Environment Canterbury Greenhouse Gas Emissions 2017 Calendar Year

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1 INTRODUCTION

1.1 Organisation Description

Environment Canterbury is the Regional Council for Canterbury, the largest region in the South Island, New Zealand. Environment Canterbury's jurisdiction covers of all the river catchments on the east coast of the South Island from the Clarence River, north of Kaikoura, to the Waitaki River, in South Canterbury. This encompasses an area of just under 45,000 kilometres squared and a population of 612,000 people.

The Regional Council's vision is to facilitate sustainable development in the Canterbury region and has strategic responsibility across air, land and water. Environment Canterbury undertakes a wide range of responsibilities, which include regional policy and planning, land use consents, coastal permits, water permits, discharge permits, biosecurity, river engineering, transportation, and environmental monitoring.

Environment Canterbury employs approximately 650 staff. The main office is in Tuam Street, Christchurch, where the majority of the Council's staff are located. There is another key office in Timaru. Both offices are owned by Environment Canterbury.

1.2 Statement of Intent

New Zealand is a signatory to the Paris Agreement, adopted under the United Nations Framework Convention on Climate Change. The Agreement commits countries to take action on climate change, with the aim of limiting global average temperature increases, by reducing emissions. Achieving a low carbon economy will require action at all levels across society.

Environment Canterbury has a role in supporting the region and communities to better understand and proactively respond to climate change risks and opportunities. As an organisation with its own carbon footprint, Environment Canterbury seeks to reduce the greenhouse gas emissions from its day-to-day operations.

A greenhouse gas (GHG) inventory is a comprehensive analysis of all GHG emissions and removals from an organisation over a specified period of time. This report is the first annual GHG emissions inventory report undertaken by Environment Canterbury. The Council has no reporting obligation and this inventory has been undertaking on a voluntary basis, primarily for an internal audience, with the following key aims:

- Provide a base year for data, which will allow Environment Canterbury to understand their emission profile and subsequently track and compare GHG emissions or removals over subsequent years.
- Provide a starting point for action, which enables Environment Canterbury to make informed decisions when managing GHG emissions.
- Recommend measures to reduce emissions, thereby providing a means to encourage staff to contribute towards reducing emissions during their day-to-day work practices, through informed choices.

1.3 Approach and Scope

This report follows guidance given by the New Zealand Government, *Guidance for Voluntary Greenhouse Gas Reporting* (MfE 2016). These include adopting the methodology outlined by *The GHG Protocol* (World Business Council & World Resources Institute 2001) and *ISO 14064-1: 2006 standard* (International Standards Organisation 2006).

A GHG is a gaseous constituent of the atmosphere, both natural and anthropogenic. There are six GHGs [carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)] covered by ISO 14064-1: 2006 and the GHG Protocol. Each gas absorbs and emits radiation at different wavelengths, within a specific atmospheric residence time. These differences result in different global warming potentials (GWPs). In order to make comparisons, GHG emissions are typically measured as tonnes of carbon dioxide equivalent ($CO_{2\text{-}e}$) [note: in order to help the reader comprehend smaller units, this report uses kilograms as well as tonnes of $CO_{2\text{-}e}$]. The quantification methodology in this report uses calculations based on GHG activity data multiplied by GHG emissions or removal factors.

Activity data relates to a measure of activity that results in a GHG emission or removal (e.g. litres of diesel fuel from vehicle travel). Emissions factors are calculated from activity data to estimate GHG emissions. These emission factors have been calculated using GWPs sourced from the IPCC's Fourth Assessment Report (2007). Wherever possible the calculations in this report use actual activity data, which has been accurately recorded throughout the reporting period. However, there are data limitations and gaps with regards to some of Environment Canterbury's activity data. In these situations estimates have been made, by extrapolating available data across the entire year.

The *GHG Protocol* categorises emission sources into three activities, which are all covered by this report:

- ***Scope 1 Direct GHG emissions***: defined as 'emissions from sources that are owned or controlled by the organisation'. This scope includes stationary combustion (e.g. heating and generators), transport fuels, rental cars and taxis.
- ***Scope 2 Indirect GHG emissions***: defined as 'emissions from the consumption of electricity, steam, or other sources of energy generated upstream from the organisation'. This scope includes purchased electricity.
- ***Scope 3 Other indirect GHG emissions***: defined as 'emissions that are a consequence of the operations of an organisation, but are not directly owned or controlled by the organisation'. This scope includes transmission and distribution losses from purchased electricity, air travel and waste.

The calculations in this report are for gross and net GHG emissions, thereby including GHG removals. Environment Canterbury manages 2,700 hectares or forestry, which provides a carbon sink by taking up carbon dioxide from the atmosphere. Due to availability of data, only forestry associated with the Emissions Trading Scheme is included in this report.

1.4 Report Layout

This report is in two sections:

- **Section 1:** Outlines the GHG emissions and removals, with explanatory details on the activity data and emissions factors.
- **Section 2:** Provides more technical details on the methodology of how the activity data has been calculated (using either actual data, or estimates from samples), and specific figures relating to calculations.

1.5 Organisational Boundaries

Organisational boundaries have been determined as required by the methodology in the *ISO 14064-1: 2006 standard*, which allows for two approaches:

- ***Control***: the organisation accounts for all quantified GHG emissions and/or removals from facilities over which it has financial or operational control; or
- ***Equity share***: the organisation accounts for its portion of GHG emissions and/or removals from respective facilities.

This report takes an operational control consolidation approach to account for emissions, which is recommended as best practice. This approach allows Environment Canterbury to focus on the emissions sources over which the organisation has control and can consequently implement management decisions.

Environment Canterbury does have responsibilities for other areas, including planning and tendering out the bus and ferry services, marketing and providing information such as timetables, telephone services and websites. The city and district councils are responsible for the transport infrastructure, including bus exchanges, stops and shelters. Red Bus Ltd, Go Bus Ltd, Ritchies Transport Holdings Limited and Black Cat Ltd are responsible for supplying the vehicles and drivers for the bus and ferry routes that they have been awarded through tender processes for the Greater Christchurch and Timaru passenger transport network. As Environment Canterbury makes no operational decisions about the day-to-day running of these services, and has no direct control over the infrastructure and vehicles, the emissions for the transport network has been excluded.

1.6 Operational Boundaries & Exclusions

This report focuses on Environment Canterbury's two main offices:

- ***Tuam Street Office***: The Christchurch office has been in full operation since April 2016, and is designed to accommodate over 450 staff. The building has five floors across two wings, encompassing a total area of 9,600 square metres, of which 7,000 square metres are dedicated to office space. The building has a best practice 4 Green Star rating, which assesses energy, water, materials, indoor environmental quality, transport, land use and ecology, management, emissions and innovation when rating a building's overall environmental impact.
- ***Timaru Office***: The Timaru office is located in Church Street and accommodates 100 staff. In 2014 the renovations on this office were completed.

Outside of the two main offices a number of staff members are located at regional facilities. The Regional Council has a varying degree of control over the 15 sites that these staff occupy, with facilities either owned or leased by Environment Canterbury. These facilities are all relatively minor, housing between two and ten staff members. Some staff members are also co-located with other organisations (e.g. Kaikoura District Council).

This report excludes all direct and indirect emission associated outside of the Tuam Street and Timaru Offices. The *ISO 14064-1: 2006 standard* allows exclusions of direct or indirect emissions, which are not material or whose quantification would not be technically feasible or cost effective. This report also excludes emissions from refrigerants which are a scope 3 emission. HFCs are associated with unintentional leaks and spills from refrigeration units, air conditioners and heat pumps. However, these emissions are estimated to be *de minimus*, being well below the 5% threshold of the entire inventory.

1.7 Reporting Period: Calendar Year 2017

This report covers the period from 1 January 2017 to 31 December 2017, which will be established as a base year for comparative purposes within future reports. It is recommended that Environment Canterbury undertakes a GHG emissions inventory annually.

Organisations can choose to report on a calendar or financial year basis. In this instance the 2017 calendar year has been chosen as the base year, due to the availability of data during this period. During recent years Environment Canterbury has changed providers across many of the key activity areas, with data being more limited and harder to access prior to the start of 2017. Furthermore, Environment Canterbury moved into the Tuam street office in mid-2016. Therefore, it was determined that it would be reasonable to allow for a 'settling-in' period of six months, while staff, systems and operations became accustomed to the new building.

2 TOTAL EMISSIONS

This total gross carbon dioxide equivalents for Environment Canterbury's Tuam Street and Timaru Offices are **914 tonnes**. This equates to 2 tonnes per staff member (based on 450 staff in the two offices). The most significant emissions are associated with transportation and travel, which are 79% of all emissions:

Scope	Activity	Activity Data	Units	Kilograms				Tonnes			
				Total CO_{2-e}	CO_{2-e}	CH_4	N_2O	Total CO_{2-e}	CO_{2-e}	CH_4	N_2O
Scope 1	Stationary Combustion	14,080	Litres: Diesel	37,875	37,593	128	92	37.9	37.6	0.1	0.1
Scope 1	Transport Fuels	248,691	Litres: Fuel	639,921	619,724	3,626	15,352	639.9	619.7	3.6	15.4
Scope 1	Rental Vehicles	20,135	Kilometres	4,208	4,027	42	137	4.2	4.0	0.0	0.1
Scope 1	Taxis	20,174	Kilometres	4,025	3,853	41	131	4	3.9	0.0	0.1
Scope 2	Purchased Electricity	1,023,016	kWh	121,739				121.7	0.0	0.0	0.0
Scope 3	Transmission & Distribution Losses	1,023,016	kWh	9,923				9.9	0.0	0.0	0.0
Scope 3	Air Travel	570,036	Kilometres	77,843				77.8	0.0	0.0	0.0
Scope 3	Waste	24,787	Kilograms	17,995				18.0	0.0	0.0	0.0
	Environment Canterbury Total			**913,529**	**665,197**	**3,838**	**15,713**	**914**	**665**	**3.8**	**16**

Table 2-1 Total Emissions

Scope 1 emissions account for the largest proportion of emissions:

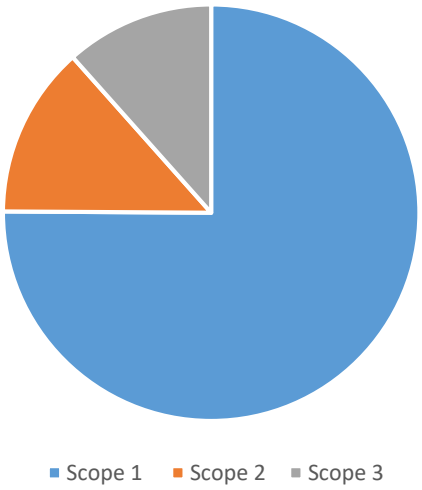

Figure 2.1 Total Emissions by Scope

Scope 1: Direct GHG emissions, including stationary combustion, transport fuels, rental cars and taxis.

Scope 2: Indirect GHG emissions, including purchased electricity.

Scope 3: Other indirect GHG emissions, including transmission and distribution losses from purchased electricity, air travel and waste.

By activity transport fuels accounting for 70% of total emissions, purchased electricity 13%, and air travel 9%:

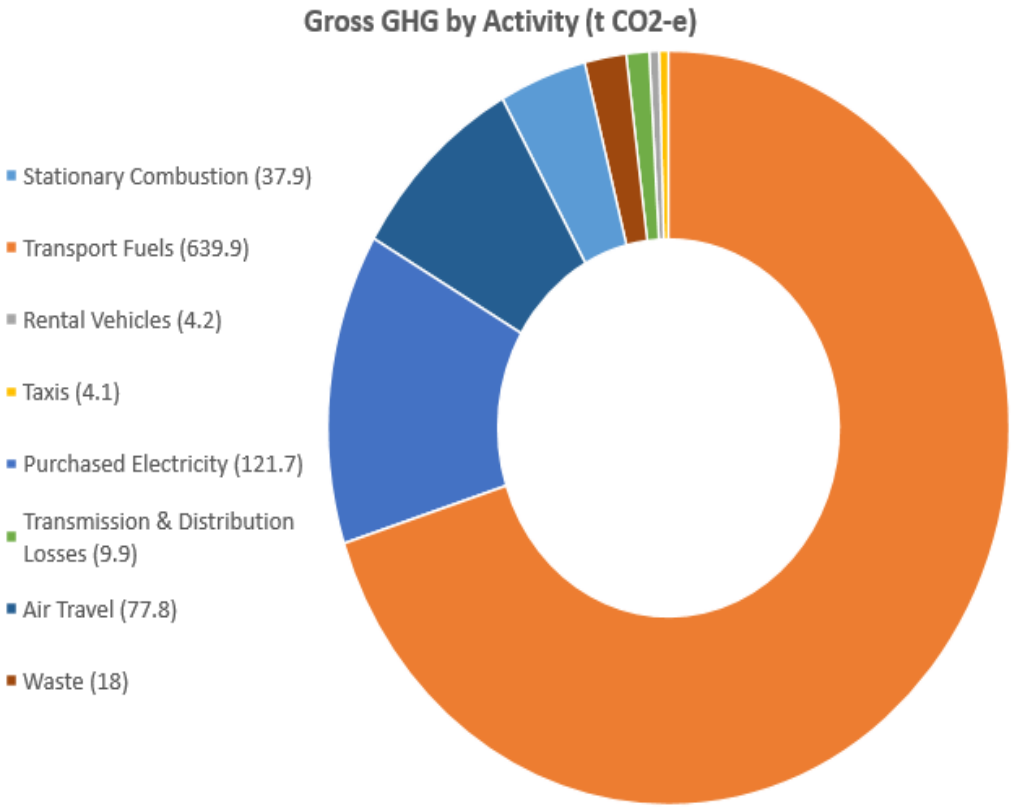

Figure 2.2 Total Emissions by Activity

3 EMISSION SOURCE METHODOLOGY

This following table provides a summary of the methodology and data sources. For full details see Section 2.

Scope	Category	Emissions Source	Data Source	Methodology/ Uncertainties
1	Stationary combustion of fuels	~250 kVA diesel generator at Tuam Street.	Diesel generator fuel (dollars).	Estimate based on good records of dollars spent on diesel, and utilising average cost of a litre of fuel.
1	Transport Fuels	Fleet of 100 vehicles, using regular/ premium petrol & diesel.	Fuel summary 2017 (litres per vehicle).	Actual emissions based on vehicles associated with the Tuam Street and Timaru Offices. Significant emissions from the remaining fleet vehicles have not been included in overall inventory, as focus is on two main offices (Tuam Street & Timaru).
1	Rental Cars	Default rental vehicles (1600 -< 2000 cc category).	Orbit World Travel data for Environment Canterbury.	Estimate based on four month sample, using available kilometre travelled records and number of car rental days. High uncertainty due to incompleteness of available records.
1	Taxis	Default taxi (average of the 1350 - < 1600 & 1600 - <2000 categories).	Orbit World Travel data for Environment Canterbury.	Estimate based on four month sample, using airport data and kilometres to/ from airport to office/ CBD. High uncertainty due to lack of attainable records on actual taxi use.
2	Purchased Electricity	Electricity consumed in Tuam Street & Timaru Offices.	Tracking energy data.	Actual energy use: Kilowatt hour (kWh).
3	Transmission & Distribution Line Losses	Electricity consumed in Tuam Street & Timaru Offices.	Tracking energy data.	Actual energy use: Kilowatt hour (kWh).
3	Air Travel	Domestic and international flights	Orbit World Travel data for Environment Canterbury.	Estimate based on four month sample, using complete available flight records, including cabin class, and kilometres travelled. Assumes all flights booked through Orbit.
3	Waste to Landfill	Default office waste emission factor.	Tuam Street Waste data	Actual volumes of commercial waste sent to landfill from Tuam Street. Estimate and uncertainty for Timaru Office, as data based on Tuam Street waste per staff member data.

Table 3-1 Methodology and Data Sources

4 GREENHOUSE GAS EMISSIONS

The following sections provide results for each GHG emission across each scope, along with initial recommendations that Environment Canterbury may consider to reduce emissions further. Environment Canterbury has no formal strategy for achieving a lower footprint, however considers it as an important factor as part of the decision making process. Overall recommendations are to:

- ✓ Develop a climate action management plan, including targets, for managing and reducing emissions.
- ✓ Establish training opportunities (including staff inductions) and communications to ensure that all staff are aware of their impact on the organisation's emissions; make data available to staff to understand Environment Canterbury's emissions inventory and their own contribution to it.
- ✓ Address gaps in record keeping to prevent data limitations in future emission inventories.
- ✓ Undertake an annual emissions inventory and consider applying for programme certification.

4.1 Scope 1. Emissions

4.1.1 Stationary Combustion of Fuels

Stationary combustion emissions result from sources such as heaters, generators, and boiler, which generate heat, energy and hot water.

The only significant form of stationary combustion utilised in the two offices is a ~250 kVA generator at Tuam Street, which is used to reduce electricity network demand during peak periods. Diesel is the fuel used to run this generator, however consumption is relatively minor.

Diesel Commercial		Emissions Factors (kg)			
	Litres	Total $CO_{2\text{-}e}$	$CO_{2\text{-}e}$	CH_4	N_2O
Total Activity Data	**14,080**	**37,875 [37.9 tonnes]**	**37,593**	**128**	**92**

Table 4-1 Stationary Combustion of Fuels Emissions

Note that the reason that the emission weight is higher than the starting weight of the diesel fuel, is that through the combustion process oxygen is added to create carbon dioxide.

4.1.2 Transport Fuels

Environment Canterbury has an extensive fleet of vehicles, with 100 of the total 158 vehicles associated with the Tuam Street and Timaru Offices. These vehicles generate emissions through the consumption of fuel.

The Council encourages the use of alternative, low carbon transport options to staff, such as cycling and public transport. Electric bikes have recently been added as another way for staff to get to meetings in other parts of the city, with electric scooters also under consideration. Environment Canterbury does not currently have electric cars in its fleet due to the high capital cost of the vehicles and infrastructure, however is a foundation member of the Yoogo electric car sharing scheme in Christchurch (http://www.yoogo.co.nz/).

Environment Canterbury have been repositioning the fleet within the allocated capital budget, with the 4WD vehicles taking priority. Environment Canterbury is aiming to have 50% of the passenger vehicles to be electric by 2020. However, in a region the size of Canterbury and the terrain that staff work in, vehicles are necessary for the Council to undertake its work. Face to face meetings will continue to be an important way to effectively reach organisational goals

GHG emissions from vehicles depend on the amount of fuel that is consumed. When fuel is burnt in a vehicle the reaction results in the release of carbon dioxide, along with other compounds that include nitrous oxides and sulphide. Different fuels have different GWPs (Global Warming Potentials), with Environment Canterbury's vehicles using a range of fuels that include regular petrol (48% of emissions), premium petrol (2%), and diesel (50%):

	Regular Petrol	**Premium Petrol**	**Diesel**	**Emissions Factors (kg)**			
	Litres			**Total $CO_{2\text{-}e}$**	**$CO_{2\text{-}e}$**	**CH_4**	**N_2O**
Timaru Office	36,118	735	53,987	236,760	230,014	1,099	5,212
Tuam Street	89,017	4,369	64,464	403,161	389,709	2,527	10,141
Total Activity Data	**125,135**	**5,105**	**118,452**	**639,921 [640 tonnes]**	**619,724**	**3,626**	**15,352**

Table 4-2 Transport Fuels Emissions

R*ecommendations:*

- ✓ Expand future GHG emissions inventories to include Environment Canterbury's entire fleet.
- ✓ Consider opportunity to offset carbon emissions when travel costs are passed onto third parties, such in resource consent applications, with fees used in carbon offset schemes.
- ✓ Encourage staff to use alternative transport options for appropriate trips rather than being a single occupant in a fleet vehicle.
- ✓ Use video conferencing as an alternative to face-to-face meetings whenever possible.
- ✓ Transition to small engine vehicles, electric cars and hybrids.

4.1.3 Rental Cars

Rental cars are primarily used by staff when working outside of the region. Based on available data Environment Canterbury incurred an estimated 186 days of rental car charges in 2017, with an average of 108 kilometres travelled per day.

Rental Car (mid-size)		Emissions Factors (kg)			
	Kilometres	Total $CO_{2\text{-}e}$	$CO_{2\text{-}e}$	CH_4	N_2O
Total Activity Data	20,135	4,208 [4.2 tonnes]	4,026	42.5	137

Table 4-3 Rental Cars Emissions

Recommendation:

- ✓ Improve travel booking record keeping for rental car use, to capture usage ideally including litres of fuel consumed, so that accurate calculations of GHG emissions can be undertaken.

4.1.4 Taxis

Taxis are used by staff for a range of reasons, including to and from domestic airports. Staff are also encouraged to use buses whenever possible. Data is extremely limited on actual usage, so this report makes an estimated based on assumed taxi journeys to and from airports.

Taxis		Emissions Factors (kg)			
	Kilometres	Total $CO_{2\text{-}e}$	$CO_{2\text{-}e}$	CH_4	N_2O
Total Activity Data	20,174	4,025 [4 tonnes]	3,853	41	131

Table 4-4 Taxis Emissions

Recommendations:

- ✓ Improve travel booking record keeping for taxi use, so that accurate figures for kilometres travelled can be captured.
- ✓ Ensure that staff members share taxis whenever possible, or utilise buses.

4.2 Scope 2. Emissions

4.2.1 Purchased Electricity

These are indirect emissions from energy, consumed in owned or controlled equipment by Environment Canterbury, but generated by another company. Meridian Energy supplies electricity to Environment Canterbury, via the electricity distribution company Orion.

In the commissioning review of Environment Canterbury's new Tuam Street office it was estimated that the office would use approximately 1,105,500 kWh/year of electricity, with an energy intensity for the building of 158 kWh per square metre a year (Enercon 2017). However, for the 2017 calendar year actual electricity consumption for Tuam Street was 921,976 kWh, with an energy intensity of 132 kWh per square metre. This lower than predicted annual consumption may be the result of improved energy management.

Electricity consumption at the Timaru Office was 101,040 kWh for 2017.

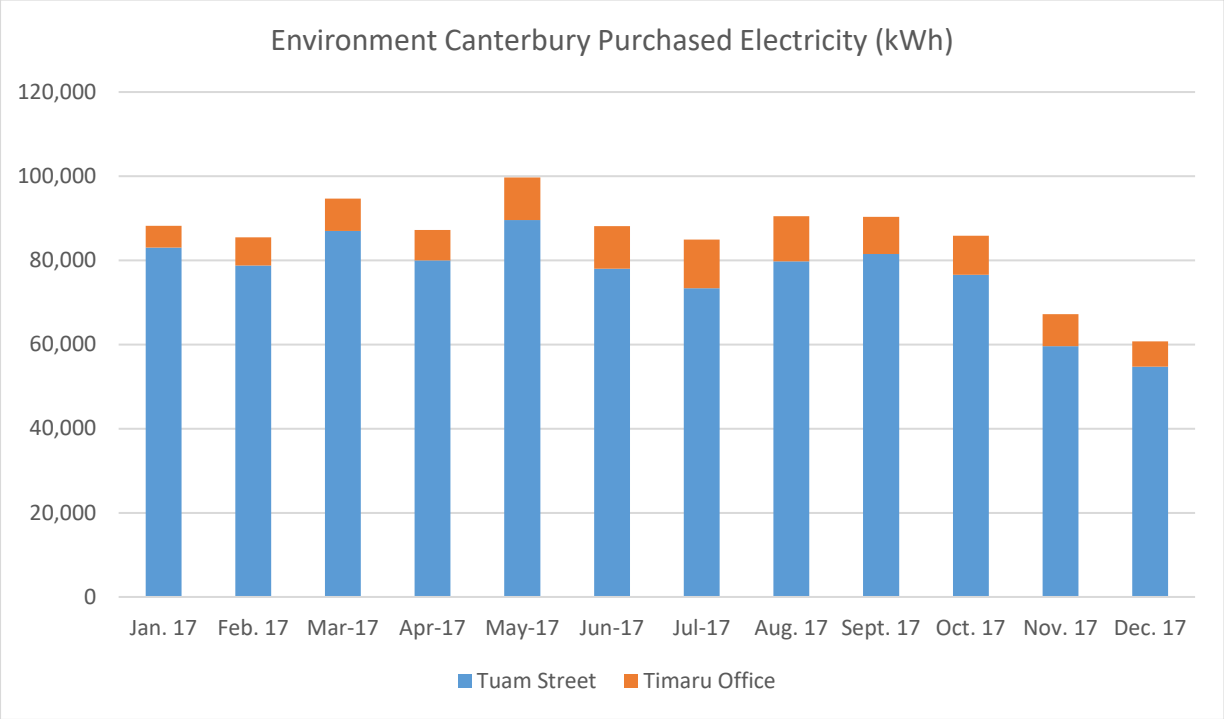

Figure 4.1 Purchased Electricity (kWh)

As with fuels for stationary combustion emission factors, this emission factor does not incorporate emissions associated with the extraction, production and transport of the fuels used in the production of electricity.

Purchased Electricity	**Unit**	**Total CO_{2-e}**
Emissions Factor	*kWh*	*0.119*
Tuam Street Activity Data	921,976	109,715 [110 tonnes]
Timaru Office Activity Data	101,040	12,024 [12 tonnes]
Total Environment Canterbury Activity Data	**1,023,016**	**121,739 [122 tonnes]**

Table 4-5 Purchased Electricity Emissions

The following table details the amounts of electricity consumed and emissions produced from purchased electricity per staff member. These figures are based on 450 staff members at Tuam Street and 100 staff members at the Timaru Office:

Per Staff Member	**kWh**	**Total CO_{2-e} (kg)**
Tuam Street	2,049	244
Timaru Office	1,010	120
Both Offices	**1,860**	**221**

Table 4-6 Purchased Electricity Emissions per Staff

Recommendations:

- ✓ Continue to implement the range of energy management opportunities recommended by Enercon (2017), including implementing controlled lighting, and placing computers in sleep mode.
- ✓ Undertake further energy audits every five years.
- ✓ Develop internal awareness raising initiatives to make staff more energy aware, including training, communication and general encouragement.

4.3 Scope 3. Emissions

These indirect emissions are a consequence of the activities of Environment Canterbury, but are not owned or controlled by the organisation.

4.3.1 Transmission & Distribution Line Losses for Purchased Electricity

This factor accounts for emissions from generation, required to compensate for electricity lost in the transmission and distribution network, resulting from inefficiencies in the grid.

Electricity Transmission & Distribution Losses	**kWh**	**Total $CO_{2\text{-}e}$ (Kg)**
Tuam Street Activity Data	921,976	8,943 [9 tonnes]
Timaru Office Activity Data	101,040	980 [1 tonne]
Total Activity Data	**1,023,016**	**9,923 [10 tonnes]**

Table 4-7 Electricity Transmission and Distribution Losses Emissions

4.3.2 Air Travel

Air travel emissions are based on the total distance travelled and on the area of the plane that each passenger takes up. If a plane is comprised totally of business-class seats, as opposed to more densely-packed economy class seats, this means that fewer passengers can fly. Therefore, business class travel incurs higher emissions. However, all flights undertaken by Environment Canterbury were in economy class. The emission factors in this report refer to direct carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions only. The science around other impacts, such as water vapour and NO_x is currently uncertain and these other aviation gases and effects have not been taken into account. However, the calculations in this report do take into account non-direct routes taken by plans and delays/ circling.

International: Environment Canterbury undertakes a limited number of international flights, at just under 20 per year, of which all in 2017 were short haul (less than 3,700 kilometres) to and from Australia.

Domestic: Staff from Christchurch and Timaru made just under 1,000 domestic flights in the report year, travelling to a total of 14 different domestic destinations. Christchurch Airport in understandably the most popular destination (with 44% of domestic flights), followed by Wellington (25%), Auckland (10%), and Hamilton (11%).

Flights	**Emissions Factors**	
Class	**Kilometres**	**Total $CO_{2\text{-}e}$ (kg)**
International	47,997	4,021 [4 tonnes]
Domestic	522,039	73,822 [74 tonnes]
Total Activity Data	**570,036**	**77,843 [78 tonnes]**

Table 4-8 Air Travel Emissions

Recommendations:

- ✓ Use video conferencing as an alternative to face-to-face meetings whenever possible.
- ✓ Evaluate and where possible reduce the number of staff that need to travel to meetings in other parts of the country.

4.3.3 Waste to Landfill

The biological decomposition of waste, particularly organic matter, in landfills results in the production of landfill gases. The main gases produced are carbon dioxide (CO_2) and methane (CH_4). Methane is of particular concern, being a potent greenhouse gas that has a global warming potential that is over 21 times that of carbon dioxide (IPCC 2007). Methane can be destroyed through combustion, with some landfills recovering, flaring or combusting methane for energy. Consequently, there is an adjustment for the emissions factors for organisations that send their waste to landfills with landfill gas collection systems.

Tuam Street Office has excellent facilities and systems of separating out waste, as well as detailed records on volumes of waste produced.

Organic waste, such as food scraps, are collected for composting. Mixed plastic and metal materials are separated for recycling, along with paper and cardboard.

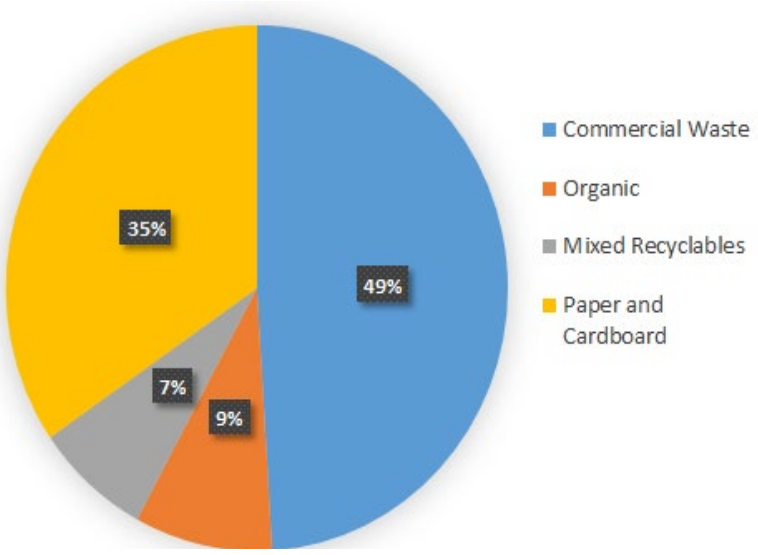

Figure 4.2 Composition of Waste

The remaining waste, which is approximately half of all waste produced, is sent to landfill. However, the exact composition of this waste is not known. The receiving landfill, Kate Valley at Amberley, has landfill gas collection and energy generation systems in place.

Timaru Office also separates waste for recycling and composting, however this office does not keep detailed records on volumes of waste produced. Consequently, this report has utilised Tuam Street data in order to give an estimate of potential volumes. The receiving landfill, Redruth, has landfill gas collection and flaring systems in place.

Waste to landfill	**Tonnes**	**Total $CO_{2\text{-}e}$ (kg)**
Tuam Street Activity Data	20,280	14,723 [15 tonnes]
Timaru Office Activity Data	4,507	3,272 [3 tonnes]
Total Activity Data	**24,787**	**17,995 [18 tonnes]**

Table 4-9 Waste to Landfill Emissions

Recommendations:

- ✓ Establish systems for recording waste at Timaru Office.
- ✓ Undertake waste audits at both offices in order to develop a detailed understanding of the types of waste produced, and therefore determine the exact greenhouse gas emissions factor.

5 REMOVALS

5.1 Background

Environment Canterbury has extensive landholdings of 25,800 hectares, which includes:

- 11,000 hectares that are leased for a variety of purposes, predominantly agriculture.
- 11,800 hectares that is river bed and berm land, with variable crown cover.
- 3,000 hectares of pine forest, which is comprised of:
    - 605 hectares of post 1989 forest.
    - 2,395 hectares of pre 1990 forest.

Ecosystems, including forests, play an important role in the stocks and flows of the global carbon cycle. Forests can act as carbon sinks when trees absorb carbon from the atmosphere through photosynthesis. The carbon stock is measured by the amount of carbon stored in the tree's biomass - the roots, trunk, branches and leaves. This process is referred to as carbon sequestration. Conversely, forests can act as emission sources, with carbon released into the atmosphere through respiration, and in more significant volumes when trees burn or decay after dying. Carbon stock values are expressed in units of tonnes of carbon dioxide equivalents per hectare. They are equivalent to the weight of carbon dioxide that is removed from the atmosphere and stored in the forest during growth. This is also the same weight of carbon that would be released back to the atmosphere if the forest fully decayed.

5.2 Emissions Trading Scheme

Environment Canterbury participates in the Emissions Trading Scheme (ETS). The ETS puts a price on GHG emissions and encourages landowners to establish and manage forests in a way that increases carbon storage. Eligible post 1989 forest can voluntarily become part of the scheme, earning New Zealand emissions units (NZUs), which must be surrendered if trees are subsequently deforested or removed through burning. One NZU represents one tonne of carbon dioxide. These units can be held or bought or sold within New Zealand.

This report only focuses on forest owned and managed by Environment Canterbury, which is reported under the ETS. Data is not available for other forests. There is uncertainty over the amount sequestered by these other forests, as carbon flows will depend on a range of attributes, including species type and age. Leased land is out of Environment Canterbury's day-to-day control and has not been examined in this report.

5.3 Forestry Removals

The calculations in this report utilise Environment Canterbury's Mandatory Emissions Returns under the ETS for the current five year reporting period:

Forestry	**Removal Factors**	
	Hectares	**Total CO_{2-e}**
Post 1989 forest	605	(7,883)

Table 5-1 Forestry Removals

5.4 Double Counting & Offsetting

Double counting occurs when emissions have been offset in the GHG emissions inventories of two different organisations. This applies to forest registered under voluntary offsetting, as well as national level schemes. Any carbon removals used for offsetting cannot be further traded. The Council has a policy of retaining NZUs. Consequently, there has been no double-counting by Environment Canterbury with regards to these removals.

If Environment Canterbury's ETS policy changes in the future then the Council must be aware of double counting prior to selling any NZUs. The amount of carbon removals through forestry provides a significant balance to Environment Canterbury's emissions. These forestry removals currently offset the Council's emissions by a factor of just under nine (914 tonnes of emissions and 7,883 tonnes of removals). Although, it must be noted that these emissions do not include the wider vehicle fleet.

Caution should be used by organisations when attempting to claim the offsetting of emissions through forests that are also accounted for at the national level. Without due care, claiming offsets through this route can lead to double counting. The purpose of this report has been to establish a GHG inventory for Environment Canterbury's emissions, and the sequestration through the Council's forests. Establishing the extent to which forests formally offset Environment Canterbury's emissions will require assessment and advice not within scope of an inventory.

Recommendations:

- ✓ Continue to positively manage forestry in order to provide a carbon sink and reduce Environment Canterbury's GHG footprint.
- ✓ Determine Environment Canterbury's future policy with NZUs and the balance between offsetting requirements and potentially selling units.

6 NET EMISSIONS

Taking into account Environment Canterbury's emissions outlined in the previous section and the above forest removals results in net emissions of (6,969) tonnes:

	Total $CO_{2\text{-}e}$
Environment Canterbury Gross Emissions	914
Environment Canterbury Removals	(7,883)
Net Emissions	(6,969)

Table 6-1 Net Emissions

Environment Canterbury's forest removals ensure that the Council is making a positive contribution towards reducing its impact on climate change. However, in subsequent GHG inventories it is recommended that wider implications are also taken into account, including GHG emissions from the wider vehicle fleet and operations. This will allow the Council to have a deeper understanding of the gross and net emissions.

7 SUMMARY OF RECOMMENDATIONS

Scope	Recommendation
General	✓ Develop a climate action management plan, including targets, for managing and reducing emissions. ✓ Establish training opportunities (including staff inductions) and communications to ensure that all staff are aware of their impact on the organisation's emissions; make data available to staff to understand Environment Canterbury's emissions inventory and their own contribution to it. ✓ Address gaps in record keeping to prevent data limitations in future emission inventories. ✓ Undertake an annual emissions inventory and consider applying for programme certification, which confirms that the inventory is a fair representation of the actual situation.
Transport Fuels	✓ Expand future GHG emissions inventories to include Environment Canterbury's entire fleet. ✓ Consider opportunity to offset carbon emissions when travel costs are passed onto third parties, such in resource consent applications, with fees used in carbon offset schemes. ✓ Encourage staff to use alternative transport options for appropriate trips rather than being a single occupant in a fleet vehicle. ✓ Use video conferencing as an alternative to face-to-face meetings whenever possible. ✓ Transition to small engine vehicles, electric cars and hybrids.
Rental Cars	✓ Improve travel booking record keeping for rental car use, to capture usage ideally including litres of fuel consumed, so that accurate calculations of GHG emissions can be undertaken.
Taxis	✓ Improve travel booking record keeping for taxi use, so that accurate figures for kilometres travelled can be captured. ✓ Ensure that staff members share taxis whenever possible, or utilise buses.
Purchased Electricity	✓ Continue to implement the range of energy management opportunities recommended by Enercon (2017), including implementing controlled lighting, and placing computers in sleep mode. ✓ Undertake further energy audits every five years. ✓ Develop internal awareness raising initiatives to make staff more energy aware, including training, communication and general encouragement.
Air Travel	✓ Use video conferencing as an alternative to face-to-face meetings whenever possible. ✓ Evaluate and where possible reduce the number of staff that need to travel to meetings in other parts of the country.
Waste to Landfill	✓ Establish systems for recording waste at Timaru Office. ✓ Undertake waste audits at both offices in order to develop a detailed understanding of the types of waste produced, and therefore determine the exact greenhouse gas emissions factor.
Forestry	✓ Continue to positively manage forestry in order to provide a carbon sink and reduce Environment Canterbury's GHG footprint. ✓ Determine Environment Canterbury's future policy with NZUs and the balance between offsetting requirements and potentially selling units.

Table 7-1 Summary of Recommendations

8 METHODOLOGY

GHG emissions sources were identified with reference to the methodology described in the GHG Protocol and ISO14064-1: 2006 standards.

Identification of emissions sources was undertaken via communications with Environment Canterbury staff, using established databases for Environment Canterbury's activities. Where available records exist, calculations used actual data for the entire 2017 calendar year. In other cases, available records were utilised as a sample, with data then extrapolated across the entire year in order to provide a best estimate. In these instances data was also checked against available records for the 2018 year, so that any anomalies could be identified.

Emission Factors have been sourced using best available recommendations, predominantly obtained from the Ministry for the Environment, in order to ensure that they are the most applicable for a New Zealand context.

Note all emissions in this section are in kilograms, unless otherwise stated.

8.1 Scope 1.

8.1.1 Stationary Combustion of Fuels

There is no data on actual litres of diesel utilised by the generator at Tuam Street, with records only showing expenditure. Consequently, this report has used total expenditure and average annual prices of diesel to determine estimated litres of fuel:

- Average 2017 price of commercial diesel fuel, excluding GST: $0.7908/ litre (MBIE 2018).
- Environment Canterbury direct spend on diesel fuel of $3,464, plus credit note from electricity supplier of $7,670, giving a total of $11,134.
- $11,134 (total fuel cost) divided by $.07908 (average price/ litre) results in a total of 14,080 litres of diesel

Diesel Commercial		**Emissions Factors**			
	Unit	**Total $CO_{2\text{-}e}$**	**$CO_{2\text{-}e}$**	**CH_4**	**N_2O**
Emission Factors	Litre	2.69	2.67	0.00912	0.00652
Environment Canterbury Total	**14,080**	**37,875**	**37,593**	**128**	**92**

Table 8-1 Stationary Combustion of Fuel Calculations

8.1.2 Transport Fuels

Environment Canterbury has records for vehicle fleet use, with data for each vehicle. These records include total litres of fuel, which provides the most accurate way to quantify vehicle emissions. Driver behaviour and individual engine performance are not taken into account. As this study has focussed on the two main offices, only vehicles associated with Tuam Street and Timaru Office have been included in this GHG emissions inventory. This incorporates a total of 100 vehicles. The $CO_{2\text{-}e}$ per activity unit emission factors are derived by the Ministry of Business, Innovation and Employment using calorific values, and incorporate relevant oxidation factors sourced from *The IPCC Guidelines for National Greenhouse Gas Inventories* (2006).

		Emissions Factors			
Fuel	**Unit**	**Total $CO_{2\text{-}e}$**	**$CO_{2\text{-}e}$**	**CH_4**	**N_2O**
Regular petrol	Litre	2.44	2.33	0.0246	0.0793
Premium petrol	Litre	2.43	2.33	0.0247	0.0797
Diesel	Litre	2.72	2.67	0.00356	0.0424

Table 8-2 Transport Fuels Emissions Factors

Group	**Regular Petrol**	**Premium Petrol**	**Diesel**	**Total $CO_{2\text{-}e}$**	**$CO_{2\text{-}e}$**	**CH_4**	**N_2O**
Timaru	554	26	1,151	4,546	4,425	18	95
Timaru Biosecurity	15	0	15,898	43,280	42,483	57	675
Timaru Groundwater	0	0	5,186	14,105	13,846	18	220
Timaru Hydrology	360	0	20,113	55,586	54,541	80	881
Timaru Investigation & Incident R.	4,280	0	0	10,443	9,972	105	339
Timaru Managers	2,659	0	538	7,952	7,632	67	234
Timaru Pool Cars	23,883	710	8,191	82,279	79,171	634	2,298
Timaru Surface Water	4,356	0	0	10,627	10,148	107	345
Timaru River Engineering	0	0	318	864	848	1	13
Timaru Survey	11	0	2,592	7,078	6,948	10	111
Executive Management Group	4,902	3,663	3,704	30,936	29,845	224	838
Tuam St. Air Quality	0	0	1,732	4,710	4,624	6	73
Tuam St. Biosecurity	3,707	0	3,417	18,340	17,762	103	439
Tuam St. Investigation & Incident R.	7,709	66	5,028	32,646	31,540	209	830
Tuam St. Pool Cars	46,996	211	10,171	142,847	137,148	1,198	4,175
Tuam St. Property	8,354	22	23,570	84,548	82,448	290	1,664
Tuam St. River Engineering	0	0	4,023	10,943	10,742	14	171
Tuam St. RMO	1,534	287	0	4,440	4,243	45	145
Timaru Office Total	**36,118**	**735**	**53,987**	**236,760**	**230,014**	**1,099**	**5,212**
Tuam Street Total	**89,017**	**4,369**	**64,464**	**403,161**	**389,709**	**2,527**	**10,141**
Environment Canterbury Total	**125,135**	**5,105**	**118,452**	**639,921**	**619,724**	**3,626**	**15,352**

Table 8-3 Transport Fuels Calculations

Emissions Profile for Entire Fleet (Including satellite offices): In total there are 238 vehicles within the fleet, which include cars, heavy vehicles, tractors, a bulldozer, a jet boat, a jet ski and two motor bikes. The majority of this fleet is determined to be outside the boundaries of this inventory which is solely focused on Tuam Street and Timaru Offices. However, for completeness, the following tables outline the emissions associated with the entire fleet, in order to provide a comparison with the vehicles associated with the two main offices.

In summary, emissions from vehicles associated directly with the two main offices represent 33% of total fleet emissions.

The Council is in the process of changing suppliers, so calculations have involved analysis of litres of fuel purchased from three different providers:

	Regular 91	Premium 95	Diesel	Total
LeasePlan	169,610	5,565	509,393	**684,567**
BP	16,729	628	16,212	**33,569**
McKeown	5,934	940	22,948	**29,822**
Total Fuel	**192,273**	**7,133**	**548,553**	**747,959**

Table 8-4 Litres of Fuel Purchased

The high volumes of regular petrol and in particularly of diesel, results in a large volume of GHG emissions:

Fuel	Litres	Total $CO_{2\text{-}e}$	$CO_{2\text{-}e}$	CH_4	N_2O
Regular petrol	192,273	469,147	447,997	4,730	15,247
Premium petrol	7,133	17,332	16,619	176	568
Diesel	548,553	1,492,065	1,464,638	1,953	23,259
Environment Canterbury Total		**1,978,544**	**1,929,253**	**6,859**	**39,074**

Table 8-5 Transport Fuel Calculations

8.1.3 Rental Cars

Records for rental car use were obtained from Orbital World Travel, Environment Canterbury's travel agent. In mid-2017 Environment Canterbury changed travel agents and earlier records from the previous provider are not attainable. Consequently, data for rental car usage is only available from September 2017. Records only include basic car-hire details, including name of staff member, dates, and car type. Only a few records include actual kilometres travelled. As such, the calculations in this report are based on extremely limited data within a four month period, and there is consequently a high level of uncertainty:

- Average daily travel based on only four days of recorded travel was 108.25 kilometres/ day.
- Across a four month period Environment Canterbury incurred 62 days of rental car charges. Rental car use is deemed to be fairly consistent throughout the year, so this data has been extrapolated to give 186 days of rental car across an entire year.
- 186 days at 108.25 kilometres results in an estimate of 20,135 kilometres travelled in rental vehicles for 2017.

The most accurate way to calculate emissions is based on fuel consumption data. However, this data is not available so calculations have been based on kilometres travelled. The default emission factor for rental cars is the same as that for vehicles in the 1600 -<2000 cc category:

Rental Car		Emissions Factors			
Class Size	**Unit**	**Total CO_{2-e}**	**CO_{2-e}**	**CH_4**	**N_2O**
1600<2000 cc	Kilometres	0.209	0.2	0.00211	0.00681
Environment Canterbury Total	**20,135**	**4,208.1**	**4,026.9**	**42.5**	**137.1**

Table 8-6 Rental Car Calculations

8.1.4 Taxis

There are no records for taxi use, either in terms of dollar spent or kilometres travelled. Anecdotal evidence suggests that most taxis are used for transportation to and from airports in New Zealand. Other destinations are unknown, so only airports have been used in order to make calculations. Therefore, in order to determine taxi usage this report has used domestic flight records obtained from Orbital World Travel. These records are only available for the final four months in 2017, so data has been extrapolated to give an annual estimate.

The road distance to the CBD for each airport has been calculated, as well as the distance from Environment Canterbury's offices to respective airports. The number of trips are multiplied by the distance, to give an estimate of taxi kilometres. It has been assumed that when more than one staff member is on the same flight then a taxi is shared.

City	Distance Airport to CBD (km)	4 Month Sample Period		2017 Annual Estimate			
		No. Taxi Trips	**Taxi Kilometres**	**No. Taxi Trips**	**Taxi Kilometres**	**Percentage of Total Trips**	**Percentage of Total Distance**
Auckland	26	62	1,612	186	4,836	11%	24%
Christchurch	10.8	249	2,689	747	8,068	44%	40%
Dunedin	28.4	11	312	33	937	2%	5%
Hamilton	15	34	510	102	1,530	6%	7%
Invercargill	3.3	2	7	6	20	0%	0%
Marlborough	15.9	2	32	6	95	0%	0%
Napier	6.2	16	99	48	298	3%	1%
Nelson	7.5	7	53	21	158	1%	1%
New Plymouth	11.2	6	67	18	202	1%	1%
Palmerston North	5.4	1	5	3	16	0%	0%
Queenstown	7.6	2	15	6	46	0%	0%
Rotorua	9.5	6	57	18	171	1%	1%
Tauranga	6.3	4	25	12	76	1%	0%
Timaru	12.7	11	140	33	419	2%	2%
Wellington	7.7	143	1,101	429	3,303	26%	16%
Total Kilometres		**556**	**6,725**	**1,668**	**20,174**		

Table 8-7 Taxi Trips

The default emission factor for taxis is the average of the 1350 - < 1600 and the 1600 -<2000 categories for vehicles:

Taxi	Emissions Factors				
Class Size	**Kilometres**	**Total $CO_{2\text{-}e}$**	**$CO_{2\text{-}e}$**	**CH_4**	**N_2O**
Car - (1350 - <1600 cc)		0.19	0.182	0.00192	0.0062
Car - (1600 - <2000 cc)		0.209	0.2	0.00211	0.00681
Average		0.1995	0.191	0.002015	0.006505
Total Environment Canterbury	**20,174**	**4,025**	**3,853**	**41**	**131**

Table 8-8 Taxi Calculations

8.2 Scope 2

8.2.1 Purchased Electricity

Environment Canterbury has monthly records for electricity usage for both Tuam Street and Timaru Office, covering kilowatt hours and dollars spent. Consequently, the calculations in this report use exact data, based on a total of 1,023,016 kWh, comprised of:

Month	Actual Energy Use kWh	
	Tuam Street	**Timaru Office**
Jan. 17	83,036	5,160
Feb. 17	78,789	6,680
Mar-17	86,982	7,720
Apr-17	80,025	7,200
May-17	89,565	10,120
Jun-17	78,002	10,160
Jul-17	73,349	11,560
Aug. 17	79,795	10,720
Sept. 17	81,489	8,880
Oct. 17	76,562	9,280
Nov. 17	59,631	7,600
Dec. 17	54,750	5,960
TOTAL	**921,976**	**101,040**

Table 8-9 Actual Energy Use

The electricity emission factor covers purchased electricity from a supplier who sources its electricity from the national grid. The emission factor for purchased electricity is derived from the net electricity generation data in *Energy in New Zealand* (MBIE 2016):

Purchased Electricity	Unit	Total $CO_{2\text{-}e}$
Emission Factor	kWh	0.119
Tuam Street Activity Data	921,976	109,715
Timaru Office Activity Data	101,040	12,024
Total Environment Canterbury	**1,023,016**	**121,739**

Table 8-10 Purchased Electricity Calculations

8.3 Scope 3

8.3.1 Transmission and Distribution Line Losses for Purchased Electricity

The emissions factor is an average figure that makes no allowance for location of the end-user within the national grid, or for emissions associated with the extraction, production and transport of the fuels burnt to produce the electricity. The calculation in this report was based on a total of 1,023,016 kWh and an emissions factor of 0.0097, resulting in 9,923 Total $CO_{2\text{-}e}$.

8.3.2 Air Travel

Records for air travel were obtained from Orbital World Travel, Environment Canterbury's travel agent. In mid-2017 Environment Canterbury changed travel agents and earlier records from the previous provider are not easily attainable. Consequently, records are only available from September to December 2017, requiring data extrapolation across the whole year in order to determine an estimate of total travel.

The emission factors utilised in this report follow those published by the UK Department for Business, Energy & Industrial Strategy, which are deemed by the Ministry for the Environment to be the most suitable emission factors currently available (MfE 2016).

The calculations in this report incorporate a circle distance uplift factor to take into account non-direct routes between airports and delays/ circling. The UK Department for Business, Energy & Industrial Strategy applies an eight percent uplift factor, based on analysis of UK flights. There is no comparable New Zealand analysed figure, therefore this report takes a conservative approach and utilises a nine percent uplift factor. This figure is based on the Intergovernmental Panel on Climate Change (IPCC) publication *Aviation and the Global Atmosphere* (Penner 1999).

International Flights: A total of six international flights were made between September and December 2017, with all travel being between New Zealand and Australia. This included a total of four flights between Christchurch and Melbourne, and two flights between Christchurch and Brisbane, incurring a total of 14,678 actual kilometres. This data has been extrapolated across the entire 2017 year, resulting in an estimated 44,034 kilometres of international air travel. Multiplying this figure by 1.09 to incorporate the uplift factor, results in a total distance of 47,997 kilometres.

The following calculations utilise the *2017 UK Government Conversion Factors for Company Reporting:*

International Flights	**Emissions Factors**	
Class	**Unit**	**Total $CO_{2\text{-}e}$**
International short haul	Kilometres	0.08378
Environment Canterbury Activity Data	44,034	3,689
Additional Uplift Factor	47,997	4,021

Table 8-11 Air Travel Emissions Factors

Domestic Flights: A total of 331 domestic flights were made between September and December 2017, within New Zealand, which gives an estimated annual figure of 993 flights. This includes two domestic flights made in Australia during the four month sample period (for the purposes of this report these flights have been classed as domestic). The following table outlines the number of domestic trips to each city airport within New Zealand, during the four month sample period:

To City	Trips	Percentage of Trips
Auckland	33	10%
Chatham Islands	6	2%
Christchurch	148	45%
Dunedin	7	2%
Hamilton	22	7%
Invercargill	1	0%
Marlborough	1	0%
Napier	11	3%
Nelson	4	1%
New Plymouth	5	2%
Palmerston North	1	0%
Queenstown	1	0%
Rotorua	1	0%
Tauranga	2	1%
Timaru	5	2%
Wellington	81	25%
Total	**329**	

Table 8-12 Domestic Flight Trips

During this four month period a total of 159,645 actual kilometres of domestic air travel were incurred. This data has been extrapolated across the entire 2017 year, resulting in an estimated 478,935 kilometres of domestic air travel. Multiplying this figure by 1.09 to incorporate the uplift factor, results in a total distance of 522,039 kilometres.

The following calculations utilise the *2017 UK Government Conversion Factors for Company Reporting:*

Domestic Flights	Emissions Factors	
Class	**Unit**	**Total $CO_{2\text{-}e}$**
Domestic	Kilometres	0.14141
Environment Canterbury Activity Data	478,935	67,726
Additional Uplift Factor	522,039	73,822

Table 8-13 Air Travel Calculations

8.3.3 Waste to Landfill

The Council possesses excellent data on waste within Tuam Street Office, including costs and volumes associated with commercial waste, organic material for composting, mixed recyclables (plastics and metals), paper and cardboard:

Month	Commercial Waste (kg)	Organic (kg)	Mixed Recyclables (kg)	Paper and Cardboard (kg)	Total Waste (kg)
Jan-17	824	276	238	608	1,946
Feb-17	680	46	238	1,382	2,346
Mar-17	880	460	297	1,569	3,206
Apr-17	2,424	276	238	1,236	4,174
May-17	1,170	368	297	1,324	3,159
Jun-17	1,338	322	238	1,138	3,036
Jul-17	870	230	238	942	2,280
Aug-17	1,119	322	297	1,383	3,121
Sep-17	5,847	368	238	991	7,444
Oct-17	1,224	276	238	1,040	2,778
Nov-17	1,377	552	297	1,462	3,688
Dec-17	2,527	184	238	1,236	4,185
Totals	**20,280**	**3,680**	**3,092**	**14,311**	**41,363**

Table 8-14 Waste and Recycling Volumes

Conversely, Timaru Office has no records for volumes of waste. As this office also separates waste into recyclables and organics, it is reasonable to assume that similar volumes of commercial waste will be produced. Consequently, this report uses Tuam Street's figures to determine a total amount of waste sent to landfill by Timaru Office:

- Tuam Street volume of commercial waste divided by number of staff, to give a volume of 45 kg/ year per staff member (20,280 kg divided by 450 staff).
- Volume of waste per staff member multiplied by number of staff at Timaru, to give an overall figure of 4,507 of waste sent to landfill per year by Timaru Office (45 kg multiplied by 100 staff).

It must be noted that this figures relate to office waste only. These figures do not include any waste generated by the Council through its wider operations, or any construction/ demolition waste generated in any work renovation or building work undertaken on these offices.

In determining accurate solid waste emission factors it is preferable to know the composition of the waste. However, in Environment Canterbury's case it is not known what the residual waste is comprised of. Although paper/ cardboard and organics are collected separately for recycling/ composting, these greenhouse gas producing materials may still be present in Environment Canterbury's residual waste. As such, the calculations in this report have used the default 'office waste' emission factor (0.726), as required for organisations that do not have information on waste composition. This factor is higher than the default 'mixed waste' factor (0.444), due to the higher proportion of organic matter found in these organisations' waste streams, including paper and food. However, it must be noted that in Environment Canterbury's case this may overestimate emissions, due to the fact that the organisation has an advanced waste diversion system.

Emission factor total $CO_{2\text{-}e}$: Landfilled waste with landfill gas recovery (office waste default)	**0.726**
Environment Canterbury activity data: estimated volume of waste sent to landfill	**24,787 kg**
Total CO_2-e emissions: waste to landfill	**17,995 kg CO_2-e**

Table 8-15 Waste to Landfill Calculations

8.4 Forestry Removals

The calculations in this report utilise Environment Canterbury's Mandatory Emissions Returns under the ETS for the latest full reporting period. This period covers the period of carbon stock change between 1st January 2013 and 31st December 2017.

On 23 August 2018 Environment Canterbury has been allocated, by the Ministry for Primary Industries, 39,417 NZUs. There are 76 Carbon Accounting Areas (CAAs) reported on under the ETS. There have been some negative carbon loses in some CAAs across the reporting period, although the large majority are positively removing carbon.

The amount of removals for the 2017 calendar year were calculated by taking an annual average of the NZUs over the five year reporting period. This value equates to 7,883 NZUs or tonnes of carbon dioxide equivalents removed. It must be noted that the amount of sequestration will vary as trees age and an average calculation does not give a precise figure. However, determining the exact sequestration for a specific year in the reporting period would require considerable analysis.

Environment Canterbury holds an additional 166,878 of allocated units for pre 1990 forest. Changes for pre 1990 forests are not available and, therefore, removals only from post 1990 forests are included in these calculations.

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