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Tauranga Community Carbon Footprint

28-Sep-2022

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Client: Bay of Plenty Regional Council

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Prepared by

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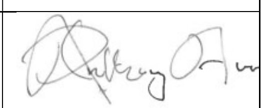
2	28-Sep-2022	Update to Table 3.4	Anthony Hume Team Leader - Sustainability	

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Executive Summary

Greenhouse Gas (GHG) emissions for the Tauranga District Territorial Area (that is covered by the Tauranga City Council) have been measured using the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory (GPC) methodology. This approach includes emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture and Forestry sectors. This document reports greenhouse gas emissions produced in or resulting from activity or consumption within the geographic boundaries of the Tauranga District Territorial Area for the 2020/21 financial reporting year and examines greenhouse gas emissions produced from 2015/16 to 2020/21.

The Tauranga District Territorial Area is referred to hereafter as Tauranga for ease. Greenhouse gas 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 project include:

2020/21 Emissions Footprint

- In the 2020/21 reporting year (1st July 2020 to 30th June 2021), **total gross emissions** in Tauranga were 1,345,115 tCO_2e.
- **Transport** (e.g. emissions from road and air travel) is the largest source of emissions in Tauranga, representing 74% of total gross emissions, with petrol and diesel consumption accounting for 36% of Tauranga's total gross emissions and marine freight accounting for 35% of Tauranga's total gross emissions.
- **Stationary Energy** (e.g. consumption of electricity and natural gas) is the second highest emitting sector in the region, producing 19% of total gross emissions. Electricity consumption accounts for 10% of Tauranga's total gross emissions.
- After consideration of carbon sequestration (carbon captured and stored in plants or soil by forests) and harvesting emissions, **total net emissions** in Tauranga were 1,360,530 tCO_2e. This is larger than total gross emissions because carbon sequestration (6,110 tCO_2e) was less than emissions released following forest harvesting during this year (21,524 tCO_2e).

Changes in Emissions, 2015/16 to 2020/21

- Between 2015/16 and 2020/21, **total gross emissions** in Tauranga increased from 1,096,155 tCO_2e to 1,345,115 tCO_2e, an increase of 23% (248,961 tCO_2e).
- Over this time the population of the district increased by 22%, with **per capita gross emissions** in Tauranga remaining stable with a slight increase of 1% between 2015/16 and 2020/21, from 8.7 to 8.8 tCO_2e per person per year.
- **Transport** emissions increased by 33% between 2015/16 and 2020/21 (245,775 tCO_2e), driven by a 50% increase in marine freight emissions (157,853 tCO_2e) and a 21% increase in on-road fuel emissions (74,671 tCO_2e).
- Emissions from **Stationary Energy** increased by 32% between 2015/16 and 2020/21 (62,309 tCO_2e), driven by a 51% increase in electricity consumption emissions (44,016 tCO_2e). This increase in electricity consumption emissions was due to a 2% increase in electricity consumption coupled with a 48% increase in the emissions intensity of the national electricity grid (tCO_2e/kWh).
- Emissions from **Waste** decreased by 67% between 2015/16 and 2020/21 (70,511 tCO_2e) driven by improvements in landfill gas recovery at landfill sites.
- **IPPU** and **Agriculture** emissions increased between 2015/16 and 2020/21, by 26%, and 16% respectively (10,429 tCO_2e and 958 tCO_2e).
- **Forestry** emissions increased by 12,812 tCO_2e between 2015/16 and 2020/21. This increase was predominantly due to an increase in total harvest emissions (estimated based on regional harvesting data and the age of commercial forests in Tauranga).

Figure 1: Tauranga's 2020/21 Emissions Footprint

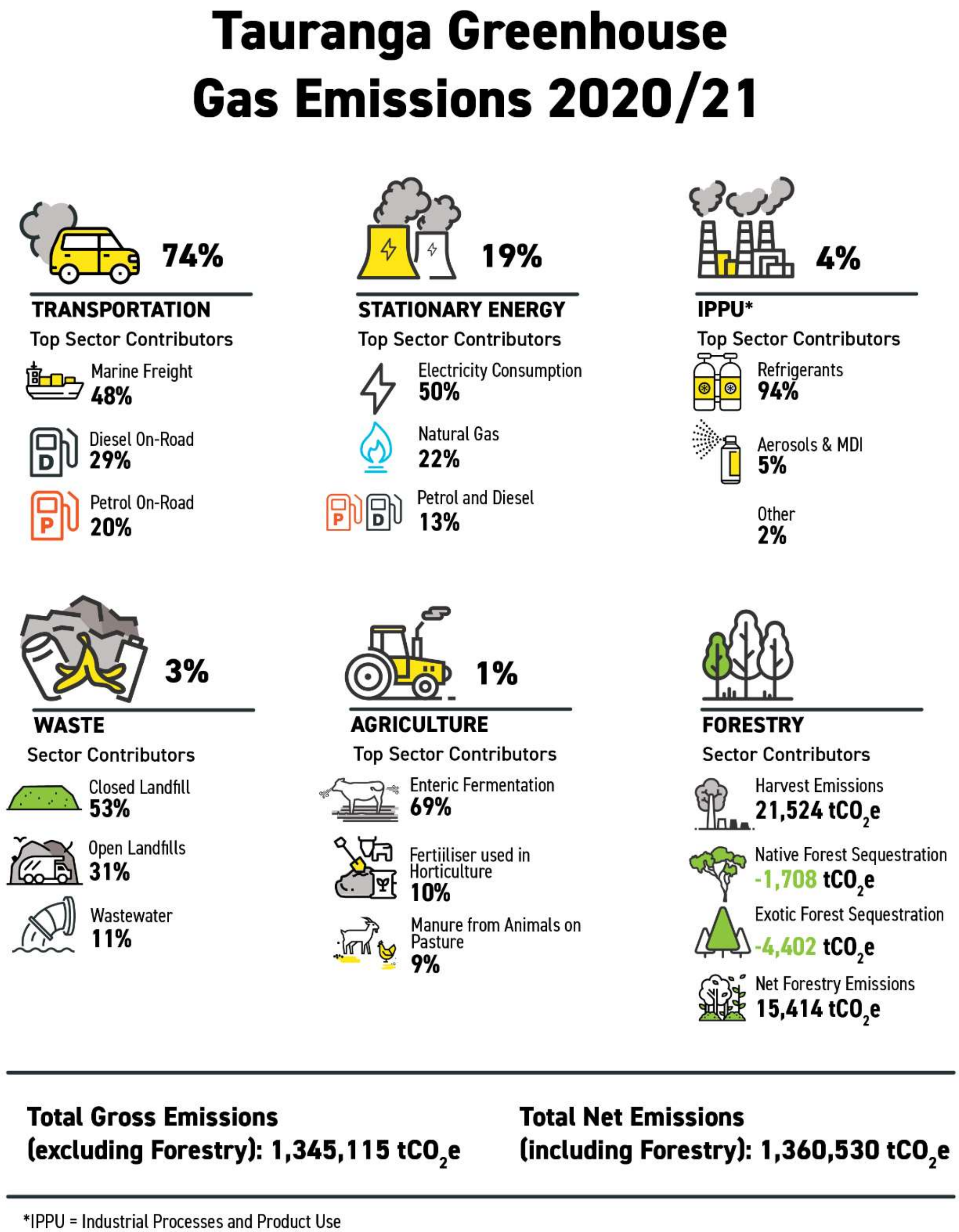
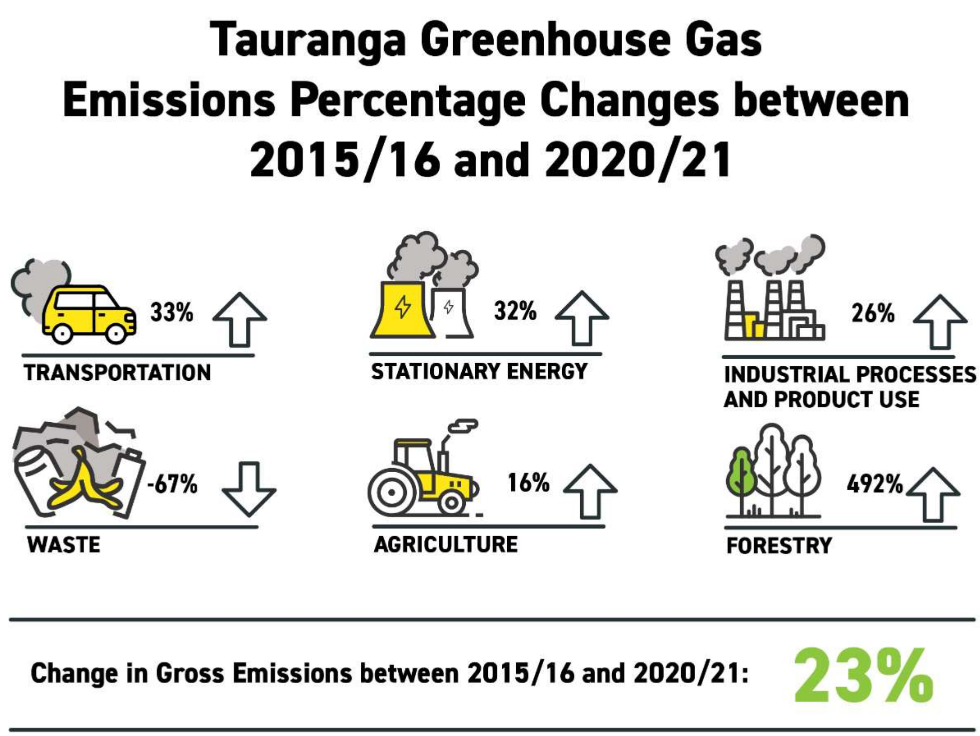


Figure 2: Change in Tauranga's Emissions Footprint between 2015/16 and 2020/21



1.0 Introduction

AECOM New Zealand Limited (AECOM) was commissioned by the Bay of Plenty Regional Council to assist in the development of community-scale greenhouse gas (GHG) footprints for Tauranga for the 2018/19, 2019/20, and 2020/21 financial years. This is part of a wider study to develop community carbon footprints for each district within the Bay of Plenty region. As part of this work, AECOM recalculated emissions for the footprint year (2015/16) previously calculated by AECOM, using current best-practice methodology and additional emissions sources to enable direct comparison to the other reported years. Emissions are reported for the period from 1 July to 30 June for the respective years. The study boundary reported in the following pages incorporates the jurisdiction of the Tauranga District Council.

The Tauranga District Territorial Area is referred to hereafter as Tauranga for ease. Greenhouse gas emissions are generally reported in this document in units of Carbon Dioxide Equivalents (CO_2e) and are referred to as 'emissions'.

2.0 Approach and Limitations

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 includes emissions from Stationary Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture, and Forestry activities within the district's boundary. The sector calculations for Agriculture, Forestry and Waste are based on Intergovernmental Panel on Climate Change (IPCC) workbooks and guidance for emissions measurement. The sector calculators also use methods consistent with GHG Protocol standards published by the WRI for emissions measurement when needed.

The same methodology has been used for other community scale GHG footprints around New Zealand, (e.g. Wellington, Auckland, Christchurch, Dunedin and the Waikato region) and internationally. The GPC methodology[1] represents international best practice for city and regional level GHG emissions reporting.

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 location of consumption. An example of indirect emissions is those associated with the consumption of electricity, 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 fit into Scope 3.

All major assumptions made during data collection and analysis have been detailed within **Appendix A – Assumptions**. The following aspects are worth noting in reviewing the emissions footprint:

- Emissions are expressed on a carbon dioxide-equivalent basis (CO_2e) including climate change feedback using the 100-year Global Warming Potential (GWP) values[2]. Climate change feedbacks are the climate change impacts from GHGs that are increased as the climate changes. For example, once the Earth begins to warm, it triggers other processes on the surface and in the atmosphere. Current climate change feedback guidance is important to estimate the long-term impacts of GHGs.
- 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.).

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[1] http://www.ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities
[2] https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf (Table 8.7)

- Total emissions are reported as both gross emissions (excluding Forestry) and net emissions (including Forestry).
- Emissions for individual main greenhouse gases for each emissions source are provided in the supplementary spreadsheet information supplied with this report.
- Where location specific data were not accessible, information was calculated based on national or regional level data.

- Transport emissions:
  - Transport emissions associated with air travel, rail, and marine fuel were calculated by working out the emissions relating to each journey arriving or departing the area based on data provided by the relevant operators. Emissions for these sources are then split equally between the destination and origin. Emissions relating to a particular point source (e.g. an airport or port) are allocated to the expected users of that source, not just the area that it is located in. For example, in the Bay of Plenty Region, it is expected that all territorial authorities will use the Port of Tauranga for imported and exported goods, emissions from this source have been allocated to all territorial authorities in the region based on population. It is understood that freight imports moving through the Port of Tauranga do not exclusively serve the Bay of Plenty Region, and freight exports do not exclusively originate from the Bay of Plenty Region, this should be considered when examining these emissions.
  - All other transport emissions are calculated using the fuel sold in the area (e.g. petrol, diesel, LPG).
- Solid waste emissions:
  - Solid waste emissions from landfill are measured using the IPCC First Order Decay method that covers landfill activity between 1950 and the present day.
  - Emissions are calculated for waste produced within the geographic boundary, even if they are transported outside the boundary to be entered into landfill. Much of the landfill waste originating in the Bay of Plenty is transported to landfill sites in the Waikato, this has been accounted for in these calculations.
  - An additional assessment of transport emissions related to the transport of landfill waste and recycled/diverted waste has been included in this assessment, outside of the GPC requirements for Community Carbon Footprints. Emissions were estimated based on the amount of material, distance transported from transfer station to next processing location, and the vehicles used. Any onward transport of materials post-processing have not been included.
- Wastewater emissions:
  - Emissions have been calculated based on the local data provided, following IPCC 2019 guidelines. Where data is missing, IPCC and Ministry for the Environment (MfE) figures have been used. Wastewater emissions from both wastewater treatment plants, and individual septic tanks have been calculated.
  - Wastewater emissions include those released directly from wastewater treatment, flaring of captured gas and from discharge onto land/water.
- Industrial Processes and Product Use (IPPU) emissions:
  - IPPU emissions are estimated based on data provided in the New Zealand Greenhouse Gas Emissions 1990-2019 report (MfE 2021). Emissions are estimated on a per capita basis applying a national average per person.
- Forestry emissions:
  - 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.

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

It is important to consider the level of uncertainty associated with the results, particularly given the different datasets used. Depending on data availability, national, regional, and local datasets are used across the different calculators. At the national level, New Zealand’s Greenhouse Gas Inventory shows that for 2018 (the most recent national level inventory) an estimate of gross emissions uncertainty was +/- 9%, whereas a net emissions uncertainty estimate was +/- 12%. These levels of uncertainty should be considered when interpreting the results of this community carbon footprint (MfE, 2020).

3.0 Community Carbon Footprint for 2020/21

The paragraphs, figures and tables below outline Tauranga's greenhouse gas emissions, referred to as 'emissions' in this assessment. This includes Tauranga's total emissions, emissions from each sector, and major emissions sources within each sector. The focus of emissions reporting is on gross emissions.

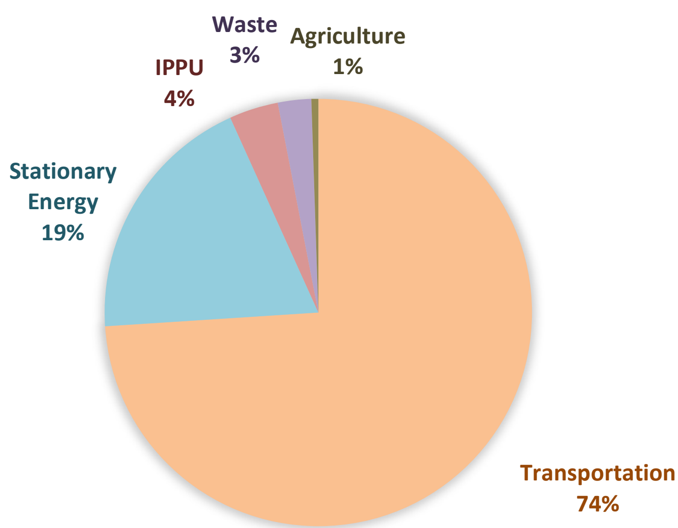
During the 2020/21 reporting period, Tauranga emitted **gross** 1,345,115 tCO_2e. Note that gross emissions do not account for Forestry. Transport is the largest contributor to total gross emissions for the district.

The population of Tauranga in 2020/21 was approximately 153,700 people, resulting in per capita gross emissions of 8.8 tCO_2e/person. Discussion of per capita emissions is limited to when it is useful for comparing emission figures against other territorial authorities. A breakdown of net emissions (i.e. including results from Forestry resources) is reported separately.

Table 1 Total net and gross emissions

Total emissions	tCO_2e
Total Net Emissions (including forestry)	1,360,530
Total Gross emissions (excluding forestry)	1,345,115

Figure 3: Tauranga District's total gross GHG emissions split by sector (tCO_2e).



During the 2020/21 reporting period, Tauranga emitted **net** 1,360,530 tCO_2e.

Net emissions differ from gross emissions because they include emissions related to forestry activity (harvesting and planting) within an area. Forestry emissions are influenced by the cyclical nature of harvesting and planting regimes. In addition, with each subsequent planting of harvestable trees, there is a decreasing ebb and flow of sequestration.

Carbon sequestered by forestry can be viewed as a liability/risk that needs careful consideration. For example, if plantations are not replanted or other land use change occurs to exotic forested areas, then net emissions may rise quickly. Equally, if native forest is not protected from removal, and removal does happen, then net emissions may rise.

The community carbon footprint comprises emissions from six different sectors, summarised below:

3.1 Transport

Transport was the highest emitting sector in Tauranga and produced 995,138 tCO_2e in 2020/21 (74% of Tauranga's gross total emissions). Table 2 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emissions source.

Table 2 Transport energy by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Marine Freight	473,045	35.2%	47.5%
Diesel	290,141	21.6%	29.2%
Petrol	194,145	14.4%	19.5%
Rail Emissions	21,479	1.6%	2.2%
Jet Kerosene	11,334	0.8%	1.1%
Marine Diesel (local)	2,822	0.2%	0.3%
LPG	1,316	0.1%	0.1%
Aviation Gas	856	0.1%	0.1%
Bioethanol	0.04	<0.1%	<0.01%
Total	**995,138**	**74.0%**	**100.0%**

Almost half of transport emissions can be attributed to diesel and petrol, which produced a total of 290,141 tCO_2e and 194,145 respectively (collectively 49% of the sector's emissions and 36% of total gross emissions). Diesel and petrol transport emissions are broken down into on-road and off-road use. On-road transport consists of all standard transportation vehicles used on roads (including cars, trucks, buses, etc.). Off-road transport consists of all fuel used for the movement of machinery and vehicles off roads (including agricultural tractors and vehicles, forklifts, etc.). On-road transport produced 430,316 tCO_2e (43.2% of Transport emissions). Off-road transport produced 55,287 tCO_2e (5.6% of Transport emissions).

The next largest emission source for Tauranga is marine freight, which contributed to 48% of the sectors emissions and 35% of total gross emissions (473,045 tCO_2e). Marine freight emissions are the result of freight movements to and from the Port of Tauranga. Emissions from this source have been divided between all territorial authorities in the Bay of Plenty region based on relative population sizes. It is understood that the imports and exports through this port are not exclusively related to activities in the Bay of Plenty region, however, to ensure that these emissions are reflected in community carbon footprints as per the GPC requirements this approach is appropriate.

The remaining transport emissions are attributed to air travel (jet kerosene and aviation gas), rail freight emissions, and LPG use for transport (e.g. forklifts).

One contributing element of transport emissions is from the movement of waste, recycling, and other diverted materials from transfer facilities to their end location. These transport emissions (displayed in Table 3) are included in the totals outlined above and are not additional to the totals above. These reported emissions are high-level estimations only based on the data available and fall outside of the GPC requirements for Community Carbon Footprinting. Transport of landfill waste is responsible for the largest proportion of these transport emissions with all waste transported to the sites in the Waikato Region.

Table 3 Tauranga emissions from the transport of waste, recycling, and other diverted materials

	Total material (tonnes)	Total distance travelled (return) (km)	Emissions (tCO_2e)
Landfill Waste	113,102	1,771,931	1,091
Composting	10,449	202,019	124
Diverted/Recycled Materials	13,593	259,614	160
Total	**137,144**	**2,233,564**	**1,375**

3.2 Stationary Energy

Producing 259,044 tCO_2e in 2020/21, Stationary Energy was Tauranga's second highest emitting sector (19% of total gross emissions). Table 4 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emissions source.

Table 4 Stationary energy emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Electricity Consumption	129,583	9.6%	50.0%
Natural Gas	55,863	4.2%	21.6%
Stationary Petrol & Diesel Use	32,612	2.4%	12.6%
Electricity transmission and distribution losses	11,902	0.9%	4.6%
LPG	10,434	0.8%	4.0%
Coal	9,536	0.7%	3.7%
Natural Gas transmission and distribution losses	4,516	0.3%	1.7%
Biofuel / Wood	4,498	0.3%	1.7%
Biogas	101	<0.1%	<0.1%
Total:	**259,044**	**19.3%**	**100%**

Electricity consumption was the cause of 50% of Stationary Energy emissions (129,583 tCO_2e), and 10% of Tauranga's total gross emissions. Electricity consumption emissions increase to 141,485 tCO_2e when including transmission and distribution losses related to that consumption.

Natural gas consumption accounted for 23% of the sector's emissions (60,379 tCO_2e) when including transmission and distribution losses. Stationary petrol and diesel consumption generated 13% of the sector's emissions (32,612 tCO_2e). Use of LPG, and the burning of coal, biofuels and biogas produced the remaining Stationary Energy emissions.

Stationary Energy demand can also be broken down by the sector in which it is consumed. Stationary Energy demand is reported for the following sectors: commercial; residential and industrial. Emissions from petrol and diesel used for Stationary Energy are not able to be broken down by sector.

- Industrial Stationary Energy consumption accounts for 48% of Stationary Energy emissions (123,433 tCO_2e) and 9% of total gross emissions. Industrial Stationary Energy is energy used within all industrial settings (including agriculture, forestry and fishing, mining, food processing, textiles, chemicals, metals, mechanical/electrical equipment and building and construction activities).

- Residential Stationary Energy consumption accounts for 23% of Stationary Energy emissions (59,723 tCO_2e) and 4% of total gross emissions. Residential Stationary Energy is energy used in homes (e.g. for heating, lighting, and cooking).
- Commercial Stationary Energy consumption accounts for 17% of Stationary Energy emissions (43,176 tCO_2e) and 3% of total gross emissions. Commercial Stationary Energy is energy used in all non-residential and non-industrial settings (e.g. in retail, hospitality, education, and healthcare).
- The remaining 13% of Stationary Energy emissions (32,713 tCO_2e) were produced by diesel and petrol, and the burning of biogas, which were not allocated to the above categories. Stationary Energy uses of diesel and petrol include stationary generators and motors and for heating.

3.3 Industrial Processes and Product Use (IPPU)

IPPU in Tauranga produced 49,896 tCO_2e in 2020/21, contributing 4% to Tauranga's total gross emissions. This sector includes emissions associated with the production of GHGs from refrigerants, foam blowing, fire extinguishers, aerosols, metered dose inhalers and Sulphur Hexafluoride for electrical insulation and equipment production. IPPU emissions do not include energy use for industrial manufacturing, which is included in the relevant Stationary Energy sub-category (e.g. coal, electricity and/or petrol and diesel). These emissions are based on nationally reported IPPU emissions and apportioned based on population due to the difficulty of allocating emissions to particular geographic locations. Addressing IPPU emissions is typically a national policy issue.

There are no known industrial processes (as defined in the GPC requirements) present in Tauranga (e.g. aluminium manufacture).

Table 5 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emissions source. The most significant contributor to IPPU emissions is the use of refrigerants which produced 94% of IPPU emissions (46,739 tCO_2e).

Table 5 Industrial processes and product use emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Refrigerants and air conditioning	46,739	3.5%	93.7%
Aerosols	2,413	0.2%	4.8%
SF6 - Electrical Equipment	402	<0.1%	0.8%
Foam Blowing	187	<0.1%	0.4%
SF6 - Other	85	<0.1%	0.2%
Fire extinguishers	70	<0.1%	0.1%
Total	**49,896**	**3.7%**	**100%**

3.4 Waste

Waste originating in Tauranga (solid waste and wastewater) produced 34,099 tCO_2e in 2020/21, which comprises 3% of Tauranga's total gross emissions. Table 6 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emissions source.

Table 6 Waste emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Waste in closed landfill sites	18,240	1.4%	53.5%
Waste in open landfill sites	10,455	0.8%	30.7%
Individual septic tanks	3,183	0.2%	9.3%
Composting	1,797	0.1%	5.3%
Wastewater treatment plants	424	<0.1%	1.2%
Total:	**34,099**	**2.5%**	**100%**

Solid waste produced the bulk of Waste emissions (28,695 tCO_2e in 2020/21), making up 84% of total Waste emissions. Solid waste emissions include emissions from open landfills and closed landfills. Both open and closed landfills emit methane from the breakdown of organic materials disposed of in the landfill for many years after waste enters the landfill. It has been assumed that landfill waste in Tauranga has been transported to either Tirohia or Hampton Downs since 2001. Waste from Tauranga sent to these open landfill sites contributed 10,455 tCO_2e in 2020/21. Emissions from closed landfill sites produced 18,240 tCO_2e in 2020/21. Annual emissions from closed landfill sites will decrease over time as no new waste enters these sites.

Composting produced 1,797 tCO_2e making up 5% of total Waste emissions.

Wastewater (both treatment plants and individual septic tanks) produced 3,607 tCO_2e making up 11% of total Waste emissions. The majority of households in Tauranga are connected to wastewater treatments plants, which produced total emissions of 424 tCO_2e. Households connected to individual septic tanks produced 3,183 tCO_2e in wastewater emissions. Due to the production of methane, septic tanks have a higher emissions intensity compared to the wastewater treatments plants in Tauranga.

Wastewater treatment tends to be a relatively small emission source compared to solid waste as advanced treatment of wastewater produces low emissions. In contrast, solid waste generates methane gas over many years as organic material enters landfill and emissions depend on the efficiency and scale of landfill gas capture.

3.5 Agriculture

Agriculture emitted 6,938 tCO_2e in 2020/21 (1% of Tauranga's total gross emissions). Table 7 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emissions source. Agricultural emissions are the result of both livestock and crop farming and do not include emissions relating to fuel or electricity consumption (reported in the Transport and Stationary Energy sectors). Enteric fermentation from livestock produced 67% of Tauranga's agricultural emissions (4,759 tCO_2e). Enteric fermentation GHG emissions are produced by methane (CH_4) released from the digestive process of ruminant animals (e.g. cattle and sheep).

Table 7 Agriculture emissions by emission source

Sector / Emissions Source	tCO_2e	% of Total Gross Emissions	% of Sector Total
Enteric Fermentation	4,759	0.4%	68.6%
Fertiliser used in Horticulture	691	0.1%	10.0%
Other Agriculture Emissions	628	<0.1%	9.0%
Manure from Grazing Animals on pasture	626	<0.1%	9.0%
Atmospheric Deposition	168	<0.1%	2.4%
Manure Management	66	<0.1%	1.0%
Total	**6,938**	**0.5%**	**100%**

3.6 Forestry

Planting of native forest (e.g. mānuka and kānuka) and exotic forest (e.g. pine), sequesters (captures) carbon from the atmosphere while the trees are growing to maturity. Harvesting of forest releases emissions via the release of carbon from plants and soils following harvesting. When sequestration by forests exceeds emissions from harvesting in a particular year, the extra quantity of carbon sequestered by forest reduces total gross emissions for that year. Conversely when emissions from harvesting exceed the amount of carbon sequestered by native and exotic forests, then total gross emissions will increase.

Sequestration in 2020/21 was 6,110 tCO_2e (which was mostly from exotic forestry) while harvesting emissions were 21,524 tCO_2e. This meant that Forestry in Tauranga was a net positive source of emissions in 2020/21 (rather than a negative source of emissions, where sequestration exceeds harvesting emissions). Total Forestry emissions in 2020/21 were 15,414 tCO_2e.

Table 8 Forestry emissions by emission source (including sequestration)

Sector / Emissions Source	tCO_2e
Total harvest emissions	21,524
Native forest sequestration	-1,708
Exotic forest sequestration	-4,402
Total	**15,414**

3.7 Total Gross Emissions by Greenhouse Gas

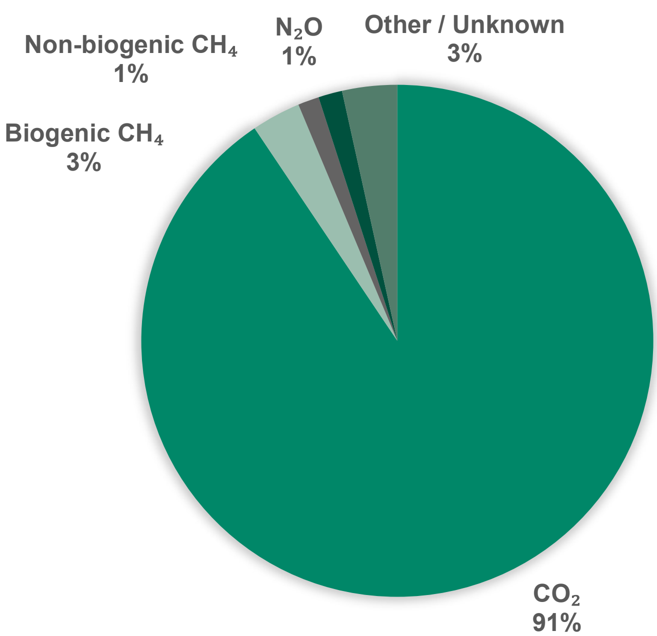
Each greenhouse gas has a different level of impact on climate change, this is accounted for when converting quantities of each gas into units of carbon dioxide equivalent (CO_2e).

Table 9: Tauranga's total gross emissions, by greenhouse gas

Greenhouse Gas	Tonnes	Tonnes of CO_2e
Carbon Dioxide (CO_2)	1,218,422	1,218,422
Biogenic Methane (CH_4)	1,232	41,894
Non-biogenic Methane (CH_4)	529	17,976
Nitrous Oxide (N_2O)	68	20,129
Other / Unknown Gas (in CO_2e)	46,694	46,694
Total	**1,266,945**	**1,345,115**

Figure 4 illustrates Tauranga's total gross emissions by greenhouse gas in units of carbon dioxide equivalents (CO_2e).

Figure 4: Tauranga District's total gross emissions, by greenhouse gas (in tCO_2e)



By far the largest source of emissions in tonnes is carbon dioxide (CO_2) at 1,218,442 tonnes. Due to the greater global warming impact of methane, methane represents 0.1% of the total tonnage of GHG emissions from Tauranga but represents 3% of CO_2e. Nitrous oxide represents 0.005% of the total tonnage of GHG emissions from Tauranga but represents 1% of CO_2e.

3.8 Biogenic emissions

Biogenic carbon dioxide and methane emissions are stated in Table 10 and Table 11, respectively.

Biogenic CO_2 emissions are those that 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 plants and animals are excluded from gross and net emissions as they are part of the natural carbon cycle.

Table 10: Biogenic CO_2 in Tauranga (Excluded from gross emissions)

Biogenic Carbon Dioxide (CO_2) (Excluded from gross emissions)		
Biofuel	147,287	t CO_2
Combusted Landfill Gas	15,590	t CO_2
Biodiesel	540	t CO_2
Total Biogenic CO_2	**163,417**	**t CO_2**

Biogenic CH_4 emissions (e.g., produced by farmed cattle via enteric fermentation) are included in gross emissions due to their relatively large impact on global warming relative to biogenic CO_2. Biogenic methane represents <0.1% of the gross total tonnage of GHG emissions in Tauranga but represents 3% 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. The total tonnage of each GHG and the contribution of each GHG to total gross emissions when expressed in CO_2e is shown in Table 9.

The importance of biogenic CH_4 is highlighted in NZ's Climate Change Response (Zero Carbon) Amendment Act. The Act includes specific targets to reduce biogenic CH_4 by between 24% and 47% below 2017 levels by 2050, and by 10% below 2017 levels by 2030. More information on the Act is available here: https://www.mfe.govt.nz/climate-change/zero-carbon-amendment-act.

Table 11: Biogenic Methane in Tauranga (Included in gross emissions)

Biogenic Methane (CH_4) (Included in gross emissions)		
Landfill Gas	844	t CH_4
Enteric Fermentation	140	t CH_4
Biofuel	118	t CH_4
Wastewater Treatment	97	t CH_4
Composting (Green Waste)	31	t CH_4
Manure Management	2	t CH_4
Total Biogenic CH_4	**1,232**	**t CH_4**

3.9 Comparison with other Territorial Authorities in the Bay of Plenty Region

The Bay of Plenty regional area contains several territorial authorities. Tauranga City, Western Bay of Plenty District, Whakatāne District, Ōpōtiki District, and Kawerau District are all exclusively within the boundaries of the Bay of Plenty region. However, areas of Rotorua District and Taupō District are also part of the Waikato region. We estimate that 93% of Rotorua's population and 62% of Rotorua's area, and 4% of Taupō's population and 14% of Taupō's area are within the Bay of Plenty region.

Figure 5 shows the Bay of Plenty's total gross emissions divided by territorial authority. The Bay of Plenty regional area contains several territorial authorities. Tauranga City, Western Bay of Plenty District, Whakatāne District, Ōpōtiki District, and Kawerau District are all exclusively within the boundaries of the Bay of Plenty region. However, areas of Rotorua District and Taupō District are also part of the Waikato region. We estimate that 93% of Rotorua's population and 62% of Rotorua's area, and 4% of Taupō's population and 14% of Taupō's area are within the Bay of Plenty region. Figure 6 shows total gross emissions for the territorial authorities in the Bay of Plenty Region, split by sector. Both figures only include the emissions produced within the Bay of Plenty region for Rotorua and Taupō.

Tauranga is the highest emitting territorial authority in the region, representing 24% of the Bay of Plenty's total gross emissions. Tauranga's emissions inventory is predominantly transport-related emissions while the next largest territorial authorities by; Rotorua, Western Bay of Plenty and Whakatāne, contain significant agricultural emissions. Ōpōtiki, Kawerau, and Taupō collectively represent just 12% of the Bay of Plenty's emissions.

Figure 5 Bay of Plenty's total gross emissions divided by territorial authority (tCO_2e). *Rotorua and Taupō totals only include emissions produced in the Bay of Plenty region.

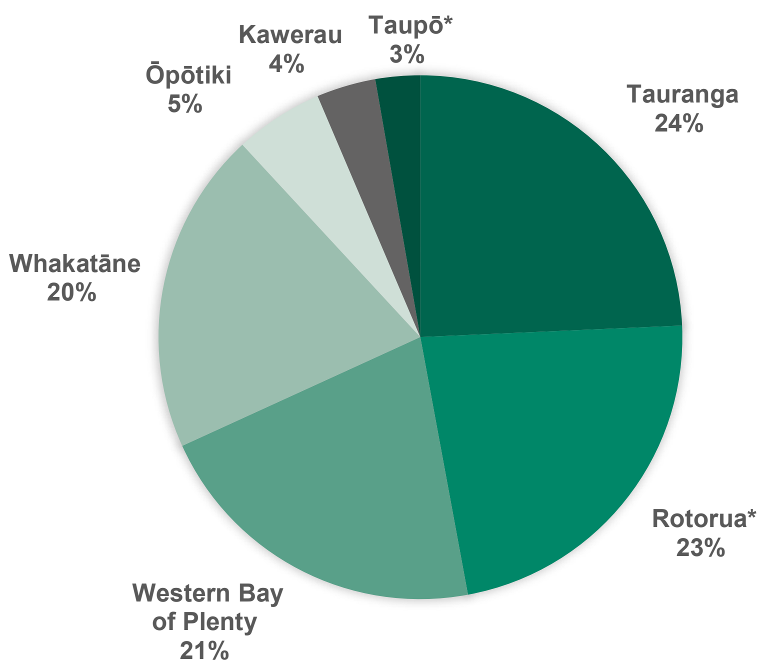
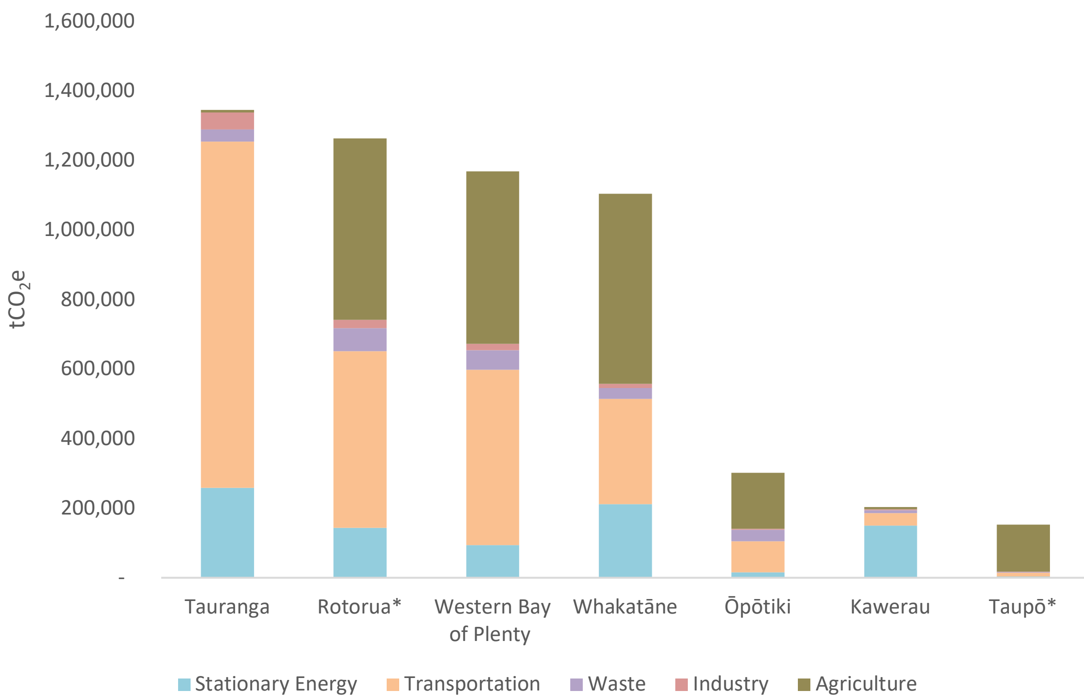


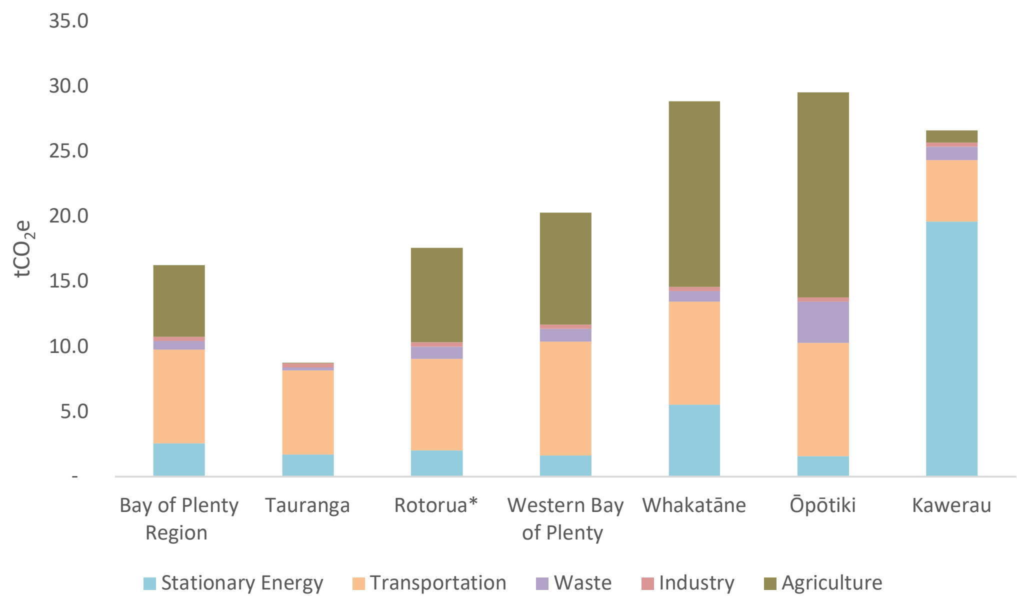
Figure 6 Total gross emissions by territorial authority in the Bay of Plenty region (tCO_2e). *Rotorua and Taupō totals only include emissions produced in the Bay of Plenty region.



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 7 shows emissions per capita for the region and territorial authorities within the region. Taupō is excluded from this figure due to the tiny population and large agriculture creating very large per capita emissions (this is not the case for the entire Taupō District.

The Bay of Plenty has a 16.2 tCO_2e/per capita figure for total gross emissions which is higher than the national value of 15.7 tCO_2e/per capita. Notably, Tauranga has the lowest per capita total emissions at 8.8 tCO_2e/per capita. Ōpōtiki and Whakatāne have the largest per capita total gross emissions at 29.5 tCO_2e/per capita and 28.9 tCO_2e/per capita respectively. Kawerau has the third highest per capita emissions at 26.6 tCO_2e/per capita, this is due to a small population and large industrial and manufacturing energy use in the area.

Figure 7 Total gross emissions per capita for the region and territorial authorities within the region (tCO_2e). *Rotorua total only includes emissions produced in the Bay of Plenty region.



4.0 Emissions change from 2015/16 to 2020/21

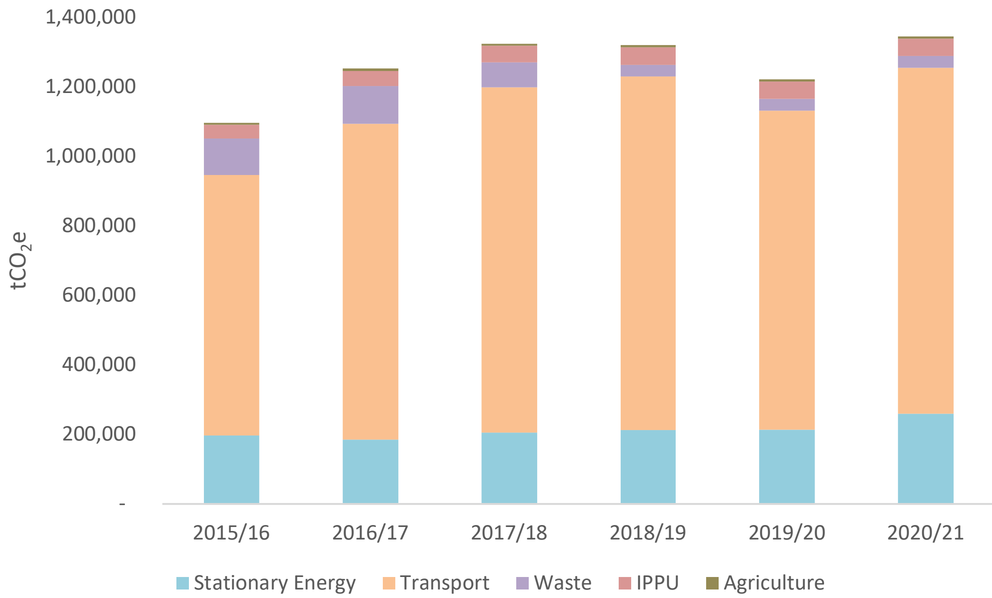
Alongside calculating Tauranga's emissions footprint for 2020/21, we have calculated Tauranga's emissions footprint for 2018/19 and 2019/20. By calculating these three years we can assess the emissions footprint before the COVID pandemic caused disruptions, changes, and enforced restrictions, and assess the impact of the COVID pandemic on emissions in Tauranga. We have also recalculated Tauranga's most recent emissions footprint (2015/16) using the same methodology, data sources, and emission factors as for the other footprints reported here. This enables us to directly compare these emissions footprints. A discussion of the updated 2015/16 footprint and significant changes is found in section 7.0. For the years in between (2016/17 and 2017/18) we have calculated emissions from key sources (e.g. electricity consumption, petrol and diesel consumption, marine freight, livestock and air travel) and estimated all other emission sources as part of the agreed approach.

This section displays the results of the 2015/16, 2018/19, 2019/20, and 2020/21 emissions footprints with a focus on Gross emissions and examines the change in emissions from 2015/16 to 2020/21. An analysis of the impact of the COVID pandemic on Tauranga's emissions is found in section 6.0.

Table 12 Change in Tauranga's Total Gross and Net emissions from 2015/16 to 2020/21

	2015/16 (tCO_2e)	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2015/16 to 2020/21)
Total Net Emissions (including forestry)	1,098,757	1,322,459	1,226,290	1,360,530	24%
Total Gross Emissions (excluding forestry)	1,096,155	1,319,775	1,221,060	1,345,115	23%

Figure 8 Change in Tauranga's total gross emissions from 2015/16 to 2020/21

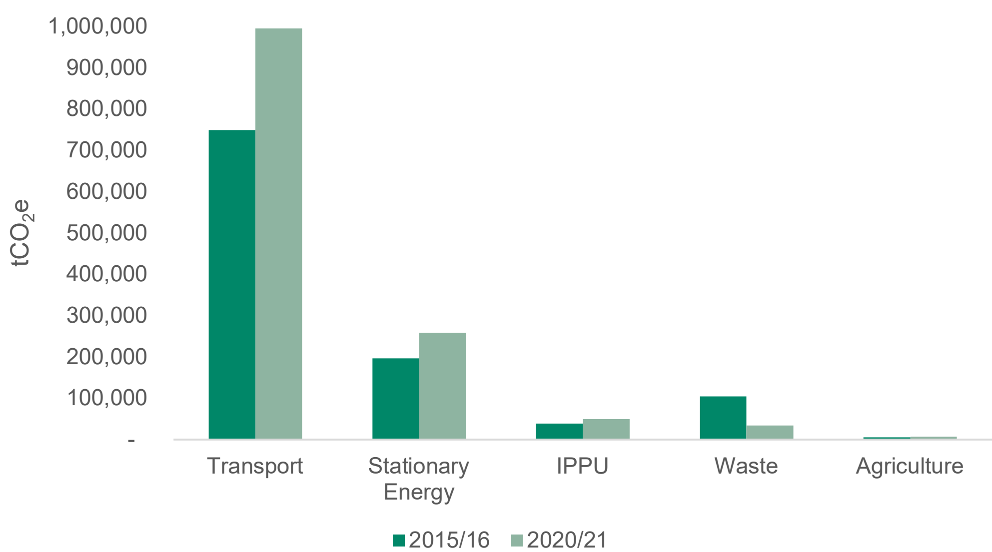


Total gross emissions per year increased by 23% from 1,096,155 tCO_2e in 2015/16 to 1,345,115 tCO_2e in 2020/21. This is driven by increases in transport and stationary energy emissions. Emissions from all sectors with the exception of Waste have increased since 2015/16.

Per capita gross emissions in Tauranga remained steady between 2015/16 and 2020/21, changing from 8.7 to 8.8 tCO_2e per person per year. The population of Tauranga grew by 22% during this time which is almost the same as the growth in total gross emissions. A discussion of the decoupling of gross emissions from population growth and GDP is found in section 5.0.

The sections below outline the change in emissions between 2015/16 and 2020/21 for each sector and emissions source, highlighting the changes that have had the largest impact on total gross emissions.

Figure 9 Emissions for each sector of Tauranga's gross emissions footprint for 2015/16 and 2020/21



4.1 Transport

Table 13 Change in Tauranga's Transport emissions from 2015/16 to 2020/21

Sector / Emissions Source	2015/16 (tCO_2e)	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2015/16 to 2020/21)
Marine Freight	315,457	518,431	461,563	473,045	50.0%
Diesel	218,978	270,253	252,749	290,141	32.5%
Petrol	177,367	188,471	168,404	194,145	9.5%
Rail	24,632	23,214	21,017	21,479	-12.8%
Jet Kerosene	8,627	11,685	8,794	11,334	31.4%
Marine Diesel (local)	2,556	3,214	3,059	2,822	10.4%
LPG	1,005	1,213	1,244	1,316	31.0%
Aviation Gas	741	843	641	856	15.5%
Bioethanol	0.03	0.03	0.03	0.04	32.6%
Total:	**749,362**	**1,017,326**	**917,470**	**995,138**	**33%**

Transport emissions increased by 33% between 2015/16 and 2020/21 (245,775 tCO_2e). This was driven by a 50% increase in marine freight emissions (245,775 tCO_2e) and a 21% increase in on-road fuel emissions (74,671 tCO_2e).

The largest annual increase in greenhouse gas emissions from marine freight transport occurred from 2016 to 2017. This is associated with an increase in average vessel size following the introduction of 9,500 Twenty-foot Equivalent Unit (TEU) vessels, which was over double the capacity of the previous largest container vessel visiting Tauranga. This shift occurred following shipping channel deepening and widening in the Tauranga Harbour. These largest vessels call directly and exclusively to the Bay of Plenty, whereas smaller vessels are likely to call at more than one New Zealand port/region. These larger vessels are generally more fuel efficient as they emit fewer greenhouse gases per unit of cargo (e.g. per container). In general, marine freight emissions have increased over the period from 2016 to 2021 due to an increase in import and export freight movements through Tauranga Port.

With the exception of rail, no transport emissions sources decreased between 2015/16 and 2020/21. Notably, the impact of the COVID pandemic can be seen in Transport emissions where emissions decreased by 11% between 2018/19 and 2019/20 before increasing again by 8% between 2019/20 and 2020/21.

4.2 Stationary Energy

Table 14 Change in Tauranga's Stationary Energy emissions from 2015/16 to 2020/21

Sector / Emissions Source	2015/16 (tCO_2e)	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2015/16 to 2020/21)
Electricity Consumption	85,568	89,012	89,920	129,583	51%
Natural Gas	51,742	54,953	56,465	55,863	8%
Stationary Petrol & Diesel Use	24,800	30,483	28,468	32,612	31%
Coal	12,991	11,383	11,881	9,536	-27%
LPG	7,962	9,613	9,863	10,434	31%
Electricity Transmission and Distribution Losses	5,157	7,770	7,893	11,902	131%
Biofuel / Wood	4,333	4,498	4,498	4,498	4%
Natural Gas Transmission and Distribution Losses	4,183	4,442	4,565	4,516	8%
Biogas (landfill)	-	90	96	101	*NA*
Total:	**196,735**	**212,244**	**213,648**	**259,044**	**32%**

Emissions from Stationary Energy increased by 32% between 2015/16 and 2020/21 (62,309 tCO_2e). This was driven by a 51% increase in electricity consumption emissions (44,016 tCO_2e). This rise in electricity consumption emissions was caused by a 2% increase in electricity consumption in Tauranga coupled with a 48% increase in the emissions intensity of the national electricity grid (tCO_2e/kWh). The emissions intensity of the national grid has increased in recent years due to the increased use of fossil fuels during years with low hydro electricity generation.

4.3 Waste

Table 15 Change in Tauranga's Waste emissions from 2015/16 to 2020/21

Sector / Emissions Source	2015/16 (tCO_2e)	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2015/16 to 2020/21)
Waste in open landfill sites	77,412	9,356	9,922	10,455	-86%
Waste in closed landfill sites	24,742	20,542	19,348	18,240	-26%
Composting (Green Waste)	-	-	899	1,797	N/A
Wastewater treatment plants	526	531	458	424	-19%
Individual septic tanks	1,929	3,064	3,223	3,183	65%
Total	**104,609**	**33,493**	**33,849**	**34,099**	**-67%**

Waste emissions decreased between 2015/16 and 2020/21, by 67% (70,511 tCO_2e).

Total solid waste in landfill emissions decreased by 72%. Emissions from closed landfills decreased because as no extra waste is added, the existing waste in landfill releases fewer emissions over time. Emissions from open landfills decreased due to improvements in landfill gas capture at landfill sites.

Total wastewater emissions increased by 47%, this is based an increase in the assumed number of people using septic tank systems. Data availability improvements in future years may improve the accuracy of this estimate.

4.4 Industrial Processes and Product Use (IPPU)

Table 16 Change in Tauranga's IPPU emissions from 2015/16 to 2020/21

Sector / Emissions Source	2015/16 (tCO_2e)	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2015/16 to 2020/21)
Refrigerants and air conditioning	36,440	46,870	46,048	46,739	28.3%
Aerosols	2,384	2,408	2,378	2,413	1.2%
SF6 - Electrical Equipment	396	375	396	402	1.5%
Foam Blowing	110	168	184	187	69.7%
SF6 - Other	76	82	84	85	11.0%
Fire extinguishers	60	67	69	70	15.7%
Total	**39,468**	**49,971**	**49,158**	**49,896**	**26%**

IPPU emissions increased between 2015/16 and 2020/21, by 26% (10,429 tCO_2e). The increase in IPPU emissions is mainly caused by an increased use of refrigerant gases. Note that national level data is used for this sector and is portioned out using a population approach; exact emissions for the district are unknown.

4.5 Agriculture

Table 17 Change in Tauranga's Agriculture emissions from 2015/16 to 2020/21

Sector / Emissions Source	2015/16 (tCO_2e)	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2015/16 to 2020/21)
Enteric Fermentation	4,068	4,616	4,759	4,759	17.0%
Fertiliser used in Horticulture	675	685	688	691	2.4%
Manure from Grazing Animals	533	607	626	626	17.3%
Other Agriculture Emissions	505	607	628	628	24.4%
Atmospheric Deposition	144	163	168	168	17.3%
Manure Management	55	64	66	66	18.9%
Total	**5,980**	**6,742**	**6,935**	**6,938**	**16%**

Agriculture's emissions increased by 16% between 2015/16 and 2020/21 (958 tCO_2e). This increase is due to an increase in livestock numbers.

4.6 Forestry

Table 18 Change in Tauranga's Forestry emissions from 2015/16 to 2020/21

Sector / Emissions Source	2015/16 (tCO_2e)	2018/19 (tCO_2e)	2019/20 (tCO_2e)	2020/21 (tCO_2e)	% Change (2015/16 to 2020/21)
Total harvest emissions	8,657	8,788	11,334	21,524	148.6%
Native forest sequestration	-1,707	-1,708	-1,708	-1,708	<0.1%
Exotic forest sequestration	-4,348	-4,396	-4,396	-4,402	1.2%
Total	**2,602**	**2,684**	**5,230**	**15,414**	**492%**

Forestry emissions increased by 12,812 tCO_2e between 2015/16 and 2020/21. This increase was driven by an increase in total harvest emissions (12,867 tCO_2e) as more exotic forest is harvested. Sequestration by both exotic forest and native forest remained relatively stable during this time, increasing the net emissions from forestry.

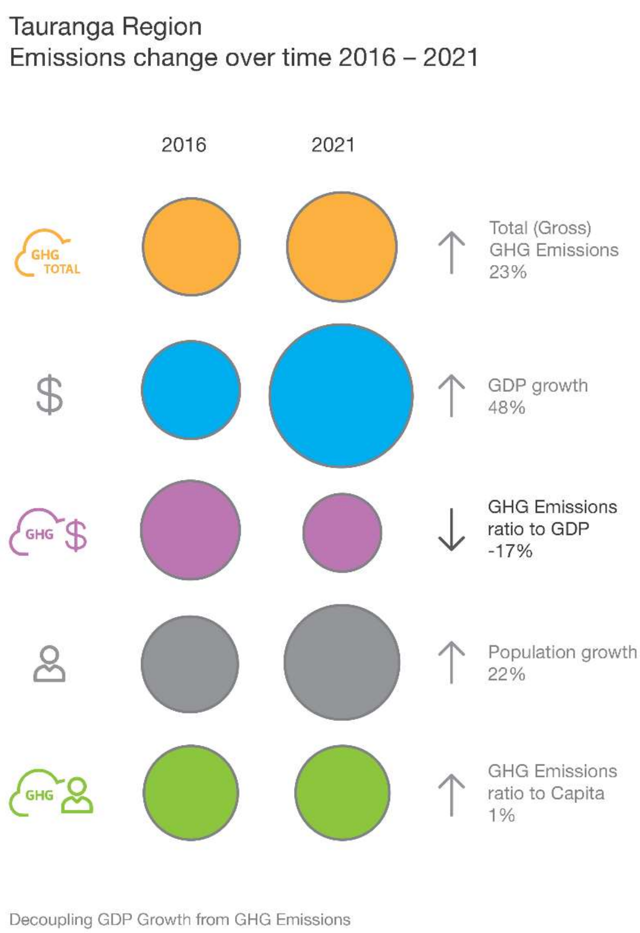
5.0 Decoupling of GHG emissions from population growth and GDP

Figure 10 shows the change in gross emissions when compared to changes in other metrics of interest between 2015/16 and 2020/21. In Tauranga during this period, total gross emissions growth (22%) has matched population growth (22%) resulting in a 1% increase in total gross emissions per capita.

When emissions grow less rapidly than Gross Domestic Product (GDP) as a measure of income then this process is known as decoupling. The term decoupling is an expression of the desire to mitigate emissions without harming economic wellbeing. A full discussion of decoupling of emissions is beyond the scope of this project. However, the changes in emissions and GDP illustrated in Figure 10 suggest at a high-level decoupling has occurred between 2015/16 and 2020/21. GDP increased by 48% while gross emissions increased by 23%, resulting in a 17% decrease in GHG emissions ration to GDP.

The exact drivers for the decoupling of emissions from GDP are difficult to pinpoint. New policies, for restructuring the way to meet demand for energy, food, transportation and housing will all contribute. In this case, both direct local actions including reducing the emissions from landfill gas and indirect national trends e.g. reduction of emissions from electricity generation will have contributed to the trends noted.

Figure 10 Change in total gross emissions compared to other metrics of interest



6.0 Impact of the COVID-19 pandemic on GHG Emissions

COVID-19 impacted New Zealand and the entire world during 2020 and 2021; causing widespread government-imposed restrictions on businesses and individuals and huge shifts in behaviours and economic markets. Restrictions in New Zealand relating to COVID-19 began in mid-March with many personal and business restrictions continuing past the end of 2019/20 and throughout 2020/21.[3]

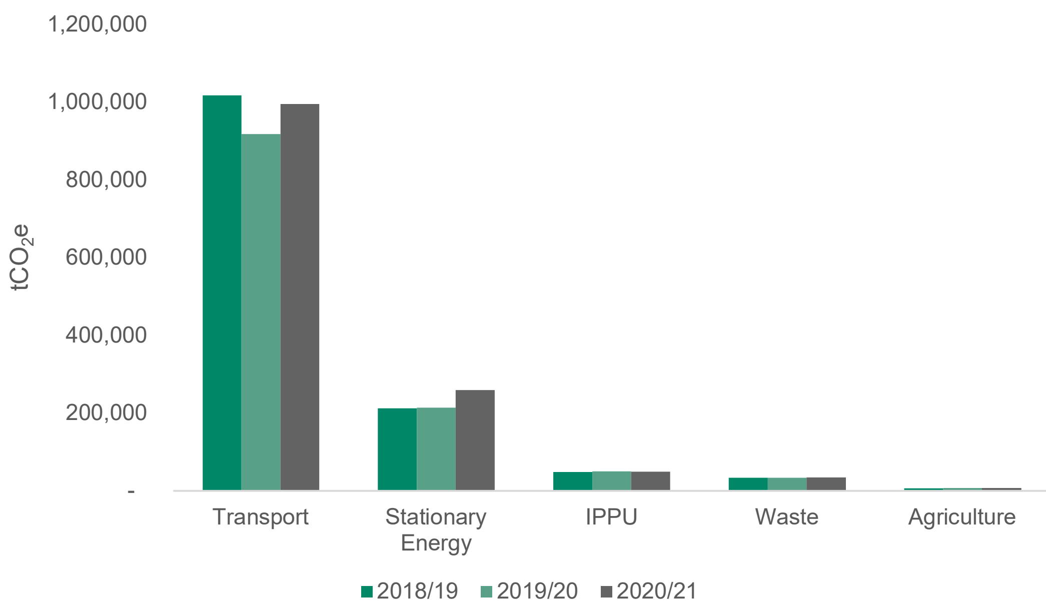
Globally, carbon dioxide emissions from fossil fuels (the largest contributor to greenhouse gas emissions) in 2020 decreased by 7% compared to 2019[4]. Emissions from the transportation sector account for the largest share of this decrease. Surface transport, e.g. car journeys, fell by approximately half at the peak of COVID-19 restrictions in April 2020 (when restrictions were at their maximum, particularly across Europe and the U.S. Globally, emissions recovered to near 2019 levels and are expected to continue to increase.

In New Zealand, national daily carbon dioxide emissions are estimated to have fell by up to 41% during the level 4 lockdown in April 2020[5]. National gross emissions decreased by 3% from 2018/19 to 2019/20, which was largely driven by a decrease in fuel use in road transport due to COVID-19 pandemic restrictions, a decrease in fuel use in manufacturing industries and construction due to COVID-19 restrictions, and a decrease in fuel use from domestic aviation also due to COVID-19 restrictions.

Total gross emissions in Tauranga decreased by 98,715 tCO_2e (8%) between 2018/19 and 2019/20. Total gross emissions then increased by 124,055 tCO_2e (9%) from 2019/20 to 2020/21 to above that of the pre-COVID-19 year.

The impact on emissions in different sectors varied. Notably, Transport emissions reduced by 11% between 2018/19 and 2019/20, driven by reduced transport fuel use across all transport emission sources. Despite changes in Stationary Energy, Agriculture, Waste, and IPPU emissions, these sectors are not judged to have been significantly affected by the COVID-19.

Figure 11 Tauranga emissions per sector for 2018/19, 2019/20, and 2020/21 (tCO_2e)



[3] https://covid19.govt.nz/alert-system/history-of-the-covid-19-alert-system/
[4] Pierre Friedlingstein et al. - Global Carbon Budget 2020 (2020)
[5] Corinne Le Quere et al. – Temporary Reduction in Daily Global CO_2 Emissions During the COVID-19 Forced Confinement

7.0 Update to the 2015/16 Emissions Footprint

Improvements to the methodology, improvements in available data, and updates to emission factors since the 2015/16 Community Carbon Footprint was first published in 2017 have meant that the 2015/16 footprint results are required to be updated to allow direct comparison with the 2018/19, 2019/20, and 2020/21 footprints.

The previous 2015/16 inventory and updated 2015/16 inventory results are presented in Table 19

Key reasons for results changes between these footprints are outlined below:

- Stationary Energy emissions have been adjusted due to improvements in data and methodology changes, notably through the inclusion of emissions related to industry-specific natural gas connection points.
- Transportation emissions have been adjusted due to the inclusion of marine freight emissions relating to the Port of Tauranga which were not previously included. Data improvements and methodology changes have also impacted this sector.
- Waste emissions have been adjusted due to updates to IPCC guidance and improvements in data.
- IPPU emissions have been adjusted due to a change in emission factors provided by the Ministry for the Environment (MfE).
- Agriculture emissions have been adjusted due to improvements in data and changes in MfE emission factors.
- Forestry emissions have been adjusted due to improvements in published data.

Table 19 Reported GHG emissions in Tauranga for 2015/16, showing the change in emissions between those previously reported (2017) and the updated results (2022)

	2015/16 previous inventory (2017) – tCO_2e	2015/16 updated inventory (2022) – tCO_2e
Stationary Energy	177,341	196,735
Transportation	463,960	749,362
Waste	62,250	104,609
IPPU	40,336	39,468
Agriculture	16,042	5,980
Forestry	5,442	2,602
Total Net Emissions (incl. forestry)	**765,371**	**1,098,757**
Total Gross Emissions (excl. forestry)	**759,929**	**1,096,155**

Future community carbon footprints for Tauranga may also require adjustments to the emission results reported here due to improvements to the inventory process.

8.0 Closing Statement

Tauranga's GHG emissions footprint provides information for decision-making and action by the council, Tauranga stakeholders, and the wider community. We encourage the council to use the results of this study to update current climate actions plans and set emission reduction targets.

The emissions footprint developed for Tauranga covers emissions produced in the Stationary Energy, Transport, Waste, IPPU, Agriculture, and Forestry sectors using the GPC reporting framework. Sector-level data allows Tauranga to target and work with the sectors that contribute the most emissions to the footprint.

Understanding of the extensive and long-lasting effects of climate change is improving all the time. It is recommended that this emissions footprint be updated regularly (every two or three years) to inform ongoing positive decision making to address climate change issues.

The accuracy of any emissions footprint is limited by the availability, quality, and applicability of data. Solid waste and wastewater, marine freight emissions, IPPU, and on and off-road transport fuel use.

9.0 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 **December 2021 and September 2022** 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

Sector / Category	Assumption and Exclusions
General	
Geographical Boundary	LGNZ local council mapping boundaries have been applied. The emissions footprint for the Bay of Plenty Region covers the entirety of the Bay of Plenty Region (this excludes some of the Rotorua and Taupō territorial authorities). Emissions footprints for each territorial authority covers the entirety of the territorial authority area (for Rotorua and Taupō territorial authorities, this includes areas outside the Bay of Plenty Region).
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 2018 and 2019 calendar year populations for FY19). The population of Rotorua and Taupō inside/outside the Bay of Plenty Region has been estimated by AECOM and approved by the Bay of Plenty Regional Council (BoPRC).
Transport Emissions	
Petrol and Diesel:	Bay of Plenty fuel sales figures (litres) provided by Rotorua Lakes District Council. Sales have been divided between territorial authorities based on the number of kilometres travelled by vehicles on roads (VKT) in each territorial authority. VKT data provided by Waka Kotahi. The division into transport and stationary energy end use (and within transport into on-road and off-road) has been calculated using fuel end use data provided by the Energy Efficiency and Conservation Authority (EECA) from the 2019 database. Biofuel sales information provided directly by the supplier.
Rail Diesel	Emissions from fuel use have been calculated and provided by Kiwi Rail. The following assumptions were made: - Net Weight is product weight only and excludes container tare (the weight of an empty container) - The Net Tonne-Kilometres (NTK) measurement has been used. NTK is the sum of the tonnes carried multiplied by the distance travelled. - 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. The trans-boundary routes were determined, and the number of stops taken along the way derived. The total amount of litres of diesel consumed per route was then split between the

	departure district, arrival district and any district the freight stopped at along the way. If the freight travelled through but did not stop within a district, no emissions were allocated. This data is subject to commercial confidentiality.
Jet Kerosene (Scheduled Flights)	Calculated from information provided by Rotorua, Tauranga, Taupō, and Whakatāne airports. Emissions from scheduled flights are allocated equally between the origin and destination area emissions footprints. Flight emissions relating to each airport have been divided between territorial authorities based on the expected users of the airports: - Rotorua Airport to Rotorua territorial authority only - Taupō Airport to Taupō territorial authority only - Whakatāne Airport to Whakatāne, Ōpōtiki, and Kawerau territorial authorities, allocated based on population size - Tauranga Airport to Tauranga and Tauranga territorial authorities, allocated based on population size
Aviation Gas (General Aviation)	Aviation Gas consumption has been estimated based on community carbon footprints developed for other regions in New Zealand. The relative size of this consumption has been based on the number of general aviation flights taken from each airport for each year. This information has been provided by the respective airports. Emissions relating to each airport have been divided between territorial authorities as described for 'Schedules Flights' above.
Marine Freight	Shipping schedules have been provided by the Port of Tauranga. Emissions have been calculated based on ship weight and distance from the origin/destination to Tauranga. This figure does not include fishing vessels, or vessels with Tauranga as both the origin and destination. Emissions from freight and international shipping are allocated equally between the origin and destination area emissions footprints. It is expected that imports and exports travelling through the Port of Tauranga service the entire Bay of Plenty Region. Emissions relating to freight and international shipping emissions have been divided between all Bay of Plenty territorial authorities based on population size.
Marine Fuel (Local)	This emissions source relates to vessels servicing the Port of Tauranga. All emissions have been allocated to Tauranga territorial authority. Does not include fuel use for private boating. Most private marine vessels use fuel purchased at vehicle fuel stations. Petrol and diesel used in private marine vessels is included in off-road transportation.

LPG Consumption	North Island LPG sales data (tonnes) has been provided by the LPG Association. 'Auto' and 'Forklift' sales represent transport uses of LPG. Sales have been divided between territorial authorities on a per capita basis.
Stationary Energy Emissions	
Electricity Demand	Electricity demand has been calculated using grid exit point (GXP) data from the EMI website (www.emi.ea.govt.nz). Reconciled demand has been used as per EMI's confirmation. The territorial authorities serviced by each GXP have been confirmed by the respective electricity suppliers. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per Ministry for the Environment (MfE) data.
Electricity Generation	Electricity generation has been calculated using data from the EMI website (www.emi.ea.govt.nz). Small electricity generation has not been included in this data (e.g. domestic solar generation). This figure only includes electricity that is connected to the national electricity grid, direct users of electricity are not included.
Coal Consumption	National coal consumption data has been provided by MBIE. 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.
Coal Production and Fugitive Emissions	Not Calculated: There are no active coal mines within the region.
Biofuel Consumption	National biofuel consumption data has been provided by the Ministry for Business, Innovation and Employment (MBIE). Biofuel consumption has been divided between territorial authorities on a per capita basis. Biofuel emissions are broken down into Biogenic emissions (CO_2) and Non-Biogenic emissions (CH_4 and N_2O)
LPG Consumption	North Island LPG sales data (tonnes) has been provided by the LPG Association. 'Auto' and 'Forklift' sales represent transport uses of LPG. All other sales represent stationary energy uses of LPG.

	Sales have been divided between territorial authorities on a per capita basis. The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per MfE data.
Natural Gas Consumption	Natural gas consumption data has been provided by FirstGas. Territorial Authorities supplied by gas from each Point of Connection (POC) have been confirmed by FirstGas. Natural gas consumption has been split into residential, commercial, and industrial consumption based on national statistics from MBIE. Some POCs supply gas to particular industrial users exclusively, these have been taken into account.
Oil and Gas Fugitive Emissions	Not Calculated: There are no gas or oil processing plants within the region.
Agricultural Emissions	
General	Territorial authority livestock numbers and fertiliser data taken from the Agricultural Census (StatsNZ). The last territorial authority census was in 2017. Regional agricultural data from StatsNZ (2021) has been used to estimate the change in livestock and fertiliser use since 2017. Territorial authority land-use data provided by BoPRC covering horticulture land-use.
Solid Waste Emissions	
Waste in Landfill	Landfill waste volume and end location information has been provided by the respective council departments. Where information is not available, waste volumes have been estimated based on historical national data on a per capita basis. 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.
Wastewater Emissions	
Wastewater Volume and Treatment Systems	Information on treated wastewater, and treatment plants has been provided by the respective council departments. Where information is not available, reasonable assumptions have been made. The population connected to septic tank systems have been estimated by the respective council departments. Emissions are allocated to territorial authorities based on where the wastewater was produced, even if the wastewater is treated outside the territorial authority.
Industrial Emissions	

Industrial processes	It is assumed that there are no significant non-energy related emissions of greenhouse gasses from industrial processes in the Region (e.g. aluminium manufacture).
Industrial Product Use	National data covering industrial product use (e.g. fire extinguishers, refrigerants) has been provided by the MfE. Emissions have been allocated to territorial authorities on a per capita basis.
Forestry Emissions	
Exotic Forestry Harvested	Regional exotic wood harvested has been provided by the Ministry for Primary Industries (MPI) in the Agricultural Production Statistics. The 2017/18 year is the latest year’s data available, for 2018/19, 2019/20 and 2020/21, the 2017/18 figure is used. Exotic forest of harvestable age land area for each territorial authority has been provided by the Ministry for Primary Industries (MPI) in the National Exotic Forest Description (NEFD). This has been used to estimate the likely breakdown of the region’s harvested wood by territorial authority. Emissions from roundwood, slash, and the underground tree are all accounted for.
Exotic and Native Forest sequestration	Exotic forest land area for each territorial authority has been provided by the Ministry for Primary Industries (MPI) in the National Exotic Forest Description (NEFD). Native forest land area is provided by Landcare Research Land-use Change Database (LCDB v5). The 2018/19 year is the latest year’s data available, for 2019/20 and 2020/21, the 2018/19 figure is used.
Emission Factors	
General	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 EFs have been applied. AR5 Global Warming Potential (GWP) figures for greenhouse gases have been used accounting for climate change feedbacks.