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AECOM

Whakatāne Community Carbon Footprint

20-Oct-2022

Whakatāne Community Carbon Footprint

Client: Bay of Plenty Regional Council

Co No.: N/A

Prepared by

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Executive Summary

Greenhouse Gas (GHG) emissions for the Whakatāne District Territorial Area (that is covered by the Whakatāne District 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 Whakatāne District Territorial Area for the 2020/21 financial reporting year and examines greenhouse gas emissions produced from 2015/16 to 2020/21.

The Whakatāne District Territorial Area is referred to hereafter as Whakatāne for ease. Greenhouse gas emissions are generally reported in this document in units of Carbon Dioxide Equivalents (CO₂e) 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 Whakatāne were 1,103,953 tCO₂e.
- **Agriculture** (e.g. emissions from livestock and crops) is the largest source of emissions, accounting for 49% of Whakatāne's total gross emissions, with enteric fermentation from livestock accounting for 37% of Whakatāne's total gross emissions.
- **Transport** (e.g. emissions from road and air travel) is the second largest emitting sector in Whakatāne, representing 27% of total gross emissions, with petrol and diesel consumption accounting for 16% of Whakatāne's total gross emissions.
- **Stationary Energy** (e.g. consumption of electricity and natural gas) is the third highest emitting sector in the region, producing 19% of total gross emissions. Electricity consumption accounted for 5% of Whakatāne'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 Whakatāne were 1,408,527 tCO₂e. This is larger than total gross emissions because carbon sequestration (3,863,455 tCO₂e) was less than emissions released due to forest harvesting in this year (4,168,028 tCO₂e).

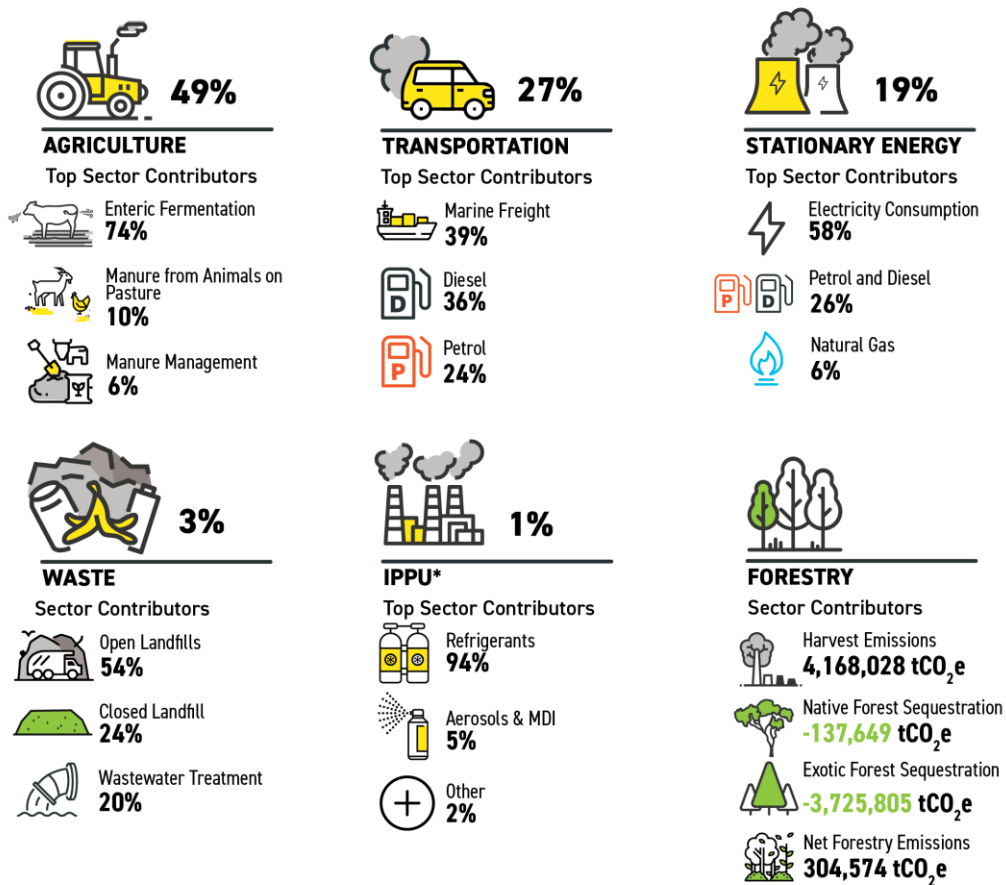
Changes in Emissions, 2015/16 to 2020/21

- Between 2015/16 and 2020/21, **total gross emissions** in Whakatāne increased from 1,053,113 tCO₂e to 1,103,953 tCO₂e, an increase of 5% (50,840 tCO₂e).
- Over this time the population of the district increased by 10%, resulting in **per capita gross emissions** in Whakatāne decreasing by 5% between 2015/16 and 2020/21, from 30.3 to 28.9 tCO₂e per person per year.
- **Transport** emissions increased by 19% between 2015/16 and 2020/21 (47,454 tCO₂e), driven by a 36% increase in marine freight emissions (30,872 tCO₂e) and a 10% increase in on-road fuel emissions (14,317 tCO₂e).
- Emissions from **Stationary Energy** increased by 19% between 2015/16 and 2020/21 (33,479 tCO₂e), driven by a 43% increase in electricity consumption emissions (16,721 tCO₂e). This increase in electricity consumption emissions was due to a 48% increase in the emissions intensity of the national electricity grid (tCO₂e/kWh).
- **IPPU** emissions increased between 2015/16 and 2020/21 by 14% (1,551 tCO₂e).
- Emissions from **Waste** and **Agriculture** decreased by 7% and 5% between 2015/16 and 2020/21 (2,291 tCO₂e and 29,353 tCO₂e), respectively. Agriculture emissions reduced due to a reduction in livestock numbers in the area.

- **Forestry** emissions increased by 234,566 tCO₂e between 2015/16 and 2020/21, this is the largest real and proportional change in emissions. This increase was predominantly due to an increase in total harvest emissions.

Figure 1: Whakatāne’s 2020/21 Emissions Footprint

Whakatane Greenhouse Gas Emissions 2020/21



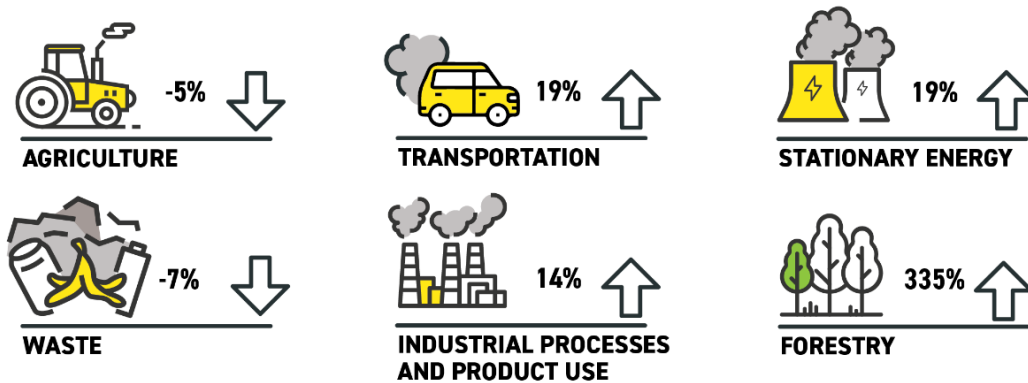
Total Gross Emissions (excluding Forestry): 1,103,953 tCO₂e

Total Net Emissions (including Forestry): 1,408,527 tCO₂e

*IPPU = Industrial Processes and Product Use

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

Whakatane Greenhouse Gas Emissions Percentage Changes between 2015/16 and 2020/21



Change in Gross Emissions between 2015/16 and 2020/21:

5%

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 the Whakatāne District 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 Whakatāne District Council.

The Whakatāne District Territorial Area is referred to hereafter as Whakatāne 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 methodology¹ 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) values². 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.).

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)

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- 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 Whakatāne District 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 Whakatāne’s greenhouse gas emissions, referred to as ‘emissions’ in this assessment. This includes Whakatāne’s total emissions, emissions from each sector, and major emissions sources within each sector. The focus of emissions reporting is on gross emissions.

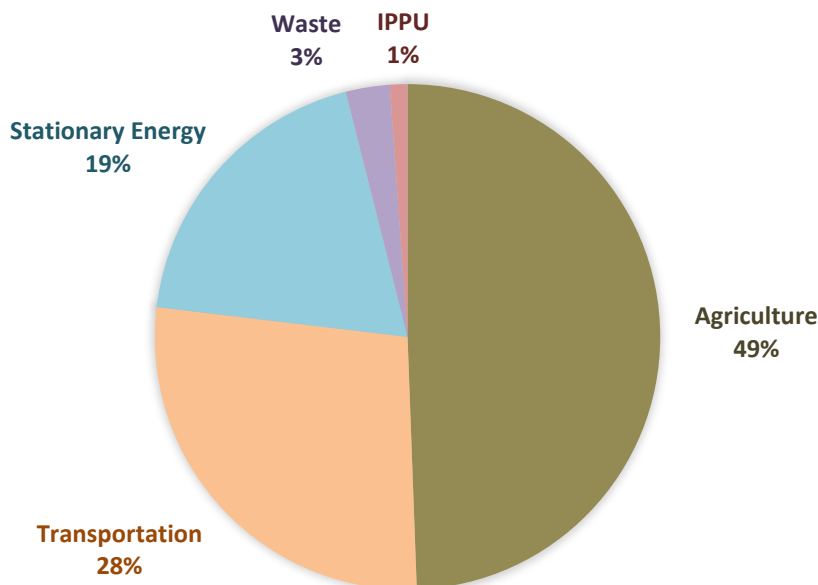
During the 2020/21 reporting period, Whakatāne emitted **gross** 1,103,953 tCO₂e. Note that gross emissions do not account for Forestry. Agriculture and Transport emissions are the largest contributors to total gross emissions for the district.

The population of Whakatāne in 2020/21 was approximately 38,250 people, resulting in per capita gross emissions of 28.9 tCO₂e/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 ₂ e
Total Net Emissions (including forestry)	1,408,527
Total Gross emissions (excluding forestry)	1,103,953

Figure 3: Whakatāne District District’s total gross GHG emissions split by sector (tCO₂e).



During the 2020/21 reporting period, Whakatāne emitted **net** 1,408,527 tCO₂e.

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 Agriculture

The highest emitting sector in Whakatāne, Agriculture, emitted 545,534 tCO₂e in 2020/21. Table 2 provides the emissions, percentage of 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 74% of Whakatāne's agricultural emissions (402,769 tCO₂e). Enteric fermentation GHG emissions are produced by methane (CH₄) released from the digestive process of ruminant animals (e.g. cattle and sheep). The second highest source of agricultural emissions was produced from nitrous oxide (N₂O) released by unmanaged manure from grazing animals on pasture (53,600 tCO₂e or 9.8% of the agricultural sector's emissions).

Table 2 Agriculture emissions by emission source

Sector / Emissions Source	tCO ₂ e	% of Total Gross Emissions	% of Sector Total
Enteric Fermentation	402,769	36.5%	73.8%
Manure from Grazing Animals	53,600	4.9%	9.8%
Manure Management	32,816	3.0%	6.0%
Other Agriculture Emissions	25,257	2.3%	4.6%
Atmospheric Deposition	16,691	1.5%	3.1%
Agricultural Soils	9,888	0.9%	1.8%
Fertiliser used in Horticulture	4,512	0.4%	0.8%
Total	545,534	49.4%	100%

Livestock were responsible for the majority of the Agriculture sector's GHG emissions (96%, or 524,825 tCO₂e) (Table 3). Dairy cattle account for 78% of agricultural emissions in Whakatāne and 38% of Whakatāne's total gross emissions. Non-dairy cattle account for 14% of agricultural emissions in Whakatāne and 7% of Whakatāne's total gross emissions.

Table 3 Agriculture emissions by emission source

Sector / Emissions Source	tCO ₂ e	% of Total Gross Emissions	% of Sector Total
Dairy Cattle	423,338	38.3%	77.6%
Non-dairy Cattle	78,646	7.1%	14.4%
Sheep	19,925	1.8%	3.7%
Fertiliser (other)	16,168	1.5%	3.0%
Fertiliser for Horticulture	4,512	0.4%	0.8%
Other livestock	2,945	0.3%	0.5%
Total	545,534	49.4%	100%

Fertilisers used for livestock and horticulture represent 4% of Agriculture emissions. An additional breakdown of emissions from fertiliser use in horticulture is included based on land-use information provided by BoPRC.

The largest contributor to 'Fertiliser for Horticulture' in Whakatāne was arable land (3,439 tCO₂e) followed by kiwifruit (Table 4). There is some potential for emissions double counting between the 'Fertiliser for Horticulture' and 'Fertiliser (other)' emission sources as these emissions have been calculated based on different datasets, where the 'Fertiliser (other)' category may also include some fertilisers used in horticulture. However, it is expected that the majority of the 'Fertiliser (other)' emissions are caused by fertiliser use for livestock land.

Table 4 Fertiliser used in horticulture emissions by crop type

Sector / Emissions Source	tCO ₂ e	% of Total Gross Emissions	% of Sector Total
Arable	3,439	0.3%	0.6%
Kiwifruit	909	0.1%	0.2%
Orchard or permanent horticulture	102	0.0%	0.0%
Vegetables	51	0.0%	0.0%
Avocado	10	0.0%	0.0%
Total	4,512	0.4%	0.8%

3.2 Transport

Transport produced 303,160 tCO₂e in 2020/21 (27% of the Whakatāne's gross total emissions). Table 5 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emissions source.

Table 5 Transport energy by emission source

Sector / Emissions Source	tCO ₂ e	% of Total Gross Emissions	% of Sector Total
Marine Freight	117,723	10.7%	38.8%
Diesel	108,413	9.8%	35.8%
Petrol	71,924	6.5%	23.7%
Rail	3,976	0.4%	1.3%
Jet Kerosene	429	<0.1%	0.1%
Aviation Gas	369	<0.1%	0.1%
LPG	328	<0.1%	0.1%
Total	303,160	27.5%	100%

Most of the transport emissions can be attributed to diesel and petrol, which produced 71,924 tCO₂e and 108,413 tCO₂e respectively (collectively 60% of the sector's emissions and 16% 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 159,256 tCO₂e (53% of Transport emissions). Off-road transport produced 21,408 tCO₂e (7% of Transport emissions).

The next largest emission source for Whakatāne is marine freight, which contributed to 39% of the sectors emissions and 11% of total gross emissions (117,723 tCO₂e). 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 7) 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 6 Whakatāne District emissions from the transport of waste, recycling, and other diverted materials

	Total material (tonnes)	Total distance travelled (return) (km)	Emissions (tCO ₂ e)
Landfill Waste	2,277	65,274	40
Diverted/Recycled Materials	1,658	55,719	34
Total	3,935	120,993	74

3.3 Stationary Energy

Producing 211,830 tCO₂e in 2020/21, Stationary Energy was Whakatāne's third highest emitting sector (19% of 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.

Table 7 Stationary energy emissions by emission source

Sector / Emissions Source	tCO ₂ e	% of Total Gross Emissions	% of Sector Total
Natural Gas	122,698	11.1%	57.9%
Electricity Consumption	55,869	5.1%	26.4%
Stationary Petrol & Diesel Use	12,060	1.1%	5.7%
Natural Gas Transmission and Distribution Losses	9,923	0.9%	4.7%
Electricity Transmission and Distribution Losses	5,131	0.5%	2.4%
LPG	2,597	0.2%	1.2%
Coal	2,373	0.2%	1.1%
Biofuel / Wood	1,163	0.1%	0.5%
Biogas	16	<0.1%	<0.1%
Total:	211,830	19.2%	100%

Natural gas was the cause of 58% of Stationary Energy emissions (122,698 tCO₂e), and 11% of Whakatāne's total gross emissions (132,621 tCO₂e when including transmission and distribution losses related to that consumption). Industrial consumers of natural gas are responsible for most of the natural gas consumption. Electricity consumption generated 27% of Stationary Energy emissions (55,869

tCO₂e), and 5% of Whakatāne's total gross emissions (61,000 tCO₂e when including transmission and distribution losses related to that consumption). Stationary petrol and diesel consumption generated 5.7% of the sectors emissions (12,060 tCO₂e). 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 77% of Stationary Energy emissions (162,173 tCO₂e) and 15% 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). This figure is dominated by natural gas used for industrial purposes.
- Residential Stationary Energy consumption accounts for 11% of Stationary Energy emissions (22,194 tCO₂e) and 2% 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 7% of Stationary Energy emissions (15,387 tCO₂e) and 1% 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 6% of Stationary Energy emissions (12,076 tCO₂e, 2% of gross emissions) 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.

3.4 Waste

Waste originating in Whakatāne (solid waste and wastewater) produced 31,011 tCO₂e in 2020/21, which comprises 3% of Whakatāne's total gross emissions. Table 8 provides the total emissions, percentage of the total gross emissions, and percentage of the sector total for each sector/emissions source.

Table 8 Waste emissions by emission source

Sector / Emissions Source	tCO ₂ e	% of Total Gross Emissions	% of Sector Total
Waste in open landfill sites	16,740	1.5%	54.0%
Waste in closed landfill sites	7,340	0.7%	23.7%
Individual septic tanks	3,172	0.3%	10.2%
Wastewater treatment plants	2,872	0.3%	9.3%
Composting	887	0.1%	2.9%
Total:	31,011	2.8%	100%

Solid waste produced the bulk of waste emissions (24,080 tCO₂e in 2020/21), making up 78% 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 Whakatāne has been transported to either Tirohia or Hampton Downs since 2001. Waste from Whakatāne District sent to these open landfill sites contributed 16,740 tCO₂e in 2020/21. Emissions from closed landfill sites produced 7,340 tCO₂e in 2020/21. Annual emissions from closed landfill sites will decrease over time as no new waste enters these sites.

Wastewater (both treatment plants and individual septic tanks) produced 6,044 tCO₂e making up 20% of total Waste emissions. More than half of households in Whakatāne are connected to wastewater treatments plants, which produced total emissions of 2,872 tCO₂e. Households connected to individual septic tanks produced 3,172 tCO₂e in wastewater emissions. Due to the production of methane, septic tanks have a higher emissions intensity compared to the wastewater treatments plants in Whakatāne.

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.

The remaining waste emissions are made up by composting facilities (887 tCO₂e, 3% of total waste emissions).

3.5 Industrial Processes and Product Use (IPPU)

IPPU in Whakatāne produced 12,417 tCO₂e in 2020/21, contributing 1% to Whakatāne'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 Whakatāne District (e.g. aluminium manufacture).

Table 9 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 (11,632 tCO₂e).

Table 9 Industrial processes and product use emissions by emission source

Sector / Emissions Source	tCO ₂ e	% of Total Gross Emissions	% of Sector Total
Refrigerants and air conditioning	11,632	1.1%	93.7%
Aerosols	601	0.1%	4.8%
SF6 - Electrical Equipment	100	<0.1%	0.8%
Foam Blowing	47	<0.1%	0.4%
SF6 - Other	21	<0.1%	0.2%
Fire extinguishers	17	<0.1%	0.1%
Total	12,417	1.1%	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 3,863,455 tCO₂e (which was mostly from exotic forestry) while harvesting emissions were 4,168,028 tCO₂e. This meant that Forestry in Whakatāne was a net positive source of emissions in 2020/21 (rather than a negative source of emissions, where sequestration exceeds harvesting). Total Forestry emissions in 2020/21 were 304,574 tCO₂e.

Table 10 Forestry emissions by emission source (including sequestration)

Sector / Emissions Source	tCO ₂ e
Total harvest emissions	4,168,028
Native forest sequestration	-137,649
Exotic forest sequestration	-3,725,805
Total	304,574

3.7 Total Gross Emissions by Greenhouse Gas

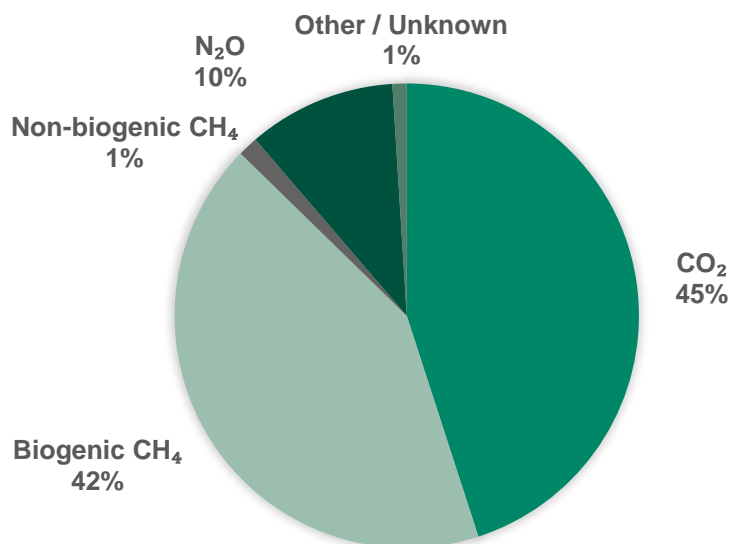
Each greenhouse gas has a different level of impact on climate change, this is accounted for when converting quantities of each gas into units of carbon dioxide equivalent (CO₂e).

Table 11: Whakatāne's total gross emissions, by greenhouse gas

Greenhouse Gas	Tonnes	Tonnes of CO ₂ e
Carbon Dioxide (CO ₂)	496,818	496,818
Biogenic Methane (CH ₄)	13,736	467,040
Non-biogenic Methane (CH ₄)	453	15,414
Nitrous Oxide (N ₂ O)	382	113,735
Other / Unknown Gas (in CO ₂ e)	10,945	10,945
Total	522,335	1,103,953

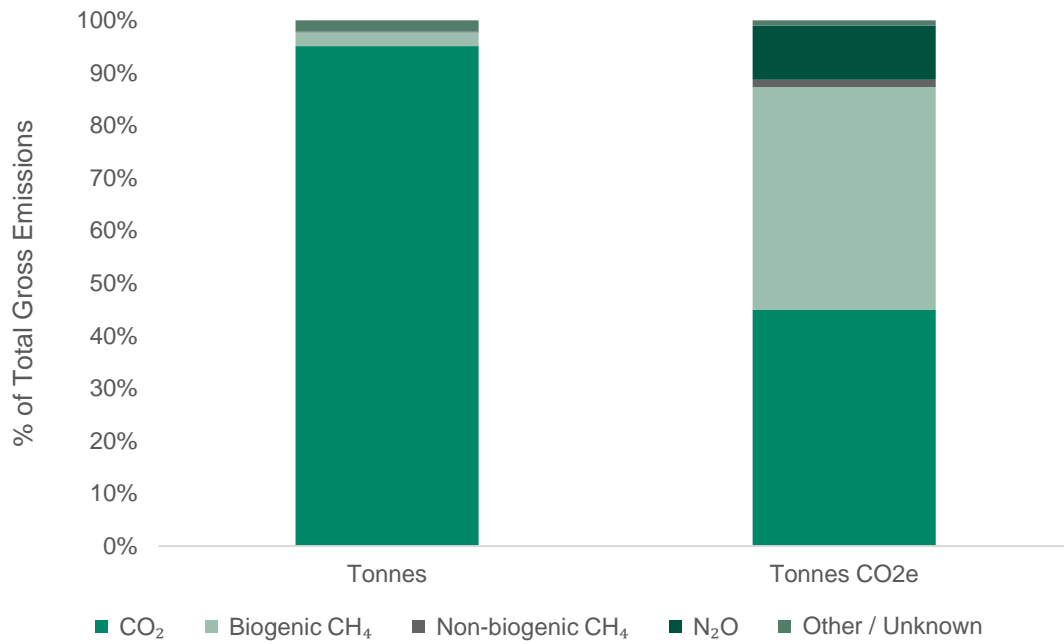
Figure 4 illustrates Whakatāne's total gross emissions by greenhouse gas in units of carbon dioxide equivalents (CO₂e).

Figure 4: Whakatāne District's total gross emissions, by greenhouse gas (in tCO₂e)



By far the largest source of emissions in tonnes is carbon dioxide (CO₂) at 496,818 tonnes. Due to the greater global warming impact of methane, methane represents 3% of the total tonnage of GHG emissions from Whakatāne but represents 43% of CO₂e. Nitrous oxide represents 0.1% of the total tonnage of GHG emissions from Whakatāne but represents 10% of CO₂e. This effect can be seen in Figure 5.

Figure 5: Whakatāne District District’s total gross emissions, by greenhouse gas in tonnes and in tonnes of CO₂e



3.8 Biogenic emissions

Biogenic carbon dioxide and methane emissions are stated in Table 12 and Table 13, respectively.

Biogenic CO₂ emissions are those that result from the combustion of biomass materials that store and sequester CO₂, including materials used to make biofuels (e.g. trees, crops, vegetable oils, or animal fats). Biogenic CO₂ emissions from plants and animals are excluded from gross and net emissions as they are part of the natural carbon cycle.

Table 12: Biogenic CO₂ in Whakatāne District (Excluded from gross emissions)

Biogenic Carbon Dioxide (CO ₂) (Excluded from gross emissions)		
Biofuel	38,085	t CO ₂
Combusted Landfill Gas	2,496	t CO ₂
Biodiesel	200	t CO ₂
Total Biogenic CO₂	40,782	t CO₂

Biogenic CH₄ 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 CO₂. Biogenic methane represents 3% of the gross total tonnage of GHG emissions in Whakatāne but represents 42% of total gross GHG emissions when expressed in CO₂e. 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 CO₂e is shown in Table 11.

The importance of biogenic CH₄ is highlighted in NZ's Climate Change Response (Zero Carbon) Amendment Act. The Act includes specific targets to reduce biogenic CH₄ 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 13: Biogenic Methane in Whakatāne District (Included in gross emissions)

Biogenic Methane (CH ₄) (Included in gross emissions)		
Enteric Fermentation	11,846	t CH ₄
Manure Management	965	t CH ₄
Landfill Gas	708	t CH ₄
Wastewater Treatment	171	t CH ₄
Biofuel	31	t CH ₄
Composting (Green Waste)	15	t CH ₄
Total Biogenic CH₄	13,736	t CH₄

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 6 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 7 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 6 Bay of Plenty’s total gross emissions divided by territorial authority (tCO₂e). *Rotorua and Taupō totals only include emissions produced in the Bay of Plenty region.

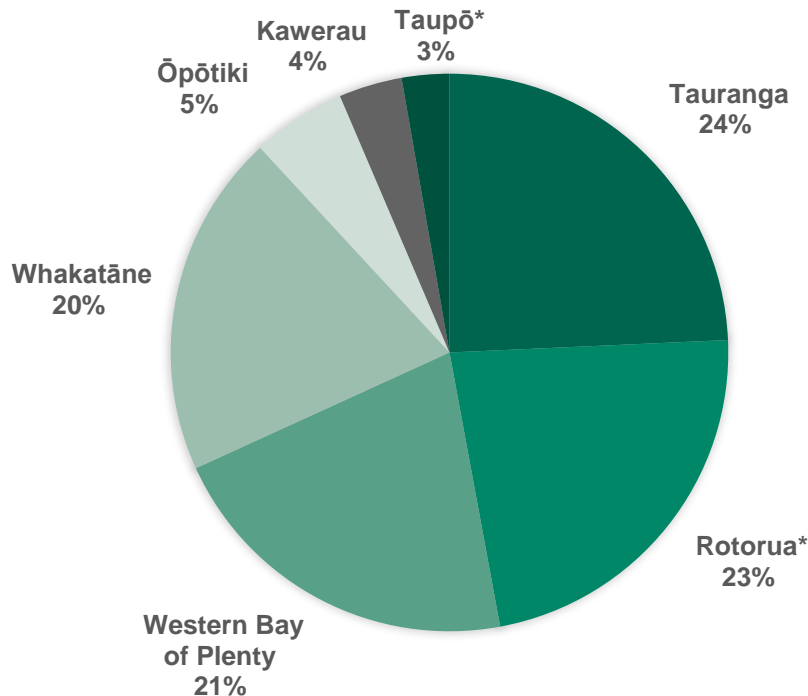
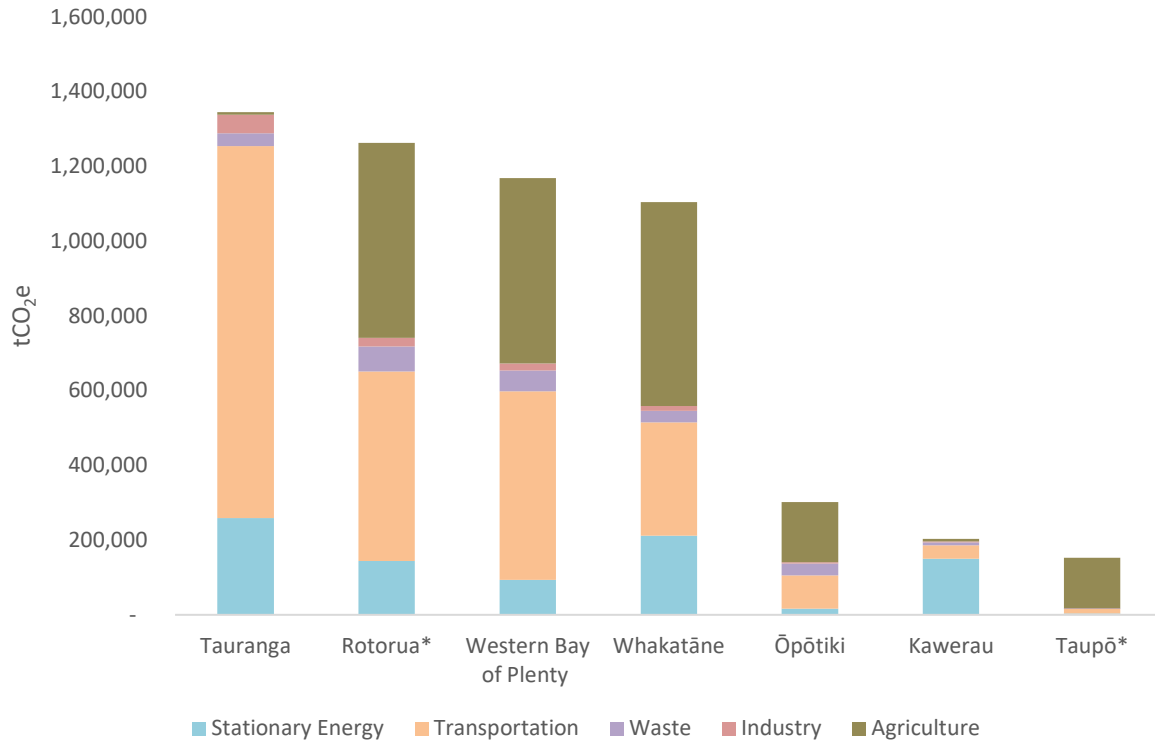


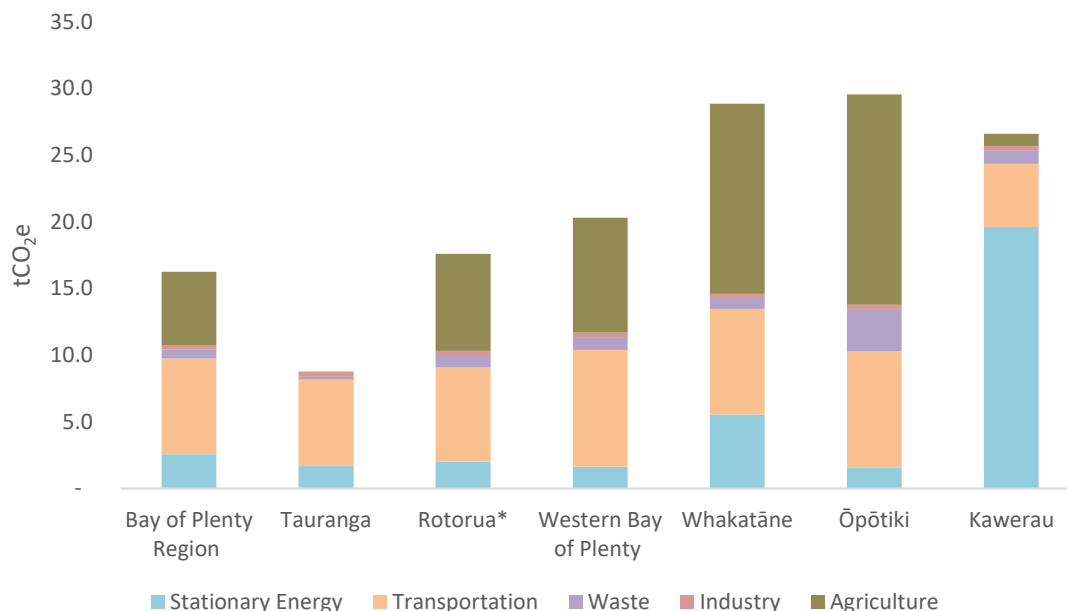
Figure 7 Total gross emissions by territorial authority in the Bay of Plenty region (tCO₂e). *Rotorua and Taupō totals only include emissions produced in the Bay of Plenty region.



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 8 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 tCO₂e/per capita figure for total gross emissions which is higher than the national value of 15.7 tCO₂e/per capita. Notably, Tauranga has the lowest per capita total emissions at 8.8 tCO₂e/per capita. Ōpōtiki and Whakatāne have the largest per capita total gross emissions at 29.5 tCO₂e/per capita and 28.9 tCO₂e/per capita respectively. Kawerau has the third highest per capita emissions at 26.6 tCO₂e/per capita, this is due to a small population and large industrial and manufacturing energy use in the area.

Figure 8 Total gross emissions per capita for the region and territorial authorities within the region (tCO₂e). *Rotorua total only includes emissions produced in the Bay of Plenty region.



4.0 Emissions change from 2015/16 to 2020/21

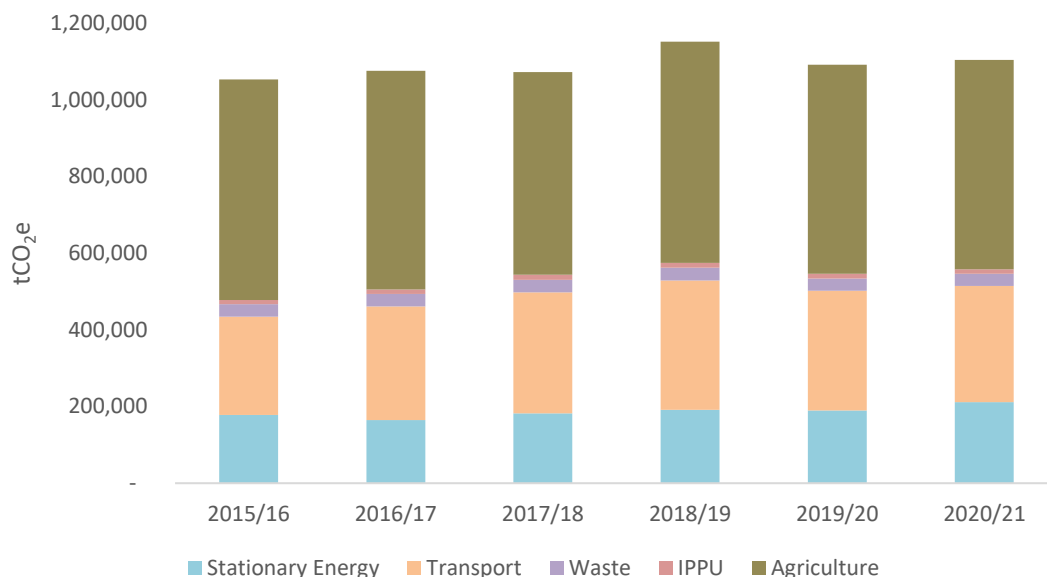
Alongside calculating the Whakatāne District’s emissions footprint for 2020/21, we have calculated Whakatāne District’s emissions footprint for 2018/19 and 2019/20. By calculating these three years we can assess the emissions footprint before the COVID pandemic caused disruptions, changes, and enforced restrictions, and assess the impact of the COVID pandemic on emissions in the Whakatāne District. We have also recalculated the Bay of Plenty’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. livestock, electricity consumption, petrol and diesel consumption, marine freight, 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 Whakatāne District’s emissions is found in section 6.0.

Table 14 Change in Whakatāne District’s Total Gross and Net emissions from 2015/16 to 2020/21

	2015/16 (tCO ₂ e)	2018/19 (tCO ₂ e)	2019/20 (tCO ₂ e)	2020/21 (tCO ₂ e)	% Change (2015/16 to 2020/21)
Total Net Emissions (including forestry)	1,123,121	1,262,209	1,284,727	1,408,527	25%
Total Gross Emissions (excluding forestry)	1,053,113	1,151,745	1,091,756	1,103,953	5%

Figure 9 Change in Whakatāne’s total gross emissions from 2015/16 to 2020/21



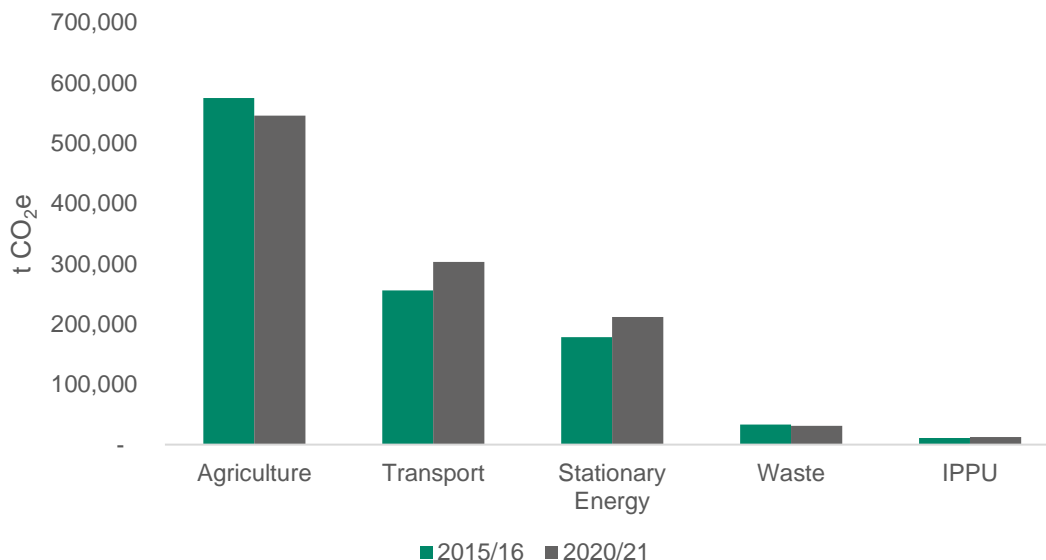
Annual total gross emissions increased by 5% from 1,053,113 tCO₂e in 2015/16 to 1,103,953 tCO₂e in 2020/21. This is driven by increases in Transport and Stationary Energy emissions. Emissions from IPPU have also increased since 2015/16 whilst emissions from the waste and agriculture sectors have decreased.

Total net emissions in Whakatāne increased by 25% from 1,123,121 in 2015/16 to 1,408,527 tCO₂e. This increase in net emissions is predominantly due to an increase in forest harvesting emissions and a reduction in exotic forest sequestration. This is discussed further below under the ‘Forestry’ heading.

The population of Whakatāne grew by 10% during this time, this is a larger increase than the increase in gross emissions resulting in a 5% decrease in per capita gross emissions between 2015/16 and 2020/21, from 30.3 to 28.9 tCO₂e per person per year. 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 10 Emissions for each sector of Whakatāne’s gross emissions footprint for 2015/16 and 2020/21



4.1 Agriculture

Table 15 Change in Whakatāne's Agriculture emissions from 2015/16 to 2020/21

Sector / Emissions Source	2015/16 (tCO ₂ e)	2018/19 (tCO ₂ e)	2019/20 (tCO ₂ e)	2020/21 (tCO ₂ e)	% Change (2015/16 to 2020/21)
Enteric Fermentation	425,415	426,894	402,769	402,769	-5%
Manure from Grazing Animals	56,958	56,817	53,600	53,600	-6%
Manure Management	37,490	35,256	32,816	32,816	-12%
Other Agriculture Emissions	25,183	26,229	25,257	25,257	0%
Atmospheric Deposition	17,384	17,580	16,691	16,691	-4%
Agricultural Soils	8,047	9,670	9,888	9,888	23%
Fertiliser used in Horticulture	4,410	4,471	4,492	4,512	2%
Total	574,887	576,919	545,513	545,534	-5%

Agriculture is the most significant contributor to Whakatāne's community carbon footprint. The sector's emissions decreased by 5% between 2015/16 and 2020/21 (29,353 tCO₂e). This decrease is driven by a reduction in enteric fermentation emissions (22,646 tCO₂e) which was caused by a decrease in total livestock numbers, especially of dairy cattle and sheep (see Table 16).

Table 16 Change in Whakatāne's livestock numbers from 2015/16 to 2020/21

	Number of animals (2015/16)	Number of animals (2020/21)	Change in number of animals (2015/16 to 2020/21)
Dairy Cattle	121,223	105,361	-15,862
Non-dairy Cattle	26,194	31,154	4,959
Sheep	43,375	36,351	-7,024
Other livestock	3,537	3,350	-187
Total livestock	194,330	176,217	-18,113

Table 17 Change in Whakatāne's livestock-associated Agriculture emissions from 2015/16 to 2020/21

	2015/16 emissions (tCO ₂ e)	2020/21 emissions (tCO ₂ e)	% Change in emissions (2015/16 to 2020/21)
Dairy Cattle	464,453	423,338	-8.9%
Non-dairy Cattle	67,174	78,646	17.1%
Sheep	23,353	19,925	-14.7%
Other livestock	2,899	2,945	1.6%
Total livestock	557,879	524,854	-5.9%

4.2 Transport

Table 18 Change in Whakatāne's Transport emissions from 2015/16 to 2020/21

Sector / Emissions Source	2015/16 (tCO ₂ e)	2018/19 (tCO ₂ e)	2019/20 (tCO ₂ e)	2020/21 (tCO ₂ e)	% Change (2015/16 to 2020/21)
Diesel	90,248	116,891	114,410	108,413	20%
Marine Freight	86,850	134,055	116,859	117,723	36%
Petrol	72,350	80,668	75,422	71,924	-1%
Rail	5,327	5,020	4,307	3,976	-25%
Jet Kerosene	331	443	333	429	30%
Aviation Gas	323	364	276	369	14%
LPG	277	314	315	328	18%
Biodiesel	<0.1	<0.1	<0.1	<0.1	N/A
Total	255,706	337,755	311,921	303,160	19%

Transport emissions increased by 19% between 2015/16 and 2020/21 (47,454 tCO₂e). This was driven by a 36% increase in marine freight emissions (30,872 tCO₂e) and a 10% increase in on-road fuel emissions (14,317 tCO₂e).

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.

Notably, the impact of the COVID pandemic can be seen in Transport emissions where emissions increased by 24% between 2015/2016 and 2018/19, before decreasing by 8% between 2018/2019 and 2019/20, and then decreasing a further 3% between 2019/2020 and 2020/21.

4.3 Stationary Energy

Table 19 Change in Whakatāne's Stationary Energy emissions from 2015/16 to 2020/21

Sector / Emissions Source	2015/16 (tCO ₂ e)	2018/19 (tCO ₂ e)	2019/20 (tCO ₂ e)	2020/21 (tCO ₂ e)	% Change (2015/16 to 2020/21)
Natural Gas	110,805	118,918	116,904	122,698	11%
Electricity Consumption	39,148	39,762	40,717	55,869	43%
Stationary Petrol & Diesel Use	10,116	13,026	12,723	12,060	19%
Natural Gas Transmission and Distribution Losses	8,961	9,617	9,454	9,923	11%
Coal	3,577	2,943	3,008	2,373	-34%
Electricity Transmission and Distribution Losses	2,359	3,471	3,574	5,131	117%
LPG	2,192	2,486	2,497	2,597	18%
Biofuel / Wood	1,193	1,163	1,163	1,163	-2%
Biogas	0	17	17	16	N/A
Total	178,351	191,402	190,058	211,830	19%

Emissions from Stationary Energy increased by 19% between 2015/16 and 2020/21 (33,479 tCO₂e). This was driven by a 43% increase in electricity consumption emissions (16,721 tCO₂e). This rise in electricity consumption emissions was caused by a 48% increase in the emissions intensity of the national electricity grid (tCO₂e/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.

Natural gas emissions also rose during this period by 11% (12,855 tCO₂e when you include transmission and distribution losses related to that consumption).

4.4 Waste

Table 20 Change in Whakatāne's Waste emissions from 2015/16 to 2020/21

Sector / Emissions Source	2015/16 (tCO ₂ e)	2018/19 (tCO ₂ e)	2019/20 (tCO ₂ e)	2020/21 (tCO ₂ e)	% Change (2015/16 to 2020/21)
Waste in open landfill sites	17,030	17,745	17,203	16,740	-2%
Waste in closed landfill sites	9,928	8,259	7,782	7,340	-26%
Individual septic tanks	2,873	3,129	3,156	3,172	10%
Wastewater treatment plants	2,584	2,728	2,789	2,872	11%
Composting (Green Waste)	887	887	887	887	0%
Total	33,302	32,747	31,817	31,011	-7%

Waste emissions decreased between 2015/16 and 2020/21, by 7% (2,291 tCO₂e) mainly due to a reduction in solid waste in landfill emissions.

Total solid waste in landfill emissions decreased by 11% (2,878 tCO₂e). This was driven by a 2,587 tCO₂e decrease in annual emissions from closed landfill sites. Emissions from closed landfills decreased because as no extra waste is added, the existing waste in landfill releases fewer emissions over time. Emissions from waste in open landfills remained steady during this period. Insufficient data to determine changes in composting emissions was available at the time of calculation. Future community carbon footprints should look to address this gap.

Total wastewater emissions increased by 11%, in line with Whakatāne's population growth. Emissions from centralised wastewater treatment, and individual septic tanks increased by a similar proportion.

4.5 Industrial Processes and Product Use (IPPU)

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

Sector / Emissions Source	2015/16 (tCO ₂ e)	2018/19 (tCO ₂ e)	2019/20 (tCO ₂ e)	2020/21 (tCO ₂ e)	% Change (2015/16 to 2020/21)
Refrigerants and air conditioning	10,033	12,119	11,658	11,632	16%
Aerosols	656	623	602	601	-9%
SF6 - Electrical Equipment	109	97	100	100	-8%
Foam Blowing	30	43	47	47	53%
SF6 - Other	21	21	21	21	0%
Fire extinguishers	17	17	17	17	5%
Total	10,866	12,921	12,446	12,417	14%

IPPU emissions increased between 2015/16 and 2020/21, by 14% (1,551 tCO₂e). 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.

4.6 Forestry

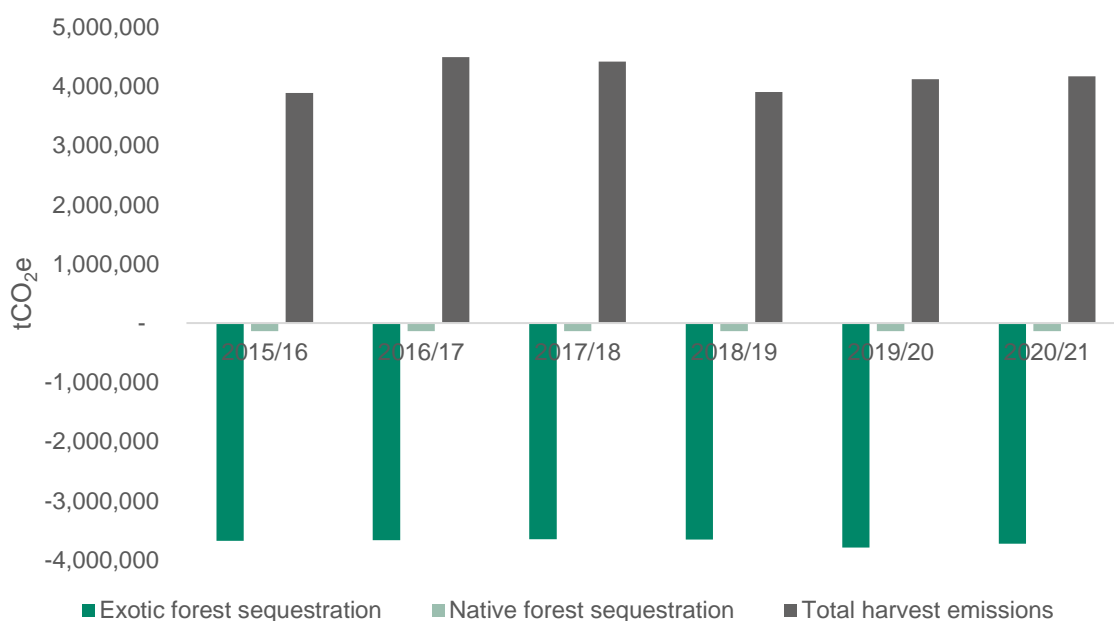
Table 22 Change in Whakatāne's Forestry emissions from 2015/16 to 2020/21

Sector / Emissions Source	2015/16 (tCO ₂ e)	2018/19 (tCO ₂ e)	2019/20 (tCO ₂ e)	2020/21 (tCO ₂ e)	% Change (2015/16 to 2020/21)
Total harvest emissions	3,884,149	3,903,646	4,119,046	4,168,028	7%
Native forest sequestration	-137,685	-137,649	-137,649	-137,649	0%
Exotic forest sequestration	-3,676,455	-3,655,533	-3,788,427	-3,725,805	1%
Total	70,008	110,464	192,971	304,574	335%

Forestry emissions increased by 234,566 tCO₂e between 2015/16 and 2020/21, this is the largest real and proportional change in emissions for Whakatāne. This increase was driven by an increase in total harvest emissions (283,880 tCO₂e) as more exotic forest is harvested. Forestry emissions are influenced by the cyclical nature of harvesting and planting regimes where some years will have higher sequestration and some years will have higher harvesting emissions depending on the age of forests and the demand for lumber and timber. The rise in Whakatāne's harvesting emissions during this period is reflective of an increase in forestry harvesting across the region coupled with exotic forestry growing to harvestable age in Whakatāne. Improved and updated data sources may impact the estimation of emissions from this source in the future.

Sequestration by native forest remained relatively stable during this time, whilst sequestration by exotic forest increased slightly during this time, decreasing the net emissions from forestry.

Figure 11 Forestry sequestration and harvesting emissions from 2015/16 to 2020/21



5.0 Decoupling of GHG emissions from population growth and GDP

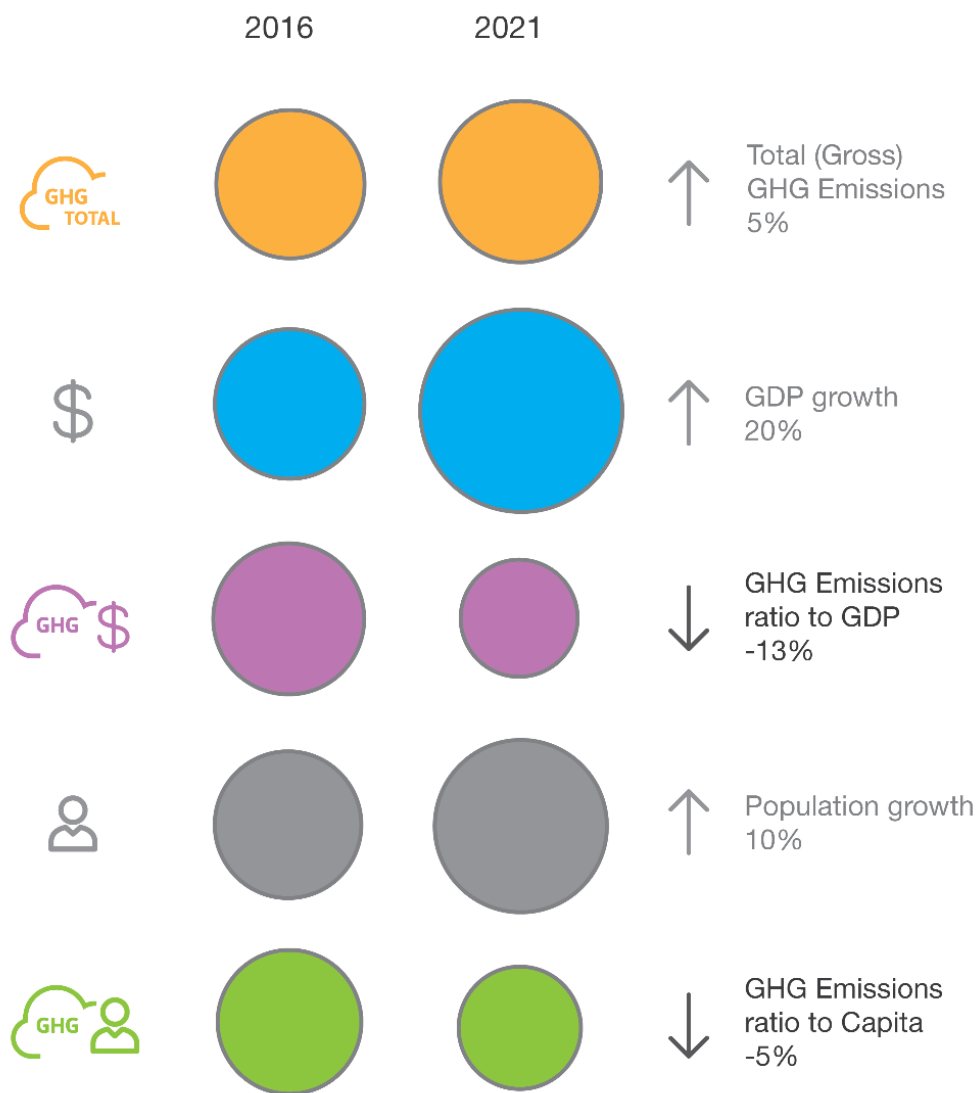
Figure 12 shows the change in gross emissions when compared to changes in other metrics of interest between 2015/16 and 2020/21. For example, while total gross emissions have increased by 5%, per capita gross emissions have decreased by 5% as the population has grown faster than emissions during this time (by 10%).

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 12 suggest at a high-level decoupling has occurred between 2015/16 and 2020/21. GDP increased by 20% while gross emissions increased by 5%, resulting in a 13% decrease in GHG emissions ratio 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 (e.g. landfill gas reductions) and indirect national trends (e.g. changes to emissions from electricity generation) will have contributed to the trends noted.

Figure 12 Change in total gross emissions compared to other metrics of interest

Whakatane Emissions change over time 2016 – 2021



Decoupling GDP Growth from GHG Emissions

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

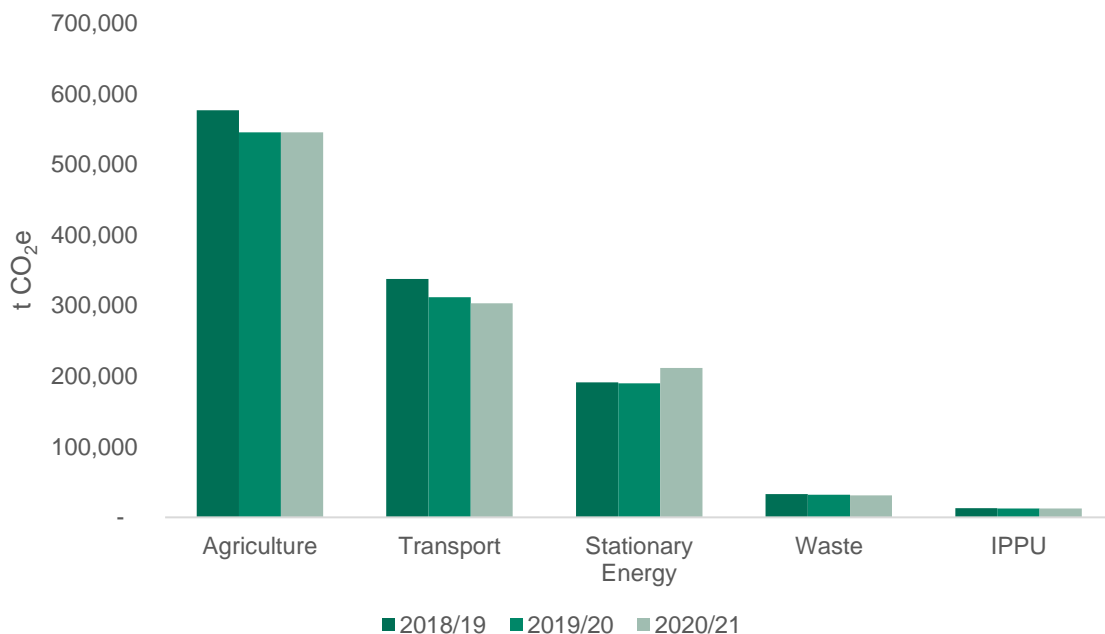
Globally, carbon dioxide emissions from fossil fuels (the largest contributor to greenhouse gas emissions) in 2020 decreased by 7% compared to 2019⁴. Emissions from the transportation sector account for the largest share of this decrease. Surface transport, e.g. car journeys, fell by approximately half 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 2020⁵. 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 Whakatāne decreased by 59,988 tCO₂e (5%) between 2018/19 and 2019/20. Total gross emissions then increased by 12,196 tCO₂e (1%) from 2019/20 to 2020/21, however gross emissions were still lower than the pre-COVID 2018/19 year.

The impact on emissions in different sectors varied. Notably, Transport emissions reduced by 8% between 2018/19 and 2019/20, driven by reduced road and marine transport fuel use. Agriculture emissions reduced by 5% between 2018/19 and 2019/20, possibly impacted by shipping disruptions, however this decrease does fit into a potential longer-term trend of emissions reductions in this sector. Despite changes in Stationary Energy, Waste, and IPPU emissions, these sectors are not judged to have been significantly affected by the COVID-19 disruptions.

Figure 13 Whakatāne emissions per sector for 2018/19, 2019/20, and 2020/21 (tCO₂e)



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 CO₂ Emissions During the COVID-19 Forced Confinement

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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 23

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 and emission factors.

Table 23 Reported GHG emissions in Whakatāne for 2015/16, showing the change in emissions between those previously reported (2017) and the updated results (2022)

	2015/16 previous inventory (2017) – tCO ₂ e	2015/16 updated inventory (2022) – tCO ₂ e
Stationary Energy	168,638	178,351
Transportation	161,558	255,706
Waste	29,552	33,302
IPPU	11,012	10,866
Agriculture	629,468	574,887
Forestry	-299,139	70,008
Total Net Emissions (incl. forestry)	701,088	1,123,121
Total Gross Emissions (excl. forestry)	1,000,227	1,053,113

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

8.0 Closing Statement

Whakatāne's GHG emissions footprint provides information for decision-making and action by the council, Whakatāne 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 Whakatāne covers emissions produced in the Stationary Energy, Transport, Waste, IPPU, Agriculture, and Forestry sectors using the GPC reporting framework. Sector-level data allows Whakatāne 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. Areas where data could be improved for future footprints include forestry (forest cover and harvesting), agriculture (especially livestock numbers), solid waste and wastewater, 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	<p>LGNZ local council mapping boundaries have been applied.</p> <p>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).</p> <p>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).</p>
Population	<p>Population figures are provided by StatsNZ.</p> <p>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).</p> <p>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).</p>
Transport Emissions	
Petrol and Diesel:	<p>Bay of Plenty fuel sales figures (litres) provided by Rotorua Lakes District Council.</p> <p>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.</p> <p>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.</p> <p>Biofuel sales information provided directly by the supplier.</p>
Rail Diesel	<p>Emissions from fuel use have been calculated and provided by Kiwi Rail. The following assumptions were made:</p> <ul style="list-style-type: none"> - 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. <p>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</p>

	<p>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.</p> <p>This data is subject to commercial confidentiality.</p>
Jet Kerosene (Scheduled Flights)	<p>Calculated from information provided by Rotorua, Tauranga, Taupō, and Whakatāne airports.</p> <p>Emissions from scheduled flights are allocated equally between the origin and destination area emissions footprints.</p> <p>Flight emissions relating to each airport have been divided between territorial authorities based on the expected users of the airports:</p> <ul style="list-style-type: none"> - 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 Whakatāne District territorial authorities, allocated based on population size
Aviation Gas (General Aviation)	<p>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.</p> <p>Emissions relating to each airport have been divided between territorial authorities as described for 'Schedules Flights' above.</p>
Marine Freight	<p>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.</p> <p>This figure does not include fishing vessels, or vessels with Tauranga as both the origin and destination.</p> <p>Emissions from freight and international shipping are allocated equally between the origin and destination area emissions footprints.</p> <p>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.</p>
Marine Fuel (Local)	<p>This emissions source relates to vessels servicing the Port of Tauranga. All emissions have been allocated to Tauranga territorial authority.</p> <p>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.</p>

LPG Consumption	<p>North Island LPG sales data (tonnes) has been provided by the LPG Association.</p> <p>'Auto' and 'Forklift' sales represent transport uses of LPG.</p> <p>Sales have been divided between territorial authorities on a per capita basis.</p>
Stationary Energy Emissions	
Electricity Demand	<p>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.</p> <p>The territorial authorities serviced by each GXP have been confirmed by the respective electricity suppliers.</p> <p>The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per Ministry for the Environment (MfE) data.</p>
Electricity Generation	<p>Electricity generation has been calculated using data from the EMI website (www.emi.ea.govt.nz).</p> <p>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.</p>
Coal Consumption	<p>National coal consumption data has been provided by MBIE. Regional industrial coal data has been provided by EECA.</p> <p>National residential and commercial coal consumption has been divided between territorial authorities on a per capita basis.</p> <p>Regional industrial coal consumption has been divided between territorial authorities on a per capita basis.</p>
Coal Production and Fugitive Emissions	Not Calculated: There are no active coal mines within the region.
Biofuel Consumption	<p>National biofuel consumption data has been provided by the Ministry for Business, Innovation and Employment (MBIE).</p> <p>Biofuel consumption has been divided between territorial authorities on a per capita basis.</p> <p>Biofuel emissions are broken down into Biogenic emissions (CO₂) and Non-Biogenic emissions (CH₄ and N₂O)</p>
LPG Consumption	<p>North Island LPG sales data (tonnes) has been provided by the LPG Association.</p> <p>'Auto' and 'Forklift' sales represent transport uses of LPG. All other sales represent stationary energy uses of LPG.</p>

	<p>Sales have been divided between territorial authorities on a per capita basis.</p> <p>The breakdown into sectors (Residential, Commercial, and Industrial) is based on NZ average consumption per sector as per MfE data.</p>
Natural Gas Consumption	<p>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.</p> <p>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.</p>
Oil and Gas Fugitive Emissions	<p>Not Calculated: There are no gas or oil processing plants within the region.</p>
Agricultural Emissions	
General	<p>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.</p> <p>Territorial authority land-use data provided by BoPRC covering horticulture land-use.</p>
Solid Waste Emissions	
Waste in Landfill	<p>Landfill waste volume and end location information has been provided by the respective council departments.</p> <p>Where information is not available, waste volumes have been estimated based on historical national data on a per capita basis.</p> <p>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.</p>
Wastewater Emissions	
Wastewater Volume and Treatment Systems	<p>Information on treated wastewater, and treatment plants has been provided by the respective council departments.</p> <p>Where information is not available, reasonable assumptions have been made.</p> <p>The population connected to septic tank systems have been estimated by the respective council departments.</p> <p>Emissions are allocated to territorial authorities based on where the wastewater was produced, even if the wastewater is treated outside the territorial authority.</p>
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.