO_2	448.7	410.9	0.002	0.4	92.4
1.B.2.c.1.ii	Venting – Gas	CO_2	109.3	283.0	0.002	0.3	92.7
1.B.2.b.5	Natural Gas – Distribution	CH_4	277.5	210.9	0.002	0.3	93.0
1.A.3.a	Domestic Aviation – Jet Kerosene	CO_2	892.6	989.6	0.002	0.3	93.4
1.A.4.b	Other Sectors – Residential Gaseous Fuels	CO_2	185.6	369.6	0.002	0.3	93.7
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Gaseous Fuels	CO_2	348.9	315.7	0.002	0.3	94.0
5.C	Waste – Incineration and Open Burning of Waste	CO_2	158.8	90.2	0.002	0.3	94.2
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Solid Fuels	CO_2	382.9	383.7	0.002	0.2	94.4
1.A.4.a	Other Sectors – Commercial/ Institutional Solid Fuels	CO_2	142.2	80.7	0.002	0.2	94.7
3.B.1.2	CH_4 Emissions – Sheep	CH_4	148.8	95.2	0.001	0.2	94.9
1.A.2.d	Manufacturing Industries and Construction – Pulp, Paper and Print Solid Fuels	CO_2	109.5	47.2	0.001	0.2	95.1
3.G	Agriculture – Liming	CO_2	360.1	546.1	0.001	0.2	95.3
1.B.2.d	Other (please specify) – Geothermal	CH_4	54.8	156.9	0.001	0.2	95.5
2.F.4	Product Uses as Substitutes for ODS – Aerosols	HFCs	0.0	87.2	0.001	0.2	95.7
5.C	Waste – Incineration and Open Burning of Waste	CH_4	127.3	77.8	0.001	0.2	95.9

IPCC Tier 1 category trend assessment – gross emissions (excluding LULUCF)							
CRF Category code	IPCC Category	Gas	1990 estimate (kt CO_2-e)	2019 estimate (kt CO_2-e)	Trend assessment	Contribution to trend (%)	Cumulative total (%)
1.B.2.b.2	Natural Gas – Production	CH_4	47.7	135.0	0.001	0.2	96.0
1.A.3.b	Transport – Road Transportation Liquid Fuels	CH_4	72.9	18.2	0.001	0.2	96.2
2.B.8	Chemical Industry – Petrochemical and Carbon Black Production	CH_4	27.6	107.2	0.001	0.2	96.4
3.A.4	Other livestock – Deer	CH_4	445.5	492.9	0.001	0.2	96.5
1.A.4.c	Other Sectors – Agriculture/ Forestry/Fishing Gaseous Fuels	CO_2	106.2	73.0	0.001	0.1	96.7
2.A.4	Mineral Industry – Other Process Uses of Carbonates	CO_2	30.5	99.1	0.001	0.1	96.8
3.B.2.5	N_2O and NMVOC Emissions – Indirect N_2O Emissions	N_2O	34.7	101.2	0.001	0.1	96.9
1.A.2.e	Manufacturing Industries and Construction – Food Processing, Beverages and Tobacco Liquid Fuels	CO_2	269.4	287.7	0.001	0.1	97.0
1.B.2.c.2.iii	Flaring – Combined	CH_4	64.6	29.6	0.001	0.1	97.2
1.A.4.a	Other Sectors – Commercial/ Institutional Liquid Fuels	CO_2	500.6	587.4	0.001	0.1	97.3
2.G.3	Other Product Manufacture and Use – N_2O from Product Uses	N_2O	102.4	84.5	0.001	0.1	97.4
3.D.1.4	Direct N_2O Emissions from Managed Soils – Crop Residues	N_2O	175.5	265.4	0.001	0.1	97.5
1.A.2.g.i	Other (please specify) – Manufacturing of Machinery Gaseous Fuels	CO_2	41.9	13.5	0.001	0.1	97.6
1.A.2.g.vi	Other (please specify) – Textile and Leather Gaseous Fuels	CO_2	59.2	37.1	0.001	0.1	97.6
3.A.4	Other Livestock – Horses	CH_4	42.3	17.3	0.001	0.1	97.7
3.B.1.3	CH_4 Emissions – Swine	CH_4	58.6	38.0	0.001	0.1	97.8
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Liquid Fuels	CO_2	48.4	96.8	0.001	0.1	97.9
1.A.3.d	Domestic Navigation – Residual Fuel Oil	CO_2	232.9	329.1	0.001	0.1	98.0
1.A.3.a	Domestic Aviation – Aviation Gasoline	CO_2	47.7	25.6	0.001	0.1	98.0
5.B	Waste – Biological Treatment of Solid Waste	CH_4	2.7	38.0	0.001	0.1	98.1
1.A.2.f	Manufacturing Industries and Construction – Non-metallic Minerals Gaseous Fuels	CO_2	64.3	115.2	0.001	0.1	98.2
2.B.10	Chemical Industry – Other (please specify)	CO_2	152.3	159.0	0.001	0.1	98.3
1.A.3.e	Transport – Other Transportation (please specify) Gaseous Fuels	CO_2	5.5	39.8	0.001	0.1	98.3
1.A.4.b	Other Sectors – Residential Solid Fuels	CH_4	27.3	1.9	0.001	0.1	98.4
3.D.1.2	Direct N_2O Emissions from Managed Soils – Organic N Fertilizers	N_2O	36.3	76.9	0.000	0.1	98.5
1.A.3.c	Transport – Railways Liquid Fuels	CO_2	78.4	126.4	0.000	0.1	98.6
5.D	Waste – Wastewater Treatment and Discharge	CH_4	221.2	253.6	0.000	0.1	98.6

IPCC Tier 1 category trend assessment – gross emissions (excluding LULUCF)							
CRF Category code	IPCC Category	Gas	1990 estimate (kt CO_2-e)	2019 estimate (kt CO_2-e)	Trend assessment	Contribution to trend (%)	Cumulative total (%)
1.A.2.g.iii	Other (please specify) – Mining (excluding fuels) and Quarrying Solid Fuels	CO_2	19.9	0.0	0.000	0.1	98.7
5.B	Waste – Biological Treatment of Solid Waste	N_2O	2.0	27.2	0.000	0.1	98.7
1.B.2.c.1.iii	Venting – Combined	CH_4	1.4	26.0	0.000	0.1	98.8
1.A.4.b	Other Sectors – Residential Liquid Fuels	CO_2	167.4	234.3	0.000	0.1	98.8
3.B.1.1	Option A – Non-Dairy *(Beef)* Cattle	CH_4	82.0	81.4	0.000	0.1	98.9
1.A.2.g.iii	Other (please specify) – Mining (excluding fuels) and Quarrying Gaseous Fuels	CO_2	10.7	35.1	0.000	0.0	98.9
1.A.2.g.vi	Other (please specify) – Textile and Leather Liquid Fuels	CO_2	20.3	4.3	0.000	0.0	99.0
3.D.1.3	Direct N_2O Emissions from Managed Soils – Urine and Dung Deposited by Grazing Animals	N_2O	3,068.6	3,899.3	0.000	0.0	99.0

Note: Key categories are those that comprise 95 per cent of the total.

Annex 1: References

IPCC. 2006. Eggleston HS, Buendia L, Miwa K, Ngara T, Tanabe K (eds). *2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 1. General Guidance and Reporting.* IPCC National Greenhouse Gas Inventories Programme. Japan: Published for the IPCC by the Institute for Global Environmental Strategies.

Annex 2: Uncertainty analysis

Uncertainty estimates are an essential element of a complete emissions inventory. The purpose of uncertainty information is to help prioritise efforts to improve the accuracy of inventories in the future and guide decisions on methodological choice (IPCC, 2006).

New Zealand has followed Approach 1 for uncertainty analysis, as required by the inventory reporting guidelines under United Nations Framework Convention on Climate Change (UNFCCC, 2013) and Intergovernmental Panel on Climate Change (IPCC) methodological guidelines (IPCC, 2006). Uncertainties in the categories are combined in the uncertainty analysis to provide uncertainty estimates for the entire inventory in any year and the uncertainty in the overall inventory trend over time. Uncertainties for the categories themselves are described in the sector chapters 3-8 and chapter 11, as well as in chapter 1 section 1.6. Land Use, Land-Use Change and Forestry (LULUCF) sector categories have been included using the absolute value of any removals of carbon dioxide (table A2.1.1). Table A2.1.2 calculates the uncertainty only in emissions, that is, excluding LULUCF removals.

A2.1 Approach 1 uncertainty calculation

The uncertainty in activity data and emission and/or removal factors shown in tables A2.1.1 and A2.1.2 are equal to half the 95 per cent confidence interval divided by the mean and expressed as a percentage. The reason for halving the 95 per cent confidence interval is that the value corresponds to the familiar plus or minus value when uncertainties are loosely quoted as 'plus or minus x per cent'.

Where uncertainty is highly asymmetrical, the larger percentage difference between the mean and the confidence limit is entered. Where only the total uncertainty is known for a category, then:

- if uncertainty is correlated across years, the uncertainty is entered as the emission or the removal factor uncertainty and as zero in the activity data uncertainty
- if uncertainty is not correlated across years, the uncertainty is entered as the uncertainty in the activity data and as zero in the emission or the removal factor uncertainty.

In Approach 1, uncertainties in the trend are estimated using two sensitivities.

- Type A sensitivity is the change in the difference of total emissions between the base year and the current year, expressed as a percentage. Further, this change results from a 1 per cent increase in emissions of a given source category and a greenhouse gas in both the base year and the current year.
- Type B sensitivity is the change in the difference of total emissions between the base year and the current year, expressed as a percentage. Further, this change results from a 1 per cent increase in emissions of a given source category and gas in the current year only.

Uncertainties that are fully correlated between years are associated with Type A sensitivities, and uncertainties that are not correlated between years are associated with Type B sensitivities. Once the uncertainties introduced into the national inventory by Type A and Type B sensitivities have been calculated, they are summed using equation 3.1 (IPCC, 2006) to give the overall uncertainty in the trend.

In tables A2.1.1 and A2.1.2, the figure labelled 'Uncertainty in the trend' is an estimate of the total uncertainty in the trend in emissions since the base year. This is expressed as the number of percentage points in the 95 per cent confidence interval in the per cent change in emissions since the base year. The values for individual categories are an estimate of the uncertainty introduced into the trend by the category in question.

Table A2.1.1 Uncertainty calculation (including LULUCF) for New Zealand's Greenhouse Gas Inventory 1990–2019 (IPCC, 2006, Approach 1)

IPCC source category	Gas	1990 emissions or absolute value of removals (kt CO_2-e)	2019 emissions or absolute value of removals (kt CO_2-e)	Activity data uncertainty (%)	Emission or removal factor uncertainty (%)	Combined uncertainty (%)	Combined uncertainty as a per cent of the national total in 1990 (%)	Combined uncertainty as a per cent of the national total in 2019 (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in the trend in national total introduced by emission or removal factor uncertainty (%)	Uncertainty in trend in national total introduced by activity data uncertainty (%)	Combined uncertainty of the national total in 1990 ((%)^2)	Combined uncertainty of the national total in 2019 ((%)^2)
Energy – Liquid fuels	CO_2	11803.54	20235.22	1.5	0.5	1.5	0.1980	0.2609	0.0530	0.2201	0.0265	0.4541	0.0392	0.0681
Energy – Solid fuels	CO_2	3211.03	4155.77	4.6	2.2	5.1	0.1776	0.1767	0.0002	0.0452	0.0005	0.2940	0.0316	0.0312
Energy – Gaseous fuels	CO_2	7095.50	7787.32	9.3	2.4	9.6	0.7390	0.6235	0.0157	0.0847	0.0378	1.1100	0.5461	0.3887
Energy – Fugitive – geothermal	CO_2	228.58	585.06	5.0	5.0	7.1	0.0176	0.0346	0.0031	0.0064	0.0156	0.0450	0.0003	0.0012
Energy – Fugitive – venting/ flaring	CO_2	229.84	434.30	9.3	2.4	9.6	0.0239	0.0348	0.0015	0.0047	0.0035	0.0619	0.0006	0.0012
Energy – Fugitive – oil and gas activities	CO_2	0.08	0.20	5.0	100.0	100.1	0.0001	0.0002	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
Energy – Fugitive – transmission and distribution	CO_2	1.46	1.31	9.3	100.0	100.4	0.0016	0.0011	0.0000	0.0000	0.0007	0.0002	0.0000	0.0000
IPPU – Cement production	CO_2	448.75	410.94	1.0	1.0	1.4	0.0069	0.0049	0.0019	0.0045	0.0019	0.0063	0.0000	0.0000
IPPU – Lime production	CO_2	82.60	108.04	2.0	2.0	2.8	0.0025	0.0026	0.0000	0.0012	0.0000	0.0033	0.0000	0.0000
IPPU – Ceramics	CO_2	0.01	0.01	50.0	20.0	53.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IPPU – Other uses of soda ash	CO_2	5.87	6.63	3.0	2.0	3.6	0.0002	0.0002	0.0000	0.0001	0.0000	0.0003	0.0000	0.0000
IPPU – Other uses of limestone	CO_2	24.63	92.45	3.0	2.0	3.6	0.0010	0.0028	0.0007	0.0010	0.0013	0.0043	0.0000	0.0000
IPPU – Ammonia production	CO_2	21.68	22.83	2.0	6.0	6.3	0.0015	0.0012	0.0001	0.0002	0.0004	0.0007	0.0000	0.0000
IPPU – Calcium carbide	CO_2	1.43	1.43	50.0	50.0	70.7	0.0011	0.0008	0.0000	0.0000	0.0002	0.0011	0.0000	0.0000
IPPU – Hydrogen production	CO_2	152.29	159.04	2.0	6.0	6.3	0.0105	0.0084	0.0004	0.0017	0.0025	0.0049	0.0001	0.0001
IPPU – Iron and steel	CO_2	1306.73	1661.61	5.0	7.0	8.6	0.1223	0.1195	0.0004	0.0181	0.0029	0.1278	0.0150	0.0143
IPPU – Aluminium	CO_2	448.98	574.50	5.0	2.0	5.4	0.0263	0.0259	0.0001	0.0062	0.0002	0.0442	0.0007	0.0007
IPPU – Secondary lead production	CO_2	1.80	0.00	50.0	50.0	70.7	0.0014	0.0000	0.0000	0.0000	0.0013	0.0000	0.0000	0.0000
IPPU – Lubricant use	CO_2	22.83	42.53	20.0	50.0	53.9	0.0134	0.0192	0.0001	0.0005	0.0070	0.0131	0.0002	0.0004
IPPU – Paraffin wax	CO_2	2.35	2.35	20.0	100.0	102.0	0.0026	0.0020	0.0000	0.0000	0.0008	0.0007	0.0000	0.0000
IPPU – Other: Urea catalyst in road transport	CO_2	0.00	3.16	50.0	10.0	51.0	0.0000	0.0013	0.0000	0.0000	0.0003	0.0024	0.0000	0.0000
Agriculture – Liming	CO_2	360.06	546.14	3.4	50.0	50.1	0.1963	0.2289	0.0008	0.0059	0.0423	0.0286	0.0385	0.0524

IPCC source category	Gas	1990 emissions or absolute value of removals (kt CO_2-e)	2019 emissions or absolute value of removals (kt CO_2-e)	Activity data uncertainty (%)	Emission or removal factor uncertainty (%)	Combined uncertainty (%)	Combined uncertainty as a per cent of the national total in 1990 (%)	Combined uncertainty as a per cent of the national total in 2019 (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in the trend in national total introduced by emission or removal factor uncertainty (%)	Uncertainty in trend in national total introduced by activity data uncertainty (%)	Combined uncertainty of the national total in 1990 ($(\%)^2$)	Combined uncertainty of the national total in 2019 ($(\%)^2$)
Agriculture – Urea application	CO_2	39.19	570.72	10.0	50.0	51.0	0.0217	0.2433	0.0057	0.0062	0.2827	0.0878	0.0005	0.0592
LULUCF – Forest land	CO_2	23325.33	22280.41	6.4	78.9	79.2	20.0958	14.7565	0.0875	0.2424	6.9054	2.1888	403.8417	217.7538
LULUCF – Cropland	CO_2	468.49	379.36	8.0	69.0	69.4	0.3538	0.2202	0.0025	0.0041	0.1726	0.0467	0.1251	0.0485
LULUCF – Grassland	CO_2	531.37	4181.18	8.4	27.9	29.1	0.1683	1.0182	0.0380	0.0455	1.0584	0.5404	0.0283	1.0367
LULUCF – Wetlands	CO_2	10.70	13.33	33.0	124.8	129.1	0.0150	0.0144	0.0000	0.0001	0.0008	0.0068	0.0002	0.0002
LULUCF – Settlements	CO_2	74.44	112.66	22.0	64.7	68.3	0.0553	0.0644	0.0002	0.0012	0.0111	0.0381	0.0031	0.0041
LULUCF – Other land	CO_2	12.65	48.64	8.0	27.1	28.3	0.0039	0.0115	0.0004	0.0005	0.0095	0.0060	0.0000	0.0001
LULUCF – Harvested wood products	CO_2	2072.91	10067.30	15.0	67.4	69.0	1.5560	5.8095	0.0802	0.1095	5.3995	2.3230	2.4213	33.7500
Waste – Incineration and open burning of waste	CO_2	158.78	90.20	50.0	40.0	64.0	0.1106	0.0483	0.0013	0.0010	0.0506	0.0694	0.0122	0.0023
Tokelau Energy industries – sectoral approach – liquid	CO_2	0.23	0.25	10.0	7.0	12.2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Gas Diesel Oil – Sectoral approach – liquid	CO_2	0.90	2.18	50.0	1.5	50.0	0.0005	0.0009	0.0000	0.0000	0.0000	0.0017	0.0000	0.0000
Tokelau Other/Residential – Sectoral approach – liquid	CO_2	0.12	0.07	20.0	7.0	21.2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Waste – Incineration and open burning of waste	CO_2	0.05	0.04	50.0	40.0	64.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Energy – Liquid fuels	CH_4	82.86	26.73	1.5	50.0	50.0	0.0451	0.0112	0.0009	0.0003	0.0441	0.0006	0.0020	0.0001
Energy – Solid fuels	CH_4	36.38	23.97	4.6	50.0	50.2	0.0199	0.0101	0.0003	0.0003	0.0127	0.0017	0.0004	0.0001
Energy – Gaseous fuels	CH_4	9.07	4.63	9.3	50.0	50.9	0.0050	0.0020	0.0001	0.0001	0.0039	0.0007	0.0000	0.0000
Energy – Biomass	CH_4	66.60	74.23	50.0	50.0	70.7	0.0512	0.0439	0.0001	0.0008	0.0068	0.0571	0.0026	0.0019
Energy – Fugitive – geothermal	CH_4	54.79	156.88	5.0	5.0	7.1	0.0042	0.0093	0.0009	0.0017	0.0047	0.0121	0.0000	0.0001
Energy – Fugitive – venting/ processing	CH_4	66.06	55.61	9.3	50.0	50.9	0.0365	0.0236	0.0003	0.0006	0.0165	0.0079	0.0013	0.0006
Energy – Fugitive – Coal mining	CH_4	328.23	135.35	4.6	50.0	50.2	0.1793	0.0568	0.0032	0.0015	0.1586	0.0096	0.0321	0.0032
Energy – Fugitive – transmission and distribution	CH_4	279.97	215.87	9.3	100.0	100.4	0.3058	0.1813	0.0016	0.0023	0.1613	0.0308	0.0935	0.0329

IPCC source category	Gas	1990 emissions or absolute value of removals (kt CO_2-e)	2019 emissions or absolute value of removals (kt CO_2-e)	Activity data uncertainty (%)	Emission or removal factor uncertainty (%)	Combined uncertainty (%)	Combined uncertainty as a per cent of the national total in 1990 (%)	Combined uncertainty as a per cent of the national total in 2019 (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in the trend in national total introduced by emission or removal factor uncertainty (%)	Uncertainty in trend in national total introduced by activity data uncertainty (%)	Combined uncertainty of the national total in 1990 ($(\%)^2$)	Combined uncertainty of the national total in 2019 ($(\%)^2$)
Energy – fugitive – oil and gas activities	CH_4	50.43	135.03	9.3	100.0	100.4	0.0551	0.1134	0.0008	0.0015	0.0755	0.0192	0.0030	0.0129
Energy – fugitive – oil transportation and storage	CH_4	1.67	4.75	5.0	50.0	50.2	0.0009	0.0020	0.0000	0.0001	0.0014	0.0004	0.0000	0.0000
IPPU – chemical industry	CH_4	27.60	107.25	2.0	80.0	80.0	0.0240	0.0718	0.0008	0.0012	0.0621	0.0033	0.0006	0.0052
Agriculture – enteric fermentation	CH_4	27350.36	28974.60	3.9	15.5	16.0	4.7601	3.8766	0.0716	0.3152	1.1113	1.7383	22.6583	15.0279
Agriculture – manure management	CH_4	727.81	1622.56	5.0	20.0	20.6	0.1632	0.2797	0.0074	0.0176	0.1470	0.1248	0.0266	0.0782
Agriculture – burning of residues	CH_4	22.62	20.03	6.0	20.0	20.9	0.0051	0.0035	0.0001	0.0002	0.0020	0.0018	0.0000	0.0000
LULUCF	CH_4	93.51	76.56	30.0	48.3	56.9	0.0578	0.0364	0.0005	0.0008	0.0237	0.0353	0.0033	0.0013
Waste – solid waste disposal	CH_4	3337.79	2692.93	92.0	40.0	100.3	3.6420	2.2589	0.0179	0.0293	0.7172	3.8108	13.2642	5.1024
Waste – wastewater treatment and discharge	CH_4	221.17	253.58	10.0	40.0	41.2	0.0992	0.0874	0.0004	0.0028	0.0148	0.0390	0.0098	0.0076
Waste – Biological treatment of solid waste	CH_4	2.74	38.02	100.0	100.0	141.4	0.0042	0.0450	0.0004	0.0004	0.0375	0.0585	0.0000	0.0020
Waste – incineration and open burning of waste	CH_4	127.32	77.82	50.0	100.0	111.8	0.1548	0.0728	0.0010	0.0008	0.0955	0.0599	0.0240	0.0053
Tokelau Energy industries – Sectoral approach – liquid	CH_4	0.00	0.00	10.0	50.0	51.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Gas Diesel Oil – Sectoral approach – liquid	CH_4	0.00	0.01	50.0	50.0	70.7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Other/ Residential – Sectoral approach – liquid	CH_4	0.00	0.00	20.0	50.0	53.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Agriculture – enteric fermentation	CH_4	0.09	0.06	20.0	50.0	53.9	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Agriculture – manure management	CH_4	1.06	0.76	20.0	30.0	36.1	0.0004	0.0002	0.0000	0.0000	0.0002	0.0002	0.0000	0.0000
Tokelau Waste – solid waste disposal	CH_4	0.39	0.31	140.0	40.0	145.6	0.0006	0.0004	0.0000	0.0000	0.0001	0.0007	0.0000	0.0000
Tokelau Waste – wastewater treatment and discharge	CH_4	0.15	0.26	10.0	40.0	41.2	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

IPCC source category	Gas	1990 emissions or absolute value of removals (kt CO_2-e)	2019 emissions or absolute value of removals (kt CO_2-e)	Activity data uncertainty (%)	Emission or removal factor uncertainty (%)	Combined uncertainty (%)	Combined uncertainty as a per cent of the national total in 1990 (%)	Combined uncertainty as a per cent of the national total in 2019 (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in the trend in national total introduced by emission or removal factor uncertainty (%)	Uncertainty in trend in national total introduced by activity data uncertainty (%)	Combined uncertainty of the national total in 1990 ((%)^2)	Combined uncertainty of the national total in 2019 ((%)^2)
Tokelau Waste – incineration and open burning of waste	CH_4	0.09	0.07	50.0	100.0	111.8	0.0001	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
Energy – liquid fuels	N_2O	141.23	154.20	1.5	50.0	50.0	0.0768	0.0645	0.0003	0.0017	0.0161	0.0035	0.0059	0.0042
Energy – solid fuels	N_2O	14.96	19.16	4.6	50.0	50.2	0.0082	0.0080	0.0000	0.0002	0.0002	0.0014	0.0001	0.0001
Energy – gaseous fuels	N_2O	5.55	3.87	9.3	50.0	50.9	0.0031	0.0016	0.0000	0.0000	0.0018	0.0006	0.0000	0.0000
Energy – biomass	N_2O	36.59	53.33	50.0	50.0	70.7	0.0281	0.0315	0.0001	0.0006	0.0031	0.0410	0.0008	0.0010
Energy – fugitive – venting/ flaring	N_2O	0.06	0.08	5.0	100.0	100.1	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IPPU – Other product manufacture and use	N_2O	102.45	84.48	15.0	0.0	15.0	0.0167	0.0106	0.0005	0.0009	0.0000	0.0195	0.0003	0.0001
Agriculture – agricultural soils	N_2O	5284.78	7763.12	11.4	54.1	55.3	3.1791	3.5900	0.0097	0.0844	0.5228	1.3571	10.1064	12.8878
Agriculture – manure management	N_2O	50.69	116.38	5.0	100.0	100.1	0.0552	0.0974	0.0005	0.0013	0.0549	0.0090	0.0030	0.0095
Agriculture – burning of residues	N_2O	4.77	4.15	6.0	20.0	20.9	0.0011	0.0007	0.0000	0.0000	0.0004	0.0004	0.0000	0.0000
LULUCF	N_2O	214.02	110.88	30.0	48.3	56.9	0.1324	0.0527	0.0018	0.0012	0.0880	0.0512	0.0175	0.0028
Waste – wastewater treatment and discharge	N_2O	82.11	118.90	10.0	90.0	90.6	0.0809	0.0900	0.0001	0.0013	0.0118	0.0183	0.0065	0.0081
Waste – Incineration and open burning of waste	N_2O	29.45	18.27	50.0	100.0	111.8	0.0358	0.0171	0.0002	0.0002	0.0218	0.0141	0.0013	0.0003
Waste – Biological treatment of solid waste	N_2O	1.96	27.19	100.0	150.0	180.3	0.0038	0.0410	0.0003	0.0003	0.0402	0.0418	0.0000	0.0017
Tokelau Energy industries – Sectoral approach – liquid	N_2O	0.00	0.00	10.0	50.0	51.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Gas Diesel Oil – Sectoral approach – liquid	N_2O	0.01	0.02	50.0	50.0	70.7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Other/Residential – Sectoral approach – liquid	N_2O	0.00	0.00	20.0	50.0	53.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau IPPU – Other product manufacture and use	N_2O	0.05	0.02	15.0	0.0	15.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Waste – Wastewater treatment and discharge	N_2O	0.02	0.00	10.0	90.0	90.6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

IPCC source category	Gas	1990 emissions or absolute value of removals (kt CO_2-e)	2019 emissions or absolute value of removals (kt CO_2-e)	Activity data uncertainty (%)	Emission or removal factor uncertainty (%)	Combined uncertainty (%)	Combined uncertainty as a per cent of the national total in 1990 (%)	Combined uncertainty as a per cent of the national total in 2019 (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in the trend in national total introduced by emission or removal factor uncertainty (%)	Uncertainty in trend in national total introduced by activity data uncertainty (%)	Combined uncertainty of the national total in 1990 ($(\%)^2$)	Combined uncertainty of the national total in 2019 ($(\%)^2$)
Tokelau Waste – Incineration and open burning of waste	N_2O	0.01	0.01	50.0	100.0	111.8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IPPU – Refrigeration and air conditioning	HFCs	0.00	1637.74	25.0	0.0	25.0	0.0000	0.3424	0.0178	0.0178	0.0000	0.6298	0.0000	0.1172
IPPU – Foam blowing agents	HFCs	0.00	6.71	12.0	50.0	51.4	0.0000	0.0029	0.0001	0.0001	0.0036	0.0012	0.0000	0.0000
IPPU – Fire protection	HFCs	0.00	2.22	10.0	41.0	42.2	0.0000	0.0008	0.0000	0.0000	0.0010	0.0003	0.0000	0.0000
IPPU – Aerosols	HFCs	0.00	87.16	25.0	10.0	26.9	0.0000	0.0196	0.0009	0.0009	0.0095	0.0335	0.0000	0.0004
IPPU – Aluminium	PFCs	909.95	89.12	5.0	30.0	30.4	0.3010	0.0227	0.0119	0.0010	0.3571	0.0069	0.0906	0.0005
IPPU – Refrigeration and air conditioning	PFCs	0.00	0.00	25.0	0.0	25.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IPPU – Other product use	PFCs	0.00	0.01	80.0	0.0	80.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IPPU – Magnesium production	SF6	2.74	0.00	100.0	0.0	100.0	0.0030	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IPPU – Electrical equipment	SF6	14.50	12.97	20.0	30.0	36.1	0.0057	0.0039	0.0001	0.0001	0.0019	0.0040	0.0000	0.0000
IPPU – Other product use	SF6	2.74	2.74	80.0	0.0	80.0	0.0024	0.0018	0.0000	0.0000	0.0000	0.0034	0.0000	0.0000
Tokelau IPPU – Product uses as substitutes for ODS	HFCs	0.00	0.23	32.0	0.0	32.0	0.0000	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
Total emissions removals		**91.932.6**	**119,588.0**		**Uncertainty in the base year**	**21.3**			**Uncertainty in the final year**	**16.9**		**Uncertainty in the trend**	**10.6**	

Table A2.1.2 Uncertainty calculation (excluding LULUCF) for New Zealand's Greenhouse Gas Inventory 1990–2019 (2006 IPCC, Approach 1)

IPCC source category	Gas	1990 emissions Kt CO_2-e	2019 emissions, kt CO_2-e	Activity data uncertainty (%)	Emission factor uncertainty (%)	Combined uncertainty (%)	Combined uncertainty as a per cent of the national total in 1990 (%)	Combined uncertainty as a per cent of the national total in 2018 (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in the trend in national total introduced by emission factor uncertainty (%)	Uncertainty in trend in national total introduced by activity data uncertainty (%)	Combined uncertainty of the national total in 1990 ($(\%)^2$)	Combined uncertainty of the national total in 2019 ($(\%)^2$)
Energy – liquid fuels	CO_2	11803.54	20235.22	1.5	0.5	1.5	0.2795	0.3791	0.0815	0.3107	0.0407	0.6410	0.0781	0.1437
Energy – solid fuels	CO_2	3211.03	4155.77	4.6	2.2	5.1	0.2508	0.2568	0.0015	0.0638	0.0032	0.4149	0.0629	0.0659
Energy – gaseous fuels	CO_2	7095.50	7787.32	9.3	2.4	9.6	1.0431	0.9057	0.0181	0.1196	0.0436	1.5668	1.0880	0.8204
Energy – fugitive – geothermal	CO_2	228.58	585.06	5.0	5.0	7.1	0.0248	0.0503	0.0045	0.0090	0.0227	0.0635	0.0006	0.0025
Energy – fugitive – venting/ flaring	CO_2	229.84	434.30	9.3	2.4	9.6	0.0338	0.0505	0.0022	0.0067	0.0053	0.0874	0.0011	0.0026
Energy – fugitive – oil and gas activities	CO_2	0.08	0.20	5.0	100.0	100.1	0.0001	0.0002	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
Energy – fugitive – transmission and distribution	CO_2	1.46	1.31	9.3	100.0	100.4	0.0023	0.0016	0.0000	0.0000	0.0008	0.0003	0.0000	0.0000
IPPU – Cement production	CO_2	448.75	410.94	1.0	1.0	1.4	0.0097	0.0071	0.0024	0.0063	0.0024	0.0089	0.0001	0.0000
IPPU – Lime production	CO_2	82.60	108.04	2.0	2.0	2.8	0.0036	0.0037	0.0001	0.0017	0.0001	0.0047	0.0000	0.0000
IPPU – Ceramics	CO_2	0.01	0.01	50.0	20.0	53.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IPPU – Other uses of soda ash	CO_2	5.87	6.63	3.0	2.0	3.6	0.0003	0.0003	0.0000	0.0001	0.0000	0.0004	0.0000	0.0000
IPPU – Other uses of limestone	CO_2	24.63	92.45	3.0	2.0	3.6	0.0014	0.0040	0.0009	0.0014	0.0019	0.0060	0.0000	0.0000
IPPU – Ammonia production	CO_2	21.68	22.83	2.0	6.0	6.3	0.0021	0.0018	0.0001	0.0004	0.0004	0.0010	0.0000	0.0000
IPPU – Calcium carbide	CO_2	1.43	1.43	50.0	50.0	70.7	0.0016	0.0012	0.0000	0.0000	0.0003	0.0016	0.0000	0.0000
IPPU – Hydrogen production	CO_2	152.29	159.04	2.0	6.0	6.3	0.0148	0.0122	0.0005	0.0024	0.0031	0.0069	0.0002	0.0001
IPPU – Iron and steel	CO_2	1306.73	1661.61	5.0	7.0	8.6	0.1726	0.1736	0.0002	0.0255	0.0011	0.1804	0.0298	0.0302
IPPU – Aluminium	CO_2	448.98	574.50	5.0	2.0	5.4	0.0371	0.0376	0.0001	0.0088	0.0002	0.0624	0.0014	0.0014
IPPU – Secondary lead production	CO_2	1.80	0.00	50.0	50.0	70.7	0.0020	0.0000	0.0000	0.0000	0.0017	0.0000	0.0000	0.0000
IPPU – Lubricant use	CO_2	22.83	42.53	20.0	50.0	53.9	0.0189	0.0278	0.0002	0.0007	0.0105	0.0185	0.0004	0.0008
IPPU – Paraffin wax	CO_2	2.35	2.35	20.0	100.0	102.0	0.0037	0.0029	0.0000	0.0000	0.0010	0.0010	0.0000	0.0000
IPPU – Other: Urea catalyst in road transport	CO_2	0.00	3.16	50.0	10.0	51.0	0.0000	0.0020	0.0000	0.0000	0.0005	0.0034	0.0000	0.0000
Agriculture – Liming	CO_2	360.06	546.14	3.4	50.0	50.1	0.2771	0.3325	0.0014	0.0084	0.0699	0.0403	0.0768	0.1106
Agriculture – Urea application	CO_2	39.19	570.72	10.0	50.0	51.0	0.0307	0.3535	0.0080	0.0088	0.4001	0.1239	0.0009	0.1250
Waste – Incineration and open burning of waste	CO_2	158.78	90.20	50.0	40.0	64.0	0.1561	0.0702	0.0017	0.0014	0.0679	0.0979	0.0244	0.0049

IPCC source category	Gas	1990 emissions Kt CO_2-e	2019 emissions, kt CO_2-e	Activity data uncertainty (%)	Emission factor uncertainty (%)	Combined uncertainty (%)	Combined uncertainty as a per cent of the national total in 1990 (%)	Combined uncertainty as a per cent of the national total in 2018 (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in the trend in national total introduced by emission factor uncertainty (%)	Uncertainty in trend in national total introduced by activity data uncertainty (%)	Combined uncertainty of the national total in 1990 ($(\%)^2$)	Combined uncertainty of the national total in 2019 ($(\%)^2$)
Tokelau Energy industries – Sectoral approach – liquid	CO_2	0.23	0.25	10.0	7.0	12.2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
Tokelau Gas Diesel Oil – Sectoral approach – liquid	CO_2	0.90	2.18	50.0	1.5	50.0	0.0007	0.0013	0.0000	0.0000	0.0000	0.0024	0.0000	0.0000
Tokelau Other/Residential – Sectoral approach – liquid	CO_2	0.12	0.07	20.0	7.0	21.2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Waste – Incineration and open burning of waste	CO_2	0.05	0.04	50.0	40.0	64.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Energy – Liquid fuels	CH_4	82.86	26.73	1.5	50.0	50.0	0.0636	0.0162	0.0012	0.0004	0.0599	0.0008	0.0040	0.0003
Energy – Solid fuels	CH_4	36.38	23.97	4.6	50.0	50.2	0.0280	0.0146	0.0003	0.0004	0.0169	0.0024	0.0008	0.0002
Energy – Gaseous fuels	CH_4	9.07	4.63	9.3	50.0	50.9	0.0071	0.0029	0.0001	0.0001	0.0052	0.0009	0.0001	0.0000
Energy – Biomass	CH_4	66.60	74.23	50.0	50.0	70.7	0.0723	0.0638	0.0002	0.0011	0.0076	0.0806	0.0052	0.0041
Energy – Fugitive – geothermal	CH_4	54.79	156.88	5.0	5.0	7.1	0.0059	0.0135	0.0013	0.0024	0.0067	0.0170	0.0000	0.0002
Energy – Fugitive – venting/ processing	CH_4	66.06	55.61	9.3	50.0	50.9	0.0516	0.0344	0.0004	0.0009	0.0214	0.0112	0.0027	0.0012
Energy – Fugitive – coal mining	CH_4	328.23	135.35	4.6	50.0	50.2	0.2531	0.0826	0.0043	0.0021	0.2146	0.0135	0.0640	0.0068
Energy – Fugitive – transmission and distribution	CH_4	279.97	215.87	9.3	100.0	100.4	0.4317	0.2634	0.0021	0.0033	0.2119	0.0434	0.1864	0.0694
Energy – Fugitive – oil and gas activities	CH_4	50.43	135.03	9.3	100.0	100.4	0.0778	0.1647	0.0011	0.0021	0.1095	0.0272	0.0060	0.0271
Energy – Fugitive – oil transportation and storage	CH_4	1.67	4.75	5.0	50.0	50.2	0.0013	0.0029	0.0000	0.0001	0.0020	0.0005	0.0000	0.0000
IPPU – Chemical industry	CH_4	27.60	107.25	2.0	80.0	80.0	0.0339	0.1043	0.0011	0.0016	0.0889	0.0047	0.0012	0.0109
Agriculture – Enteric fermentation	CH_4	27350.36	28974.60	3.9	15.5	16.0	6.7190	5.6318	0.0855	0.4449	1.3272	2.4537	45.1455	31.7167
Agriculture – Manure management	CH_4	727.81	1622.56	5.0	20.0	20.6	0.2304	0.4064	0.0108	0.0249	0.2158	0.1762	0.0531	0.1651
Agriculture – Burning of residues	CH_4	22.62	20.03	6.0	20.0	20.9	0.0073	0.0051	0.0001	0.0003	0.0026	0.0026	0.0001	0.0000
Waste – Solid waste disposal	CH_4	3337.79	2692.93	92.0	40.0	100.3	5.1409	3.2816	0.0234	0.0413	0.9366	5.3791	26.4284	10.7688
Waste – Wastewater treatment and discharge	CH_4	221.17	253.58	10.0	40.0	41.2	0.1400	0.1270	0.0004	0.0039	0.0159	0.0551	0.0196	0.0161
Waste – Biological treatment of solid waste	CH_4	2.74	38.02	100.0	100.0	141.4	0.0059	0.0653	0.0005	0.0006	0.0531	0.0825	0.0000	0.0043

IPCC source category	Gas	1990 emissions Kt CO_2-e	2019 emissions, kt CO_2-e	Activity data uncertainty (%)	Emission factor uncertainty (%)	Combined uncertainty (%)	Combined uncertainty as a per cent of the national total in 1990 (%)	Combined uncertainty as a per cent of the national total in 2018 (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in the trend in national total introduced by emission factor uncertainty (%)	Uncertainty in trend in national total introduced by activity data uncertainty (%)	Combined uncertainty of the national total in 1990 $((\%)^2)$	Combined uncertainty of the national total in 2019 $((\%)^2)$
Waste – Incineration and open burning of waste	CH_4	127.32	77.82	50.0	100.0	111.8	0.2186	0.1057	0.0013	0.0012	0.1276	0.0845	0.0478	0.0112
Tokelau Energy industries – Sectoral approach – liquid	CH_4	0.00	0.00	10.0	50.0	51.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Gas Diesel Oil – Sectoral approach – liquid	CH_4	0.00	0.01	50.0	50.0	70.7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Other/Residential – Sectoral approach – liquid	CH_4	0.00	0.00	20.0	50.0	53.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Agriculture – enteric fermentation	CH_4	0.09	0.06	20.0	50.0	53.9	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Agriculture – manure management	CH_4	1.06	0.76	20.0	30.0	36.1	0.0006	0.0003	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000
Tokelau Waste – solid waste disposal	CH_4	0.39	0.31	140.0	40.0	145.6	0.0009	0.0005	0.0000	0.0000	0.0001	0.0009	0.0000	0.0000
Tokelau Waste – wastewater treatment and discharge	CH_4	0.15	0.26	10.0	40.0	41.2	0.0001	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
Tokelau Waste – incineration and open burning of waste	CH_4	0.09	0.07	50.0	100.0	111.8	0.0002	0.0001	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000
Energy – Liquid fuels	N_2O	141.23	154.20	1.5	50.0	50.0	0.1085	0.0937	0.0004	0.0024	0.0187	0.0049	0.0118	0.0088
Energy – Solid fuels	N_2O	14.96	19.16	4.6	50.0	50.2	0.0115	0.0117	0.0000	0.0003	0.0002	0.0019	0.0001	0.0001
Energy – Gaseous fuels	N_2O	5.55	3.87	9.3	50.0	50.9	0.0043	0.0024	0.0000	0.0001	0.0024	0.0008	0.0000	0.0000
Energy – Biomass	N_2O	36.59	53.33	50.0	50.0	70.7	0.0397	0.0458	0.0001	0.0008	0.0054	0.0579	0.0016	0.0021
Energy – Fugitive – venting/ flaring	N_2O	0.06	0.08	5.0	100.0	100.1	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IPPU – Other product manufacture and use	N_2O	102.45	84.48	15.0	0.0	15.0	0.0236	0.0154	0.0007	0.0013	0.0000	0.0275	0.0006	0.0002
Agriculture – Agricultural soils	N_2O	5284.78	7763.12	11.4	54.1	55.3	4.4874	5.2154	0.0166	0.1192	0.8997	1.9156	20.1365	27.1999
Agriculture – Manure management	N_2O	50.69	116.38	5.0	100.0	100.1	0.0779	0.1416	0.0008	0.0018	0.0803	0.0126	0.0061	0.0200
Agriculture – Burning of residues	N_2O	4.77	4.15	6.0	20.0	20.9	0.0015	0.0011	0.0000	0.0001	0.0006	0.0005	0.0000	0.0000
Waste – Wastewater treatment and discharge	N_2O	82.11	118.90	10.0	90.0	90.6	0.1142	0.1308	0.0002	0.0018	0.0209	0.0258	0.0130	0.0171

IPCC source category	Gas	1990 emissions Kt CO_2-e	2019 emissions, kt CO_2-e	Activity data uncertainty (%)	Emission factor uncertainty (%)	Combined uncertainty (%)	Combined uncertainty as a per cent of the national total in 1990 (%)	Combined uncertainty as a per cent of the national total in 2018 (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in the trend in national total introduced by emission factor uncertainty (%)	Uncertainty in trend in national total introduced by activity data uncertainty (%)	Combined uncertainty of the national total in 1990 ((%)^2)	Combined uncertainty of the national total in 2019 ((%)^2)
Waste – Incineration and open burning of waste	N_2O	29.45	18.27	50.0	100.0	111.8	0.0506	0.0248	0.0003	0.0003	0.0291	0.0198	0.0026	0.0006
Waste – Biological treatment of solid waste	N_2O	1.96	27.19	100.0	150.0	180.3	0.0054	0.0595	0.0004	0.0004	0.0569	0.0590	0.0000	0.0035
Tokelau Energy industries – Sectoral approach – liquid	N_2O	0.00	0.00	10.0	50.0	51.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Gas Diesel Oil – Sectoral approach – liquid	N_2O	0.01	0.02	50.0	50.0	70.7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Other/Residential – Sectoral approach – liquid	N_2O	0.00	0.00	20.0	50.0	53.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau IPPU – Other product manufacture and use	N_2O	0.05	0.02	15.0	0.0	15.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Waste – wastewater treatment and discharge	N_2O	0.02	0.00	10.0	90.0	90.6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tokelau Waste – Incineration and open burning of waste	N_2O	0.01	0.01	50.0	100.0	111.8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IPPU – Refrigeration and air conditioning	HFCs	0.00	1637.74	25.0	0.0	25.0	0.0000	0.4974	0.0251	0.0251	0.0000	0.8890	0.0000	0.2474
IPPU – Foam blowing agents	HFCs	0.00	6.71	12.0	50.0	51.4	0.0000	0.0042	0.0001	0.0001	0.0051	0.0017	0.0000	0.0000
IPPU – Fire protection	HFCs	0.00	2.22	10.0	41.0	42.2	0.0000	0.0011	0.0000	0.0000	0.0014	0.0005	0.0000	0.0000
IPPU – Aerosols	HFCs	0.00	87.16	25.0	10.0	26.9	0.0000	0.0285	0.0013	0.0013	0.0134	0.0473	0.0000	0.0008
IPPU – Aluminium	PFCs	909.95	89.12	5.0	30.0	30.4	0.4249	0.0329	0.0163	0.0014	0.4886	0.0097	0.1806	0.0011
IPPU – Refrigeration and air conditioning	PFCs	0.00	0.00	25.0	0.0	25.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IPPU – Other product use	PFCs	0.00	0.01	80.0	0.0	80.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IPPU – Magnesium production	SF6	2.74	0.00	100.0	0.0	100.0	0.0042	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
IPPU – Electrical equipment	SF6	14.50	12.97	20.0	30.0	36.1	0.0080	0.0057	0.0001	0.0002	0.0025	0.0056	0.0001	0.0000
IPPU – Other product use	SF6	2.74	2.74	80.0	0.0	80.0	0.0034	0.0027	0.0000	0.0000	0.0000	0.0048	0.0000	0.0000
Tokelau IPPU – Product uses as substitutes for ODS	HFCs	0.00	0.23	32.0	0.0	32.0	0.0000	0.0001	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000
Total emissions		**65,129.2**	**82,317.7**			**Uncertainty in the base year**	**9.7%**		**Uncertainty in the final year**	**8.5%**		**Uncertainty in the trend**	**6.8%**	

Annex 2: References

IPCC. 2006. Eggleston HS, Buendia L, Miwa K, Ngara T, Tanabe K (eds). *2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 1. General Guidance and Reporting.* IPCC National Greenhouse Gas Inventories Programme. Japan: Published for the IPCC by the Institute for Global Environmental Strategies.

UNFCCC. 2013. FCCC/CP/2013/Add.3. *Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories (addendum to Decision 24/CP.19)*.

Annex 3: Detailed methodological information for other sectors

A3.1 Supplementary information for the Agriculture sector

A3.1.1 Livestock population data

2017 Agricultural Production Census and 2019 Agricultural Production Survey

Details of the Agricultural Production Census (APC) and Agricultural Production Survey (APS) are included to provide an understanding of the livestock statistics process and uncertainty values. The information here is provided by Stats NZ, with full details available from the Stats NZ website (www.stats.govt.nz/information-releases/agricultural-production-statistics-june-2019-final).

Stats NZ holds the APC every five years, with the most recent census held in 2017. In all other years, Stats NZ holds the APS, which applies a very similar method to the APC, but targets only about half of the businesses involved in agriculture or forestry production. The National Inventory Report is compiled with data from the APC and APS.

The 2019 APS used a stratified sample design to select a sample from the target population (all businesses that were engaged in agricultural production activity (including livestock, cropping, horticulture and forestry) or that owned land that was intended for agricultural activity during the year ended 30 June 2019). The response rate, or the estimated proportion of eligible businesses that responded to the 2019 APS, was 83 per cent.

The imputation levels of the 2017 APC and the 2019 APS are provided in table A3.1.1. Full details on APC and APS data collection methodology can be found on the Stats NZ website (datainfoplus.stats.govt.nz).

Sampling error arises in the APS from selecting a sample of businesses and weighting the results rather than taking a complete enumeration (i.e., census). Non-sampling error arises from biases in the patterns of response and non-response, inaccuracies in reporting by respondents and errors in the recording and classification of data. Stats NZ adopts procedures to detect and minimise these types of errors, but they may still occur and are not easy to quantify.

Table A3.1.1 Imputation levels and sampling errors for recent Agricultural Production surveys

Statistic	Proportion of total estimate imputed (%)		Relative sampling errors at 95% confidence interval (%)	
Survey year	2018	2019	2018	2019
Ewe hoggets put to ram	17	17	4	5
Breeding ewes, two tooth and over	17	16	2	3
Total number of sheep	**17**	**16**	**3**	**3**
Lambs born to ewe hoggets	18	16	4	5
Lambs born to ewes	17	16	2	3
Total number of lambs	**17**	**16**	**2**	**3**

Statistic	Proportion of total estimate imputed (%)		Relative sampling errors at 95% confidence interval (%)	
Survey year	2018	2019	2018	2019
Calves born alive to dairy heifers and/or cows	29	28	4	4
Dairy cows and heifers, in milk or calf	28	25	6	4
Total number of dairy cattle	**27**	**24**	**6**	**3**
Calves born alive to beef heifers and/or cows	18	18	2	4
Beef cows and heifers (in calf) one to two years	17	18	3	13
Beef cows and heifers (in calf) two years and over	17	18	2	3
Total number of beef cattle	**18**	**19**	**2**	**3**
Female deer mated	13	8	5	5
Total number of deer	**13**	**8**	**5**	**5**
Fawns born on farm and alive at four months	13	8	5	5
Total pigs	**9**	**3**	**1**	**1**
Area of wheat harvested	15	14	4	5
Area of barley harvested	20	17	7	8
Area of oat grain harvested	14	18	13	22
Area of maize grain harvested	11	15	12	10

Livestock characterisation in New Zealand's Tier 2 modelling

The delineation of the major livestock categories in New Zealand's Tier 2 livestock nutritional and energy requirements modelling (see table A3.1.2) are taken from population data collected by the APC and APS and Ministry for Primary Industries slaughter statistics.

Table A3.1.2 Characterisation of major livestock subcategories (dairy cattle, beef cattle, sheep and deer) in New Zealand's Tier 2 livestock modelling

Livestock category		Subcategory
Dairy cattle	Milking cows and heifers	Milking cows and heifers
	Growing females less than one year	Growing females less than one year
	Growing females one to two years	Growing females one to two years
	Breeding bulls	Breeding bulls
	Northland	Northland
	Auckland	Auckland
	Waikato	Waikato
	Bay of Plenty	Bay of Plenty
	Gisborne	Gisborne
	Hawke's Bay	Hawke's Bay
	Taranaki	Taranaki
	Manawatu–Whanganui	Manawatu–Whanganui
	Wellington	Wellington
	Tasman	Tasman
	Nelson	Nelson
	Marlborough	Marlborough
	West Coast	West Coast
	Canterbury	Canterbury
	Otago	Otago
	Southland	Southland

Livestock category	Subcategory
Beef cattle categories	Breeding growing cows less than one year
	Breeding growing cows one to two years
	Breeding growing cows two to three years
	Breeding mature cows
	Breeding bulls – mixed age
	Slaughter heifers less than one year
	Slaughter heifers one to two years
	Slaughter steers less than one year
	Slaughter steers one to two years
	Slaughter bulls less than one year
	Slaughter bulls one to two years
Sheep categories	Dry ewes
	Mature breeding ewes
	Growing breeding sheep
	Growing non-breeding sheep
	Wethers
	Lambs
	Rams
Deer categories	Breeding hinds
	Hinds less than one year
	Hinds one to two years
	Stags less than one year
	Stags one to two years
	Stags two to three years
	Mixed age and breeding stags

A3.1.2 Key parameters and emission factors used in the Agriculture sector

For the major livestock categories, milk yield varies over the course of a year, which affects energy requirements, feed intake and greenhouse gas emissions. Table A3.1.3 shows the proportions that are used to calculate milk yield for different months over the course of a year. Table A3.1.4 shows the emission factors used to calculate methane emissions from minor livestock species, while tables A3.1.5 and A3.1.6 show the emission factors used to calculate nitrous oxide emissions from agriculture. Table A3.1.7 shows some of the parameter values used to calculate nitrous oxide emissions.

Table A3.1.3 Proportion of annual milk yield each month for major livestock categories

Month	Dairy cattle	Beef cattle	Sheep	Deer
July	0.0088	0.0000	0.0000	0.0000
August	0.0578	0.0000	0.0000	0.0000
September	0.1213	0.1670	0.1639	0.0000
October	0.1503	0.1670	0.2541	0.0000
November	0.1425	0.1670	0.2459	0.1000
December	0.1282	0.1670	0.2541	0.2583
January	0.1109	0.1670	0.0820	0.2583
February	0.0900	0.1670	0.0000	0.2333

Month	Dairy cattle	Beef cattle	Sheep	Deer
March	0.0851	0.0000	0.0000	0.1500
April	0.0654	0.0000	0.0000	0.0000
May	0.0335	0.0000	0.0000	0.0000
June	0.0061	0.0000	0.0000	0.0000

Source: Suttie (2012) and Pickering and Fick (2015)

Note: All values presented in the table are rounded to four decimal places for presentation purposes and precise values are available upon request.

Table A3.1.4 Methane emission factors for Tier 1 enteric fermentation livestock and manure management

Emission factor	Emission type	Source	Parameter value ($kg\ CH_4$/head/yr)
EF_{GOATS}	Enteric fermentation – goats	Lassey (2011)	9.0[1]
EF_{HORSES}	Enteric fermentation – horses	IPCC (2006), table 10.10	18.0
EF_{MULES}	Enteric fermentation – mules and asses	IPCC (2006), table 10.10	10.0
EF_{SWINE}	Enteric fermentation – swine	Hill (2012)	1.06
EF_{ALPACA}	Enteric fermentation – alpaca	IPCC (2006), table 10.10	8.0
MM_{GOATS}	Manure management – goats	IPCC (2006), table 10.15	0.20
MM_{HORSES}	Manure management – horses	IPCC (2006), table 10.15	2.34
MM_{MULES}	Manure management – mules and asses	IPCC (2006), table 10.15	1.1
MM_{SWINE}	Manure management – swine	Hill (2012); IPCC (2000)	5.94
$MM_{BROILERS}$	Manure management – broilers	Fick et al. (2011)	0.022
MM_{LAYERS}	Manure management – layer hens	Fick et al. (2011)	0.016
$MM_{OTHER\ POULTRY}$	Manure management – other poultry	IPCC (1996), table 4.5	0.117
MM_{ALPACA}	Manure management – alpaca	New Zealand 1990 sheep value[2]	0.103

Table A3.1.5 Emission factors for New Zealand's agriculture nitrous oxide emissions

Emission factor	Emissions	Source	Parameter value
EF_1 (kg N_2O-N/kg N)	Direct emissions from nitrogen input to soil	Kelliher and de Klein (unpublished)	0.0100
$EF_{1\text{-}UREA}$ (kg N_2O-N/kg N)	Direct emissions from nitrogen input to soil from urea fertiliser	van der Weerden et al. (2016)	0.0059
$EF_{1\text{-}DAIRY}$ (kg N_2O-N/kg N)	Direct emissions from nitrogen input to soil from dairy cattle manure	van der Weerden et al. (2016)	0.0025
EF_2 (kg N_2O-N/ha-yr)	Direct emissions from organic soil mineralisation due to cultivation	IPCC (2006), table 11.1	8.0000
EF_{3SSD} (kg N_2O-N/kg N excreted)	Direct emissions from waste in the solid waste and dry lot animal waste management systems	IPCC (2000), table 4.12	0.0200
$EF_{3(PRP\text{-}MINOR)}$ (kg N_2O-N/kg N excreted)	Direct emissions from manure (dung and urine) from minor grazing animals (i.e., *excluding* cattle, sheep and deer) in pasture, range and paddock systems	Carran et al. (1995); Muller et al. (1995); de Klein et al. (2003)	0.0100

1 Value is for 2019. In 1990, the value was EF 7.4 kg CH_4/head/year. Values for the intermediate years between 1990 and 2018 are calculated based on the estimated proportion of dairy goats in the overall goat population.

2 As was reported in the 2010 submission, that is, the first year that alpacas were included in *New Zealand's Greenhouse Gas Inventory* (Ministry for the Environment, 2010).

Emission factor	Emissions	Source	Parameter value
$EF_{3(PRP\ DUNG)}$ (kg N_2O-N/kg N excreted)	Direct emissions from dung in pasture, range and paddock systems for cattle, sheep and deer (direct emission factors for dung are reported in table A3.1.6)	van der Weerden et al. (2019)	0.0012
EF_{3OTHER} (kg N_2O-N/kg N excreted)	Direct emissions from waste in other animal waste management systems	IPCC (2000), table 4.13	0.0050
$EF_{3POULTRY}$ (kg N_2O-N/kg N excreted)	Direct emissions from waste in other animal waste management systems – poultry specific	Fick et al. (2011)	0.0010
EF_4 (kg N_2O-N/kg NH_x-N)	Indirect emissions from volatising nitrogen	IPCC (2006), table 11.3	0.0100
EF_5 (kg N_2O-N/kg N leached and run-off)	Indirect emissions from leaching nitrogen	IPCC (2006), table 11.3	0.0075

Table A3.1.6 Direct nitrous oxide emission factors for urine deposited by cattle, sheep and deer, by livestock type and slope

	Emission factor by topography (kg N_2O–N/kg N excreted)	
Livestock type	Flat and low sloped land (less than 12° gradient) $EF_{3(PRP\text{-}FLAT)}$	Medium and steep sloped land (greater than 12° gradient) $EF_{3(PRP\text{-}STEEP)}$
All cattle (includes dairy and non-dairy)	0.0098	0.0033
Deer	0.0074	0.0020
Sheep	0.0050	0.0008

Source: Values used as calculated by van der Weerden et al. (2019)

Note: N = nitrogen; N_2O = nitrous oxide.

Table A3.1.7 Parameter values for New Zealand's agriculture nitrous oxide emissions

Parameter (fraction)	Fraction of the parameter	Source	Parameter value
$Frac_{GASF}$ (kg NH_3-N + NO_x-N/kg of synthetic fertiliser N applied)	Total synthetic fertiliser emitted as NO_x or NH_3	IPCC (2006) verified by Sherlock et al. (2008)	0.1
$Frac_{GASM}$ (kg NH_3-N + NO_x-N/kg of N excreted by livestock)	Total nitrogen emitted as NO_x or NH_3	Sherlock et al. (2008)	0.1
$Frac_{LEACH(-H)}$ (kg N/kg fertiliser or manure N)	Nitrogen input to soils that is lost through leaching and run-off	Thomas et al. (unpublished, 2005)	0.07
$Frac_{BURN}$ (kg N/kg crop-N)	Crop residue burned in fields	Thomas et al. (2008), table 14	Crop specific survey data
$Frac_{BURNL}$ (kg N/kg legume-N)	Legume crop residue burned in fields	Thomas et al. (2008) Practice does not occur in New Zealand	0
$Frac_{RENEW}$	Fraction of land undergoing pasture renewal	Thomas et al. (2014)	Year specific
$Frac_{REMOVE}$	Fraction of nitrogen in above-ground residues removed for bedding, feed or construction	Thomas et al. (2014) Practice does not occur in New Zealand	0
$Frac_{FUEL}$ (N/kg N excreted)	Livestock nitrogen excretion in excrements burned for fuel	Practice does not occur in New Zealand	0

Some of the parameters used to calculate *Nitrous oxide emissions from crop residue returned to soil* and emissions from *Field burning of agricultural residues* are summarised in table A3.1.8. These values are taken from research conducted by Thomas et al. (2008, 2011).

Table A3.1.8 Parameter values for New Zealand's cropping emissions

Crop	HI	dmf	AG_N	Root Shoot ratio R_{BG}	BG_N
Wheat	0.41	0.86	0.005	0.1	0.009
Barley	0.46	0.86	0.005	0.1	0.009
Oats	0.30	0.86	0.005	0.1	0.009
Maize grain	0.50	0.86	0.007	0.1	0.007
Field seed peas	0.50	0.21	0.02	0.1	0.015
Lentils	0.50	0.86	0.02	0.1	0.015
Peas fresh and processed	0.45	0.86	0.03	0.1	0.015
Potatoes	0.90	0.22	0.02	0.1	0.01
Onions	0.80	0.11	0.02	0.1	0.01
Sweet corn	0.55	0.24	0.009	0.1	0.007
Squash	0.80	0.20	0.02	0.1	0.01
Herbage seeds	0.11	0.85	0.015	0.1	0.01
Legume seeds	0.09	0.85	0.04	0.1	0.01
Brassica seeds	0.20	0.85	0.01	0.1	0.008

Source: Thomas et al. (2008, 2011)

Note: AG_N = above-ground nitrogen residue; BG_N = below-ground nitrogen residue; dmf = dry-matter conversion factor; HI = harvest index; R_{BG} = ratio of below-ground residues to the harvest yield.

A3.1.3 Methodology and data used to allocate livestock excreta to different hill slopes, for cattle, sheep and deer

The emission factors used to calculate direct N_2O emissions from all cattle, sheep and deer were described in detail in chapter 5, section 5.5.2. These pages explained the research behind the revised emission factors and how they were applied to estimate emissions from cattle, sheep and deer.

These revised emission factors are disaggregated by slope (as well as livestock type), and a methodology is used to calculate the amount of nitrogen (in the form of urine or dung) deposited on these different slopes. The steps described below are used to do this.

The nutrient transfer model outlined by Saggar et al. (2015) is used to allocate total dung and urine (calculated elsewhere in the Inventory model) between low, medium and steep slopes. The nutrient transfer model was discussed by the Agriculture Inventory Panel in 2015, which agreed that the methodology used in the nutrient transfer model was appropriate. Beef + Lamb New Zealand provides data (on the topography and number of animals on different farm types) used in the nutrient transfer model.

Dairy excreta is not allocated to different slope types because the Inventory assumes that all dairy cattle graze on flatland. The flatland/low slope emission factor for cattle urine ($EF_{3(PRP\ FLAT)}$ = 0.0098) is applied to all dairy cattle urine.

Step 1: Calculations of total nitrogen excretion rates for each animal category

Total nitrogen excretion rates (N_{ex}) for each animal category are calculated using the methods described in chapter 5, section 5.3.2 of the National Inventory Report (*Nitrogen excretion rates for the major livestock categories*), and in chapter 5 of Pickering and Gibbs (2019).

Step 2: Split of nitrogen between urine and dung

The total N_{ex} calculated in step 1 is split into urine and dung using the method described by Pacheco et al. (unpublished), and section 5.2.4 (beef cattle), section 5.3.5 (sheep) and section 5.4.5 (deer) of Pickering and Gibbs (2019).

Step 3: Allocating urine excreta to different hill slopes

The nutrient transfer model (described by Saggar et al. (2015)) uses Beef + Lamb New Zealand data on the proportion of sheep and beef farmland on different hill slopes to allocate urine excreta to different hill slopes. The nutrient transfer model takes into account the preference for animals to spend more time on flatter slopes. Using this model, the proportion of excreta deposited on low slopes is greater than the proportion of low slope land area, because animals spend more time on flatter land.

The equations and variables needed to allocate excreta to different slopes are outlined in table A3.1.9 and figures A3.1.1 and A3.1.2. For example, an area with 60 per cent low slopes and 25 per cent steep slopes will have 72 per cent of livestock urine deposited on low slope land (0.45*60 per cent + 0.45 = 72 per cent), 14 per cent of livestock urine deposited on steep slope land. After the allocation of excreta to low and high slope areas, the remainder (14 per cent) is assumed to be deposited onto medium sloped land.

Because a single dung emission factor ($EF_{3(PRP\text{-}DUNG)}$ = 0.0012) is used across all slope categories for cattle, sheep and deer, dung excreta does not need to be allocated to different slopes.

Table A3.1.9 Allocation of urine deposition to low slope (0–12 degrees) and steep slope (more than 24 degrees), split by the percentage of low slope and steep slope land available

Allocation to flat land	
Percentage of low land area	**Fraction urine deposition**
Less than 1%	27x
1–5%	0.27
5–9%	0.405
9–35%	0.55
35–85%	(0.45x + 0.45)
Greater than 85%	(0.5x + 0.5)
Allocation to steep land	
Percentage of steep land area	**Fraction urine deposition**
Less than 1%	10x
1–20%	0.10
20–40%	0.14
40–60%	0.21
60–85%	0.28
Greater than 85%	4.8x – 3.8

Figure A3.1.1 **Proportion of urine nitrogen (N) applied to low (0–12 degree) slopes using nutrient transfer model (equal proportion line shown in grey for comparison)**

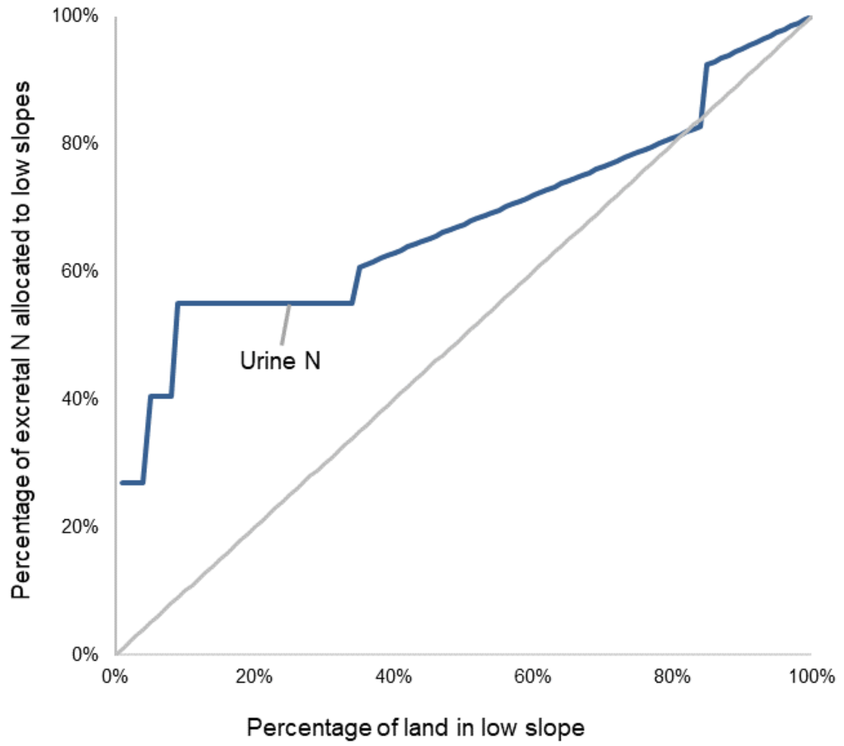
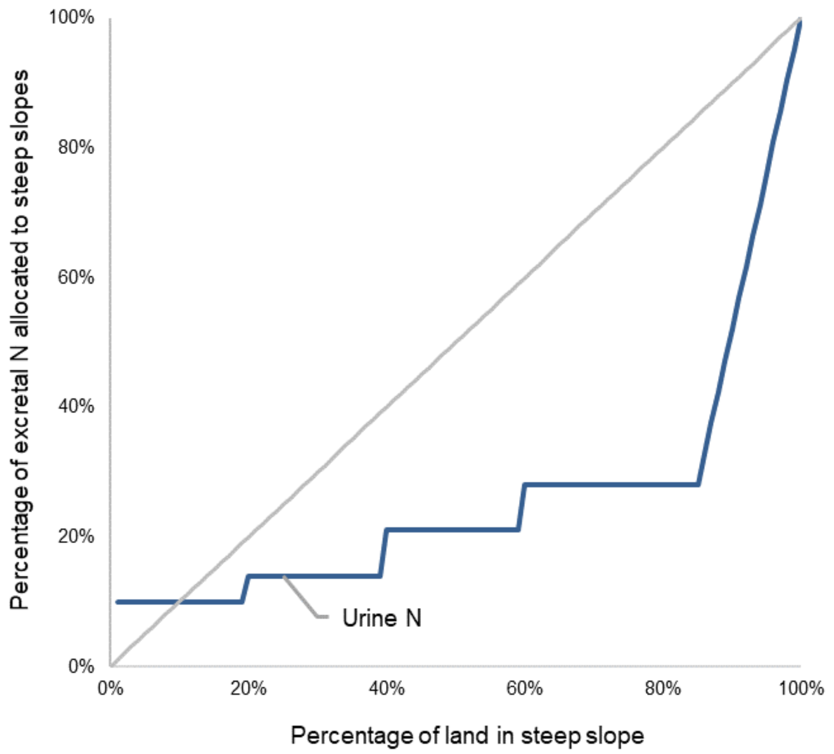


Figure A3.1.2 **Proportion of urine nitrogen (N) applied to steep (more than 24 degree) slopes using nutrient transfer model (equal proportion line shown in grey for comparison)**



Tables A3.1.10, A3.1.11, A3.1.12 and figure A3.1.3 provide examples of how this nutrient allocation methodology uses Beef + Lamb New Zealand data to allocate urine nitrogen (N) to different hill slopes. First, data on the number of sheep, beef cattle and deer in each farm class are used to allocate total urine N (calculated using the methods described in chapter 5, section 5.3.2 of the National Inventory Report) to these different farm classes (tables A.3.1.11 and A.3.1.12).

Table A3.1.10 Share of livestock population, and amount of urine nitrogen (N) deposition in 2019, by Beef + Lamb New Zealand farm class

Farm class	Percentage of sheep population on farm class (%)	Amount of sheep urine N on farm class (kg N)	Percentage of beef cattle population on farm class (%)	Amount of beef cattle urine N on farm class (kg N)	Percentage of deer population on farm class (%)	Amount of deer urine N on farm class (kg N)
1. South Island High Country	7.4	26,550,296	3.5	8,048,380	14.3	2,831,091
2. South Island Hill Country	12.1	43,132,632	6.7	15,618,726	7.8	1,544,421
3. North Island Hard Hill Country	17.2	61,282,608	15.7	36,654,059	7.7	1,534,984
4. North Island Hill Country	25.4	90,627,947	41.3	96,240,410	32.0	6,338,045
5. North Island Intensive Finishing	6.8	24,437,161	11.1	25,806,893	2.2	437,992
6. South Island Finishing Breeding	19.1	68,037,424	14.0	32,686,935	27.5	5,457,651
7. South Island Intensive Finishing	10.1	36,093,050	3.4	7,890,935	8.5	1,685,597
8. South Island Mixed Finishing	1.9	6,933,601	4.2	9,858,498	0.0	0
Total		**357,094,719**		**232,894,836**		**19,829,780**

Each farm class has a different proportion of land in low, medium and steep slopes, as shown in table A3.1.11. These data are combined with the nutrient transfer methodology to calculate total urine N that is estimated to be deposited on different hill slopes for different animal categories. From this point, direct N_2O emissions can be calculated using the emission factors in chapter 5, table 5.5.3.

Table A3.1.11 Proportion of total sheep, beef and deer land on different hill slopes, by Beef + Lamb New Zealand farm class, for 2018/19 year

Farm class	Land type by slope		
	Flat/low (0–12° slope) (%)	Rolling/medium (12–24° slope) (%)	Steep (>24° slope) (%)
1. South Island High Country	8.3	26.4	65.2
2. South Island Hill Country	16.2	25.8	58.0
3. North Island Hard Hill Country	8.1	35.7	56.1
4. North Island Hill Country	15.1	54.4	30.5
5. North Island Intensive Finishing	44.2	50.7	5.1
6. South Island Finishing Breeding	36.3	47.3	16.4
7. South Island Intensive Finishing	58.7	41.3	0.0
8. South Island Mixed Finishing	87.1	12.9	0.0
Total sheep, beef and deer land	**20.8**	**38.4**	**40.8**

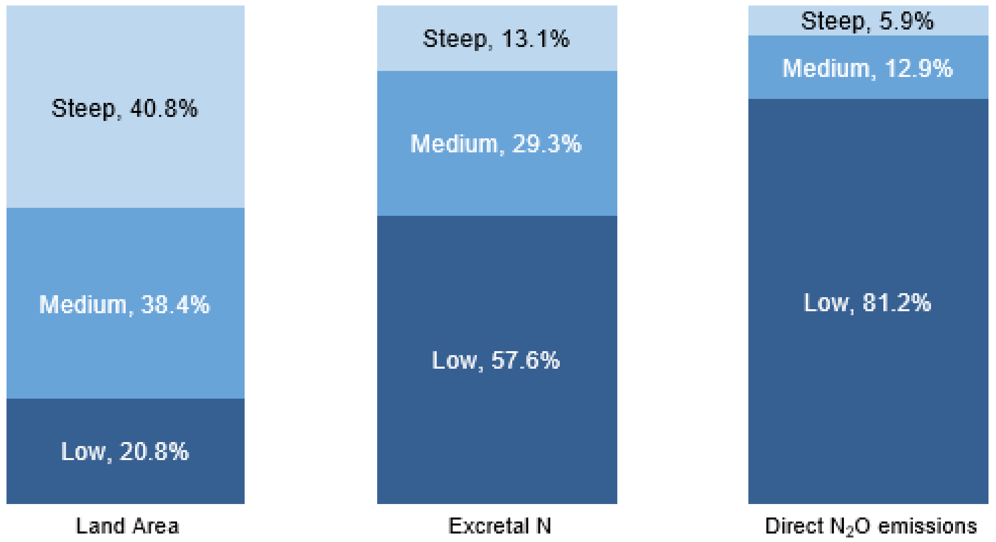
Note: The percentages may not add up to 100 per cent due to rounding.

Table A3.1.12 Proportion of total sheep, beef and deer urine nitrogen deposited on different hill slopes, by Beef + Lamb New Zealand farm class, for 2019

Farm class	Flat/low	Rolling/medium	Steep
1. South Island High Country	0.41	0.32	0.28
2. South Island Hill Country	0.55	0.24	0.21
3. North Island Hard Hill Country	0.41	0.39	0.21
4. North Island Hill Country	0.55	0.31	0.14
5. North Island Intensive Finishing	0.65	0.25	0.10
6. South Island Finishing Breeding	0.61	0.29	0.10
7. South Island Intensive Finishing	0.71	0.29	0.00
8. South Island Mixed Finishing	0.94	0.06	0.00
Total sheep urine	**0.56**	**0.30**	**0.14**
Total beef urine	**0.56**	**0.30**	**0.14**
Total deer urine	**0.55**	**0.30**	**0.15**
Total sheep, beef and deer urine	**0.56**	**0.30**	**0.14**

Note: The proportions may not add up to 1 due to rounding.

Figure A3.1.3 Proportion of land area, excretal nitrogen (N) and nitrous oxide (N_2O) emissions by hill slope category for sheep, beef cattle and deer farms in 2019



A3.2 Supplementary information for the LULUCF sector

A3.2.1 Annual land-use change summary

This section contains a summary of the annual land-use change from 1990 to 2019 (see table A3.2.1).

Table A3.2.1 Annual land-use changes (units in thousand hectares)

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
From Pre-1990 natural forest											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - high producing	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Grassland - low producing	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	Grassland - with woody biomass	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
From Pre-1990 planted forest											
To	Pre-1990 natural forest	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	-	-	-	-	-	-	-	-	-	-
	Grassland - low producing	-	-	-	-	-	-	-	-	-	-
	Grassland - with woody biomass	-	-	-	-	-	-	-	-	-	-
	Wetland - open water	-	-	-	-	-	-	-	-	-	-
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	-	-	-	-	-	-	-	-	-	-
	Other land	-	-	-	-	-	-	-	-	-	-
From Post-1989 planted forest											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	-	-	-	-	-	-	-	-	-	-
	Grassland - low producing	-	-	-	-	-	-	-	-	-	-
	Grassland - with woody biomass	-	-	-	-	-	-	-	-	-	-
	Wetland - open water	-	-	-	-	-	-	-	-	-	-
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	-	-	-	-	-	-	-	-	-	-
	Other land	-	-	-	-	-	-	-	-	-	-
From Post-1989 natural forest											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	-	-	-	-	-	-	-	-	-	-
	Grassland - low producing	-	-	-	-	-	-	-	-	-	-
	Grassland - with woody biomass	-	-	-	-	-	-	-	-	-	-
	Wetland - open water	-	-	-	-	-	-	-	-	-	-
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	-	-	-	-	-	-	-	-	-	-
	Other land	-	-	-	-	-	-	-	-	-	-

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
From Cropland - annual											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0
	Post-1989 natural forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Grassland - high producing	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Grassland - low producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - with woody biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
From Cropland - perennial											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Post-1989 natural forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - annual	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Grassland - low producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - with woody biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
From Grassland - high producing											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	2.7	2.6	8.5	10.4	16.6	12.5	14.1	10.7	8.6	6.7
	Post-1989 natural forest	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1
	Cropland - annual	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3
	Cropland - perennial	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7
	Grassland - high producing	-	-	-	-	-	-	-	-	-	-
	Grassland - low producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - with woody biomass	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1.0	1.0	1.0
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
From Grassland - low producing											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	8.0	7.8	25.3	31.0	49.5	37.2	42.1	32.1	25.8	20.1
	Post-1989 natural forest	0.4	0.5	0.6	0.5	0.4	0.4	0.4	1.2	1.3	1.5
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - perennial	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Grassland - high producing	54.7	54.7	54.7	54.7	54.7	54.7	54.7	56.0	56.0	56.0
	Grassland - low producing	-	-	-	-	-	-	-	-	-	-
	Grassland - with woody biomass	3.3	3.3	3.3	3.3	3.3	3.3	3.3	4.9	4.9	4.9
	Wetland - open water	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Other land	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
From Grassland - with woody biomass											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	2.8	2.7	8.9	10.9	17.4	13.1	14.8	11.3	9.1	7.1
	Post-1989 natural forest	0.5	0.6	0.7	0.6	0.5	0.4	0.4	1.3	1.5	1.6
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - high producing	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.3	1.3	1.3
	Grassland - low producing	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.7	1.7	1.7
	Grassland - with woody biomass	-	-	-	-	-	-	-	-	-	-
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
From Wetland - open water											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - high producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - low producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - with woody biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - open water	-	-	-	-	-	-	-	-	-	-
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
From Wetland - vegetative non forest											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1
	Post-1989 natural forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - high producing	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Grassland - low producing	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Grassland - with woody biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
From Settlements											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Post-1989 natural forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - high producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - low producing	-	-	-	-	-	-	-	-	-	-
	Grassland - with woody biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	-	-	-	-	-	-	-	-	-	-
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
From Other land											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.1	0.1	0.2	0.3	0.4	0.3	0.4	0.3	0.2	0.2
	Post-1989 natural forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - high producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - low producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - with woody biomass	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	-	-	-	-	-	-	-	-	-	-

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
From Pre-1990 natural forest											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.1	0.1
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Grassland - high producing	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.3	0.6
	Grassland - low producing	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.3	0.8
	Grassland - with woody biomass	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.9
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
From Pre-1990 planted forest											
To	Pre-1990 natural forest	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.4
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	-	0.0
	Grassland - high producing	1.8	1.7	1.3	2.4	5.1	9.9	12.4	16.5	2.4	3.2
	Grassland - low producing	0.5	0.5	0.5	0.7	1.1	1.7	2.2	2.9	1.0	1.4
	Grassland - with woody biomass	0.3	0.3	0.3	0.4	0.7	0.9	1.1	1.5	0.3	1.0
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
	Settlements	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
From Post-1989 planted forest											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Cropland - perennial	-	-	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
	Grassland - high producing	-	-	0.5	1.5	1.3	1.5	1.3	3.1	0.8	0.9
	Grassland - low producing	-	-	0.1	0.3	0.2	0.3	0.2	0.5	0.2	0.9
	Grassland - with woody biomass	-	-	0.0	0.1	0.1	0.1	0.1	0.3	0.1	0.2
	Wetland - open water	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Wetland - vegetative non forest	-	-	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Settlements	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	-	-	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
From Post-1989 natural forest											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	-	-	-	-	-	-	-	-	0.00	0.01
	Grassland - low producing	-	-	-	-	-	-	-	-	0.00	0.02
	Grassland - with woody biomass	-	-	-	-	-	-	-	-	0.01	0.02
	Wetland - open water	-	-	-	-	-	-	-	-	-	-
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	-	-	-	-	-	-	-	-	-	-
	Other land	-	-	-	-	-	-	-	-	-	-
From Cropland - annual											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Post-1989 natural forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.1	0.1
	Grassland - high producing	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
	Grassland - low producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Grassland - with woody biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
From Cropland - perennial											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Post-1989 natural forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Cropland - annual	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Grassland - low producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - with woody biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
From Grassland - high producing											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	0.0	0.0
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	0.0	0.0
	Post-1989 planted forest	5.7	5.1	3.7	3.4	1.8	1.0	0.4	0.4	1.1	1.6
	Post-1989 natural forest	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.0	0.0
	Cropland - annual	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.2	0.0	0.0
	Cropland - perennial	1.7	1.7	1.6	1.6	1.6	1.6	1.6	1.6	0.4	0.4
	Grassland - high producing	-	-	-	-	-	-	-	-	-	-
	Grassland - low producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6
	Grassland - with woody biomass	1.0	1.0	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.5	0.5
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
From Grassland - low producing											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	0.0	0.0
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	0.0	0.0
	Post-1989 planted forest	16.9	15.2	11.1	10.0	5.3	3.0	1.3	1.2	1.8	3.9
	Post-1989 natural forest	1.8	2.2	1.8	2.0	2.6	3.1	3.5	3.3	0.7	0.7
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - perennial	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0
	Grassland - high producing	56.0	56.0	54.7	54.7	54.7	54.7	54.7	54.7	7.5	7.5
	Grassland - low producing	-	-	-	-	-	-	-	-	-	-
	Grassland - with woody biomass	4.9	4.9	3.3	3.3	3.3	3.3	3.3	3.3	1.9	1.9
	Wetland - open water	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Other land	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
From Grassland - with woody biomass											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	0.0	0.0
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	0.0	0.0
	Post-1989 planted forest	5.9	5.3	3.9	3.5	1.9	1.1	0.5	0.4	0.7	1.1
	Post-1989 natural forest	2.0	2.5	2.0	2.2	2.9	3.4	3.9	3.7	1.0	1.0
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - high producing	1.3	1.3	1.1	1.1	1.1	1.1	1.1	1.1	1.4	1.4
	Grassland - low producing	1.7	1.7	1.2	1.2	1.2	1.2	1.2	1.2	2.5	2.5
	Grassland - with woody biomass	-	-	-	-	-	-	-	-	-	-
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
From Wetland - open water											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	-	-	-	-	-	-	-	-	0.0	0.0
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Grassland - high producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - low producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - with woody biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Wetland - open water	-	-	-	-	-	-	-	-	-	-
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
From Wetland - vegetative non forest											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	0.0	0.0
	Post-1989 planted forest	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Post-1989 natural forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Grassland - high producing	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Grassland - low producing	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Grassland - with woody biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
From Settlements											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Post-1989 natural forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Grassland - high producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Grassland - low producing	-	-	-	-	-	-	-	-	-	-
	Grassland - with woody biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	-	-	-	-	-	-	-	-	-	-
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
From Other land											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	0.0	0.0
	Post-1989 planted forest	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	Post-1989 natural forest	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Grassland - high producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - low producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - with woody biomass	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	-	-	-	-	-	-	-	-	-	-

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
From Pre-1990 natural forest											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	0.0	-	-	0.0	0.0	0.0	-	-	-	-
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	0.5	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
	Grassland - low producing	0.5	0.3	0.3	0.5	0.2	0.2	0.2	0.6	0.6	0.6
	Grassland - with woody biomass	0.8	0.4	0.5	0.4	0.1	0.2	0.1	-	-	-
	Wetland - open water	-	0.0	-	-	-	0.0	-	-	-	-
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
	Other land	0.1	0.1	0.1	0.1	0.0	0.1	0.0	-	-	-
From Pre-1990 planted forest											
To	Pre-1990 natural forest	0.4	0.4	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-	-	-
	Cropland - perennial	-	-	-	-	0.0	-	0.0	-	-	-
	Grassland - high producing	3.6	2.7	4.7	5.8	3.8	2.0	0.9	1.2	1.4	1.7
	Grassland - low producing	2.2	2.0	2.4	3.2	2.4	1.2	0.5	0.9	1.0	1.3
	Grassland - with woody biomass	0.7	0.6	0.4	0.7	0.2	0.2	0.1	-	-	-
	Wetland - open water	0.0	0.0	-	0.0	0.0	0.0	-	-	-	-
	Wetland - vegetative non forest	0.0	0.0	-	0.0	0.0	0.0	0.0	-	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
	Other land	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-	-	-
From Post-1989 planted forest											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-	-	-
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	1.0	1.1	0.7	1.6	0.9	1.1	0.7	0.3	0.4	0.5
	Grassland - low producing	0.5	0.8	0.4	0.8	0.5	0.4	0.3	0.3	0.3	0.4
	Grassland - with woody biomass	0.2	0.1	0.1	0.3	0.1	0.1	0.2	-	-	-
	Wetland - open water	-	0.0	0.0	0.0	-	0.0	-	-	-	-
	Wetland - vegetative non forest	0.0	-	-	-	0.0	-	-	-	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-	-	-
From Post-1989 natural forest											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	0.00	0.00	0.00	0.01	-	0.00	0.00	0.02	0.03	0.03
	Grassland - low producing	0.01	0.08	0.01	0.03	0.00	0.01	0.03	0.02	0.02	0.03
	Grassland - with woody biomass	0.01	0.00	0.04	0.07	0.11	0.04	0.05	-	-	-
	Wetland - open water	-	-	-	-	-	-	-	-	-	-
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	-	-	-	-	-	-	0.01	-	-	-
	Other land	0.00	-	-	-	-	-	-	-	-	-
From Cropland - annual											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	0.1	0.1	0.1	-	-	-	-	-	-	-
	Grassland - high producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
	Grassland - low producing	-	-	-	-	-	-	-	-	-	-
	Grassland - with woody biomass	0.0	0.0	0.0	-	-	-	-	-	-	-
	Wetland - open water	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0
	Other land	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
From Cropland - perennial											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	0.2	0.2	0.2	-	-	-	-	-	-	-
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - low producing	0.0	0.0	0.0	-	-	-	-	-	-	-
	Grassland - with woody biomass	0.0	0.0	0.0	-	-	-	-	-	-	-
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
From Grassland - high producing											
To	Pre-1990 natural forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
	Pre-1990 planted forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
	Post-1989 planted forest	2.0	3.2	3.1	0.8	0.7	0.7	0.7	0.6	0.7	1.9
	Post-1989 natural forest	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.1	0.2
	Cropland - annual	0.0	0.0	0.0	-	-	-	0.0	-	-	-
	Cropland - perennial	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Grassland - high producing	-	-	-	-	-	-	-	-	-	-
	Grassland - low producing	0.6	0.6	0.6	0.3	0.3	0.3	0.3	0.3	0.2	0.2
	Grassland - with woody biomass	0.6	0.6	0.6	0.1	0.1	0.1	0.1	0.0	0.0	0.0
	Wetland - open water	0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.5	0.5	0.5	0.8	0.8	0.8	0.8	0.7	0.7	0.7
	Other land	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
From Grassland - low producing											
To	Pre-1990 natural forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
	Pre-1990 planted forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
	Post-1989 planted forest	5.4	10.7	10.2	3.6	2.5	2.5	3.0	4.6	6.0	16.8
	Post-1989 natural forest	0.7	0.7	0.7	1.5	1.5	1.5	1.5	2.6	2.0	2.5
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
	Cropland - perennial	0.0	0.0	0.0	-	-	-	-	-	-	-
	Grassland - high producing	7.5	7.5	7.5	12.3	12.3	12.3	12.3	12.1	12.0	12.0
	Grassland - low producing	-	-	-	-	-	-	-	-	-	-
	Grassland - with woody biomass	1.9	1.9	1.9	0.4	0.5	0.4	0.5	0.3	0.3	0.3
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0
From Grassland - with woody biomass											
To	Pre-1990 natural forest	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-	-	-
	Pre-1990 planted forest	0.0	0.0	0.0	0.1	0.1	0.1	0.1	-	-	-
	Post-1989 planted forest	1.4	2.5	2.4	0.7	0.6	0.6	0.5	1.3	0.9	2.9
	Post-1989 natural forest	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.4	0.5
	Cropland - annual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - perennial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - high producing	1.4	1.4	1.4	0.8	0.8	0.9	0.8	0.6	0.5	0.5
	Grassland - low producing	2.5	2.5	2.5	1.7	1.8	1.7	1.7	1.3	1.2	1.2
	Grassland - with woody biomass	-	-	-	-	-	-	-	-	-	-
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
From Wetland - open water											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	-	-	-	-	-	-	-
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	0.0	0.0	0.0	-	-	-	-	-	-	-
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - low producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - with woody biomass	-	-	-	-	-	-	-	-	-	-
	Wetland - open water	-	-	-	-	-	-	-	-	-	-
	Wetland - vegetative non forest	0.0	0.0	0.0	-	-	-	-	-	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
From Wetland - vegetative non forest											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	0.0	0.0	0.0	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Post-1989 natural forest	-	-	-	-	-	-	-	-	-	-
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Grassland - low producing	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - with woody biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
From Settlements											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	-	-	-	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	-	-	-	-	-	-	-
	Post-1989 natural forest	0.0	0.0	0.0	-	-	-	-	-	-	-
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	-	-	-	-	-	-	-	-	-	-
	Grassland - low producing	-	-	-	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Grassland - with woody biomass	-	-	-	-	-	-	-	-	-	-
	Wetland - open water	0.0	0.0	0.0	-	-	-	-	-	-	-
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	-	-	-	-	-	-	-	-	-	-
	Other land	-	-	-	-	-	-	-	-	-	-
From Other land											
To	Pre-1990 natural forest	-	-	-	-	-	-	-	-	-	-
	Pre-1990 planted forest	0.0	0.0	0.0	-	-	-	-	-	-	-
	Post-1989 planted forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Post-1989 natural forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland - annual	-	-	-	-	-	-	-	-	-	-
	Cropland - perennial	-	-	-	-	-	-	-	-	-	-
	Grassland - high producing	0.0	0.0	0.0	-	-	-	-	0.0	-	-
	Grassland - low producing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grassland - with woody biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wetland - vegetative non forest	-	-	-	-	-	-	-	-	-	-
	Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other land	-	-	-	-	-	-	-	-	-	-

A3.2.2 Natural forest yield tables

This section contains the natural forest yield tables used for this submission.

Table A3.2.2 Pre-1990 natural forest – tall forest yield table (tonnes C ha^{-1})[1]

Year	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Total biomass
1990	148.6	34.9	45.9	22.7	252.1
1991	148.6	34.9	45.9	22.7	252.1
1992	148.6	34.9	45.9	22.7	252.1
1993	148.6	34.9	45.9	22.7	252.1
1994	148.6	34.9	45.9	22.7	252.1
1995	148.6	34.9	45.9	22.7	252.1
1996	148.6	34.9	45.9	22.7	252.1
1997	148.6	34.9	45.9	22.7	252.1
1998	148.6	34.9	45.9	22.7	252.1
1999	148.6	34.9	45.9	22.7	252.1
2000	148.6	34.9	45.9	22.7	252.1
2001	148.6	34.9	45.9	22.7	252.1
2002	148.6	34.9	45.9	22.7	252.1
2003	148.6	34.9	45.9	22.7	252.1
2004	148.6	34.9	45.9	22.7	252.1
2005	148.6	34.9	45.9	22.7	252.1
2006	148.6	34.9	45.9	22.7	252.1
2007	148.6	34.9	45.9	22.7	252.1
2008	148.6	34.9	45.9	22.7	252.1
2009	148.6	34.9	45.9	22.7	252.1
2010	148.6	34.9	45.9	22.7	252.1
2011	148.6	34.9	45.9	22.7	252.1
2012	148.6	34.9	45.9	22.7	252.1

Year	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Total biomass
2013	148.6	34.9	45.9	22.7	252.1
2014	148.6	34.9	45.9	22.7	252.1
2015	148.6	34.9	45.9	22.7	252.1
2016	148.6	34.9	45.9	22.7	252.1
2017	148.6	34.9	45.9	22.7	252.1
2018	148.6	34.9	45.9	22.7	252.1
2019	148.6	34.9	45.9	22.7	252.1

[1] Yield table data source: Paul et al. (2020, submitted).

Table A3.2.3 Pre-1990 natural forest – regenerating forest yield table (tonnes C ha^{-1})[1]

Year	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Total biomass
1990	26.1	6.2	3.1	8.8	44.1
1991	26.5	6.3	3.1	8.8	44.7
1992	27.0	6.4	3.2	8.8	45.4
1993	27.4	6.5	3.3	8.8	46.0
1994	27.9	6.6	3.3	8.8	46.6
1995	28.3	6.7	3.4	8.8	47.2
1996	28.8	6.8	3.4	8.8	47.9
1997	29.3	7.0	3.5	8.8	48.5
1998	29.7	7.1	3.6	8.8	49.1
1999	30.2	7.2	3.6	8.8	49.7
2000	30.6	7.3	3.7	8.8	50.4
2001	31.1	7.4	3.7	8.8	51.0
2002	31.5	7.5	3.8	8.8	51.6
2003	32.0	7.6	3.9	8.8	52.3
2004	32.4	7.7	3.9	8.8	52.9
2005	32.9	7.8	4.0	8.8	53.5
2006	33.3	8.0	4.1	8.8	54.1
2007	33.8	8.1	4.1	8.8	54.8
2008	34.2	8.2	4.2	8.8	55.4
2009	34.7	8.3	4.2	8.8	56.0
2010	35.2	8.4	4.3	8.8	56.6
2011	35.6	8.5	4.4	8.8	57.3
2012	36.1	8.6	4.4	8.8	57.9
2013	36.5	8.7	4.5	8.8	58.5
2014	37.0	8.8	4.5	8.8	59.1
2015	37.4	8.9	4.6	8.8	59.8
2016	37.9	9.1	4.7	8.8	60.4
2017	38.3	9.2	4.7	8.8	61.0
2018	38.8	9.3	4.8	8.8	61.6
2019	39.2	9.4	4.9	8.8	62.3

[1] Yield table data source: Paul et al. (2020, submitted).

Table A3.2.4 Post-1989 natural forest yield table (tonnes C ha^{-1})[1]

Age	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Total biomass
0	1.6	0.4	0.0	0.0	2.0
1	2.5	0.6	0.0	0.0	3.2
2	3.7	0.9	0.0	0.1	4.7
3	5.1	1.3	0.0	0.1	6.5
4	6.6	1.7	0.0	0.1	8.4
5	8.3	2.1	0.0	0.1	10.6
6	10.2	2.6	0.1	0.2	13.0
7	12.2	3.1	0.1	0.2	15.5
8	14.4	3.6	0.1	0.2	18.2
9	16.6	4.2	0.1	0.2	21.1
10	18.9	4.7	0.1	0.3	24.0
11	21.4	5.3	0.1	0.3	27.1
12	23.9	6.0	0.1	0.3	30.2
13	26.4	6.6	0.1	0.4	33.5
14	29.0	7.2	0.1	0.4	36.7
15	31.6	7.9	0.1	0.4	40.0
16	34.2	8.6	0.1	0.4	43.3
17	36.8	9.2	0.1	0.5	46.7
18	39.4	9.9	0.1	0.5	49.9
19	42.0	10.5	0.1	0.5	53.2
20	44.5	11.1	0.1	0.6	56.4
21	47.0	11.8	0.2	0.6	59.5
22	49.4	12.3	0.2	0.6	62.5
23	51.7	12.9	0.2	0.6	65.4
24	53.9	13.5	0.2	0.7	68.2
25	56.0	14.0	0.2	0.7	70.9
26	57.9	14.5	0.2	0.7	73.3
27	59.7	14.9	0.2	0.8	75.6
28	61.4	15.3	0.2	0.8	77.7
29	62.9	15.7	0.2	0.8	79.6
30	64.1	16.0	0.2	0.9	81.3

[1] Yield table source Paul et al. (unpublished(a)).

A3.2.3 Planted forest yield tables

This section contains the planted forest yield tables used for this submission.

Table A3.2.5 Pre-1990 'planted before 1990' planted forest yield table (tonnes C ha^{-1})[1]

Age	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Total biomass
0	3.53	0.81	0.30	0.00	4.64
1	3.67	0.86	0.30	0.01	4.83
2	4.08	0.99	0.30	0.03	5.40
3	5.34	1.41	0.30	0.14	7.18
4	8.11	2.18	0.31	0.43	11.02
5	12.31	3.21	0.39	1.21	17.11
6	17.56	4.40	0.67	2.54	25.17
7	22.69	5.48	1.74	4.49	34.39
8	26.95	6.37	3.60	6.81	43.72
9	32.36	7.51	4.54	8.14	52.55
10	39.58	9.02	4.39	8.50	61.47
11	45.91	10.31	5.54	9.21	70.96
12	52.44	11.64	6.66	9.69	80.43
13	60.55	13.30	6.48	9.53	89.86
14	68.56	14.94	6.72	9.48	99.70
15	76.47	16.56	7.24	9.48	109.74
16	83.42	17.96	8.81	9.64	119.82
17	90.81	19.46	9.77	9.61	129.65
18	99.10	21.17	9.33	9.36	138.96
19	107.36	22.87	9.00	9.15	148.37
20	116.22	24.72	8.51	8.81	158.24
21	124.96	26.56	8.24	8.54	168.29
22	133.67	28.42	8.04	8.30	178.42
23	142.46	30.29	7.80	8.06	188.61
24	151.03	32.14	7.78	7.89	198.84
25	159.31	33.93	7.89	7.77	208.89
26	167.37	35.69	7.98	7.65	218.67
27	175.31	37.42	7.99	7.54	228.25
28	182.78	39.04	8.32	7.51	237.65
29	190.20	40.66	8.61	7.48	246.94
30	198.14	42.40	8.40	7.35	256.28
31	206.16	44.18	8.20	7.22	265.76
32	214.00	45.92	8.03	7.11	275.05
33	221.72	47.62	7.87	7.00	284.21
34	229.45	49.37	7.76	6.90	293.47
35	237.07	51.09	7.72	6.80	302.67
36	244.54	52.80	7.74	6.70	311.77
37	251.88	54.50	7.81	6.61	320.79
38	259.13	56.18	7.92	6.53	329.75
39	266.27	57.85	8.08	6.45	338.63

Age	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Total biomass
40	273.30	59.51	8.26	6.37	347.43
41	280.20	61.14	8.46	6.30	356.10
42	286.92	62.74	8.69	6.24	364.58
43	293.42	64.30	8.93	6.17	372.82
44	299.70	65.83	9.19	6.10	380.81
45	305.80	67.32	9.46	6.02	388.60
46	311.74	68.79	9.73	5.94	396.20
47	317.55	70.25	10.01	5.86	403.67
48	323.26	71.68	10.29	5.78	411.02
49	328.83	73.09	10.57	5.70	418.20
50	334.27	74.48	10.85	5.62	425.21
51	339.57	75.84	11.13	5.54	432.08
52	344.76	77.19	11.41	5.46	438.81
53	349.83	78.51	11.68	5.38	445.39
54	354.80	79.82	11.94	5.31	451.85
55	359.66	81.11	12.19	5.23	458.18
56	364.42	82.38	12.44	5.16	464.39
57	369.08	83.63	12.68	5.09	470.48
58	373.66	84.87	12.92	5.02	476.47
59	378.15	86.09	13.15	4.96	482.34
60	382.61	87.30	13.37	4.89	488.16

[1] Yield table source: Paul and Wakelin (unpublished).

Table A3.2.6 Pre-1990 'planted between 1990 and 2009' planted forest yield table (tonnes C ha^{-1})[1]

Age	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Total biomass
0	2.23	0.51	0.10	0.00	2.94
1	2.37	0.56	0.10	0.01	3.13
2	2.77	0.68	0.10	0.04	3.68
3	4.00	1.09	0.10	0.15	5.44
4	6.77	1.88	0.12	0.47	9.33
5	11.12	2.95	0.18	1.24	15.58
6	16.83	4.25	0.38	2.48	24.03
7	23.51	5.69	0.82	4.10	34.21
8	30.32	7.10	1.79	6.05	45.35
9	37.23	8.51	3.01	7.83	56.68
10	44.99	10.10	3.67	8.95	67.81
11	53.24	11.77	4.22	9.68	79.00
12	61.75	13.48	4.87	10.21	90.40
13	70.91	15.35	5.14	10.41	101.90
14	80.21	17.23	5.59	10.55	113.67
15	90.00	19.23	5.77	10.52	125.61
16	100.47	21.38	5.41	10.28	137.63
17	110.94	23.53	5.17	10.05	149.79
18	121.21	25.66	5.12	9.86	161.93

Age	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Total biomass
19	131.32	27.77	5.15	9.66	173.99
20	141.41	29.91	5.19	9.45	186.05
21	151.39	32.06	5.33	9.26	198.14
22	161.32	34.22	5.53	9.10	210.25
23	170.82	36.31	6.18	9.01	222.41
24	180.17	38.39	6.85	8.93	234.44
25	189.78	40.54	7.13	8.78	246.32
26	199.29	42.68	7.46	8.64	258.16
27	208.66	44.81	7.86	8.52	269.94
28	217.87	46.93	8.30	8.41	281.60
29	226.91	49.03	8.78	8.32	293.13
30	235.76	51.10	9.29	8.23	304.47
31	244.40	53.14	9.84	8.14	315.60
32	252.82	55.15	10.41	8.05	326.52
33	261.03	57.14	11.00	7.96	337.22
34	269.04	59.09	11.61	7.87	347.70
35	276.85	61.02	12.22	7.77	357.96
36	284.47	62.93	12.84	7.68	368.02
37	291.92	64.81	13.46	7.59	377.88
38	299.21	66.68	14.08	7.50	387.56
39	306.35	68.52	14.70	7.41	397.08
40	313.37	70.35	15.30	7.33	406.45
41	320.22	72.14	15.90	7.26	415.61
42	326.86	73.89	16.48	7.18	424.52
43	333.31	75.62	17.05	7.10	433.18
44	339.57	77.31	17.60	7.02	441.60
45	345.65	78.97	18.14	6.94	449.79
46	351.56	80.60	18.65	6.85	457.76
47	357.31	82.21	19.14	6.76	465.51
48	362.90	83.79	19.61	6.67	473.06
49	368.34	85.34	20.06	6.58	480.41
50	373.66	86.87	20.48	6.49	487.59
51	378.85	88.38	20.88	6.40	494.59
52	383.92	89.86	21.26	6.31	501.44
53	388.87	91.32	21.61	6.23	508.13
54	393.73	92.77	21.94	6.15	514.67
55	398.49	94.19	22.25	6.07	521.09
56	403.15	95.60	22.55	5.99	527.38
57	407.74	96.99	22.82	5.92	533.56
58	412.25	98.37	23.07	5.85	539.62
59	416.68	99.73	23.31	5.78	545.59
60	421.08	101.08	23.54	5.71	551.50

[1] Yield table source: Paul and Wakelin, unpublished.

Table A3.2.7 Pre-1990 ‘planted between 2009 and 2019’ planted forest yield table (tonnes C ha^{-1})[1]

Age	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Total biomass
0	1.54	0.42	0.20	0.00	2.25
1	1.74	0.49	0.20	0.01	2.53
2	2.28	0.65	0.20	0.04	3.26
3	4.05	1.22	0.21	0.14	5.70
4	8.13	2.35	0.21	0.46	11.24
5	14.70	3.88	0.22	1.23	20.13
6	23.41	5.77	0.24	2.57	32.08
7	33.55	7.88	0.26	4.46	46.24
8	44.39	10.07	0.46	6.59	61.60
9	55.63	12.32	0.72	8.49	77.25
10	67.23	14.68	0.84	9.88	92.71
11	79.01	17.09	0.96	10.81	107.96
12	90.87	19.54	1.16	11.35	123.01
13	102.72	22.02	1.44	11.59	137.87
14	114.52	24.52	1.80	11.63	152.56
15	126.23	27.03	2.25	11.53	167.13
16	137.81	29.54	2.78	11.35	181.57
17	149.21	32.04	3.39	11.14	195.87
18	160.40	34.52	4.08	10.90	210.00
19	171.30	36.96	4.85	10.66	223.87
20	181.98	39.41	5.69	10.42	237.59
21	192.55	41.88	6.59	10.19	251.30
22	203.02	44.34	7.54	9.98	264.98
23	213.35	46.80	8.55	9.80	278.60
24	223.50	49.24	9.62	9.65	292.10
25	233.46	51.66	10.72	9.52	305.46
26	243.22	54.06	11.86	9.41	318.65
27	252.75	56.44	13.02	9.32	331.62
28	262.04	58.79	14.21	9.23	344.36
29	271.11	61.10	15.40	9.15	356.86
30	279.92	63.38	16.60	9.07	369.06
31	288.45	65.63	17.79	8.99	380.95
32	296.72	67.84	18.97	8.91	392.53
33	304.75	70.01	20.13	8.82	403.80
34	312.54	72.14	21.27	8.74	414.78
35	320.10	74.25	22.38	8.65	425.46
36	327.46	76.32	23.45	8.56	435.87
37	334.62	78.37	24.48	8.47	446.03
38	341.60	80.40	25.48	8.38	455.94
39	348.43	82.40	26.43	8.29	465.64
40	355.11	84.37	27.35	8.20	475.13
41	361.60	86.30	28.22	8.12	484.34
42	367.85	88.18	29.05	8.04	493.22

Age	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Total biomass
43	373.88	90.04	29.83	7.96	501.79
44	379.71	91.85	30.56	7.87	510.08
45	385.36	93.63	31.24	7.77	518.09
46	390.83	95.38	31.88	7.67	525.85
47	396.13	97.09	32.46	7.57	533.35
48	401.28	98.78	33.00	7.47	540.63
49	406.29	100.44	33.49	7.37	547.69
50	411.17	102.07	33.94	7.27	554.54
51	415.93	103.68	34.34	7.17	561.21
52	420.57	105.26	34.70	7.07	567.70
53	425.11	106.83	35.03	6.97	574.03
54	429.55	108.37	35.31	6.88	580.21
55	433.91	109.89	35.56	6.79	586.25
56	438.19	111.39	35.78	6.70	592.16
57	442.40	112.87	35.97	6.62	597.96
58	446.55	114.34	36.12	6.54	603.65
59	450.65	115.80	36.25	6.46	609.25
60	454.72	117.25	36.37	6.38	614.81

[1] Yield table data source: Paul and Wakelin (unpublished).

Table A3.2.8 Post-1989 planted forest yield table (tonnes C ha^{-1}) [1]

Year	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Total biomass
0	3.43	0.81	0.40	0.00	4.74
1	3.61	0.88	0.40	0.01	4.99
2	4.23	1.05	0.40	0.04	5.91
3	5.30	1.59	0.41	0.16	6.96
4	7.68	2.81	0.43	0.48	9.27
5	12.98	4.14	0.46	1.26	14.30
6	21.05	5.43	1.48	2.88	27.18
7	28.69	6.80	2.52	5.21	42.70
8	34.33	7.92	3.74	7.71	53.89
9	38.71	8.76	6.56	10.08	64.33
10	43.12	9.66	9.05	11.63	73.69
11	49.27	10.95	10.04	12.05	82.55
12	57.05	12.56	10.03	11.89	91.74
13	65.86	14.37	9.65	11.54	101.56
14	75.11	16.26	9.29	11.22	111.94
15	84.65	18.19	8.91	10.89	122.64
16	94.37	20.17	8.52	10.57	133.57
17	104.19	22.18	8.17	10.26	144.71
18	113.92	24.18	7.97	9.96	155.91
19	123.48	26.16	7.96	9.69	167.06
20	133.00	28.15	8.09	9.40	178.09
21	142.41	30.14	7.23	9.09	189.03

Year	Above-ground biomass	Below-ground biomass	Dead wood	Litter	Total biomass
22	151.82	32.15	7.10	8.80	200.02
23	161.31	34.19	7.23	8.55	211.17
24	170.77	36.24	5.70	8.29	222.38
25	179.96	38.25	7.23	8.29	233.59
26	189.02	40.24	9.54	8.13	244.76
27	198.12	42.26	7.49	7.75	255.84
28	207.12	44.27	4.83	7.56	266.87
29	216.01	46.27	4.54	7.36	277.83
30	224.72	48.25	4.81	7.24	288.65
31	233.23	50.20	4.75	7.12	299.29
32	241.54	52.12	4.72	7.00	309.74
33	249.65	54.01	6.38	6.95	319.99
34	257.56	55.88	8.30	6.95	330.03
35	265.29	57.72	8.77	6.92	339.87
36	272.82	59.53	9.21	6.84	349.51
37	280.17	61.32	9.63	6.76	358.94
38	287.35	63.07	10.06	6.68	368.19
39	294.37	64.81	10.49	6.59	377.27
40	301.32	66.54	10.92	6.50	386.26

[1] Yield table source: Paul et al., unpublished(b)

A3.2.4 Uncertainty analysis for the LULUCF sector

This section contains the disaggregated uncertainty analysis for the Land Use, Land-Use Change and Forestry (LULUCF) sector. This additional information has been provided as a result of the review of New Zealand’s 2012 inventory submission. One of the recommendations of the review was that New Zealand provides “a detailed disaggregated assessment of uncertainty, as well as the aggregated uncertainty associated with the LULUCF sector, consistent with the Intergovernmental Panel on Climate Change (IPCC) good practice guidance for LULUCF”. This information is now provided in table A3.2.9.

Table A3.2.9 Uncertainty analysis for the LULUCF sector

IPCC category	Gas	1990 emissions or removals (kt CO_2-e)	2019 emissions or removals (kt CO_2-e)	Activity data uncertainty (%)	Emission factor / estimation parameter uncertainty (biomass) (%)	Emission factor / estimation parameter uncertainty (mineral soil) (%)	Combined uncertainty (%)	Contribution to variance by category in 2019 (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend in LULUCF emissions introduced by emission factor / estimation parameter uncertainty (%)	Uncertainty in trend in LULUCF emissions introduced by activity data uncertainty (%)	Uncertainty introduced into the trend in total LULUCF emissions (%)	Emission factor quality indicator	Activity data quality indicator
Post-1989 natural forest remaining post-1989 natural forest	CO_2	0.0	−156.7	8.0	44.8	10.4	45.5	0.3	0.7	0.7	0.3	0.1	0.3	M	M
Land converted to post-89 natural forest	CO_2	23.7	−556.6	8.0	44.8	10.4	41.2	0.8	2.4	2.3	1.1	0.3	1.1	M	M
Pre-1990 natural forest remaining pre-1990 natural forest	CO_2	−2,730.3	−2,717.0	5.0	39.3	7.9	39.5	3.9	−1.7	11.3	−0.7	−0.1	0.7	M	M
Land converted to pre-1990 natural forest	CO_2	19.0	50.6	5.0	39.3	7.9	45.8	0.1	−0.1	−0.2	0.0	0.0	0.0	M	M
Pre-1990 planted forest remaining pre-1990 planted forest	CO_2	2,042.3	−8,351.6	5.0	27.1	12.3	201.8	61.4	44.5	34.8	12.1	3.1	12.5	M	M
Land converted to pre-1990 planted forest	CO_2	−22,758.1	−482.1	5.0	27.1	12.3	20.7	0.4	−105.2	2.0	−28.5	−7.4	29.4	M	M
Post-1989 forest remaining post-1989 forest	CO_2	0.0	−5,920.9	8.0	8.9	10.4	55.9	12.1	24.7	24.7	2.2	2.8	3.6	M	M
Land converted to post-1989 planted forest	CO_2	78.1	−4,146.2	8.0	8.9	10.4	15.5	2.3	17.6	17.3	1.6	2.0	2.5	M	M
G-WB remaining G-WB	CO_2	34.1	27.6	83.0	75.0	7.3	86.8	0.1	0.0	−0.1	0.0	0.1	0.1	M	M
Land converted to G-WB	CO_2	22.6	−70.0	83.0	75.0	7.3	85.0	0.2	0.4	0.3	0.3	0.5	0.6	M	M

IPCC category	Gas	1990 emissions or removals (kt CO_2-e)	2019 emissions or removals (kt CO_2-e)	Activity data uncertainty (%)	Emission factor / estimation parameter uncertainty (biomass) (%)	Emission factor / estimation parameter uncertainty (mineral soil) (%)	Combined uncertainty (%)	Contribution to variance by category in 2019 (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend in LULUCF emissions introduced by emission factor / estimation parameter uncertainty (%)	Uncertainty in trend in LULUCF emissions introduced by activity data uncertainty (%)	Uncertainty introduced into the trend in total LULUCF emissions (%)	Emission factor quality indicator	Activity data quality indicator
G-HP remaining G-HP	CO_2	1,114.4	1,186.3	8.0	75.0	5.8	90.4	3.9	0.4	–4.9	0.3	0.0	0.3	M	M
Land converted to G-HP	CO_2	–726.9	1,426.5	8.0	75.0	5.8	28.1	1.5	–9.4	–5.9	–7.0	–1.1	7.1	M	M
G-LP remaining G-LP	CO_2	202.1	61.8	8.0	75.0	7.3	90.4	0.2	0.7	–0.3	0.5	0.1	0.5	M	M
Land converted to G-LP	CO_2	–115.0	1,549.0	8.0	75.0	7.3	16.9	1.0	–7.0	–6.5	–5.2	–0.8	5.3	M	M
Cropland – perennial remaining cropland – perennial	CO_2	73.5	44.7	8.0	75.0	14.1	188.6	0.3	0.2	–0.2	0.1	0.0	0.1	M	M
Land converted to cropland – perennial	CO_2	52.2	21.0	8.0	75.0	14.1	162.6	0.1	0.2	–0.1	0.1	0.0	0.1	M	M
Cropland – annual remaining cropland – annual	CO_2	269.1	272.4	8.0	75.0	9.7	90.4	0.9	0.1	–1.1	0.1	0.0	0.1	M	M
Land converted to cropland – annual	CO_2	73.6	41.3	8.0	75.0	9.7	23.7	0.0	0.2	–0.2	0.1	0.0	0.1	M	M
Wetland – open water remaining wetlands – open water	CO_2	0.0	0.0	33.0	0.0	90.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	M	M
Land converted to wetland – open water	CO_2	–20.3	–3.0	33.0	0.0	90.0	139.5	0.0	–0.1	0.0	0.0	0.0	0.0	M	M
Wetland – vegetative non-forest remaining wetland – vegetative non-forest	CO_2	9.4	17.9	33.0	75.0	12.3	95.9	0.1	0.0	–0.1	0.0	0.0	0.0	M	M

IPCC category	Gas	1990 emissions or removals (kt CO_2-e)	2019 emissions or removals (kt CO_2-e)	Activity data uncertainty (%)	Emission factor / estimation parameter uncertainty (biomass) (%)	Emission factor / estimation parameter uncertainty (mineral soil) (%)	Combined uncertainty (%)	Contribution to variance by category in 2019 (%)	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend in LULUCF emissions introduced by emission factor / estimation parameter uncertainty (%)	Uncertainty in trend in LULUCF emissions introduced by activity data uncertainty (%)	Uncertainty introduced into the trend in total LULUCF emissions (%)	Emission factor quality indicator	Activity data quality indicator
Land converted to wetland – vegetative non-forest	CO_2	0.2	–1.6	33.0	75.0	12.3	49.0	0.0	0.0	0.0	0.0	0.0	0.0	M	M
Settlements remaining settlements	CO_2	67.2	75.7	22.0	75.0	95.0	92.6	0.3	0.0	–0.3	0.0	0.0	0.0	M	M
Land converted to settlements	CO_2	7.3	37.0	22.0	75.0	95.0	73.9	0.1	–0.1	–0.2	–0.1	0.0	0.1	M	M
Other land remaining other land	CO_2	0.0	0.0	22.0	75.0	70.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	M	M
Land converted to other land	CO_2	12.6	48.6	22.0	75.0	70.7	28.6	0.1	–0.1	–0.2	–0.1	0.0	0.1	M	M
Harvested wood products	CO_2	–2,072.9	–10,067.3	15.0	67.4	–	68.2	25.0	32.0	41.9	21.6	6.8	22.6	M	M
LULUCF CH_4 (CO_2-e)	CO_2-e	93.5	76.6	30.0	48.3	–	56.9	0.2	0.1	–0.3	0.1	0.1	0.1	R	R
LULUCF N_2O (CO_2-e)	CO_2-e	214.0	110.9	30.0	48.3	–	17.4	0.1	0.6	–0.5	0.3	0.2	0.4	R	R

Note: G-HP = high producing grassland; G-LP = low producing grassland; G-WB = grassland with woody biomass; M = measurements; R = national referenced information.

A3.2.5 LUCAS data management system

The Land Use Carbon Analysis System (LUCAS) data management system stores, manages and archives data for international greenhouse gas reporting for the LULUCF sector. This system is used for managing the land use spatial databases, plot and reference data, and for combining the two sets of data to calculate the numbers required for reporting under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (see figure A3.2.1).

The data collected are stored and manipulated within three systems: the Geospatial System, the Gateway, and the Calculation and Reporting Application (CRA).

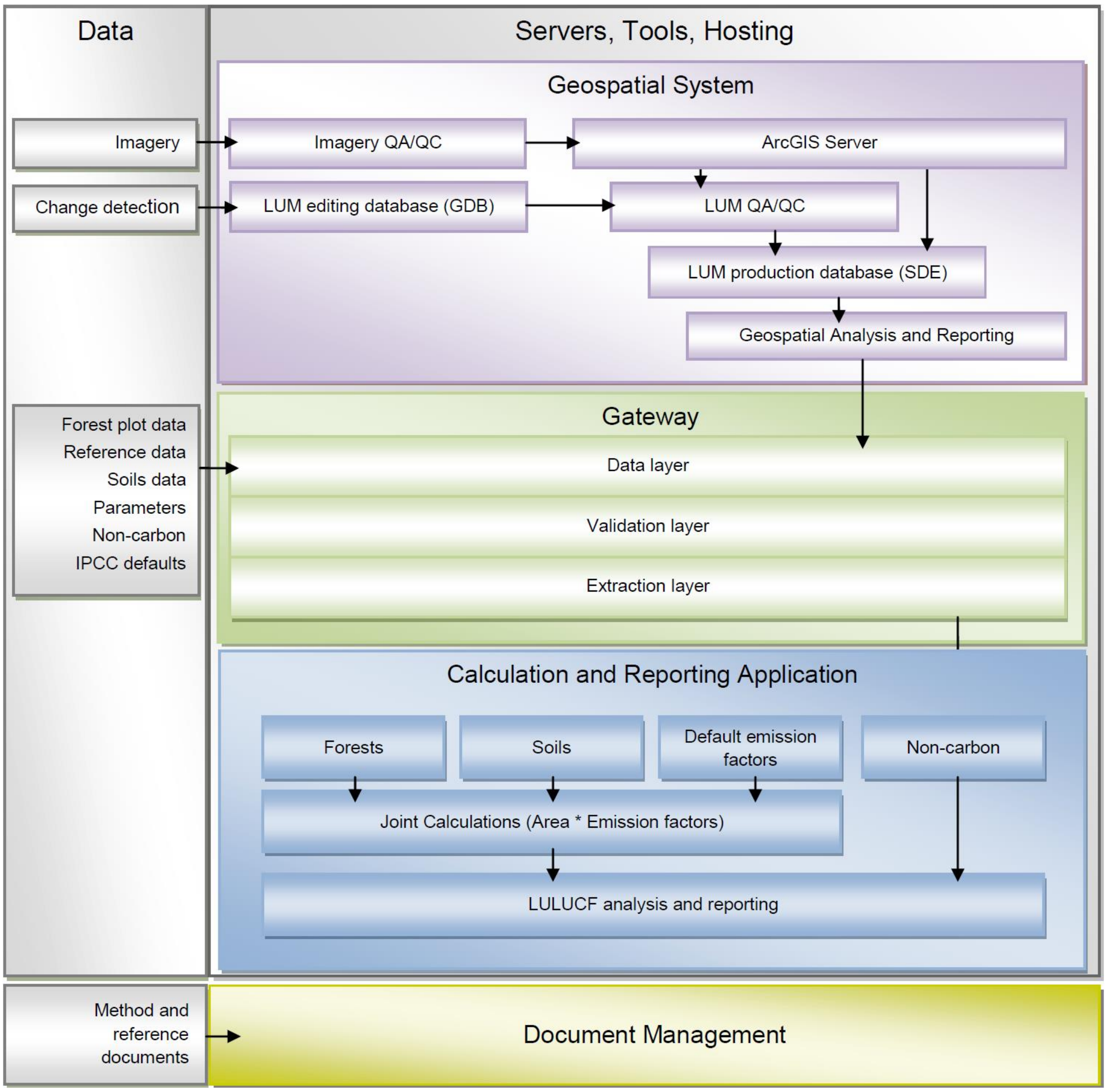
The main objectives of these systems are to:

- provide a transparent system for data storage and carbon calculations
- provide a repository for the versioning and validation of plot measurements and land-use data
- calculate carbon stocks, emissions and removals per hectare for land uses and carbon pools based on the plot and spatial data collected
- calculate biomass burning emissions by land use based on area and emission factors stored in the Gateway
- produce the outputs required for the LULUCF sector reporting under the UNFCCC and the Kyoto Protocol
- archive all inputs and outputs used in reporting.

The module 'joint calculations' refers to the process New Zealand uses to estimate national average carbon values by carbon pool for each land-use category and subcategory.

The joint calculation process is performed within the CRA. Within the joint calculations interface, the user selects the appropriate area data and emission factors. The results of the calculations are carbon gains, losses and net change for all land-use subcategories (whether in a conversion state or land remaining land), by year and by carbon pool.

Figure A3.2.1 New Zealand's LUCAS data management system

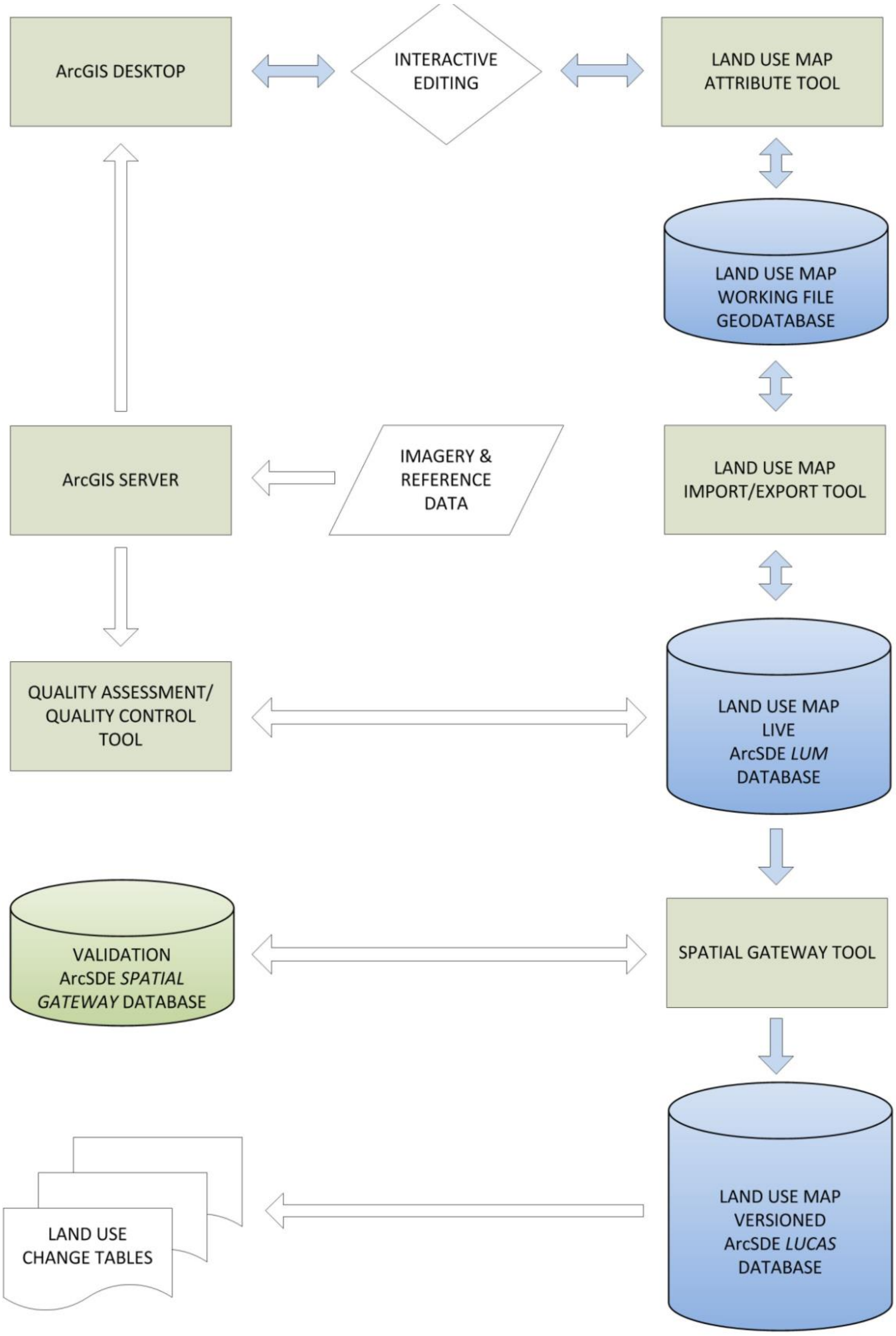


Note: IPCC = Intergovernmental Panel on Climate Change; LULUCF = Land Use, Land-Use Change and Forestry; LUM = land use map; QA/QC = quality assurance/quality control. Joint calculations are described below.

Geospatial System

The Geospatial System consists of hardware and specific applications designed to meet LULUCF reporting requirements. Most of the hardware comprises servers for spatial database storage, management, versioning and running web-mapping applications. The core components of the Geospatial System are outlined in figure A3.2.2.

Figure A3.2.2 New Zealand's Geospatial System components



Note: Blue indicates land use mapping data flow. LUCAS = Land Use Carbon Analysis System; LUM = land use map.

Land use mapping functionality

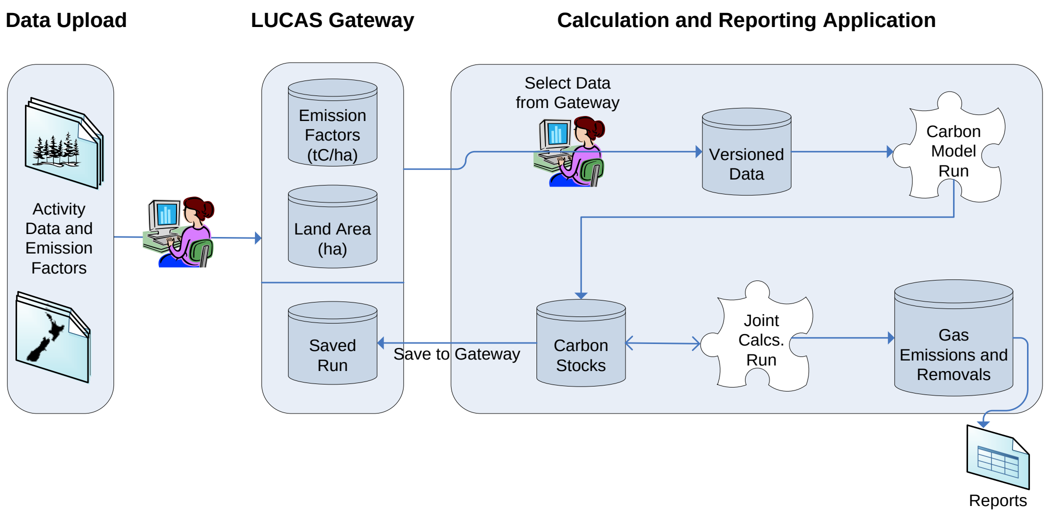
The land use mapping (LUM) functionality of the Geospatial System largely involves the editing and maintenance of time-stamped land use mapping data. The five main components within the LUM functionality are:

- LUM Import/Export Tool – providing functionality to manage importing LUM data in to and exporting LUM data out of the database
- LUM Attribute Tool – an extension to the standard ArcGIS Desktop software that facilitates maintenance of and updates to the LUM data by external contractors
- LUM Database – a non-versioned geographic information system (GIS) database for interim LUM data
- Spatial Gateway Tool – used to validate version data from the LUM database prior to loading into the LUCAS GIS database. Validation business rules are stored in the Spatial Gateway database
- LUCAS Database – storing versions of LUM used to derive land-use change reporting.

LUCAS Management Studio

The LUCAS Management Studio (see figure A3.2.3) is the package of applications used to store activity data and calculate and report New Zealand's emissions and removals for LULUCF. The LUCAS Gateway is a data warehouse with the purpose of storing, versioning and validating activity data and emission factors. The CRA sources all data from the Gateway. It then calculates and outputs New Zealand's emissions and removals for LULUCF for land remaining land and land converted to another land use by pool and year.

Figure A3.2.3 LUCAS Management Studio



LUCAS Gateway

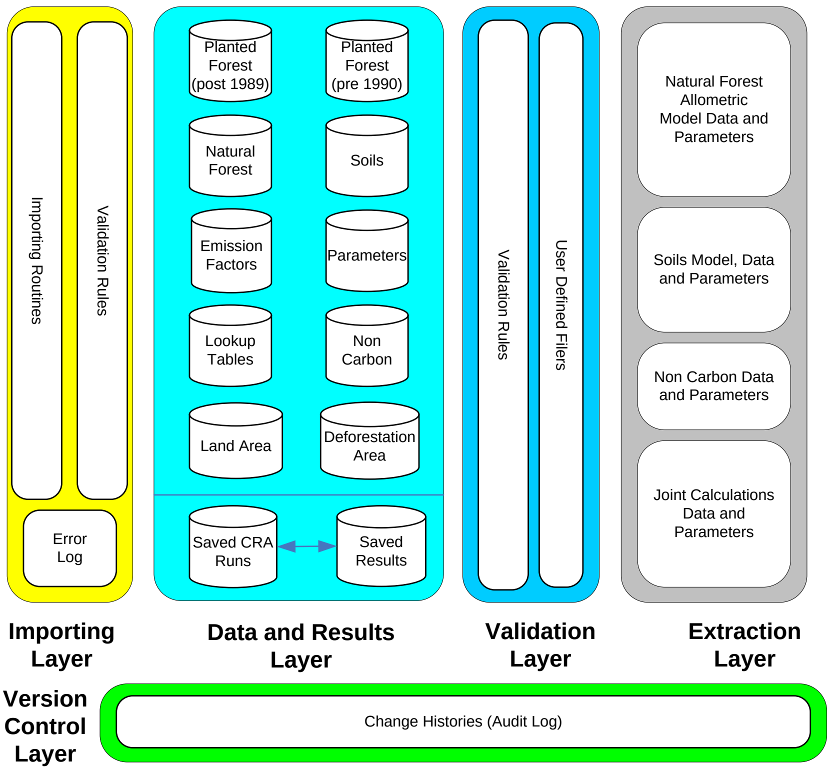
The LUCAS Gateway enables the storage of activity data such as field plot data, land use area, biomass burning and other data needed by the CRA, such as IPCC defaults.

The LUCAS Gateway provides a viewing, querying and editing interface to the source (plot, land use area, carbon and non-carbon) data. It also stores any published or saved results from running the CRA.

All activity data and emission factors are stored within the Gateway database (see figure A3.2.4). It contains the following main components.

- A data and results layer contains all activity data (natural, planted forest, soils, default carbon, non-carbon, land use areas, land-use change and reference tables). The user has the ability to create a 'snapshot' in time (a data set archiving system) of the data held in the Gateway. This enables users of the CRA to select from a range of data snapshots and ensures past results can be replicated over time.
- A validation layer allows users to judge the suitability of data for use in the CRA calculations, subsequent to passing primary validation. Where records are deemed not acceptable for use within published reports, they are tagged as 'invalid' in the LUCAS Gateway database.
- An audit trail provides a history of any changes to the database tables within the Gateway.
- Versioning at a number of levels ensures any changes to data, schema or the database itself are logged and versioned, while providing the user with the ability to track what changes have been applied and roll back to a previous version if required. The results of saved or published reports within the CRA are also stored within the Gateway for repeatability and reference.
- Primary data validation, both during data capture and during import of the data into the Gateway, ensures only data that has passed acceptability criteria is available for a publishable CRA run.
- Hosting and application support provides hosting services, system security, backup and restore, daily maintenance and monitoring for the Gateway and CRA.

Figure A3.2.4 LUCAS Gateway database



Calculation and Reporting Application

The CRA enables users to import carbon and non-carbon data from the Gateway and, by running the various modules, determine emissions and removals by New Zealand's *Forest land*, *Cropland*, *Grassland* and other land use types. This information, combined with land area data, enables New Zealand to meet its reporting requirements under the UNFCCC and the Kyoto Protocol.

The CRA allows for the inclusion of other data sets, models and calculations without the complete redesign of the applications. All models, data and results are versioned, and the CRA allows the user to alter specific key values within a model or calculation (parameters) without the intervention of a programmer or technical support officer. The CRA is deployed as a client-based application that sources the required data from the Gateway.

The CRA comprises four modules: natural forest, soils, non-carbon and joint calculations. Any of these modules can be run independently or as a group. The results are provided as 'views' to the user at the completion of the run.

To activate a module, the user selects the module to run within the CRA, the version of the data set to be used, the model version and other calculation parameters. The natural forest and soil carbon modules use R statistical language as the base program language, while the non-carbon module and joint calculations module are developed in the programming language C Sharp (C#).

Within the joint calculations module, the user has the option of using the carbon results from running the modules or using default carbon estimates (based on published reports) stored within the Gateway. The joint calculations module combines the carbon estimates with the land use area to calculate carbon stock and change following the methodology set out in section 2.3 of volume 4 of the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC, 2006). The results represent carbon stock and change for every 'from' and 'to' land use combination outlined by the IPCC since 1990.

On completion of running a module, the results can be saved or published back to the Gateway. This provides a versioned and auditable record of the results used for reporting. If the results are saved or published, other information such as the time created, the user's identification and the module-particular parameters that were used are also saved for tracking and audit control.

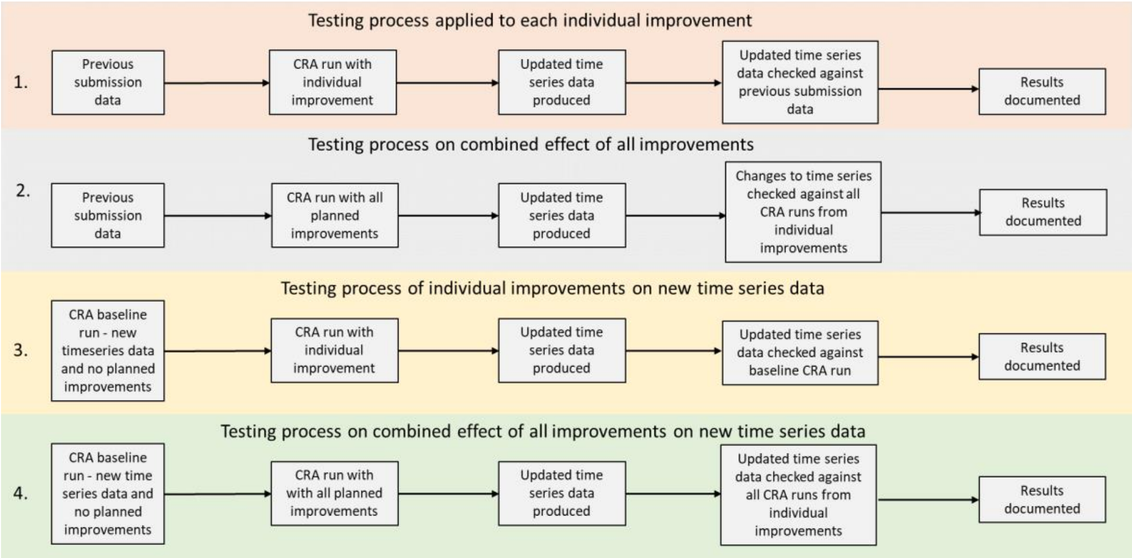
The CRA is maintained and supported by Interpine Innovation, a New Zealand-based company that specialises in forestry inventories and related information technology development. Interpine Innovation also provides support services, such as database and application backups, day-to-day issue resolution and enhancement projects to the Gateway or CRA as required.

Any changes to the data or table structure within the Gateway, or to the people accessing the Gateway or CRA, are tracked via audit logs. For any changes to the data within the Gateway, the person making the change, the date, the reason for change and the version are logged and reports are made available to users for review.

Quality control management for implementing planned improvements

In 2020 further quality control processes were introduced and formalised for introducing improvements to the national inventory report. This was done to help manage the large number of improvements to the LULUCF sector that were made for the 2021 submission. The quality control process is described in figure A3.2.5.

Figure A3.2.5 Quality control procedure for implementing improvements



Document management

All reference material, including scientific reports containing information on methodologies or emission factors used in the production of the LULUCF and Kyoto Protocol estimates, is archived on the Ministry for the Environment's document management store, Te Puna.

The emission factors and area estimates for published runs are also archived within the Gateway and can be accessed via the Gateway or the CRA.

Annex 3: References

Some references may be downloaded directly from the following webpage: www.mpi.govt.nz/news-and-resources/statistics-and-forecasting/greenhouse-gas-reporting/agriculture-greenhouse-gas-inventory-reports.

The Ministry for Primary Industries is progressively making reports used for the inventory available on this page, provided copyright permits.

Carran RA, Theobold PW, Evans JP. 1995. Emissions of nitrous oxide from some grazed pasture soils. *New Zealand and Australian Journal of Soil Research* 33: 341–352.

de Klein CAM, Barton L, Sherlock RR, Li Z, Littlejohn RP. 2003. Estimating a nitrous oxide emission factor for animal urine from some New Zealand pastoral soils. *Australian Journal of Soil Research* 41: 381–399.

Fick J, Saggar S, Hill J, Giltrap D. 2011. *Poultry Management in New Zealand: Production, Manure Management and Emissions Estimations for the Commercial Chicken, Turkey, Duck and Layer Industries within New Zealand*. Report prepared for the Ministry of Agriculture and Forestry by Poultry Industry Association, Egg Producers Association, Landcare Research and Massey University. Wellington: Ministry of Agriculture and Forestry.

Hill J. 2012. *Recalculate Pork Industry Emissions Inventory*. Report prepared for the Ministry of Agriculture and Forestry by Massey University and the New Zealand Pork Industry Board. Wellington: Ministry of Agriculture and Forestry.

IPCC. 1996. Houghton JT, Meira Filho LG, Lim B, Treanton K, Mamaty I, Bonduki Y, Griggs DJ, Callender BA (eds). *IPCC/OECD/IEA. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. Bracknell: United Kingdom Meteorological Office.

IPCC. 2000. Penman J, Kruger D, Galbally I, Hiraishi T, Nyenzi B, Emmanuel S, Buendia L, Hoppaus R, Martinsen T, Meijer J, Miwa K, Tanabe K (eds). *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. IPCC National Greenhouse Gas Inventories Programme. Japan: Published for the IPCC by the Institute for Global Environmental Strategies.

IPCC. 2006. Eggleston HS, Buendia L, Miwa K, Ngara T, Tanabe K (eds). *2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4. Agriculture, Forestry and Other Land Use*. IPCC National Greenhouse Gas Inventories Programme. Japan: Published for the IPCC by the Institute for Global Environmental Strategies.

Kelliher FM, de Klein CAM. Unpublished. Review of New Zealand's Fertiliser Nitrous Oxide Emission Factor (EF_1) Data. Report prepared for the Ministry for the Environment by Landcare Research and AgResearch in 2006.

Lassey K. 2011. *Methane Emissions and Nitrogen Excretion Rates for New Zealand Goats*. Report for the Ministry of Agriculture and Forestry, National Institute of Water and Atmospheric Research. Wellington: National Institute of Water and Atmospheric Research.

Luo J, van der Weerden T, Hoogendoorn C, de Klein C. 2009. *Determination of the N_2O Emission Factor for Animal Dung Applied in Spring in Three Regions of New Zealand*. Report prepared for the Ministry of Agriculture and Forestry by AgResearch. Wellington: Ministry of Agriculture and Forestry.

Ministry for the Environment. 2010. *New Zealand's Greenhouse Gas Inventory 1990–2008*. Wellington: Ministry for the Environment.

Muller C, Sherlock RR, Williams PH. 1995. Direct field measurements of nitrous oxide emissions from urine-affected and urine-unaffected pasture in Canterbury. In: *Proceedings of the Workshop on Fertilizer Requirements of Grazed Pasture and Field Crops: Macro and Micronutrients*. Currie LD, Loganathan P (eds). Occasional Report No. 8. Palmerston North: Massey University. pp 243–234.

Paul TSH, Beets PN, Kimberley MO. Unpublished(a). Carbon stocks in New Zealand's Post-1989 Natural Forest – Analysis of the 2018/2019 forest inventory data. Contract report prepared for the Ministry for the Environment by the New Zealand Forest Research Institute Ltd (trading as Scion) in 2020.

Paul TSH, Kimberley MO, Beets PN. 2020. Natural Forests in New Zealand – a large terrestrial carbon pool in a national state of equilibrium. Manuscript submitted for publication.

Paul TSH, Kimberley MO, Dodunski C. Unpublished(b). The 2019 NFI plot analysis Yield tables and carbon stocks at measurement. Contract report prepared for the Ministry for the Environment by New Zealand Forest Research Institute Ltd (trading as Scion) in 2020.

Paul TSH, Wakelin SJ. Unpublished Yield tables and approach for estimating historic carbon stocks in pre-1990 planted forests for greenhouse gas inventory reporting. Contract report prepared for the Ministry for the Environment by New Zealand Forest Research Institute Ltd (trading as Scion) in 2020.

Pickering A, Fick JM. 2015. *Detailed methodologies for agricultural greenhouse gas emission calculation*. Version 3. Wellington: Ministry for Primary Industries. (Refer to: http://mpi.govt.nz/news-and-resources/statistics-and-forecasting/greenhouse-gas-reporting.)

Sherlock RR, Jewell P, Clough T. 2008. *Review of New Zealand Specific $Frac_{GASM}$ and $Frac_{GASF}$ Emissions Factors*. Report prepared for the Ministry of Agriculture and Forestry by Landcare Research and AgResearch. Wellington: Ministry of Agriculture and Forestry.

Suttie J. 2012. *Report to the Deer Industry New Zealand: Estimation of Deer Population and Productivity Data 1990 to 2012*. Dunedin: Suttie Consulting Limited.

Thomas S, Hume E, Fraser T, Curtin, D. 2011. *Factors and Activity Data to Estimate Nitrous Oxide Emissions from Cropping Systems, and Stubble and Tussock Burning*. Report prepared for Ministry of Agriculture and Forestry by Plant and Food Research. Wellington: Ministry of Agriculture and Forestry.

Thomas S, Wallace D, Beare M. 2014. *Pasture Renewal Activity Data and Factors for New Zealand*. Report prepared for the Ministry for Primary Industries by Plant and Food Research. Wellington: Ministry for Primary Industries.

Thomas SM, Fraser T, Curtin D, Brown H, Lawrence E. 2008. *Review of Nitrous Oxide Emission Factors and Activity Data for Crops*. Report prepared for the Ministry of Agriculture and Forestry by Plant and Food Research. Wellington: Ministry of Agriculture and Forestry.

Thomas SM, Ledgard SF, Francis GS. Unpublished. Appropriateness of IPCC Default Values for Estimating New Zealand's Indirect Nitrous Oxide Emissions. Report prepared for the Ministry of Agriculture and Forestry in 2003.

Thomas SM, Ledgard SF, Francis GS. 2005. Improving estimates of nitrate leaching for quantifying New Zealand's indirect nitrous oxide emissions. *Nutrient Cycling in Agroecosystems* 73: 213–226.

van der Weerden T, Cox N, Luo J, Di HJ, Podolyan A, Phillips RL, Saggar S, de Klein CAM, Ettema P, Rys G. 2016. Refining the New Zealand nitrous oxide emission factor for urea fertiliser and farm dairy effluent. *Agriculture Ecosystems & Environment* 222: 133–137.

Annex 4: Methodology and data collection for estimating emissions from fossil fuel combustion

New Zealand emission factors are based on gross calorific value. Energy activity data and emission factors in New Zealand are conventionally reported in gross (higher heating value) terms, with some minor exceptions. The convention adopted by New Zealand to convert gross calorific value to net calorific value follows the Organisation for Economic Co-operation and Development and International Energy Agency assumptions:

Net calorific value = 0.95 × gross calorific value for coal and liquid fuels

Net calorific value = 0.90 × gross calorific value for gas

Net calorific value = 0.80 × gross calorific value for wood

Emission factors for gas, coal, biomass and liquid fuels used by New Zealand are shown in tables A4.1–A4.4. Where Intergovernmental Panel on Climate Change (IPCC) default emission factors are used, a net-to-gross factor as above is used to account for New Zealand activity data representing gross energy figures:

Gross EF = Net EF × Factor

Table A4.1 Gross carbon dioxide emission factors used for New Zealand's energy sector in 2019

	Emission factor (t CO_2/TJ)	Source
Gas		
Maui	52.26	1
Kapuni	53.57	1
McKee	54.42	2
Kaimiro	63.51	2
Ngatoro	61.81	2
TAWN	52.72	2
Mangahewa	54.34	2
Turangi	55.05	2
Pohokura	54.84	1
Rimu/Kauri	51.46	2
Maari	54.56	2
Weighted average	54.1	
Kapuni LTS	86.31	1
Methanol – Mixed Feed – to 94	62.44	2
Methanol – LTS – to 94	83.97	2
Liquid fuels		
Crude oil	69.67	4
Regular petrol	66.77	3
Petrol – premium	66.95	3
Diesel (10 parts (sulphur) per million)	69.45	3
Jet kerosene	68.33	3

	Emission factor ($t CO_2/TJ$)	Source
Av gas	65.89	3
LPG	60.79	6
Heavy fuel oil	73.33	3
Light fuel oil	73.02	3
Bitumen (asphalt)	76.43	3
Biomass		
Biogas	49.17	4
Wood (industrial)	89.47	4
Bioethanol	64.20	5
Biodiesel	67.26	4
Wood (residential)	85.8	4
Coal		
All sectors excl. electricity (sub-bituminous)	91.99	6
All sectors (bituminous)	89.13	6
All sectors (lignite)	93.11	6

1. New Zealand Emissions Trading Scheme data.
2. Specific gas field operator.
3. Refining NZ.
4. IPCC Guidelines (2006).
5. *New Zealand Energy Information Handbook* (Eng et al., 2008).
6. *Review of Default Emission Factors in Draft Stationary Energy and Industrial Processes Regulations: Coal* (CRL Energy, 2009).

Table A4.2 Consumption-weighted average emission factors used for New Zealand's sub-bituminous coal-fired electricity generation for 1990 to 2019

Year	Emission factor ($t CO_2/TJ$)
1990	91.20
1991	91.24
1992	91.29
1993	91.33
1994	91.38
1995	91.42
1996	91.47
1997	91.51
1998	91.56
1999	91.60
2000	91.64
2001	91.69
2002	91.73
2003	91.78
2004	91.82
2005	91.87
2006	91.91
2007	92.43
2008	92.31
2009	92.39
2010 onwards	92.20

Table A4.3 Methane emission factors used for New Zealand's energy sector for 1990 to 2019

	Emission factor ($t\ CH_4/PJ$)	Source
Natural gas		
Electricity industries	0.9	IPCC 2006 (table 2.2)
Commercial	4.50	IPCC 2006 (table 2.4)
Residential	4.50	IPCC 2006 (table 2.5)
Domestic transport (CNG)	82.80	IPCC 2006 (table 3.2.2)
Other stationary (mainly industrial)	0.9	IPCC 2006 (table 2.3)
Liquid fuels		
Stationary sources		
Electricity – residual oil	2.85	IPCC 2006 (table 2.2)
Industrial (including refining) – residual oil	2.85	IPCC 2006 (table 2.3)
Industrial – LPG	0.95	IPCC 2006 (table 2.3)
Commercial – residual oil	9.50	IPCC 2006 (table 2.4)
Commercial – distillate oil	9.50	IPCC 2006 (table 2.4)
Commercial – LPG	4.75	IPCC 2006 (table 2.4)
Residential – distillate oil	9.50	IPCC 2006 (table 2.5)
Residential – LPG	4.75	IPCC 2006 (table 2.5)
Agriculture – stationary	2.85	IPCC 2006 (table 2.5)
Mobile sources		
LPG	58.9	IPCC 2006 (table 3.2.2)
Petrol	28.05	IPCC 2006 (table 3.2.2)
Diesel	3.71	IPCC 2006 (table 3.2.2)
Navigation (fuel oil and diesel)	6.65	IPCC 2006 (table 3.5.3)
Aviation fuel/kerosene	0.48	IPCC 2006 (table 3.6.5)
Coal		
Electricity generation	0.95	IPCC 2006 (table 2.2)
Industry	9.50	IPCC 2006 (table 2.3)
Commercial	9.50	IPCC 2006 (table 2.4)
Residential	285.00	IPCC 2006 (table 2.5)
Biomass		
Wood/wood waste	24	IPCC 2006 (table 2.3)
Wood – fireplaces	240.00	IPCC 2006 (table 2.5) wood – residential
Bioethanol	18.00	IPCC 2006 (table 3.2.2) – ethanol, cars, Brazil
Biodiesel	18.00	IPCC 2006 (table 3.2.2) – ethanol, cars, Brazil
Gas biomass	0.9	IPCC 2006 (table 2.2)

Table A4.4 Nitrous oxide emission factors used for New Zealand's energy sector for 1990 to 2019

	Emission factor (t N_2O/PJ)	Source
Natural gas		
Electricity generation	0.09	IPCC 2006 (table 2.2)
Commercial	0.09	IPCC 2006 (table 2.4)
Residential	0.09	IPCC 2006 (table 2.5)
Domestic transport (CNG)	2.70	IPCC 2006 (table 3.2.2)
Other stationary (mainly industrial)	0.09	IPCC 2006 (table 2.3)
Liquid fuels		
Stationary sources		
Electricity – residual oil	0.57	IPCC 2006 (table 2.2)
Electricity – distillate oil	0.57	IPCC 2006 (table 2.2)
Industrial (including refining) – residual oil	0.57	IPCC 2006 (table 2.2)
Industrial – distillate oil	0.57	IPCC 2006 (table 2.3)
Commercial – residual oil	0.57	IPCC 2006 (table 2.4)
Commercial – distillate oil	0.57	IPCC 2006 (table 2.4)
Residential (all oil)	0.57	IPCC 2006 (table 2.5)
LPG (all uses)	0.095	IPCC 2006 (tables 2.2–2.5)
Agriculture – stationary	0.38	Tier 2, diesel engines – agriculture
Mobile sources		
LPG	0.19	IPCC 2006 (table 3.22)
Petrol	7.6	IPCC 2006 (table 3.2.2)
Diesel	3.71	IPCC 2006 (table 3.2.2)
Fuel oil (ships)	1.90	IPCC 2006 (table 3.5.3)
Aviation fuel/kerosene	1.90	IPCC 2006 (table 3.6.5)
Coal		
Electricity generation	1.43	IPCC 2006 (table 2.2)
Industry	1.43	IPCC 2006 (table 2.3)
Commercial	1.43	IPCC 2006 (table 2.4)
Residential	1.43	IPCC 2006 (table 2.5)
Biomass		
Wood (all uses)	3.20	IPCC 2006 (table 2.5) wood/wood waste
Gas biomass	0.09	IPCC 2006 (table 2.5)

A4.1 Emissions from liquid fuels

A4.1.1 Activity data and uncertainties

The *Delivery of Petroleum Fuels by Industry Survey* is conducted by the Ministry of Business, Innovation and Employment (MBIE). Because it is a census, there is no sampling error. The only possible sources of error are non-sampling errors (such as respondent error and processing error). The 2019 statistical difference for liquid fuels in the balance table of the publication *Energy in New Zealand* (MBIE, 2020) was 1.4 per cent. This is used as the activity data uncertainty for liquid fuels in 2019.

A4.1.2 Emission factors and uncertainties

The carbon dioxide (CO_2) emission factors are described in table A4.1. Table A4.5 shows a complete time series of gross calorific values, while table A4.6 shows a complete time series of carbon content of liquid fuels. This information is supplied by Refining New Zealand Ltd and is used in the calculation of annual emission factors for liquid fuels.

A 2009 consultant report (Hale and Twomey, unpublished) to the Ministry for the Environment estimates the uncertainty of CO_2 emission factors for liquid fuels at ±0.5 per cent. The uncertainty for methane (CH_4) and nitrous oxide (N_2O) emission factors is ±50.0 per cent because almost all emission factors are IPCC defaults.

Table A4.5 Gross calorific values (MJ/kg) for liquid fuels for 1990 to 2019

	Premium petrol	Regular petrol	Diesel	Jet kerosene	Heavy fuel oil	Light fuel oil	Bitumen (asphalt)
1990	47.24	47.22	45.76	46.37	43.07	44.12	41.30
1991	47.17	47.17	45.73	46.38	43.02	44.07	41.30
1992	47.18	47.14	45.75	46.41	43.03	44.14	41.30
1993	47.09	47.14	45.74	46.36	43.01	44.13	41.31
1994	47.10	47.11	45.75	46.34	43.03	44.16	41.30
1995	47.07	47.14	45.59	46.31	43.03	44.01	41.30
1996	46.91	47.14	45.54	46.26	43.00	43.98	41.30
1997	46.93	47.17	45.58	46.32	42.92	43.92	41.30
1998	46.89	47.12	45.64	46.27	43.06	44.02	41.27
1999	46.92	47.13	45.56	46.29	43.09	43.93	41.28
2000	46.91	47.12	45.58	46.22	43.07	43.90	41.27
2001	46.92	47.15	45.64	46.25	43.08	43.96	41.27
2002	46.90	47.16	45.62	46.29	43.03	43.84	41.26
2003	46.87	47.11	45.61	46.23	43.06	43.79	41.27
2004	46.91	47.10	45.59	46.25	43.04	43.90	41.30
2005	46.95	47.10	45.73	46.28	43.11	43.94	41.30
2006	46.97	47.09	45.79	46.23	42.93	43.68	41.30
2007	46.97	47.10	45.77	46.23	42.97	43.72	41.30
2008	46.93	47.06	45.72	46.19	42.86	43.72	41.30
2009	46.95	47.03	45.72	46.17	42.89	43.75	41.29
2010	46.96	47.03	45.69	46.17	42.95	43.70	41.29
2011	46.96	47.04	45.69	46.19	42.89	43.72	41.27
2012	46.98	47.03	45.66	46.18	43.03	43.71	41.27
2013	46.99	47.05	45.71	46.23	43.05	43.84	41.26
2014	46.95	47.02	45.71	46.23	42.94	43.73	41.26
2015	46.96	47.03	45.67	46.19	42.98	43.70	41.28
2016	46.92	46.99	45.79	46.29	42.99	43.91	41.29
2017	46.91	47.00	45.77	46.27	42.97	43.71	41.27
2018	46.90	46.99	45.77	46.28	42.93	43.69	41.28
2019	46.91	46.97	45.75	46.25	42.98	43.67	41.28

Table A4.6 Carbon content (per cent mass) for liquid fuels for 1990 to 2019

	Premium petrol	Regular petrol	Diesel	Jet kerosene	Heavy fuel oil	Light fuel oil	Bitumen (asphalt)
1990	84.87	84.92	86.28	85.92	86.22	86.67	86.57
1991	85.04	85.04	86.33	85.89	86.26	86.30	86.57
1992	85.03	85.13	86.29	85.84	86.25	86.18	86.57
1993	85.25	85.13	86.32	85.94	86.27	86.20	86.56
1994	85.21	85.19	86.30	85.99	86.25	86.13	86.57
1995	85.30	85.13	86.63	86.05	86.25	86.39	86.57
1996	85.66	85.13	86.73	86.16	86.28	86.45	86.57
1997	85.63	85.04	86.64	86.04	86.35	86.55	86.58
1998	85.72	85.17	86.52	86.14	86.22	86.39	86.63
1999	85.65	85.15	86.69	86.10	86.20	86.53	86.63
2000	85.67	85.16	86.64	86.25	86.22	86.58	86.63
2001	85.65	85.09	86.53	86.18	86.21	86.49	86.64
2002	85.68	85.06	86.57	86.10	86.25	86.68	86.66
2003	85.76	85.19	86.58	86.23	86.23	86.76	86.63
2004	85.66	85.22	86.62	86.20	86.24	86.58	86.58
2005	85.58	85.22	86.62	86.12	86.18	86.52	86.57
2006	85.54	85.25	86.57	86.24	86.34	86.93	86.57
2007	85.54	85.23	86.61	86.24	86.30	86.87	86.57
2008	85.63	85.32	86.70	86.32	86.39	86.87	86.57
2009	85.56	85.38	86.72	86.36	86.37	86.83	86.60
2010	85.54	85.40	86.77	86.35	86.31	86.90	86.59
2011	85.55	85.37	86.78	86.32	86.37	86.87	86.64
2012	85.51	85.38	86.84	86.34	86.25	86.89	86.63
2013	85.49	85.35	86.73	86.22	86.24	86.68	86.65
2014	85.57	85.42	86.74	86.23	86.33	86.87	86.65
2015	85.54	85.40	86.81	86.33	86.30	86.90	86.62
2016	85.66	85.48	86.56	86.11	86.28	86.58	86.60
2017	85.68	85.46	86.60	86.15	86.30	86.89	86.63
2018	85.69	85.49	86.61	86.31	86.04	86.93	86.04
2019	85.66	85.53	86.65	86.19	85.97	86.96	86.04

Table A4.7 Emission factors for European gasoline and diesel vehicles – COPERT IV model (European Environment Agency, 2007)

Vehicle type and emission standard	N_2O emission factors (mg/km)				CH_4 emission factors (mg/km)			
	Urban		Rural	Highway	Urban		Rural	Highway
	Cold	Hot			Cold	Hot		
Passenger car								
Gasoline								
pre-Euro	10.0	10.0	6.5	6.5	201.0	131.0	86.0	41.0
Euro 1	18.8	26.5	10.7	5.5	45.0	26.0	16.0	14.0
Euro 2	12.6	12.7	4.9	2.7	94.0	17.0	13.0	11.0
Euro 3	8.3	1.50	0.33	0.23	83.0	3.0	2.0	4.0
Euro 4	5.5	1.95	0.34	0.22	57.0	2.87	2.69	5.08
Euro 5	2.15	2.22	0.19	1.20	57.0	2.87	2.69	5.08
Euro 6	2.15	2.22	0.19	1.20	57.0	2.87	2.69	5.08
Diesel								
pre-Euro	0.0	0.0	0.0	0.0	22.0	28.0	12.0	8.0
Euro 1	0.0	2.0	4.0	4.0	18.0	11.0	9.0	3.0
Euro 2	3.0	4.0	6.0	6.0	6.0	7.0	3.0	2.0
Euro 3	15.0	9.0	4.0	4.0	3.0	3.0	0.0	0.0
Euro 4	15.0	9.0	4.0	4.0	1.1	1.1	0.0	0.0
Euro 5	15.0	9.0	4.0	4.0	1.1	1.1	0.0	0.0
Euro 6	9.0	9.0	4.0	4.0	1.1	1.1	0.0	0.0
LPG								
pre-Euro	0.0	0.0	0.0	0.0	80.0	80.0	35.0	25.0
Euro 1	38.0	21.0	13.0	8.0	80.0	80.0	35.0	25.0
Euro 2	23.0	13.0	3.0	2.0	80.0	80.0	35.0	25.0
Euro 3	9.0	5.0	2.0	1.0	80.0	80.0	35.0	25.0
Euro 4	9.0	5.0	2.0	1.0	80.0	80.0	35.0	25.0
Euro 5	1.8	2.1	0.2	1.0	80.0	80.0	35.0	25.0
Euro 6	1.8	2.1	0.2	1.0	80.0	80.0	35.0	25.0
Light duty vehicles								
Gasoline								
pre-Euro	10.0	10.0	6.5	6.5	201.0	131.0	86.0	41.0
Euro 1	47.3	46.3	27.5	13.8	45.0	26.0	16.0	14.0
Euro 2	83.8	27.7	15.8	12.3	94.0	17.0	13.0	11.0
Euro 3	17.1	8.5	1.5	1.5	83.0	3.0	2.0	4.0
Euro 4	14.1	1.17	0.36	0.36	57.0	2.0	2.0	0.0
Euro 5	2.10	2.22	0.19	1.20	57.0	2.0	2.0	0.0
Euro 6	2.10	2.22	0.19	1.20	57.0	2.0	2.0	0.0
Diesel								
pre-Euro	0.0	0.0	0.0	0.0	22.0	28.0	12.0	8.0
Euro 1	0.0	2.0	4.0	4.0	18.0	11.0	9.0	3.0
Euro 2	3.0	4.0	6.0	6.0	6.0	7.0	3.0	2.0
Euro 3	15.0	9.0	4.0	4.0	3.0	3.0	0.0	0.0
Euro 4	15.0	9.0	4.0	4.0	1.1	1.1	0.0	0.0
Euro 5	15.0	9.0	4.0	4.0	1.1	1.1	0.0	0.0

Vehicle type and emission standard	N_2O emission factors (mg/km)				CH_4 emission factors (mg/km)			
	Cold	Urban Hot	Rural	Highway	Cold	Urban Hot	Rural	Highway
Euro 6	9.0	9.0	4.0	4.0	1.1	1.1	0.0	0.0
Heavy duty truck and bus								
Gasoline all technologies	6.0	6.0	6.0	6.0	140.0	140.0	110.0	70.0
Diesel								
		GVW≤12t				GVW≤12t		
pre-Euro	30.0	30.0	30.0	30.0	85.0	85.0	23.0	20.0
Euro I	6.0	6.0	5.0	3.0	85.0	85.0	23.0	20.0
Euro II	5.0	5.0	5.0	3.0	54.4	54.4	20.0	18.6
Euro III	3.0	3.0	3.0	2.0	47.6	47.6	21.4	18.2
Euro IV	6.0	6.0	7.2	5.8	2.6	2.6	1.6	1.2
Euro V	15.0	15.0	19.8	17.2	2.6	2.6	1.6	1.2
Euro VI	18.5	18.5	19.0	15.0	2.6	2.6	1.6	1.2
		12t<GVW≤16t				12t<GVW≤16t		
pre-Euro	30.0	30.0	30.0	30.0	85.0	85.0	23.0	20.0
Euro I	11.0	11.0	9.0	7.0	85.0	85.0	23.0	20.0
Euro II	11.0	11.0	9.0	6.0	54.4	54.4	20.0	18.6
Euro III	5.0	5.0	5.0	4.0	47.6	47.6	21.4	18.2
Euro IV	11.2	11.2	13.8	11.4	2.6	2.6	1.6	1.2
Euro V	29.8	29.8	40.2	33.6	2.6	2.6	1.6	1.2
Euro VI	37.0	37.0	39.0	29.0	2.6	2.6	1.6	1.2
		16t<GVW≤28t				16t<GVW≤28t		
pre-Euro	30.0	30.0	30.0	30.0	175.0	175.0	80.0	70.0
Euro I	11.0	11.0	9.0	7.0	175.0	175.0	80.0	70.0
Euro II	11.0	11.0	9.0	6.0	112.0	112.0	69.6	65.1
Euro III	5.0	5.0	5.0	4.0	98.0	98.0	74.4	63.7
Euro IV	11.2	11.2	13.8	11.4	5.3	5.3	5.6	4.2
Euro V	29.8	29.8	40.2	33.6	5.3	5.3	5.6	4.2
Euro VI	37.0	37.0	39.0	29.0	5.3	5.3	5.6	4.2
		28t<GVW≤34t				28t<GVW≤34t		
pre-Euro	30.0	30.0	30.0	30.0	175.0	175.0	80.0	70.0
Euro I	17.0	17.0	14.0	10.0	175.0	175.0	80.0	70.0
Euro II	17.0	17.0	14.0	10.0	112.0	112.0	69.6	65.1
Euro III	8.0	8.0	8.0	6.0	98.0	98.0	74.4	63.7
Euro IV	17.4	17.4	21.4	17.4	5.3	5.3	5.6	4.2
Euro V	45.6	45.6	61.6	51.6	5.3	5.3	5.6	4.2
Euro VI	56.5	56.5	59.5	44.5	5.3	5.3	5.6	4.2
		GVW>34t				GVW>34t		
pre-Euro	30.0	30.0	30.0	30.0	175.0	175.0	80.0	70.0
Euro I	18.0	18.0	15.0	11.0	175.0	175.0	80.0	70.0
Euro II	18.0	18.0	15.0	10.0	112.0	112.0	69.6	65.1
Euro III	9.0	9.0	9.0	7.0	98.0	98.0	74.4	63.7
Euro IV	19.0	19.0	23.4	19.2	5.3	5.3	5.6	4.2
Euro V	49.0	49.0	66.6	55.8	5.3	5.3	5.6	4.2

Vehicle type and emission standard	N_2O emission factors (mg/km)				CH_4 emission factors (mg/km)			
	Urban Cold	Urban Hot	Rural	Highway	Urban Cold	Urban Hot	Rural	Highway
Euro VI	61.0	61.0	64.0	48.0	5.3	5.3	5.6	4.2
Urban bus or coach		All types				All types		
pre-Euro	30.0	30.0	30.0	30.0	175.0	175.0	80.0	70.0
Euro I	12.0	12.0	9.0	7.0	175.0	175.0	80.0	70.0
Euro II	12.0	12.0	9.0	6.0	113.8	113.8	52.0	45.5
Euro III	6.0	6.0	5.0	4.0	103.3	103.3	47.2	41.3
Euro IV	12.8	12.8	13.8	11.4	5.3	5.3	2.4	2.1
Euro V	33.2	33.2	40.2	33.6	5.3	5.3	2.4	2.1
Euro VI	41.5	41.5	39.0	29.0	5.3	5.3	2.4	2.1
CNG								
pre-Euro					6,800	6,800	6,800	6,800
Euro I					6,800	6,800	6,800	6,800
Euro II					4,500	4,500	4,500	4,500
Euro III					1,280	1,280	1,280	1,280
Euro IV and later					980	980	980	980
Power two wheeler								
Gasoline								
<50 cm^3	1.0	1.0	1.0	1.0	219	219	219	219
>50 cm^3 2-stroke	2.0	2.0	2.0	2.0	150	150	150	150
>50 cm^3 4-stroke	2.0	2.0	2.0	2.0	200	200	200	200

A4.2 Emissions from solid fuels

A4.2.1 Activity data and uncertainties

The *New Zealand Quarterly Statistical Return of Coal Production and Sales* conducted by MBIE has near coverage of the sector, meaning that sampling error is small. The only other possible sources of error are non-sample errors (such as respondent error and processing error). The 2019 statistical difference for solid fuels in the balance table of the publication *Energy in New Zealand* (MBIE, 2020) was 5.0 per cent. This is used as the activity data uncertainty for solid fuels in 2019.

A4.2.2 Emission factors and uncertainties

The estimated uncertainty in CO_2 emission factors for solid fuels is ±2.2 per cent. This is based on the difference between the range of updated emission factors for the three different ranks of coal used in New Zealand. The uncertainty for CH_4 and N_2O emission factors is ±50.0 per cent because almost all emission factors are IPCC defaults.

A4.3 Emissions from gaseous fuels

A4.3.1 Activity data

Through the various surveys and information it collects, MBIE has full coverage of the natural gas sector. This means that there is no sampling error in natural gas statistics and the only possible sources of error include those such as respondent error and processing error. The 2019 statistical difference for gaseous fuels in the balance table of the publication *Energy in New Zealand* (MBIE, 2020) was 9.3 per cent. This is used as the activity data uncertainty for gaseous fuels in 2019.

A4.3.2 Emission factors

The estimated uncertainty in CO_2 emission factors for gaseous fuels is ±2.8 per cent. This is based on the difference between the range of emission factors for three large gas fields in New Zealand. Together, these gas fields made up over 55 per cent of New Zealand's total gas supply in 2019. The uncertainty for CH_4 and N_2O emission factors is ±50.0 per cent because almost all emission factors are IPCC defaults.

A4.4 Energy balance

Detailed and up-to-date energy balance tables for New Zealand are available online: www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-balances.

Further information can be found within the publication *Energy in New Zealand* (MBIE, 2020), also available online: www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-publications-and-technical-papers/energy-in-new-zealand.

Table A4.8 gives a time series of energy use versus non-energy use of natural gas.

Table A4.8 Split of energy use and non-energy use of natural gas in petajoules

	Energy use	Non-energy use
1990	129.5	14.2
1991	143.9	22.1
1992	152.6	18.8
1993	148.0	21.1
1994	137.7	25.8
1995	127.4	36.2
1996	147.7	47.5
1997	170.4	48.9
1998	146.2	46.6
1999	168.5	54.2
2000	173.9	61.8
2001	190.6	55.4
2002	177.1	57.8
2003	151.9	26.1
2004	129.8	32.1

	Energy use	Non-energy use
2005	136.4	13.0
2006	137.2	15.0
2007	148.6	15.4
2008	138.2	18.4
2009	134.6	25.5
2010	150.0	25.6
2011	134.0	24.5
2012	146.2	32.0
2013	145.1	40.3
2014	149.2	60.7
2015	144.3	51.4
2016	134.1	59.1
2017	145.6	53.8
2018	131.4	45.3
2019	139.7	51.2

A4.5 Carbon dioxide reference approach for the Energy sector

A4.5.1 Estimation of carbon dioxide using the IPCC reference approach

The reference approach uses a country's energy supply data to calculate the CO_2 emissions from the combustion of fossil fuels using the apparent consumption equation. The apparent consumption in the reference approach is derived from production, import and export data. This information is included as a check for combustion-related emissions calculated from the sectoral approach.

The apparent consumption for primary fuels in the reference approach is obtained from 'calculated' energy-use figures (see annex 2 and section A4.4). These are derived as a residual figure from an energy balance equation comprising production, imports, exports, stock change and international transport on the supply side according to the IPCC Guidelines (IPCC, 2006).

The majority of the CO_2 emission factors for the reference approach are specific to New Zealand. Most emission factors for liquid fuels are based on annual carbon content and the gross calorific value data provided by New Zealand's only oil refinery, Refining New Zealand Ltd. Where these data are not available, an IPCC default is used. The natural gas emission factor is based on a production-derived, weighted average of emission factors from all gas production fields. The CO_2 emission factors for solid fuels were updated for the 2014 inventory submission following analysis to verify default emission factors used for the New Zealand Emissions Trading Scheme. For more information on this improvement, see chapter 3, section 3.3.2.

Solid fuels in iron and steel manufacture

As mentioned in chapter 3, section 3.2.3, some of the coal production activity data in the reference approach are used in steel production. The Industrial Processes and Product Use sector accounts for the CO_2 emissions from this coal in the sectoral approach, as recommended by the IPCC Guidelines (IPCC, 2006); therefore they are not included in the common reporting format table 1.AA *Fuel combustion* – sectoral approach.

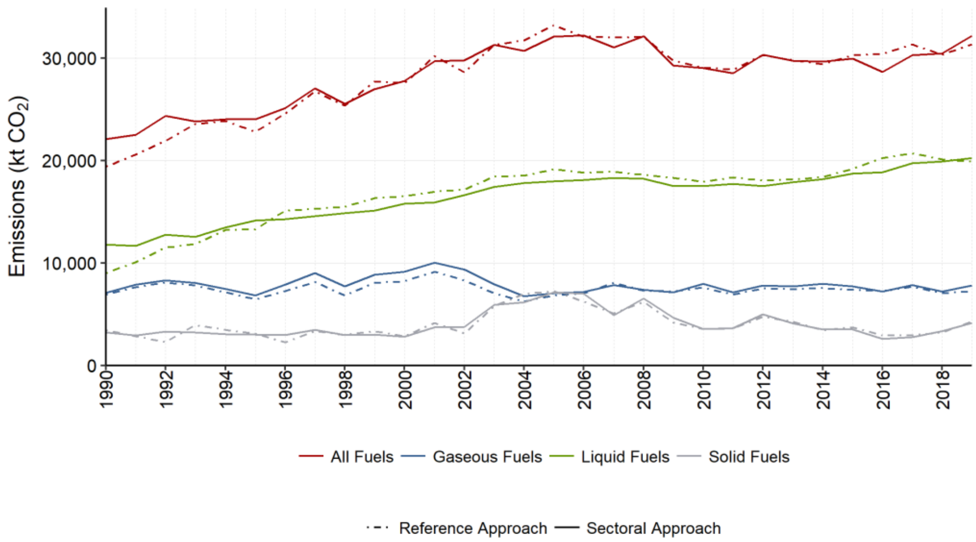
For simplicity, all feedstock carbon is excluded from the reference approach according to the IPCC Guidelines (IPCC, 2006). Without taking into account the use of by-product gases, this can create some discrepancies between the reference and sectoral approaches.

A4.5.2 Comparison of the IPCC reference approach with the New Zealand sectoral methodology

For 2019, CO_2 emissions estimated with the sectoral approach were 2.6 per cent higher than those estimated with the reference approach. Figure A4.1 shows the results for the two approaches for the period 1990 to 2019.

In some years, differences exist between the reference and sectoral approaches. Much of this is due to the statistical differences found in the energy balance tables (MBIE, 2020) that are used as the basis for the reference and sectoral approach. Since 2000, the standard of national energy data has improved significantly, due to increased resources and focus. In 2008, Stats NZ delegated responsibility for the collection and analysis of national energy data to MBIE. Before 2008, various energy statistics were collected by Stats NZ or MBIE. The change resulted in a more consistent and transparent approach to energy data collection because one agency collected data across the supply chain.

Figure A4.1 Reference and sectoral approach carbon dioxide by fuel type (kt CO_2)



Sources of differences

- For gaseous fuels, the field-specific emission factors are used for natural gas supplied for industrial processes, while the reference approach uses an average emission factor.
- For liquid fuels, the energy balance is mass balanced but not carbon balanced. The fuel category 'other oil' is an aggregation of several fuel types, and so it is difficult to quantify a reliable carbon emission factor for the reference approach.
- In the sectoral approach, sector- or even plant-specific calorific values are used to calculate energy consumption, whereas in the reference approach, average (country-specific) calorific values are applied.

Annex 4: References

CRL Energy Ltd. 2009. *Reviewing Default Emission Factors in Draft Stationary Energy and Industrial Processes Regulations: Coal.* Contract report prepared for the Ministry for the Environment. Wellington: Ministry for the Environment.

Eng G, Bywater I, Hendtlass C. 2008. *New Zealand Energy Information Handbook*. Christchurch: New Zealand Centre for Advanced Engineering.

European Environment Agency. 2007. *EMEP/CORINAIR Emission Inventory Guidebook – 2007*. Copenhagen: European Environment Agency.

Hale R, Twomey I. Unpublished. Reviewing default emission factors for liquid fossil fuels adopted by the New Zealand Emissions Trading Scheme. Report by consultants Hale & Twomey Limited prepared for the Ministry for the Environment in 2009.

IPCC. 2006. Eggleston HS, Buendia L, Miwa K, Ngara T, Tanabe K (eds). *2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2. Energy*. IPCC National Greenhouse Gas Inventories Programme. Japan: Institute for Global Environmental Strategies for IPCC.

Ministry of Business, Innovation and Employment. 2020. *Energy in New Zealand 2020*. Wellington: Ministry of Business, Innovation and Employment.

Annex 5: Supplementary information for the KP-LULUCF sector

A5.1 Technical corrections to the FMRL

A5.1.1 Introduction

For the second commitment period, reporting on *Forest management* under the Kyoto Protocol is mandatory. Accounting for *Forest management* during the second commitment period is relative to a forest management reference level (FMRL) (Decision 2/CMP.7, UNFCCC, 2012).

New Zealand's FMRL was initially set at 11.15 million tonnes carbon dioxide equivalent (Mt CO_2-e) on average per year for the period 2013 to 2020 (New Zealand Government, 2011). This value was constructed using a business-as-usual projection of pre-1990 planted forest growth and harvest for the period 2013 to 2020. It was based on yield tables and statistics on the area in each age class of pre-1990 planted forest from the National Exotic Forest Description (NEFD) as at 2009 (Ministry for Primary Industries, 2009).

The 2011 FMRL included the following assumptions:

- pre-1990 natural forests were in steady state
- no pre-1990 planted forest deforestation would occur between 2013 and 2020 (pre-1990 natural forests were excluded from the analyses; post-1989 forest deforestation is reported under Article 3.3 – *Deforestation*)
- between 2013 and 2020, 2,000 hectares per year would be converted to non-forest land, and the equivalent forest would be planted elsewhere (i.e., 2,000 hectares per year would be reported as carbon equivalent forest (CEF) and be accounted for under *Forest management*)
- while harvest of post-1989 planted forest will increase over the period, pre-1990 planted forests will still make up a substantial proportion of total forest harvest
- all carbon is assumed to be instantly emitted at the time of harvest (emissions and removals by the *Harvested wood products* pool were not considered)
- no allowance was made for the impacts of potential natural disturbances beyond background levels captured in the carbon stock yield tables.

The FMRL also reflects the following New Zealand legislation (including amendments) and current policies:

- the Forest Act 1949, which regulates the removal of timber from natural indigenous forests
- the South Island Landless Natives Act 1906, which transferred 17,000 hectares of natural indigenous forest to South Island Māori. The harvesting of this forest is also subject to the Resource Management Act 1991
- the Climate Change Response Act 2002, which makes owners of pre-1990 forest who deforest liable for the emissions associated with that activity

- the New Zealand's biofuels policy of the time (under which it was thought most feedstock for biofuel was likely to be derived from non-forest sources).

It was assumed that this legislation and these policies would prevent any significant deforestation of pre-1990 forests, and that the New Zealand Emissions Trading Scheme would encourage harvest in pre-1990 planted forests over post-1989 forest.

The 2011 FMRL was determined by modelling the pre-1990 planted forest estate using a Forestry-Oriented Linear Programming Interpreter (FOLPI). As mentioned above, the model developed in FOLPI was based on an age-class distribution of pre-1990 planted forest as at 2009 from the NEFD, and simulated expected harvesting and replanting of this forest. Some additional modelling of decay of residues from harvest events was also carried out in MS Excel.

Since the 2011 FMRL was submitted, supplementary guidance has been prepared that describes the circumstances that would trigger a technical correction to the FMRL (IPCC, 2014). Changes to policies that affect harvest rate (as listed above) cannot be corrected for, but corrections can be made to reflect changes to the method for reporting against the FMRL and to address recommendations made by United Nations Framework Convention on Climate Change (UNFCCC) expert review teams (ERTs).

A technical assessment of New Zealand's reference level submission was carried out by an ERT in 2011 (UNFCCC, 2011). The ERT noted a number of items for New Zealand to address either through the provision of additional data or through applying technical corrections. These included (UNFCCC, 2011, pp 6–10):

- maintaining consistency in the fraction of harvested biomass instantaneously oxidised when estimating emissions from harvest in the FMRL and in reporting against it (paragraph 21)
- ensuring consistency between the National Inventory Report (NIR) and the FMRL and, therefore, the updating of the current FMRL when new data or information become available (paragraph 22)
- making efforts to disaggregate gains and losses by biomass pool (paragraph 35);
- providing further information on how forest owners will be able to move from historical and current harvesting practice to the longer rotation length projected in the FOLPI model (paragraph 36)
- explaining in more detail how the difference in both harvested areas and harvesting age as calculated by FOLPI could be achieved (paragraph 36)
- comparing the results provided in its submission with a rerun of the FOLPI model in which the harvesting of over-mature forests (over 32 years of age) is constrained, and modify the reference level accordingly if necessary (paragraph 36)
- if estimates for natural forests are included in future NIR submissions, making a technical adjustment of the FMRL (paragraph 37)
- agreeing that in the future a technical correction should be made to incorporate the *Harvested wood products* pool (paragraph 38).

A5.1.2 Technical corrections required

For the 2016 submission, the following technical corrections were made to meet IPCC guidance and address recommendations by the UNFCCC ERT. These aimed to:

1. ensure consistency between the method used for greenhouse gas reporting of *Forest management* and that used to calculate the FMRL (Kyoto Protocol Supplement, IPCC, 2014, sections 2.7.5.2 and 2.7.6). This involved making changes to:
   a. align forest area estimates
   b. align CEF emissions calculation methods
   c. include overplanting estimates (pre-1990 natural forest conversions to pre-1990 planted forest)
   d. include non-carbon emissions
2. include an estimate for pre-1990 natural forest emissions following completion of the re-measurement of the pre-1990 natural forest inventory and subsequent analysis
3. address new elements of Decision 2/CMP.7 including
   a. accounting for *Harvested wood products*
   b. the application of the natural disturbances provision.

For the 2019 submission, an additional technical correction was applied to the FMRL to capture recent improvements to the *Harvested wood products* estimates on exported, unprocessed logs.

Another technical correction was applied to the 2021 submission. The technical correction was made to address a number of methodological inconsistencies between emissions estimated for *Forest management* and those used to calculate the FMRL, including:

1. aligning pre-1990 natural forest methods
2. aligning the pre-1990 planted forest yield tables
3. correcting a model assumption to align the harvesting projections with the *Harvested wood products* estimates
4. correcting the background disturbance level and aligning this calculation with the FMRL.

Technical corrections: Addressing methodological inconsistencies between the 2011 FMRL and *Forest management* reporting

The first step taken to calculate technical corrections to the FMRL was to replicate the FMRL as submitted in 2011, applying the same policy assumptions, but using the reporting system and historical data that are used to report on *Forest management* in the inventory.

This technical correction addresses two of the findings of the technical assessment (listed above) by:

1. maintaining consistency in the fraction of harvested biomass instantaneously oxidised
2. ensuring consistency between the emissions reported in the inventory for *Forest management* and the FMRL.

This is achieved by using the harvest and deforestation data from 1990 to 2008 from the 2013 inventory (Ministry for the Environment, 2015) as the starting point for the revised projections. Harvesting and deforestation areas for 2009 to 2020, sourced from the Ministry for Primary Industries, are the same as those used for the 2011 FMRL. The first year of projected data within New Zealand’s 2011 FMRL submission was 2009, as data were required to be projected forward from 2009 to enable the projections for the 2013 to 2020 period to be made.

Minor adjustments were made to these data as outlined below.

- The forest area estimate was aligned to match it to the area of forest that is included under the definition of forest used for UNFCCC reporting.
- Pre-1990 harvesting data (average harvest age) from 2009 to 2020 have been altered from those used in the 2011 FMRL. The average age at harvest has been adjusted down to 28 years, to address the issue raised by the ERT in its technical assessment of the 2011 FMRL. The area of harvest, however, has been kept the same.
- The age distribution of plantation forest under *Forest management* was incorrectly assumed for *Forest land* prior to 2010. We know this because the age-class of *Forest land* harvested post 2010 would not have been possible had our harvest age assumptions made for the FMRL projection been correct. A technical correction to the forest age harvest assumptions needed to be made because otherwise there would be a methodological inconsistency between the age-classes being harvested under *Forest management* and the input age-class data used for the FMRL projection. This technical correction is made in alignment with 2013 Kyoto Protocol Supplement, section 2.7.5.2, page 2.97, item (ii). Note that this text has been revised to address ERT review comment KL.13, 2019 (FCCC/ARR/2019/NZL, UNFCCC, 2019).
- Changes to CEF reporting were made to reflect updated guidance for this reporting released after the 2011 FMRL submission.

Aligning forest area estimates

The 2011 FMRL submission was based on data derived from the NEFD (Ministry for Primary Industries, 2015). The NEFD is an annual survey of forest owners that represents the 'net stocked area' of the planted production forest estate established with the primary intention of producing wood or fibre. The Land Use and Carbon Analysis System (LUCAS) that is used for reporting emissions for *Forest management* in the inventory uses complete wall-to-wall mapping to estimate forest area. This means LUCAS maps to a 'gross stocked area' where harvested areas, skid sites, forest roads and unstocked gullies are included in the mapped forest area. This gross stocked area is also the basis for the national sampling system used for deriving emission factors for the *Forest land* use classes. For modelling emissions for reporting under the UNFCCC, LUCAS has isolated the net stocked area from the mapped gross stocked area so the modelled area is compatible between the two data sources (LUCAS and NEFD). The LUCAS gross stocked area of pre-1990 planted forest area is 1.47 million hectares as at 2009. The LUCAS net stocked area, as at 2009, is estimated to be 1.25 million hectares (a 12.4 per cent difference). This compares with 1.14 million hectares from the NEFD as at 2009. Because the 2011 FMRL did not take into account differences in the data sources due to the two purposes for which the data are collected, a technical correction is required to correct the original NEFD-based FMRL to the LUCAS mapped area estimates used for reporting for *Forest management*.

The need for this adjustment extends to estimates of the area of CEF and deforestation, meaning these original net stocked area values need to have an unstocked area component added to them (the same adjustment of 12.4 per cent is used). The harvest areas, however, remain unchanged because both approaches harvest a net stocked area.

Harvest data

Pre-1990 planted forest harvesting uses projections from 2009 to 2020 at an average age of (approximately) 28 years (see table A5.1.1). This is to address the issue raised by the ERT that harvest ages in the projection were older than those observed historically and there were no policies in place that would influence rotation length or change the average harvest ages of planted forests. While the average harvest ages used for the technical correction do not match, the harvest areas match the 2011 FMRL harvest areas.

Table A5.1.1 Pre-1990 planted forest data used to estimate emissions for the technically corrected FMRL

Year	Pre-1990 planted forest deforestation (kha)	Pre-1990 planted forest harvested (kha)	Pre-1990 planted forest harvest average age (years)
1990	–	19.369	28.0
1991	–	19.883	28.0
1992	–	22.639	28.0
1993	–	23.275	28.0
1994	–	25.000	28.0
1995	–	29.275	28.0
1996	–	31.250	28.0
1997	–	32.175	28.0
1998	–	31.575	28.0
1999	–	34.075	28.0
2000	2.305	35.551	28.0
2001	2.225	39.371	28.0
2002	1.616	46.149	28.0
2003	3.137	40.428	28.0
2004	6.777	33.867	28.0
2005	13.186	27.198	28.0
2006	16.596	27.036	28.0
2007	22.022	22.175	28.0
2008	4.103	37.243	28.0
2009	2.389	29.218	27.8
2010	2.383	33.086	28.4
2011	2.396	37.479	28.2
2012	2.378	41.354	27.8
2013	2.378	46.112	27.7
2014	2.247	50.021	27.8
2015	2.247	49.697	28.0
2016	2.247	49.724	28.1
2017	2.247	50.018	28.5
2018	2.247	49.967	28.9
2019	2.247	45.817	29.8
2020	2.247	43.817	28.9

Carbon equivalent forests

The method used to calculate the emissions from the application of CEF in the 2011 FMRL was inconsistent with the provisions of Decision 2/CMP.7 (UNFCCC, 2012) and the guidance for reporting (Kyoto Protocol Supplement, IPCC, 2014). The correct method for calculating emissions for CEF is to model the events by applying the same methods as would apply to deforestation and afforestation events but report all emissions (and removals) under *Forest management*.

Carbon equivalent forest harvested and converted

The estimate for carbon equivalent forest harvested and converted (CEF_{hc}) included in the technical correction uses projections of land-use change from 2009 to 2020 at an average age of (approximately) 28 years and at the rate of 2,247 hectares per annum (the net stocked area from the 2011 FMRL of 2,000 hectares, plus an unstocked proportion of 247 hectares, which contains a much lower carbon stock as explained above under 'Aligning forest area estimates').

Carbon equivalent forest newly established

Carbon equivalent forest newly established (CEF_{ne}) land is replanted at an equivalent annual area (2,000 hectares net stocked area plus 247 hectares that is unstocked), and the post-1989 planted forest yield table is applied to the net stocked area. The post-1989 planted forest yield table is deemed appropriate because the new forest is established on *Grassland* and the history of this newly planted land is most similar to post-1989 planted forest land.

In the technical correction to the FMRL, CEF land is modelled as going to and coming from the three *Grassland* types (low producing grassland, high producing grassland and grassland with woody biomass) in equal amounts. Soil emissions resulting from conversion and establishment of CEF land are also now included in the FMRL.

Overplanting

The 2011 FMRL did not model emissions from overplanting that occurs on *Forest management* land. This activity occurs when pre-1990 natural forest is converted to planted forest. Overplanting has been occurring since 1990, as demonstrated in the common report format (CRF) data. The system used for national greenhouse gas reporting for the sector reports the area and emissions associated with that practice within the *Forest management* category. Overplanting should have been captured in the original FMRL projection but was omitted due to an error. There has been no management practice change that has encouraged overplanting to develop over the reporting period. To maintain consistency with *Forest management* reporting, a technical correction was applied. This technical correction results in the addition of 0.039 kilotonnes carbon dioxide (kt CO_2) emissions to the annual estimate of emissions in the FMRL. Note that this text has been revised to address review recommendation KL.14, 2019 (FCCC/ARR/2019/NZL, UNFCCC, 2019).

Non-carbon emissions

Non-carbon emissions were not included in the 2011 FMRL submission; therefore, a technical correction is required to include these emissions. Non-carbon emissions are estimated based on the average controlled burning from 1990 to 2009 and the minimum historical level for wildfire.

Controlled burning

Emissions from the burning of pre-1990 planted forest harvest residues are now included. The harvest rate is as per the FMRL, and the proportion burned is that applied to the LULUCF *Forest land remaining forest land* category during the first commitment period of the Kyoto Protocol.

Burning of residues associated with conversions of pre-1990 natural forest to pre-1990 planted forest are included and are assumed to occur at the same rate as reported during the first commitment period.

Wildfire emissions

Wildfires are hard to predict and are influenced by inter-annual climatic conditions and regional drought. To estimate emissions from wildfire, the default methodology described in the Kyoto Protocol Supplement, IPCC, 2014, section 2.3.9.6 has been applied:

> the value of the mean [of natural disturbance time series data] plus two times the standard deviation is calculated using the entire time series of data in the calibration period. Any outlier value (ie above mean plus two times the standard deviation) is removed. This process is repeated until there are no outliers.

The default method calibration period has been applied between 1990 and 2009. This approach is taken to be consistent with New Zealand's background level of natural disturbance.

Nitrous oxide emissions

It is assumed that there are no nitrous oxide emissions from fertilisation of forests within the FMRL. These are minor and captured within the Agriculture sector.

Natural disturbance

Emissions from natural disturbance events were not originally considered in the calculation of the 2011 FMRL. New Zealand has reported its intention to apply the natural disturbance provision, and, for *Forest management*, the background level has been set using the default method described in section 2.3.9.6 of the Kyoto Protocol Supplement (IPCC, 2014). This is included in the estimate of the non-carbon emissions as described above.

However, emissions from, and associated with, salvage logging cannot be excluded from accounting during the second commitment period.[3] This means that, when developing the natural disturbance background level, historical emissions from natural disturbances should exclude these emissions. New Zealand has not excluded these emissions from the historical data used to calculate its background level of natural disturbance emissions under its technically corrected FMRL. If New Zealand applies the provision to exclude emissions from natural disturbances from its accounting, the background level will then be adjusted to remove these salvage logging emissions.

Pre-1990 planted forest

To improve the accuracy of the *Forest management* emissions estimates, multiple yield tables have been applied to the pre-1990 planted forest estate in the 2021 submission. Previously only one yield table was applied to all pre-1990 planted forest. However, due to improved genetics and management practices, a single yield table was found not to be representative of the entire pre-1990 planted forest estate. Therefore, in the 2021 submission three yield tables have been applied: one for all years prior to 1990; one for 1990 to 2009; and a third for 2010 to 2019.

The application of multiple yield tables to the pre-1990 planted forest estate creates an inconsistency between the methods used to calculate *Forest management* emissions and those used to calculate the FMRL. Therefore, a technical correction is required. The FMRL has been corrected using two yield tables for the pre-1990 planted forest estate: one for all years

3 Paragraph 33(c) of annex to Decision 2/CMP.7 contained in document FCCC/KP/CMP/2011/10/Add.1, p 18.

prior to 1990; and one for 1990 to 2009. The third yield table, 2010 to 2019, has not been included in the FMRL technical correction, as it includes developments in management practices that would not have been known at the time of the FMRL construction. Therefore, the projected FMRL from 2009 onwards uses the 1990 to 2009 yield table.

Pre-1990 natural forest

Emissions and removals by pre-1990 natural forest were not included in the 2011 FMRL submission. Because pre-1990 natural forest is now included in New Zealand's reporting of emissions for *Forest management* land, a technical correction is required. The rate of carbon change used for this technical correction is consistent with that reported from 1990 to 2013 in the 2015 inventory.

When projections of pre-1990 natural forest emissions are incorporated into the technically corrected FMRL, the area under *Forest management* is reduced to factor in the projected deforestation of these forests. This deforested land will be reported under Article 3.3 – *Deforestation*. The business-as-usual projection of pre-1990 natural forest deforestation is based on the historical rate seen between 1990 and 2009.

In the 2020 submission, an updated, improved method to measure stock change in natural forests was applied. This updated methodology was not applied to the methodology used to calculate the FMRL. This methodological inconsistency between the methods used to calculate the pre-1990 natural forest under *Forest Management* and that used in the FMRL has been addressed in the 2021 submission, resulting in a correction of –2.711 Mt CO_2-e yr^{-1} to the FMRL.

Harvested wood products

Emissions and removals for the *Harvested wood products* pool were not included in the 2011 FMRL submission. The technical correction for this uses the same spreadsheet model as that used for New Zealand's *Forest management* reporting with minor modifications, in order to enable reporting to 2020. The technical correction made reflects that there were no government policies either in place, or being planned, that would increase wood use and/or domestic production between 2013 and 2020.

To estimate emissions from harvested wood products from 2013 to 2020, the activity data time series was investigated for trends from 1990 to 2009. Production of products with relatively flat trends through the time series (i.e., pulp and paper) was held at 2009 rates between 2009 and 2020, and products whose production had been increasing over the period (i.e., panels and sawn wood) were increased at the projected rate of population increase (1 per cent; sourced from Stats NZ). Changes in the harvesting rate between 2013 and 2020 have no impact on the production of domestic harvested wood products because wood that is not processed in New Zealand is assumed to be exported.

Previously, exported harvested wood products were not considered in the FMRL. In the 2016 NIR (2018 submission), New Zealand revised its harvested wood products model to include products made from exported logs based on an export markets study. This investigated the use and discard rate of harvested wood products produced from raw materials of New Zealand origin. The inclusion of exported harvested wood products is in line with paragraph 27 of Decision 2/CMP.7 and follows the methodology provided for in table 12.1, chapter 12, volume 4 of the 2006 IPCC Guidelines.

To ensure consistency between the method used for greenhouse gas reporting of exported harvested wood products derived from *Forest management* activities and that used to calculate the FMRL (Kyoto Protocol Supplement, IPCC, 2014, sections 2.7.5.2 and 2.7.6), a technical correction was applied to the FMRL in the 2019 submission.

However, the inclusion of exported harvested wood products in the FMRL calculation considered that the volume of this export commodity would not change. A technical correction has been applied to the 2021 submission to correct this assumption. This correction has been applied to ensure methodological consistency between the emissions reported under *Forest management* and those used to calculate the FMRL. The FMRL projects that harvesting under *Forest management* increases through time. Given the capacity for domestic production of harvested wood products is limited, it should have been assumed that an increase in harvest would therefore lead to an increase in exported harvested wood products. This assumption has been corrected.

Harvested wood products from pre-1990 natural forest are excluded. The volume produced from the harvesting of pre-1990 natural forests is less than 0.1 per cent of New Zealand's total harvest volume (Ministry for Primary Industries, 2015).

A5.1.3 Technical corrections and their impact

The impact of the technical corrections made in the 2016, 2019 and 2021 submissions to the FMRL is summarised in table A5.1.2.

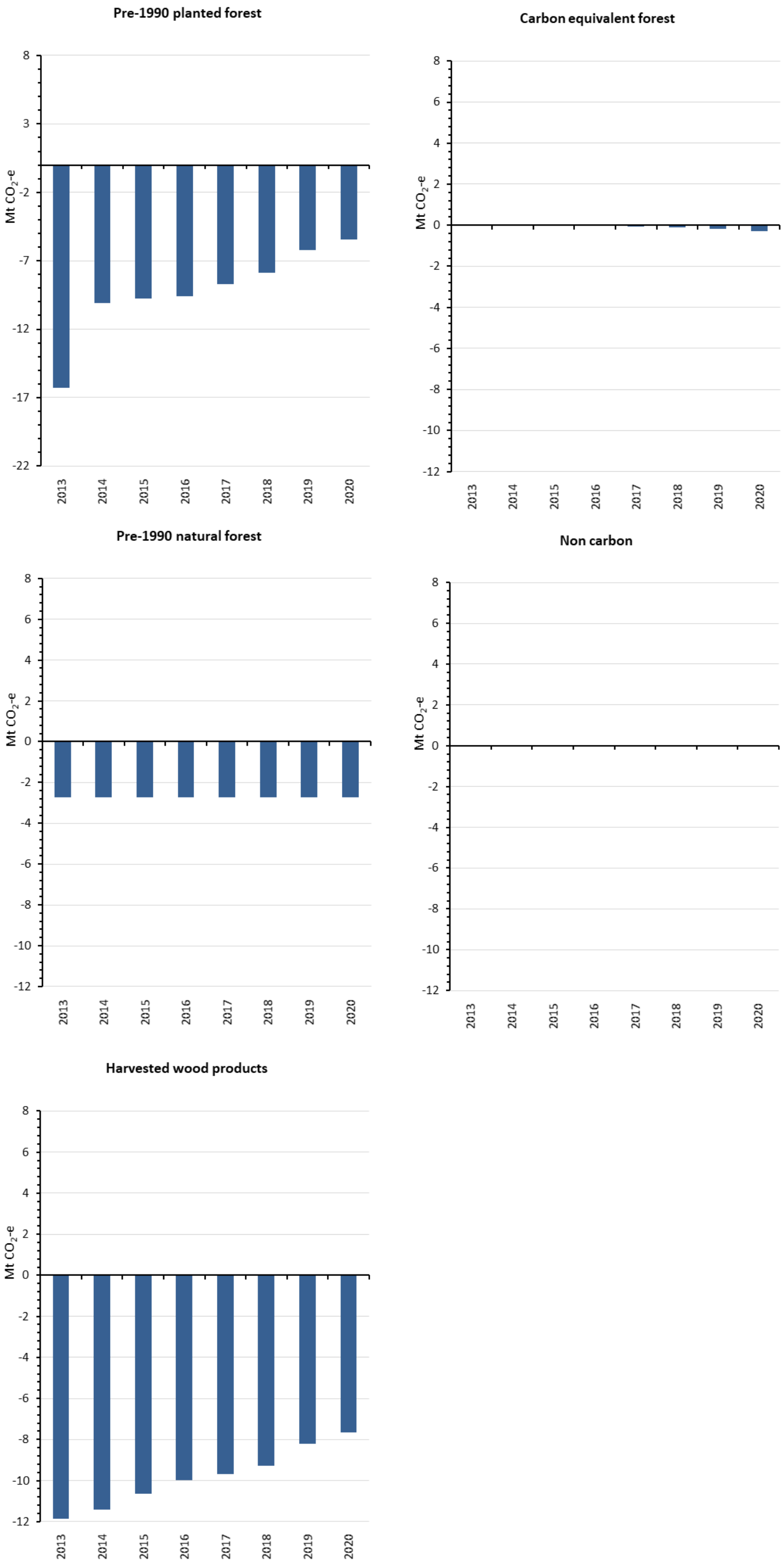
Table A5.1.2 Summary of the technical corrections to the FMRL

	Emissions (Mt CO_2-e yr^{-1})
FMRL	**11.150**
Technical corrections	
Carbon equivalent forest (CEF)	–0.074
Pre-1990 planted forest	–9.245
Non-carbon (including natural disturbance)	0.009
Pre-1990 natural forest	–2.711
Harvested wood products	–9.839
Sum of technical corrections	**–21.860**
$FMRL_{corr}$	**–10.710**

Note: FMRL = forest management reference level; $FMRL_{corr}$ = technically corrected forest management reference level.

Figure A5.1.1 provides a breakdown of the various components of the technical corrections over the time series.

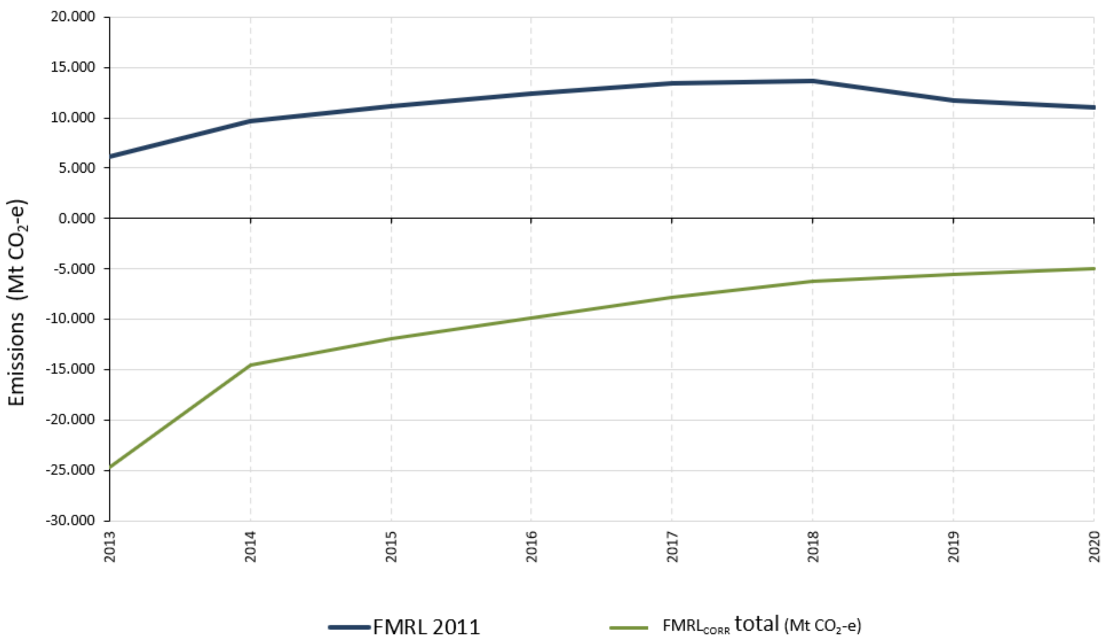
Figure A5.1.1 Technical corrections to the FMRL by category



Note: Non-carbon emissions are 0.009 Mt CO_2-e per year, which is too small to display at this scale. FM = forest management; FMRL = forest management reference level.

Figure A5.1.2 provides a comparison of recalculated estimates with previous estimates. This illustrates the time-series consistency of the estimates.

Figure A5.1.2 Comparison of the 2011 FMRL and total of technical corrections over the period to 2020



Note: FMRL = forest management reference level; $FMRL_{CORR}$ = technically corrected forest management reference level.

A5.2 Natural disturbance

New Zealand has chosen to apply the default method described in section 2.3.9.6 of the Kyoto Protocol Supplement (IPCC, 2014) for calculating its background level of natural disturbances for both *Afforestation and reforestation* and *Forest management*. This method has been applied following ERT recommendation KL.10, 2019 (FCCC/ARR/2019/NZL, UNFCCC, 2019).

Types of natural disturbances New Zealand intends to exclude from the accounting are:

- wildfires
- invertebrate and vertebrate pests and diseases
- extreme weather events
- geological disturbances.

In all cases except fire, New Zealand assumes a zero baseline between 1990 and 2009. While other natural disturbance events occurred throughout the calibration period, assumptions were made for the purposes of calculating the background level.

For planted forests reported under *Afforestation and reforestation* and *Forest management*, salvage logging is considered to take place in all disturbed forests.

In the case of pre-1990 natural forests, the ground plot measurement programme captures emissions from natural disturbances implicitly, and the emissions from natural disturbance events, apart from wildfires, cannot be separated from other disturbance events. The stock change estimates reported for natural forests include background levels of small-scale natural disturbance events.

Only direct oxidation of biomass in wildfires is considered for the purposes of calculating a background level of natural disturbance for both *Afforestation and reforestation* and *Forest management* land, regardless of forest type. The data used are as reported under the UNFCCC for the period 1990 to 2009 (see chapter 6, section 6.11.5).

A5.2.1 Afforestation and reforestation

New Zealand may choose to apply the provision for the treatment of natural disturbance emissions to its *Afforestation and reforestation* accounting (Ministry for the Environment, 2015). Due to the nature of *Afforestation and reforestation* accounting and reporting methods, the background level of carbon dioxide emissions from natural disturbance is already captured implicitly within the reported estimates. New Zealand separately estimates and reports the non-carbon emissions from natural disturbances. The background level has been calculated using the default method described in section 2.3.9.6 of the Kyoto Protocol Supplement (IPCC, 2014). However, both the post-1989 forest area and the carbon stock increase during the calibration period. To account for the annual change, background level for the calibration period is calculated as a proportion of the post-1989 forest estate. This proportion is then multiplied by the carbon stock in post-1989 forest for each year in the reporting period (2013 to 2020). This approach provides the background level and corrects for the increasing area and age (and therefore carbon stock exposed to natural disturbance) in post-1989 forests.

The *Afforestation and reforestation* background level for 2019 was 2.414 kilotonnes carbon dioxide equivalent (kt CO_2-e).

Avoiding the expectation of net credits or net debits for the application of the natural disturbance provision: Afforestation and reforestation

The background level is calculated using the default methodology described in section 2.3.9.6 of the Kyoto Protocol Supplement (IPCC, 2014). The proportion from the calibration period is then multiplied by the carbon stock in post-1989 forest for each year in the reporting period (2013 to 2020). This approach is taken because:

- a trend is observed in natural disturbance emissions during the calibration period for *Afforestation and reforestation*. Emissions from natural disturbances have been increasing throughout the calibration period as the age of these forests and, therefore, biomass increase through time. This trend has continued during the second commitment period. The calibration period was used to obtain an annual emissions value by proportion of carbon stocks and then used to calculate the background level for the 2013 year onwards, based on the carbon stocks of *Afforestation and reforestation* lands in each year
- gross:net accounting applies to *Afforestation and reforestation* activities. Emissions from natural disturbances occurring during any year of the commitment period, which fall below the background level, are not excluded from the accounting. Emissions from natural disturbances that are greater than the background level in any year of the commitment period are able to be excluded from the accounting if a Party chooses
- if emissions from natural disturbances are greater than the background level, they can be excluded from the accounting and there is no expectation of net debits arising. If emissions are less than the background level in any year of the commitment period, all emissions from natural disturbance will still be accounted for. There is no expectation of net debits in this scenario. Under gross:net accounting for *Afforestation and reforestation* activities, it would not be possible to expect net credits when applying this approach to excluding the emissions from natural disturbances.

A5.2.2 Forest management

The background level of natural disturbance for *Forest management* was calculated as 9.249 kt CO_2-e.

Avoiding the expectation of net credits or net debits for the application of the natural disturbance provision: Forest management

The background level has been calculated using the default methodology described in section 2.3.9.6 of the Kyoto Protocol Supplement (IPCC, 2014). Using this method, the expectation of net credits or net debits for the application of the natural disturbance provision is avoided because:

- there is no observed trend in natural disturbance emissions during the calibration period for *Forest management* and therefore none can be expected during the second commitment period
- any emissions from natural disturbances during the commitment period that fall below the background level are not excluded from the accounting. During the commitment period, emissions from natural disturbances that are above the background level are, subject to New Zealand's discretion, able to be excluded from the accounting
- the accounting for *Forest management* is against a projected business-as-usual FMRL. The background level is included implicitly within the FMRL, and any emissions greater than the background level can be excluded from the accounting.

A5.3 Carbon equivalent forests

Information on carbon equivalent forests is provided in aggregated form in CRF table 4(KP-I)B.1.2. Details of each application that make up the reported estimates are provided in table A5.3.1.

Table A5.3.1 Breakdown of carbon equivalent forests by domestic scheme application from 2014 to 2019

Scheme ID	Management type	2014	2015	2016	2017	2018	2019
CEF – 31	Newly established (ha)	–	–	–	–	10.19	–
	Harvested and converted (ha)	–	–	–	7.17	–	–
	Net change (tC)	–	–	–	–1.81	–0.02	0.00
CEF – 20	Newly established (ha)	–	–	–	14.47	–	–
	Harvested and converted (ha)	–	7.69	–	–	–	–
	Net change (tC)	–	–1.67	0.01	–0.04	–0.00	0.01
CEF – 11	Newly established (ha)	–	–	–	771.43	992.04	–
	Harvested and converted (ha)	3.36	76.81	409.17	488.34	235.11	9.37
	Net change (tC)	–0.74	–16.49	–87.87	–124.05	–58.41	–1.87
CEF – 25	Newly established (ha)	–	–	–	–	279.64	–
	Harvested and converted (ha)	–	–	–	79.63	–	5.24
	Net change (tC)	–	–	–	–20.16	–0.42	–1.37
CEF – 3	Newly established (ha)	–	–	189.93	–	247.19	–
	Harvested and converted (ha)	42.96	373.95	1.43	–	–	–
	Net change (tC)	–9.21	–80.52	0.17	0.19	0.50	0.37

Scheme ID	Management type	2014	2015	2016	2017	2018	2019
CEF – 17	Newly established (ha)	–	–	–	8.61	–	–
	Harvested and converted (ha)	–	–	6.60	–	–	–
	Net change (tC)	–	–	–1.43	–0.07	0.00	0.01
CEF – 36	Newly established (ha)	–	–	–	–	–	225.10
	Harvested and converted (ha)	–	–	104.12	59.62	32.65	–
	Net change (tC)	–	–	–22.62	–15.03	–8.16	0.37
CEF – 35	Newly established (ha)	–	–	–	–	–	9.72
	Harvested and converted (ha)	–	6.11	–	–	–	–
	Net change (tC)	–	–1.32	0.00	0.00	0.00	0.01
CEF – 15	Newly established (ha)	–	–	–	194.01	–	–
	Harvested and converted (ha)	–	–	47.83	89.18	–	–
	Net change (tC)	–	–	–10.38	–24.11	0.07	0.18
CEF – 2	Newly established (ha)	–	–	–	302.95	–	–
	Harvested and converted (ha)	5.70	62.70	148.37	56.57	27.28	–
	Net change (tC)	–1.22	–13.40	–31.69	–16.83	–6.75	0.35
CEF – 24	Newly established (ha)	–	–	–	22.47	–	–
	Harvested and converted (ha)	–	–	–	17.89	–	–
	Net change (tC)	–	–	–	–4.52	0.00	0.01
CEF – 40	Newly Established (ha)	–	–	–	–	–	36.57
	Harvested and Converted (ha)	–	–	–	36.08	–	–
	Net change (tC)	–	–	–	–9.13	0.02	–0.21
CEF – 38	Newly established (ha)	–	–	–	–	–	11.35
	Harvested and converted (ha)	–	–	–	10.37	–	–
	Net change (tC)	–	–	–	–2.62	0.01	–0.08
CEF – 42	Newly established (ha)	–	–	–	–	–	86.55
	Harvested and converted (ha)	–	–	–	–	82.96	–
	Net change (tC)	–	–	–	–	–21.00	–0.03
CEF – 43	Newly established (ha)	–	–	–	–	–	49.57
	Harvested and converted (ha)	–	–	–	–	–	41.78
	Net change (tC)	–	–	–	–	–	–10.75
CEF – 39	Newly established (ha)	–	–	–	–	–	135.53
	Harvested and converted (ha)	–	–	7.58	103.48	–	–
	Net change (tC)	–	–	–1.65	–26.19	0.07	–0.17
CEF – 44	Newly established (ha)	–	–	–	–	–	20.75
	Harvested and converted (ha)	–	–	–	–	19.63	–
	Net change (tC)	–	–	–	–	–4.97	0.03
CEF – 9	Newly established (ha)	–	–	26.15	–	–	–
	Harvested and Converted (ha)	–	4.01	19.49	–	–	–
	Net change (tC)	–	–0.86	–4.14	0.00	0.02	0.04
CEF – 13	Newly established (ha)	–	–	111.53	–	–	–
	Harvested and converted (ha)	–	1.61	106.49	–	–	–
	Net change (tC)	–	–0.35	–22.65	0.02	0.08	0.19
CEF – 12	Newly established (ha)	–	–	168.21	–	–	–
	Harvested and converted (ha)	–	–	167.54	–	–	–
	Net change (tC)	–	–	–35.69	0.03	0.13	0.28

Scheme ID	Management type	2014	2015	2016	2017	2018	2019
CEF – 21	Newly established (ha)	–	–	–	180.17	–	–
	Harvested and converted (ha)	–	1.78	67.81	104.54	–	–
	Net change (tC)	–	–0.38	–14.50	–26.23	0.03	0.13
CEF – 41	Newly established (ha)	–	–	–	–	–	4.58
	Harvested and converted (ha)	–	–	–	–	6.78	–
	Net change (tC)	–	–	–	–	–1.72	0.01
CEF – 14	Newly established (ha)	–	–	–	153.61	–	–
	Harvested and converted (ha)	–	2.42	148.44	–	–	–
	Net change (tC)	–	–0.53	–32.19	0.14	0.03	0.12
CEF – 18	Newly established (ha)	–	–	–	–	130.00	–
	Harvested and converted (ha)	–	5.00	124.80	–	–	–
	Net change (tC)	–	–1.09	–27.11	0.09	–0.07	0.03
TOTAL	**Newly established (ha)**	–	–	612.34	1,685.68	1,795.02	579.73
	Harvested and converted (ha)	52.02	543.40	1,470.80	1,181.27	404.40	56.39
	Net change (tC)	–11.17	–116.89	–315.71	–302.84	–100.36	–12.12

Note: CEF = carbon equivalent forest; ha = hectares; tC = tonnes carbon.

Annex 5: References

IPCC. 2006. Eggleston HS, Buendia L, Miwa K, Ngara T, Tanabe K (eds). *2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4. Agriculture, Forestry and Other Land Use*. IPCC National Greenhouse Gas Inventories Programme. Japan: Published for the IPCC by the Institute for Global Environmental Strategies.

IPCC. 2014. Hiraishi T, Krug T, Tanabe K, Srivastava N, Baasansuren J, Fukuda M, Troxler TG (eds). *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol*. Switzerland: IPCC.

Ministry for Primary Industries. 2009. *National Exotic Forest Description as at 1 April 2009*. Wellington: Ministry for Primary Industries.

Ministry for Primary Industries. 2015. *Log and Roundwood Removal Statistics*. Retrieved from: www.mpi.govt.nz/news-and-resources/statistics-and-forecasting/forestry (July 2015).

Ministry for the Environment. 2015. *New Zealand's Greenhouse Gas Inventory 1990–2013*. Wellington: Ministry for the Environment.

New Zealand Government. 2011. *Forest Management Reference Level Submission*. Retrieved from unfccc.int/files/meetings/ad_hoc_working_groups/kp/application/pdf/newzealand_frml.pdf (22 February 2016).

UNFCCC. 2011. *Report of the technical assessment of the forest management reference level submission of New Zealand submitted in 2011*. Retrieved from http://unfccc.int/ resource/docs/2011/tar/nzl01.pdf (22 February 2016).

UNFCCC. 2012*. Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its seventh session, held in Durban from 28 November to 11 December 2011: Addendum – Part 2: Action taken by the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol at its seventh session*. FCCC/KP/CMP/2011/10/Add.1.

UNFCCC. 2019. *Report on the individual review of the annual submission of New Zealand submitted in 2019. Note by the expert review team*. FCCC/ARR/2019/NZL.

Annex 6: Additional information on the inventory system and completeness

A6.1 Quality assurance and quality control processes

The quality assurance and quality control (QA/QC) processes have a significant role in the preparation of the inventory, to ensure the core principles of transparency, accuracy, completeness, comparability and consistency are achieved. Table A6.1.1 describes the main QA/QC processes used in the preparation of the inventory. These processes are under continual review and improvement to ensure they are fit for purpose.

Table A6.1.1 Quality assurance and quality control processes used in preparation of the inventory

ID	QA/QC process or activity description
QA file	All external reviews of the whole or part of the inventory are documented in the QA file. Reviews are performed by qualified personnel, and the review records are included in the submission of the inventory to the United Nations Framework Convention on Climate Change. These reviews help identify improvements to the inventory.
QC 1	Planned recalculations and improvements are approved by the reporting governance group that oversees all climate change reporting by the New Zealand Government. The role of this group is further described in chapter 1.
QC 2	Planned improvements are peer reviewed before being implemented, when they affect the emission factor, parameter, methodology or activity data source. Some sectors have a dedicated panel of experts that review improvements.
QC 3	Tier 1 checklist QC sheets are completed to ensure transparency, accuracy, completeness, comparability and consistency principles are met. Examples are included in the submission of the inventory.
QC 4	The chapter text for each sector is peer reviewed and follows the checklist provided, to ensure that the peer review is comprehensive and consistent.
QC 5	Recalculations that exceed a certain threshold (see figure A6.1.1) are analysed and clearly documented. This includes changes resulting from planned improvements, errors, recommendations from the expert review team, and changes to guidelines.
QC 7	All sectors in the inventory are approved by the applicable member of the reporting governance group that oversees all international climate change reporting by the New Zealand Government before being submitted to the National Inventory Compiler.
QC 10	Common reporting format QC tools identify any potential issues with the data and are used to ensure the data integrity standards are met.
Sector submission checks	Sector submissions are checked against the data integrity standards and chapter formatting standards by the inventory agency before sector submission. Any issues must be resolved before submitting. This enables the remainder of the inventory compilation to proceed smoothly because quality is assured.

Figure A6.1.1 shows how these QA/QC processes align with the overall preparation of the inventory.

Figure A6.1.1 How the quality assurance and quality control processes and products align with the preparation of the inventory

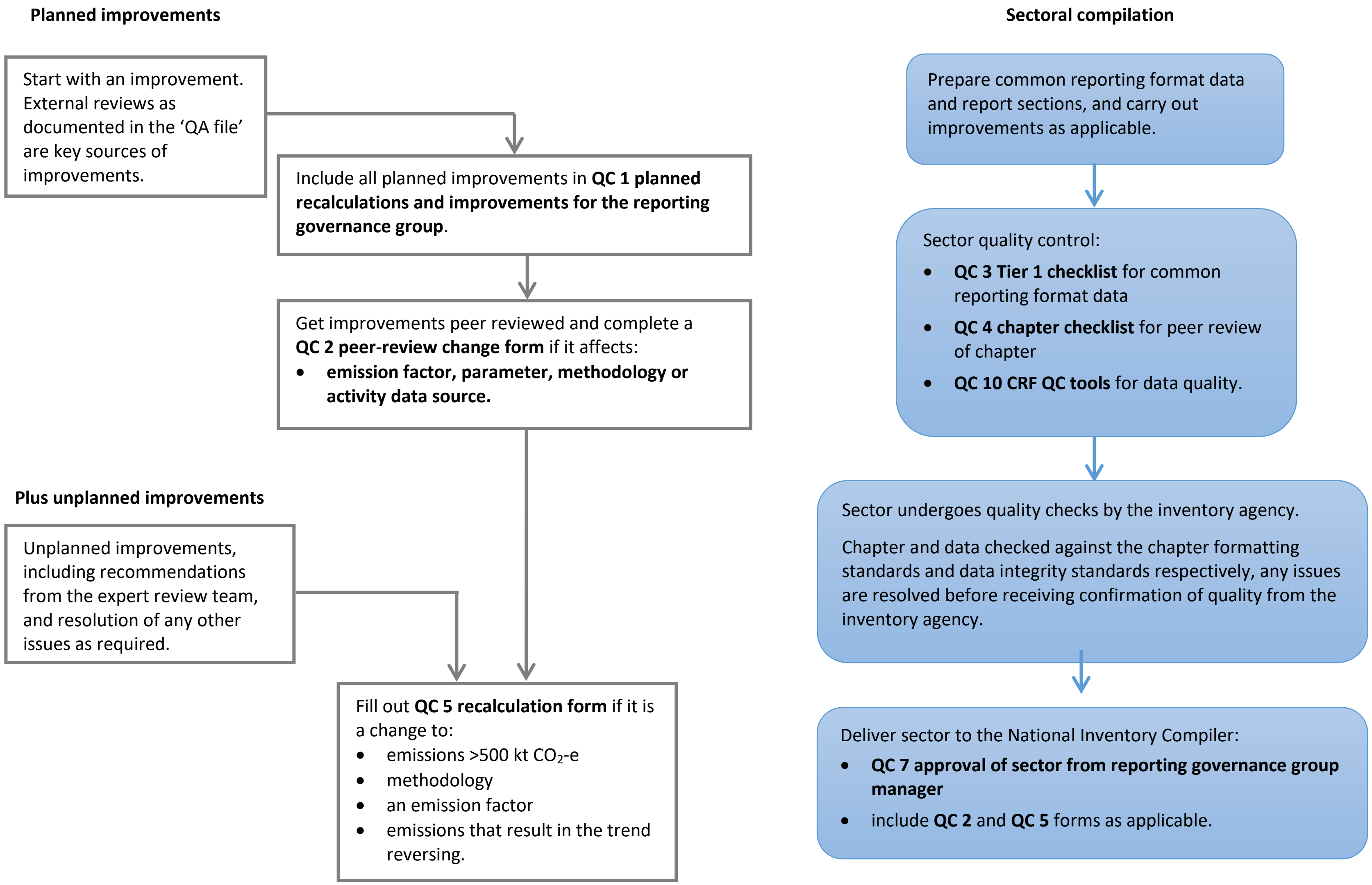
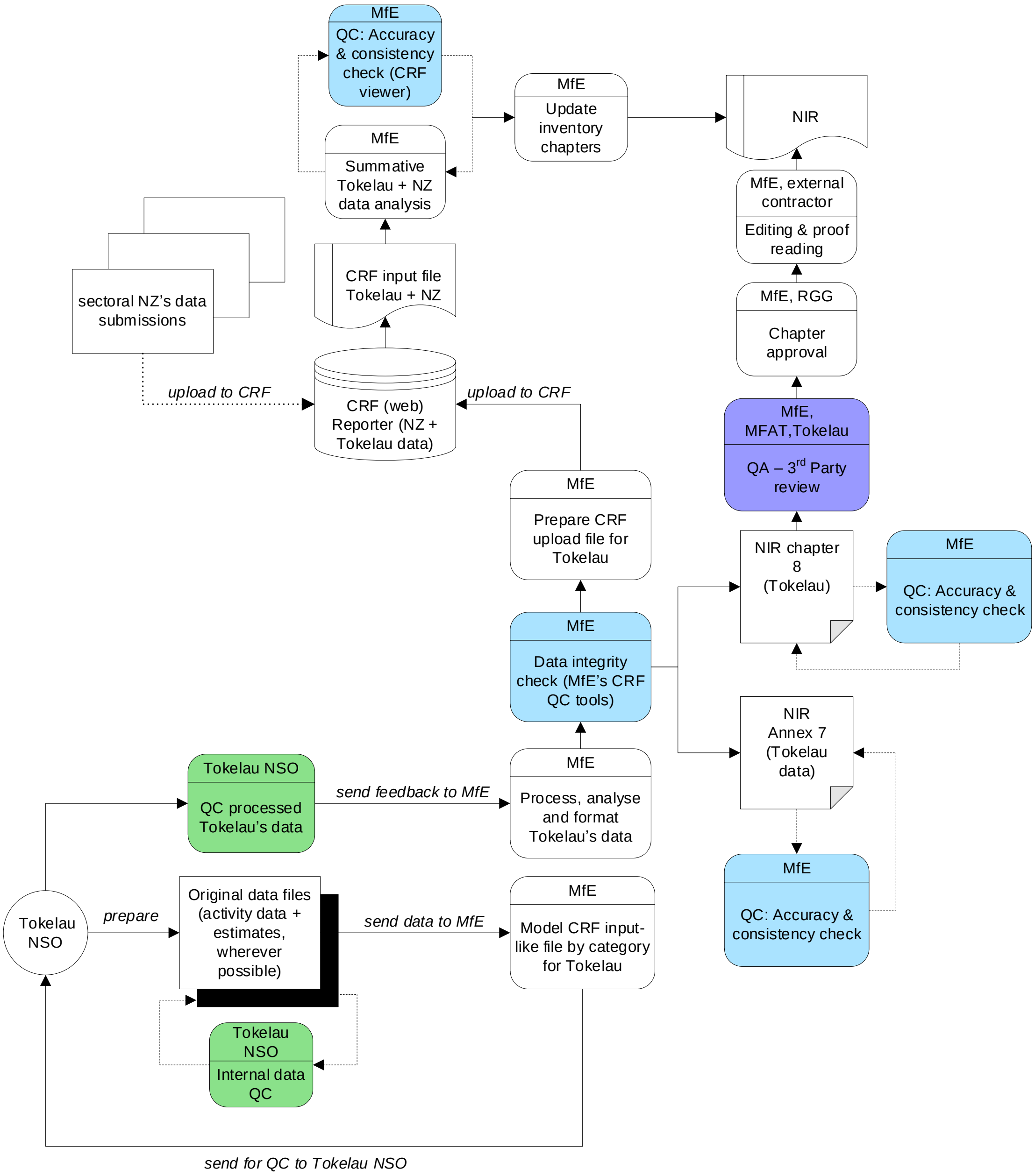


Figure A6.1.2 presents an overview of the compilation process for Tokelau, and it is integrated into New Zealand's inventory. It also shows where QA/QC steps are applied.

Figure A6.1.2 Data processing, quality assurance and quality control processes during the inventory preparation of the data from Tokelau into New Zealand's inventory



CRF	Common reporting format
MFAT	Ministry of Foreign Affairs and Trade
MfE	Ministry for the Environment (New Zealand)
	QA/QC procedures performed by Tokelau NSO
	QA/QC procedures performed by MfE
	QA/QC procedures performed by third parties
NIR	National inventory report
NSO	National Statistics Office (Tokelau)
QA/QC	Quality assurance and quality control
RGG	Reporting Governance Group

A6.2 General assessment of completeness

A6.2.1 Emissions reported as 'NE' (not estimated)

According to the United Nations Framework Convention on Climate Change (UNFCCC) reporting guidelines (UNFCCC, 2013), the notation key 'NE' (not estimated) signifies that emissions and/or removals occur but have not been estimated or reported. It can be applied for the following reasons:

- if emissions of a gas from a category are insignificant, that is, they should not exceed 0.05 per cent of the national total greenhouse gas (GHG) emissions, and do not exceed 500 kilotonnes carbon dioxide equivalent (kt CO_2-e) (paragraph 37(b) of the UNFCCC reporting guidelines)
- the total national aggregate of estimated emissions for all gases and categories considered insignificant shall remain below 0.1 per cent of the national total GHG emissions (paragraph 37(b) of the UNFCCC reporting guidelines)
- when an activity occurs in the Party but the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC, 2006) do not provide methodologies to estimate emissions and removals (footnote 6 of the UNFCCC reporting guidelines (UNFCCC, 2013)). If this is the case, the category is considered to be non-mandatory, providing the emissions from the category have not been reported previously.

The UNFCCC reporting guidelines also state that, once emissions from a specific category have been reported in a previous submission, emissions from this specific category shall be reported in subsequent GHG inventory submissions (UNFCCC, 2013).

New Zealand's gross emissions were 82,317.9 kt CO_2-e in 2019. The threshold of 0.1 per cent for New Zealand's 2021 submission is 82.3 kt CO_2-e and the threshold of 0.05 per cent is 41.2 kt CO_2-e. Both values are below 500 kt CO_2-e.

Table A6.2.1 summarises New Zealand's direct GHG emissions reported as 'NE' (not estimated) in the 2021 submission.

Table A6.2.1 Summary of NE (not estimated) entries in 2021 submission

CRF category code	Category	Gas	Explanation
Energy			
1.B.1.a.1.iii	Abandoned underground mines	CO_2, CH_4	Methane (CH_4) emissions from this category do not occur in the North Island of New Zealand and are not estimated for the South Island. Because the historical information is not available, New Zealand does not have any reliable information on activities related to CH_4 emissions from abandoned mines to reliably report on it. A project focusing on collating and digitising mine data for the South Island commenced in December 2019 and is ongoing. The data still requires significant manual processing before it will be usable for a meaningful assessment of fugitive emissions. Further progress will be reported in the 2022 submission.
1.B.2.a.5	Distribution of oil products	CO_2, CH_4	According to the article 37(b) of the United Nations Framework Convention on Climate Change (UNFCCC) reporting guidelines (Decision 24/CP.19), this category is not mandatory: the 2006 IPCC Guidelines do not provide the default Intergovernmental Panel on Climate Change (IPCC) emission factor for calculating Tier 1 estimates of CH_4 emissions from the distribution of refined oil products. New Zealand did not report an emissions estimate from this category prior to the 2018 submission.

CRF category code	Category	Gas	Explanation
1.B.2.b.3	Processing	CO_2, CH_4	Fugitive emissions of carbon dioxide (CO_2) and CH_4 have not been formally estimated, though a rough estimate of the likely level of emissions indicates that they are insignificant. While emissions from the Kapuni Gas Treatment Plant may include traces of CH_4, the level of these emissions has been determined to be insignificant in comparison with national emissions: a conservative estimate (using default emission factors from the 2006 IPCC Guidelines) gives approximately 1.5 kilotonnes carbon dioxide equivalent (kt CO_2-e) per year. CH_4: 625 Mm^3 (Kapuni field production) * 9.7e-5 * 25 = 1.5 kt CO_2-e. The conservative estimated value is below 0.05 per cent of New Zealand's gross emissions. This would keep the national total aggregate of estimated emissions for all gases and categories considered insignificant below 0.1 per cent of the national total greenhouse gas emissions, which is in line with paragraph 37(b) of the UNFCCC reporting guidelines. Carbon dioxide from gas processing is mostly associated with direct venting through a stack and, therefore, is reported under 1.B.2.c.1, as recommended in the 2017 assessment review report. However, there is a possibility of the presence of trace amounts of CO_2 from processing due to leakage, which is estimated to be no higher than 0.1 per cent of vented CO_2. A conservative estimate of 0.1 per cent of vented CO_2 from all categories is 0.26 kt, which is below 0.05 of the gross emissions and thus can be considered insignificant.
1.B.2.c.1.ii	Venting	CH_4	No meaningful activity data are available. According to the article 37(b) of the UNFCCC reporting guidelines, this category is not mandatory: the 2006 IPCC Guidelines do not provide the default IPCC emission factor for calculating Tier 1 estimates of CH_4 emissions from raw CO_2 venting.
Agriculture			
3.A.4 (for both New Zealand and Tokelau)	Poultry	CH_4	According to the article 37(b) of the UNFCCC reporting guidelines, this category is not mandatory: the 2006 IPCC Guidelines state (page 10.27, vol 4-2) that the Tier 1 method for estimating CH_4 emissions from enteric fermentation for poultry is not developed. Also, table 10.10 (page 10.28, vol 4-2) indicates that there is insufficient research to establish a CH_4 emission factor for poultry for either developed or developing countries.
3.B.2.5	Indirect N_2O emissions	N_2O	According to footnote 6 in paragraph 37(b) of the UNFCCC reporting guidelines (Decision 24/CP.19), this category is not mandatory for reporting. The 2006 IPCC Guidelines for determining indirect nitrous oxide (N_2O) emissions do not provide a methodology for estimating emissions from leaching and run-off. In addition, indirect N_2O emissions from leaching and run-off are insignificant in New Zealand, because almost all livestock are kept outdoors all year around on pasture.
3.B.2.5	N_2O emissions per MMS[4]	N_2O	Direct N_2O emissions from anaerobic lagoons (dairy and swine) and daily spread (swine) are reported under *Agricultural soils*. The 2006 IPCC Guidelines assume that negligible direct N_2O emissions occur in anaerobic lagoons and daily spread, and only occur once the stored effluent is spread onto agricultural soil. For more information, see chapter 5, sections 5.3.2 (Direct nitrous oxide emissions from manure management) and 5.5.2 (Urine and dung deposited by grazing animals) of the NIR. According to footnote 6 in paragraph 37(b) of the UNFCCC reporting guidelines (Decision 24/CP.19), this category is not mandatory for reporting.
3.D.1.2.c	Other organic fertilisers applied to soils	N_2O	Emissions from 'Other organic fertilisers applied to soils' are not estimated due to their insignificance as defined in accordance with the UNFCCC reporting guidelines (Decision 24/CP.19, paragraph 37(b)). Emissions are roughly estimated to be 20 kt CO_2-e (van der Weerden et al., 2014). Emissions are below the threshold of 0.05 per cent of the national total greenhouse gas emissions and do not exceed 500 kt CO_2-e.

[4] MMS stands for a manure management system (see chapter 5).

CRF category code	Category	Gas	Explanation
3.I	Other carbon-containing fertilisers	CO_2	According to the UNFCCC reporting guidelines (Decision 24/CP.19, paragraph 37), this category is not mandatory because the 2006 IPCC Guidelines do not provide guidance for reporting on other carbon-containing fertilisers. Other carbon-containing synthetic fertilisers besides limestone, dolomite and urea are not applied to agricultural land in New Zealand.
Land Use, Land-Use Change and Forestry			
4.D.1	Forest land, cropland, grassland and wetlands: Drainage and rewetting and other management of organic and mineral soils	CH_4, N_2O	No methodology is provided in the 2006 IPCC Guidelines for estimating emissions from this source category. According to footnote 6 in paragraph 37(b) of the UNFCCC reporting guidelines (Decision 24/CP.19), this category is not mandatory for reporting.
4.B.1	Cropland remaining cropland/4(V) Biomass burning/ Wildfires/Cropland remaining cropland	CH_4, N_2O	New Zealand does not have sufficient information on biomass burning activities to reliably report on it.
4.B.2	Land converted to cropland/4(V) Biomass burning/ Wildfires/Land converted to cropland	CH_4, N_2O	New Zealand does not have sufficient information on biomass burning activities to reliably report on it.
4.D.1	Wetlands remaining wetlands/4(V) Biomass burning/ Wildfires/Wetland remaining wetland	CH_4, N_2O	According to the article 37(b) of the UNFCCC reporting guidelines (Decision 24/CP.19), this category is not mandatory because no IPCC guidance is provided for calculating Tier 1 estimates of carbon stock changes in organic soils for this land use category. New Zealand does not have sufficient information on biomass burning activities to reliably report on it.
Waste			
5.C.2.2.a	Incineration of municipal solid waste	CO_2, CH_4 and N_2O	Approximately 100–200 rural schools in New Zealand still incinerate their waste production. Estimates indicate that this practice emits 0.04 kt CO_2-e per year. NE (not estimated) is used because New Zealand does not have sufficient information regarding the practice of incinerating waste in schools, and the amount is negligible. This is in accordance with paragraph 37(b) of the UNFCCC reporting guidelines (Decision 24/CP.19).
5.D.1 and 5.D.2	Domestic wastewater and Industrial wastewater	Amount of CH_4 flared and for energy recovery	NE (not estimated) is used for activity data, because New Zealand does not have any information regarding the CH_4 flaring in this source category. The amount of CH_4 flared does not contribute to New Zealand's total emissions because it produces biogenic CO_2 (as per the 2006 IPCC Tier 1 methodology provided in table 5D of the common reporting format tables).

The estimate of emissions for all of New Zealand's source categories marked as 'NE' results in 21.8 kt CO_2-e, which is below the 0.1 per cent of the total emissions threshold (82.3 kt CO_2-e).

A6.2.2 Emissions reported as 'IE' (included elsewhere)

According to the UNFCCC reporting guidelines (UNFCCC, 2013), the notation key 'IE' (included elsewhere) signifies that emissions and/or removals for this activity or category are estimated and included in the inventory but not presented separately for this category.

Table A6.2.2 details where the notation key 'IE' has been used in this submission of the inventory.

Table A6.2.2 Emissions reported using the 'IE' (included elsewhere) notation key

CRF category code	Category	Reported under the following source category:	Notation key explanation
1.A.2.a	Iron and steel – liquid fuels	1.A.2.g.viii – Other – Liquid fuels	Liquid fuels activity data for this category do not exist.
1.A.2.a	Iron and steel – solid fuels	2.C.1 – Iron and steel production	All emissions from the use of coal in this category are included in the Industrial Processes and Product Use sector because the primary purpose of the coal is to produce iron.
1.A.2.f	Non-metallic minerals – biomass	1.A.2.g.viii – Other – Biomass	Activity data for this category do not exist.
1.A.2.g.v	Construction – all fuels	1.A.2.g.iii – Mining	Disaggregated data do not exist.
1.A.3.b.ii–iv	Road transportation (other than 'Cars') – all fuels	1.A.3.b.i – Cars	Disaggregated data do not exist. Disaggregation of carbon dioxide (CO_2) emissions is included in the plan, but the implementation has not yet been completed.
1.A.4.c.ii–iii	Agriculture/forestry/fishing – Off-road vehicles and other machinery	1.A.4.c.i – Agriculture/ forestry/fishing – Stationary	Agriculture/forestry/fishing has not been disaggregated into stationary, mobile and fishing: data are not available.
1.B.2.b.1	Natural gas/exploration	1.B.2.a.1 – Oil exploration	In New Zealand, exploration is not specifically aimed at obtaining oil or gas, that is, oil exploration is not separated from gas exploration by planning, processes, equipment or resources. Thus the exploratory wells are drilled without distinction of their purpose, that is, whether the expected outcome is oil, gas, both or none and there is no reliable way to predict which it would be to estimate proportions of mostly oil and mostly gas wells. In that sense, disaggregated data for oil and gas exploration do not exist. Considering that available emission factors for well drilling and testing also do not distinguish between oil and gas, all emissions from oil and gas exploration are placed in the same category.
1.B.2.c.1.i–ii	Venting/oil and Venting/gas	1.B.2.c.1.iii – Venting/combined	The fields produce both oil and gas and, therefore, are reported as combined. Disaggregated data do not exist.
1.B.2.c.1.i–ii	Flaring/oil and Flaring/gas	1.B.2.c.1.iii – Flaring/combined	The fields produce both oil and gas and, therefore, are reported as combined. Disaggregated data do not exist.
2.A.3	Glass production	2.A.4.b – Other process uses of carbonates/Other uses of soda ash	Carbon dioxide emissions are reported in 2.A.4.b because this aggregates emissions from glass production with other uses of carbonates, due to confidentiality concerns for both glass and aluminium production. A very small number of firms in New Zealand are involved in these activities and use carbonates.
3.A.4	Enteric fermentation/ other/buffalo	3.A.1.A – Dairy cattle	A small herd of around 200 buffalo was brought into New Zealand around 2007 for specialised cheese and dairy production. These buffalo are reported within the dairy herd so the notation key 'IE' is used from 2007 onwards.

CRF category code	Category	Reported under the following source category:	Notation key explanation
3.B.1.4 & 3.B.2.4	Manure management/ other/buffalo	3.B.1.A – Dairy cattle 3.B.2.A – Dairy cattle	For both nitrous oxide (N_2O) and CH_4 emissions, the notation key 'NO' (not occurring) is used up to 2006 because no buffalo were recorded in New Zealand before 2007. A small herd of around 200 buffalo was brought into New Zealand around 2007 for specialised cheese and dairy production. See notation key explanation for 3.A.4. For more information, see chapter 5, section 5.1.4 (Minor livestock categories) of this national inventory report (NIR).
3.B.2.5	N_2O emissions per MMS[5]	3.D – Agricultural soils	Direct N_2O emissions from anaerobic lagoons (dairy and swine) and daily spread (swine) are reported under *Agricultural soils*.
3.D.1.2.b	Sewage sludge applied to soils	Included under the Waste sector 5.A.1.a	Direct N_2O emissions from sewage sludge are reported under 5.A.1.a in the Waste sector. Sewage sludge activity data are obtained from water treatment industry surveys and do not disaggregate the amount of sludge used for different purposes. Due to the small amount of emissions coming from sewage sludge, further disaggregation of the activity data is considered resource prohibitive. Sewage sludge is a very small source of nitrogen (van der Weerden et al., 2014).
3.E	Prescribed burning of savannas	Biomass burning (table 4(V) of LULUCF), category C Grassland	Prescribed burning of savanna is reported under the Land Use, Land-Use Change and Forestry (LULUCF) sector. See chapter 6, section 6.11.5 (Biomass burning (table 4(V) of LULUCF), category C Grassland).
4.A.1/4(V)	Controlled burning/Forest land remaining forest land	Carbon dioxide emissions are captured by the general carbon stock change calculation if the fire-damaged area is harvested and replanted. If the stand is allowed to grow on but with a reduced stocking, the CO_2 emissions are accounted for at the eventual time of harvest.	Carbon dioxide emissions are captured by the general carbon stock change calculation if the fire-damaged area is harvested and replanted. If the stand is allowed to grow on but with a reduced stocking, the CO_2 emissions are accounted for at the eventual time of harvest.
4.A.2/4(V)	Controlled burning/Land converted to forest land Wildfires/Land converted to forest land	Carbon dioxide emissions are captured by the general carbon stock change calculation if the fire-damaged area is harvested and replanted. If the stand is allowed to grow on but with a reduced stocking, the CO_2 emissions are accounted for at the eventual time of harvest.	Carbon dioxide emissions are captured by the general carbon stock change calculation if the fire-damaged area is harvested and replanted. If the stand is allowed to grow on but with a reduced stocking, the CO_2 emissions are accounted for at the eventual time of harvest.
4.B.1/4(V)	Controlled burning/Cropland remaining cropland	Included under the Agriculture sector	Carbon dioxide and CH_4 emissions from burning of crop stubble are reported in the Agriculture sector.

5 MMS stands for a manure management system (see chapter 5).

CRF category code	Category	Reported under the following source category:	Notation key explanation
4.B.1/4(V)	Wildfires/Cropland remaining cropland	Any CO_2 emissions from wildfires on non-forest land are likely to be offset by the subsequent carbon gain from the regrowth of biomass, which is also not accounted for. Alternatively, if the wildfire resulted in land-use change, then any CO_2 emissions would be captured by the general carbon stock change calculation that is performed when land is converted to a new land use.	Any CO_2 emissions from wildfires on non-forest land are likely to be offset by the subsequent carbon gain from the regrowth of biomass, which is also not accounted for. Alternatively, if the wildfire resulted in land-use change, then any CO_2 emissions would be captured by the general carbon stock change calculation that is performed when land is converted to a new land use.
4.B.2/4(V) 4.C.1/4(V) 4.C.2/4(V) 4.D.2/4(V)	Wildfires/Land converted to cropland Wildfires/Grassland remaining grassland Wildfires/Land converted to grassland Wildfires/Land converted to wetlands	Any CO_2 emissions from wildfires on non-forest land are likely to be offset by the subsequent carbon gain from the regrowth of biomass, which is also not accounted for. Alternatively, if the wildfire resulted in land-use change, then any CO_2 emissions would be captured by the general carbon stock change calculation that is performed when land is converted to a new land use.	Any CO_2 emissions from wildfires on non-forest land are likely to be offset by the subsequent carbon gain from the regrowth of biomass, which is also not accounted for. Alternatively, if the wildfire resulted in land-use change, then any CO_2 emissions would be captured by the general carbon stock change calculation that is performed when land is converted to a new land use.
 4.A.1/4(I) 4.D.1/4(I) 4.D.2/4(I) 4.E.1/4(I) 4.E.2/4(I) 4.B.1/4(V)	Direct N_2O emissions from nitrogen (N) inputs to managed soils/Inorganic N fertilisers and Direct N_2O emissions from N inputs to managed soils/Organic N fertilisers from the following categories: Forest land remaining forest land Wetlands remaining wetlands Land converted to wetlands Settlements remaining settlements Land converted to settlements Settlements remaining settlements Land converted to settlements Controlled burning/Cropland remaining cropland	Included under the Agriculture sector. Included under the Agriculture sector. Included under the Agriculture sector.	New Zealand does not disaggregate data on nitrogen fertiliser by land use, therefore, all N_2O emissions from organic and inorganic fertilisers are reported in the Agriculture sector. New Zealand does not disaggregate data on nitrogen fertiliser by land use, therefore, all N_2O emissions from organic and inorganic fertilisers are reported in the Agriculture sector. All emissions from burning of crop stubble are reported in the Agriculture sector.
4.C.1/4(V) 4.D.1/4(V)	Controlled burning/Grassland remaining grassland Controlled burning/Wetland remaining wetland Wildfires/Wetland remaining wetland	If due to temperate climate and rainfall, any CO_2 emissions from burning on non-forest land are likely to be offset by the subsequent carbon gain from the regrowth of biomass, which is also not accounted for. Alternatively, if the fire resulted in land-use change, then any CO_2 emissions would be captured by the general carbon stock change calculation that is performed when land is converted to a new land use.	This is not a significant activity in New Zealand due to its temperate climate and rainfall distribution, and any CO_2 emissions from burning on non-forest land are likely to be offset by the subsequent carbon gain from the regrowth of biomass, which is also not accounted for. Alternatively, if the fire resulted in land-use change, then any CO_2 emissions would be captured by the general carbon stock change calculation that is performed when land is converted to a new land use.

CRF category code	Category	Reported under the following source category:	Notation key explanation
4.C.2/4(V) 4.D.2/4(V) 4.E/4(V)	Controlled burning/Land converted to grassland Controlled burning/Land converted to wetlands Biomass burning/Land converted to settlements	Carbon dioxide emissions from the controlled burning of land converted to this category are captured by the general carbon stock change calculation that is performed when land is converted to a new land use.	Carbon dioxide emissions from the controlled burning of land converted to this category are captured by the general carbon stock change calculation that is performed when land is converted to a new land use.
5.D.1	Domestic wastewater	5.A Solid waste	Activity data – sludge amounts are included under solid waste disposal because sludge is disposed to landfill.
5.D.2	Industrial wastewater	5.A Solid waste	Activity data – sludge amounts are included under solid waste disposal because sludge is disposed to landfill.
5.D.2	Industrial wastewater	1.A.2.e Food processing, beverages and tobacco – Biomass	Emissions from CH_4 recovered for energy generation are known to occur at the Tirau dairy processing plant, and emissions of CH_4 and N_2O from the combustion of biogas are reported under 1.A.2.e *Food processing, beverages and tobacco – Biomass*.
Within the Tokelau sector 6, categories 1.A.3.b.i and 1.A.4.c.iii were reported elsewhere	Road transport/Gasoline and diesel oil	Domestic navigation	The number of petrol cars has, until recently, been very small in Tokelau (in 2018 only about 40 cars, 30 motorbikes, with an entire road network less than 10 kilometres). Census 2001 and prior record only four registered cars. Aluminium boats are the main means of family transport: there were, on average, about 100 outboard motors travelling both outside and within the large lagoons. Therefore, any petrol use for road transport is far outweighed by Domestic navigation, and is included there.
Within the Tokelau sector 6, category 1.A.4.b is reported elsewhere	Residential (1.A.4.b) liquid fuels	Domestic navigation	Only gas used for cooking is listed here. Amounts of liquid fuel use are miniscule compared with Domestic navigation and are included there.

Annex 6: References

IPCC. 2006. Eggleston HS, Buendia L, Miwa K, Ngara T, Tanabe K (eds). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. IPCC National Greenhouse Gas Inventories Programme. Japan: Published for the IPCC by the Institute for Global Environmental Strategies.

UNFCCC. 2013. FCCC/CP/2013/10/Add.3. *Report of the Conference of the Parties on its nineteenth session, held in Warsaw from 11 to 23 November 2013, Addendum; Decision 24/CP.19 Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention*.

van der Weerden A, de Klein C, Kelliher F, Rollo M. 2014. *Reporting to 2006 IPCC Guidelines for N_2O Emissions from Additional Sources of Organic N: Final Report*. MPI Technical Report. Wellington: Ministry for Primary Industries.

Annex 7: Tokelau

A7.1 Emissions estimate data and relevant supporting information by category for Tokelau[6]

Tokelau CRF Table 1.A.1.a: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.1 Energy Industries][1.A.1.a Public Electricity and Heat Production] (Part 1 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.1 Energy Industries][1.A.1.a Public Electricity and Heat Production]	Unit	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)
Fuel Consumption	TJ	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27
Liquid fuels	TJ	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Liquid fuels		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Liquid fuels	kt	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
CH_4	kt	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093
Liquid fuels	kt	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093

6 The category names and CRF codes for source categories are consistent with New Zealand's CRF tables. Only the tables that include reported emissions (by value, IE or NE) are included. For explanations and methodological issues, please refer to chapter 8.

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.1 Energy Industries][1.A.1.a Public Electricity and Heat Production]	Unit	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)
N_2O	kt	0.0000019	0.0000019	0.0000019	0.0000019	0.0000019	0.0000019	0.0000019	0.0000019	0.0000019	0.0000019
Liquid fuels	kt	0.0000019	0.0000019	0.0000019	0.0000019	0.0000019	0.0000019	0.0000019	0.0000019	0.0000019	0.0000019
Amount captured											
CO_2	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Liquid fuels	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
CO_2											
Liquid fuels	t/TJ	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40
CH_4											
Liquid fuels	kg/TJ	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85
N_2O											
Liquid fuels	kg/TJ	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57

Tokelau CRF Table 1.A.1.a: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.1 Energy Industries][1.A.1.a Public Electricity and Heat Production] (Part 2 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.1 Energy Industries][1.A.1.a Public Electricity and Heat Production]	Unit	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)
Fuel Consumption	TJ	3.27	3.27	3.27	3.27	9.81	16.34	16.34	16.34	16.34	16.34
Liquid fuels	TJ	3.27	3.27	3.27	3.27	9.81	16.34	16.34	16.34	16.34	16.34
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Liquid fuels		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.1 Energy Industries][1.A.1.a Public Electricity and Heat Production]	Unit	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)
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	0.23	0.23	0.23	0.23	0.69	1.15	1.15	1.15	1.15	1.15
Liquid fuels	kt	0.23	0.23	0.23	0.23	0.69	1.15	1.15	1.15	1.15	1.15
CH_4	kt	0.0000093	0.0000093	0.0000093	0.0000093	0.0000279	0.0000466	0.0000466	0.0000466	0.0000466	0.0000466
Liquid fuels	kt	0.0000093	0.0000093	0.0000093	0.0000093	0.0000279	0.0000466	0.0000466	0.0000466	0.0000466	0.0000466
N_2O	kt	0.0000019	0.0000019	0.0000019	0.0000019	0.0000056	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093
Liquid fuels	kt	0.0000019	0.0000019	0.0000019	0.0000019	0.0000056	0.0000093	0.0000093	0.0000093	0.0000093	0.0000093
Amount captured											
CO_2	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Liquid fuels	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
CO_2											
Liquid fuels	t/TJ	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40
CH_4											
Liquid fuels	kg/TJ	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85
N_2O											
Liquid fuels	kg/TJ	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57

Tokelau CRF Table 1.A.1.a: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.1 Energy Industries][1.A.1.a Public Electricity and Heat Production] (Part 3 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.1 Energy Industries][1.A.1.a Public Electricity and Heat Production]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Fuel Consumption	TJ	16.34	16.34	12.97	2.86	2.86	2.86	3.05	3.24	3.42	3.61
Liquid fuels	TJ	16.34	16.34	12.97	2.86	2.86	2.86	3.05	3.24	3.42	3.61
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Liquid fuels		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	1.15	1.15	0.91	0.20	0.20	0.20	0.21	0.23	0.24	0.25
Liquid fuels	kt	1.15	1.15	0.91	0.20	0.20	0.20	0.21	0.23	0.24	0.25
CH_4	kt	0.0000466	0.0000466	0.0000370	0.0000082	0.0000082	0.0000082	0.0000087	0.0000092	0.0000098	0.0000103
Liquid fuels	kt	0.0000466	0.0000466	0.0000370	0.0000082	0.0000082	0.0000082	0.0000087	0.0000092	0.0000098	0.0000103
N_2O	kt	0.0000093	0.0000093	0.0000074	0.0000016	0.0000016	0.0000016	0.0000017	0.0000018	0.0000020	0.0000021
Liquid fuels	kt	0.0000093	0.0000093	0.0000074	0.0000016	0.0000016	0.0000016	0.0000017	0.0000018	0.0000020	0.0000021
Amount captured											
CO_2	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Liquid fuels	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
CO_2											
Liquid fuels	t/TJ	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40	7.40
CH_4											
Liquid fuels	kg/TJ	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85
N_2O											
Liquid fuels	kg/TJ	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57

Tokelau CRF Table 1.A.3.b.i: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.b Road Transportation][1.A.3.b.i Cars][Gasoline] (Part 1 of 3)

[1.A.3 Transport][1.A.3.b Road Transportation][1.A.3.b.i Cars][Gasoline]	Unit	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)
Fuel Consumption	TJ	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
CH_4	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
N_2O	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Implied Emission Factor											
CO_2	t/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: This category is included under 1.A.3.d. For explanation please refer to section 8.2.5.

Tokelau CRF Table 1.A.3.b.i: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.b Road Transportation][1.A.3.b.i Cars][Gasoline] (Part 2 of 3)

[1.A.3 Transport] [1.A.3.b Road Transportation] [1.A.3.b.i Cars][Gasoline]	Unit	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)
Fuel Consumption	TJ	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
CH_4	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
N_2O	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Implied Emission Factor											
CO_2	t/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kg/T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Tokelau CRF Table 1.A.3.b.i: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.b Road Transportation][1.A.3.b.i Cars][Gasoline] (Part 3 of 3)

[1.A.3 Transport] [1.A.3.b Road Transportation] [1.A.3.b. Cars][Gasoline]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Fuel Consumption	TJ	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1

[1.A.3 Transport] [1.A.3.b Road Transportation] [1.A.3.b. Cars][Gasoline]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
CH_4	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
N_2O	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Implied Emission Factor											
CO_2	t/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kg/T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 1.A.3.b.i Diesel Oil: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.b Road Transportation][1.A.3.b.i Cars][Diesel Oil] (Part 1 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport] [1.A.3.b Road Transportation][1.A.3.b.i Cars][Diesel Oil]	Unit	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)
Fuel Consumption	TJ	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Calorific Value		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.b Road Transportation][1.A.3.b.i Cars][Diesel Oil]	Unit	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)
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
CH_4	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
N_2O	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Implied Emission Factor											
CO_2	t/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 1.A.3.b.i Diesel Oil: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.b Road Transportation][1.A.3.b.i Cars][Diesel Oil] (Part 2 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.b Road Transportation][1.A.3.b.i Cars][Diesel Oil]	Unit	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)
Fuel Consumption	TJ	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Calorific Value		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
CH_4	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.b Road Transportation][1.A.3.b.i Cars][Diesel Oil]	Unit	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)
N_2O	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Implied Emission Factor											
CO_2	t/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 1.A.3.b.i Diesel Oil: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.b Road Transportation][1.A.3.b.i Cars][Diesel Oil] (Part 3 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.b Road Transportation][1.A.3.b.i Cars][Diesel Oil]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Fuel Consumption	TJ	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Calorific Value		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
CH_4	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
N_2O	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Implied Emission Factor											
CO_2	t/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 1.A.3.d Gas/Diesel Oil: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.d Domestic Navigation][Gas/Diesel Oil] (Part 1 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.d Domestic Navigation][Gas/Diesel Oil]	Unit	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)
Fuel Consumption	TJ	12.76	12.98	13.21	13.43	13.66	13.89	14.11	14.34	14.56	14.79
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	0.90	0.91	0.93	0.95	0.96	0.98	0.99	1.01	1.03	1.04
CH_4	kt	0.00008	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00010	0.00010	0.00010
N_2O	kt	0.00002	0.00002	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
Implied Emission Factor											
CO_2	t/TJ	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40
CH_4	kg/TJ	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65
N_2O	kg/TJ	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90

CRF Table 1.A.3.d Gas/Diesel Oil: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.d Domestic Navigation][Gas/Diesel Oil (Part 2 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.d Domestic Navigation][Gas/Diesel Oil]	Unit	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)
Fuel Consumption	TJ	15.01	15.24	15.47	15.69	15.92	16.14	16.37	16.59	16.82	17.04
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	1.06	1.07	1.09	1.10	1.12	1.14	1.15	1.17	1.18	1.20
CH_4	kt	0.00010	0.00010	0.00010	0.00010	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
N_2O	kt	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
Implied Emission Factor											
CO_2	t/TJ	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40
CH_4	kg/TJ	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65
N_2O	kg/TJ	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90

CRF Table 1.A.3.d Gas/Diesel Oil: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.d Domestic Navigation][Gas/Diesel Oil (Part 3 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.d Domestic Navigation][Gas/Diesel Oil]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Fuel Consumption	TJ	17.27	17.50	17.72	17.95	18.17	18.03	18.89	19.88	21.08	30.91
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.3 Transport][1.A.3.d Domestic Navigation][Gas/Diesel Oil]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	1.22	1.23	1.25	1.26	1.28	1.27	1.33	1.40	1.48	2.18
CH_4	kt	0.00011	0.00012	0.00012	0.00012	0.00012	0.00012	0.00013	0.00013	0.00014	0.00021
N_2O	kt	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00004	0.00004	0.00004	0.00006
Implied Emission Factor											
CO_2	t/TJ	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40	70.40
CH_4	kg/TJ	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65
N_2O	kg/TJ	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90

CRF Table 1.A.4.b: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.b Residential] (Part 1 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.b Residential]	Unit	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)
Fuel Consumption	TJ	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16
Liquid fuels	TJ	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gaseous fuels	TJ	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Liquid fuels		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Gaseous fuels		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.b Residential]	Unit	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)
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Liquid fuels	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gaseous fuels	kt	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
CH_4	kt	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Liquid fuels	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gaseous fuels	kt	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
N_2O	kt	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004
Liquid fuels	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gaseous fuels	kt	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004
NO_x	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
SO_2	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Amount captured											
CO_2	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Liquid fuels	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous fuels	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
CO_2											
Liquid fuels	t/TJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous fuels	t/TJ	56.79	56.79	56.79	56.79	56.79	56.79	56.79	56.79	56.79	56.79
CH_4											
Liquid fuels	kg/TJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous fuels	kg/TJ	55.80	55.80	55.80	55.80	55.80	55.80	55.80	55.80	55.80	55.80
N_2O											
Liquid fuels	kg/TJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous fuels	kg/TJ	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18

CRF Table 1.A.4.b: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.b Residential] (Part 2 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.b Residential]	Unit	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)
Fuel Consumption	TJ	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16
Liquid fuels	TJ	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gaseous fuels	TJ	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Liquid fuels		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Gaseous fuels		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Liquid fuels	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gaseous fuels	kt	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
CH_4	kt	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Liquid fuels	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gaseous fuels	kt	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
N_2O	kt	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004
Liquid fuels	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gaseous fuels	kt	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004
Nox	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
SO_2	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.b Residential]	Unit	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)
Amount captured											
CO_2	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Liquid fuels	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous fuels	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
CO_2											
Liquid fuels	t/TJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous fuels	t/TJ	56.79	56.79	56.79	56.79	56.79	56.79	56.79	56.79	56.79	56.79
CH_4											
Liquid fuels	kg/TJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous fuels	kg/TJ	55.80	55.80	55.80	55.80	55.80	55.80	55.80	55.80	55.80	55.80
N_2O											
Liquid fuels	kg/TJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous fuels	kg/TJ	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18

CRF Table 1.A.4.b: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.b Residential] (Part 3 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.b Residential]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Fuel Consumption	TJ	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	1.25
Liquid fuels	TJ	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gaseous fuels	TJ	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	1.25
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Liquid fuels		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Gaseous fuels		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.b Residential]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.07
Liquid fuels	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gaseous fuels	kt	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.07
CH_4	kt	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.00007
Liquid fuels	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gaseous fuels	kt	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.00007
N_2O	kt	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000002
Liquid fuels	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Gaseous fuels	kt	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000004	0.0000002
Nox	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
SO_2	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Amount captured											
CO_2	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Liquid fuels	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous fuels	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
CO_2											
Liquid fuels	t/TJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous fuels	t/TJ	56.79	56.79	56.79	56.79	56.79	56.79	56.79	56.79	56.79	56.79
CH_4											
Liquid fuels	kg/TJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous fuels	kg/TJ	55.80	55.80	55.80	55.80	55.80	55.80	55.80	55.80	55.80	55.80

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.b Residential]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
N_2O											
Liquid fuels	kg/TJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous fuels	kg/TJ	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18

CRF Table 1.A.4.c.iii Gas/Diesel Oil: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.c Agriculture/Forestry/Fishing] [1.A.4.c.iii Fishing] [Gas/Diesel Oil] (Part 1 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.c Agriculture/Forestry/Fishing][1.A.4.c.iii Fishing][Gas/Diesel Oil]	Unit	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)
Fuel Consumption	TJ	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
CH_4	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
N_2O	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Implied Emission Factor											
CO_2	t/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 1.A.4.c.iii Gas/Diesel Oil: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.c Agriculture/Forestry/Fishing][1.A.4.c.iii Fishing] [Gas/Diesel Oil] (Part 2 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.c Agriculture/Forestry/Fishing][1.A.4.c.iii Fishing][Gas/Diesel Oil]	Unit	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)
Fuel Consumption	TJ	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
CH_4	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
N_2O	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Implied Emission Factor											
CO_2	t/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 1.A.4.c.iii Gas/Diesel Oil: [1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors][1.A.4.c Agriculture/Forestry/Fishing][1.A.4.c.iii Fishing][Gas/Diesel Oil] (Part 3 of 3)

[1. Energy][1.AA Fuel Combustion – Sectoral approach][1.A.4 Other Sectors] [1.A.4.c Agriculture/Forestry/Fishing] [1.A.4.c.iii Fishing][Gas/Diesel Oil]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Fuel Consumption	TJ	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
CH_4	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
N_2O	kt	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Implied Emission Factor											
CO_2	t/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O	kg/TJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 1.AB Gasoline: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Gasoline] (Part 1 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels] [Gasoline]	Unit	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)
Imports	PJ	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.80
Emission Factor											
C	t/TJ	17.96	17.96	17.96	17.96	17.96	17.96	17.96	17.96	17.96	17.96
Carbon content											
C	kt	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
CO_2	kt	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65

CRF Table 1.AB Gasoline: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Gasoline] (Part 2 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Gasoline]	Unit	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)
Imports	PJ	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.80
Emission Factor											
C	t/TJ	17.96	17.96	17.96	17.96	17.96	17.96	17.96	17.96	17.96	17.96
Carbon content											
C	kt	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
CO_2	kt	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65

CRF Table 1.AB Gasoline: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Gasoline] (Part 3 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels] [Gasoline]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Imports	PJ	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.80	9.39
Emission Factor											
C	t/TJ	17.96	17.96	17.96	17.96	17.96	17.96	17.96	17.96	17.96	17.96
Carbon content											
C	kt	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.17
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.17
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.17
CO_2	kt	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.62

CRF Table 1.AB Gas Diesel Oil: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Gas / Diesel Oil] (Part 1 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels] [Gas / Diesel Oil]	Unit	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)
Imports	PJ	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	5.83	6.06	6.29	6.51	6.74	6.96	7.19	7.41	7.64	7.86
Emission Factor											
C	t/TJ	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19
Carbon content											
C	kt	0.11	0.12	0.12	0.12	0.13	0.13	0.14	0.14	0.15	0.15
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.11	0.12	0.12	0.12	0.13	0.13	0.14	0.14	0.15	0.15
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.11	0.12	0.12	0.12	0.13	0.13	0.14	0.14	0.15	0.15
CO_2	kt	0.4104824	0.4263607	0.4422390	0.4581173	0.4739956	0.4898739	0.5057522	0.5216305	0.5375088	0.5533871

CRF Table 1.AB Gas Diesel Oil: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Gas / Diesel Oil] (Part 2 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels] [Gas / Diesel Oil]	Unit	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)
Imports	PJ	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	8.09	8.32	8.54	8.77	15.53	22.29	22.52	22.74	22.97	23.19
Emission Factor											
C	t/TJ	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19
Carbon content											
C	kt	0.16	0.16	0.16	0.17	0.30	0.43	0.43	0.44	0.44	0.45
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.16	0.16	0.16	0.17	0.30	0.43	0.43	0.44	0.44	0.45
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.16	0.16	0.16	0.17	0.30	0.43	0.43	0.44	0.44	0.45
CO_2	kt	0.5692654	0.5851437	0.6010220	0.6169003	1.0927211	1.5685419	1.5844201	1.6002984	1.6161767	1.6320550

CRF Table 1.AB Gas Diesel Oil: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Gas / Diesel Oil] (Part 3 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels] [Gas / Diesel Oil]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Imports	PJ	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	23.42	23.65	20.50	10.62	10.84	10.70	11.74	12.93	14.31	24.98
Emission Factor											
C	t/TJ	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19
Carbon content											
C	kt	0.45	0.45	0.39	0.20	0.21	0.21	0.23	0.25	0.27	0.48
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.45	0.45	0.39	0.20	0.21	0.21	0.23	0.25	0.27	0.48
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.45	0.45	0.39	0.20	0.21	0.21	0.23	0.25	0.27	0.48
CO_2	kt	1.6479333	1.6638116	1.4425810	0.7471324	0.7630107	0.7529823	0.8262569	0.9095598	1.0067726	1.7579367

CRF Table 1.AB Other Kerosene: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Other Kerosene] (Part 1 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Other Kerosene]	Unit	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)
Imports	PJ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Emission Factor											
C	t/TJ	18.62	18.62	18.62	18.62	18.62	18.62	18.62	18.62	18.62	18.62
Carbon content											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CO_2	kt	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

CRF Table 1.AB Other Kerosene: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Other Kerosene] (Part 2 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels] [Other Kerosene]	Unit	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)
Imports	PJ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Emission Factor											
C	t/TJ	18.62	18.62	18.62	18.62	18.62	18.62	18.62	18.62	18.62	18.62
Carbon content											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CO_2	kt	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

CRF Table 1.AB Other Kerosene: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Other Kerosene] (Part 3 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels] [Other Kerosene]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Imports	PJ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0002
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0002
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.23
Emission Factor											
C	t/TJ	18.62	18.62	18.62	18.62	18.62	18.62	18.62	18.62	18.62	18.62
Carbon content											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.004
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.004
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.004
CO_2	kt	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.02

CRF Table 1.AB LPG: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Liquefied Petroleum Gases (LPG)] (Part 1 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Liquefied Petroleum Gases (LPG)]	Unit	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)
Imports	PJ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49
Emission Factor											
C	t/TJ	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48
Carbon content											
C	kt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
CO_2	kt	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

CRF Table 1.AB LPG: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Liquefied Petroleum Gases (LPG)] (Part 2 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels] [Liquefied Petroleum Gases (LPG)]	Unit	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)
Imports	PJ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49
Emission Factor											
C	t/TJ	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48
Carbon content											
C	kt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
CO_2	kt	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

CRF Table 1.AB LPG: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Liquefied Petroleum Gases (LPG)] (Part 3 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Liquefied Petroleum Gases (LPG)]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Imports	PJ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.02
Emission Factor											
C	t/TJ	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48
Carbon content											
C	kt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
CO_2	kt	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.06

CRF Table 1.AB Lubricants: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Lubricants] (Part 1 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach] [Liquid Fuels] [Lubricants]	Unit	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)
Imports	PJ	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Emission Factor											
C	t/TJ	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Carbon content											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CO_2	kt	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

CRF Table 1.AB Lubricants: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Lubricants] (Part 2 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach] [Liquid Fuels] [Lubricants]	Unit	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)
Imports	PJ	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Emission Factor											
C	t/TJ	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Carbon content											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CO_2	kt	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

CRF Table 1.AB Lubricants: [1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Lubricants] (Part 3 of 3)

[1. Energy][1.AB Fuel Combustion – Reference Approach][Liquid Fuels][Lubricants]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Imports	PJ	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0002
Exports	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Stock change	PJ	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Apparent Consumption	PJ	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0002
Conversion factor	TJ/unit	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Calorific Value		GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV	GCV
Apparent Consumption	TJ	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.15
Emission Factor											
C	t/TJ	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Carbon content											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Carbon stored											
C	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Net carbon emissions											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Fraction of carbon oxidized		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Emissions											
C	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
CO_2	kt	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01

CRF Table 2.F.1.b HFC-134a Product Uses as Substitutes for ODS: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning] [2.F.1.b Domestic Refrigeration][HFC-134a] (Part 1 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.b Domestic Refrigeration][HFC-134a]	Unit	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)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	NO	NO	NO	NO	0.02	0.04	0.07	0.09	0.11	0.13
Remaining in products at decommissioning	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	NO	NO	NO	NO	0.00	0.01	0.01	0.01	0.02	0.02
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	NO	NO	NO	NO	0.00	0.01	0.01	0.01	0.02	0.02
From disposal	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	NO	NO	NO	NO	15.00	15.00	15.00	15.00	15.00	15.00
Disposal loss factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.1.b HFC-134a Product Uses as Substitutes for ODS: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning] [2.F.1.b Domestic Refrigeration][HFC-134a] (Part 2 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.b Domestic Refrigeration][HFC-134a]	Unit	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)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	0.14	0.16	0.20	0.25	0.27	0.29	0.32	0.32	0.31	0.31
Remaining in products at decommissioning	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	0.02	0.02	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.05
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	0.02	0.02	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.05

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.b Domestic Refrigeration][HFC-134a]	Unit	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)
From disposal	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Disposal loss factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.1.b HFC-134a Product Uses as Substitutes for ODS: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.b Domestic Refrigeration][HFC-134a] (Part 3 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.b Domestic Refrigeration][HFC-134a]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	0.31	0.31	0.29	0.27	0.25	0.23	0.21	0.21	0.21	0.21
Remaining in products at decommissioning	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03
From disposal	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Disposal loss factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.1.f: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air Conditioning] (Part 1 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning]	Unit	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)
Method											
HFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF_6		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NF_3		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emission Factor information											
HFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emissions											
HFCs	t CO_2-e	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-32	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-125	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFCs and PFCs	t CO_2-e	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery											
Aggregated F-gases	t CO_2-e	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.1.f: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning] (Part 2 of 3)

[2. Industrial Processes and Product Use] [2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning]	Unit	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)
Method											
HFCs		NA	NA	NA	NA	NA	NA	NA	T1a	T1a	T1a
PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF_6		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NF_3		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emission Factor information											
HFCs		NA	NA	NA	NA	NA	NA	NA	D	D	D
Emissions											
HFCs	t CO_2-e	NO	NO	NO	NO	NO	NO	NO	17.06	34.12	51.17
HFC-32	t	NO	NO	NO	NO	NO	NO	NO	0.003	0.006	0.009
HFC-125	t	NO	NO	NO	NO	NO	NO	NO	0.004	0.008	0.013
HFC-134a	t	NO	NO	NO	NO	NO	NO	NO	0.0003	0.001	0.001
HFCs and PFCs	t CO_2-e	NO	NO	NO	NO	NO	NO	NO	17.06	34.12	51.17
Recovery											
Aggregated F-gases	t CO_2-e	NO	NO	NO	NO	NO	NO	NO	17.06	34.12	51.17

CRF Table 2.F.1.f: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning] (Part 3 of 3)

[2. Industrial Processes and Product Use] [2.F Product Uses as Substitutes for ODS] [2.F.1 Refrigeration and Air conditioning] [2.F.1.f Stationary Air conditioning]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Method											
HFCs		T1a	T1a	T1a	T1a	T1a	T1a	T1a	T1a	T1a	T1a
PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF_6		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NF_3		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emission Factor information											
HFCs		D	D	D	D	D	D	D	D	D	D
Emissions											
HFCs	t CO_2-e	68.23	85.29	102.35	119.41	136.46	153.52	170.58	170.58	170.58	170.58
HFC-32	t	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03
HFC-125	t	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04
HFC-134a	t	0.001	0.001	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003
HFCs and PFCs	t CO_2-e	68.23	85.29	102.35	119.41	136.46	153.52	170.58	170.58	170.58	170.58
Recovery											
Aggregated F-gases	t CO_2-e	68.23	85.29	102.35	119.41	136.46	153.52	170.58	170.58	170.58	170.58

CRF Table 2.F.1.f HFC-32: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-32] (Part 1 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-32]	Unit	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)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Remaining in products at decommissioning	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From disposal	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Disposal loss factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.1.f HFC-32: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-32] (Part 2 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-32]	Unit	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)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	NO	NO	NO	NO	NO	NO	NO	0.02	0.04	0.06
Remaining in products at decommissioning	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	NO	NO	NO	NO	NO	NO	NO	0.00	0.01	0.01
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	NO	NO	NO	NO	NO	NO	NO	0.00	0.01	0.01

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-32]	Unit	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)
From disposal	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	NO	NO	NO	NO	NO	NO	NO	15.00	15.00	15.00
Disposal loss factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.1.f HFC-32: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-32] (Part 3 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-32]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.20	0.20	0.20
Remaining in products at decommissioning	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03
From disposal	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Disposal loss factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.1.f HFC-125: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-125] (Part 1 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-125]	Unit	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)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Remaining in products at decommissioning	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From disposal	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Disposal loss factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.1.f HFC-125: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-125] (Part 2 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-125]	Unit	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)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	NO	NO	NO	NO	NO	NO	NO	0.03	0.06	0.08
Remaining in products at decommissioning	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	NO	NO	NO	NO	NO	NO	NO	0.00	0.01	0.01
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	NO	NO	NO	NO	NO	NO	NO	0.00	0.01	0.01

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-125]	Unit	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)
From disposal	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	NO	NO	NO	NO	NO	NO	NO	15.00	15.00	15.00
Disposal loss factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.1.f HFC-125: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning] [HFC-125] (Part 3 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-125]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	0.11	0.14	0.17	0.19	0.22	0.25	0.28	0.28	0.28	0.28
Remaining in products at decommissioning	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04
From disposal	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Disposal loss factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.1.f HFC-134a: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning] [HFC-134a] (Part 1 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-134a]	Unit	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)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Remaining in products at decommissioning	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From disposal	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Disposal loss factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.1.f HFC-134a: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning] [HFC-134a] (Part 2 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-134a]	Unit	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)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	NO	NO	NO	NO	NO	NO	NO	0.002	0.004	0.01
Remaining in products at decommissioning	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	NO	NO	NO	NO	NO	NO	NO	0.0003	0.001	0.001
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	NO	NO	NO	NO	NO	NO	NO	0.0003	0.001	0.001

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-134a]	Unit	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)
From disposal	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	NO	NO	NO	NO	NO	NO	NO	15.00	15.00	15.00
Disposal loss factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.1.f HFC-134a: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-134a] (Part 3 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.1 Refrigeration and Air conditioning][2.F.1.f Stationary Air conditioning][HFC-134a]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Remaining in products at decommissioning	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	0.001	0.001	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	0.001	0.001	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003
From disposal	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Disposal loss factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.4.a: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers] (Part 1 of 3)

[2. Industrial Processes and Product Use] [2.F Product Uses as Substitutes for ODS] [2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers]	Unit	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)
Method											
HFCs		NA	NA	NA	NA	NA	T1a	T1a	T1a	T1a	T1a
PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF_6		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NF_3		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emission Factor information											
HFCs		NA	NA	NA	NA	NA	D	D	D	D	D
PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF_6		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NF_3		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emissions		NO	NO	NO	NO	NO	0.0001	0.001	0.001	0.002	0.002
HFCs	t CO_2 equivalent	NO	NO	NO	NO	NO	0.12	0.70	1.14	1.69	2.44
HFC-134a	t	NO	NO	NO	NO	NO	0.0001	0.0005	0.001	0.001	0.002
HFC-227ea	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Aggregated F-gases	t CO_2 equivalent	NO	NO	NO	NO	NO	0.12	0.70	1.14	1.69	2.44

CRF Table 2.F.4.a: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers] (Part 2 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers]	Unit	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)
Method											
HFCs		T1a	T1a	T1a	T1a	T1a	T1a	T1a	T1a	T1a	T1a
PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF_6		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NF_3		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emission Factor information											
HFCs		D	D	D	D	D	D	D	D	D	D
PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF_6		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NF_3		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emissions	kt CO_2-e	0.003	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
HFCs	t CO_2-e	2.85	6.09	11.54	13.90	13.66	13.66	13.35	13.62	14.18	14.76
HFC-134a	t	0.002	0.004	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
HFC-227ea	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Aggregated F-gases	t CO_2-e	2.85	6.09	11.54	13.90	13.66	13.66	13.35	13.62	14.18	14.76

CRF Table 2.F.4.a: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers] (Part 3 of 3)

[2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Method											
HFCs		T1a	T1a	T1a	T1a	T1a	T1a	T1a	T1a	T1a	T1a
PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF_6		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NF_3		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emission Factor information											
HFCs		D	D	D	D	D	D	D	D	D	D
PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unspecified mix of HFCs and PFCs		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF_6		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NF_3		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emissions	kt CO_2-e	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
HFCs	t CO_2-e	15.46	17.22	18.93	19.10	19.14	19.47	19.50	19.15	19.01	19.01
HFC-134a	t	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
HFC-227ea	t	NO	0.0004	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Aggregated F-gases	t CO_2-e	15.46	17.22	18.93	19.10	19.14	19.47	19.50	19.15	19.01	19.01

CRF Table 2.F.4.a HFC-134a: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers][HFC-134a] (Part 1 of 3)

[2. Industrial Processes and Product Use] [2.F Product Uses as Substitutes for ODS] [2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers] [HFC-134a]	Unit	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)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	NO	NO	NO	NO	NO	0.0001	0.0005	0.001	0.001	0.002
Emissions	t	NO	NO	NO	NO	NO	0.0001	0.0005	0.001	0.001	0.002
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	NO	NO	NO	NO	NO	0.0001	0.0005	0.001	0.001	0.002
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	NO	NO	NO	NO	NO	100.00	100.00	100.00	100.00	100.00

CRF Table 2.F.4.a HFC-134a: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers][HFC-134a] (Part 2 of 3)

[2. Industrial Processes and Product Use] [2.F Product Uses as Substitutes for ODS] [2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers] [HFC-134a]	Unit	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)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	0.002	0.004	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Emissions	t	0.002	0.004	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	0.002	0.004	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

CRF Table 2.F.4.a HFC-134a: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers][HFC-134a] (Part 3 of 3)

[2. Industrial Processes and Product Use] [2.F Product Uses as Substitutes for ODS] [2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers] [HFC-134a]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Emissions	t	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

CRF Table 2.F.4.a HFC-227ea: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers][HFC-227ea] (Part 1 of 3)

[2. Industrial Processes and Product Use] [2.F Product Uses as Substitutes for ODS] [2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers] [HFC-227ea]	Unit	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)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.4.a HFC-227ea: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers][HFC-227ea] (Part 2 of 3)

[2. Industrial Processes and Product Use] [2.F Product Uses as Substitutes for ODS] [2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers] [HFC-227ea]	Unit	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)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

CRF Table 2.F.4.a HFC-227ea: [2. Industrial Processes and Product Use][2.F Product Uses as Substitutes for ODS][2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers][HFC-227ea] (Part 3 of 3)

[2. Industrial Processes and Product Use] [2.F Product Uses as Substitutes for ODS] [2.F.4 Aerosols][2.F.4.a Metered Dose Inhalers] [HFC-227ea]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Amount											
Filled into new manufactured products	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
In operating systems (average annual stocks)	t	NO	0.0004	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Emissions	t	NO	0.0004	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
From manufacturing	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
From stocks	t	NO	0.0004	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Recovery	t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
Product manufacturing factor	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Product life factor	%	NO	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

CRF Table 2.G.3.a: [2. Industrial Processes and Product Use][2.G Other Product Manufacture and Use][2.G.3 N_2O from Product Uses][2.G.3.a Medical Applications] (Part 1 of 3)

[2. Industrial Processes and Product Use] [2.G Other Product Manufacture and Use] [2.G.3 N_2O from Product Uses][2.G.3.a Medical Applications]	Unit	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)
Activity data											
N_2O imported	kt	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Method											
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
N_2O	kt	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Recovery											
N_2O	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
N_2O	t/t	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03

CRF Table 2.G.3.a: [2. Industrial Processes and Product Use][2.G Other Product Manufacture and Use][2.G.3 N_2O from Product Uses][2.G.3.a Medical Applications] (Part 2 of 3)

[2. Industrial Processes and Product Use] [2.G Other Product Manufacture and Use] [2.G.3 N_2O from Product Uses] [2.G.3.a Medical Applications]	Unit	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)
Activity data											
N_2O imported	kt	0.0001	0.0001	0.0001	0.0001	0.0001	0.00004	0.00004	0.00004	0.00005	0.00005
Method											
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
N_2O	kt	0.0001	0.0001	0.0001	0.0001	0.00005	0.00004	0.00004	0.00005	0.00005	0.00005
Recovery											
N_2O	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
N_2O	t/t	1.03	1.03	1.03	1.04	1.04	1.05	1.05	0.89	0.94	1.06

CRF Table 2.G.3.a: [2. Industrial Processes and Product Use][2.G Other Product Manufacture and Use][2.G.3 N_2O from Product Uses][2.G.3.a Medical Applications] (Part 3 of 3)

[2. Industrial Processes and Product Use] [2.G Other Product Manufacture and Use] [2.G.3 N_2O from Product Uses] [2.G.3.a Medical Applications]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Activity data											
N_2O imported	kt	0.00005	0.00005	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Method											
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
N_2O	kt	0.00005	0.00005	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Recovery											
N_2O	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Implied Emission Factor											
N_2O	t/t	0.94	1.07	0.91	1.02	1.00	0.97	1.05	0.92	0.85	0.85

CRF Table 3.A.3 Tokelau Swine: [3. Agriculture][3.1 Livestock][3.A Enteric Fermentation][3.A.3 Swine][Other (please specify)][Tokelau_Swine] (Part 1 of 3)

[3. Agriculture][3.1 Livestock][3.A Enteric Fermentation][3.A.3 Swine][Other (please specify)][Tokelau_Swine]	Unit	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)
Population	1000s	2.293	2.500	2.395	2.290	2.186	2.081	1.976	2.111	2.247	2.382
Average gross energy intake	MJ/head/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average CH_4 conversion rate	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions											
CH_4	kt	0.003	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.004
Implied Emission Factor											
CH_4	kg/head/year	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50

[3. Agriculture][3.1 Livestock][3.A Enteric Fermentation][3.A.3 Swine][Other (please specify)][Tokelau_Swine]	Unit	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)
Additional information											
Weight	kg	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Feeding situation		Pen	Pen	Pen	Pen	Pen	Pen	Pen	Pen	Pen	Pen
Milk yield	kg/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Work	h/day	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Pregnant	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Digestibility of feed	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross energy	MJ/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 3.A.3 Tokelau Swine: [3. Agriculture][3.1 Livestock][3.A Enteric Fermentation][3.A.3 Swine][Other (please specify)][Tokelau_Swine] (Part 2 of 3)

[3. Agriculture][3.1 Livestock] [3.A Enteric Fermentation] [3.A.3 wine][Other (please specify)] [Tokelau_Swine]	Unit	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)
Population	1000s	2.518	2.653	2.633	2.613	2.592	2.572	2.552	2.514	2.476	2.438
Average gross energy intake	MJ/head/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average CH_4 conversion rate	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions											
CH_4	kt	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Implied Emission Factor											
CH_4	kg/head/year	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Additional information											
Weight	kg	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Feeding situation		Pen	Pen	Pen	Pen	Pen	Pen	Pen	Pen	Pen	Pen
Milk yield	kg/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Work	h/day	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

[3. Agriculture][3.1 Livestock] [3.A Enteric Fermentation] [3.A.3 wine][Other (please specify)] [Tokelau_Swine]	Unit	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)
Pregnant	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Digestibility of feed	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross energy	MJ/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 3.A.3 Tokelau Swine: [3. Agriculture][3.1 Livestock][3.A Enteric Fermentation][3.A.3 Swine][Other (please specify)][Tokelau_Swine] (Part 3 of 3)

[3. Agriculture][3.1 Livestock] [3.A Enteric Fermentation][3.A.3 Swine] [Other (please specify)][Tokelau_Swine]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Population	1000s	2.400	2.362	2.219	2.076	1.933	1.790	1.647	1.647	1.647	1.647
Average gross energy intake	MJ/head/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average CH_4 conversion rate	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions											
CH_4	kt	0.004	0.004	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002
Implied Emission Factor											
CH_4	kg/head/year	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Additional information											
Weight	kg	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Feeding situation		Pen	Pen	Pen	Pen	Pen	Pen	Pen	Pen	Pen	Pen
Milk yield	kg/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Work	h/day	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Pregnant	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Digestibility of feed	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross energy	MJ/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 3.A.4 Tokelau Poultry [3. Agriculture][3.1 Livestock][3.A Enteric Fermentation][3.A.4 Other livestock][Tokelau_Poultry] (Part 1 of 3)

[3. Agriculture][3.1 Livestock][3.A Enteric Fermentation][3.A.4 Other livestock][Tokelau_Poultry]	Unit	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)
Population	1000s	3.439	3.500	3.394	3.288	3.182	3.076	2.970	2.840	2.709	2.579
Average gross energy intake	MJ/head/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average CH_4 conversion rate	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method											
CH_4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emission Factor information											
CH_4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emissions											
CH_4	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Implied Emission Factor											
CH_4	kg/head/year	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Additional information											
Weight	kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Feeding situation		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Milk yield	kg/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Work	h/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pregnant	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Digestibility of feed	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross energy	MJ/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 3.A.4 Tokelau Poultry [3. Agriculture][3.1 Livestock][3.A Enteric Fermentation][3.A.4 Other livestock][Tokelau_Poultry] (Part 2 of 3)

[3. Agriculture][3.1 Livestock][3.A Enteric Fermentation][3.A.4 Other livestock][Tokelau_Poultry]	Unit	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)
Population	1000s	2.448	2.318	2.229	2.140	2.052	1.963	1.874	1.712	1.550	1.388
Average gross energy intake	MJ/head/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average CH_4 conversion rate	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method											
CH_4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emission Factor information											
CH_4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emissions											
CH_4	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Implied Emission Factor											
CH_4	kg/head/year	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Additional information											
Weight	kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Feeding situation		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Milk yield	kg/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Work	h/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pregnant	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Digestibility of feed	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross energy	MJ/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 3.A.4 Tokelau Poultry [3. Agriculture][3.1 Livestock][3.A Enteric Fermentation][3.A.4 Other livestock][Tokelau_Poultry] (Part 3 of 3)

[3. Agriculture][3.1 Livestock][3.A Enteric Fermentation][3.A.4 Other livestock] [Tokelau_Poultry]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Population	1000s	1.226	1.064	0.976	0.888	0.801	0.713	0.625	0.625	0.625	0.625
Average gross energy intake	MJ/head/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average CH_4 conversion rate	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method											
CH_4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emission Factor information											
CH_4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Emissions											
CH_4	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Implied Emission Factor											
CH_4	kg/head/year	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Additional information											
Weight	kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Feeding situation		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Milk yield	kg/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Work	h/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pregnant	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Digestibility of feed	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gross energy	MJ/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CRF Table 3.B.1.3 Tokelau Swine: [3. Agriculture][3.1 Livestock][3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.3 Swine][Other (please specify)][Pigs] (Part 1 of 3)

[3. Agriculture][3.1 Livestock][3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.3 Swine][Other (please specify)][Pigs]	Unit	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)
Population	1000s	2.293	2.500	2.395	2.290	2.186	2.081	1.976	2.111	2.247	2.382
Allocation by climate region											
Warm	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Typical animal mass (average)	kg	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
VS daily excretion (average)	kg dm/head/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4 producing potential (average)	m^3/kg VS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions											
CH_4	kt	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Implied Emission Factor											
CH_4	kg/head/year	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50

CRF Table 3.B.1.3 Tokelau Swine: [3. Agriculture][3.1 Livestock][3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.3 Swine][Other (please specify)][Pigs] (Part 2 of 3)

[3. Agriculture][3.1 Livestock] [3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.3 Swine] [Other (please specify)][Pigs]	Unit	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)
Population	1000s	2.518	2.653	2.633	2.613	2.592	2.572	2.552	2.514	2.476	2.438
Allocation by climate region											
Warm	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Typical animal mass (average)	kg	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
VS daily excretion (average)	kg dm/head/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4 producing potential (average)	m^3/kg VS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method											

[3. Agriculture][3.1 Livestock] [3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.3 Swine] [Other (please specify)][Pigs]	Unit	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)
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions											
CH_4	kt	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Implied Emission Factor											
CH_4	kg/head/year	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50

CRF Table 3.B.1.3 Tokelau Swine: [3. Agriculture][3.1 Livestock][3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.3 Swine][Other (please specify)][Pigs] (Part 3 of 3)

[3. Agriculture][3.1 Livestock] [3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.3 Swine] [Other (please specify)][Pigs]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Population	1000s	2.400	2.362	2.219	2.076	1.933	1.790	1.647	1.647	1.647	1.647
Allocation by climate region											
Warm	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	101.00	102.00
Typical animal mass (average)	kg	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
VS daily excretion (average)	kg dm/head/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4 producing potential (average)	m^3/kg VS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions											
CH_4	kt	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03
Implied Emission Factor											
CH_4	kg/head/year	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50

CRF Table 3.B.1.4 Tokelau Poultry: [3. Agriculture][3.1 Livestock][3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.4 Other livestock][Tokelau_Poultry] (Part 1 of 3)

[3. Agriculture][3.1 Livestock][3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.4 Other livestock][Tokelau_Poultry]	Unit	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)
Population	1000s	3.439	3.500	3.394	3.288	3.182	3.076	2.970	2.840	2.709	2.579
Allocation by climate region											
Cool	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Temperature	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Warm	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Typical animal mass (average)	kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VS daily excretion (average)	dm/head/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4 producing potential (average)	m^3/kg VS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions											
CH_4	kt	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Implied Emission Factor											
CH_4	kg/head/year	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

CRF Table 3.B.1.4 Tokelau Poultry: [3. Agriculture][3.1 Livestock][3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.4 Other livestock][Tokelau_Poultry] (Part 2 of 3)

[3. Agriculture][3.1 Livestock] [3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.4 Other livestock] [Tokelau_Poultry]	Unit	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)
Population	1000s	2.448	2.318	2.229	2.140	2.052	1.963	1.874	1.712	1.550	1.388
Allocation by climate region											
Cool	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Temperature	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Warm	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Typical animal mass (average)	kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VS daily excretion (average)	dm/head/day	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4 producing potential (average)	m^3/kg VS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions											
CH_4	kt	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.00005	0.00004
Implied Emission Factor											
CH_4	kg/head/year	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

CRF Table 3.B.1.4 Tokelau Poultry: [3. Agriculture][3.1 Livestock][3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.4 Other livestock][Tokelau_Poultry] (Part 3 of 3)

[3. Agriculture][3.1 Livestock][3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.4 Other livestock] [Tokelau_Poultry]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Population	1000s	1.226	1.064	0.976	0.888	0.801	0.713	0.625	0.625	0.625	0.625
Allocation by climate region											
Cool	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Temperature	%	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Warm	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Typical animal mass (average)	kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VS daily excretion (average)	Kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[3. Agriculture][3.1 Livestock][3.B Manure Management][3.B.1 CH_4 Emissions][3.B.1.4 Other livestock] [Tokelau_Poultry]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
	dm/head/day										
CH_4 producing potential (average)	m^3/kg VS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions											
CH_4	kt	0.00004	0.00003	0.00003	0.00003	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Implied Emission Factor											
CH_4	kg/head/year	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

CRF Table 5.A: [5. Waste][5.A Solid Waste Disposal] (Part 1 of 3)

[5. Waste][5.A Solid Waste Disposal]	Unit	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)
Method											
CO_2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions	kt CO_2 equivalent	0.39	0.39	0.39	0.39	0.38	0.38	0.38	0.38	0.37	0.37
CO_2	kt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
Nox	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

CRF Table 5.A: [5. Waste][5.A Solid Waste Disposal] (Part 2 of 3)

[5. Waste][5.A Solid Waste Disposal]	Unit	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)
Method											
CO_2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions	kt CO_2 equivalent	0.37	0.37	0.36	0.36	0.35	0.35	0.34	0.33	0.32	0.31
CO_2	kt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Nox	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

CRF Table 5.A: [5. Waste][5.A Solid Waste Disposal] (Part 3 of 3)

[5. Waste][5.A Solid Waste Disposal]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Method											
CO_2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions	kt CO_2 equivalent	0.31	0.31	0.30	0.30	0.30	0.30	0.30	0.30	0.31	0.31
CO_2	kt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Nox	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

CRF Table 5.A.3: [5. Waste][5.A Solid Waste Disposal] [5.A.3 Uncategorized Waste Disposal Sites] (Part 1 of 3)

[5. Waste][5.A Solid Waste Disposal][5.A.3 Uncategorized Waste Disposal Sites]	Unit	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)
Annual waste at the SWDS	kt	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.51	0.51
McF		0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
DOcF	%	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Method											
CO_2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
Amount of CH_4 flared	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Amount of CH_4 for energy re	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
No_x	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Implied Emission Factor											
CO_2	kg/t	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kg/t	0.029	0.030	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029

CRF Table 5.A.3: [5. Waste][5.A Solid Waste Disposal] [5.A.3 Uncategorized Waste Disposal Sites] (Part 2 of 3)

[5. Waste][5.A Solid Waste Disposal][5.A.3 Uncategorized Waste Disposal Sites]	Unit	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)
Annual waste at the SWDS	kt	0.50	0.50	0.48	0.46	0.44	0.42	0.40	0.40	0.40	0.41
McF		0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
DOcF	%	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Method											
CO_2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Amount of CH_4 flared	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Amount of CH_4 for energy re	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Nox	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Implied Emission Factor											
CO_2	kg/t	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kg/t	0.029	0.029	0.030	0.031	0.032	0.033	0.034	0.033	0.032	0.031

CRF Table 5.A.3: [5. Waste][5.A Solid Waste Disposal] [5.A.3 Uncategorized Waste Disposal Sites] (Part 3 of 3)

[5. Waste][5.A Solid Waste Disposal] [5.A.3 Uncategorized Waste Disposal Sites]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Annual waste at the SWDS	kt	0.41	0.42	0.42	0.43	0.43	0.44	0.44	0.44	0.44	0.44
McF		0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
DOcF	%	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Method											
CO_2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Amount of CH_4 flared	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Amount of CH_4 for energy recovery	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
NO_x	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Implied Emission Factor											
CO_2	t/t	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4	t/t	0.030	0.030	0.029	0.028	0.028	0.028	0.027	0.027	0.028	0.028

CRF Table 5.C.2.2.a: [5. Waste][5.C Incineration and Open Burning of Waste][5.C.2 Open Burning of Waste][5.C.2.2 Non-biogenic][5.C.2.2.a Municipal Solid Waste] (Part 1 of 3)

[5. Waste][5.C Incineration and Open Burning of Waste][5.C.2 Open Burning of Waste][5.C.2.2 Non-biogenic]	Unit	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)
Amount of Waste incinerated/open	kt	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.51	0.51
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04
CH_4	kt	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
N_2O	kt	0.00005	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004
Implied Emission Factor											
CO_2	kg/t	86.73	86.73	86.73	86.73	86.73	86.73	86.73	86.73	86.73	86.73
CH_4	kg/t	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
N_2O	kg/t	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

CRF Table 5.C.2.2.a: [5. Waste][5.C Incineration and Open Burning of Waste][5.C.2 Open Burning of Waste][5.C.2.2 Non-biogenic][5.C.2.2.a Municipal Solid Waste] (Part 2 of 3)

[5. Waste][5.C Incineration and Open Burning of Waste][5.C.2 Open Burning of Waste][5.C.2.2 Non-biogenic]	Unit	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)
Amount of Waste incinerated/open	kt	0.50	0.50	0.48	0.46	0.44	0.42	0.40	0.40	0.40	0.41
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.04
CH_4	kt	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
N_2O	kt	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00003	0.00003	0.00003	0.00003
Implied Emission Factor											
CO_2	kg/t	86.73	86.73	86.73	86.73	86.73	86.73	86.73	86.73	86.73	86.73
CH_4	kg/t	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
N_2O	kg/t	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

CRF Table 5.C.2.2.a: [5. Waste][5.C Incineration and Open Burning of Waste][5.C.2 Open Burning of Waste][5.C.2.2 Non-biogenic][5.C.2.2.a Municipal Solid Waste] (Part 3 of 3)

[5. Waste][5.C Incineration and Open Burning of Waste][5.C.2 Open Burning of Waste][5.C.2.2 Non-biogenic]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Amount of Waste incinerated/open burned	kt	0.41	0.42	0.42	0.43	0.43	0.44	0.44	0.44	0.44	0.44
Method											
CO_2		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CO_2		D	D	D	D	D	D	D	D	D	D
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CO_2	kt	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
CH_4	kt	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
N_2O	kt	0.00003	0.00003	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004
Implied Emission Factor											
CO_2	kg/t	86.73	86.73	86.73	86.73	86.73	86.73	86.73	86.73	86.73	86.73
CH_4	kg/t	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
N_2O	kg/t	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

CRF Table 5.D: [5. Waste][5.D Wastewater Treatment and Discharge] (Part 1 of 3)

[5. Waste][5.D Wastewater Treatment and Discharge]	Unit	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)
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions	kt CO_2 equivalent	0.17	0.17	0.17	0.18	0.18	0.19	0.19	0.21	0.22	0.23
CH_4	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
N_2O	kt	0.0001	0.0001	0.0001	0.0001	0.00005	0.00005	0.00004	0.00004	0.00003	0.00003
NO_x	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Additional information											
Population	1000s	1.568	1.537	1.531	1.525	1.519	1.513	1.507	1.495	1.484	1.472
Protein consumption	kg/person/yr	32.45	32.45	32.45	32.45	32.45	32.45	32.45	32.45	32.45	32.45
Fraction of nitrogen in protein		0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Factor of non-consumed protein added to the wastewater		1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Factor of industrial and commercial co-discharged protein into the sewer system		1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Degree of utilization of modern, centralized WWT plants	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

CRF Table 5.D: [5. Waste][5.D Wastewater Treatment and Discharge] (Part 2 of 3)

[5. Waste][5.D Wastewater Treatment and Discharge]	Unit	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)
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions	kt CO_2 equivalent	0.24	0.26	0.25	0.24	0.23	0.22	0.21	0.22	0.22	0.22
CH_4	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
N_2O	kt	0.00002	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
NO_x	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Additional information											
Population	1000s	1.461	1.449	1.389	1.330	1.270	1.211	1.151	1.162	1.173	1.183
Protein consumption	kg/person/yr	32.45	32.45	32.45	32.45	32.45	32.45	32.45	32.45	32.45	32.45
Fraction of nitrogen in protein		0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Factor of non-consumed protein added to the wastewater		1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Factor of industrial and commercial co-discharged protein into the sewer system		1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Degree of utilization of modern, centralized WWT plants	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

CRF Table 5.D: [5. Waste][5.D Wastewater Treatment and Discharge] (Part 3 of 3)

[5. Waste][5.D Wastewater Treatment and Discharge]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission Factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions	kt CO_2 equivalent	0.23	0.23	0.24	0.24	0.25	0.26	0.26	0.26	0.26	0.26
CH_4	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
N_2O	kt	0.00001	0.00001	0.00001	0.000004	0.000003	0.000001	0.00	0.00	0.00	0.00
NO_x	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Additional information											
Population	1000s	1.194	1.205	1.221	1.237	1.253	1.269	1.285	1.285	1.285	1.285
Protein consumption	kg/person/yr	32.45	32.45	32.45	32.45	32.45	32.45	32.45	32.45	32.45	32.45
Fraction of nitrogen in protein		0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Factor of non-consumed protein added to the wastewater		1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Factor of industrial and commercial co-discharged protein into the sewer system		1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Degree of utilization of modern, centralized WWT plants	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00

CRF Table 5.D.1: [5. Waste][5.D Wastewater Treatment and Discharge] [5.D.1 Domestic Wastewater] (Part 1 of 3)

[5. Waste][5.D Wastewater Treatment and Dischargel][5.D.1 Domestic wastewater]	Unit	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)
Total organic product	kt DC	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Sludge removed	kt DC	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
N in effluent	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.005	0.004	0.003
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CH_4	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Amount of CH_4 flared	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Amount of CH_4 for energy re	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
N_2O	kt	0.0001	0.0001	0.0001	0.0001	0.00005	0.00005	0.00004	0.00004	0.00003	0.00003
NO_x	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Implied Emission Factor											
CH_4	kg/kg DC	0.14	0.14	0.15	0.16	0.16	0.17	0.18	0.19	0.21	0.22
N_2O	kg N_2O-N/kg N	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

CRF Table 5.D.1: [5. Waste][5.D Wastewater Treatment and Discharge] [5.D.1 Domestic Wastewater] (Part 2 of 3)

[5. Waste][5.D Wastewater Treatment and Dischargel] [5.D.1 Domestic wastewater]	Unit	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)
Total organic product	kt DC	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
Sludge removed	kt DC	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
N in effluent	kt	0.003	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CH_4	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Amount of CH_4 flared	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Amount of CH_4 for energy re	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
N_2O	kt	0.00002	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
NO_x	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Implied Emission Factor											
CH_4	kg/kg DC	0.24	0.25	0.26	0.26	0.26	0.26	0.27	0.27	0.27	0.27
N_2O	kg N_2O-N/kg N	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

CRF Table 5.D.1: [5. Waste][5.D Wastewater Treatment and Discharge] [5.D.1 Domestic Wastewater] (Part 3 of 3)

[5. Waste][5.D Wastewater Treatment and Dischargel] [5.D.1 Domestic wastewater]	Unit	2010 (kt CO_2-equivalent)	2011 (kt CO_2-equivalent)	2012 (kt CO_2-equivalent)	2013 (kt CO_2-equivalent)	2014 (kt CO_2-equivalent)	2015 (kt CO_2-equivalent)	2016 (kt CO_2-equivalent)	2017 (kt CO_2-equivalent)	2018 (kt CO_2-equivalent)	2019 (kt CO_2-equivalent)
Total organic product	kt DC	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
Sludge removed	kt DC	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
N in effluent	kt	0.001	0.001	0.001	0.0005	0.0003	0.0002	NO	NO	NO	NO
Method											
CH_4		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
N_2O		T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Emission factor information											
CH_4		D	D	D	D	D	D	D	D	D	D
N_2O		D	D	D	D	D	D	D	D	D	D
Emissions											
CH_4	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Amount of CH_4 flared	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Amount of CH_4 for energy recovery	kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
N_2O	kt	0.00001	0.00001	0.00001	0.000004	0.000003	0.000001	NO	NO	NO	NO
NO_x	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
NMVOC	kt	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Implied Emission Factor											
CH_4	kg/kg DC	0.28	0.28	0.28	0.29	0.29	0.30	0.30	0.30	0.30	0.30
N_2O	kg N_2O-N/kg N	0.01	0.01	0.01	0.01	0.01	0.01	NO	NO	NO	NO

Annex 8: Agricultural emissions from fertilisers and by livestock type

A8.1 Agricultural emissions from fertilisers

Fertilisers provide the nutrients to grow and nourish pastures and crops. Nitrogen, phosphate, potassium and sulphur are the four most important nutrients for pasture and crop yields and sustainable food production.

New Zealand's farmers use both organic and synthetic nitrogen (N) fertilisers. The main types of synthetic N fertilisers used in New Zealand include urea, diammonium phosphate (DAP) and ammonium sulphate. Urea fertiliser accounts for the majority of the synthetic N fertiliser used in New Zealand. It is mainly applied to dairy pasture land to boost pasture growth during the autumn and spring months.

All nitrogen fertilisers provide N inputs to agricultural soils that result in direct and indirect emissions of nitrous oxide (N_2O) (see figure 5.5.1 in chapter 5). Urea also releases carbon dioxide (CO_2).

Emissions from organic fertilisers come solely from animal manure. Most animal manure in New Zealand is excreted directly onto pasture, but some manure from dairy farms is kept in manure management systems and applied to soils as an organic fertiliser (see table 5.3.2 in chapter 5, for further details). Some manure is also collected but not stored; rather, it is spread directly onto pasture daily (e.g., swine manure and some dairy manure).

Emissions of N_2O from all synthetic (including urea) N fertilisers are reported in categories 3.D.1.1 and 3.D.1.2 respectively. Emissions of CO_2 from urea are not included under synthetic N fertilisers and are reported under a dedicated category 3.H.

2019

In 2019, the combined effect of synthetic and organic N fertilisers amounted to 23.6 per cent of emissions from the *Agricultural soils* category and 6.1 per cent from all agricultural emissions (when CO_2-e from urea is included).

Table A8.1.1 shows comparisons of both N_2O and CO_2 emissions from fertilisers to New Zealand's national totals for each gas and New Zealand's gross emissions.

Table A8.1.1 Direct and indirect emissions by fertiliser in 2019

			Percentage of	
Fertiliser type	Gas/source	Emissions kt CO_2-e	N_2O emissions from Agriculture soils by gas (%)	all emissions from Agriculture (%)
Synthetic N fertiliser	Direct N_2O emissions	1,429.3	18.4	3.6
	Urea	989.1	12.7	2.5
	Other synthetic N fertilisers	440.2	5.7	1.1
	Indirect N_2O emissions from all synthetic N fertilisers	296.0	**3.8**	**0.7**

Fertiliser type	Gas/source	Emissions kt CO_2-e	Percentage of N_2O emissions from Agriculture soils by gas (%)	Percentage of all emissions from Agriculture (%)
	All N_2O (direct + indirect) from synthetic N fertilisers	1,725.3	22.2	4.4
	CO_2 from urea	570.7	NA	1.4
Organic fertiliser	Direct N_2O emissions	76.9	1.0	0.2
	Indirect N_2O emissions	30.7	0.4	0.1
	All N_2O (direct + indirect) from organic fertilisers	107.7	1.4	0.3

Note: NA = not applicable. Columns may not add up due to rounding.

1990–2019

The total amount of fertilisers applied to agricultural soils in New Zealand has significantly increased since 1990. Synthetic N fertiliser applied to agricultural land has increased by 662.7 per cent since 1990, while the use of organic fertiliser has grown by 174.8 per cent (table A8.1.2).

Table A8.1.2 Use of fertilisers in New Zealand in 1990 and 2019

Fertiliser type	1990 Application tonnes (N)	1990 Percentage of synthetic N fertiliser (%)	1990 Percentage of all fertilisers (%)	2019 Application tonnes (N)	2019 Percentage of synthetic N fertiliser (%)	2019 Percentage of all fertilisers (%)	Change in the use between 1990 and 2019 tonnes (N)	Change in the use between 1990 and 2019 (%)
Synthetic N fertiliser (ammonium phosphates, for example, DAP)	34,679	58.5	46.3	94,000	20.8	19.0	59,321	171.1
Urea	24,586	41.5	32.8	358,000	79.2	72.3	333,414	1,356.1
Total synthetic N fertilisers (urea + ammonium phosphates)	59,265	100.0	79.1	452,000	100.0	91.3	392,735	662.7
Organic fertilisers (animal manure applied to soils)	15,644	NA	20.9	42,992	NA	8.7	27,348	174.8

Note: DAP = diammonium phosphate; NA = not applicable. Columns may not add up due to rounding.

Between 1990 and 2019, N_2O emissions from synthetic N fertiliser (both direct and indirect emissions, including urea) have increased by 532.8 per cent, while total emissions from these fertilisers (N_2O and CO_2) have increased by 636.3 per cent. For the same period, total emissions from organic fertilisers increased by 126.9 per cent (see table A8.1.3).

In 1990 and 2019 respectively, 0.8 per cent and 4.4 per cent of total agricultural emissions originated from N_2O from synthetic N fertiliser. Total emissions from synthetic N fertiliser (including urea) have increased from 0.9 per cent to 5.8 per cent of total agricultural emissions for 1990 and 2019 respectively (see chapter 5 for further details).

Table A8.1.3 Emissions from fertilisers in 1990 and 2019

			Synthetic N fertilisers	Organic fertilisers
1990	N_2O emissions	kt CO_2-e	272.6	47.4
	CO_2 emissions	kt	39.2	NA
	Total emissions	**kt CO_2-e**	**311.8**	**47.4**
2019	N_2O emissions	kt CO_2-e	1,725.3	107.7
	CO_2 emissions	kt	570.7	NA
	Total emissions	**kt CO_2-e**	**2,296.1**	**107.7**
Change in N_2O emissions between 1990 and 2019		kt CO_2-e	1,452.7	60.2
Percentage change in N_2O emissions between 1990 and 2019		%	532.8	126.9
Change in all emissions between 1990 and 2019		kt CO_2-e	1,984.21	60.2
Percentage change in all emissions between 1990 and 2019		%	636.3	126.9

Note: NA = not applicable.

A8.2 Agricultural emissions by livestock type

This section covers distribution of greenhouse gas emissions from the Agriculture sector by livestock type in 1990, 2018 and 2019, including the changes in emissions. Table A8.2.1 shows total emissions of all greenhouse gases across all categories of the Agriculture sector. For further details on emissions by gas and by category, refer to the common reporting format (CRF) tables (sector 3 – Agriculture).

Table A8.2.1 Total emissions by livestock type in 1990, 2018 and 2019

	1990	2018	2019	1990–2019		2018–19	
Livestock type		kt CO_2-e		kt CO_2-e	(%)	kt CO_2-e	(%)
Dairy cattle	8,006.4	18,533.9	18,460.1	10,453.7	130.6	–73.8	–0.4
Beef cattle	7,040.6	6,646.3	7,000.8	–39.8	–0.6	354.6	5.3
Sheep	16,278.4	9,745.3	9,595.8	–6,682.6	–41.1	–149.5	–1.5
Deer	517.4	585.8	568.5	51.0	9.9	–17.3	–3.0
Swine	102.0	80.5	71.5	–30.5	–29.9	–9.0	–11.2
Goats	262.8	26.5	27.9	–234.9	–89.4	1.4	5.4
Horses	78.4	33.8	32.0	–46.3	–59.1	–1.7	–5.1
Alpaca	0.1	2.4	2.8	2.7	2,465.5	0.4	18.2
Mules and asses	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Poultry (including all types of poultry)	26.3	56.3	59.4	33.1	125.7	3.1	5.6
Total, all livestock types	**32,312.5**	**35,710.6**	**35,818.9**	**3,506.4**	**9.8**	**108.3**	**0.3**

Note: Columns may not add up due to rounding.