

Bay of Plenty Community Carbon Footprint 2015/16

Final Results

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Prepared by

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1.0 Introduction

AECOM New Zealand Limited (AECOM) has been commissioned by the Bay of Plenty Regional Council (BoPRC) to assist in the development of a community carbon footprint for the Region and each of the districts within the Region. The districts included in the community carbon footprint comprised: Tauranga City, Western Bay of Plenty, Rotorua Lakes, Whakatane, Ōpōtiki and Kawerau.

1.1 Setting the scene

In 2016 representatives of 196 nations negotiated the Paris Agreement committing to reducing global climate change to less than 2 degrees and striving for no more than 1.5 degrees global warming¹.

To achieve this goal, we as a global society need to transition towards a low carbon economy by the second half of this century. This requires reducing global emissions by about 60-80% by 2050.

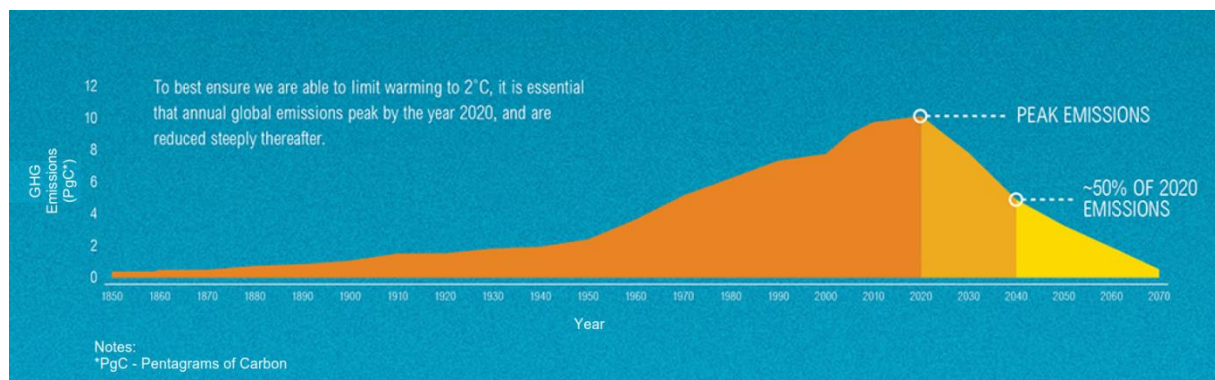


Figure 1 Global Carbon Budget (Source: World Resources Institute)

The New Zealand government signed the Paris Accord in 2016 and ratified it in 2017, supporting global action to reduce impacts from climate change. Action on climate change is however not limited to national governments and will require action on all levels from national government, to local government, cities, businesses and individuals. Over the last decade local governments globally have increasingly recognised their role in taking action on climate change both around mitigation and adaptation.

Globally more than 7,500 cities and local governments have signed up to the Global Covenant of Mayors for Energy and Climate (www.globalcovenantofmayors.org) reporting on their community greenhouse gas emissions and emission reduction measures.

1.2 Report overview

This report provides the Bay of Plenty Region and six districts within the Region with a snapshot of their respective emission profiles for the 2015/16 financial year. The report also identifies key emission sources and their relative contribution.

The principal aim of this report is to:

- Help the Region and District to understand their local emissions profile;
- Enable informed decision making when managing greenhouse gas emissions;
- Identify key emission sectors and stakeholders that could be encouraged to reduce local emissions.

¹ As of August 2017 195 nations have signed and 160 have ratified the agreement. The agreement has come into force in November 2016.

The emission estimates are a reflection of the local economy and demographic set-up of the communities. This makes it difficult to compare individual districts and the region against each other or the national average. We have however attempted to compare the respective emissions on a per capita basis to provide some context and relative scale.

Regionally, and for New Zealand in general, agricultural and forestry related activities play a significant role in terms of emissions generation, but also present mitigation options.

Globally emissions will need to reduce significantly over the next 30 years. Cooperating and working with stakeholders in each emission sector will be crucial to achieving this target. More so in the agricultural sector where limited technological measures exist today for emission reductions.

This document summarises the findings from the data collection and calculations and also outlines the underlying assumptions and limitations.

1.3 Scope and Approach for Community Carbon Footprint

This inventory report follows the methodology outlined in the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory (GPC), published by the World Resources Institute (2015)².

The GPC represents international best practice and is the same methodology used for other community scale GHG inventories around New Zealand (e.g. Auckland, Dunedin and Wellington) and internationally.

This inventory assesses both direct emission sources generated within the geographic area (Scope 1) and indirect emission sources (Scope 2 and 3) generated outside the geographic area. Examples of indirect sources include emissions from electricity purchased from the national grid (Scope 2), as well as emissions from transport that originates or terminates outside the district boundary e.g. aviation, or emissions from waste deposited in landfills outside the Region (Scope 3).

The inventory does not include emissions associated with the consumption of consumer goods such as imported food products or other commodities (e.g. cars, phone, clothes, etc.).

Emissions are reported for the period from 1 July 2015 to 30 June 2016. The reporting boundary for this report are the territorial boundaries of the six districts within the Region and excludes the part of the Taupō district that lies within the Bay of Plenty Region.

The calculations include emissions from stationary energy, transport, waste, industry, agriculture and forestry:

- Stationary energy includes emissions from electricity consumed by residential, commercial and industry users, electricity generated from non-renewable sources (i.e. landfill gas combustion), as well as consumption of coal, natural gas, biodiesel and wood;
- Transport includes emissions from petrol and diesel sold within the Region, rail diesel use, jet kerosene and aviation gas used for aviation and LPG used for road transport;
- Waste includes emissions from the treatment of wastewater, the disposal of solid waste and composting of organic material;
- Industrial processes and product use (IPPU) cover GHG emissions from industrial chemical or physical processes, as well as emissions associated with the consumption (i.e. product use) of GHGs for refrigerants, foam blowing, fire extinguishers, aerosols, metered dose inhalers and Sulphur Hexafluoride (SF₆) for electrical insulation and equipment production;
- Agriculture includes emissions from livestock, crops and fertiliser use;
- The forestry sector includes carbon sequestered from commercial exotic forests and other native forest cover, as well as emissions from harvested trees. Carbon stored in mature forests are not included in the inventory.

² <http://www.ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities>

The following aspects are worth noting in reviewing the inventory:

- Emissions are expressed on a carbon dioxide-equivalent basis including climate change feedbacks using the 100-year GWP (Global Warming Potential) values including climate-carbon feedback from the Intergovernmental Panel on Climate Change Fifth Assessment Report: Climate Change 2013³;
- Total emissions are reported for gross emissions (excluding forestry) and net emissions (including forestry);
- The report should be read in full, including the assumptions, limitations, exclusions and data issues outlined in Appendix A. Emissions from various sources should be assessed across the whole region, or at least with the regional overall performance in mind;
- It is difficult to compare individual districts directly, especially smaller districts with a low population. These are much more impacted by individual activities compared to larger districts or the region overall (e.g. Kawerau electricity consumption or Ōpōtiki forestry emissions);
- The baseline emissions reported here are a starting point for action. The emission trends over time will need to be measured through future inventories;
- Due to data limitations and assumptions, the inventory does not assess emissions from international shipping, these however are likely to represent a significant source of emissions for the Region;
- Due to data limitations, this inventory estimates emissions from industrial product use by scaling national emissions from industrial product use on a population basis;
- This inventory accounts for forest carbon stock changes from afforestation, reforestation, deforestation and forest management (i.e. it applies land-use accounting conventions under the UN Framework Convention on Climate Change rather than the Kyoto Protocol);
- In contrast to national reporting and due to lack of available local data, this report treats emissions from harvesting and deforestation as instantaneous rather than accounting for the longer-term emission flows associated with harvested wood products as; and,
- It is likely that the overall carbon balance from forestry within the Region and the individual districts is relatively stable over a 50-100 year period. However, on an annual basis the emissions and sequestration values vary significantly depending on the level of harvesting taking place as illustrated in Figure 2 below;
- Maturing forests sequestered carbon in trees and wood products. When trees are harvested the carbon is released back to the atmosphere through decay or combustion. Assuming that the total area used for forestry activities remains similar (i.e. all forests harvested are being replanted) the overall carbon balance is expected to neutral. Increasing the forest area will lead to net sequestration, while reducing the forest area will result in net emissions to the atmosphere;
- While forest harvests present a short term liability to the Region, it is worth noting that the forestry sector can also play a major role in reducing the overall emissions. Increasing the total forest area will reduce the overall net emissions of the region (as long as these areas remain in forest). Over time carbon stocks will adjust to a new equilibrium following any change in land use.
- Substituting fossil fuel products with wood based products can also help to reduce the overall greenhouse gas footprint, as wood products recapture the carbon when replanted.

³ https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf (Table 8.7)

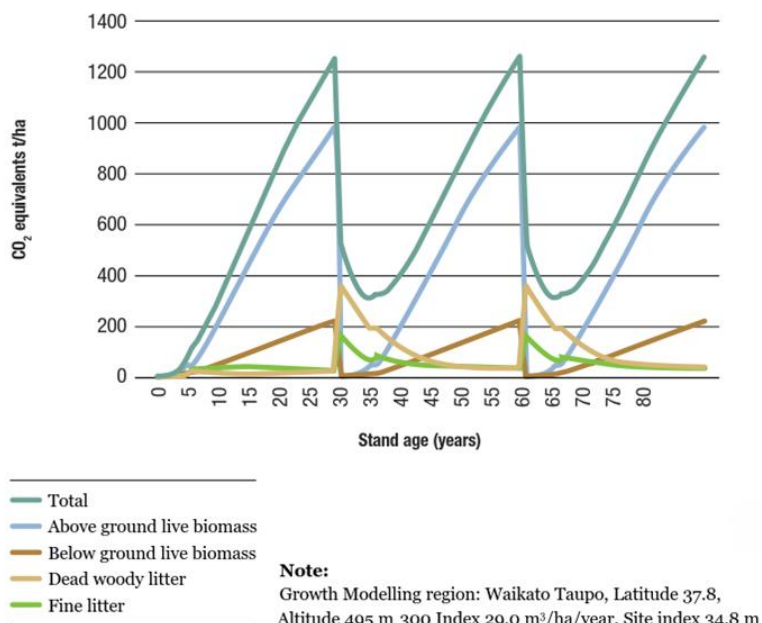


Figure 2 Carbon yield - multiple rotations (Source: Forest Ownership Association, Facts & Figures, 2014)

1.4 Potential next steps

- The report findings are aimed at helping Councils to understand their emissions profile and to identify key emission sources. This in turn provides a solid basis for developing appropriate mitigation responses;
- This report provides a high level summary of the emission results. We encourage Councils to analyse the underlying data for a more complete picture of contributing activities and for identifying opportunities for emissions reduction;
- These carbon footprints provide baseline data. We encourage Councils to share these results with key stakeholders in their communities and identify areas for action and collaboration;
- The regional assessment confirms that several districts have similar key emission sources. Understanding these better will help Councils to identify areas for collaboration. There are also other districts outside the Bay of Plenty that face similar challenges. Working together will allow Councils to learn from one another and pool resources and know-how leading to better outcomes;
- There were some data limitations and gaps identified in the development of these carbon footprints. Councils should review these (see Appendix A) with the aim to improve data availability for future reports;
- Ongoing reporting (e.g. every 3 years) will be required to measure the emission trends and to assess the effectiveness of the mitigation responses put forward.

2.0 Bay of Plenty Community Carbon Footprint

2.1 Key Messages

- During the 2015/16 reporting period, the BoP Region was responsible for 4,079,415 tCO₂e gross emissions;
- The average per capita (gross) emissions in the BoP Region are estimated to be below the NZ national overall average – 13.9 tCO₂e versus 17.8 tCO₂e, particularly Stationary Energy, Waste, Industry and Agriculture. Please refer to Appendix B for more detail regarding per capita sector break down for each district and the region, in comparison to the national average;
- Agriculture represents the largest emission source for the Region, with the majority of these emissions resulting from animal farming. Agricultural emissions contributed 47.2% of the regional gross emissions. This is on par with the national emissions profile where 49% emissions come from agriculture;
- On a per capita basis the Bay of Plenty Region is emitting fewer agricultural emissions than the national average. To a large extent this difference is a result of the extensive horticultural sector in the Bay, generating a significant contribution to the local economy while generating fewer emissions;
- Continuing working with the agricultural sector around farm efficiency improvements (i.e. increasing farming output without increasing stock numbers) and diversification will be important to reduce the regional emissions while ensuring the region's prosperity;
- Transport emissions (on a per capita basis 4.2 tCO₂e/capita) are above the national average (3.3 tCO₂e/capita). The largest contribution is from diesel (17.3%) and petrol (12.2%) use for road transport;
- Forest carbon stocks change as a result of afforestation, reforestation, harvesting and forest management. While forestry emissions in the BoP Region were high in 2015/16, the overall carbon balance of the Region's forestry sector is expected to be relatively neutral over a 50-100 year period⁴.
- In the 2015/16 reporting period the amount of forestry that took place in the BoP Region resulted in forestry-related emissions of 1,898,638 tCO₂e, bringing the total net emissions for the Region to 5,978,054 tCO₂e;
- The forestry emissions in the BoP Region are in contrast to the national greenhouse gas inventory. For 2015 the Ministry for the Environment (MfE) reported that national forestry and land use change activities sequestered more carbon than they emitted⁵;
- The forestry sector plays a major role in tackling climate change and provides a direct way to reduce emissions. Likewise the sector can represent a significant liability, as plantation forests are destined for harvesting. Working with the forestry sector and national government to better understand the net carbon changes in the regional forestry and land-use sector will be needed to get a better understanding of the sector's true contribution to the regional emissions and sequestration potential;
- Afforestation, specifically of marginal hill land and indigenous forest, presents an opportunity to reduce regional emissions.

⁴ See Section 1.3.

⁵ This is partly due to a difference in methodology, with the national estimates including carbon stored in Harvested Wood Products, while the regional estimates calculated here assume that all trees harvested are emitting carbon stored in trees instantaneously.

2.2 Overall Results

During the 2015/16 reporting period, the BoP Region was responsible for 4,079,415 tCO₂e gross emissions and 5,978,054 tCO₂e net emissions.

The population in 2015/16 was approximately 293,500 people, resulting in per capita gross emissions of 13.9 tCO₂e/person⁶ compared to a national average of 17.8 tCO₂e/capita.

Emissions from agriculture represent the largest emissions source for the Bay of Plenty Region over the reporting period, contributing 47.2% to the overall emissions. The majority of the agricultural sector emissions are a result of dairy and beef farming.

Transport related emissions represent the second largest emissions sector for the Region, contributing 30.4% to the overall emissions. The majority of the transport emissions result from petrol (12.2%) and diesel use (17.3%). Transport emissions currently do not include emissions from international shipping, which are likely to be significant.

Table 1 Summary of Overall Results by Source 2015/16 – Bay of Plenty

Sector/Category Source		Emissions (tCO ₂ e)		% Gross Emissions Contribution
Stationary Energy	Electricity Consumption	286,659	591,379	14.5%
	Electricity Transmission & Distribution (T&D) Loss	27,962		
	Natural Gas	228,299		
	Natural Gas T&D Loss	14,140		
	LPG	19,856		
	Coal	14,459		
	Biofuel use	5		
Transportation	Petrol	498,960	1,239,963	30.4%
	Diesel	704,907		
	Rail Emissions	12,065		
	Jet Kerosene	18,126		
	Av Gas	2,954		
	LPG	2,950		
Waste	Solid Waste Disposal	210,702	230,928	5.7%
	Waste Water	20,227		
IPPU (Industry)		93,484		2.3%
Agriculture		1,923,661		47.2%
Total gross emissions (excl. forestry)		4,079,415		
Forestry	Exotic Forest Sequestration	-6,962,895	1,898,638	Not included in gross emissions
	Native Forest Sequestration	-225,435		
	Total Harvest Emissions	9,086,968		
Total net emissions (incl. forestry)		5,978,054		

⁶ Gross emissions exclude forestry related emissions, whilst net emissions also consider the effects of forestry (sinks and sources). This distinction has been made in the carbon footprints for Wellington and Dunedin where the forestry sectors sequester more carbon than they emit and thereby offset some of the other city wide emissions.

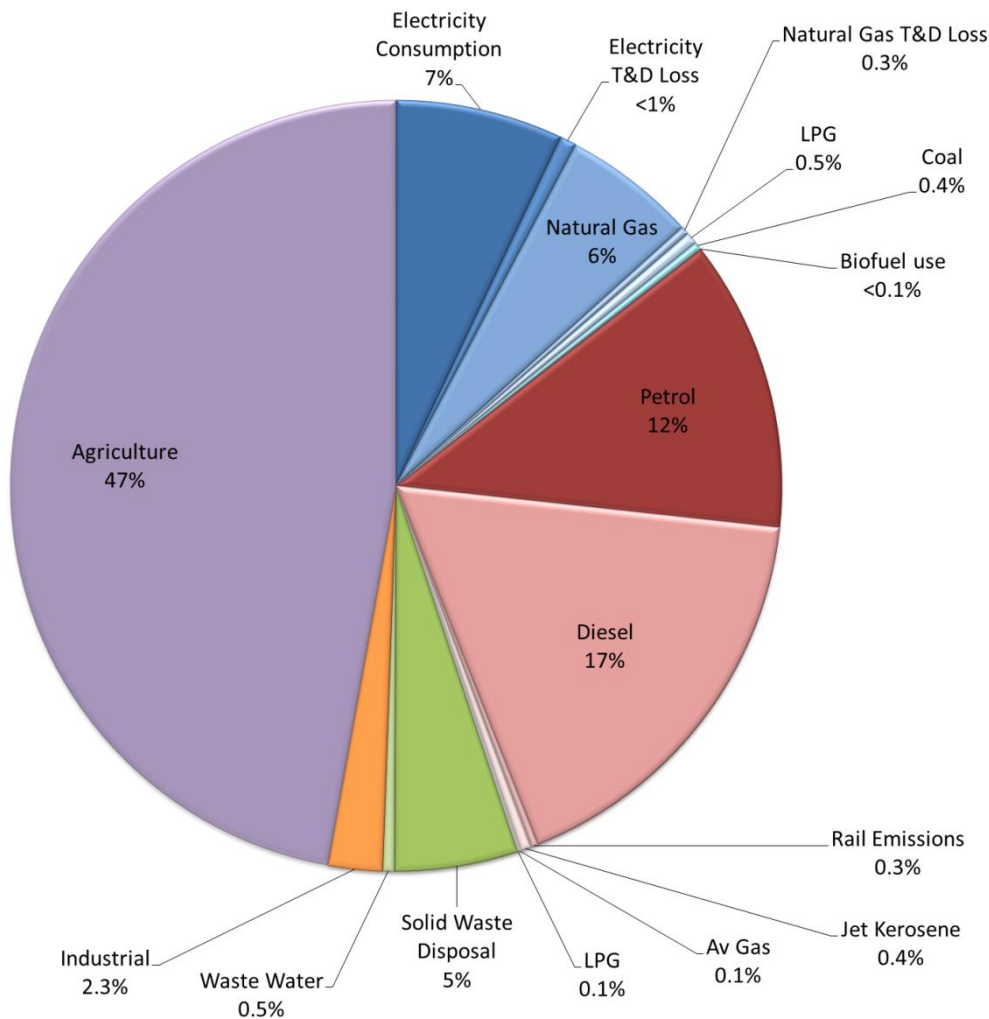


Figure 3 Summary of Overall Gross Emissions by Source, excluding Forestry, 2015/16 – Bay of Plenty

2.3 Biogenic emissions

Biogenic CO₂ emissions, such as the combustion or digestion of biological materials, are part of the natural carbon cycle. The GPC Standard recommends reporting these emissions outside of the total greenhouse gas emissions. The Region generated approximately 3,657 tCO₂ from biogenic sources (i.e. from combustion of firewood and flaring of landfill gas). CH₄ and N₂O emissions from these sources are however included in the overall GHG emissions, due to their higher radiative forcing.

2.4 Stationary Energy Emissions

Stationary energy use in the Region is responsible for 591,379 tCO₂e in 2015/16; representing 14.5% of the gross emissions.

The main source of emissions from stationary energy is electricity consumption⁷ (Scope 2) contributing approximately 48.5%, with a further 4.7% from electricity transmission and distribution (T&D) losses. Natural gas consumption contributed approximately 38.6%, with an additional 2.4% from T&D losses. A detailed breakdown of the stationary energy emission sources is provided in the table and chart below.

⁷ Emissions from electricity consumption are based on the national average emission factor, as the electricity generated regionally is fed into the national grid but is not necessarily consumed locally.

Table 2 Summary of Stationary Energy Emissions by Source 2015/16 - Bay of Plenty

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Stationary Energy	Electricity Consumption	286,659	591,379	48.5%
	Electricity T&D Loss	27,962		4.7%
	Natural Gas	228,299		38.6%
	Natural Gas T&D Loss	14,140		2.4%
	LPG	19,856		3.4%
	Coal	14,459		2.4%
	Biofuel	5		<0.01%

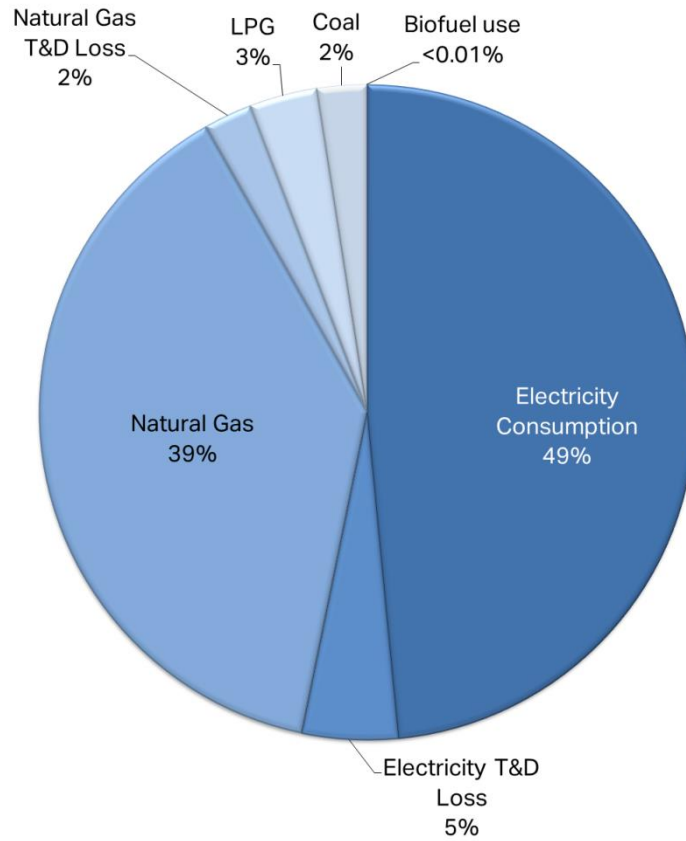


Figure 4 Summary of Stationary Energy Emissions by Source 2015/16 - Bay of Plenty

2.5 Transportation Emissions

In 2015/16 transportation sources contributed 1,239,963 tCO₂e, representing 30% of Region’s overall gross emissions. Transportation was the second highest sector contributor to regional GHG emissions.

The emissions profile for transportation sources is dominated by road transport⁸ (predominantly Scope 1) contributing approximately 97.3% of the transportation emissions during the reporting period. Road transport emissions (petrol, diesel and LPG) were estimated based on fuel sales figures. This approach does not allow for separate reporting of cross boundary road transport under Scope 3.

The remainder of the emissions generated in the transportation sector included rail electricity and rail diesel (1.0%), jet kerosene (1.5%) and aviation gas (0.2%).

No emissions were estimated for international shipping and marine transport due to a lack of available bunker fuel data. High level estimates by AECOM indicate that emissions from shipping are likely to be significant. We recommend further investigating the emissions from national and international shipping and reporting these in future inventories.

Table 3 Summary of Transportation Emissions by Source 2015/16 - Bay of Plenty

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Transportation	Road	1,206,818	1,239,963	97.3%
	Rail	12,065		1.0%
	Aviation	21,080		1.7%

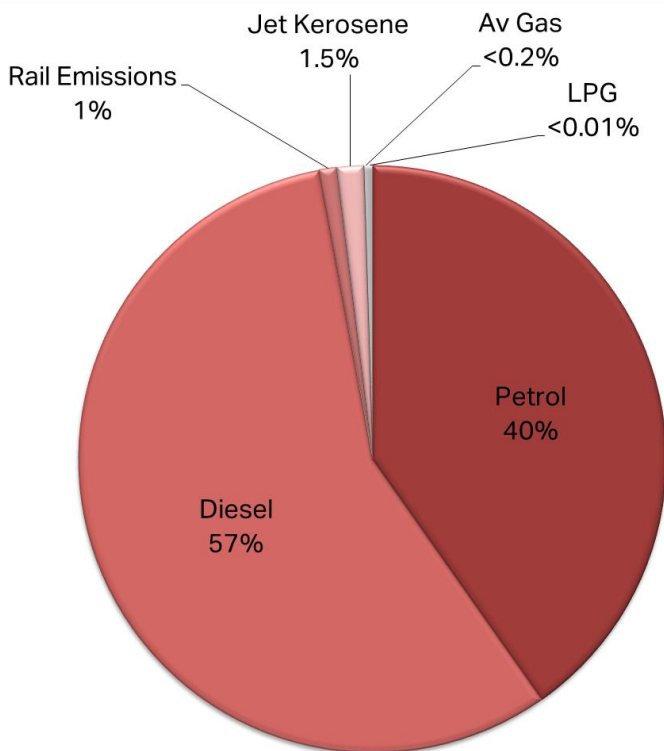


Figure 5 Summary of Transportation Emissions by Source 2015/16 - Bay of Plenty

⁸ Due to lack of more detailed data, petrol and diesel used for off-road transport (e.g. farming machineries), recreational maritime navigation and for stationary energy (e.g. diesel generators) are included in the fuel data and emissions reported for road transport.

2.6 Waste Emissions

In 2015/16 emissions associated to waste contributed 230,928 tCO₂e, representing 5.7% of the Region’s overall gross emissions. Waste emissions are dominated by solid waste disposal contributing approximately 91.2% of the waste related emissions.

The combustion of landfill gas (LFG) generates approximately 2,690 tCO₂, which are reported outside the total emissions, as part of the biogenic emissions outlined in Section 2.3 above.

Table 4 Summary of Waste Emissions by Source 2015/16 - Bay of Plenty

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution	
Waste	Solid Waste Disposal	210,702	230,928	91.2%	
	Waste Water	20,227		8.8%	

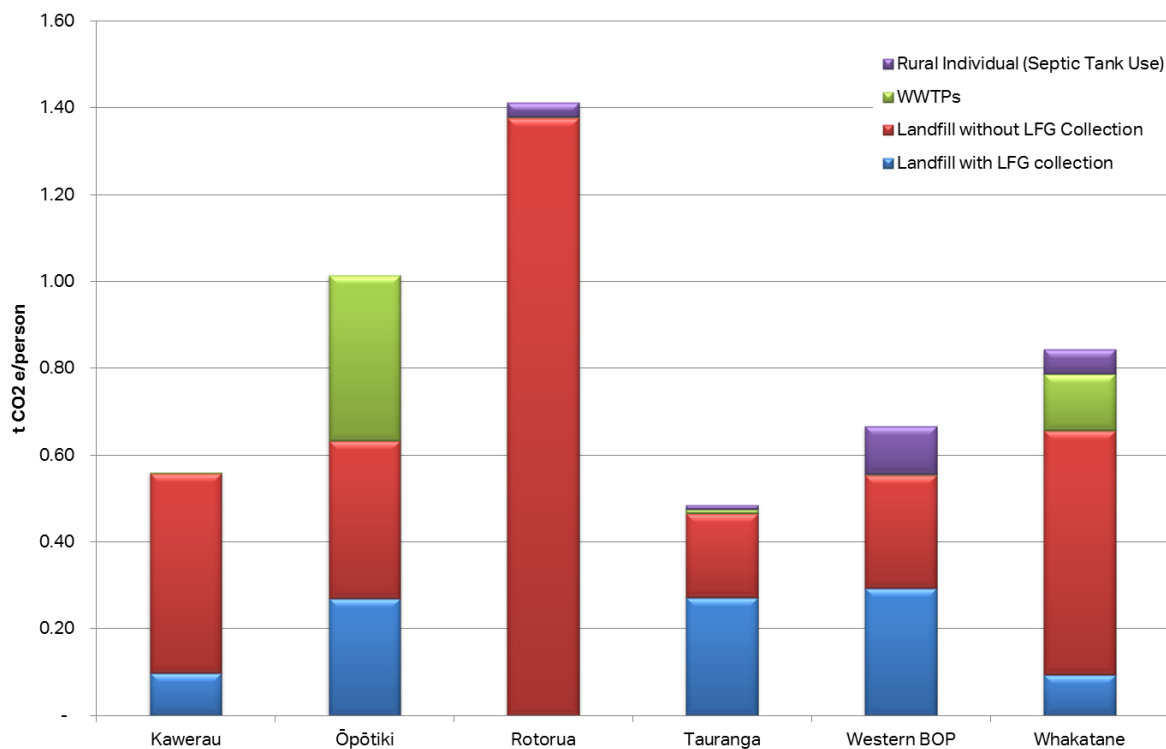


Figure 6 Summary of Waste Emissions by Source 2015/16 - Bay of Plenty

2.6.1 Solid Waste Details

Solid waste emissions were estimated using a 1st-order decay model that requires waste volume estimates for the last 50 years. Historical waste volumes sent to landfill were estimated using the average waste generated per person per year, as reported by MfE, and historical national population figures as reported by Statistics New Zealand.

During the 2015/16 reporting period the majority of municipal solid waste generated within the Region was mostly disposed of at the Hampton Downs and Tirohia Landfill (Scope 1), with a smaller amount deposited at the Rotorua Landfill.

The majority of solid waste emissions (73.8%) are released from landfills without landfill gas collection, including from closed landfills that have been used in the past but are still emitting landfill gas. The calculations assume all waste sent to landfills other than Hampton Downs and Tirohia was sent to landfill without LFG collection systems.

Emissions from landfills with landfill gas collection systems (i.e. Hampton Downs and Tirohia Landfills) are responsible for 26.2% of the regional emissions from solid waste. Details of Landfill Gas (LFG) collection and efficiency were unable to be obtained. Therefore the NZ average was used, as reported by the Ministry for Environment (MfE) 2017.

Rotorua Landfill does capture some landfill gas that is combusted through an enclosed flare. However, the council reported that the system does not run continuously and does not always reach high enough temperatures for full destruction. Emission estimates for the Rotorua Landfill therefore assume that no landfill gas is recovered.

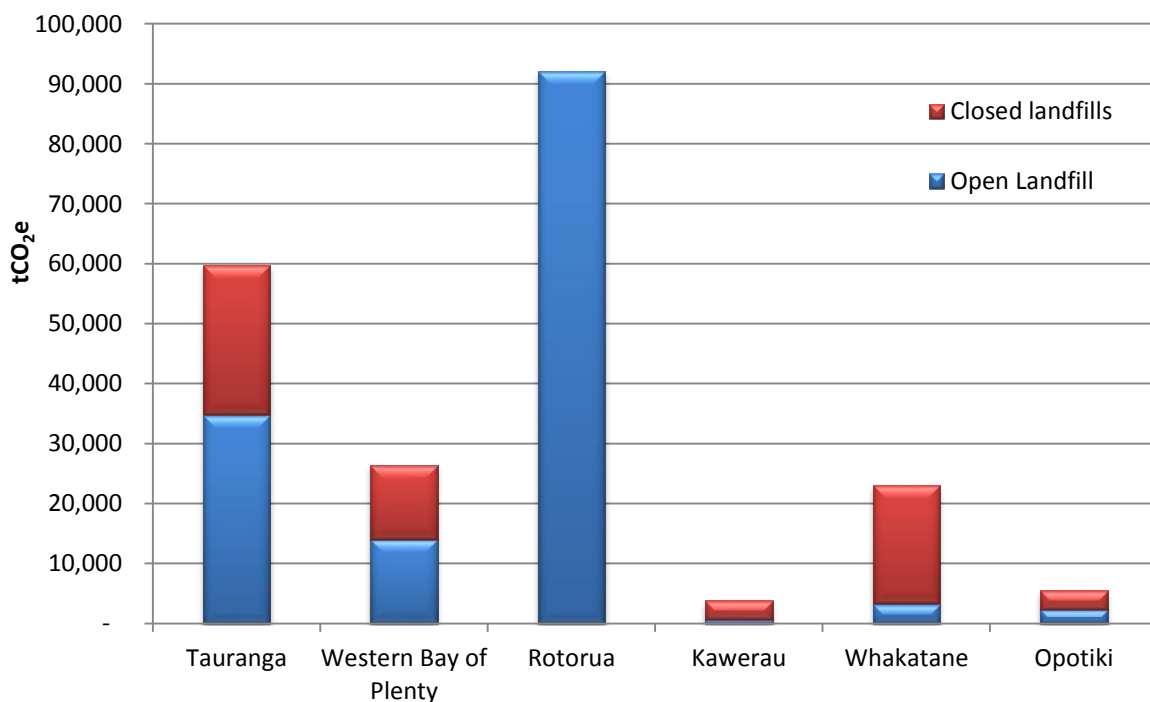


Figure 7 Summary of Solid Waste Emissions by District 2015/16

2.6.2 Waste Water Details

Waste water treatment generated 20,227 tCO₂e or approximately 0.5% of the total gross emissions for the Bay of Plenty.

Waste water treated within the region falls into two broad categories, waste water treated in waste water treatment plants and individual rural systems (i.e. septic tanks). The majority of waste water in the region is treated by advanced waste water treatment systems resulting in very low emissions.

Half (53.2%) of the waste water related emissions are however emitted from small scale rural treatment systems.

The Kawerau District reported that all dwellings within the council boundary are connected to the waste water treatment plant (which has minimal emissions). Western Bay of Plenty has a large number of properties that are not connected to advanced treatment systems, as a result of the large rural population and the large area covered by the district. No information was available for the number of septic tank users in the Ōpōtiki district, and this was assumed to be insignificant, reflecting the small population.

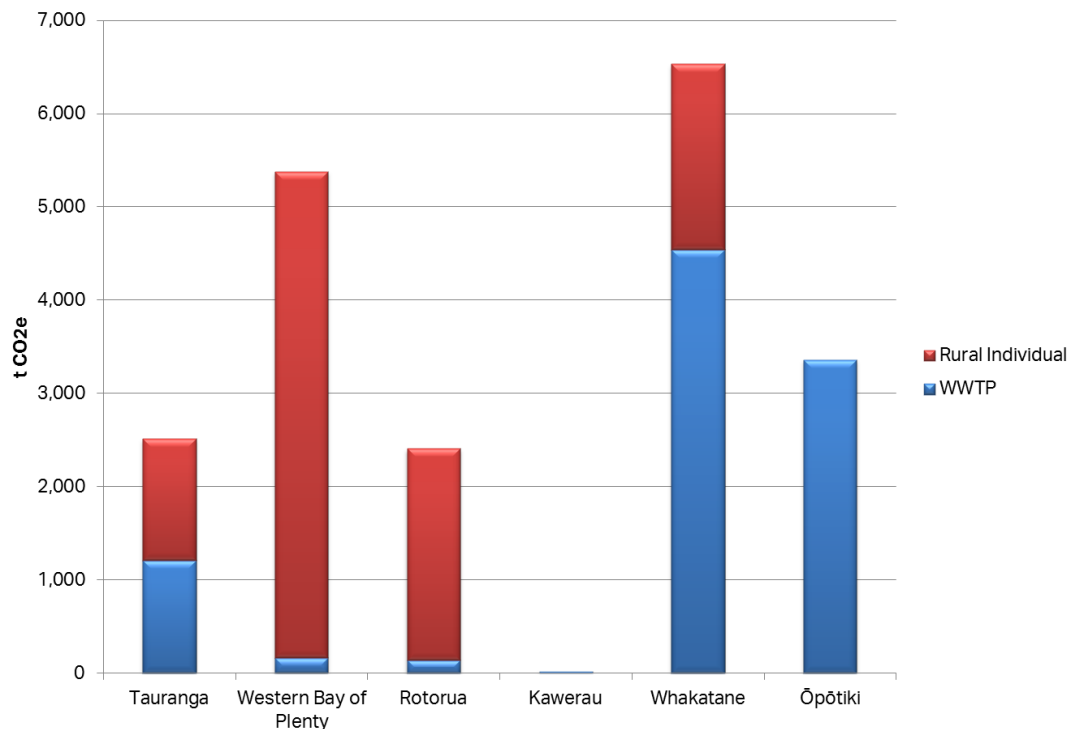


Figure 8 Summary of Waste Water Treatment Emissions by District 2015/16

2.7 Industrial Emissions

In 2015/16 industrial GHG emissions contributed 93,484 tCO₂e (2.3%) towards regional gross emissions. The emissions for industrial product use include emissions from hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) (Scope 1). Nitrogen trifluoride emissions do not occur in New Zealand, and therefore are not included in this report.

Emissions from industrial product use were estimated based on New Zealand's average emissions per capita and the regional population.

No emissions from industrial processes have been estimated, due to a lack of specific data. Very few large industrial operations emitting GHG from physical or chemical processes are understood to take place within the Region. Energy used by industrial processes is included in the relevant stationary energy sector (e.g. coal, gas and electricity).

2.8 Agricultural Emissions

In 2015/16 agricultural GHG emissions contributed 1,923,661 tCO₂e (47.2%) to the regional gross emissions.

Methane (CH₄) is the most significant emission source (70.7%), predominantly from enteric fermentation of farmed animals (e.g. cows and sheep). Nitrous oxide (N₂O) emissions from farming of animals, manure management and agricultural soils contributed approximately 29.3% of emissions in 2015/16.

Dairy and beef farming contribute most of the agricultural emissions, being responsible for 89.6% of the agricultural emissions.

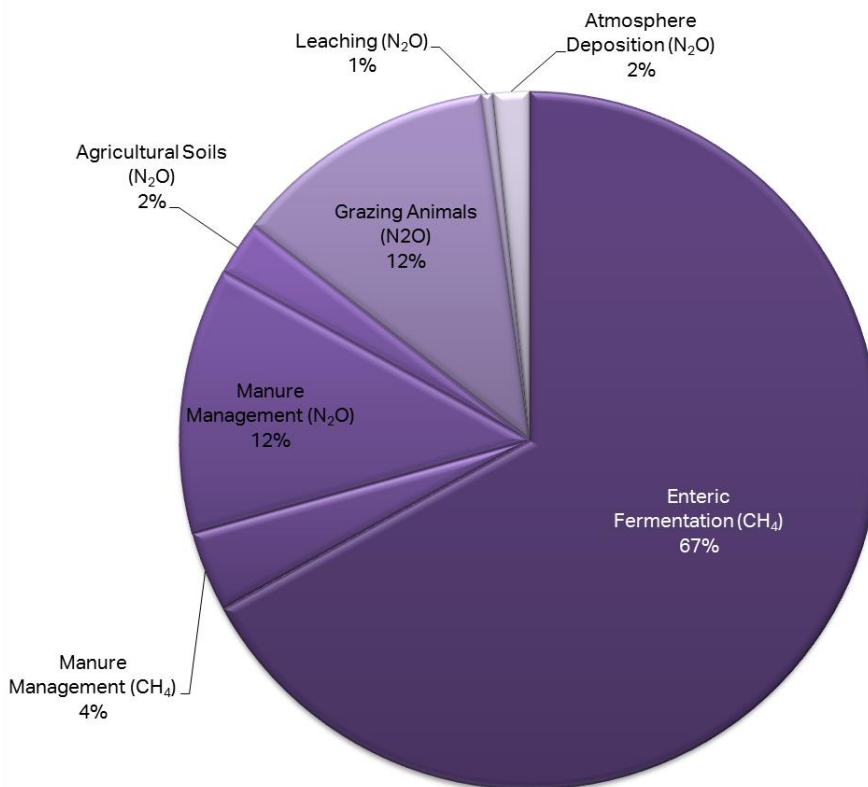


Figure 9 Summary of Agricultural Emissions by Source 2015/16 - Bay of Plenty

2.9 Forest Carbon Sequestration and Emissions

The overall emissions from Land use, land use change and forestry (LULUCF) activities in the BoP Region are 1,898,638 t CO₂e. See chart overleaf for activity summary.

Indigenous and exotic forests sequestered an estimated -7,188,330 tCO₂e during the 2015/16 reporting period. The majority of carbon is sequestered by exotic forest plantations (96.9%), while still maturing native forests (i.e. manuka and kanuka forest stocks) sequestered the remaining 3.1%.

Harvesting related emissions were estimated based on harvesting volumes reported by Statistics New Zealand and Ministry for Primary Industries (MPI) National Exotic Forest Description (NEFD) data for 2015 and 2016, and resulted in 9,086,968 t CO₂e⁹ of emissions.

⁹ Due to the accounting method chosen for this report, all carbon stored in harvested trees, including in the wood products removed, below ground and in residues left on site, is assumed to result in emissions in the harvesting year.

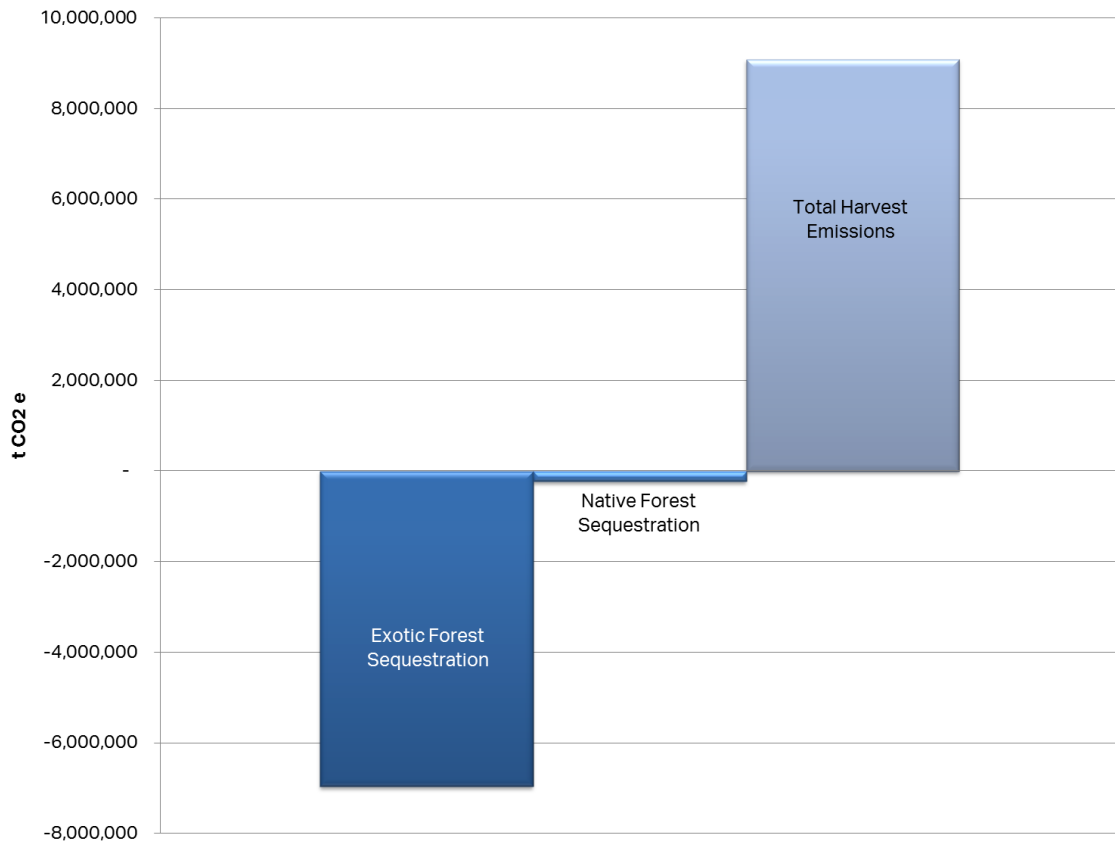


Figure 10 Summary of Forestry Emissions and Sequestration 2015/16 - Bay of Plenty

3.0 Tauranga City Community Carbon Footprint

3.1 Key Messages

- During the 2015/16 reporting period, Tauranga City was estimated to emit 759,929 tCO₂e gross emissions, or approximately 18.6% of the regional (gross) emissions;
- The average per capita (gross) emissions for Tauranga are 5.9 tCO₂e. This is below the NZ national average of 17.8 tCO₂e/capita;
- Transport related emissions represent the largest emission source for the city (61.1%). On a per capita average, transport emissions in Tauranga are above the NZ National Average transportation emissions;
- All other emission sectors have lower than the national average per capita emissions. This is in line with other cities carbon footprints and is mostly due to the fact that there is limited industrial activity in Tauranga City, as well as very little agricultural and forestry related activity within the city boundary.

3.2 Overall Results

In 2015/16, Tauranga City generated estimated gross emissions of 759,929 tCO₂e and net emissions of 765,371 tCO₂e (including forestry). The city population in 2015/16 was understood to be approximately 128,200 people, resulting in per capita gross emissions of 5.9 tCO₂e/person and per capita net emissions of 6.0 tCO₂e/person¹⁰.

Transportation emissions represent the largest emissions sector for Tauranga City over the reporting period, contributing 61.1% to the overall emissions for the city. Transportation emissions are predominantly produced by road transport, which contributes 59.3% of the city wide emissions. As noted earlier, transportation emissions currently do not include emissions from international shipping.

Stationary energy represents the second largest emissions sector for Tauranga City, contributing 23.3% to the overall emissions for the city. The majority of the stationary energy emissions result from electricity consumed within the city, which contributes 14.2% of the city wide emissions (including transmission and distribution (T&D) losses), and from natural gas consumption, which contributes 7.5%.

¹⁰ Gross emissions exclude forestry related emissions, whilst net emissions also consider the effects of forestry (sinks and sources). This distinction has been made in the carbon footprints for Wellington and Dunedin where the forestry sectors sequester more carbon than they emit and thereby offset some of the other city wide emissions.

Table 5 Summary of Tauranga City Emissions by Source 2015/16

Sector/Category Source		Emissions (tCO ₂ e)		% Gross Emissions Contribution
Stationary Energy	Electricity Consumption	98,296	177,341	23.3%
	Electricity T&D Loss	9,588		
	Natural Gas	51,254		
	Natural Gas T&D Loss	5,849		
	LPG	8,672		
	Coal	3,680		
	Biofuel use	2		
Transportation	Petrol	186,158	463,960	61.1%
	Diesel	262,995		
	Rail Emissions	1,212		
	Jet Kerosene	11,192		
	Av Gas	1,115		
	LPG	1,289		
Waste	Solid Waste Disposal	59,733	62,250	8.2%
	Waste Water	2,516		
IPPU (Industry)		40,336		5.3%
Agriculture		16,042		2.1%
Total gross emissions (excl. forestry)		759,929		
Forestry		-4,364	5,442	Not included in gross emissions
		-754		
		10,560		
Total net emissions (incl. forestry)		765,371		

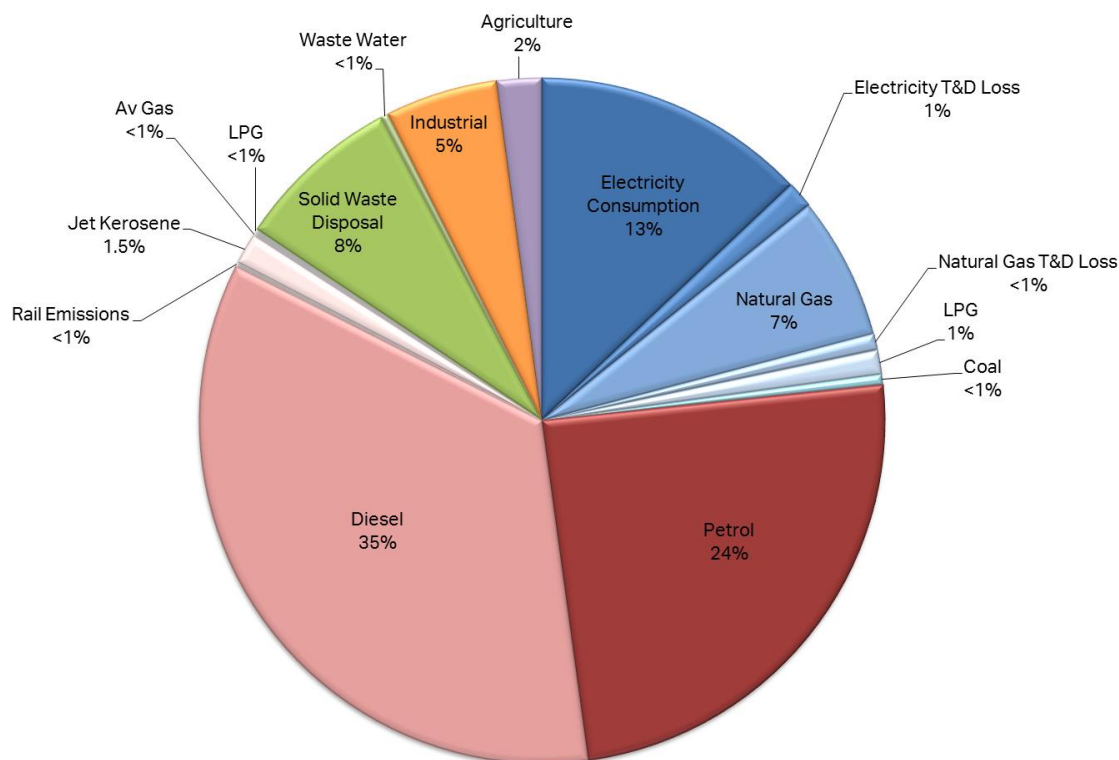


Figure 11 Summary of Tauranga City Gross Emissions by Source 2015/16

3.3 Biogenic emissions

Biogenic CO₂ emissions, such as the combustion or digestion of biological materials, are part of the natural carbon cycle. However, the GPC Standard recommends reporting these emissions outside of the total greenhouse gas emissions.

Tauranga City generated approximately 1,539 tCO₂ from biogenic sources (i.e. from combustion of firewood and flaring of landfill gas). CH₄ and N₂O emissions from these sources are included in the overall GHG emissions, due to their higher radiative forcing.

3.4 Stationary Energy Emissions

Stationary energy use within Tauranga City generated an estimated 177,341 tCO₂e in 2015/16; representing 23% of gross emissions.

The two main sources from stationary energy are electricity and natural gas consumption. A detailed breakdown of the stationary energy emission sources is provided in the table and chart below.

Table 6 Summary of Tauranga City Stationary Energy Use GHG Emissions 2015/16 by Source

Sector/Category Source		Emissions (t CO ₂ e)	Sector Percentage Contribution
Stationary Energy	Electricity Consumption	98,296	55.4%
	Electricity T&D Loss	9,588	5.4%
	Natural Gas	51,254	28.9%
	Natural Gas T&D Loss	5,849	3.3%
	LPG	8,672	4.9%
	Coal	3,680	2.1%
	Biofuel Use	2	<0.01%
		177,341	

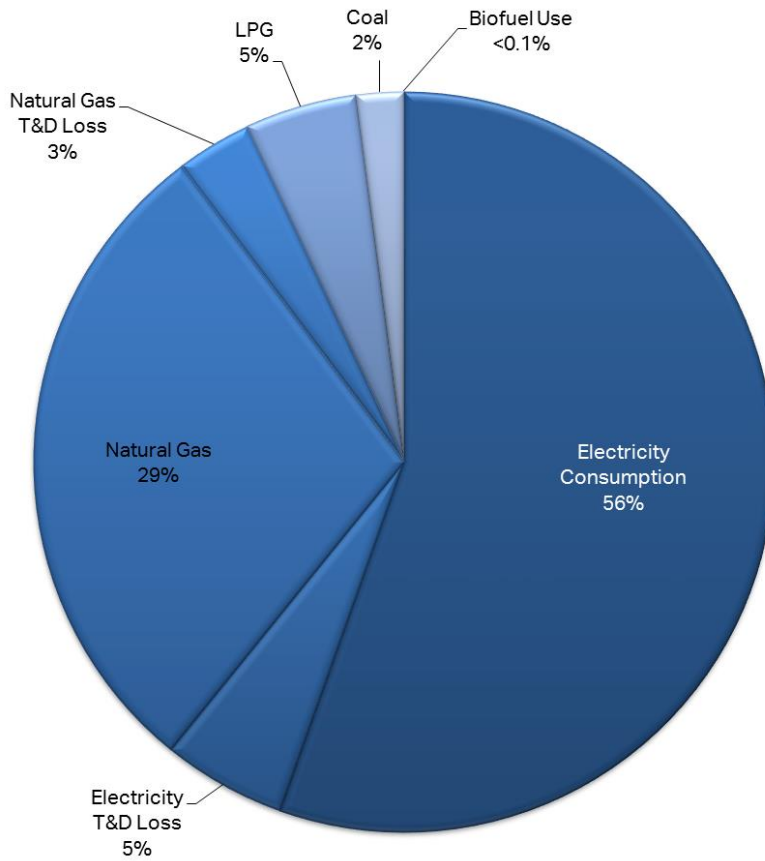


Figure 12 Summary of Stationary Energy Use GHG Emissions 2015/16 by Source - Tauranga

3.5 Transportation Emissions

In 2015/16 transportation sources contributed **463,960 tCO₂e**, representing 61.1% of Tauranga City’s overall gross emissions. Transportation was the highest sector contributor to Tauranga City GHG emissions.

The emissions profile for transportation sources is dominated by road transport¹¹ (predominantly Scope 1) contributing approximately 97.1% of the transportation emissions during the reporting period. Road transport emissions (petrol, diesel and LPG) were estimated based on fuel sales figures. This approach does not allow for separate reporting of cross boundary road transport under Scope 3.

The remainder of the emissions generated in the transportation sector included rail electricity and rail diesel (0.3%), and air travel (2.7%). See the table and chart below for details.

No emissions were estimated for international shipping and marine transport due to a lack of available bunker fuel data. High level estimates by AECOM indicate that emissions from shipping are likely to be significant. We recommend further investigating the emissions from national and international shipping and reporting these in future inventories.

Table 7 Summary of Tauranga City Transportation GHG Emissions 2015/16 by Source

Sector/Category Source		Emissions (tCO ₂ e)		Sector % Contribution
Transportation	Road	450,442	463,960	97.1%
	Rail	1,212		0.3%
	Aviation	12,307		2.7%

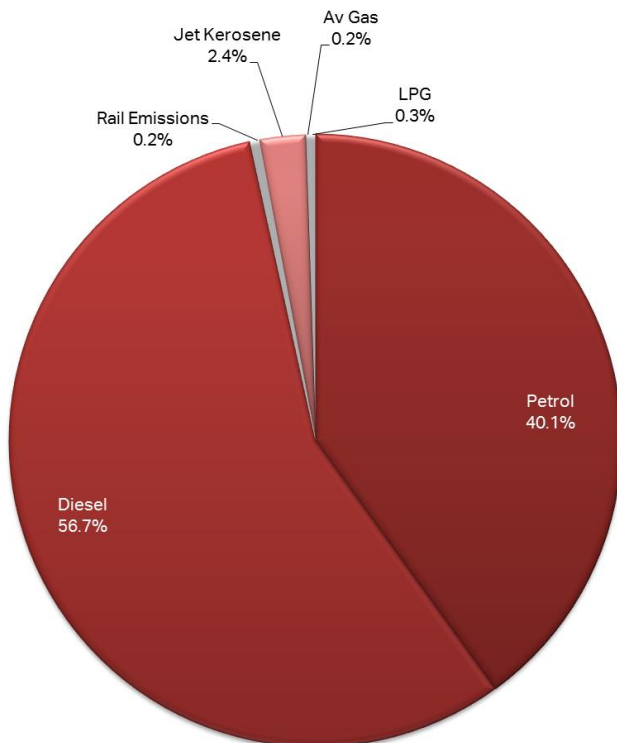


Figure 13 Summary of Transportation GHG Emissions 2015/16 by Source - Tauranga

¹¹ Due to lack of more detailed data, petrol and diesel used for off-road transport (e.g. farming machineries), recreational maritime navigation and for stationary energy (e.g. diesel generators) are included in the fuel data and emissions reported for road transport.

3.6 Waste Emissions

In 2015/16 emissions associated to waste contributed 62,250 tCO₂e, representing 7.7% of Tauranga City’s overall gross emissions. Waste emissions are dominated by solid waste disposal. Table 8 and Figure 14 provide details.

The combustion of landfill gas (LFG) was estimated to generate approximately 1,539 tCO₂, which are reported outside the total emissions, as part of the biogenic emissions.

Table 8 Summary of Tauranga City Waste GHG Emissions 2015/16 by Source

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Waste	Solid Waste Disposal	59,733	62,250	96.0%
	Waste Water	2,516		4.0%

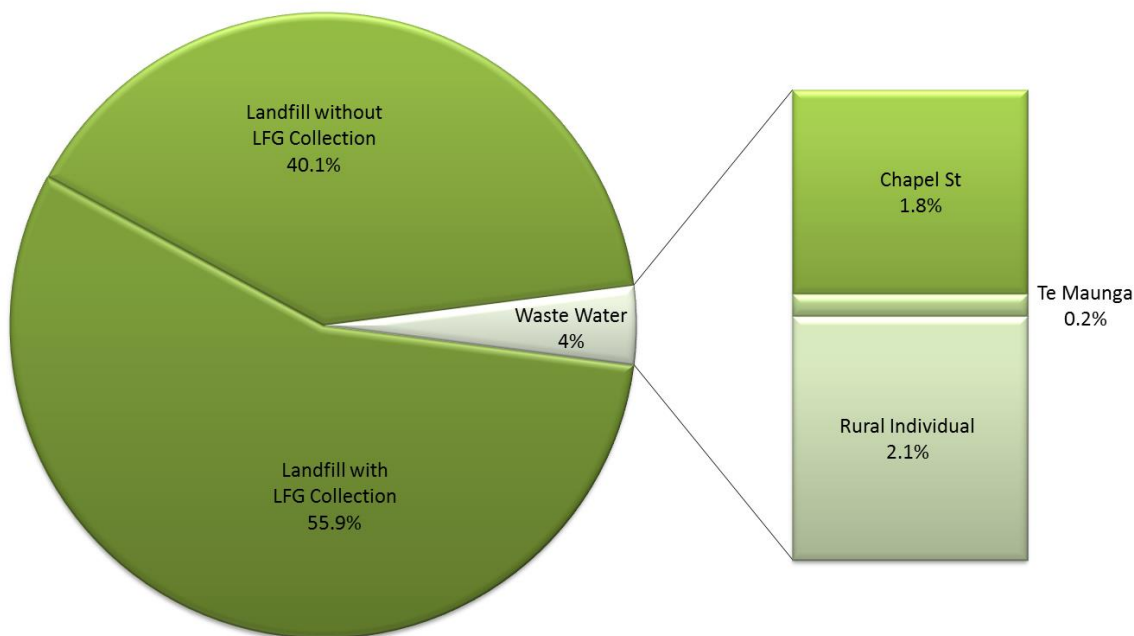


Figure 14 Summary of Waste GHG Emissions 2015/16 - Tauranga

3.6.1 Solid Waste Details

Municipal solid waste generated within Tauranga City in 2015/16 was disposed of at the Hampton Downs Landfill, which opened in 2005 and Tirohia Landfill, which opened in 2001. Both these landfills recovered landfill gas. Historically, municipal solid waste was disposed of at the Te Maunga Landfill (Scope 1), which closed in 1994 and Cambridge Road/Judea Landfill, which closed in 1998, and the Horotiu and Redvale Landfills.

Details of Landfill Gas (LFG) collection and efficiency were unable to be obtained during data collection therefore the NZ average was used, as reported by the Ministry for Environment (MfE) 2017. The calculations assume all waste sent to landfill prior to 2001 was sent to landfill without LFG collection systems.

3.6.2 Waste Water Details

Waste water treated by the two waste water treatment plants within the city is treated by advanced treatment systems resulting in very low emissions. The majority of the waste water related emissions originated from the large number of septic tanks registered within the city, referred to as “rural individual”. It is estimated that there were 1,891 septic tanks within Tauranga City accounting for 51.9% of the waste water emissions during the reporting period.

Emissions from the Chapel Street treatment plant are significantly higher than the emissions from the Te Maunga Plant. The main reason for this is the Nitrogen assumed to be discharged after treating the waste water. Te Maunga measured an average of 4g N/m³. No information was available for Chapel Street and as a result Nitrogen levels from receiving waste water have been used to estimate the emissions from discharged and treated waste water. This is likely overestimating the emissions from the Chapel Street plant. Overall the emissions from waste water treatment are insignificant on a city level, representing less than 0.2% of the city wide emissions. Further investigation is required to confirm the accurate average Nitrogen loading in the waste water discharged from Chapel Street.

Table 9 Summary of Tauranga City Waste Water Emissions 2015/16 by Source

Waste Water Treatment	Emissions (CO ₂ e)		Sector Percentage Contribution
Chapel St	1,091	2,516	43.4%
Te Maunga	119		4.7%
Rural individual (Septic Tanks)	1,306		51.9%

Sludge from the Chapel St treatment plant is anaerobically digested and a cogeneration plant provides approximately 30% of the electricity used at the site. Sludge treatment at Te Maunga uses extended aeration, with sludge stabilised in the lagoon, which is desludged approximately every 5 years. Sludge sent to landfill and other disposal areas from the Chapel Street and Te Maunga waste water treatment plants is assumed to be stabilised, resulting in minimal methane emissions. As a result emissions associated with disposal of sludge have not been included as part of landfill emissions.

Methane generated at Chapel St is captured and either flared or burned in the cogeneration plant. Methane generated at Te Maunga goes through a denitrification process and is emitted as nitrogen.

The incineration of sludge and the combustion of landfill gas generated at landfills or waste water treatment plants also generate CO₂ emissions. These CO₂ emissions are considered to be biogenic (i.e. non-fossil) and are excluded from the emissions reporting, but are reported separately as shown above.

3.7 Industrial Emissions

In 2015/16 industrial GHG emissions contributed 40,336 tCO₂e (5.3%) towards Tauranga City’s overall gross emissions. The emissions for industrial product use include emissions from hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) (Scope 1). Nitrogen trifluoride emissions do not occur in New Zealand, and therefore are not included in this report.

Emissions from industrial product use were estimated based on New Zealand’s average emissions per capita and Tauranga’s population.

No emissions from industrial processes have been estimated, due to a lack of specific data. Any potential emissions are assumed to be insignificant within the Tauranga City Council boundary, given the small amount of heavy industry operating in Tauranga. Energy used in industrial processes is included in the stationary energy sector.

3.8 Agricultural Emissions

In 2015/16 agricultural GHG emissions contributed 16,042 tCO₂e (2.1%) towards Tauranga City's overall gross emissions.

Methane (CH₄) is the most significant emission source (72%), predominantly from enteric fermentation of farmed animals (e.g. cows and sheep). Nitrous oxide (N₂O) emissions from agricultural soils, farming of animals and manure management contributed approximately 28% of emissions in 2015/16.

3.9 Forest Carbon Sequestration and Emissions

The overall emissions from Land use, land use change and forestry (LULUCF) activities in Tauranga City are 5,442 tCO₂e.

Indigenous and exotic forests sequester an estimated -5,117 tCO₂e. The majority of carbon is sequestered by exotic forest plantations (85.3%), while still maturing native forests (i.e. manuka and kanuka forest stocks) sequestered the remaining 14.7%.

Harvesting related emissions were estimated based on harvesting volumes reported by Statistics New Zealand and Ministry for Primary Industries (MPI) National Exotic Forest Description (NEFD) data for 2015 and 2016, and resulted in 10,560 t CO₂e¹² of emissions.

Tauranga's forestry sector generates more emissions than it sequesters. This is in part due to the methodology used to estimate Tauranga's forest harvest emissions, and also reflects Tauranga's forest harvesting cycle. Emissions are based on regional harvest figures provided by Statistics NZ and were allocated based on the share of forest within the city over 26 years. This approach is assumed to be conservative and may have overestimated the amount of forest harvested within the city boundary.

¹² Due to the accounting method chosen for this report, all carbon stored in harvested trees, including in the wood products removed, below ground and in residues left on site, is assumed to result in emissions in the harvesting year.

4.0 Western Bay of Plenty Community Carbon Footprint

4.1 Key Messages

- During the 2015/16 reporting period, the Western Bay of Plenty district was estimated to emit 946,604 tCO₂e gross emissions, approximately 23.2% of the overall Region's gross emissions;
- The average per capita gross emission for the Western Bay of Plenty district is 19.8 tCO₂e/person. In comparison, the national average is 17.8 tCO₂e/person and the regional average is 13.9 tCO₂e/person. Emissions from agricultural activities are responsible for the majority of difference;
- The WBoP District is below the NZ national average per capita gross emissions for Stationary Energy, Waste and Industry;
- The WBoP District is above the NZ national average per capita gross emissions for Transportation and Agriculture;
- Over 63.0% of WBoP's gross emissions are from the agricultural sector. Of that approximately 92% is attributed to dairy and beef farming;
- Per capita transport-related emissions of the WBoP District are above the NZ National Average Transportation emissions;
- Forest carbon stocks change as a result of afforestation, reforestation, harvesting and forest management. While forestry emissions in the WBoP district were high in 2015/16, the overall carbon balance of the forestry sector is expected to be relatively neutral over a 50-100 year period¹³;
- Forestry emissions are significantly driven by the amount of harvesting that takes place in any given year. In the 2015/16 reporting period the forestry activity that took place in WBoP resulted in forestry-related emissions of 332,002 tCO₂e, bringing the net emissions for the District to 1,278,606 tCO₂e;
- The forestry emissions in WBoP District are in contrast to the national greenhouse gas inventory. For 2015 the Ministry for the Environment (MfE) reported that forestry and land use change activities sequestered more carbon than they emitted. This is partly due to differences in the methodology¹⁴, but also reflects the district's forest harvesting cycle.

4.2 Overall Results

In 2015/16, the Western Bay of Plenty (WBoP) District generated estimated gross emissions of 946,604 tCO₂e and net emissions of 1,278,606 tCO₂e (including forestry). The district's population in 2015/16 was understood to be approximately 47,800 people, resulting in per capita gross emissions of 18.8 tCO₂e/person and per capita net emissions of 26.7 tCO₂e/person¹⁵.

Agriculture emissions represent the largest emissions sector for the WBoP District over the reporting period, contributing 63.0% to the overall emissions for the district.

Transportation emissions represent the second largest emissions sector for the WBoP District over the reporting period, contributing 29.2% to the overall emissions for the district. Transportation emissions are predominantly produced by road transport.

¹³ See Section 1.3.

¹⁴ The National GHG Inventory (MfE 2017) estimates carbon stored in Harvested Wood Products, while the regional estimates calculated here assume that all trees harvested are emitting carbon stored in trees instantaneously.

¹⁵ Gross emissions exclude forestry related emissions, whilst net emissions also consider the effects of forestry (sinks and sources). This distinction has been made in the carbon footprints for Wellington and Dunedin where the forestry sectors sequester more carbon than they emit and thereby offset some of the other city wide emissions.

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Table 10 Summary of Overall Results by Source 2015/16 – Western Bay of Plenty

Sector/Category Source		Emissions (tCO ₂ e)		% Gross Emissions Contribution
Stationary Energy	Electricity Consumption	16,842	26,820	2.8%
	Electricity T&D Loss	1,643		
	Natural Gas	1,840		
	Natural Gas T&D Loss	210		
	LPG	3,234		
	Coal	3,050		
	Biofuel use	1		
Transportation	Petrol	112,679	276,150	29.2%
	Diesel	159,187		
	Rail Emissions	3,803		
	LPG	480		
Waste	Solid Waste Disposal	26,454	31,837	3.4%
	Waste Water	5,383		
IPPU (Industry)		15,040		1.6%
Agriculture		596,758		63.0%
Total gross emissions (excl. forestry)		946,604		
Forestry		-835,957	332,002	Not included in gross emissions
		-18,145		
		1,186,105		
Total net emissions (incl. forestry)		1,278,606		

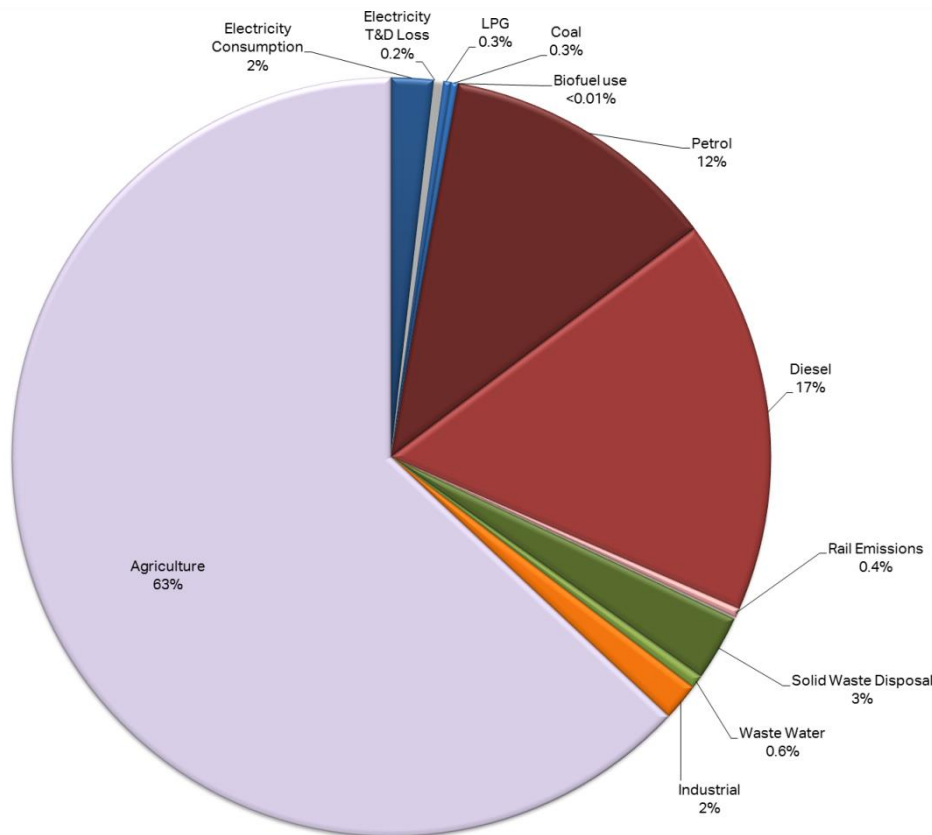


Figure 15 Summary of Gross Emissions by Source 2015/16 – Western Bay of Plenty

4.3 Biogenic emissions

Biogenic CO₂ emissions, such as the combustion or digestion of biological materials, are part of the natural carbon cycle. However, the GPC Standard recommends reporting these emissions outside of the total greenhouse gas emissions. The WBoP generated approximately **844 tCO₂** from biogenic sources (i.e. from combustion of firewood and flaring of landfill gas). CH₄ and N₂O emissions from these sources are included in the overall GHG emissions, due to their higher radiative forcing.

4.4 Stationary Energy Emissions

Stationary energy use within the WBoP generated an estimated 26,820 tCO₂e in 2015/16; representing 3.0% of the District’s gross emissions.

The main source of emissions from stationary energy is electricity consumption (Scope 2) contributing approximately 62.8%. LPG and coal emissions contribute 12.1% and 11.4% respectively. A detailed breakdown of the stationary energy emission sources is provided in the table and chart below.

The WBoP district generates more electricity from hydro generation than is consumed within the district. However, any electricity generated within the district is fed into the national grid. As a result the national average emissions factor for electricity generation has been applied, based on the GPC framework requirements.

Table 11 Summary of Stationary Energy Emissions by Source 2015/16 - Western Bay of Plenty

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Stationary Energy	Electricity Consumption	16,842	26,820	62.8%
	Electricity T&D Loss	1,643		6.1%
	Natural Gas	1,840		6.9%
	Natural Gas T&D Loss	210		0.8%
	LPG	3,234		12.1%
	Coal	3,050		11.4%
	Biofuel	1		<0.01%

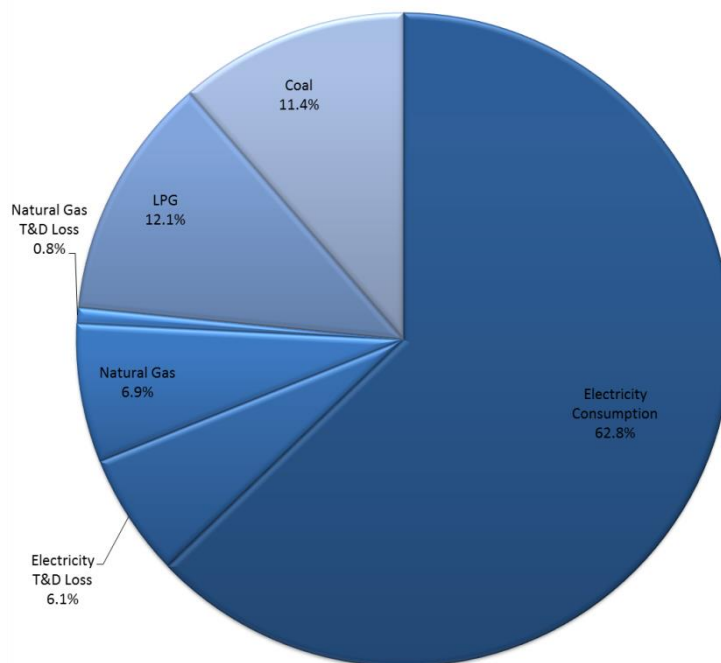


Figure 16 Summary of Stationary Energy Emissions by Source 2015/16 - Western Bay of Plenty

4.5 Transportation Emissions

In 2015/16 transportation sources contributed 276,150 tCO₂e, representing 29.2% of the WBoP’s overall gross emissions. Transportation was the second highest sector contributor to the WBoP’s GHG emissions.

The emissions profile for transportation sources is dominated by road transport (predominantly Scope 1) contributing approximately 98.4%¹⁶. A detailed breakdown of the transportation emission sources is provided in the table and chart below.

Road transport emissions (petrol, diesel and LPG) were estimated based on fuel sales figures. This approach does not allow for separate reporting of cross boundary road transport under Scope 3.

¹⁶ Due to lack of more detailed data, petrol and diesel used for off-road transport (e.g. farming machineries), recreational maritime navigation and for stationary energy (e.g. diesel generators) are included in the fuel data and emissions reported for road transport.
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Table 12 Summary of Transportation Emissions by Source 2015/16 - Western Bay of Plenty

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Transportation	Road	272,347	276,150	98.6%
	Rail	3,803		1.4%

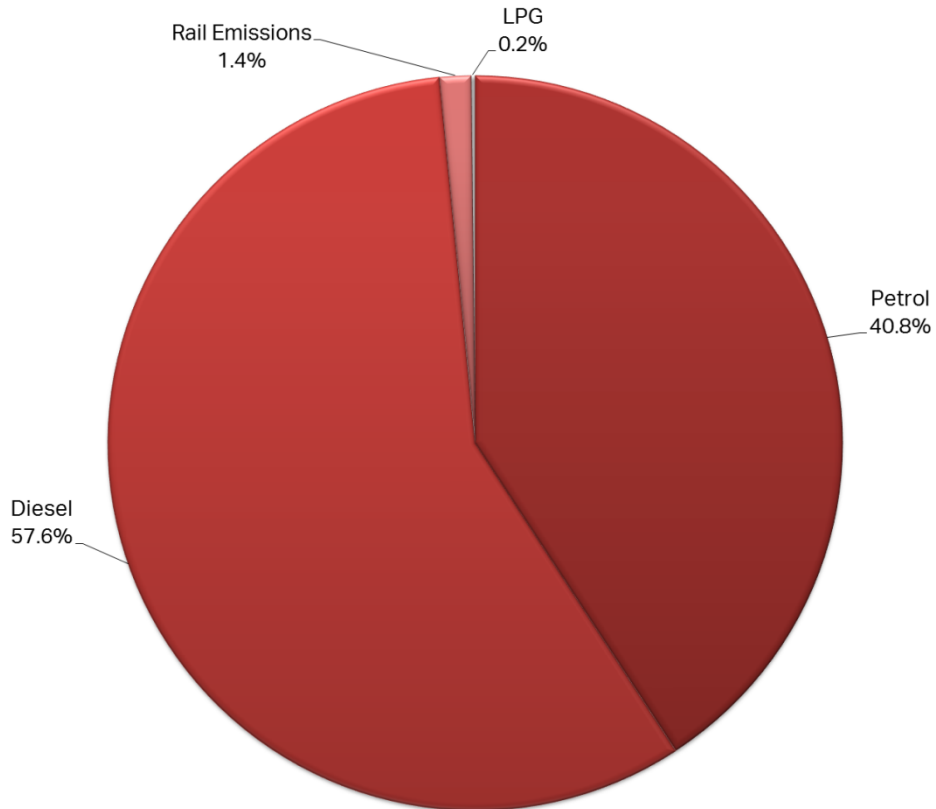


Figure 17 Summary of Transportation Emissions by Source 2015/16 - Western Bay of Plenty

4.6 Waste Emissions

In 2015/16 emissions associated to waste contributed 31,837 tCO₂e, representing 3.4% of the WBoP’s overall gross emissions. Waste emissions are dominated by solid waste disposal.

The combustion of landfill gas (LFG) was estimated to generate approximately 804 tCO₂, which are reported outside the total emissions, as part of the biogenic emissions.

Table 13 Summary of Waste Emissions by Source 2015/16 - Western Bay of Plenty

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Waste	Solid Waste Disposal	26,454	31,837	83.1%
	Waste Water	5,383		16.9%

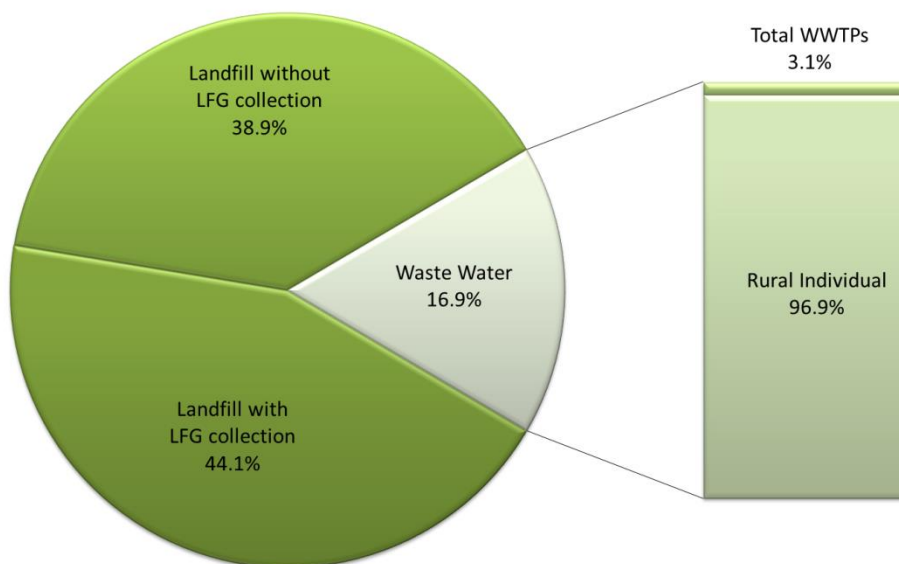


Figure 18 Summary of Waste Emissions by Source 2015/16 - Western Bay of Plenty

4.6.1 Solid Waste Details

Municipal solid waste generated within the WBoP in 2015/16 was disposed of at the Hampton Downs Landfill, which opened in 2005 and at Tirohia Landfill, which opened in 2001. Both these landfills recover landfill gas. Historically, it is understood that municipal solid waste was disposed of at the Waihi Beach Landfill, which closed in 1990, the Athenree Landfill, which closed in 2003 and the Strang Road and McLaughin Drive Landfills in Te Puke that closed in 1996 and 1980, respectively.

Details of LFG collection and efficiency were unable to be obtained during the data collection therefore the NZ average was used, as reported by the MfE 2017. The calculations assume all waste sent to landfill prior to 2001 was sent to landfill without LFG collection systems.

4.6.2 Waste Water Details

Waste water treated by the five waste water treatment plants within the district is treated by advanced treatment systems resulting in very low emissions. The majority of the waste water related emissions originated from the large number of septic tanks understood to be in place within the district, referred to as “rural individual”. It is estimated that there are approximately 18,888 people using septic tanks within the WBoP district accounting for 96.9% of the waste water emissions during the reporting period.

4.7 Industrial Emissions

In 2015/16 industrial GHG emissions contributed **15,040 tCO₂e** (1.6%) towards the WBoP's overall gross emissions. The emissions for industrial product use include emissions from hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) (Scope 1). Nitrogen trifluoride emissions do not occur in New Zealand, and therefore are not included in this report.

Emissions from industrial product use were estimated based on New Zealand's average emissions per capita and the WBoP's population.

No emissions from industrial processes have been estimated, due to a lack of specific data. Any potential emissions are assumed to be insignificant within the WBoP district boundary, given the small amount of heavy industry operating in the WBoP. Energy used in industrial processes is included in the stationary energy sector.

4.8 Agricultural Emissions

In 2015/16 agricultural GHG emissions contributed **596,758 tCO₂e** (63.0%) towards the WBoP's overall gross emissions. Agriculture was the highest sector contributor to the WBoP's GHG emissions.

Methane (CH₄) is the most significant emission source (70.8%), predominantly from enteric fermentation of farmed animals (e.g. cows and sheep). Nitrous oxide (N₂O) emissions from agricultural soils, farming of animals and manure management contributed approximately 29.2% of emissions in 2015/16.

4.9 Forest Carbon Sequestration and Emissions

The overall emissions from Land use, land use change and forestry (LULUCF) activities in the WBoP are **332,002 t CO₂e**.

Indigenous and exotic forests sequester an estimated **-854,103 tCO₂e**. The majority of carbon is sequestered by exotic forest plantations (97.9%), while still maturing native forests (e.g. manuka and kanuka forest stocks) sequestered the remaining 2.1%.

Harvesting related emissions were estimated based on harvesting volumes reported by Statistics New Zealand and MPI NEFD data for 2015 and 2016, and resulted in **1,186,105 t CO₂e**¹⁷ of emissions.

Table 14 Summary of Forestry Emissions by Source 2015/16 - Western Bay of Plenty

Sector/Category Source		Emissions (tCO ₂ e)	
Forestry	Exotic Forest Sequestration	-835,957	332,002
	Native Forest Sequestration	-18,145	
	Total Harvest Emissions	1,186,105	

¹⁷ Due to the accounting method chosen for this report, all carbon stored in harvested trees, including in the wood products removed, below ground and in residues left on site, is assumed to result in emissions in the harvesting year.

5.0 Rotorua Lakes Community Carbon Footprint

5.1 Key Messages

- During the 2015/16 reporting period, Rotorua Lakes District emitted 1,483,356 tCO₂e gross emissions or approximately 36.4% of the overall Region's gross emissions;
- The average per capita gross emissions for the Rotorua Lakes District are 21.0 tCO₂e/person. The national average is 17.8 tCO₂e/person and the regional average is 13.9 tCO₂e/person. Emissions from agricultural and forestry activities within the district are responsible for the majority of difference;
- Rotorua Lakes District has below national average per capita gross emissions for Stationary Energy and Industry;
- Rotorua Lakes District has above national average per capita gross emissions for Waste, Transportation and Agriculture;
- The majority of the emissions (67.1%) for the Rotorua Lakes District are from the agricultural sector, reflecting a rural economy.
- The forestry emissions in Rotorua are in contrast to the national greenhouse gas inventory. For 2015 the Ministry for the Environment (MfE) reported that forestry and land use change activities sequestered more carbon than they emitted.
- Forest carbon stocks change as a result of afforestation, reforestation, harvesting and forest management. While forestry emissions in the District were high in 2015/16, the overall carbon balance of the forestry sector is expected to be relatively neutral over a 50-100 year period¹⁸;
- In the 2015/16 reporting period the forestry activity that took place in Rotorua Lakes District resulted in forestry-related emissions of 58,317 tCO₂e, bringing the net emissions for the District to 1,541,673 tCO₂e;
- Some of the district's area is included in the Waikato Region. For simplicity and due to data limitations the contributing emissions have been estimated for all of the area included within the District's boundary for the purpose of this report, including agricultural and forestry activities located in the Waikato Region.

5.2 Overall Results

In 2015/16, the Rotorua Lakes District generated gross emissions of 1,483,356 tCO₂e and net emissions of 1,541,673 tCO₂e (including forestry). The district's population in 2015/16 was understood to be approximately 70,500 people, resulting in per capita gross emissions of 21.0 tCO₂e/person and per capita net emissions of 21.9 tCO₂e/person¹⁹.

Agricultural emissions represent the largest emissions sector for the Rotorua Lakes District over the reporting period, contributing 67.1% to the overall emissions for the District. Emissions from dairy and beef farming generate the majority of the agricultural emissions.

Transportation represents the second largest emissions sector for the District, contributing 18.8% to the overall emissions. The majority of the transportation emissions result from petrol and diesel consumed by road transport.

¹⁸ See Section 1.3

¹⁹ Gross emissions exclude forestry related emissions, whilst net emissions also consider the effects of forestry (sinks and sources). This distinction has been made in the carbon footprints for Wellington and Dunedin where the forestry sectors sequester more carbon than they emit and thereby offset some of the other city wide emissions.

Table 15 Summary of Overall Results by Source 2015/16 – Rotorua Lakes

Sector/Category Source		Emissions (tCO ₂ e)		% Gross Emissions Contribution
Stationary Energy	Electricity Consumption	51,021	92,062	6.2%
	Electricity Transmission & Distribution (T&D) Loss	4,977		
	Natural Gas	24,270		
	Natural Gas T&D Loss	2,769		
	LPG	4,526		
	Coal	4,499		
	Biofuel use	1		
Transportation	Petrol	112,103	279,199	18.8%
	Diesel	158,374		
	Jet Kerosene	6,934		
	Av Gas	1,115		
	LPG	673		
Waste	Solid Waste Disposal	92,115	94,526	6.4%
	Waste Water	2,411		
IPPU (Industry)		22,182		1.5%
Agriculture		995,387		67.1%
Total gross emissions (excl. forestry)		1,483,356		
Forestry	Exotic Forest Sequestration	-1,773,950	58,317	Not included in gross emissions
	Native Forest Sequestration	-46,185		
	Total Harvest Emissions	1,878,452		
Total net emissions (incl. forestry)		1,541,673		

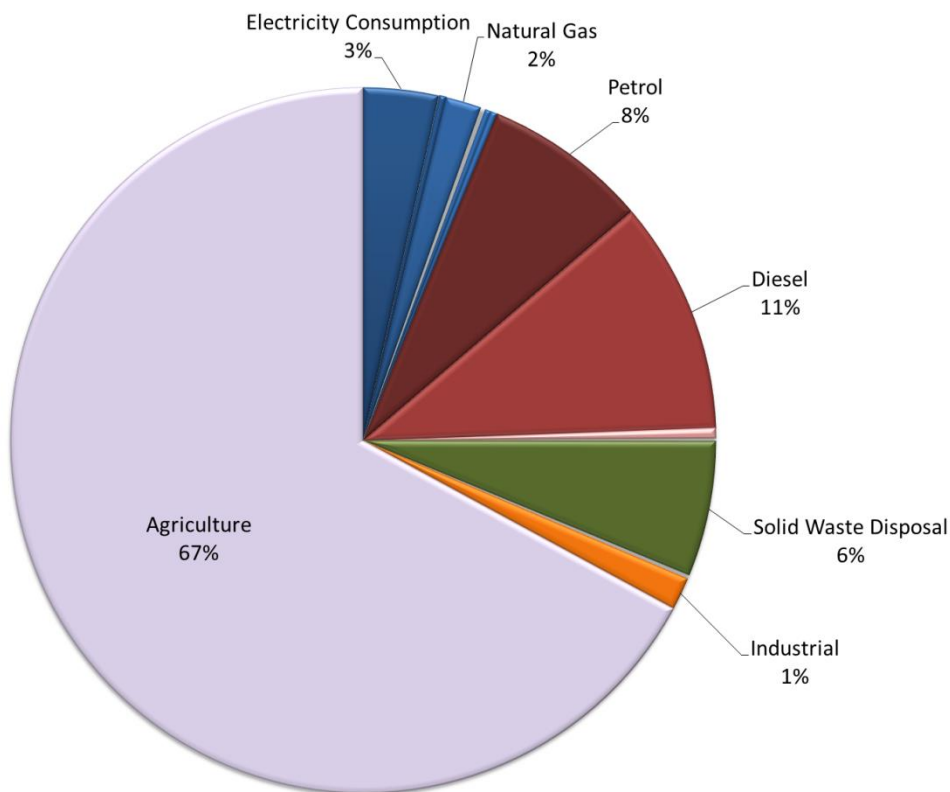


Figure 19 Summary of Gross Emission by Source 2015/16 - Rotorua Lakes

CO₂ emissions from biogenic sources are not included in the overall emissions results and are reported outside of the total greenhouse gas emissions. Rotorua Lakes District generated approximately 11.82 tCO₂ from biogenic sources (i.e. from combustion of firewood and flaring of landfill gas).

5.3 Stationary Energy Emissions

Stationary energy use within the Rotorua Lakes District generated an estimated 92,062 tCO₂e in 2015/16; representing 6.2% of gross emissions.

The main source of emissions from stationary energy is electricity consumption (Scope 2) contributing approximately 55.4%. A detailed breakdown of the stationary energy emission sources is provided in the table and chart below.

The Rotorua Lakes district generates approximately 72% of its electricity demand from hydro and co-generation power plants. However, any electricity generated within the district is fed into the national grid. As a result the national average emissions factor for electricity generation has been applied, based on the GPC framework requirements.

Table 16 Summary of Stationary Energy Emissions by Source 2015/16 - Rotorua Lakes

Sector/Category Source		Emissions (t CO ₂ e)	Sector Percentage Contribution
Stationary Energy	Electricity Consumption	51,021	55.4%
	Electricity T&D Loss	4,977	5.4%
	Natural Gas	24,270	26.4%
	Natural Gas T&D Loss	2,769	3.0%
	LPG	4,526	4.9%
	Coal	4,499	4.9%
	Biofuel	1	0.0%
		92,062	

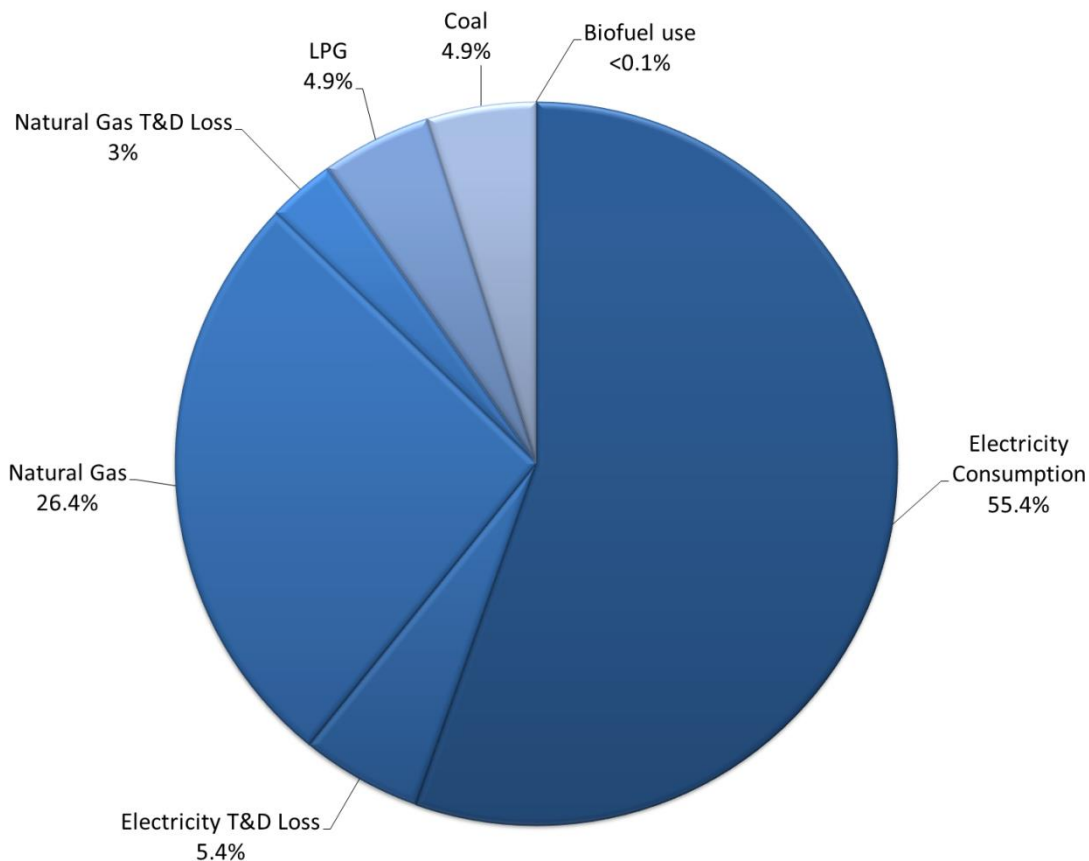


Figure 20 Summary of Stationary Energy Emissions by Source 2015/16 - Rotorua Lakes

5.4 Transportation Emissions

In 2015/16 transportation sources contributed **279,199 tCO₂e**, representing 18.8% of Rotorua’s overall gross emissions. Transportation is the second highest sector contributor to Rotorua’s GHG emissions.

The emissions profile for transportation sources is dominated by road transport (predominantly Scope 1) contributing approximately 97%²⁰. A breakdown of the transportation emission sources is provided in the table below.

Road transport emissions (petrol, diesel and LPG) were estimated based on fuel sales figures. This approach does not allow for separate reporting of cross boundary road transport under Scope 3.

Table 17 Summary of Transportation Emissions by Source 2015/16 - Rotorua Lakes

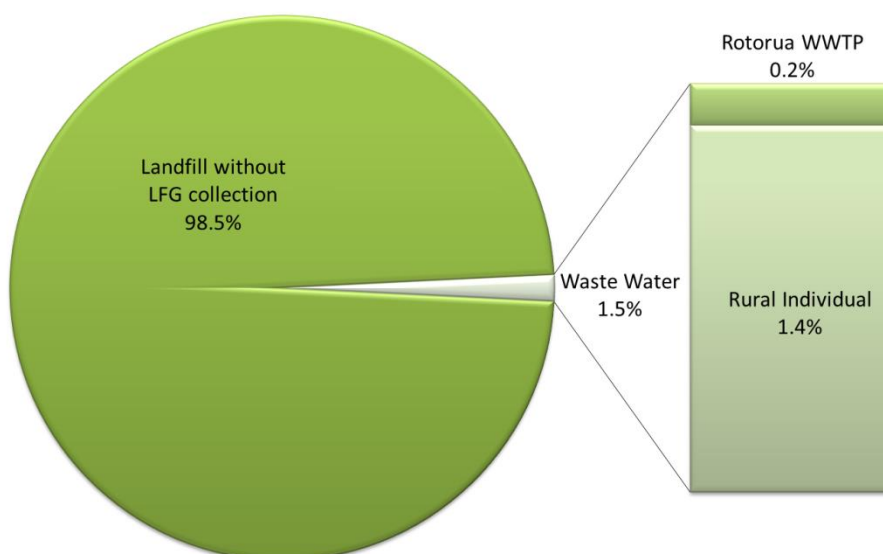
Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Transportation	Road	279,347	287,396	97.2%
	Aviation	8,049		2.8%

5.5 Waste Emissions

In 2015/16 emissions associated to waste disposal contributed 94,526 tCO₂e, representing 6.3% of Rotorua’s overall gross emissions. Waste emissions are dominated by solid waste disposal contributing approximately 97.4% of the overall waste emissions during 2015/16, with waste water treatment contributing the remaining 2.6%.

Table 18 Summary of Waste Emissions by Source 2015/16 - Rotorua Lakes

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Waste	Solid Waste Disposal	92,115	94,526	97.4%
	Waste Water	2,411		2.6%



²⁰ Due to lack of more detailed data, petrol and diesel used for off-road transport (e.g. farming machineries), recreational maritime navigation and for stationary energy (e.g. diesel generators) are included in the fuel data and emissions reported for road transport.

Figure 21 Summary of Waste GHG Emissions 2015/16 - Rotorua

5.5.1 Solid Waste Details

Municipal solid waste generated within Rotorua Lakes in 2015/16 was disposed of at the Rotorua's Atiamuri Landfill (Scope 1). Council reported that the Atiamuri Landfill captures some landfill gas, which is combusted through an enclosed flare; however, the system does not run continuously and does not always reach high enough temperatures for full destruction. Emission estimates for the Rotorua landfill therefore assume that no landfill gas generated by the Rotorua landfill is recovered. Historically, municipal solid waste was disposed of at a number of public and illegal dumping sites.

Details of LFG collection and efficiency were unable to be obtained during the data collection therefore the NZ average was used, as reported by the MfE 2017. The calculations assume all waste sent to landfill prior to 2001 was sent to landfill without LFG collection systems.

5.5.2 Waste Water Details

Waste water treated by the Te Ngae Rd waste water treatment plant which uses an advanced treatment systems results in very low emissions. The majority of the waste water related emissions originated from the large number of septic tanks understood to be in place within the District. It is estimated that there are approximately 8,200 people using septic tanks within the Rotorua Lakes District accounting for 94% of the waste water emissions during the reporting period.

5.6 Industrial Emissions

In 2015/16 industrial GHG emissions contributed **22,182 tCO₂e** (1.5%) towards Rotorua's overall gross emissions. The emissions for industrial product use include emissions from hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) (Scope 1). Nitrogen trifluoride emissions do not occur in New Zealand, and therefore are not included in this report.

Emissions from industrial product use were estimated based on New Zealand's average emissions per capita and the Rotorua Lakes District's population.

Damar Industries, an aerosol manufacturing and filling facility in Rotorua, reported that they do not use any greenhouse gases outlined in the IPCC 2013 5th Assessment Report (WG1AR5 Chapter 8).

No other emissions from industrial processes have been estimated, due to a lack of specific data. Any potential emissions are assumed to be insignificant within the Rotorua Lakes District boundary, given the small amount of heavy industry operating in the District. Energy used in industrial processes is included in the stationary energy sector.

5.7 Agricultural Emissions

In 2015/16 agricultural GHG emissions contributed **995,387 tCO₂e** (66.7%) towards Rotorua's overall gross emissions.

Methane (CH₄) is the most significant emission source (71.1%), predominantly from enteric fermentation of farmed animals (e.g. cows and sheep). Nitrous oxide (N₂O) emissions from agricultural soils, farming of animals and manure management contributed approximately 28.9% of emissions in 2015/16.

Overall the majority of agricultural emissions (89.6%) are a result of dairy and beef farming activities.

5.8 Forest Carbon Sequestration and Emissions

The overall emissions from Land use, land use change and forestry (LULUCF) activities in the Rotorua Lakes District are **58,317 t CO₂e**.

Indigenous and exotic forests sequester an estimated **-1,820,134 tCO₂e**. The majority of carbon is sequestered by exotic forest plantations (97.5%), while still maturing native forests (e.g. manuka and kanuka forest stocks) sequestered the remaining 2.5%.

Harvesting related emissions were estimated based on harvesting volumes reported by Statistics New Zealand and MPI NEFD data for 2015 and 2016, and resulted in **1,878,452 t CO₂e²¹** of emissions.

Table 19 Summary of Forestry Emissions by Source 2015/16 - Rotorua Lakes

Sector/Category Source		Emissions (tCO ₂ e)	
Forestry	Exotic Forest Sequestration	-1,773,950	58,317
	Native Forest Sequestration	-46,185	
	Total Harvest Emissions	1,878,452	

²¹ Due to the accounting method chosen for this report, all carbon stored in harvested trees, including in the wood products removed, below ground and in residues left on site, is assumed to result in emissions in the harvesting year.

6.0 Whakatāne District Community Carbon Footprint

6.1 Key Messages

- During the 2015/16 reporting period, Whakatāne District emitted 1,000,227 tCO₂e gross emissions, approximately 24.5% of the overall Region's gross emissions;
- The average per capita gross emission in Whakatāne District are 28.6 tCO₂e/person. By comparison the national average is 17.8 tCO₂e/person and the regional average is 13.9 tCO₂e/person. Emissions from agricultural activities and stationary energy consumption are largely responsible for difference;
- Whakatāne District has below national average per capita gross emissions for Waste, Industry and Forestry;
- Whakatāne District has above national average per capita gross emissions for Stationary Energy, Transportation and Agriculture;
- Whakatāne District generates hydro electricity from the Rangitaiki River. Emissions from electricity use are however estimated using the national average emissions factor for electricity generation, as all of the electricity generated within the District is fed into the national grid;
- Forest carbon stocks change as a result of afforestation, reforestation, harvesting and forest management. While forestry emissions in the Whakatāne District were high in 2015/16, the overall carbon balance of the forestry sector is expected to be relatively neutral over a 50-100 year period²²;
- Forestry emissions are significantly driven by the amount of harvesting that takes place in any given year. During the 2015/16 reporting period, the forestry activities that took place in Whakatāne District sequestered 299,139 tCO₂e, reducing the total net emissions to 700,364 tCO₂e. This demonstrates the potential impact of afforestation and harvesting activities on a district and regional level;
- The forestry sector emissions calculation do not account for carbon that is stored mature forests, nor carbon credits purchased through the New Zealand Emission Trading Scheme;
- The Agricultural emissions for Whakatāne District reflect a rural economy.

6.2 Overall Results

In 2015/16, the Whakatāne District generated estimated gross emissions of 1,000,227 tCO₂e and net emissions of 701,088 tCO₂e (including forestry). The district's population in 2015/16 was understood to be approximately 35,500 people, resulting in per capita gross emissions of 28.6 tCO₂e/person and per capita net emissions of 20.0 tCO₂e/person²³.

Agricultural emissions represent the largest emissions sector for Whakatāne District over the reporting period, contributing 62.9%. Emissions from dairy and beef farming generate the majority of the agricultural emissions.

Stationary energy represents the second largest emissions sector for the District, contributing 16.9% to the overall emissions. The majority of the stationary energy emissions result from natural gas use.

Transportation represents the third largest emissions sector for the District, contributing 16.2% to the overall emissions. The majority of the transportation emissions result from petrol and diesel consumed by road transport.

Table 20 Summary of Overall Results by Source 2015/16 – Whakatāne District

²² See Section 1.3.

²³ Gross emissions exclude forestry related emissions, whilst net emissions also consider the effects of forestry (sinks and sources). This distinction has been made in the carbon footprints for Wellington and Dunedin where the forestry sectors sequester more carbon than they emit and thereby offset some of the other city wide emissions.

Sector/Category Source		Emissions (tCO ₂ e)		% Gross Emissions Contribution
Stationary Energy	Electricity Consumption	40,732	168,638	16.9%
	Electricity Transmission & Distribution (T&D) Loss	3,973		
	Natural Gas	114,138		
	Natural Gas T&D Loss	5,193		
	LPG	2,368		
	Coal	2,233		
	Biofuel use	1		
Transportation	Petrol	63,683	161,558	16.2%
	Diesel	89,968		
	Rail Emissions	6,828		
	Jet Kerosene	724		
	LPG	353		
Waste	Solid Waste Disposal	23,016	29,552	3.0%
	Waste Water	6,536		
IPPU (Industry)		11,012		1.1%
Agriculture		629,468		62.9%
Total gross emissions (excl. forestry)		1,000,227		
Forestry	Exotic Forest Sequestration	-3,843,962	-299,139	Not included in gross emissions
	Native Forest Sequestration	-80,972		
	Total Harvest Emissions	3,625,796		
Total net emissions (incl. forestry)		701,088		

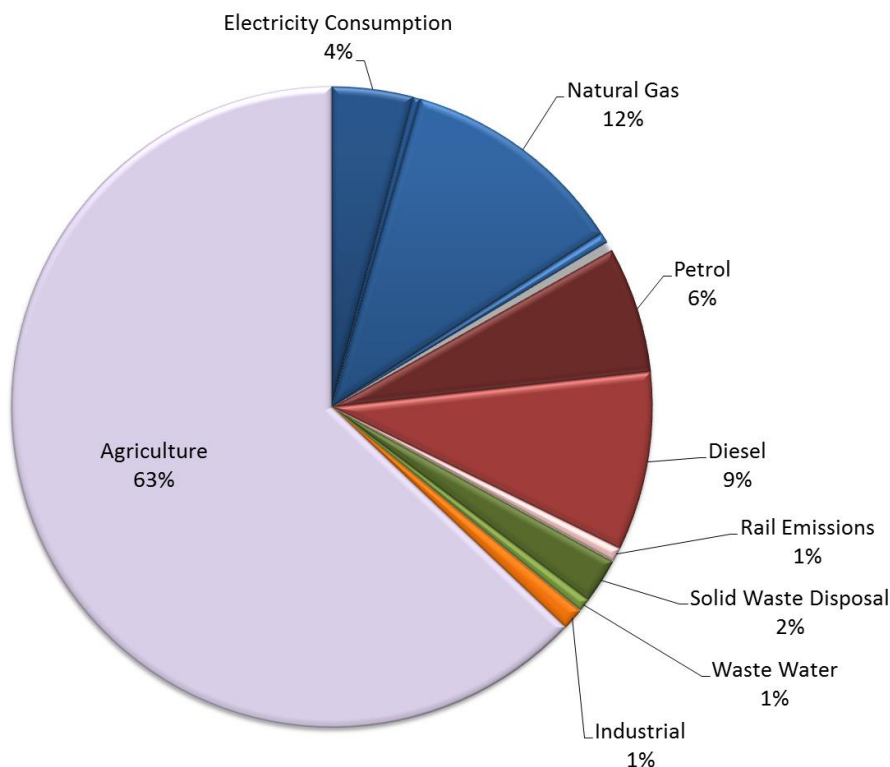


Figure 22 Summary of Gross Emissions by Source 2015/16 - Whakatāne District

CO₂ emissions from biogenic sources are not included in the overall emissions results and are reported outside of the total greenhouse gas emissions. Whakatāne District generated approximately 195 tCO₂ from biogenic sources (i.e. from combustion of firewood and flaring of landfill gas).

6.3 Stationary Energy Emissions

Stationary energy used within the Whakatāne District generated an estimated 168,638 tCO₂e in 2015/16; representing 16.9% of gross emissions.

The main source of emissions from stationary energy is natural gas use (Scope 1), representing 67.7% of the stationary energy related emissions. T&D losses for reticulated gas supply add an additional 3.1%. The majority of the natural gas is used for commercial/industrial activities within the District. Electricity consumption (Scope 2) contributed approximately 24.2%. A detailed breakdown of the stationary energy emission sources is provided in the table and chart below.

The Whakatāne district generates more electricity from hydro generation than is consumed within the district. However, any electricity generated within the district is fed into the national grid. As a result the national average emissions factor for electricity generation has been applied, based on the GPC framework requirements.

Table 21 Summary of Stationary Energy Emissions by Source 2015/16 - Whakatāne District

Sector/Category Source		Emissions (tCO ₂ e)	Sector Percentage Contribution
Stationary Energy	Electricity Consumption	40,732	24.2%
	Electricity T&D Loss	3,973	2.4%
	Natural Gas	114,138	67.7%
	Natural Gas T&D Loss	5,193	3.1%
	LPG	2,368	1.4%
	Coal	2,233	1.3%
	Biofuel	1	<0.01%
		168,638	

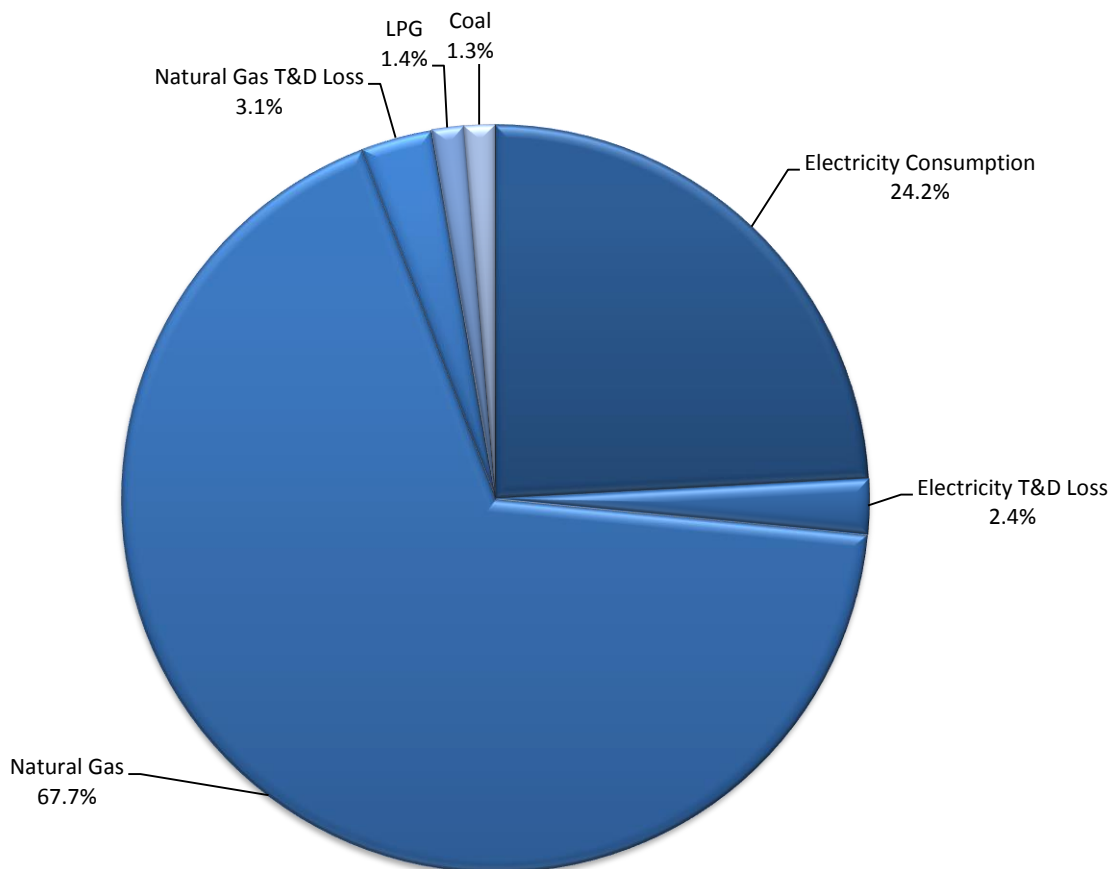


Figure 23 Summary of Stationary Energy Emissions by Source 2015/16 - Whakatāne District

6.4 Transportation Emissions

In 2015/16 transportation sources contributed **161,558 tCO₂e**, representing 16.2% of Whakatāne District’s overall gross emissions. Transportation was the third highest sector contributor to the District’s GHG emissions after agriculture and stationary energy.

The emissions profile for transportation sources is dominated by road transport (predominantly Scope 1) contributing approximately 95.1%²⁴. Road transport emissions were estimated based on fuel sales figures for petrol, diesel and LPG. This approach does not allow for separate reporting of cross boundary road transport under Scope 3.

Table 22 Summary of Transportation Emissions by Source 2015/16 - Whakatāne District

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Transportation	Road	154,005	161,558	95.3%
	Rail	6,828		4.2%
	Aviation	724		0.4%

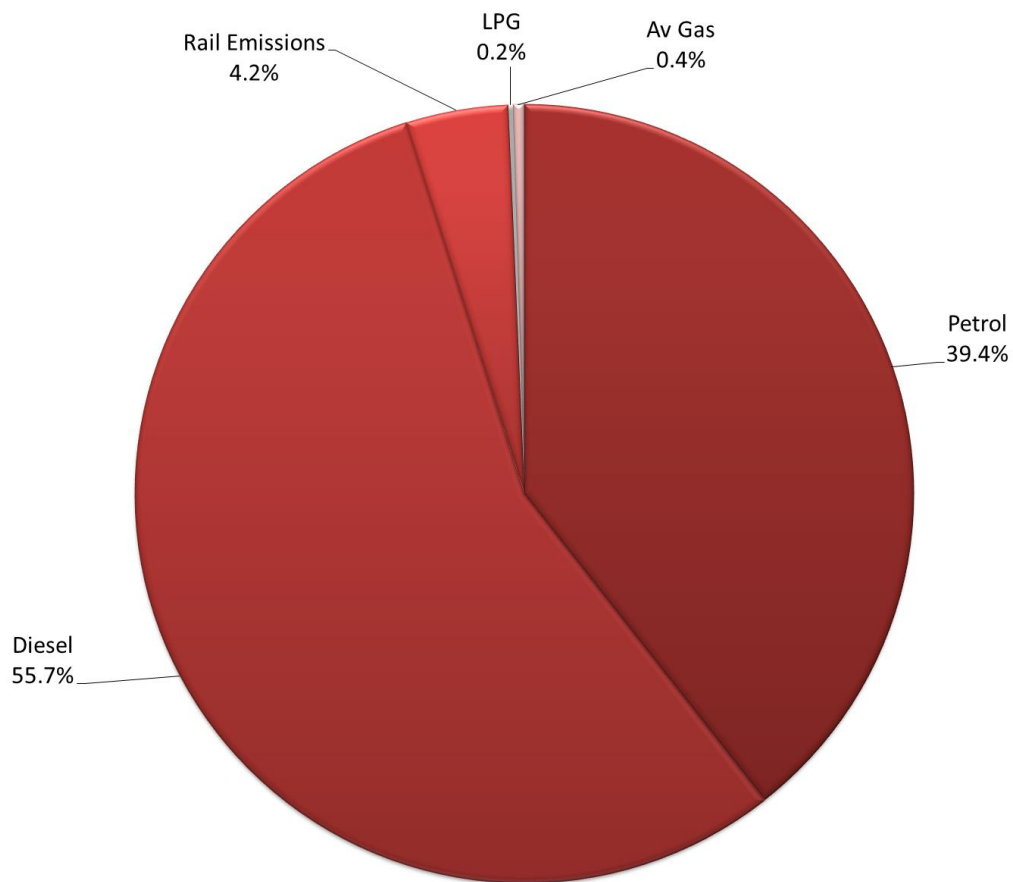


Figure 24 Summary of Transportation Emissions by Source 2015/16 - Whakatāne District

²⁴ Due to lack of more detailed data, petrol and diesel used for off-road transport (e.g. farming machineries), recreational maritime navigation and for stationary energy (e.g. diesel generators) are included in the fuel data and emissions reported for road transport.

6.5 Waste Emissions

In 2015/16 emissions associated to waste contributed 29,552 tCO₂e, representing 3.0% of Whakatāne District’s overall gross emissions. Waste emissions are dominated by solid waste disposal contributing approximately 77.9% of the overall waste emissions during 2015/16, with waste water contributing 22.1%.

The combustion of landfill gas (LFG) was estimated to generate approximately 189 tCO₂, which are reported outside the total emissions, as part of the biogenic emissions.

Table 23 Summary of Waste Emissions by Source 2015/16 - Whakatāne District

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Waste	Solid Waste Disposal	23,016	29,552	77.9%
	Waste Water	6,536		22.1%

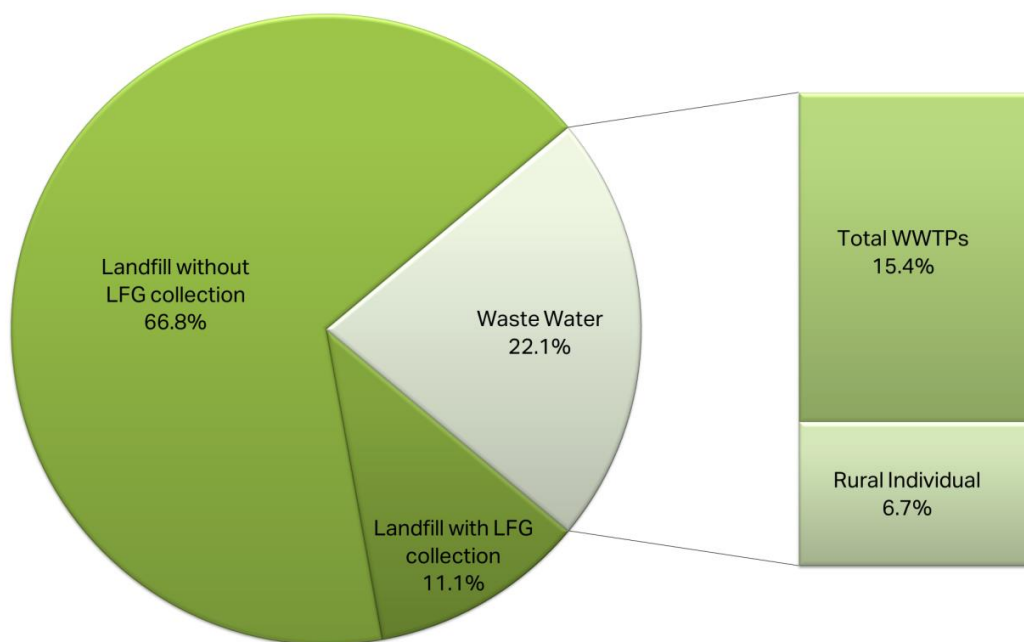


Figure 25 Summary of Waste GHG Emissions 2015/16 - Whakatāne

6.5.1 Solid Waste Details

Municipal solid waste generated within the Whakatāne District in 2015/16 was disposed of at the Tirohia Landfill (Scope 1), which collects landfill gas for electricity generation. Historically, municipal solid waste was disposed of at a range of landfills, which have all closed since.

Details of the Landfill Gas (LFG) collection and efficiency were unavailable during the data collection therefore the NZ average was used, as reported by the Ministry for Environment (MfE) 2017. The calculations assumes all waste sent to landfill prior to 2008/09 was sent to landfill without LFG collection systems.

6.5.2 Waste Water Details

Waste water is treated by the eight waste water treatment plants within the district. The majority of these treatment plants use oxidation pond treatment systems, with Te Mahoe using an intermittent sand filter and Te Teko and Matatā using large scale septic tanks. Approximately 7,200 people are connected to individual rural septic tanks.

Treated waste water from the Ōhope, Whakatāne, Tāneatua, Edgecumbe and Murupara treatment plants is discharged into aquatic systems resulting in some N₂O emissions. Overall these emissions are insignificant on the district level, representing less than 0.06% of the District's gross emissions. No information was available for the total Nitrogen in the effluent for any of these treatment plants. As a result Nitrogen levels from receiving waste water have been estimated based on the national average protein consumption per capita. This is likely overestimating the emissions from discharged waste water from these plants.

6.6 Industrial Emissions

In 2015/16 industrial GHG emissions contributed **11,012 tCO₂e** (1.1%) towards Whakatāne's overall gross emissions. The emissions for industrial product use include emissions from hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) (Scope 1). Nitrogen trifluoride emissions do not occur in New Zealand, and therefore are not included in this report.

Emissions from industrial product use were estimated based on New Zealand's average emissions per capita and the population of the Whakatāne District.

No emissions from industrial processes have been estimated, due to a lack of specific data. Any potential emissions are assumed to be insignificant within the Whakatāne district boundary, given the small amount of heavy industry operating in the District. Energy used in industrial processes is included in the stationary energy sector.

6.7 Agricultural Emissions

In 2015/16 agricultural GHG emissions contributed 629,468 tCO₂e (63.4%) towards Whakatāne's overall gross emissions.

Methane (CH₄) is the most significant emission source (70.8%), predominantly from enteric fermentation of farmed animals (e.g. cows and sheep). Nitrous oxide (N₂O) emissions from farming of animals, manure management and agricultural soils contributed approximately 29.2% of emissions in 2015/16.

6.8 Forest Carbon Sequestration and Emissions

Land use, land use change and forestry (LULUCF) activities in the Whakatāne District sequester - **299,139 t CO₂e**. Whakatāne is the only district in the Bay of Plenty to sequester more carbon than is emitted, due largely to the harvesting cycle of exotic forests.

Indigenous and exotic forests sequester an estimated -3,924,935 tCO₂e. The majority of carbon is sequestered by exotic forest plantations (97.9%), while still maturing native forests (e.g. manuka and kanuka forest stocks) sequestered the remaining 2.1%. Harvesting related emissions were estimated based on harvesting volumes reported by Statistics New Zealand and Ministry for Primary Industries (MPI) National Exotic Forest Description (NEFD) data for 2015 and 2016, and resulted in 3,625,796 t CO₂e²⁵ of emissions.

²⁵ Due to the accounting method chosen for this report, all carbon stored in harvested trees, including in the wood products removed, below ground and in residues left on site, is assumed to result in emissions in the harvesting year.

7.0 Ōpōtiki District Community Carbon Footprint

7.1 Key Messages

- During the 2015/16 reporting period, the Ōpōtiki District emitted 255,038 tCO₂e gross emissions, representing approximately 6% of the overall Region's gross emissions;
- Per capita emissions from stationary energy consumption are below the national average and second lowest in the BoP. Per capita emissions from industrial activities are also below the national average;
- Ōpōtiki's emissions profile is driven by the district's low population density and a large rural area dominated by agricultural and forestry related economic activities;
- Over 73.2% of Ōpōtiki's gross emissions are from the agricultural sector. Of that approximately 94% is attributed to dairy and beef farming;
- Transport-related emissions in the Ōpōtiki district are above the NZ National average. This is likely due to the predominately rural economy;
- During the 2015/16 reporting period Ōpōtiki generated 1,798,724 tCO₂e from forestry-related activities. These emissions are strongly influenced by harvesting rotation cycles and the level of afforestation;
- Over the last 10 years the total area used for exotic forestry has decreased, resulting in significant emissions from harvesting, demonstrating the potential impact of deforestation and harvesting activities on a district and regional level. However, assuming the total forest area remains stable from now on, the overall carbon balance of the forestry sector is expected to be relatively neutral over a 50-100 year period²⁶;
- The forestry emissions in the Ōpōtiki District are in contrast to the national greenhouse gas inventory. For 2015 the Ministry for the Environment (MfE) reported that forestry and land use change activities sequestered more carbon than they emitted. This is partly due to differences in the methodology²⁷, but also a reflection of the District's forest harvesting cycle and recent reduction in total forest area;
- The forestry sector emissions calculation do not account for carbon that is stored mature forests, nor carbon credits purchased through the New Zealand Emission Trading Scheme;

7.2 Overall Results

In 2015/16, the Ōpōtiki District generated estimated gross emissions of 255,762 tCO₂e and net emissions of 2,053,762 tCO₂e (including forestry). The district population in 2015/16 was approximately 8,820 people, resulting in per capita gross emissions of 28.9tCO₂e/person and per capita net emissions of 232.9 tCO₂e/person²⁸.

Agriculture represents the largest source of gross emissions for the Ōpōtiki District (excluding forestry), contributing 73.2% to the overall emissions of the district. The majority of the agricultural emissions are produced by dairy and beef farming.

Transportation represents the second largest emissions sector for Ōpōtiki, contributing 19.0% to the overall emissions for the district. The majority of the transport emissions result from petrol and diesel consumed for road transport.

²⁶ See Section 1.3.

²⁷ The national estimates including carbon stored in Harvested Wood Products, while the regional estimates calculated here assume that all trees harvested are emitting carbon stored in trees instantaneously

²⁸ Gross emissions exclude forestry related emissions, whilst net emissions also consider the effects of forestry (sinks and sources). Per capita net emissions for Ōpōtiki are inflated due to very high forestry emissions related to the 2015/16 harvest cycle. The overall carbon balance of the forestry sector is expected to be relatively neutral over a 50-100 year period

Table 24 Summary of Overall Results by Source 2015/16 – Ōpōtiki District

Sector/Category Source		Emissions (tCO ₂ e)		% Gross Emissions Contribution
Stationary Energy	Electricity Consumption	5,858	8,188	3.2%
	Electricity Transmission & Distribution (T&D) Loss	571		
	Natural Gas	538		
	Natural Gas T&D Loss	61		
	LPG	596		
	Coal	563		
	Biofuel use	0		
Transportation	Petrol	20,011	48,370	19.0%
	Diesel	28,270		
	LPG	88		
Waste	Solid Waste Disposal	5,588	8,948	3.5%
	Waste Water	3,360		
IPPU (Industry)		2,775		1.1%
Agriculture		186,757		73.2%
Total gross emissions (excl. forestry)		255,038		
Forestry	Exotic Forest Sequestration	-502,555	1,798,724	Not included in gross emissions
	Native Forest Sequestration	-78,292		
	Total Harvest Emissions	2,379,571		
Total net emissions (incl. forestry)		2,053,762		

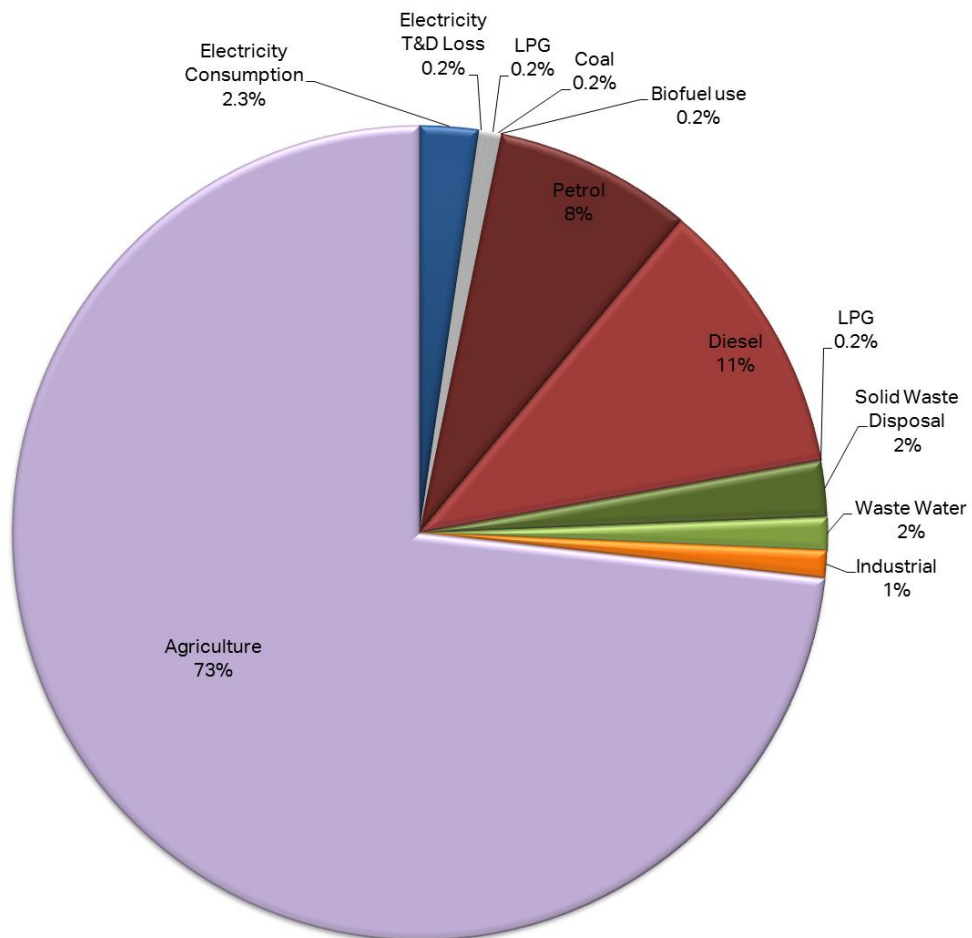


Figure 26 Summary of Gross Emission by Source 2015/16 - Ōpōtiki District

7.3 Biogenic Emissions

CO₂ emissions from biogenic sources are not included in the overall emissions results and are reported outside of the total greenhouse gas emissions. Ōpōtiki District generated approximately 139 tCO₂ from biogenic sources (i.e. from combustion of firewood and flaring of landfill gas).

7.4 Stationary Energy Emissions

Stationary energy use within the Ōpōtiki District generated an estimated 8,188 tCO₂e in 2015/16; representing 3.2% of gross emissions.

The main source of emissions from stationary energy is electricity consumption (Scope 2) contributing approximately 71.5%. A detailed breakdown of the stationary energy emission sources is provided in the table and chart below.

Table 25 Summary of Stationary Energy Emissions by Source 2015/16 - Ōpōtiki District

Sector/Category Source		Emissions (tCO ₂ e)	Sector Percentage Contribution
Stationary Energy	Electricity Consumption	5,858	71.5%
	Electricity T&D Loss	571	7.0%
	Natural Gas	538	6.6%
	Natural Gas T&D Loss	61	0.7%
	LPG	596	7.3%
	Coal	563	6.9%
	Biofuel	0	0.00%
		8,188	

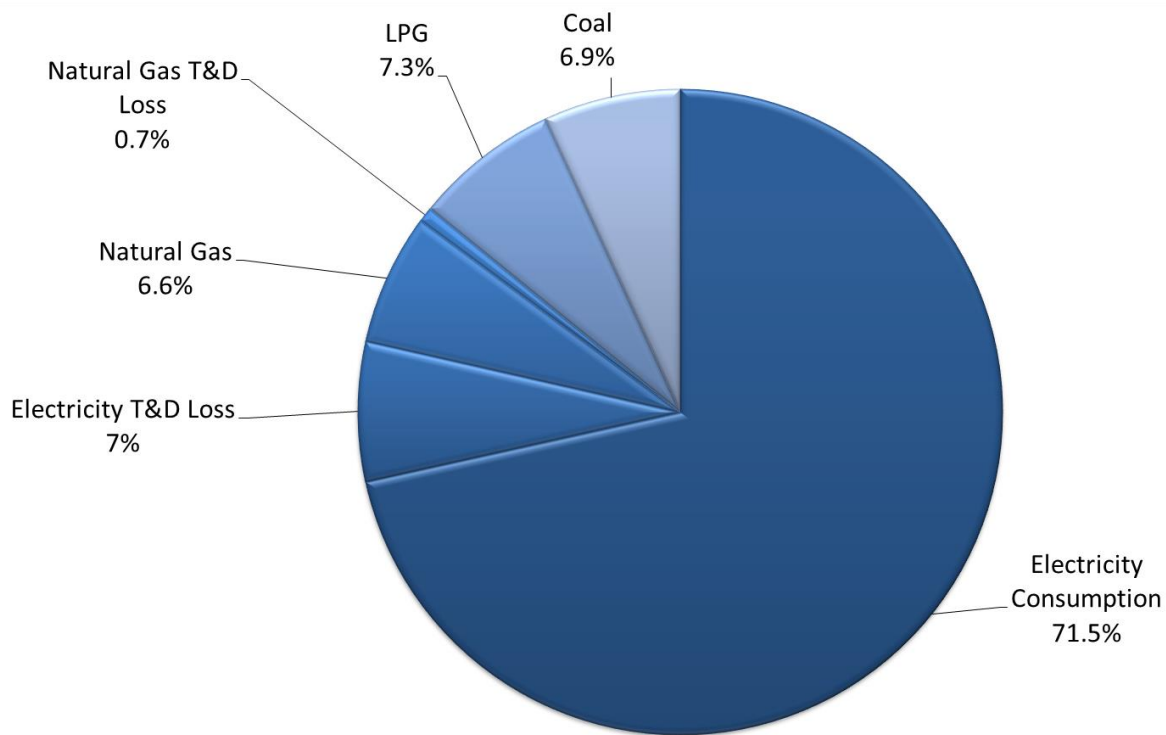


Figure 27 Summary of Stationary Energy Emissions by Source 2015/16 – Ōpōtiki District

7.5 Transportation Emissions

In 2015/16 transportation sources contributed **48,370 tCO₂e**, representing 19% of Ōpōtiki's overall gross emissions. Transportation was the second highest contributor to Ōpōtiki's gross GHG emissions.

The emissions profile for transportation sources is entirely due to road transport emissions (predominantly Scope 1). Petrol use is responsible for 41.4% of the transport emissions. Diesel contributes 58.4% while LPG contributes approximately 0.2% of the transport emissions. Due to lack of more detailed data these calculations could not be separated to include reporting of cross boundary road transport under Scope 3.

Due to lack of more detailed data, petrol and diesel used for off-road transport (e.g. farming machineries), recreational maritime navigation and for stationary energy (e.g. diesel generators) are included in the fuel data and emissions reported for road transport.

Table 26 Summary of Transportation Emissions by Source 2015/16 - Ōpōtiki District

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Transportation	Road	48,370	48,370	100%

7.6 Waste Emissions

In 2015/16 emissions associated to waste contributed 8,948 tCO₂e, representing 3.5% of Ōpōtiki's overall gross emissions. Waste emissions are dominated by solid waste disposal contributing approximately 62.4% to Ōpōtiki's overall waste emissions during 2015/16, with waste water contributing 37.6%.

The combustion of landfill gas (LFG) was estimated to generate approximately 139 tCO₂, which are reported outside the total emissions, as part of the biogenic emissions.

Table 27 Summary of Waste Emissions by Source 2015/16 - Ōpōtiki District

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Waste	Solid Waste Disposal	5,588	8,948	62.4%
	Waste Water	3,360		37.6%

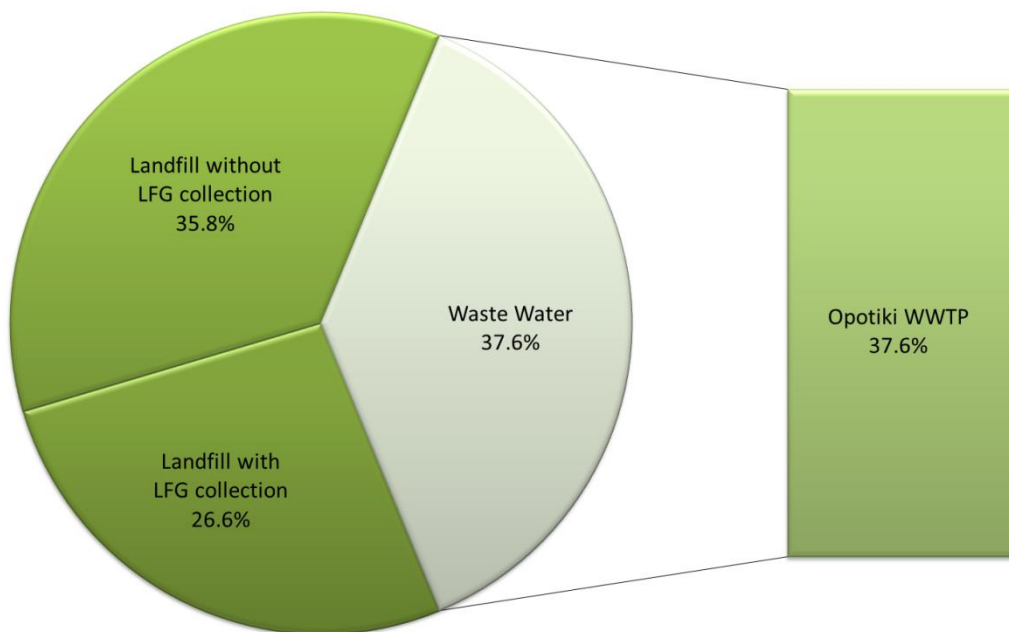


Figure 27 Summary of Waste Emissions by Source 2015/16 – Ōpōtiki District

7.6.1 Solid Waste Details

Municipal solid waste generated within Ōpōtiki District in 2015/16 was mostly disposed of at the Tirohia Landfill (Scope 1), which opened in 2001 and recovers landfill gas. Historically, municipal solid waste was disposed of at a number of smaller landfills (Scope 1), which all closed prior to 2001.

Details of the Landfill Gas (LFG) collection and efficiency were unable to be obtained during the data collection therefore the NZ average was used, as reported by the Ministry for Environment (MfE) 2017. The calculations assume all waste sent to landfill prior to 2001 was sent to landfill without LFG collection systems.

7.6.2 Waste Water Details

Waste water in the Ōpōtiki District is treated through a large scale Imhoff septic tank system. No information was available for the number of septic tank users in the Ōpōtiki district, and this was assumed to be insignificant, reflecting the small population.

The BOD loading of the incoming waste water was not available. The emissions were estimated using the national average BOD of 26 kg/person/year, as outlined in the National Inventory Report (MfE 2017).

7.7 Industrial Emissions

In 2015/16 industrial GHG emissions contributed 2,775 tCO₂e (1.1%) towards Ōpōtiki's overall gross emissions. The emissions for industrial product use include emissions from hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) (Scope 1). Nitrogen trifluoride emissions do not occur in New Zealand, and therefore are not included in this report.

Emissions from industrial product use were estimated based on New Zealand's average emissions per capita and Ōpōtiki's population.

No emissions from industrial processes have been estimated, due to a lack of specific data. Any potential emissions are assumed to be insignificant within the Ōpōtiki District Council boundary, given the small amount of heavy industry operating in Ōpōtiki. Energy used in industrial processes is included in the stationary energy sector.

7.8 Agricultural Emissions

In 2015/16 agricultural GHG emissions contributed 186,757 tCO₂e (77.6%) towards Ōpōtiki's overall gross emissions.

Dairy and beef farming is responsible for the majority of the agricultural emissions, contributing 94% of Ōpōtiki's agricultural emissions.

Methane (CH₄) is the most significant emission source (71.5%), predominantly from enteric fermentation of farmed animals (e.g. cows and sheep). Nitrous oxide (N₂O) emissions from farming of animals, manure management and agricultural soils contributed approximately 28.5% of emissions in 2015/16.

7.9 Forest Carbon Sequestration and Emissions

The overall emissions from Land use, land use change and forestry (LULUCF) activities in Ōpōtiki District are 1,798,724 t CO₂e.

Indigenous and exotic forests sequester an estimated -580,847 tCO₂e. The majority of carbon is sequestered by exotic forest plantations (86.5%), while still maturing native forests (e.g. manuka and kanuka forest stocks) sequestered the remaining 13.4%.

Harvesting related emissions were estimated based on harvesting volumes reported by Statistics New Zealand and Ministry for Primary Industries (MPI) National Exotic Forest Description (NEFD) data for 2015 and 2016, and resulted in 2,379,571 t CO₂e²⁹ of emissions. This is largely due to the harvest cycle of the exotic forest plantations within the District, highlighting the large impact of forest harvesting under the selected methodology.

The total area of exotic forest reported for the Opoitiki District has decreased over the last 10 years, resulting in high emissions associated with harvesting activities.

This demonstrates the potential short-term impact of deforestation and harvesting activities on the districts carbon footprint. However, assuming the total forest area remains stable from now on, the overall carbon balance of the forestry sector is expected to be relatively neutral over a 50-100 year period³⁰;

²⁹ Due to the accounting method chosen for this report, all carbon stored in harvested trees, including in the wood products removed, below ground and in residues left on site, is assumed to result in emissions in the harvesting year.

³⁰ See Section 1.3.

8.0 Kawerau District Community Carbon Footprint

8.1 Key Messages

- During the 2016/17 reporting period, Kawerau District emitted 135,016 tCO₂e gross emissions, approximately 3% of the overall Region's gross emissions;
- The average per capita gross emissions for the Kawerau District are 19.9 tCO₂e/person. The national average is 17.8 tCO₂e/person and the average for the region is 13.9 tCO₂e/person. Emissions industrial stationary energy consumption are largely responsible for the difference;
- Kawerau District has lower than national average per capita gross emissions for Transport, Waste, Industry and Agriculture;
- Kawerau District's stationary energy emissions on a per capita basis are above the national average gross emissions;
- Around 54.7% of Kawerau's gross emissions are from electricity consumption. Of that approximately 80.0% is attributed to a small number of large industrial users;
- Kawerau District generates approximately twice the amount of electricity than it uses, predominantly from geothermal sources. Emissions from electricity use are however estimated using the national average emissions factor for electricity generation, a methodological requirement;
- There is very limited farm land in Kawerau District and no specific data was available from Statistics New Zealand (this was classed as confidential). However it is assumed that agricultural emissions are likely to be insignificant within Kawerau, and the District's per capita agricultural emissions are expected to be below the New Zealand national average;
- Forestry emissions are significantly driven by the amount of harvesting that takes place in any given year. In the 2016/17 reporting period the MPI reported 54ha of exotic forests within the district³¹. Forestry-related activities result emissions of 3,291 tCO₂e, bringing the net emissions for the District to 138,307 tCO₂e. The overall carbon balance of the forestry sector is expected to be relatively neutral over a 50-100 year period³².

8.2 Overall Results

In 2015/16, the Kawerau District generated estimated gross emissions of 135,016 tCO₂e and net emissions of 138,307 tCO₂e (including forestry). The district's population in 2015/16 was understood to be approximately 6,800 people, resulting in per capita gross emissions of 19.9 tCO₂e/person and per capita net emissions of 20.3 tCO₂e/person.

Stationary energy represents the largest emissions sector for Kawerau District, contributing 87.6% to the overall emissions for the district. The majority of the stationary energy emissions result from electricity consumed by industrial users, which contributes 43.9% of the District's total emissions, and natural gas consumption, which contributes 26.9%.

Transportation emissions represent the second largest emissions sector for Kawerau District, contributing 7.9% to the overall emissions for the city. Transportation emissions are predominantly a result of petrol and diesel consumed for road transport.

³¹ No district level harvest values are available. Harvest values have been estimated based on the total regional harvest volume and the districts share of forests within a harvestable age (>25 years).

³² See Section 1.3.

Table 28 Summary of Overall Results by Source 2015/16 – Kawerau District

Sector/Category Source		Emissions (tCO ₂ e)		% Gross Emissions Contribution
Stationary Energy	Electricity City Supply	14,701	118,331	87.6%
	Electricity T&D Loss City Supply	1,434		
	Electricity Industrial Users	59,210		
	Electricity T&D Loss Ind. Users	5,776		
	Natural Gas	36,258		
	Natural Gas T&D Loss	57		
	LPG	461		
	Coal	434		
	Biofuel use	0		
Transportation	Petrol	4,326	10,729	7.9%
	Diesel	6,112		
	Rail Emissions	223		
	LPG	69		
Waste	Solid Waste Disposal	3,796	3,816	2.8%
	Waste Water	20		
IPPU (Industry)		2,140		1.6%
Agriculture		-		-
Total gross emissions (excl. forestry)		135,016		
Forestry	Exotic Forest Sequestration	-2,107	3,291	Not included in gross emissions
	Native Forest Sequestration	-1,087		
	Total Harvest Emissions	6,485		
Total net emissions (incl. forestry)		138,307		

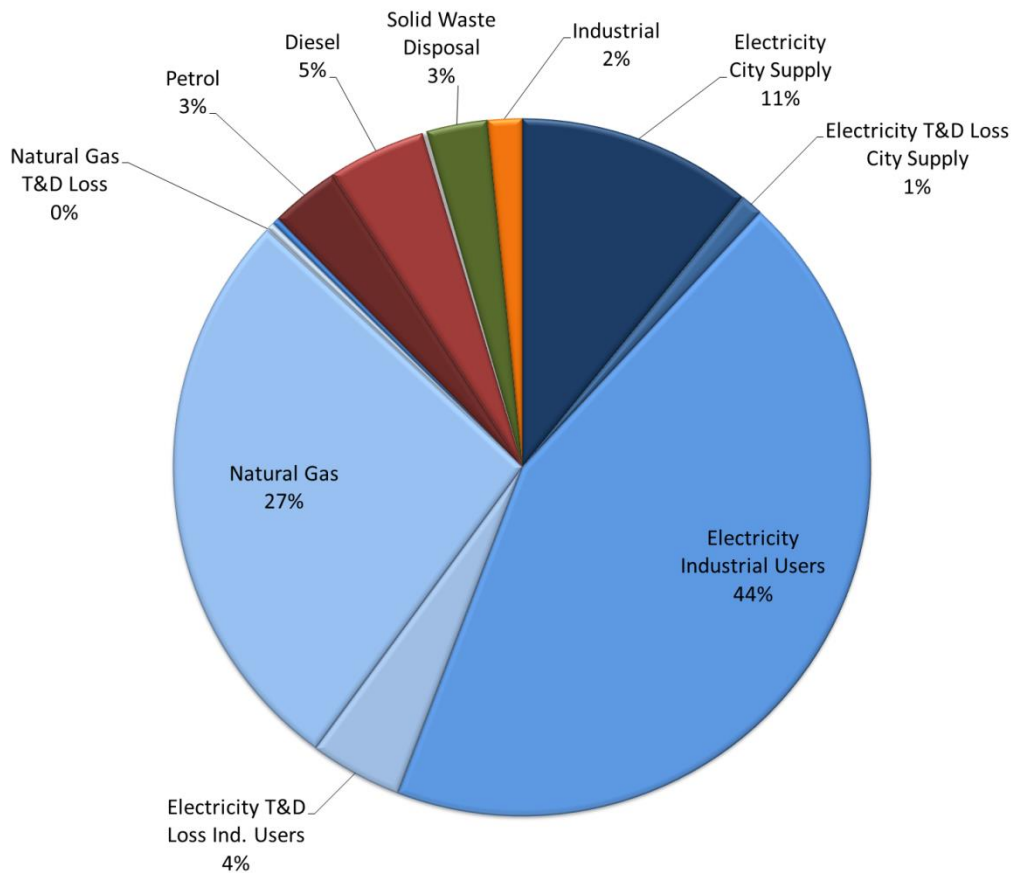


Table 29 Summary of Gross Emission by Source 2015/16 - Kawerau District

8.3 Biogenic Emissions

CO₂ emissions from biogenic sources are not included in the overall emissions results and are reported outside of the total greenhouse gas emissions. Kawerau District generated approximately 40 tCO₂ from biogenic sources (i.e. from combustion of firewood and flaring of landfill gas).

8.4 Stationary Energy Emissions

Stationary energy use within Kawerau District generated an estimated 118,331 tCO₂e in 2015/16 representing 87.6% of gross emissions. Stationary energy was the largest emissions contributor to Kawerau District gross GHG emissions.

The main source of emissions from stationary energy is electricity consumption (Scope 2) contributing approximately 62.5%, with a further 6.1% from electricity transmission and distribution (T&D) losses. Approximately 80% of the electricity consumed in the district is used for industrial purposes; 4.7% of the emissions are attributed to commercial users including public health and safety and 3.9% is attributed to residential use. A detailed breakdown of the stationary energy emission sources is provided in the table and chart below.

The Kawerau District generates more electricity from geothermal generation than is consumed within the district. However, any electricity generated within the district is fed into the national grid. As a result the national average emissions factor for electricity generation has been applied, based on the GPC framework requirements.

Table 30 Summary of Stationary Energy Emissions by Source 2015/16 - Kawerau District

Sector/Category Source		Emissions (tCO ₂ e)	Sector Percentage Contribution
Stationary Energy	Electricity City Supply	14,701	12.4%
	Electricity T&D Loss City Supply	1,434	1.2%
	Electricity Industrial Users	59,210	50.0%
	Electricity T&D Loss Industrial Users	5,776	4.9%
	Natural Gas	36,258	30.6%
	Natural Gas T&D Loss	57	0.05%
	LPG	461	0.4%
	Coal	434	0.4%
	Biofuel	0	0.0%
		118,331	

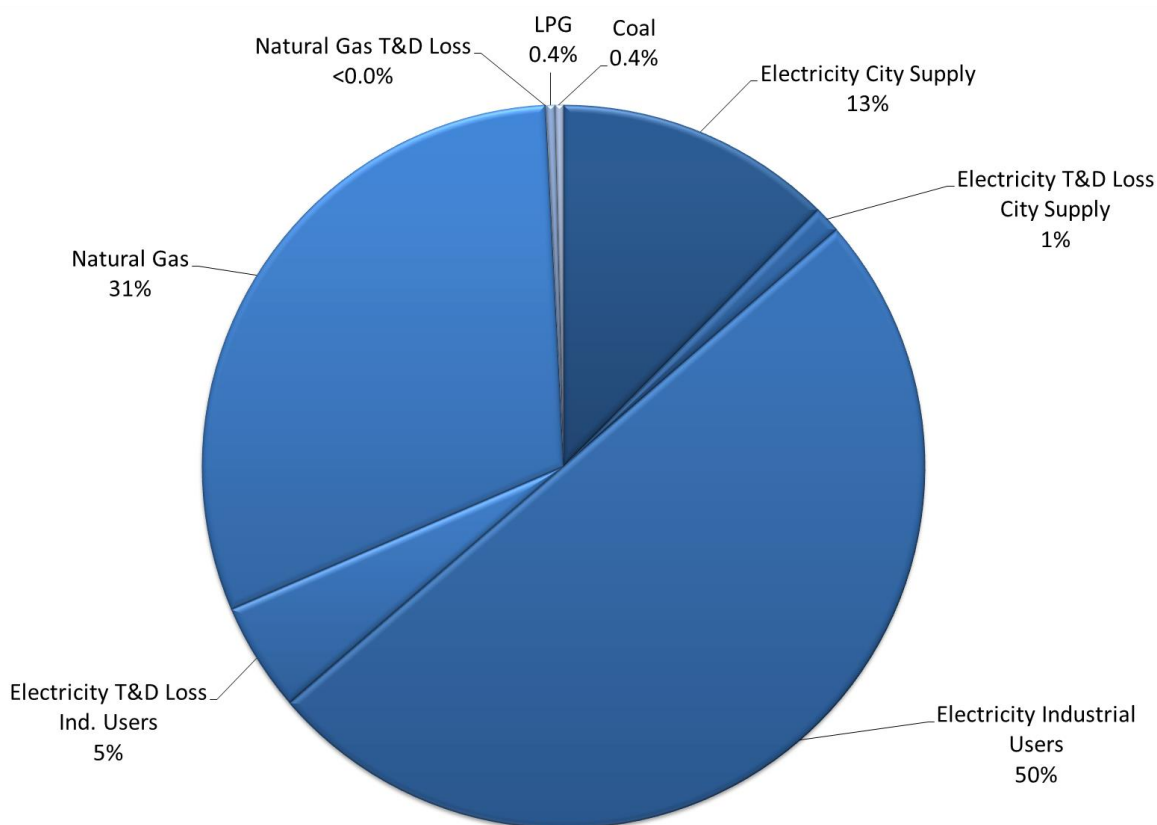


Figure 28 Summary of Stationary Energy Emissions by Source 2015/16 - Kawerau District

8.5 Transportation Emissions

In 2015/16 transportation sources contributed 10,729 tCO₂e, representing 7.9% of Kawerau District's overall gross emissions. Transportation was the second highest sector contributor to Kawerau District GHG emissions.

The emissions profile for transportation sources is dominated by road transport³³ (predominantly Scope 1) contributing approximately 97.9% of the transportation emissions. Petrol use is responsible for 40.3% of the transport emissions. Diesel contributes 57.0% while LPG contributes approximately 0.6% of the transport emissions. Due to lack of more detailed data these calculations could not be separated to include reporting of cross boundary road transport under Scope 3.

The remainder of the emissions generated in the transportation sector included rail electricity and rail diesel at 2.1%.

Table 31 Summary of Transportation Emissions by Source 2015/16 - Kawerau District

Sector/Category Source		Emissions (CO ₂ e)		Sector Percentage Contribution
Transportation	Road	10,506	10,729	97.9%
	Rail	223		2.1%

8.6 Waste Emissions

In 2015/16 emissions associated to waste contributed 3,816 tCO₂e, representing 2.8% of Kawerau District's overall gross emissions. Waste emissions are dominated by solid waste.

The combustion of landfill gas (LFG) was estimated to generate approximately 40 tCO₂, which are reported outside the total emissions, as part of the biogenic emissions.

Table 32 Summary of Waste Emissions by Source 2015/16 - Kawerau District

Sector/Category Source		Emissions (tCO ₂ e)		Sector Percentage Contribution
Waste	Solid Waste Disposal	3,796	3,816	99.5%
	Waste Water	20		0.5%

³³ Due to lack of more detailed data, petrol and diesel used for off-road transport (e.g. farming machineries), recreational maritime navigation and for stationary energy (e.g. diesel generators) are included in the fuel data and emissions reported for road transport.

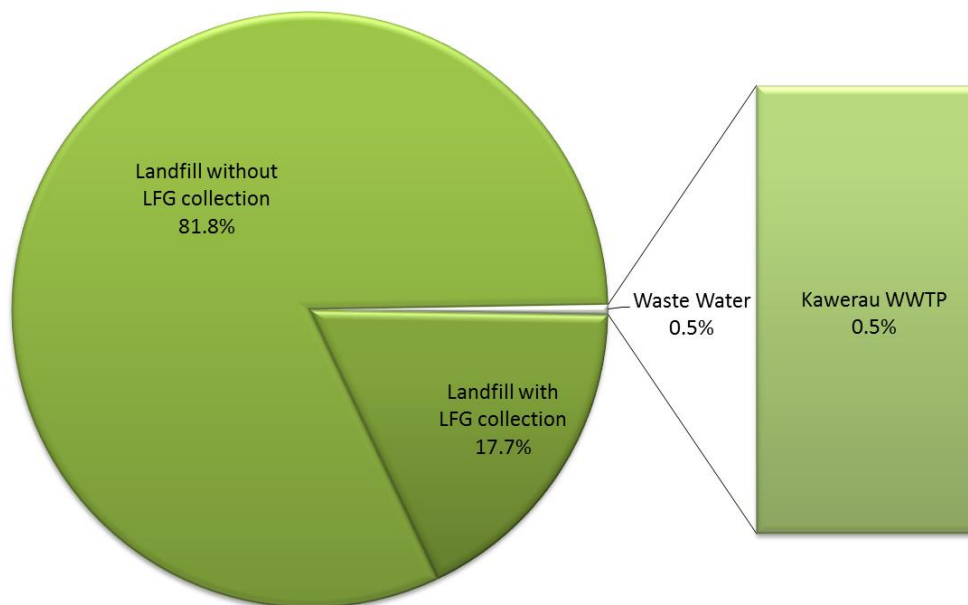


Figure 29 Summary of Waste GHG Emissions 2015/16 - Kawerau

8.6.1 Solid Waste Details

Municipal solid waste generated within Kawerau in 2015/16 was disposed of at the Tirohia Landfill (Scope 1), which recovers landfill gas for electricity generation. Historically, municipal solid waste was disposed of at two local landfills (Scope 1) which closed in 1980 and 2006 respectively.

Details of Landfill Gas (LFG) collection and efficiency were unable to be obtained during the data collection therefore the NZ average was used, as reported by the Ministry for Environment (MfE) 2017. The calculations assume all waste sent to landfill prior to 2006 was sent to landfill without LFG collection systems.

8.6.2 Waste Water Details

Waste water in Kawerau is treated by a rapid infiltration basin. This system is considered to result in very low emissions. No individual rural septic tanks were reported by the district.

As a result Kawerau has the lowest emissions from waste water treatment compared to any of the other districts within the Bay of Plenty Region.

8.7 Industrial Emissions

In 2015/16 industrial GHG emissions contributed 2,140 tCO₂e (1.6%) towards Kawerau District's overall gross emissions. The emissions for industrial product use include emissions from hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) (Scope 1). Nitrogen trifluoride emissions do not occur in New Zealand, and therefore are not included in this report.

Emissions from industrial product use were estimated based on New Zealand's average emissions per capita and Kawerau's population.

No emissions from industrial processes have been estimated, due to a lack of specific data. Any potential emissions are assumed to be insignificant within the Kawerau District Council boundary, given the small amount of heavy industry operating in the District. Energy used in industrial processes is included in the stationary energy sector.

8.8 Agricultural Emissions

In 2015/16, no available agricultural information could be obtained for Kawerau District as it was marked as confidential by Statistics New Zealand. However, based on the small area of rural land within the district it was assumed that agricultural emissions are likely to be insignificant for Kawerau.

8.9 Forest Carbon Sequestration and Emissions

The overall emissions from Land use, land use change and forestry (LULUCF) activities in Kawerau District Community are 3,291 tCO₂e.

MPI (2016 and 2017) reported 54 ha of exotic forest plantations. Further, the LCDB4 database indicates 368 ha of maturing indigenous forests. Together these forests sequester an estimated - 3,194 tCO₂e. The majority of carbon is sequestered by exotic forest plantations (66.0%), while still maturing native forests (e.g. manuka and kanuka forest stocks) sequestered the remaining 34%.

Harvesting related emissions were estimated based on regional harvesting volumes reported by Statistics New Zealand and Ministry for Primary Industries (MPI) National Exotic Forest Description (NEFD) data for 2016 and 2017. These have been allocated to each district based on the area of exotic forests in a harvestable age (i.e. >25years). Harvesting related emissions for the Kawerau District are estimated to result in 6,485 t CO₂e³⁴ of emissions.

³⁴ Due to the accounting method chosen for this report, all carbon stored in harvested trees, including in the wood products removed, below ground and in residues left on site, is assumed to result in emissions in the harvesting year.

9.0 Data Information

9.1 Data Sources

Data for the community carbon footprint was collected from a number of data sources. Key data sources are detailed below:

Table 33 Bay of Plenty GHG Inventory Data Sources – 2015/16

Emissions Category		Data Source
Stationary Energy		First Gas Limited Transpower Electricity Authority Horizon Networks Unison PowerCo Individual City and District Councils Internal LPG Association NZ MBIE (2015) Energy in NZ, Section K MfE (2015) National Greenhouse Gas Inventory Report
Transportation		Air travel movements (FlightAware.com) Air BP Kiwi Rail LPG Association NZ Port of Tauranga Tauranga Airport RightShip Individual City and District Councils Internal Ministry of Business, Innovation & Employment (fuel properties)
Waste	Solid Waste	Waste Management Envirowaste Revital Fertilisers Individual City and District Councils Internal
	Waste Water	Individual City and District Councils Internal
Industrial		MfE (2016) 1990-2014 National Greenhouse Gas Inventory Report
Agriculture		MfE (2016) 1990-2014 National Greenhouse Gas Inventory Report Statistics New Zealand (Agricultural production data)
Forestry		MPI (2015, 2016) National Exotic Forest Description Statistics New Zealand

9.2 Data limitations

A data gap analysis was undertaken during the data collection stage of the project. A number of data gaps were identified during that process. Table 34 below indicates the alternative data sources used to overcome these data limitations. In most cases this resulted in substituting unavailable local data with national or regional data set on a per capita basis.

Please note that emissions from international shipping have been excluded from the total emissions reported here, as there is insufficient data to calculate these emissions accurately and to allocate these to the relevant districts or the wider North Island. Emissions from international shipping are likely to be significant and should be included in future inventories. Emissions associated with the operation of the Port of Tauranga are included as part of the stationary energy and transport emissions.

Emissions from agricultural activities in the Kawerau District have also been excluded, due to lack of available data for the district. These emissions are however assumed to be negligible.

A more detailed description of the assumptions and limitations associated with the carbon footprint calculations is provided in Appendix A– Assumptions, Limitations, Exclusions and Data Issues.

Table 34 Bay of Plenty GHG Inventory Data Gaps – 2015/16

Emissions Category		Data Gap/Data limitations	Alternative Data Source
Stationary Energy		<ul style="list-style-type: none"> - District specific biofuel (wood) consumption data - District specific coal consumption data 	<ul style="list-style-type: none"> - No alternative data source (assumed to be included in total forest harvest emissions) - National average (on per capita basis)
Transportation		<ul style="list-style-type: none"> - Public Buses - Airport fuel sales - Port fuel sales data - Off-road fuel use - Maritime fuel use 	<ul style="list-style-type: none"> - Assumed to be included in total fuel sales data - Estimated based on flight movements - No alternative data source identified (not included in footprint) - Assumed to be included in total petrol and diesel sales data for the region/districts - Assumed to be included in the total diesel sales data for the region/districts
Waste	Solid Waste	<ul style="list-style-type: none"> - Landfill gas collection efficiency for Tirohia, Hampton Down and Rotorua Landfills - Historic waste volumes 	<ul style="list-style-type: none"> - National average collection efficiency (Rotorua landfills assumes no collection due to an inefficient combustion system) - Assume national average waste generation per person (as outlined in the national GHG inventory by MfE)
	Waste Water	<ul style="list-style-type: none"> - Number of private septic tanks for some districts - BOD loading of receiving waste water - Total N in treated waste water discharged into aquatic systems 	<ul style="list-style-type: none"> - Assume the difference between people reported to known treatment systems and total district population are using private septic tanks - Assume national average BOD/person/year - Estimated total N in waste water effluent based on national average protein consumption per person per year (IPCC 2006 Waste Water Treatment equation 6.8)
Industrial		<ul style="list-style-type: none"> - Significant industrial (physical & chemical) process activity resulting in GHG emissions - Industrial product use (e.g. asthma inhaler, aerosols, etc.) 	<ul style="list-style-type: none"> - No sources identified – assumed not to be relevant or significant - Emissions were estimated based on national emissions data on a per capita basis
Agriculture		<ul style="list-style-type: none"> - District specific agricultural production data for reporting period. 	<ul style="list-style-type: none"> - Estimates based on NZ 2012, 2007 and 2002 Agricultural Census data
Forestry		<ul style="list-style-type: none"> - District specific forest harvest figures. 	<ul style="list-style-type: none"> - Estimate based on standing forest volume in harvesting age and regional harvest data

10.0 Limitations

AECOM New Zealand Limited (AECOM) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of the Bay of Plenty Regional Council, Tauranga City Council, Western Bay of Plenty District Council, Rotorua Lakes District Council, Whakatāne District Council, Ōpōtiki District Council, the Kawerau District Council and only those third parties who have been authorised in writing by AECOM to rely on this Report.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this Report.

It is prepared in accordance with the scope of work and for the purpose outlined in the contract dated 24 May 2017, titled Scope of Works – Bay of Plenty Region Carbon Footprint.

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It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the information.

11.0 References

FOA 2014	Forest Ownership Association, Facts & Figures, 2014 http://www.nzplantedforests.org/topics/climate-change
MBIE 2017a	Ministry for Business, Innovation and Employment (2017) http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/publications/energy-in-new-zealand
MBIE 2017b	Ministry for Business, Innovation and Employment (2017) http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/statistics/electricity
MfE 2017	Ministry for the Environment (2017), New Zealand Greenhouse Gas Emissions 1990 - 2015
MfE 2016	Ministry for the Environment (2016), Guidance for voluntary greenhouse gas reporting - 2016: Data and methods for the 2014 calendar year
MPI, 2015	Ministry for Primary Industries (2015), National Exotic Forest Description as at 1 April 2015
MPI, 2016	Ministry for Primary Industries (2016), National Exotic Forest Description as at 1 April 2016
StatsNZ 2017	Statistics New Zealand, Census 2013 - Quick Stats about Tauranga City (2017) http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-about-a-place.aspx?request_value=13878&tabname=&sc_device=pdf
StatsNZ 2016a	Agricultural Production Census (Final Results): Summary of Livestock Numbers by Type and Territorial Authority 2012, 2007 & 2002
StatsNZ 2016b	Agricultural Production Statistics: June 2016
StatsNZ 2016c	Total Regional Harvest Volume for 2015 and 2016
WRI 2015	World Resources Institute (2015), <i>Global Protocol for Community-Scale Greenhouse Gas Emissions (GPC)</i> , World Resources Institute
WRI 2014	World Resources Institute (2014), Infographic: The Global Carbon Budget, World Resources Institute http://www.wri.org/resources/data-visualizations/infographic-global-carbon-budget

Appendix A

Assumptions,
Limitations, Exclusions
and Data Issues

Appendix A Assumptions, Limitations, Exclusions and Data Issues

Sector/Category	Assumptions and Exclusions
Stationary Energy Emissions	
Residential, commercial and industrial stationary energy emissions	<ul style="list-style-type: none"> - Coal and biomass related emissions have been estimated using a top down approach, applying the national average consumption for commercial, primary industry (agriculture, forestry and fisheries) and residential coal use, estimated based on population figures. - Coal consumption from agricultural, forestry and fishery activities have been included under industrial coal consumption. - It was assumed that there is no heavy industry within the Region using coal for stationary energy consumption. - Emission per user group (i.e. residential, commercial and industrial) was estimated based on national average energy use split between these groups as reported by MBIE (2017a). Consumption of natural gas and electricity data are based on the total energy distributed to grid exit points within the Region during the reporting period. The energy provided to these grid exit points (GXPs) has then been allocated to districts that they are located in. This may in some instances mean that the energy used outside of a district has been counted as part of its footprint.
Electricity Generation	<ul style="list-style-type: none"> - National emission factor for electricity generation was estimated based on data published by MBIE in their quarterly electricity and liquid fuel emissions table (MBIE 2017b). - It is understood from the Electricity Authority Generating Station List, September 2012 that electricity is generated in each of the districts with the exception of Ōpōtiki District - The majority of the electricity generated within the Region is from renewable sources such as hydro, geothermal and wood waste co-generation plants. - Based on the 2012 electricity authority data for existing generation stations approximately 15% electricity within the Region is generated from thermal and co-generation plants using gas and wood waste as fuel. Approximately 85% electricity generated within the Region is produced from hydro and geothermal plants. - All generated electricity is fed into the national grid. As such the national emissions factor has been used as there is no guarantee that local generation will be used locally. - Over the 2015-16 reporting period the BoP Region generated almost as much electricity (95%) as it consumed.
Electricity Consumption	<ul style="list-style-type: none"> - GXPs within the Bay of Plenty and each of the individual districts have been allocated based on the Transpower Transmission Network as of July 2014 overlain by the individual district boundaries. - The electricity consumption data to the Western Bay of Plenty and Tauranga City is based on the total energy distributed to GXPs from the PowerCo network. The Western Bay of Plenty is represented by data from GXP: TMI0331. Tauranga City is represented by data from GXPs: MTM0331, TGA0111, TGA0331 and KMO0331. - The electricity consumption figure used for Tauranga is understood to be slightly conservative, as the total energy distributed to the GXPs also includes supply to Te Puke, Katikati and some surrounding rural areas in the Western Bay of Plenty. In addition, the electricity consumption figure for the Western Bay of Plenty may be slightly underestimated due to the supply distribution, as stated for Tauranga City. However, it is

Sector/Category	Assumptions and Exclusions
	<p>understood that the population in these areas is relatively small and therefore the impact to the energy consumption to both Tauranga and the Western Bay of Plenty is not likely to be significant.</p> <ul style="list-style-type: none"> - The electricity consumption data to Kawerau, Whakatane and Ōpōtiki is based on the total energy distributed to GXPs from the Horizon Networks network. Kawerau is represented by data from GXP: KAW0111. Whakatane is represented by data from GXP: EDG0331. Ōpōtiki is represented by data from GXPs: TKH0111 and WAI0111. - The electricity consumption data to Rotorua is based on the total energy distributed to GXPs from the Unison Networks Limited network. The electricity data provided by Unison had been obtained from the Electricity Authority. Rotorua is represented by data from GXPs: OWH0111, ROT0111, ROT0331, ROT1101 and TRK0111. - The electricity consumption data for Rotorua are likely to be conservative as the electricity distribution network does not follow regional boundaries and Rotorua district is divided between the Bay of Plenty and Waikato Region's. - The electricity consumption data for the overall Region is based on the total energy distributed to each of the individual districts rather than the data provided by Transpower. - The electricity distribution network does not follow regional or district boundaries and may include some of the surrounding rural areas. However, it is assumed that the population in these areas is relatively small and therefore the impact to the energy consumption to both the Region and the individual districts is not likely to be significant.
LPG	<ul style="list-style-type: none"> - LPG consumption in the Bay of Plenty is based on the total amount of LPG supplied to the North Island and calculated on a per capita basis using 2016 population estimates. - LPG stationary energy estimates are based on the national share of 9kg and 45kg gas bottle, and bulk sales as outlined in New Zealand's GHG Inventory 1990-2015. - LPG consumption estimates do not take into account 9kg and 45kg gas bottle sales in the Region and the individual districts that may then be taken out of the Region or individual district boundaries.
Natural Gas	<ul style="list-style-type: none"> - Natural gas consumption is based on total gas distributed to GXPs within the Bay of Plenty and each of the individual districts, as supplied by First Gas. - The natural gas distribution network does not follow regional or district boundaries and may include some of the surrounding rural areas. However, it is assumed that the population in these areas is relatively small and therefore the impact to the energy consumption to both the Region and the individual districts is not likely to be significant. - Assumes emissions of 6.36 kgCO₂e/GJ during distribution based on the national average reported for distribution loss of reticulated natural gas (MfE 2016 - voluntary GHG reporting guidelines).
Industrial Emissions	<ul style="list-style-type: none"> - Emissions from industrial consumption of coal, natural gas and electricity have been estimated within the respective emission categories.
Fugitive Emissions	<ul style="list-style-type: none"> - Not included in the Inventory as there is no production of oil or gas within the Bay of Plenty.
Coal	<ul style="list-style-type: none"> - Emissions relating to the use of coal from residential, commercial, as well as from agriculture, forestry and fishery activities have been included in the stationary energy calculations for each of the districts, except for Tauranga City. It was assumed that emissions from coal use by agricultural, forestry and fisheries would be insignificant for

Sector/Category	Assumptions and Exclusions
	<p>Tauranga.</p> <ul style="list-style-type: none"> - Kawerau is recognised as a city district, with limited forestry (i.e. afforestation and harvesting). However the district has a number of large forest product processing plants. As a result national average coal consumption for the 'agriculture, forestry and fisheries' category has been included as part of the stationary industrial emissions calculations.
Transportation Emissions	
Road	<ul style="list-style-type: none"> - Total volume of fuel sold within the Bay of Plenty Region was provided by Rotorua Lakes Council, this includes fuel sold in the district of Taupo. - Fuel volumes were allocated to each district based on their share of the vehicle kilometre travelled (VKT) within the region, e.g. Tauranga City has a 31.2% share of all VKTs travelled within the Bay of Plenty Region and was allocated 31.2% of the regional fuel sales volumes. The VKT data was supplied by NZTA. This approach follows the same methodology selected for 'Wellington City and Regional GHG inventories' (AECOM 2014). - It was assumed that the fuel consumption figures (petrol diesel) also include fuel used for off-road transport, stationary diesel use (i.e. for generators) and recreational water transport, as these are sold through the same network. Due to lack of data these could not be separated.
Rail	<ul style="list-style-type: none"> - Emissions from rail transport are estimated are based on length of rail network and average fuel consumption per tonne km and freight volume as provided by Kiwi Rail for the 2015/16 financial year. - The rail network in the Bay of Plenty is Diesel only. The emissions factor may therefore slightly underestimate the rail related emissions, as the national average emissions factor also includes electrified rail. - We were unable to confirm whether Diesel sold for rail transport is already included in the Bay of Plenty fuel sales data for road transport. It was assumed that this was not the case and that the diesel was supplied directly to KiwiRail through a national contract. - Rail diesel use is estimated based on the average fuel consumption per tkm travelled within the Region. Due to lack of more detailed data it is not possible to estimate what portion of the rail related diesel use was purchased in- or outside the region.
Aviation	<ul style="list-style-type: none"> - Aviation fuel data sold/pumped at Tauranga, Whakatāne and Rotorua Airport could not be obtained during the data collection. - Aviation emissions, from Jet Kerosene, have been estimated using the average number of Air New Zealand movements understood to take place via the FlightAware.com website over a one week period. The number of flights estimates is likely to be conservative as it only includes Air NZ movements. It is understood that other aircrafts operating from Tauranga and Rotorua Airport are also using JetA1 fuel. These have not been estimated and are considered to be insignificant. - Aircraft operating from Whakatane Airport are assumed to use AviagionGas (AvGas) and have been estimated based on the number of Chatham Air flights departing and arriving at Whakatane Airport. - Emissions from the Tauranga Airport, Whakatāne Airport and the Rotorua Airport have been allocated to the district/city where the airports are located. However, each of these airports is likely to service people beyond their local territorial boundaries. No data was available to allocate aviation related emissions to any of the other districts within the Region. - Emissions from aircrafts operating from smaller airfields across the Bay of Plenty have not been estimated.

Sector/Category	Assumptions and Exclusions
	<ul style="list-style-type: none"> - The estimated aviation emissions represent 50% of aviation related emissions associated with Air NZ movements at Tauranga and Rotorua Airport, in line with the GPC framework. - Aviation gas fuel consumption for smaller aircraft and helicopters were estimates based on conversation with aviation fuel experts.
International Marine Transport	<ul style="list-style-type: none"> - No bunker fuel data was obtained from The Port of Tauranga during the inventory data collection. - Emissions from international marine transport have not been included in the inventory due to the assumptions and limitations in the available data. - A high level estimate of the potential emission from shipping indicates that these are likely to be significant for the Region. - This represents a potentially significant data gap and we recommend investigating the likely emissions from shipping further.
LPG	<ul style="list-style-type: none"> - LPG consumption in the Bay of Plenty is based on the total amount of LPG supplied to the North Island and calculated on a per capita basis using 2016 population estimates. - LPG transportation energy estimates are based on the national share of automotive and forklift sales as outlined in New Zealand's GHG Inventory 1990-2015. - LPG consumption estimates, does not take into account automotive and forklift sales in the Region that may then be taken out of the Region or individual district boundaries.
Off-Road	<ul style="list-style-type: none"> - Off-road fuel consumption is assumed to be included in the data reported for road transport. Due to lack of specific data these could not be reported separately.
Waste Emissions	
Solid Waste Disposal	<ul style="list-style-type: none"> - Solid waste emissions were estimated using a 1st-order decay model (which requires waste volume estimates for the last 50 years). - Data gaps in reported waste volumes sent to landfill were estimated by applying the New Zealand national average waste generation per capita (reported by MfE, 2017) and using historic population figures reported by StatsNZ. - The estimated amount of solid waste sent to landfill for Kawerau has provided by the District Council. This figure has been used rather than the New Zealand national average waste generation per capita. Using the national average per capita waste generation would lead to an increase of 1,677 t CO₂e from solid waste disposal (a 30% increase). - Historical population figures were only available for census years (i.e. every 5 years). In-between years were interpolated to generate continuous data sets. - Landfill gas emissions were estimated for landfills with and without landfill gas capturing systems. - The amount of landfill gas captured at the Hampton Downs and Tirohia landfills could not be confirmed due to the information being commercial sensitive. Therefore it has been assumed that both landfills capture landfill gas from 100% of their landfills. The collection efficiency was assumed to be similar to the national average of 68% as indicated in the national inventory (MfE, 2017). - It is understood that Rotorua Landfill does capture some landfill gas that is combusted through an enclosed flare. However, the system does not run continuously and does not always reach high enough temperatures for full destruction. Emission estimates for the Rotorua landfill therefore assume that no landfill is recovered. - Data on specific waste composition (SWAP) for Tauranga City and the

Sector/Category	Assumptions and Exclusions
	<p>Western Bay of Plenty were available for 2010, 2013 and 2016 In-between years have been interpolated. Waste composition for waste sent to landfill before 2010 was modelled based on the national average waste composition reported by MfE (2017).</p> <ul style="list-style-type: none"> - Data on SWAP for Rotorua were available for 2009 and 2017 In-between years have been interpolated. Waste composition for waste sent to landfill before 2009 was modelled based on the national average waste composition reported by MfE (2017). - Data on SWAP for Whakatane, Ōpōtiki and Kawerau was modelled based on the national average waste composition reported by MfE (2017).
Biological Treatment	<ul style="list-style-type: none"> - Emissions from biological treatment have been estimated for the Tauranga City Revital Composting facility. - CO₂ emissions from the composting facility are considered to be biogenic, i.e. not contributing any net emissions. - No other biogenic emissions from composting activities within the Bay have been estimated due to lack of data.
Incineration	<ul style="list-style-type: none"> - Emissions from waste incineration have not been included, as only small quantities of clinical and hazardous waste is incinerated in New Zealand. Emissions from these sources are assumed to be insignificant³⁵.
Waste Water Treatment	<ul style="list-style-type: none"> - Emissions from waste water treatments are based on treatment methods employed by waste water treatment plants. - Sludge removed from waste water treatment plants was understood to be sent to Landfill, spread onto land or sent to composting facilities. It was assumed that the sludge was largely inert, not resulting in additional emissions. No additional calculations for sludge treatment processes were included.
Sceptic Tank Use	<ul style="list-style-type: none"> - Due to a lack of specific data it has been assumed that all dwellings in Ōpōtiki are connected to the reticulated waste water treatment system and that no dwellings have septic tanks. It is assumed the number of septic tanks in the Ōpōtiki District is likely to be insignificant. - It has been estimated that 7,197 people are connected to septic tanks in the Whakatane District. - It is understood from the Western Bay of Plenty District Council as of May 2017 there were 14,439 properties that are not connected to the Council's reticulated waste water treatment system. From information regarding the number of connections to each waste water treatment plant in the district, it has been estimated that 18,888 people are connected to septic tanks in the Western Bay of Plenty. - It has been estimated that 4,600 people are connected to septic tanks in the Rotorua district, as part of the Bay of Plenty Region. - It is understood that all dwellings in Kawerau District are connected to the reticulated waste water treatment system. - It is understood from Tauranga City Council that there are 1,891 active septic tanks within the city boundary. - The 2013 Census reports an average of approximately 2.5 people per household for the Bay of Plenty (StatsNZ, 2017). - The BOD for septic tanks was assumed to be 26kg/ person/year, similar to the national default value (MfE, 2017).

Industrial Emissions

³⁵ Nationally, emissions from incineration of waste represent about 0.1% of the total waste emissions.

Sector/Category	Assumptions and Exclusions
Industrial Processes	<ul style="list-style-type: none"> - No emissions from industrial processes have been included due to the lack of specific activity data. Very few large industrial operations are understood to take place within the Region. - It is understood Ballance Agri-Nutrients produce super-phosphorus fertilisers, resulting in some indirect emissions (SO₂). In accordance with the national inventory and the UNFCCC these are not included in the overall emissions calculations and are assumed that these emissions are insignificant. - It is understood Damar Industries, an aerosol manufacturing and filling facility in Rotorua, do not use any of the greenhouse gases outlined in the IPCC 2013 5th Assessment Report (WG1AR5 Chapter 8, Table 8.7). The loss of gases at the Damar Industries facility have not been included in the overall emissions calculations and it is assumed that these emissions are insignificant for Rotorua and the overall Region.
Product Use including: HFC, PCFs and SF ₆	<ul style="list-style-type: none"> - Emissions for refrigerants, fire extinguishers, foam blowing, aerosols and metered dose inhalers, as well as SF₆ in electrical equipment are estimated based on New Zealand average per capita emissions (MfE 2017).
Agricultural Emissions	
Agriculture	<ul style="list-style-type: none"> - Agricultural emissions are based on agricultural production data provided by Statistics New Zealand. - 2015 and 2016 data is based on Stats NZ 2012, 2007 and 2002 Census Livestock numbers by territorial authority and region. No territorial authority specific information was available for the 2015/16 reporting period. - Statistics NZ 2012, 2007 and 2002 Census data reported a number of animal numbers as confidential for different districts. As such the districts share of animals was based on regional animal numbers share of animals in relevant districts in different Census years where information was available. - No agricultural emissions have been calculated for Kawerau as Statistics NZ 2012, 2007 and 2002 Census data has reported the animal numbers within the district as confidential and therefore the percentage share for Kawerau could not be calculated from the Region's 2016 agricultural production figures. - The number of goats has been excluded from the agricultural data sets for the region and individual districts as the number of goats was not presented in the Region's agricultural production statistics for 2016.
Forestry Emissions	
Forestry	<ul style="list-style-type: none"> - Carbon stored in exotic forests is based on data provided in the National Exotic Forest Description published by MPI (MPI 2016 and MPI 2015). - Harvest data has been calculated using the total harvest data for the BoP Region, allocating volumes to the individual districts based on their share of standing exotic forest with a harvestable age (i.e. >26years). - The harvest estimate for the Rotorua Lakes District uses the standing forest area of the whole district (including the area located in the Waikato Region). No data was available for the Rotorua Lakes District to distinguish the forest areas located within the Waikato or BoP regions. - The Taupo District area that is located within the Bay of Plenty has been excluded from the harvest and carbon sequestration estimates. - Due to insufficient data for land use changes, no emissions from land use change of cropland, wetlands, settlements and other land have

Sector/Category	Assumptions and Exclusions
	<p>been estimated.</p> <ul style="list-style-type: none"> - Carbon sequestration for exotic forests include above ground, below ground, dead wood and litter. - Maturing native forests (e.g. Manuka and Kanuka), as well as grassland with woody biomass have been included as native forests. - Data for native forests is based on LCDB vol. 4 data. - Carbon sequestration rates for exotic forest are based on yield tables provided by MfE, assuming a 50/50 split between pre 1990 and post 1989 forests within BoP. - Sequestration rates for native forest were based on data provided in the 2006/07 Wellington Inventory (LCR 2008). Following advice from MfE (2014), it was assumed that these were still applicable. - Emissions from forest harvesting activities are included in the Inventory as part of the LULUCF emissions. For the purpose of this report, it was assumed that all carbon stored in tree biomass (above and below ground as well as in dead wood and litter) become an emission in the year of the tree harvest.
Emission Factors	
Emission Factors – Mobile and Stationary Energy	<ul style="list-style-type: none"> - Emissions factors are based on published New Zealand specific emission factors were possible. Sources include the New Zealand National Greenhouse Gas Inventory (MfE 2017) and Guidance for Voluntary Greenhouse Gas Reporting for Organisations (MfE 2016), National Energy File data (MBIE 2017) and the 5th IPCC Assessment Report (IPCC 2013). A detailed list of emission factors is provided in the individual emissions calculations table in the Excel tables prepared as part of this project. - Advice received by MfE (for a previous report) supported the use of the most recently published emissions factors for all reporting years and emissions calculations. - The Global Warming Potential used to convert CH₄ and N₂O to CO₂e are based on the IPCC Fifth Assessment Report for 100 year GWP including climate-carbon feedbacks.

Appendix B

BoP Regional per capita
emissions by district and
sector

Appendix B Bay of Plenty Region per capita emissions by district and sector

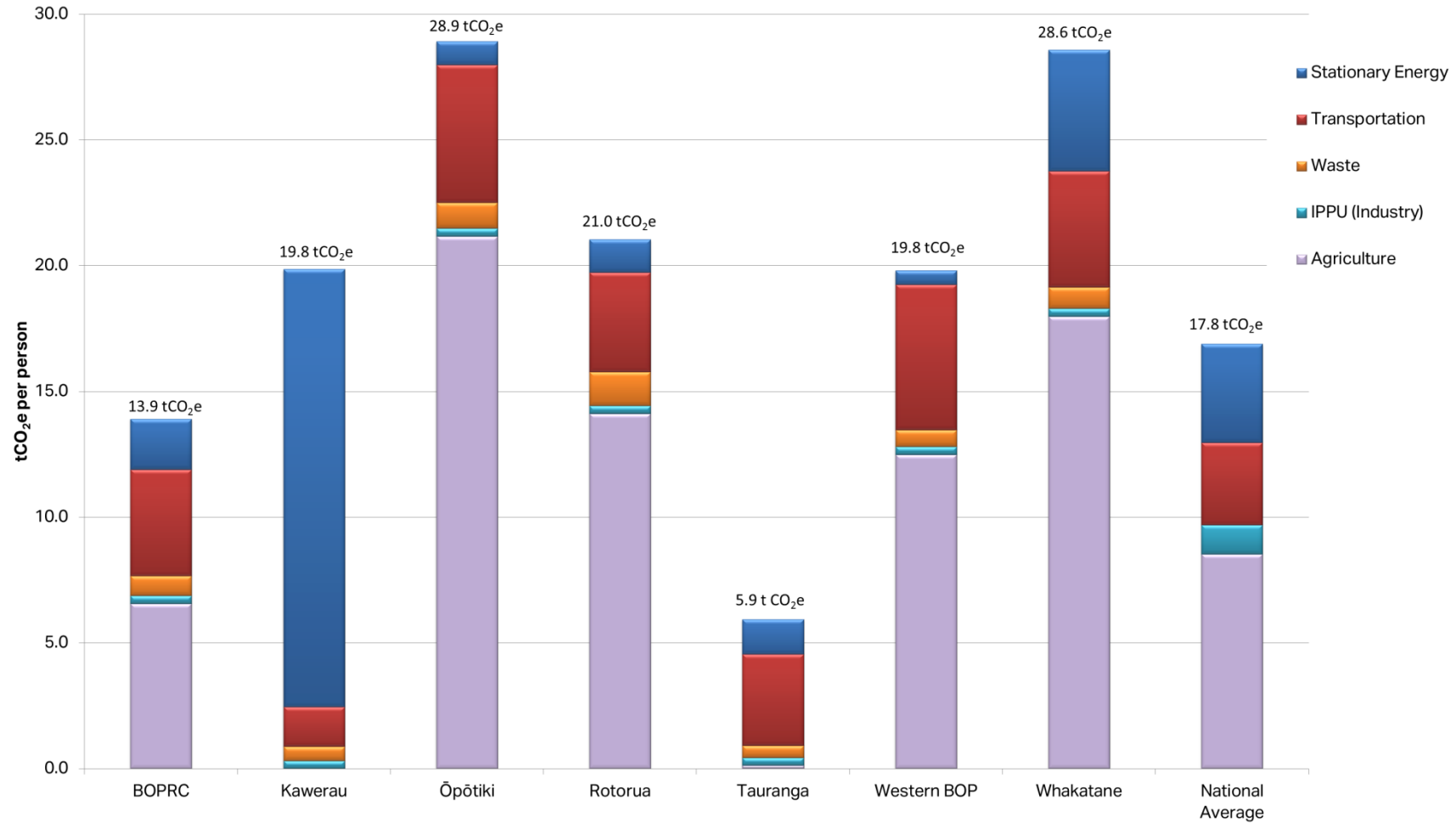


Figure 30 BoP Regional per capita emissions by sector and district