



Hauraki District Council

Hauraki District Greenhouse Gas Emissions Inventory

For the period July 2018 to June 2019

Prepared by EnviroStrat Ltd and AECOM

June 2020

Table of Contents

1	INTRODUCTION AND CONTEXT	4
1.1	Role of local government	4
1.2	Purpose of the emission inventory	4
2	INVENTORY METHODOLOGY	5
2.1	The Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories.....	5
2.2	Inventory Boundary	5
2.3	Emissions calculations and reporting.....	5
3	EMISSIONS RESULTS AND ANALYSIS	6
3.1	Main emissions sources	6
3.2	Emissions' contribution to Waikato Region	10
4	KEY INSIGHTS AND RECOMMENDATIONS	11
	REFERENCES/BIBLIOGRAPHY.....	13
	APPENDICES.....	14
A.	GPC emissions source by sector and sub-sector – Hauraki District (2018/19)	14
B.	Assumptions and limitations.....	21
C.	Data Sources and Data Gaps.....	24

Table of Figures

Figure 1. Total gross emissions by source (excl. forestry) for Hauraki District, 2018/19	6
Figure 2. GPC BASIC Community GHG Emissions Inventory for Hauraki District, 2018/19 Total Gross Emissions by Sub-Sector (%)	6
Figure 3. GPC BASIC Community GHG Emissions Inventory for Hauraki District, 2018/19 Total Stationary Energy Sector emissions by sub-sector (%).....	7
Figure 4. Stationary Energy - breakdown of emissions by fuel type (t CO ₂ e).....	7
Figure 5. GPC BASIC Community GHG Emissions Inventory for Hauraki District, 2018/19 Total Transport Emissions by sub-sector (%)	8
Figure 6. Transportation - breakdown by emission source (t CO ₂ e)	8

List of Tables

Table 1. Emissions breakdown by category and sources, Hauraki District 2018/19	9
Table 2. Overall emission estimates for Waikato Region and breakdown by territorial authorities (2018/19)	10
Table 3. Hauraki District as proportion of Waikato Region emissions estimates (2018/19 inventory).....	11

Acronyms and Abbreviations

AFOLU	Agriculture, Forestry, and Other Land Use
CH ₄	methane
CO ₂	carbon dioxide
CO ₂ e	carbon dioxide equivalent
EECA	Energy Efficiency and Conservation Authority
GHG	greenhouse gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories
GWP	global warming potential
HFCs	hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Process and Product Use
k	thousand
LPG	liquefied petroleum gas
N ₂ O	nitrous oxide
NF ₃	nitrogen trifluoride
PFCs	perfluorocarbons
SF ₆	sulphur hexafluoride
TAs	Territorial Authorities
WRC	Waikato Regional Council

Glossary

Emission factor(s)	A factor that converts activity data into GHG emissions data (e.g., kg CO ₂ e emitted per litre of fuel consumed, kg CO ₂ e emitted per kilometre travelled, etc.).
Scope 1 emissions	GHG emissions from sources located within the Waikato region boundary.
Scope 2 emissions	GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the Waikato region boundary.
Scope 3 emissions	All other GHG emissions that occur outside the Waikato region boundary as a result of activities taking place within the Waikato boundary.
BASIC	An inventory reporting level that includes all scope 1 sources except from energy generation, imported waste, IPPU, and AFOLU, as well as all scope 2 sources.

Disclaimer

This document has been prepared by Envirostrat Limited for the exclusive use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of Envirostrat Limited. Envirostrat Limited undertakes no duty, or warranty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and Envirostrat Limited's experience, having regard to assumptions that Envirostrat Limited can reasonably be expected to make in accordance with sound professional principles. Envirostrat Limited may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

1 Introduction and context

The New Zealand government ratified the Paris Agreement in April 2017, which is an international commitment to limit global warming to below two degrees. To achieve this goal and make a fair contribution to global emissions reductions, New Zealand adopted in 2019 the Carbon Change Response (Zero Carbon) Amendment Act to develop and implement clear climate change policies that contribute to the commitments under the 2015 Paris Agreement. The Act sets new mitigation targets committing New Zealand to:

- reduce annual net emissions of all greenhouse gases (except biogenic methane) to zero by 2050, and
- reduce annual emissions of biogenic methane to
 - 10% below 2017 levels by 2030
 - 24% to 47% per cent below 2017 levels by 2050.

The Act also established emissions budgets to act as stepping-stones towards the long-term target. The Ministry for the Environment is currently developing a provisional emissions budget for the 2021–2025 period. Eventually, emissions budget will be set for the following periods: 2022–2025, 2026–2030 and 2031–2035.¹

1.1 Role of local government

Globally more than 10,000 cities and local governments have signed up to the Global Covenant of Mayors for Energy and Climate (www.globalcovenantofmayors.org) and committed to report on their community greenhouse gas emission and emission reduction measures.

In 2017, the Mayors and Chairs of New Zealand have re-confirmed the 2015 Climate Change Declaration and the key commitments and actions that Councils plan to undertake. Hauraki District Council is signatory to this declaration which covers all member agencies activities, roles and functions of the sector and specifically identifies how local government will act and what it requires of central government to support action on climate change.² Several local councils have also joined the Global Covenant of Mayors including Auckland City, Dunedin City and Rotorua Lakes District.

It is recognised that solutions to climate change and transition to a low carbon economy cannot be pursued by central government without the involvement and actions of local government – for adaptation as well as mitigation. Hauraki District is committed to exploring climate actions and solutions, and understanding its emissions profile is a first step.

1.2 Purpose of the emission inventory

This inventory provides Hauraki District Council with an understanding of its emissions generation and profile for the 2018/19 financial year. A GHG emissions inventory is an estimate of GHGs emitted to, or removed from, the atmosphere over a given period.

Specifically, the purpose of this inventory is to:

- Identify where Hauraki District's emissions are coming from and their relative contribution to overall emissions footprint.
- Establish the emissions baseline as a key step towards the district's climate action plan.
- Provide information to enable the Council to engage with key sectors and stakeholders towards reducing local emissions (starting with goal setting).

This document summarises the findings and insights from the data collection and calculations of the emissions inventory. This emissions inventory was developed in conjunction with the emissions inventory preparation for Waikato Region and the other territorial authorities within the region.

¹ More information is available at: <https://www.mfe.govt.nz/climate-change/zero-carbon-amendment-act>.

² See the declaration here: <https://www.lgnz.co.nz/assets/Uploads/0827d40e5d/Climate-Change-Declaration.pdf>

For further insights and in-depth understanding of the inventory context for Hauraki District, please refer to the *Waikato Region Greenhouse Gas Emissions Inventory* report for 2018/19.

2 Inventory methodology

2.1 The Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories

The Hauraki District inventory follows the methodology outlined in the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory (GPC)³, published by the World Resources Institute (WRI 2015). The GPC methodology represents international best practice for city and community level greenhouse gas (GHG) emissions reporting.

It includes emissions from stationary energy, transport, waste, industry, agriculture and forestry activities within the regional (administrative) boundary of Waikato Region. The inventory covers seven greenhouse gases: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆) and nitrogen trifluoride (NF₃).

2.2 Inventory Boundary

The boundaries of the 2018/19 emissions inventory are the administrative boundaries of Hauraki District Council. The district covers 127,015 ha and has 20,800 residents.

2.3 Emissions calculations and reporting

This inventory assesses both direct (production-based) emission sources within the geographic area (Scope 1) and indirect (consumption-based) emission sources associated with goods and services imported into Hauraki District. Examples of indirect emission sources include electricity from the national grid (Scope 2), and transport into the area that originates or terminates outside the area e.g. aviation & railway (Scope 3).

Key aspects to note:

- Emissions are reported for the period from 1 July 2018 to 30 June 2019.
- Emissions are expressed on a carbon dioxide-equivalent basis including climate change feedbacks using the 100-year GWP (Global Warming Potential) values and climate-carbon feedback from the Intergovernmental Panel on Climate Change Fifth Assessment Report: Climate Change 2013;
- Total emissions are reported for gross emissions (excluding forestry) and net emissions (including forestry);
- Emissions are calculated by multiplying activity data by an emission factor associated with the activity;
- In line with the GPC, activity data for the various emission sources includes data from bottom up sources (locally provided measurements or estimates) and top down sources (based on national information), depending on data availability;
- Where specific district-level data was not accessible, information was calculated via a per capita breakdown of national level data. This method was applied to the following sectors:
 - Industrial product use
 - Solid waste emissions from closed landfills (1967 to 1997)
 - Stationary energy fuel types: coal, biofuel and LPG figures have been assumed on a per capita basis from national figures.

³ The protocol is available at: <http://www.ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities>.

Assumptions made during data collection and analysis are outlined in Appendix B – Assumptions and limitations. Data gaps are described in Appendix C.

3 Emissions results and analysis

Hauraki District's emissions inventory provides a picture of emissions generated by the activities of residents, businesses and industries. During July 2018 to June 2019 reporting period, Hauraki District generated a total of 733,455 t CO₂e net emissions and 775,904 tCO₂e gross emissions (excluding forestry). This represents a 35.3 t CO₂e per capita net emissions and 37.3 t CO₂e per capita gross emissions, or approximately 6% of Waikato Region total gross emissions. Agriculture is the largest emissions source (79.9%), followed by transportation (14.2%) (Figure 1).

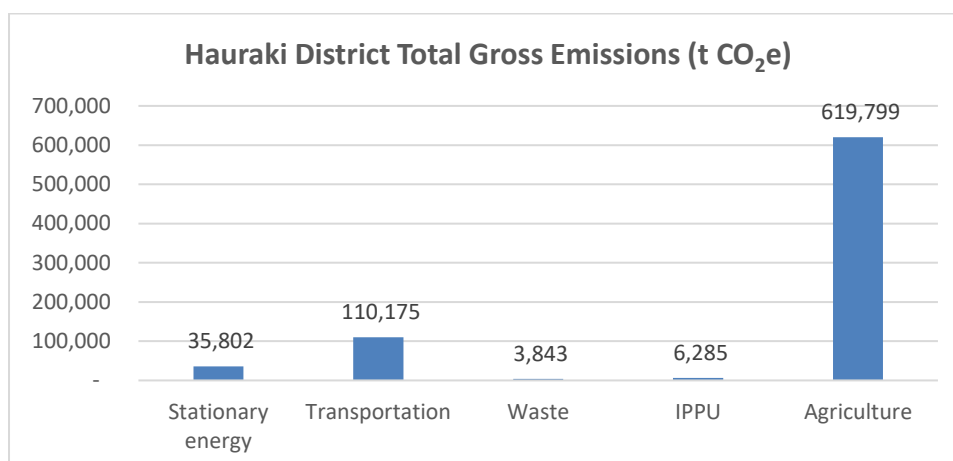


Figure 1. Total gross emissions by source (excl. forestry) for Hauraki District, 2018/19

When emissions are further broken down by sub-sectors (Figure 2), the emissions profile emerging is that outside of agriculture and land transport (which together account for 94% of emissions) stationary energy from industry, residential buildings and IPPU (Industrial processes and product use) all contribute 6% to gross emissions.

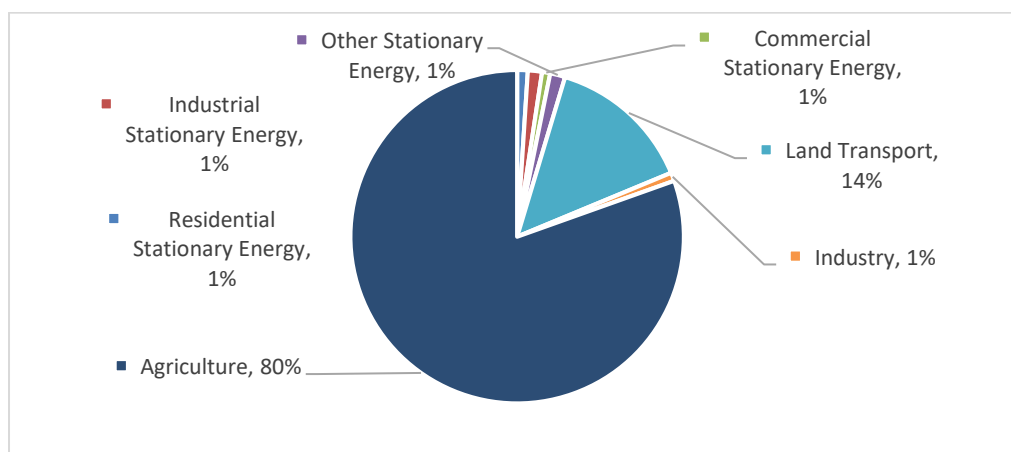


Figure 2. GPC BASIC Community GHG Emissions Inventory for Hauraki District, 2018/19
Total Gross Emissions by Sub-Sector (%)

3.1 Main emissions sources

Stationary Energy: the third largest emitting sector, stationary energy is responsible for 35,802 t CO₂e of the district's gross emissions (4.6%). Residential consumption is responsible for 22.1% of emissions, and industry (manufacturing and construction) accounts for about 29.5% of stationary energy emissions. The majority of

stationary energy represented by “other sector” emissions from fuel combustion (energy industries) is 31.4%, as shown in Figure 3.

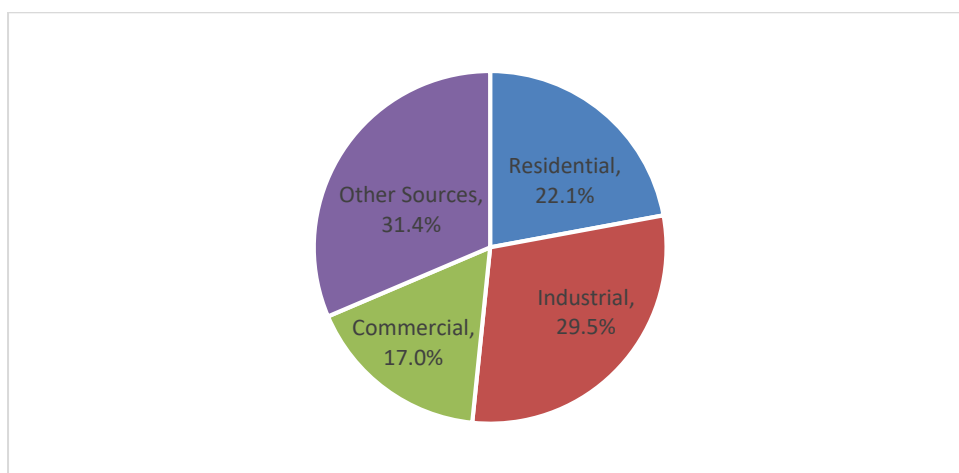


Figure 3. GPC BASIC Community GHG Emissions Inventory for Hauraki District, 2018/19
Total Stationary Energy Sector emissions by sub-sector (%)

When analysed from the perspective of the type of fuel use, electricity consumption and petrol and diesel use are the major sources (see Figure 4 below).

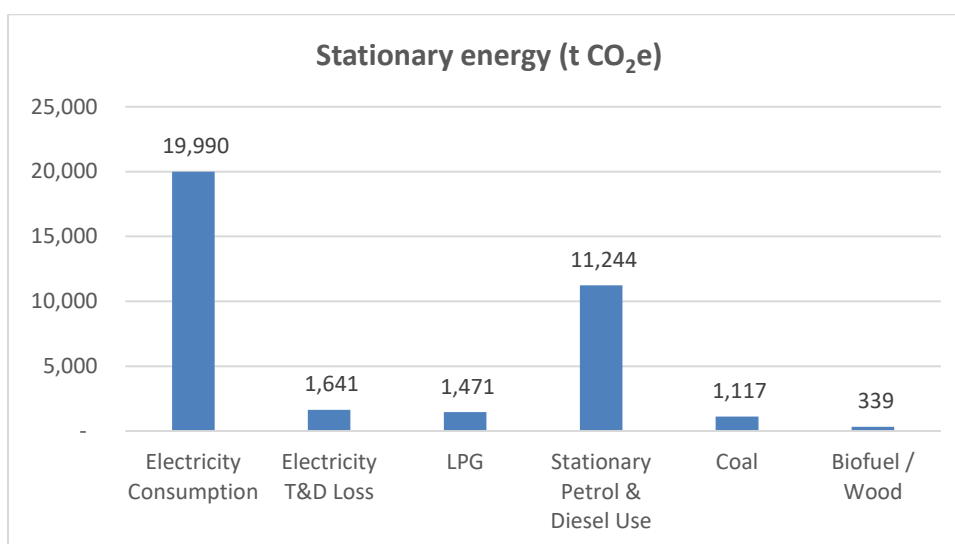


Figure 4. Stationary Energy - breakdown of emissions by fuel type (t CO₂e)

Transportation: the second largest source of emissions at 110,175 t CO₂e. Road transport is estimated to be 97,976 t CO₂e and represents about 89% of total transport emissions, followed by off-road at just under 10%.⁴

⁴ This is based on the general EECA guidance regarding the split average consumption between on and off road for New Zealand. As a result, the off-road consumption e.g. diesel consumed on farms, is likely under-estimated.

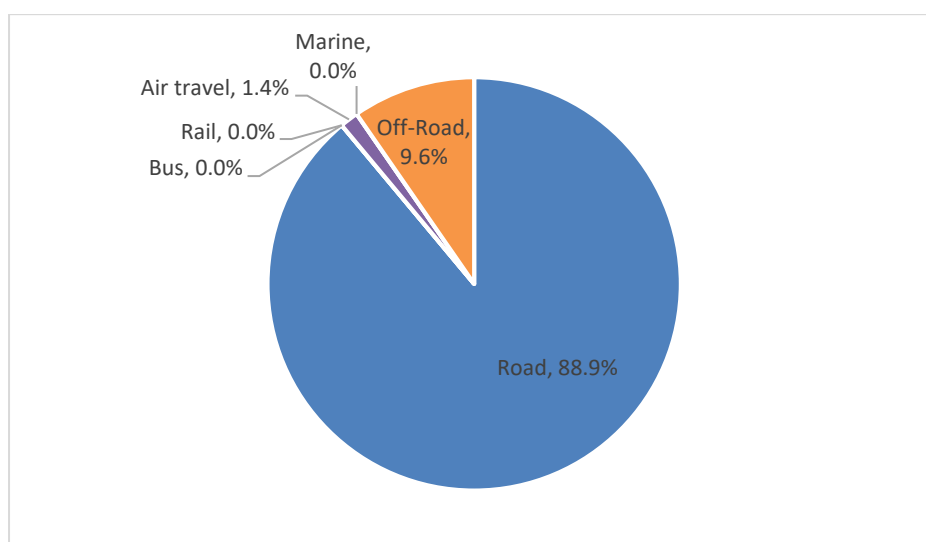


Figure 5. GPC BASIC Community GHG Emissions Inventory for Hauraki District, 2018/19
Total Transport Emissions by sub-sector (%)

When the fuel type is considered, petrol and diesel consumption make up 98.5% of all transportation emissions. Activities from aviation are responsible for about 1.5% of remaining emissions.

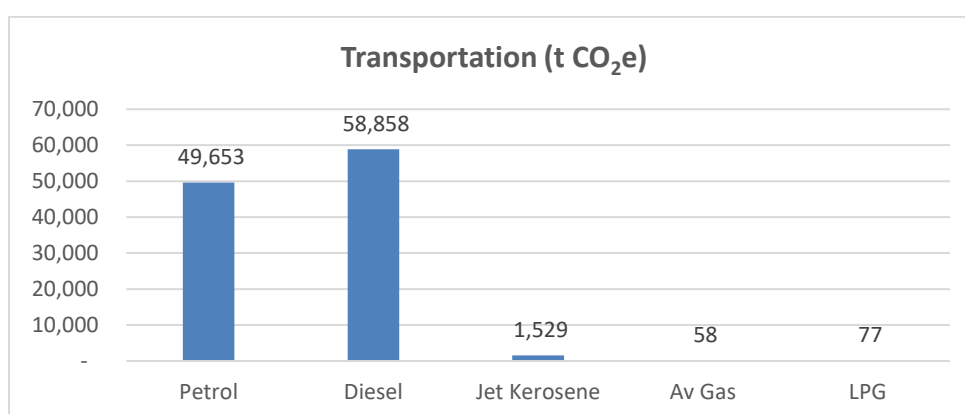


Figure 6. Transportation - breakdown by emission source (t CO₂e)

Waste (solid & wastewater): Hauraki District generates a total of 3,843 t CO₂e from waste, of which 50% is as result of solid waste disposal and 50% from wastewater.

Industrial Processes and Product Use (IPPU): This sector includes emissions associated with the consumption of GHGs for refrigerants, foam blowing, fire extinguishers, aerosols, metered dose inhalers and Sulphur Hexafluoride for electrical insulation and equipment production. The emissions from IPPU (industry) have been calculated using a top down approach, the district accounting for 6,285 t CO₂e, just 0.8% of gross emissions. IPPU emissions do not include energy use from industrial manufacturing, which is included in the relevant stationary energy sub-category (e.g. coal, electricity and/or petrol and diesel).

Agriculture: the sector has the largest footprint of 619,799 t CO₂e representing 79.9% of Hauraki District's total gross emissions. Livestock living within the district boundary is the primary source of agricultural emissions.

Forestry & Land-use Change: there is 42,449 t CO₂e sequestration from forested areas – majority from exotic cover.

A breakdown of all emissions sources for each category is provided in the table below. Full details following the GPC accounting methodology are available in Appendix A.

Table 1. Emissions breakdown by category and sources, Hauraki District 2018/19

Emission Sources		Hauraki	Unit	% gross	% sector
Stationary energy	Electricity Consumption	19,990	t CO ₂ e	2.6%	55.8%
	Electricity T&D Loss	1,641	t CO ₂ e	0.2%	4.6%
	Natural Gas	-	t CO ₂ e	0.0%	0.0%
	Natural Gas T&D Loss	-	t CO ₂ e	0.0%	0.0%
	LPG	1,471	t CO ₂ e	0.2%	4.1%
	Stationary Petrol & Diesel Use	11,244	t CO ₂ e	1.4%	31.4%
	Coal	1,117	t CO ₂ e	0.1%	3.1%
	Coal (fugitive)	-	t CO ₂ e	0.0%	0.0%
	Gas (fugitive)		t CO ₂ e	0.0%	0.0%
	Biofuel / Wood	339	t CO ₂ e	0.0%	0.9%
	Biodiesel		t CO ₂ e	0.0%	0.0%
Transportation	Petrol	49,653	t CO ₂ e	6.4%	45.1%
	Diesel	58,858	t CO ₂ e	7.6%	53.4%
	Bus Diesel		t CO ₂ e	0.0%	0.0%
	Rail Emissions	-	t CO ₂ e	0.0%	0.0%
	Bus (Electric)	-	t CO ₂ e	0.0%	0.0%
	Jet Kerosene	1,529	t CO ₂ e	0.2%	1.4%
	Av Gas	58	t CO ₂ e	0.0%	0.1%
	Marine Diesel	-	t CO ₂ e	0.0%	0.0%
	Light Fuel Oil	-	t CO ₂ e	0.0%	0.0%
	LPG	77	t CO ₂ e	0.0%	0.1%
Waste	Solid Waste Disposal	1,919	t CO ₂ e	0.2%	49.9%
	Wastewater	1,924	t CO ₂ e	0.2%	50.1%
IPPU	Industrial	6,285	t CO ₂ e	0.8%	100.0%
Agriculture	Agriculture	619,799	t CO ₂ e	79.9%	100.0%
Forestry	Forestry	-	t CO ₂ e	Not included in gross emissions	100.0%
		42,449			

3.2 Emissions' contribution to Waikato Region

To provide a perspective into Hauraki District's emissions profile, a summary overview is presented below for 2018/19 inventory for Waikato Region and the other territorial authorities. The overview is not intended as a benchmark between territorial authorities but simply as an indicative framework of reference (Table 2).

Hauraki District has a footprint of 35.3 t CO₂e (net) / 37.3 t CO₂e (gross) per capita compared to Waikato region 15 t CO₂e (net) / 26.7 t CO₂e (gross); the district has relatively larger footprint compared to larger cities however, for example Auckland (6.3 t CO₂e per capita as of 2016).

Table 2. Overall emission estimates for Waikato Region and breakdown by territorial authorities (2018/19), t CO₂e

t CO ₂ e	Waikato Region (2018/19)	Hamilton City 2018/19	Hauraki 2018/19	Matamata- Piako 2018/19	Otorohanga 2018/19	South Waikato 2018/19	Taupo 2018/19	Thames- Coromande l 2018/19	Waikato District 2018/19	Waitomo 2018/19	Waipa 2018/19
Stationary energy	1,601,427	277,392	35,802	133,351	18,448	422,036	71,704	53,937	450,305	35,616	102,836
Transportation	2,001,658	635,615	110,175	131,961	47,349	96,952	161,673	235,486	297,225	76,871	208,351
Waste	291,708	30,999	3,843	6,596	21,567	35,097	80,874	12,247	47,438	19,661	33,386
Industry	143,213	50,732	6,285	10,775	3,143	7,512	11,763	9,428	23,914	2,840	16,821
Agriculture	8,608,976	6,257	619,799	1,475,468	838,017	784,720	928,268	183,042	1,721,291	903,761	1,148,353
Forestry	-5,530,909	-752	-42,449	14,318	-62,152	-1,244,246	-2,589,419	-612,004	-350,870	-618,081	-25,254
Total net (incl. forestry)	7,116,073	1,000,243	733,455	1,772,469	866,371	102,072	-1,335,139	-117,864	2,189,304	420,668	1,484,493
Total gross (excl. forestry)	12,646,982	1,000,995	775,904	1,758,151	928,523	1,346,318	1,254,281	494,140	2,540,173	1,038,750	1,509,747
Population	473,480	167,700	20,800	35,750	10,450	24,950	38,800	31,150	78,850	9,530	55,500
Per capita net emission (incl Forestry)	15.0	6.0	35.3	49.6	82.9	4.1	- 34.4	-3.8	27.8	44.1	26.7
Per capita gross emission (excl Forestry)	26.7	6.0	37.3	49.2	88.9	54.0	32.3	15.9	32.2	109.0	27.2

Table 3. Hauraki District as proportion of Waikato Region emissions estimates (2018/19 inventory)

t CO ₂ e	Waikato Region	Hauraki District	% of Regional Emissions
Stationary energy	1,601,427	35,802	2%
Transportation	2,001,658	110,175	6%
Waste	291,708	3,843	1%
Industry	143,213	6,285	4%
Agriculture	8,608,976	619,799	7%
Forestry	- 5,530,909	- 42,449	1%
Total (net) incl. forestry	7,116,073	733,455	10%
Total (gross) excl. forestry	12,646,982	775,904	6%

4 Key insights and recommendations

The development of the 2018/19 emissions inventory provides Hauraki District with a robust and comprehensive baseline for decision making. The process for developing the inventory as part of the Waikato Region's wide emissions assessment was effective and helped leverage engagement with data holders. For preparation of future inventories, Hauraki District may consider the following recommendations to improve the quality of and access to activity data, but also enable action to reduce emissions.

For preparation of future inventories, Hauraki District may consider the following recommendations to improve the quality of, and access to activity data, and to enable actions to reduce emissions. Please refer to the Waikato regional emissions inventory for further insights and recommendations.

Recommendation 1: Data availability & quality

Specific areas that can be targeted for improvement are transportation, followed by stationary energy and waste (especially solid waste):

- **Transportation:** getting better data for road-transport (by type of vehicle) as well as the split between on-road and off-road (currently calculated using top-down approach for emissions allocation) would be useful for understanding consumption trends better and where to intervene. Note that transportation emissions are increasing for Waikato Region, and likely in Hauraki District too – primarily due to population increase. Petrol and diesel consumption is the single most important source of emissions and needs to be a key focus (for data improvement and reduction options).
- **Stationary energy:** currently stationary energy has been reported by sub-sectors (residential, commercial, industry and other). These are broad categories that require further details in order to better understand emissions generation.

For more details, refer to appendix B and C or the Waikato Region inventory report.

Recommendation 2: Reporting intervals

It is recommended that Hauraki District considers updating the inventory report in two-year time, and coordinates with WRC this development in order to use resources efficiently. An update in 21/22 is recommended so that the inventory and potential reduction target setting is aligned with the central government process for the provisory carbon budget for the period of 2021-2025.

Recommendation 3: Setting reduction goals & targets

Reduction goals need to be informed by dialogue with iwi and other stakeholders (community, industry, etc) and the level of ambition and preferred approach to setting emissions reduction targets. Communities use long term aspiration to set carbon neutral goals and other science-based approaches looking at the gap to meet the 1.5°C and 2°C temperature targets of the Paris Agreement. It is important that any reduction targets are set as part of an integrated climate action plan.

Hauraki's emissions profile requires a strong focus on transportation and agriculture as the two main sources of emissions.

The GPC suggests four different approaches to setting emissions reduction targets as follows:

- Base year emissions goals
- Fixed level goals
- Base year intensity goals
- Baseline scenario goal

A base year reduction goal or fixed level goals may be considered; if carbon neutrality approach is chosen, intermediate targets should be used at least in line with New Zealand's commitments and legal obligations. Collaboration with other Waikato region territorial authorities that have a similar emission profile and share an interest in solutions may also be considered – for example for agriculture and transportation.

References/Bibliography

IPCC (2015). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, <http://www.ipcc-nggip.iges.or.jp/public/2006gl/>.

WRI (World Resources Institute) et al. (2014). Global Protocol for Community-Scale Greenhouse Gas Emission Inventories, retrieved on 16 June 2015 from <http://www.ghgprotocol.org/about-ghgp>.

Ministry for the Environment. 2019. *New Zealand's Greenhouse Gas Inventory 1990–2017*. Wellington: Ministry for the Environment.

Appendices

A. GPC emissions source by sector and sub-sector – Hauraki District (2018/19)

GPC ref No.	Scope	GHG Emissions Source (By Sector and Sub-sector)		Unit	t CO2	t CH4	t N2O	biogenic t CO2	Total t CO2e
I	Stationary Energy				Stationary Energy				
I.1	Residential Buildings				7,561.14	9.20	0.12	3,321.87	7,910.09
I.1.1	1.00	Emissions from fuel combustion within the district boundary			709.21	9.20	0.12	3,321.87	1,058.16
	Residential	Natural Gas			-	-	-		-
		LPG			630.83	0.05	0.00		632.81
		Coal			78.38	0.24	0.00		86.97
		Biofuel			-	8.91	0.12	3,321.87	338.39
I.1.2	2.00	Emissions from grid-supplied energy consumed within the district boundary			6,331.99	-	-	-	6,331.99
		Electricity Consumption			6,331.99				6,331.99
I.1.3	3.00	Transmission and distribution losses from grid-supplied energy			519.94	-	-	-	519.94
		Grid Electricity T&D losses			519.94				519.94
		Natural Gas T&D Losses			-	-	-		-
I.2	Commercial & Institutional buildings and facilities				6,070.82	0.08	0.00	244.21	6,074.81
I.2.1	1.00	Emissions from fuel combustion within the district boundary			852.13	0.08	0.00	244.21	856.11
	Commercial	Natural Gas			-	-	-		-
		LPG			645.50	0.05	0.00		647.52
		Coal			206.63	0.02	0.00		208.30
		Biofuel			-	0.00	0.00	244.21	0.29

I.2.2	2.00	Emissions from grid-supplied energy consumed in the district for on-road transportation				4,822.69	-	-	-	4,822.69
		Electricity Consumption				4,822.69				4,822.69
I.2.3	3.00	Transmission and distribution losses from grid-supplied energy				396.01	-	-	-	396.01
		Grid Electricity T&D losses				396.01				396.01
		Natural Gas T&D Losses				-	-	-		-
I.3	Manufacturing Industries and Construction					10,565.99	0.09	0.01	-	10,572.85
I.3.1	1.00	Emissions from fuel combustion within the district boundary				1,005.50	0.09	0.01	-	1,012.36
		Natural Gas				-	-	-		-
		LPG				190.72	0.00	0.00		190.91
		Coal				814.78	0.08	0.01		821.45
I.3.2	2.00	Emissions from grid-supplied energy consumed in the district for on-road transportation				8,835.02	-	-	-	8,835.02
		Electricity Consumption				8,835.02				8,835.02
I.3.3	3.00	Transmission and distribution losses from grid-supplied energy				725.47	-	-	-	725.47
		Grid Electricity T&D losses				725.47				725.47
		Natural Gas T&D Losses				-	-			-
I.4	Energy Industries					-	-	-	-	-
I.4.1	1.00	Emissions from fuel combustion within the district boundary				-	-	-	-	-
I.4.2	2.00	Emissions from grid-supplied energy consumed in the district for on-road transportation				-	-	-	-	-
I.4.3	3.00	Transmission and distribution losses from grid-supplied energy				-	-	-	-	-
I.4.4	1.00	Emissions from energy generation supplied to the grid				-	-	-	-	-
I.5	Agriculture, forestry and fishing activities					-	-	-	-	-
I.5.1	1.00	Emissions from fuel combustion within the district boundary				-	-	-	-	-
I.5.2	2.00	Emissions from grid-supplied energy consumed in the district for on-road transportation				-	-	-	-	-

I.5.3	3.00	Transmission and distribution losses from grid-supplied energy					-	-	-	-	-
I.6	Other sources						11,192.89	0.61	0.10	-	11,244.33
I.6.1	1.00	Emissions from fuel combustion within the district boundary					11,192.89	0.61	0.10	-	11,244.33
		Diesel					10,843.73	0.45	0.09		10,885.47
		Petrol					349.16	0.16	0.01		358.86
I.6.2	2.00	Emissions from grid-supplied energy consumed in the district for on-road transportation					-	-	-	-	-
I.6.3	3.00	Transmission and distribution losses from grid-supplied energy					-	-	-	-	-
I.7	Fugitive emissions from mining, processing, storage, and transportation of coal						-	-	-	-	-
I.7.1	1	Emissions from fugitive emissions within the district boundary					-	-	-	-	-
		Sub-bituminous coal									
I.8	Fugitive emissions from oil and natural gas systems						-	-	-	-	-
I.8.1	1	Emissions from fugitive emissions within the district boundary									
II	Transportation										
II.1	On road transportation						94,790.20	24.52	7.89	-	97,975.91
II.1.1	1	Emissions from fuel combustion on-road transportation occurring within the district boundary					94,790.20	24.52	7.89	-	97,975.91
		On Road Petrol (L)					46,601.65	21.95	5.32		48,933.29
		On Road Diesel (L)					48,111.34	2.57	2.57		48,965.24
		Biodiesel						-	-	-	-
							-	-	-		-
		LPG					77.20	0.00	0.00		77.38
II.1.2	2	Emissions from grid-supplied energy consumed within the district boundary for onroad transportation					-	-	-	-	-
		Electric Bus									
II.1.3	3	Emissions from proportion of transboundary journeys occurring outside the city boundary and transmission and distribution losses from grid supplied energy consumption.					-	-	-	-	-

	Electric Bus T&D	Electricity T&D losses from bus electricity consumption							
II.2	Railways				-	-	-	-	-
II.2.1	1	Emissions from fuel combustion for railway transportation occurring within the city boundary			-	-	-	-	-
		Rail Diesel			-	-	-		-
II.2.2	2	Emissions from grid-supplied energy consumed within the city boundary for railways			-	-	-	-	-
		Rail elect. (nat. ave EF)							
II.2.3	3	Emissions from proportion of transboundary journeys occurring outside the city boundary and transmission and distribution losses from grid supplied energy consumption.			-	-	-	-	-
		Electricity T&D losses from rail electricity consumption							
II.3	Waterborne navigation				-	-	-	-	-
II.3.1	1	Emissions from fuel combustion for waterborne navigation occurring within the city boundary			-	-	-	-	-
		Marine Diesel			-	-	-	-	-
		Light Fuel Oil			-	-	-	-	-
II.3.2	2	Emissions from grid-supplied energy consumed within the city boundary for waterborne transportation			-	-	-	-	-
		Electricity							
II.3.3	3	Emissions from proportion of transboundary journeys occurring outside the city boundary and transmission and distribution losses from grid supplied energy consumption.			-	-	-	-	-
		Electricity T&D losses							
II.4	Aviation				1,528.97	0.43	0.14	-	1,586.26
II.4.1	1	Emissions from fuel combustion for aviation occurring within the city boundary							
II.4.2	2	Emissions from grid-supplied energy consumed within the city boundary for aviation			-	-	-	-	-
		Electricity							
II.4.3	3	Emissions from proportion of transboundary journeys occurring outside the city boundary and transmission and distribution losses from grid supplied energy consumption.			1,528.97	0.43	0.14	-	1,586.26
		Jet Kerosene			1,473.38	0.41	0.14		1,528.51
		Aviation Gas			55.60	0.02	0.01		57.75

		Electricity T&D losses								
II.5		Off-road transportation				10,405.85	0.84	0.60	-	10,612.67
II.5.1	1	Emissions from fuel combustion for off-road transportation occurring within the district boundary				10,405.85	0.84	0.60	-	10,612.67
		Off Road Petrol (L)				685.77	0.32	0.08		720.08
		Off Road Diesel (L)				9,720.08	0.52	0.52		9,892.59
II.5.2	2	Emissions from grid-supplied energy consumed within the district boundary for offroad transportation				-	-	-	-	-
		Electricity								
II.5.3	3	Emissions from proportion of transboundary journeys occurring outside the district boundary and transmission and distribution losses from grid supplied energy consumption.				-	-	-	-	-
		Electricity T&D losses								
III		Waste								
III.1		Solid waste disposal				-	56.43	0.00	669.44	1,919.08
III.1.1	1.00	Emissions from solid waste generated within the district boundary and disposed in landfills or open dumps within the district boundary				-	56.43	0.00	669.44	1,919.08
		Tirohia Landfill					56.43	0.00	669.44	1,919.08
		Hampton Downs Landfill								
		Other Landfill Sites								
		Composting								
III.1.2	3.00	Emissions from solid waste generated within the district boundary but disposed in landfills or open dumps outside the district boundary				-	-	-	-	-
III.1.3	1.00	Emissions from waste generated outside the district boundary and disposed in landfills or open dumps within the district boundary				-	-	-	-	-
III.2		Biological treatment of waste				-	-	-	-	-
III.2.1	1.00	Emissions from solid waste generated within the district boundary that is treated biologically within the district boundary				-	-	-	-	-
III.2.2	3.00	Emissions from solid waste generated within the district boundary but treated biologically outside of the district boundary				-	-	-	-	-

III.2.3	1.00	Emissions from waste generated outside the district boundary but treated biologically within the district boundary			-	-	-	-	-
III.3		Incineration and open burning			-	-	-	-	-
III.3.1	1.00	Emissions from solid waste generated and treated within the district boundary			-	-	-	-	-
III.3.2	3.00	Emissions from solid waste generated within the district boundary but treated outside of the district boundary			-	-	-	-	-
III.3.3	1.00	Emissions from waste generated outside the district boundary but treated within the district boundary			-	-	-	-	-
III.4		Wastewater treatment and discharge			-	56.58	-	-	1,923.66
III.4.1	1.00	Emissions from wastewater generated and treated within the district boundary			-	56.58	-	-	1,923.66
		Total WWTP emissions (t CO2e)				56.58			1,923.66
III.4.2	3.00	Emissions from wastewater generated within the district boundary but treated outside of the district boundary			-	-	-	-	-
III.4.3	1.00	Emissions from wastewater generated outside the district boundary but treated within the district boundary			-	-	-	-	-
IV	Industry								
IV.1	1	Emissions from industrial processes occurring within the district boundary			-	-	-	-	-
	Processes								
IV.2	1	Emissions from product use occurring within the district boundary			6,285.33	-	-	-	6,285.33
	Product uses	Refrigerants		tonnes	5,809.29				5,809.29
		Foam Blowing		tonnes	23.16				23.16
		Fire extinguishers		tonnes	9.41				9.41
		Aerosols & MDI*		tonnes	378.24				378.24
		SF6		tonnes	65.24				65.24

V	Agriculture, Forestry and Other landuse																		
V.1	1	Emissions from livestock within the district boundary												-	15,108.83	0.00	-	513,700.74	
		Enteric fermentation											13,935.73			473,814.81			
		Manure Management (CH4)								tonnes			1,173.10			39,885.38			
		Manure Management (N2O) (excluding organic fertilisers and pasture)											tonnes			0.00		0.55	
V.2	1											-	-	-	-	-			
	Forestry	Exotic forest sequestration											tonnes	-				-	
		Native forest sequestration								tonnes	125,807.69					125,807.69			
										tonnes	-					-			
		Total harvest emissions											tonnes	46,460.19				46,460.19	
													tonnes	129,819.01				129,819.01	
V.3	1	Emissions from aggregate sources and non-CO2 emission sources on land within the district boundary												6,074.97	-	335.65	-	106,097.80	
		Liming & Dolomite								tonnes	6,074.97					6,074.97			
		Agricultural Soils (synthetic and organic fertilisers + crop residue)											tonnes			42.57		12,684.89	
		Manure from grazing animals on pasture								tonnes				237.45		70,761.11			
		Agricultural leaching (Indirect Emissions)								tonnes				19.15		5,706.75			
		Agricultural atmospheric deposition (Indirect Emissions)										tonnes			36.48		10,870.08		
VI	Other Scope 3																		
V1.1	3	Other Scope 3																	
												Hauraki District		Total CO2	Total CH4	Total N2O		Total Emissions	
Total Emissions by Gas														112,027.29	15,257.61	344.53	4,235.52	733,454.66	

B. Assumptions and limitations

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 and residential coal use, estimated based on population figures. Consumption of natural gas and electricity data are based on total energy distributed to grid exit points within the Region. The energy provided to these grid exit points have then been allocated to the entire Region. This may in some instances mean that energy used outside the Region may be counted as part of the Region's Footprint, depending on the distribution network for gas and electricity, which may not fully match the Region's boundaries in all cases. 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). Coal and natural gas consumption for the Huntley Power Station have been excluded from the regional emissions estimates, as this is already reflected in the national emissions factor for electricity generation.
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 2020).
Electricity Consumption	<ul style="list-style-type: none"> Consumption of electricity data is based on total energy distributed to grid exit points within the Transpower Network.
LPG	<ul style="list-style-type: none"> LPG consumption in the Waikato Region is based on the total amount of LPG supplied to the North Island and calculated on a per capita basis using 2018/19 population estimates. LPG stationary energy estimates are based on the national share of 9kg and 45kg gas bottles, and bulk sales provided by the LPG Association of New Zealand.
Natural Gas	<ul style="list-style-type: none"> Natural gas consumption is based on total gas distributed to exit grid points within the Waikato Region as supplied by First Gas (excludes sites that have direct connections to the transmission network) as well as the direct gas volumes for Fonterra Te Rapa. Natural gas Te Rapa(?) cogeneration plant has not been included as these are already reflected in the national emissions factor for electricity generation. The natural gas distribution network does not follow regional 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 regional natural gas consumption is not likely to be significant. Assumes distribution loss emissions based on the national average per MfE guidance and AR5 GWP.
Industrial Stationary Energy Emissions	<ul style="list-style-type: none"> No specific data was available for industrial stationary energy consumption with the exception of natural gas use for co-generation plants at the Fonterra Te Rapa plants and fugitive emissions from mining.

	<ul style="list-style-type: none"> Emissions from industrial consumption of coal and LPG have been estimated based on a top-down approach allocating national emissions on a per capita basis. Industrial stationary petrol and diesel use have been estimated based on total fuel sold within the region and the EECA Energy Enduse Database
Fugitive Emissions	<ul style="list-style-type: none"> Not included in the Inventory as there is no production of oil or gas within the district boundary. Fugitive emissions from coal have been included in industrial stationary energy emissions.
Coal	<ul style="list-style-type: none"> Emissions relating to the use of coal from residential & commercial activities have been included. Fugitive emissions from coal mining have been included under Stationary Energy (industrial emissions), based on the national average emissions factor for fugitive emissions from sub-bituminous coal mining reported by MfE.
Transportation Emissions	
Road	<ul style="list-style-type: none"> Total volume of fuel sold within the district was provided by Hauraki District Council. Fuel consumption figures (petrol and diesel) also include fuel used for off-road transport and recreational water transport, as these are sold through the same network. Due to lack of data these could not be reported separately.
Rail	<ul style="list-style-type: none"> this section will be updated once we have the final data from KiwiRail. Emissions from rail transport are estimated based on length of rail network and average fuel consumption per tonne km and freight volume as provided by Kiwi Rail for the 2018/19 financial year. The rail network in the Waikato is electric and diesel. 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. It was assumed that Diesel sold for rail transport is not included in the Waikato fuel sales data for road transport. Electricity emissions are estimated based on the total kWh consumed by KiwiRail and the national emissions factor for electricity generation, and transmission and distribution losses.
Aviation	<ul style="list-style-type: none"> Aviation fuel data sold/pumped at Hamilton could not be obtained during the data collection. Aviation emissions, from Jet Kerosene, have been estimated using the average number of plane movements understood to take place via the FlightAware.com website. The number of flights estimated is likely to be conservative as movements of large jet planes and some smaller planes. Planes departing and arriving at the same airport (e.g. tourist flights) have not been included. The estimated aviation emissions represent 50% of aviation related emissions associated with Air NZ movements at Hamilton in line with the GPC framework.

	<ul style="list-style-type: none"> Aviation gas fuel consumption for smaller aircraft (e.g. tourist flights) and helicopters were estimated based on conversation with aviation fuel experts.
LPG	<ul style="list-style-type: none"> LPG consumption is based on the total amount of LPG supplied to the North Island and calculated on a per capita basis using 2018/19 population estimates. LPG transportation energy estimates are based on the national share of automotive and forklift sales as provided by the LPG Association of New Zealand. LPG consumption estimate 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"> Estimated based on EECA – End-Use Energy Database applying a national average split to the total amount of petrol and diesel sold within the region.
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). Reliable historic population figures, provided by StatsNZ, only go back to 1986 therefore 30 years of data has been estimated for the Waikato Region Solid Municipal Waste emissions. Due to limited specific current and/or historic data for the Region, waste volumes sent to landfill for the Waikato Region have been estimated by applying the New Zealand national average waste generation per capita (reported by MfE, 2017) and using historic population figures reported by StatsNZ. Landfill gas emissions were estimated for landfills with and without landfill gas capturing systems. Data on specific waste composition was not available therefore this data has been modelled based on the national average waste composition reported by MfE (2017). Hauraki District sends all their waste to landfill at Tirohia, which has been collecting landfill gas since 2001.
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 insignificant^[1].
Wastewater Treatment	<ul style="list-style-type: none"> National Wastewater emissions from 2017 (MfE 2019) and population data from 2018/19 were used to calculate the per capita waste water treatment and disposal emissions, and the total waste water emissions from the Waikato Region. 2017 data was the most up to date information available from the New Zealand Greenhouse Gas Inventory 1990-2017.
Industrial Emissions	
Industrial Processes	<ul style="list-style-type: none"> No emissions from industrial processes have been included due to the lack of specific activity data. It is understood there are very few large industrial

^[1] Nationally, emissions from incineration of waste represent about 0.1% of the total waste emissions.

	operations resulting in emissions from chemical or physical processes taking place within the Waikato 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 2019).

C. Data Sources and Data Gaps

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

Table 4 Waikato Region GHG Inventory Data Sources – 2018/19

Emissions Category		Data Source
Stationary Energy		First Gas Limited Transpower Electricity Authority Genesis Energy (Huntley Power Station coal and gas use) LPG Association NZ MBIE (2015) Energy in NZ, Section K MBIE (2015) Data Tables for Coal MfE (2015) National Greenhouse Gas Inventory Report
Transportation		Air travel movements (FlightAware.com) KiwiRail LPG Association NZ Hauraki District Council fuel sales data Ministry of Business, Innovation & Employment (fuel properties)
Waste	Solid Waste	Waste Management Envirowaste Individual City and District Councils Internal Waste data
	Waste Water	MfE (2019) 1990-2017 National Greenhouse Gas Inventory Report
Industrial		MfE (2019) 1990-2017 National Greenhouse Gas Inventory Report
Agriculture		MfE (2019) 1990-2017 National Greenhouse Gas Inventory Report Statistics New Zealand (Agricultural production data)
Forestry		MPI (2018) National Exotic Forest Description Statistics New Zealand

A data gap analysis was undertaken during the data collection stage of the project. The following data gaps and alternative data sources were identified:

Table 5 Hauraki District GHG Inventory Data Gaps – 2018/19

Emissions Category		Data Gap	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 - Maritime fuel use (for small private vessels) 	<ul style="list-style-type: none"> - Assumed to be included in total fuel sales data - Estimated based on flight movements - Assumed to be included in the total diesel sales data for the district
Waste	Solid Waste	<ul style="list-style-type: none"> - Landfill gas collection efficiency for Tirohia - Historic waste volumes 	<ul style="list-style-type: none"> - National average collection efficiency - Assume national average waste generation per person (as outlined in the national GHG inventory by MfE)
	Waste Water	<ul style="list-style-type: none"> - No data for local wastewater treatment (Paeroa, Ngatea or Waihi) - number of people connected 	<ul style="list-style-type: none"> - Assume national average wastewater treatment emissions on a per capita basis
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"> - No estimates of cultivated organic soils within Hauraki District 	<ul style="list-style-type: none"> - Not estimated (not relevant possibly)
Forestry		<ul style="list-style-type: none"> - No data for Harvest Wood Products (i.e. what harvested wood is used for) - Insufficient data to estimate annual changes in land use (grassland, cropland, wetland, settlements and other land) 	<ul style="list-style-type: none"> - Assumed that all carbon stored in trees is released in the year of harvest - Not estimated