Prepared for
Northland Regional Council
Co No.: N/A

Far North District GHG Emissions Inventory 2022

(1st July 2021 – 30th June 2022)

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Client: Northland Regional Council

Co No.: N/A

Prepared by

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1	01-Dec-2023	Final	Anthony Hume Associate Director - Practice Leader Sustainability & Resilience	

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Executive Summary

This report details the Greenhouse Gas (GHG) emissions produced within the geographic boundary of the Far North District (administered by Far North District Council). This document reports GHG emissions produced in or resulting from activity or consumption during the FY22 government financial year (1st July 2021 to 30th June 2022).

The emissions have been measured and reported using the production-based Global Protocol for Community-Scale Greenhouse Gas Emissions Inventory (GPC) methodology. This approach includes GHG emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture, and Forestry. The GPC methodology focusses on GHG emissions directly produced in the geographic area and does not account for emissions related to the manufacture of products consumed or used within the area but manufactured elsewhere (such as from construction materials produced elsewhere). This method ensures that all GHG emissions are accounted for within geographic boundaries and enables the direct assessment of an area's contribution to the production of global GHG emissions.

The Far North District is referred to hereafter as the Far North for ease. GHG emissions are generally reported in this document in units of carbon dioxide equivalents (CO_2e) and are referred to as 'emissions'.

Major findings of the Far North FY22 inventory include:

- **Total gross emissions** in FY22 were 1,130,970 tCO_2e.
- **Agriculture** represented 61% of total gross emissions, with cattle accounting for 87% of agricultural emissions. Cattle represented 75% of total livestock numbers in the Far North (dairy and non-dairy). Fertiliser use and sheep represented the majority of the remaining agriculture emissions.
- **Transport** (e.g., emissions resulting from road, marine, and air travel) represented 30% of total gross emissions, with on-road travel accounting for 76% of transport emissions and 23% of total gross emissions.
- **Stationary Energy** (e.g., emissions relating to electricity and LPG consumption) produced 6% of total gross emissions with electricity accounting for 62% of stationary energy emissions.
- **Industrial Processes and Product Use** (IPPU) (e.g., emissions from refrigerant gasses and aerosols) represented 2% of total gross emissions.
- **Waste** (e.g., emissions from landfill and wastewater treatment) was responsible for 1% of total gross emissions.
- **Net Forestry** emissions totalled 112,271 tCO_2e. This is because emissions from forest harvesting in this year (e.g., the release of carbon from timber, roots, and organic matter following harvesting) were greater than the carbon sequestrated by forests (carbon captured and stored in plants or soil). Net Forestry emissions are not included in total gross emissions but are included in total net emissions. Therefore, **total net emissions** (gross emissions including forestry) were 1,243,242 tCO_2e. Due to substantial commercial forestry planting and harvesting in the region, the net forestry and therefore total net emissions figure is likely to change significantly year-to-year based on commercial forestry activities in that year.

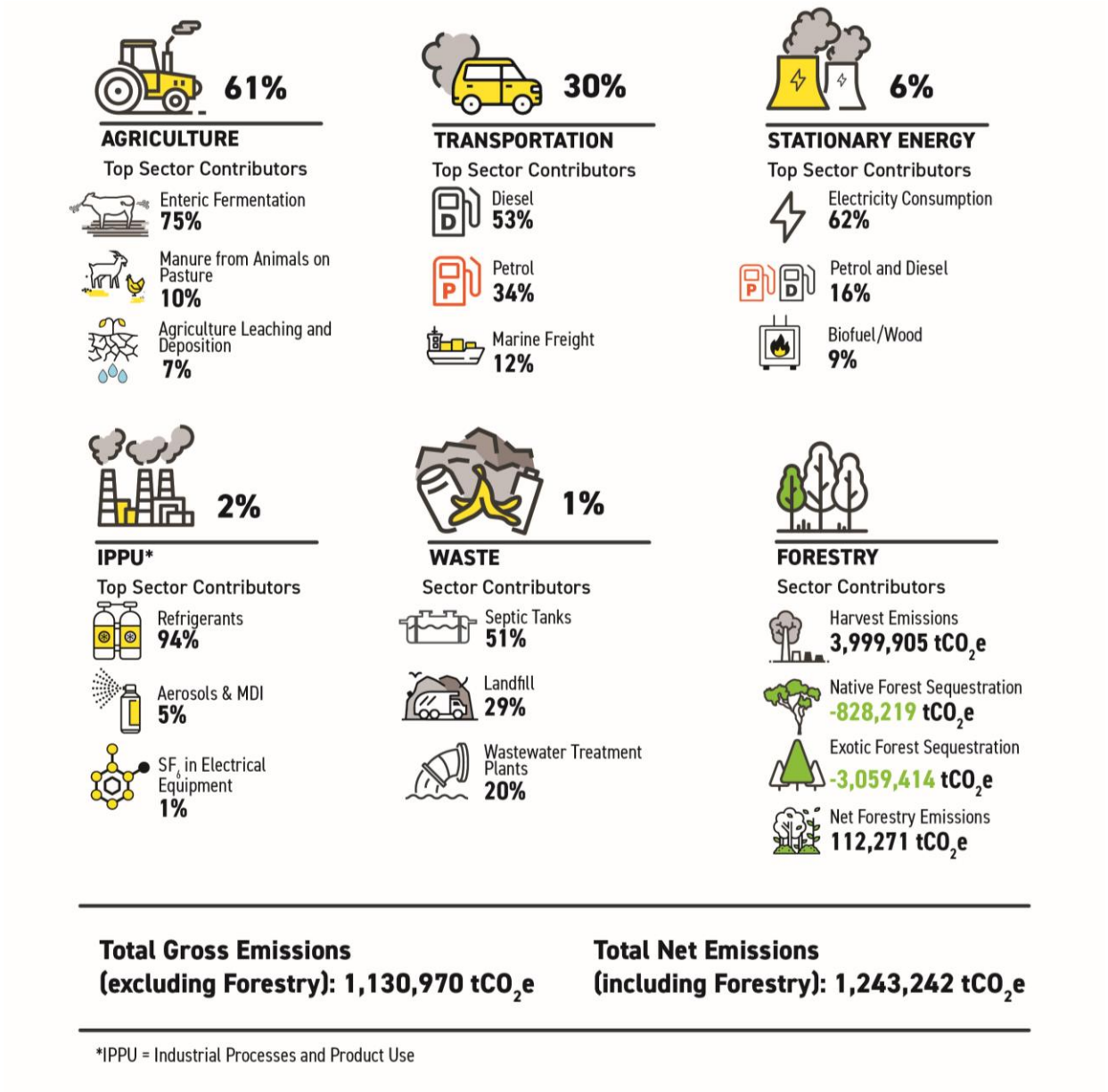

Figure 1: Far North FY22 Emissions Footprint

1.0 Introduction

Northland Regional Council commissioned AECOM New Zealand Limited (AECOM) to assist in developing a production-based community-scale greenhouse gas (GHG) emissions footprint for the Far North District for the 2022 financial year (FY22). The FY22 year covers the period from 1st July 2021 to 30th June 2022 (Government financial year). This is part of a wider study to develop emissions inventories for Te Tai Tokerau and each district within Te Tai Tokerau.

The purpose of the GHG emissions inventory for FY22 is to estimate the relative scale of GHG emissions produced in the Far North District and the relative contribution of different emission sources to the Far North's total emissions. The results of this inventory can be used to assess trends and changes in the emissions produced in the Far North District over time.

The study boundary incorporates the jurisdiction of the Far North District Council (the Far North District). The Far North District is hereafter referred to as the Far North for ease.

2.0 Approach

The methodological approach used to calculate emissions follows the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventory v1.1 (GPC) published by the World Resources Institute (WRI) 2021. The GPC methodology follows a production-based approach and allocates emissions to the geographic area where the emissions are produced as opposed to final users. Production-based approaches exclude global emissions relating to consumption (i.e., embodied emissions relating to products produced elsewhere but consumed within the geographic area, such as imported food products, cars, phones, clothes etc.).

The same methodology has been used for other community scale GHG footprints around New Zealand, (e.g., the Bay of Plenty district, Hawke's Bay district, Auckland, Christchurch, Dunedin, and the Waikato district) and internationally. The GPC methodology[1] represents international best practice for city and regional level GHG emissions reporting and offers a robust, established method, which enables comparisons between different studies.

This emissions footprint assesses both direct and indirect emissions sources. Direct emissions are production-based and occur within the geographic area (Scope 1 in the GPC reporting framework). Indirect emissions are produced outside the geographic boundary (Scope 2 and 3) but are allocated to the consumption location. An example of indirect emissions is those associated with electricity consumption, which is supplied by the national grid (Scope 2). All other indirect emissions, such as cross-boundary travel (e.g., flights) and energy transportation and distribution losses, are Scope 3.

The inventory is based on data and reporting guidance available at the time of calculation, using reasonable assumptions in line with the GPC reporting guidance, and may need to be updated in the future to account for changes in data availability or changes to reporting guidance. This inventory uses conversion figures (i.e., global warming potentials) from the IPCC 6th Assessment Report (2021).

Greenhouse gas emissions are generally reported in this document in Carbon Dioxide Equivalent (CO_2e) units and are referred to as 'emissions'.

Overall sector data and results for the emissions footprint have been provided to Northland Regional Council in calculation table spreadsheets. All major assumptions made during data collection and analysis have been detailed within **Appendix A – Assumptions**.

It is essential to consider the uncertainty associated with the results, particularly given the different datasets used. At the national level for New Zealand's Greenhouse Gas Inventory the estimate of gross emissions uncertainty was ±8.8%, with a net emissions uncertainty estimate of ±26.9% (MfE, 2022).

[1] http://www.ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

3.0 Far North District Emissions Inventory for FY22

3.1 Total Gross Emissions

Total emissions are reported as both gross emissions (excluding forestry harvesting and sequestration) and net emissions (including forestry harvesting and sequestration).

During FY22, the Far North emitted **total gross emissions** of 1,130,970 tCO_2e. Agriculture and transport are the Far North's most significant contributors to total gross emissions.

The population of the Far North in FY22 was approximately 73,400 people, resulting in per capita gross emissions of 15.4 tCO_2e/person.

Net emissions differ from gross emissions because they include emissions related to forestry activity (harvesting emissions and sequestration). Total net emissions are presented in section 3.8. The focus of this inventory is on gross emissions as per the GPC reporting guidance.

Table 1 Total gross emissions for FY22

Total Emissions	Emissions (tCO_2e)
Total Gross Emissions (excluding Forestry)	1,130,970

3.2 Emission Sectors and Sources

Figure 2 and Table 2 illustrate the six different sectors that comprise the emissions inventory. A discussion of each sector follows in Sections 3.3 through Section 3.8. Due to rounding, there may be some discrepancy between totals and the sum of results in the tables.

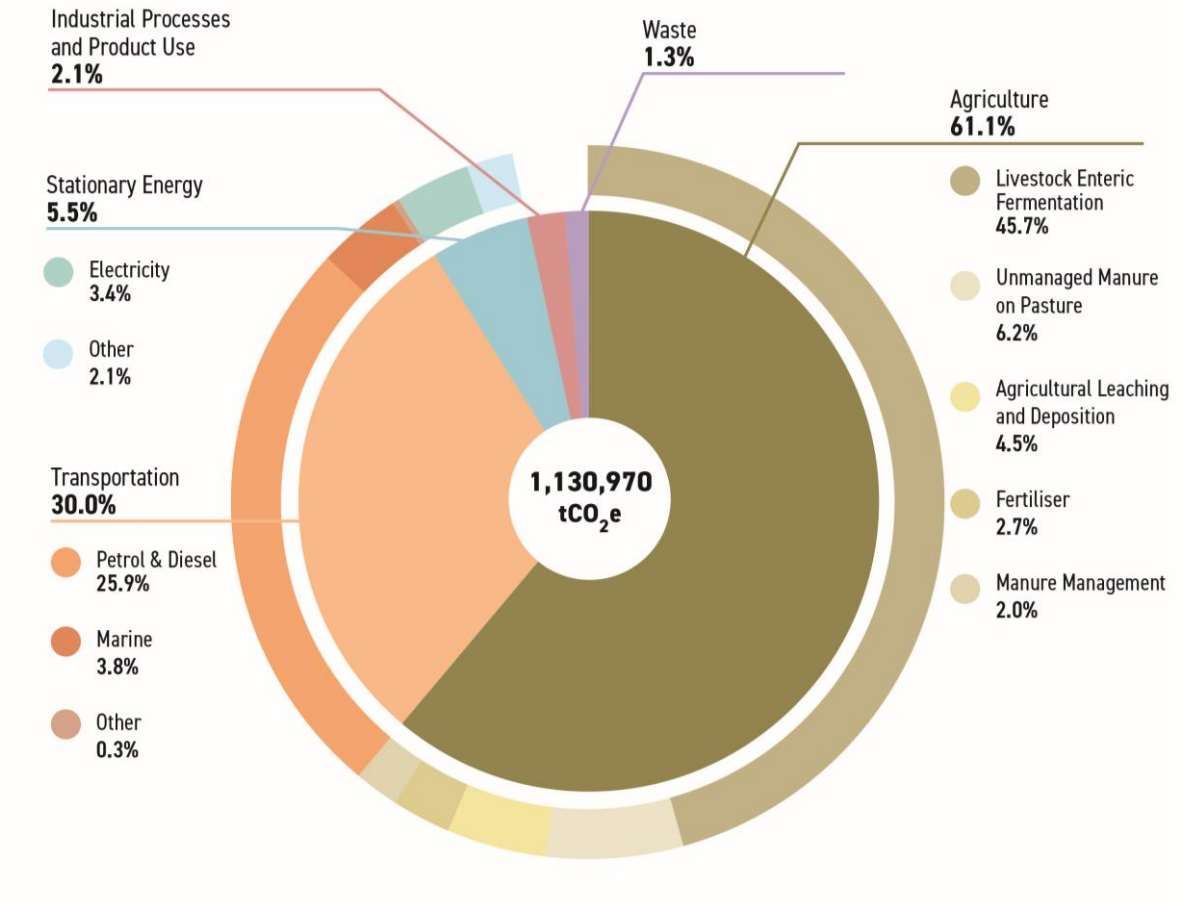

Figure 2: Far North's total gross GHG emissions split by sector (tCO2e) for FY22

Table 2 Far North FY22 emissions by sector

Emissions Source	Emissions (tCO_2e)	Percentage of Total Gross Emissions (%)
Agriculture	691,197	61%
Transportation	338,967	30%
Stationary Energy	62,219	6%
Industrial Processes and Product Use (IPPU)	23,801	2%
Waste	14,787	1%
Total Gross Emissions	**1,130,970**	**100%**

Table 3 shows the emission sources from largest to lowest emission source. Full breakdowns of emissions are presented in Appendix B.

Table 3 Far North FY22 emissions by source

Emissions Source	Emissions (tCO_2e)	Percentage of Total Gross Emissions (%)
Enteric Fermentation	516,679	46%
On-Road Transport	257,730	23%
Unmanaged Manure on Pasture	70,056	6%
Agricultural Leaching and Deposition (Manure, Urine, and Fertiliser)	51,288	5%
Marine Transport	42,430	4%
Electricity Consumption	38,551	3%
Off-Road Transport	35,944	3%
Fertiliser on Land	30,336	3%
Manure Management	22,838	2%
Refrigerant and Air Conditioning Gasses (IPPU)	22,314	2%
Wastewater	10,476	1%
Stationary Diesel and Petrol Use	10,222	1%
Biofuel and Biogas	5,429	<1%
LPG	4,792	<1%
Solid Waste	4,310	<1%
Coal	3,225	<1%
Air Travel	2,863	<1%
Other Industrial Gasses (IPPU)	1,488	<1%
Total Gross Emissions	**1,130,970**	**100%**

3.3 Agriculture

Agricultural emissions were the highest emitting sector in the Far North. Agricultural emissions from both livestock and crop farming were responsible for 61% of the Far North's total gross emissions.

- Enteric fermentation represented 75% of agricultural emissions. Enteric fermentation is the methane (CH_4) released from the digestive process of livestock.
- Nitrous oxide (N_2O) from unmanaged manure deposited directly on land by grazing animals on pasture represented 10% of agricultural emissions.
- Agricultural leaching and deposition (i.e. N_2O produced through the runoff and volatilisation of applied nitrogen inputs such as fertilisers, as well as animal excrements) were responsible for 7% of agricultural emissions.
- Fertilisers on land (i.e. CH_4 and N_2O produced by liming and dolomite use, fertiliser application for horticulture, and crop residues) represented 4% of agricultural emissions.
- Methane and nitrous oxide from managed manure represented 3% of agricultural emissions. Managed manure describes emissions from controlled manure decomposition (typically stored in piles or disposed of in tanks or lagoons).

Agriculture Emissions by Emission Source

Livestock were responsible for the majority of the agriculture sector's GHG emissions. Dairy cattle accounted for 38% of agricultural emissions in the Far North with non-dairy cattle accounting for 49%. In FY22, there were an estimated 78,822 dairy cattle and 171,494 non-dairy cattle in the Far North. Sheep represented 25% of all livestock but 5% of agricultural emissions due to their relatively lower emissions impact compared to cattle. An area of focus to reduce the GHG emissions impact of agriculture could be actions to reduce the methane impact of livestock, especially from enteric fermentation.

Table 4 Agriculture emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Non-dairy Cattle	338,789	30%	49%
Dairy Cattle	260,040	23%	38%
Fertiliser	56,658	5%	8%
Sheep	34,452	3%	5%
Other Livestock	1,258	<1%	<1%
Total	**691,197**	**61%**	**100%**

It is important to note that these agricultural results do not include emissions related to the consumption of agricultural products supplied to the Far North as per the GPC methodology.

3.4 Transport

Transport was the second-highest emitting sector in the Far North, producing a total of 338,967 tCO_2e (30% of total gross emissions). Diesel and petrol use represented 86% of the transport emissions in the Far North.

Diesel and petrol transport emissions are split into on-road and off-road use. On-road transport (e.g. cars, trucks and buses used on roads) was responsible for 76% of transport emissions and 23% of total gross emissions. A key area of focus to reduce the GHG emissions impact of transport could be actions to reduce emissions from on-road transport. Off-road transport was responsible for 11% of transport emissions. Off-road transport consists of all fuel used for off-road vehicles (e.g. agricultural, forestry, and construction vehicles and equipment, and recreational marine use).

A further breakdown of on-road emissions by vehicle type and class has been provided to Northland Regional Council as part of this work.

The next largest emission source in the transport sector was marine transport emissions (from freight vessel journeys, and local commercial operators) which produced 13% of transport emissions and 4% of total gross emissions. It is understood that marine freight imports and exports through Whangārei service the entire Te Tai Tokerau region so therefore marine freight emissions have been allocated across Te Tai Tokerau based on the relative size of the population. Where journeys travel between Te Tai Tokerau and another location, emissions are split equally between the origin and destination location.

Air travel represented 1% of the sector's emissions and 0.3% of total gross emissions. Air travel emissions are based on the fuel consumed by aircraft journeys to and from the Far North, with emissions split equally between the origin and destination location.

3.5 Stationary Energy

Electricity consumption (including transmission and distribution losses) accounted for 62% of stationary energy emissions and 3% of the Far North's total gross emissions. Electricity consumption emissions depend upon the amount of consumption (in kWh), and the emissions intensity of the national grid (tCO_2e/kWh), which changes annually. The emissions intensity of the grid was low in FY22 relative to recent years due to a high proportion of renewable generation nationally, resulting in lower than usual emissions from this source regardless of consumption.

The use of LPG, diesel, petrol, coal, and biofuels produced the remaining stationary energy emissions.

Biogenic CO_2 emissions from the burning of biofuels such as in timber and pulp processing have not been included in these totals and are reported separately in section 3.10.

Stationary Energy Emissions by End-Use

The breakdown of stationary energy emissions by end-use is presented in Table 5. Energy consumption data has been broken down by end-use based on high level information regarding energy end-use.

Industrial stationary energy represented 40% of stationary energy emissions. Industrial use relates to use in agriculture, forestry and fishing, mining, food processing, textiles, chemicals, metals, mechanical/electrical equipment and building and construction activities if present.

Residential stationary energy emissions stem from household use of electricity (e.g. for heating, lighting, and cooking). Commercial stationary energy emissions are those created from commercial and institutional buildings or facilities in all non-residential and non-industrial settings (e.g. in retail, hospitality, education, and healthcare). In the table, 'Other Sources' refers to areas where end-use was unable to be determined.

Table 5 Stationary Energy emissions by end-use

Emissions Source	Emissions (tCO_2e)	% of Sector Total
Industrial	24,858	40%
Residential	15,981	26%
Commercial	11,158	18%
Other Sources	10,222	16%
Total	**62,219**	**100%**

3.6 Waste

Waste produced in the Far North (solid waste and wastewater) comprised 1% of the Far North's total gross emissions.

Wastewater treatment (both treatment plants and individual septic tanks) accounted for 71% of total waste emissions. In the Far North approximately 63% of households were not connected to centralised wastewater treatment plants. These households not connected to wastewater treatment plants (i.e., using individual septic tanks) produced 7,524 tCO_2e in wastewater emissions. Wastewater treatment plants produced 2,952 tCO_2e.

Solid waste represented 29% of total waste emissions. Both open and closed landfills emit landfill gas (methane) from the breakdown of organic materials disposed of in the landfill for many years after waste enters the landfill. The reported emissions here relate to the emissions produced in FY22 from all waste produced in the Far North that has entered landfill sites over the last 50+ years, even if those sites are outside the district. It is noted that the annual emissions from closed landfill sites will decrease over time as no new waste enters these sites.

3.7 Industrial Processes and Product Use (IPPU)

IPPU includes emissions associated with the consumption of industrial products and synthetic gases which have a greenhouse gas impact. This includes products used for refrigerants, foam blowing, fire extinguishers, aerosols, metered dose inhalers and sulphur hexafluoride for electrical insulation and equipment production. No known industrial processes (as defined in the GPC requirements) are present in the Far North (e.g., aluminium manufacture).

IPPU contributed 2% to total gross emissions. The most significant contributor to IPPU emissions was refrigerant gasses, which produced 94% of IPPU emissions. These emissions are based on nationally reported IPPU emissions and apportioned based on population due to the difficulty of allocating emissions to geographic locations.

IPPU emissions do not include energy use for industrial manufacturing, which is included in the relevant Stationary Energy sub-category (e.g., electricity or natural gas).

3.8 Forestry and Total Net Emissions

Total Net Emissions

Net emissions differ from gross emissions because they include emissions related to forestry activity (harvesting emissions and sequestration).

Net Forestry Emissions:

- Sequestration of carbon from the atmosphere from native forests (e.g. mānuka and kānuka) and exotic forest (e.g. pine) while the trees are growing to maturity and,
- emissions released due to harvesting of forests via the release of carbon from organic matter and soils following harvesting.

When forest sequestration exceeds emissions from harvesting in a particular year, forestry is a net-negative source of emissions which results in the area's total net emissions being lower than their total gross emissions. Conversely, when emissions from harvesting exceed the amount of carbon sequestered by native and exotic forests, then forestry is a net-positive source of emissions which results in the area's total net emissions being higher than their total gross emissions. Harvesting of exotic forests can be cyclical in nature. Some years will have higher sequestration, and some years will have higher harvesting emissions determined by the age of forests, commercial operators, and the global market.

In FY22, Forestry in the Far North was a net positive source of emissions.

Table Forestry emissions by emission source (including sequestration)

Sector / Emissions Source	tCO_2e
Harvest Emissions	3,999,905
Native Forest Sequestration	- 828,219
Exotic Forest Sequestration	- 3,059,414
Total (Net)	**112,271**

During the FY22 reporting period, the Far North emitted total net emissions of 1,243,242 tCO_2e. Due to substantial commercial forestry planting and harvesting in the district, the net forestry and therefore total net emissions figure is likely to change year-to-year based on commercial forestry activities in that year.

Table 6 Total net emissions for FY22

Total Emissions	Emissions (tCO_2e)
Total Net Emissions (Gross Emissions plus Net Forestry Emissions)	**1,243,242**

Figure 3 shows total gross emissions and total net emissions in FY22, and the difference from total gross emissions due to the impact of forestry sequestration and harvesting.

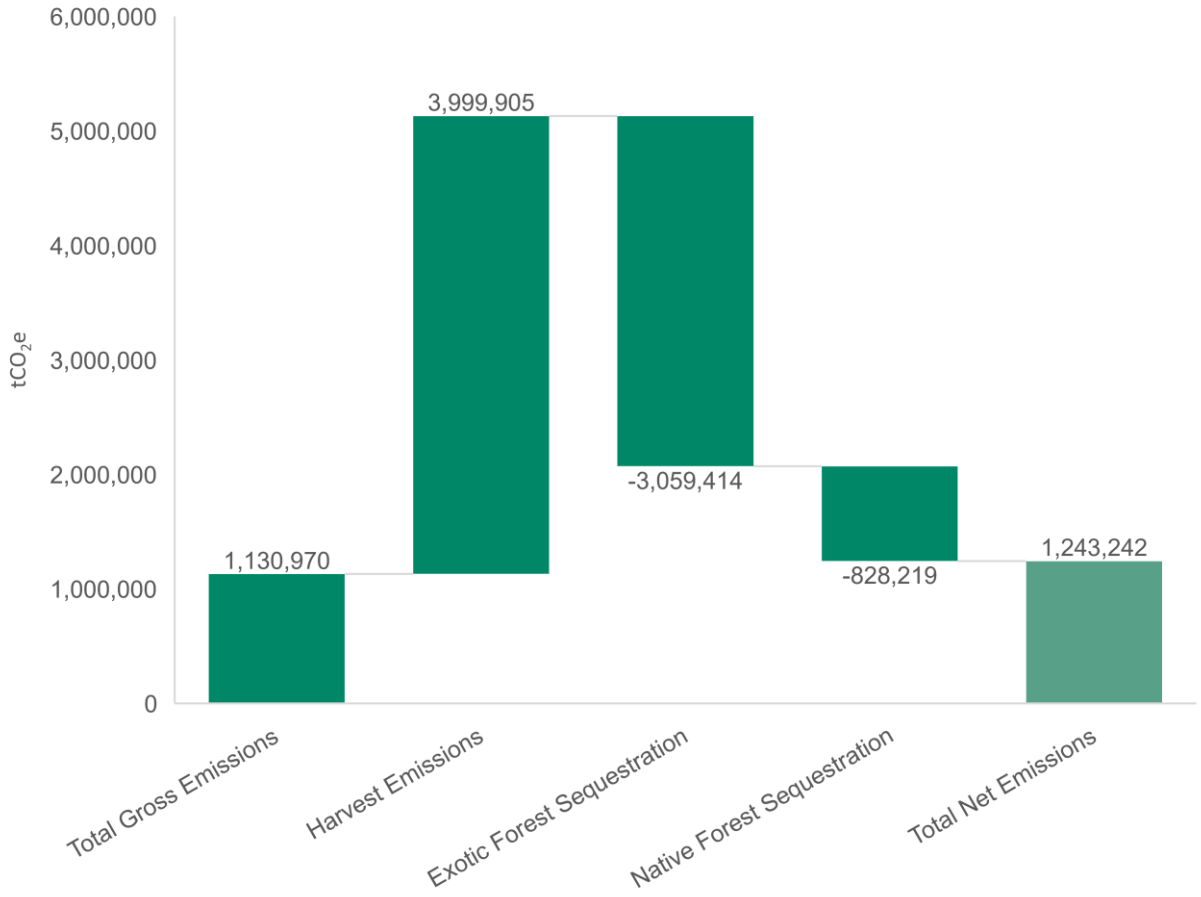

Figure 3: Contribution of gross emissions, forestry emissions, and forest sequestration to total net emissions.

3.9 Total Gross Emissions by Greenhouse Gas

Each greenhouse gas has a different level of impact on climate change, which is accounted for when converting quantities of each gas into units of carbon dioxide equivalent (CO_2e). This assessment uses conversion figures (i.e., global warming potentials) from the IPCC 6th Assessment Report (2021).

Table 7:Far North's total gross emissions by greenhouse gas

Greenhouse Gas	Tonnes	Global Warming Potential (GWP)	Tonnes of CO_2e
Carbon Dioxide (CO_2)	401,393	1	401,393
Biogenic Methane (CH_4) (non-fossil origin)	20,308	27.2	552,378
Non-biogenic Methane (CH_4) (fossil origin)	134	29.8	4,003
Nitrous Oxide (N_2O)	544	273.0	148,513
Other / Unknown Gas (in CO_2e)	24,682	1	24,682
Total	**447,062**	**-**	**1,130,970**

3.10 Biogenic Emissions

Biogenic CH_4 emissions (e.g., produced by farmed cattle via enteric fermentation) are included in gross emissions due to their relatively large contribution to anthropogenic climate change, especially when compared to biogenic CO_2. Biogenic methane represented 5% of the total gross tonnage of GHG emissions in the Far North but 49% of total gross GHG emissions when expressed in CO_2e. This is caused by the higher global warming impact of methane per tonne compared to carbon dioxide.

Table 8: Biogenic Methane in the Far North (Included in gross emissions)

Biogenic Methane (CH_4) (Included in gross emissions)		
Enteric Fermentation (Livestock)	18,996	tCH_4
Manure Management (Livestock)	839	tCH_4
Wastewater Treatment	345	tCH_4
Landfill Gas	127	tCH_4
Biofuel	2	tCH_4
Total Biogenic Methane (CH_4)	**20,308**	**tCH_4**

Biogenic CO_2 emissions result from the combustion of biomass materials that store and sequester CO_2, including materials used to make biofuels (e.g., trees, crops, vegetable oils, or animal fats). Biogenic CO_2 emissions from humans, plants and animals (i.e. non-fossil origin) are excluded from gross and net emissions as they are part of the natural carbon cycle and have a relatively small impact on anthropogenic climate change. Additional biogenic CO_2 emissions such as from landfill are also present however measurement and reporting of these emissions is not prioritised within the GPC method.

Table 9: Biogenic CO_2 in the Far North (Excluded from gross emissions)

Biogenic Carbon Dioxide (CO_2) (Excluded from gross emissions)		
Biofuel	65,549	tCO_2
Wastewater Treatment	3,004	tCO_2
Total Biogenic CO_2	**68,553**	**tCO_2**

3.11 Territorial Authorities in Te Tai Tokerau

Te Tai Tokerau contains three territorial authorities: Whangārei District, Far North District and Kaipara District.

Figure 4 shows total gross emissions for the territorial authorities in Te Tai Tokerau, split by sector.

Whangārei District is the highest emitting territorial authority in the region, representing 39% of Te Tai Tokerau's total gross emissions. Kaipara has the lowest total gross emissions.

Key findings:

- Te Tai Tokerau's emissions inventory is predominantly agriculture-related with all territorial authorities containing significant agricultural emissions.
- Transport is the second largest emissions source in the region, with significant transport emissions in Whangārei and the Far North.
- Stationary Energy is the third highest emission source in the region, with the majority of these emissions produced in Whangārei, particularly from industrial uses of natural gas.

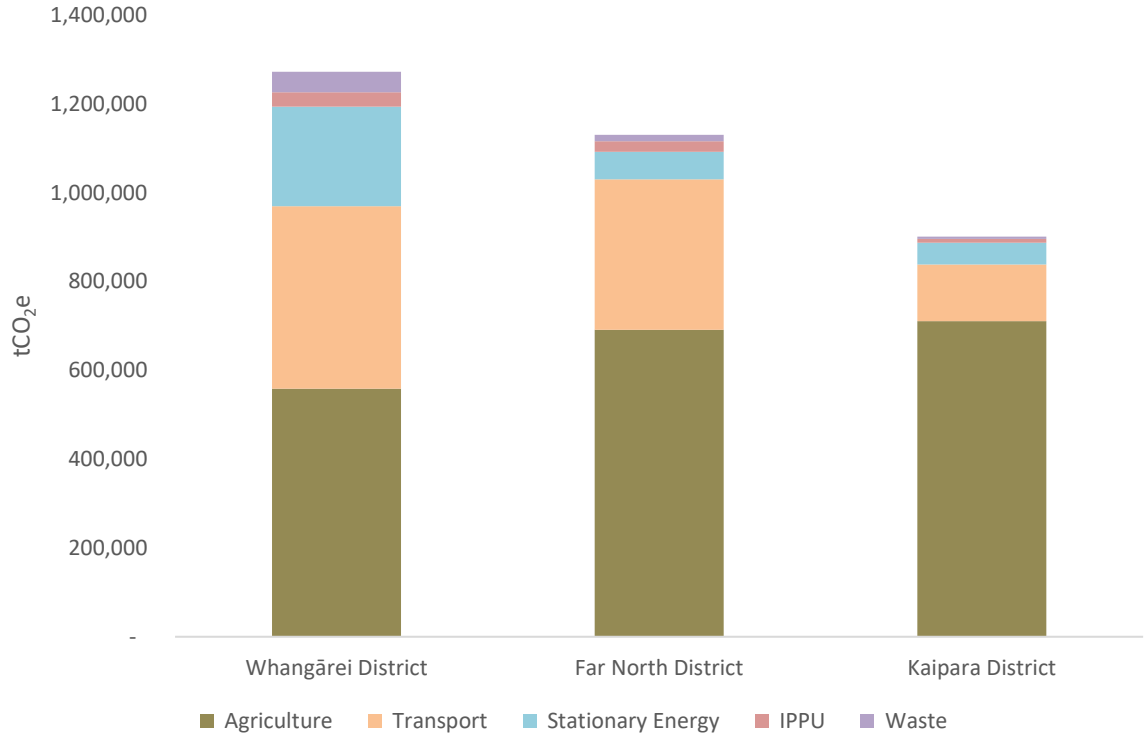

Figure 4 Total gross emissions by territorial authority in Te Tai Tokerau (tCO_2e).

When comparing emissions inventories from different areas, a per capita figure can be useful because it provides a common reference point to understand the difference in emissions. Figure 5 shows emissions per capita for the territorial authorities within Te Tai Tokerau.

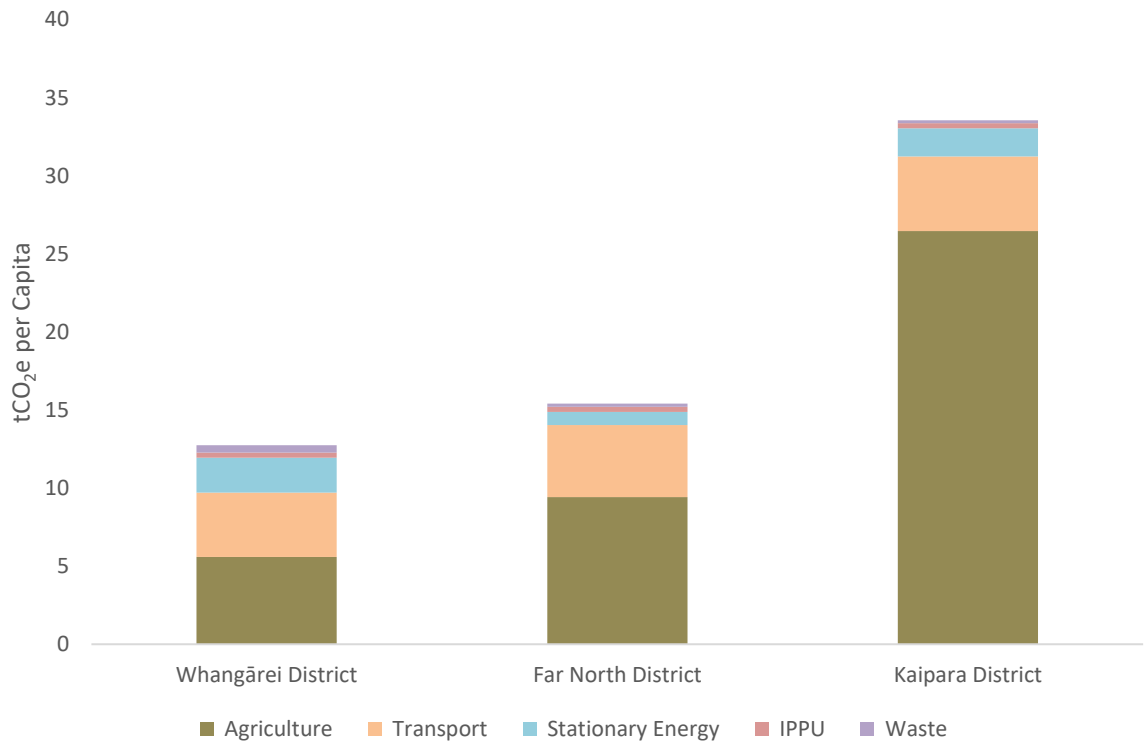

Figure 5 Total gross emissions per capita for the territorial authorities within Te Tai Tokerau (tCO_2e).

Te Tai Tokerau has a 16.5 tCO_2e/per capita figure for per capita total gross emissions. The region's per capita emissions are particularly influenced by emissions in the Whangārei area with almost 50% of the population of the region living in the Whangārei area. The Kaipara district represents just 13% of the region's population but produces 34% the region's emissions due to higher agricultural emissions per capita.

Key findings:

- Whangārei has the lowest per capita total emissions at 12.7 tCO_2e/per capita, due to a higher proportion of urban residents than the other districts and relatively low per capita agriculture emissions.
- Kaipara has the largest per capita total gross emissions at 33.6 tCO_2e/per capita, due to high agriculture emissions and a small population.
- Whangārei has the highest stationary energy emissions per capita in the region, particularly due to significant industrial natural gas use from Marsden Point and dairy processing.

4.0 Closing Statement

Far North's GHG emissions inventory provides information for decision-making and action by the District Council, stakeholders, and the wider community. We encourage the council to use the results of this study to update current climate action plans, set emission reduction targets, and track changes in emissions over time.

The emissions footprint developed for the Far North covers emissions produced in the stationary energy, transport, waste, IPPU, agriculture, and forestry sectors using the GPC reporting framework. GHG emissions data allows the Far North District Council to target and work with the sectors and emission sources that contribute the most to the area's GHG emissions inventory.

Understanding of climate change's extensive and long-lasting effects is always improving. It is recommended that this emissions inventory be updated regularly to inform ongoing positive decision-making to address climate change issues.

The availability, quality, and applicability of data limit the accuracy of any emissions footprint. These results may need updating in the future with changes in data and methodology to enable comparable figures to assess trends over time.

5.0 Limitations

Where this Report indicates that information has been provided to AECOM by third parties, AECOM has made no independent verification of this information except as expressly stated in the Report. AECOM assumes no liability for any inaccuracies in or omissions to that information. This Report was prepared between **September** and **November 2023** and is based on the information reviewed at the time of preparation. AECOM disclaims responsibility for any changes that may have occurred after this time. This Report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This Report does not purport to give legal advice.

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Appendix A

Assumptions and Data Sources

Appendix A Assumptions and Data Sources

Sector / Category	Assumptions and Exclusions
General	
Geographical Boundary	LGNZ local council mapping boundaries have been applied.
Population	Population figures are provided by StatsNZ. Financial year populations have been used, these are based on the average population from the two calendar years (e.g., the average of 2021 and 2022 calendar year populations for FY22).
Global Warming Potential Used	Emissions are expressed on a carbon dioxide-equivalent basis (CO_2e) using the 100-year Global Warming Potential (GWP) values from the IPCC 6th Assessment Report (AR6).
Full Inventory	Emissions for all sources broken down by individual main greenhouse gases are provided in the supplementary spreadsheet information supplied with this report.
GPC Production Approach	GPC reporting is predominately production-based (as opposed to consumption-based) but includes indirect emissions from energy consumption. Production-based emissions reporting is generally preferred by policy-makers due to robust established methodologies such as the GPC, which enables comparisons between different studies. Production-based approaches exclude globally produced emissions relating to consumption (e.g., embodied emissions relating to products produced elsewhere but consumed within the geographic area such as imported food products, cars, phones, clothes etc.). Cross-boundary movements such as air travel and marine freight journeys departing or arriving in the Far North have been included with emissions related to the journeys split equally between the origin and destination, despite the emissions being produced outside the Far North geographical boundary, as per the GPS requirements.
Emission Factors	All emission factors have detailed source information in the calculation tables within which they are used. Where possible, the most up to date, NZ-specific emission factors have been applied.
Transport Emissions	
Petrol and Diesel:	Total petrol and diesel consumption in the Far North was calculated from aggregated petrol and diesel sales data for Te Tai Tokerau which was then apportioned out to the territorial authorities within the region based on the total distance travelled by vehicles in each territorial authority in the financial year (known as Vehicle Kilometres Travelled or VKT). Allocating fuel consumption across a district based on VKT does not account for the likely makeup of the vehicle fleet of a particular geographic area (e.g. where a more rural area may use more diesel, or a more urban area may have more hybrid or electric vehicles travelling). Fuel sold in an area does not always mean that the fuel is used in that area, however this approach is considered to be a robust and comparable estimate of fuel consumption in a geographic area. Total petrol and diesel fuel use was then divided by likely end use. The division into transport and stationary energy end use (and within transport, on-road and

	off-road) was calculated using fuel end use data provided by the Energy Efficiency and Conservation Authority (EECA) in April 2020. - On-road transport is defined as all standard transportation vehicles used on roads (e.g. cars, bikes, buses). - Off-road transport is defined as machinery for agriculture, construction and other industry used off-roads. - Stationary energy petrol and diesel use is defined as fuel not used for transport either on or off roads. Petrol and diesel used for stationary energy has been reported in the Stationary Energy sector. This method produces results for off-road and stationary uses of petrol and diesel that are heavily impacted by changes in on-road transport uses of petrol and diesel as this represents the largest proportion of petrol and diesel sales. Better data and understanding of off-road and stationary uses of petrol and diesel are required to improve the applicability of these results.
Rail Diesel	Consumption was calculated by Kiwi Rail using the induced activity method for system boundaries. Using the induced activity method, the trans-boundary routes were determined, and the number of stops taken along the way derived. The total litres of diesel consumed per route was then split between the departure territorial authority, arrival territorial authority and any territorial authority the freight stopped at along the way. If the freight travelled through but did not stop within a territorial authority, no emissions were allocated. The following assumptions were made: - The Net Tonne-Kilometres (NTK) measurement has been used. NTK is the sum of the tonnes carried, multiplied by the distance travelled. - Net Weight is product weight only and excludes container tare (the weight of an empty container) - National fuel consumption rates have been used to derive litres of fuel for distance. - Type of locomotive engine used, and jurisdiction topography, have not been incorporated in the calculations.
Jet Kerosene	Calculated using the induced activity method as per rail diesel. An estimate of fuel use was calculated for flights arriving and departing from the Far North: - The schedule of flights arriving and departing from the Airport containing details on the aircraft used for each flight was used to calculate fuel consumption. - Flight distances and aircraft fuel burn rates were used for these calculations. - As per the induced activity method, only 50% of emissions calculated per one-way arrival and departure were allocated to the Far North. The remaining 50% of each leg was allocated to the originating or destination airport.
Aviation Gas	Aviation gas is mostly used by small aircraft for relatively short flights. Estimated data covering aviation gas use at the airport was provided directly by the airport. Fuel use by aircraft at local aerodromes, or on private land have not been included.
Marine Diesel – Freight	Marine freight emissions relating to journeys to and from Te Tai Tokerau have been allocated across Te Tai Tokerau based on the relative size of the

	population of each territorial authority. This reflects that marine freight imports and exports through Whangārei service the entire Te Tai Tokerau region. Marine freight emissions were calculated using the induced activity method as per rail diesel and jet kerosene. An estimate of journey fuel use was calculated for vessels arriving and departing from ports within Whangārei: - The schedule of vessels arriving and departing from ports in Whangārei containing details on size of the vessel was used to calculate fuel consumption. - Shipping distances and vessel fuel burn rates were used for these calculations. - As per the induced activity method, only 50% of emissions calculated per one-way arrival and departure were allocated to the ports in Far North. The remaining 50% of each leg was allocated to the originating or destination Port.
Marine Diesel (Local)	Commercial and Passenger Ferries - Fuel use has been provided by local ferry operators to determine emissions from this source. Private use, other commercial operators, and commercial fishing: - Most small private boats use fuel purchased at vehicle gas stations so this consumption will be included in off-road transport petrol and diesel emissions. - No data was available to determine emissions from other commercial operators, and commercial fishing.
Cruise Ships	No reliable data was available to determine the emissions from cruise ships. As data and understanding of cruise ship fuel usage improve, it is recommended that emissions from this source are included in future regional emissions inventories.
LPG	Total North Island consumption data for LPG used for transport was used and then split on a per capita basis to determine the territorial authority's consumption.
Stationary Energy Emissions	
Consumer Energy End Use	Stationary energy demand (e.g., electricity use, natural gas, etc.) is broken down by the sector in which they are consumed. We report stationary energy demand in the following categories: industrial (which includes agriculture, forestry, and fishing); commercial; and residential. These sectors follow the Australia New Zealand Standard Industrial Classification 2006 definitions. In addition to agriculture, forestry and fishing, the industrial sector includes mining, food processing, textiles, chemicals, metals, mechanical/electrical equipment and building and construction activities. Emissions from petrol and diesel used for stationary energy are not broken down into these sectors. Energy demand used for transport is reported in the transport sector, if known.
Electricity Consumption	Electricity demand has been calculated using grid demand trends from the EMI website (www.emi.ea.govt.nz) to obtain raw grid exit point data for the Far North. Reconciled demand has been used as per EMI's confirmation. The breakdown into sectors is based on NZ average consumption per sector (residential, commercial, and industrial).

Public Transport Electricity	No significant electric public transport identified within the Far North district.
Private Transport Electricity	Electricity used for private transport (e.g., electric cars, electric bikes, electric micro-mobility) has not been separated from other stationary energy electricity consumption due to a lack of reliable data.
Coal Consumption	National coal consumption data has been provided by MBIE for 2022. Regional industrial coal data has been provided by EECA. National residential and commercial coal consumption has been divided between territorial authorities on a per capita basis. Regional industrial coal consumption has been divided between territorial authorities on a per capita basis.
Biofuel and Wood Consumption	National biofuel consumption data has been provided by the Ministry for Business, Innovation and Employment (MBIE 2021) for residential and commercial biofuel use. This has then been divided between territorial authorities on a per capita basis. Data for industrial biofuel use (mainly from pulp, paper and timber mills) has been provided by 4 out of 9 identified sites across Te Tai Tokerau and allocated to the location of the site. This likely underestimates industrial biofuel use but is still higher than if using a national per capita approach. Biofuel emissions are broken down into Biogenic emissions (CO_2) and Non-Biogenic emissions (CH_4 and N_2O).
LPG Consumption	Total North Island consumption data for LPG used for non-transport purposes was used and then split on a per capita basis to determine the territorial authority's consumption. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per MfE data.
Petrol and Diesel (stationary energy end use)	Total petrol and diesel consumption in the Far North was calculated from aggregated petrol and diesel sales data for Te Tai Tokerau which was then apportioned out to the territorial authorities within the region based on the total distance travelled by vehicles in each territorial authority in the financial year (known as Vehicle Kilometres Travelled or VKT). Total petrol and diesel fuel use was then divided by likely end use. The division into transport and stationary energy end use (and within transport, on-road and off-road) was calculated using fuel end use data provided by the Energy Efficiency and Conservation Authority (EECA) in April 2020. - Stationary energy petrol and diesel use is defined as fuel not used for transport either on or off roads. Petrol and diesel used for stationary energy has been reported in the Stationary Energy sector. This method produces results for stationary uses of petrol and diesel that are heavily impacted by changes in transport uses of petrol and diesel. Better data and understanding of stationary uses of petrol and diesel are required to improve the applicability of these results.
Biogenic CO_2 Emissions	Some Carbon Dioxide (CO_2) emissions are biogenic. These are CO_2 emissions where the carbon has been recently derived from CO_2 present in the atmosphere (for example, some agricultural and waste emissions). These emissions are not included in calculating total CO_2e.
Agricultural Emissions	

Agriculture	Territorial authority livestock numbers and fertiliser data taken from the Agricultural Census (StatsNZ) for 2022.
Solid Waste Emissions	
Landfill Emissions	Landfill waste volume and landfill gas capture system information has been provided by the respective council departments. Solid waste emissions from landfill are measured using the IPCC First Order Decay method that covers landfill activity between 1950 and the present day. This method accounts for the gradual release of emissions from waste over a long period of time, and so calculates the emissions produced per year from waste in landfill (including emissions from closed landfill sites). Emissions are allocated to territorial authorities based on where the waste was produced, even if the waste is disposed in landfill outside the territorial authority. This approach differs from organisational footprints which generally cover only operational council-owned landfill sites. Organisational footprints methodology generally calculates the likely future emissions from the waste entering landfill that year, and attributes those emissions to that year (and doesn't include emissions from waste already in the landfill, or emissions from closed landfill sites). Waste volume: - Where information is not available, waste volumes have been estimated based on historical national data on a per capita basis.
Wastewater Emissions	
Wastewater Treatment	All wastewater emissions have been calculated following the WaterNZ (2021) guidance using data provided by the respective council departments. Wastewater Treatment Plants: - Calculation of emissions includes emissions released directly from wastewater treatment, flaring of captured gas and from discharge onto land/water. - Where data was not available assumed values have been used based on the WaterNZ (2021) guidance - Emissions relating to discharge of biosolids sent to landfill has been included in the Solid Waste emissions source. - Emissions are allocated to territorial authorities based on where the wastewater was produced, even if the wastewater is treated outside the territorial authority. Individual Septic Tanks: - Populations not connected to known wastewater treatment plants are assumed to be using septic tanks. - The population not connected to centralised wastewater treatment has been estimated based on the number of rateable properties not connected to sewerage.
Industrial Processes and Product Use Emissions	
Industrial processes	It is assumed that there are no significant non-energy related emissions of greenhouse gasses from industrial processes in the territorial authority (e.g. aluminium manufacture).
Industrial Product Use	National data covering industrial product use (e.g., fire extinguishers, refrigerants) from the New Zealand Greenhouse Gas Emissions 1990-2021 report (MfE 2023) has been used. Emissions are estimated on a per capita basis applying a national average per person.

Forestry Emissions	
Exotic Forestry Harvested and Exotic Forest coverage	Harvested forestry, and forest cover information for each territorial authority has been derived from Landcare Research data. This emissions footprint accounts for forest carbon stock changes from afforestation, reforestation, deforestation, and forest management (i.e., it applies land-use accounting conventions under the United Nations Framework Convention on Climate Change rather than the Kyoto Protocol). It treats emissions from harvesting and deforestation as instantaneous rather than accounting for the longer-term emission flows associated with harvested wood products. The emissions footprint considers regenerating (growing) forest areas only. Capture of carbon from the atmosphere is negligible for mature forests that have reached a steady state.
Native Forest	Native forest land area for each territorial authority has been provided by Landcare Research.

Appendix B

Far North Emissions Inventory FY23 – Full Inventory Tables

Appendix B Far North Emissions Inventory FY22 - Full Inventory Tables

Agriculture Emissions

Table 10 Far North FY22 Agriculture emissions by emission source

Emissions Source	FY22 Emissions (tCO_2e)	Percentage of Total Gross Emissions in FY22 (%)
Enteric Fermentation	516,679	46%
Unmanaged Manure on Pasture	70,056	6%
Agricultural Leaching and Deposition (Manure, Urine, and Fertiliser)	51,288	5%
Fertiliser on Land	30,336	3%
Manure Management	22,838	2%
Total	**691,197**	**61%**

Transport Emissions

Table 11 Far North FY22 Transport emissions by emission source

Emissions Source	FY22 Emissions (tCO_2e)	Percentage of Total Gross Emissions in FY22 (%)
Diesel	179,182	16%
Petrol	113,880	10%
Marine Freight	40,978	4%
Jet Kerosene	2,638	<1%
Marine Diesel (local)	1,451	<1%
LPG	613	<1%
Aviation Gas	225	<1%
Total	**338,967**	**30%**

Stationary Energy Emissions

Table 12 Far North FY22 Stationary Energy emissions by emission source

Emissions Source	FY22 Emissions (tCO_2e)	Percentage of Total Gross Emissions in FY22 (%)
Electricity Consumption	34,854	3%
Stationary Petrol & Diesel Use	10,222	1%
Biofuel / Wood	5,429	<1%
LPG	4,792	<1%
Electricity Transmission and Distribution Losses	3,697	<1%
Coal	3,225	<1%
Total	**62,219**	**6%**

Waste Emissions

Table 13 Far North FY22 Waste emissions by emission source

Emissions Source	FY22 Emissions (tCO_2e)	Percentage of Total Gross Emissions in FY22 (%)
Individual Septic Tanks	7,525	1%
Landfill Sites	4,310	<1%
Wastewater Treatment Plants	2,952	<1%
Total	**14,787**	**1%**

Industrial Processes and Product Use (IPPU) Emissions

Table 14 Far North FY22 IPPU emissions by emission source

Emissions Source	FY22 Emissions (tCO_2e)	Percentage of Total Gross Emissions in FY22 (%)
Refrigerants and Air Conditioning	22,314	2%
Aerosols	1,118	<1%
SF_6 - Electrical Equipment	198	<1%
Foam Blowing	94	<1%
SF_6 - Other	42	<1%
Fire Extinguishers	35	<1%
Total	**23,801**	**2%**

Forestry Emissions

Table 15 Far North FY22 Forestry emissions

Sector / Emissions Source	FY22 Emissions (tCO_2e)
Harvest Emissions	3,999,905
Native Forest Sequestration	-828,219
Exotic Forest Sequestration	-3,059,414
Total (Net)	**112,271**