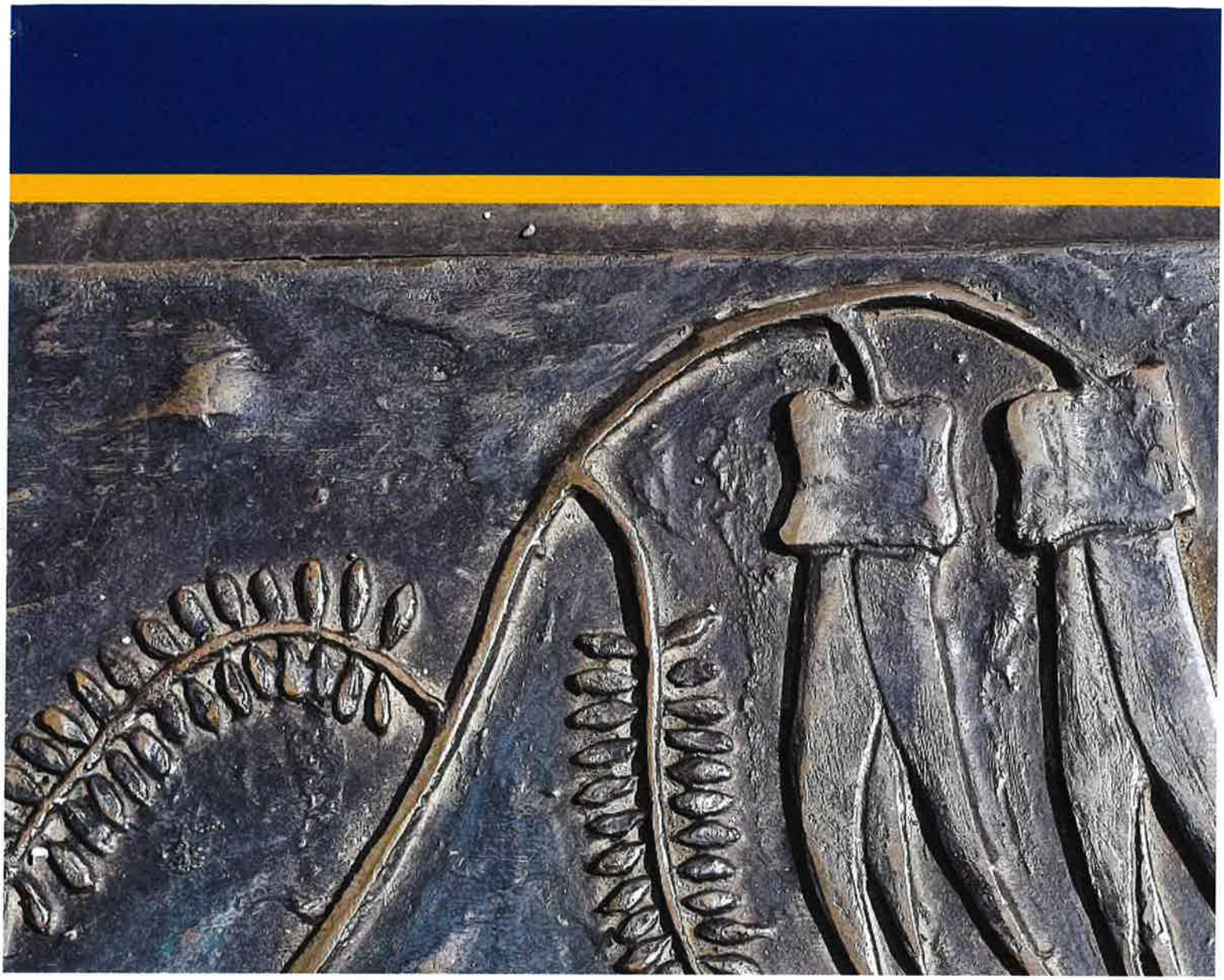


Greenhouse Gas Inventory - 2019

September 2020

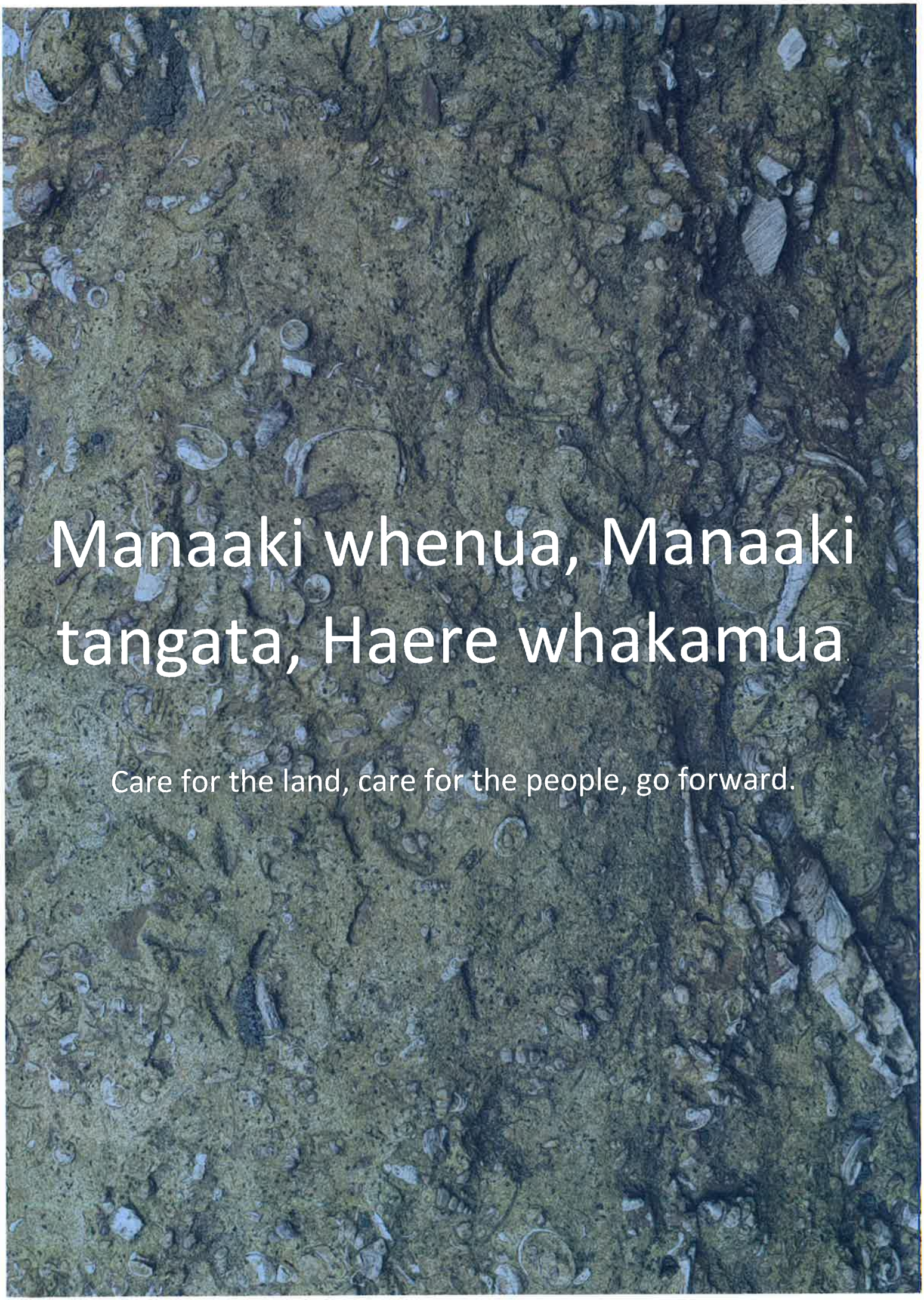
University Operations

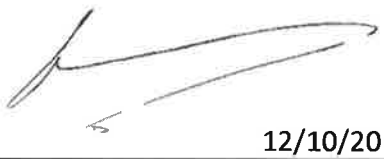
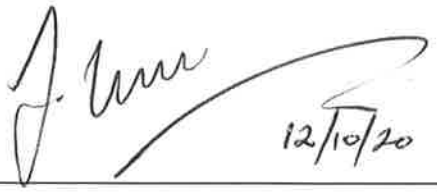
Sustainability

Campus and Collegiate Life Services | Campus Development | Chief Operating Officer
Health and Safety Compliance | Information Technology Services | Project Management
Property Services | Student Services | Risk, Assurance and Compliance

University of Otago | PO Box 56 | Dunedin 9054 | New Zealand

Enable | Engage | Experience


Manaaki whenua, Manaaki tangata, Haere whakamua
Care for the land, care for the people, go forward.

Report Prepared by: Head of Sustainability	Signature and Date  12/10/20
Report Authorised by: Chief Operating Officer	Signature and Date  12/10/20

Acknowledgement

This report has been compiled by a team of staff spread across the organisation who have all gone above and beyond their usual jobs to assist. This effort is even more significant given the challenges they have faced at the same time through lockdown due to COVID19.

In no particular order specific acknowledgement must be made of contributions by;

Shane Jenkins- Energy Manager

Kelly Li-Energy Analyst

John Hurford- Procurement Officer

Quentin Johnson- Manager Divisional Finance

Julian Phillips- Team Leader Public Transport, Otago Regional Council

Kevin Wood- Strategic Resource Planner

Rob Wilks -Building Information and Compliance Manager

Daryl Clarkson- Head of IT Infrastructure

Sanne Deen- Officer Assistant Project Support

Andrina Grigg- Waste Minimisation Coordinator

Graham Musgrave- Waste and Recycling Manager

Gary McNeil- Catering Manager

Alex Macmillan-Associate Professor Environmental Health

Cristina Cleghorn- Research Fellow

Jono Drew- Post Graduate Student

Naveka Karunaratne, Supervisor-Assurance and Advisory, Deloitte

Arveen Horsefield- Associate Director Assurance & Advisory, Deloitte

Deloitte.

INDEPENDENT REASONABLE ASSURANCE REPORT
TO THE MEMBERS OF THE UNIVERSITY OF OTAGO COUNCIL

Report on Greenhouse Gas Emissions Inventory Report

We have undertaken a reasonable assurance engagement relating to the Greenhouse Gas Emissions Inventory Report (the 'Inventory Report') of University of Otago for the year ended 31 December 2019, comprising the Emissions Inventory and explanatory notes in appendices A-C, set out on pages 10 to 62.

The Inventory Report provides information about the greenhouse gas emissions of the University of Otago for the calendar year ended 31 December 2019 and is based on historical information. This information is stated in accordance with the requirements of International Standard ISO 14064-1 Greenhouse gases – Part 1: *Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals* ('ISO 14064-1:2018') and the Greenhouse Gas Protocol: *A Corporate Accounting and Reporting Standard (2004)* ('the GHG Protocol').

University Council's Responsibility

The University Council are responsible for the preparation of the Inventory Report, in accordance with ISO 14064-1:2018 and the GHG Protocol. This responsibility includes the design, implementation and maintenance of internal control relevant to the preparation of an Inventory Report that is free from material misstatement, whether due to fraud or error.

Our Responsibility

Our responsibility is to express an opinion on the Inventory Report based on the evidence we have obtained. We conducted our reasonable assurance engagement in accordance with International Standard on Assurance Engagements (New Zealand) 3410: *Assurance Engagements on Greenhouse Gas Statements* ('ISAE (NZ) 3410'), issued by the New Zealand Auditing and Assurance Standards Board. That standard requires that we plan and perform this engagement to obtain reasonable assurance about whether the Inventory Report is free from material misstatement.

We did not evaluate the security and controls over the electronic publication of the Inventory Report.

A reasonable assurance engagement undertaken in accordance with ISAE (NZ) 3410 involves performing procedures to obtain evidence about the quantification of emissions and related information in the Inventory Report. The nature, timing and extent of procedures selected depend on the assurance practitioner's judgement, including the assessment of the risks of material misstatement, whether due to fraud or error, in the Inventory Report. In making those risk assessments, we considered internal control relevant to the university's preparation of the Inventory Report. A reasonable assurance engagement also includes:

- Assessing the suitability in the circumstances of the University of Otago's use of ISO 14064-1:2018 and the GHG Protocol as the basis for preparing the Inventory Report;
- Evaluating the appropriateness of quantification methods and reporting policies used, and the reasonableness of estimates made by the University of Otago; and
- Evaluating the overall presentation of the Inventory Report.

We believe that the evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Inherent Limitations

Greenhouse Gas quantification is subject to inherent uncertainty because of the use of estimates relating to emissions factors utilised and changes in underlying scientific understanding that develop over time. As a result, selection of different acceptable methods for measurement and application of emissions factors can give rise to materially different emissions calculations.

Deloitte.

Our Independence and Quality Control

We have complied with the independence and other ethical requirements of Professional and Ethical Standard 1 International Code of Ethics for Assurance Practitioners (including International Independence Standards) (New Zealand) ('PES-1') issued by the New Zealand Auditing and Assurance Standards Board, which is founded on fundamental principles of integrity, objectivity, professional competence and due care, confidentiality and professional behaviour.

Our firm carries out other assignments for the University of Otago in the areas of consulting, private and financial advisory services, which are compatible with those independence requirements. These services have not impaired our independence as independent accountant/auditor of the University of Otago. In addition to this, partners and employees of our firm deal with The University of Otago on normal terms within the ordinary course of trading activities of the business of The University of Otago. The firm has no other relationship with, or interest in, the University of Otago.

The firm applies Professional and Ethical Standard 3 (Amended): *Quality Control for Firms that Perform Audits and Reviews of Financial Statements, and Other Assurance Engagements* issued by the New Zealand Auditing and Assurance Standards Board, and accordingly maintains a comprehensive system of quality control including documented policies and procedures regarding compliance with ethical requirements, professional standards and applicable legal and regulatory requirements.

Use of Report

Our assurance report is made solely to the directors of University of Otago in accordance with the terms of our engagement. Our work has been undertaken so that we might state to the directors those matters we have been engaged to state in this assurance report and for no other purpose. To the fullest extent permitted by law, we do not accept or assume responsibility to anyone other than the directors of University of Otago for our work, for this assurance report, or for the conclusions we have reached.

Opinion

In our opinion, the Inventory Report of University of Otago for the year ended 31 December 2019 has been prepared, in all material respects, in accordance with the requirements of ISO 14064-1:2018 and the GHG Protocol .

Deloitte Limited

Auckland, New Zealand
12 October 2020

Contents

Glossary

CH4	Methane
CO2	Carbon dioxide
DEFRA	Department for Environment, Food, and Rural Affairs in the UK.
Emission Factor	A factor applied to an input quantity such as kg to calculate the quantity of greenhouse gas emissions resulting in consumption of that quantity.
GHG	Greenhouse Gas
HCFCs	Hydro chlorofluorocarbons- a type of refrigerant.
HFCs	Hydrofluorocarbons- a type of refrigerant
MfE	Ministry for the Environment in New Zealand.
N2O	Nitrous Oxide
NA	Not Available. For example, when emission factors are not available for all Greenhouse Gases.
tCO2-e	Emissions of greenhouse gases expressed in the number of tonnes of Carbon Dioxide that would have the same global warming impact.


Snap-shot Report on GHG
Emissions Inventory 2019

University of Otago GHG Emissions Inventory 2019 by Scope

Emission Source	Category	**Emissions (tCO2e)**	Proportion of Total Inventory
Scope 1		t CO2-e	
Stationary Combustion	Biomass	66	0.2%
Stationary Combustion	Coal	1,559	4.5%
Stationary Combustion	Diesel	78	0.2%
Stationary Combustion	LPG	1,276	3.6%
Mobile Combustion	Diesel	100	0.3%
Mobile Combustion	Marine	17	0.0%
Mobile Combustion	Petrol	95	0.3%
Mobile Combustion	PCard Purchases	31	0.1%
Fugitive Emissions	Refrigerants	106	0.3%
Total Scope 1		**3,328**	**9.5%**
Scope 2			
Electricity	Electricity	4,628	13.3%
Steam & MTHW	Coal	5,257	15.0%
Steam & MTHW	Biomass	273	0.8%
Total Scope 2		**10,158**	**29.1%**
Scope 3			
Transmission & distribution losses	Electricity	350	1.0%
Steam & MTHW losses	Coal	263	0.8%
Steam & MTHW losses	Biomass	14	0.0%
Business Travel	Air Travel (Domestic)	3,536	10.1%
Business Travel	Air Travel (Short Haul international)	1,102	3.2%
Business Travel	Air Travel (Long Haul International)	6,394	18.3%
Business Travel	Air Travel (PCard Purchases)	230	0.7%
Business Travel	Air Travel (Reimburse)	632	1.8%
Business Travel	Accommodation	269	0.8%
Business Travel	Taxi and shuttles	82	0.2%
Business Travel	Private Mileage	142	0.4%
Employee Commuting	Public Transport	47	0.1%
Employee Commuting	Private Vehicles	1,434	4.1%
Purchased Goods and Services	Water	82	0.2%
Purchased Goods and Services	Food	4,541	13.0%
Waste from operations	Recycling and other	7	0.0%
Waste from operations	Wastewater processing	118	0.3%
Waste from operations	Waste to landfill	2,232	6.4%
Total Scope 3		**21,475**	**61.4%**
Total Emissions in all Scopes		**34,961**	**100.0%**
Outside of Scope		tCO2	
Stationary Combustion- Biomass		1,385	
Steam & MTHW- Biomass		6,182	
Losses in Steam & MTHW- Biomass		309	

University of Otago GHG Emissions Inventory 2019 in Rank Order

Emission Source	Category	Emissions (tCO2e)	Proportion of total inventory
Business Travel	Air Travel (Long Haul International)	6,394	18.3%
Steam & MTHW	Coal	5,257	15.0%
Electricity	Electricity	4,628	13.3%
Purchased Goods and Services	Food	4,541	13.0%
Business Travel	Air Travel (Domestic)	3,536	10.1%
Waste from operations	Waste to landfill	2,232	6.4%
Stationary Combustion	Coal	1,559	4.5%
Employee Commuting	Private Vehicles	1,434	4.1%
Stationary Combustion	LPG	1,276	3.6%
Business Travel	Air Travel (Short Haul International)	1,102	3.2%
Business Travel	Air Travel (Reimburse)	632	1.8%
Transmission & distribution losses	Electricity	350	1.0%
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Fugitive Emissions	Refrigerants	106	0.3%
Mobile Combustion	Diesel	100	0.3%
Mobile Combustion	Petrol	95	0.3%
Waste from operations	Wastewater processing	118	0.3%
Stationary Combustion	Biomass	66	0.2%
Business Travel	Taxi and shuttles	82	0.2%
Purchased Goods and Services	Water	82	0.2%
Stationary Combustion	Diesel	78	0.2%
Employee Commuting	Public Transport	47	0.1%
Mobile Combustion	PCard Purchases	31	0.1%
Mobile Combustion	Marine	17	0.0%
Steam & MTHW losses	Biomass	14	0.0%
Waste from operations	Recycling and other	7	0.0%

Emissions by Scope

Scope	t CO2-e	Proportion of total inventory
Scope 1	3,328	9.5%
Scope 2	10,158	29.1%
Scope 3	21,475	61.4%
Total	34,961	100.0%

Emissions Liabilities

Refrigerant		*EF*	*Total Charge (kg)*	*liability (t CO2-e)*
R22	HCFC	1,810	159.6	289
R410a	HFC	2,088	665.39	1,389
R407c	HFC	1,774	253	449
R134a	HFC	1,430	107.2	153
R404a	HFC	3,922	129	506
Total Liability				2,786

Emissions KPIs

Key Performance Indicator (KPI)	Quantity	t CO2-e per KPI
Floor Area (M^2)	414,641[1]	0.08
EFTS (Equivalent Full Time Student)	18,915[2]	1.85
FTE (Full Time Equivalent Staff)	3,996[3]	8.75
Person (combined EFTS and FTE)	22,911	1.53

[1] Based on space usage report 2019 in line with Triannual reporting.
[2] Based on 2019 Annual Report
[3] Based on 2019 Annual Report

The Five Highest GHG Emissions Categories

GHG Inventory and Reporting Manual

1 Introduction

This report is the first comprehensive annual greenhouse gas (GHG) emissions inventory report for the University of Otago and as such provides the base year for monitoring of progress in the future. The inventory is a complete and accurate quantification of the amount of GHG emissions that can be directly attributed to the organisation's operations within the declared boundary and scope for the calendar year of 2019. The inventory has been prepared in accordance with the requirements of the Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (2004) and ISO 14064-1:2018 Specification with Guidance at the Organization Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals . The description of how each category is calculated also provides a manual on which future reporting can be based.

2 Statement of intent

This inventory forms part of the University of Otago's commitment to reducing the adverse impacts of climate change in line with The Paris Agreement (2015) and UNFCCC (United Nations Framework Convention on Climate Change). This is evident in the following targets:

- To be net carbon neutral by 2030.
- Reduced GHG emissions by 50% by 2020 (based on 2012 base line).
- To be operating with 100% renewable energy by 2030.

This inventory will establish an accurate and comprehensive baseline on which to plan action through to the 2030 carbon neutrality goal. It is anticipated that the inventory will be used by University Staff to inform their decision making, Students as a data source as part of their learning, other organisations such as universities to make comparisons to their own emissions.

The report will therefore be made publicly available on the university website.

3 Audit of GHG Inventory

This GHG inventory has been audited by Deloitte, a third party independent assurance provider. A reasonable assurance has been given over the assertions and quantifications included in this report.

4 Organisation description

As New Zealand's first university, founded in 1869, the University of Otago has earned an international reputation for quality research and teaching.

We provide education to around 20,000 students. Based on national data, we have the best performance indicators of any university in New Zealand for successful completion of courses and qualifications, student progression to higher level study, and students retained in study.

Achieving high approval ratings in employer surveys, Otago graduates are sought after and appreciated, with many occupying influential positions in industry, government and within their communities across the world.

Our academics hold more national teaching awards and produce more highly cited papers per capita than any other university in the country. There are currently around 4,000 full time equivalent staff.

5 Organisational boundaries

The University of Otago has applied an operational control approach to compiling a GHG inventory. This allows the focus to be on those emission sources over which it has control and can therefore implement management actions consistent with strategic objectives.

University of Otago operates across several New Zealand Campuses: Dunedin, Invercargill, Christchurch, Wellington and two separate Auckland campuses. The Dunedin campus is by far the largest. Christchurch and Wellington campuses shares sites and facilities with District Health Boards.

The Scope of this report (2019) is limited to the University of Otago owned activities on the Dunedin Campus. This includes all research, teaching and operational activity on the main central campus as well as the residential colleges and flats which are owned and operated by the university. This is represented in the campus map below (Figure 1) or online via this link.

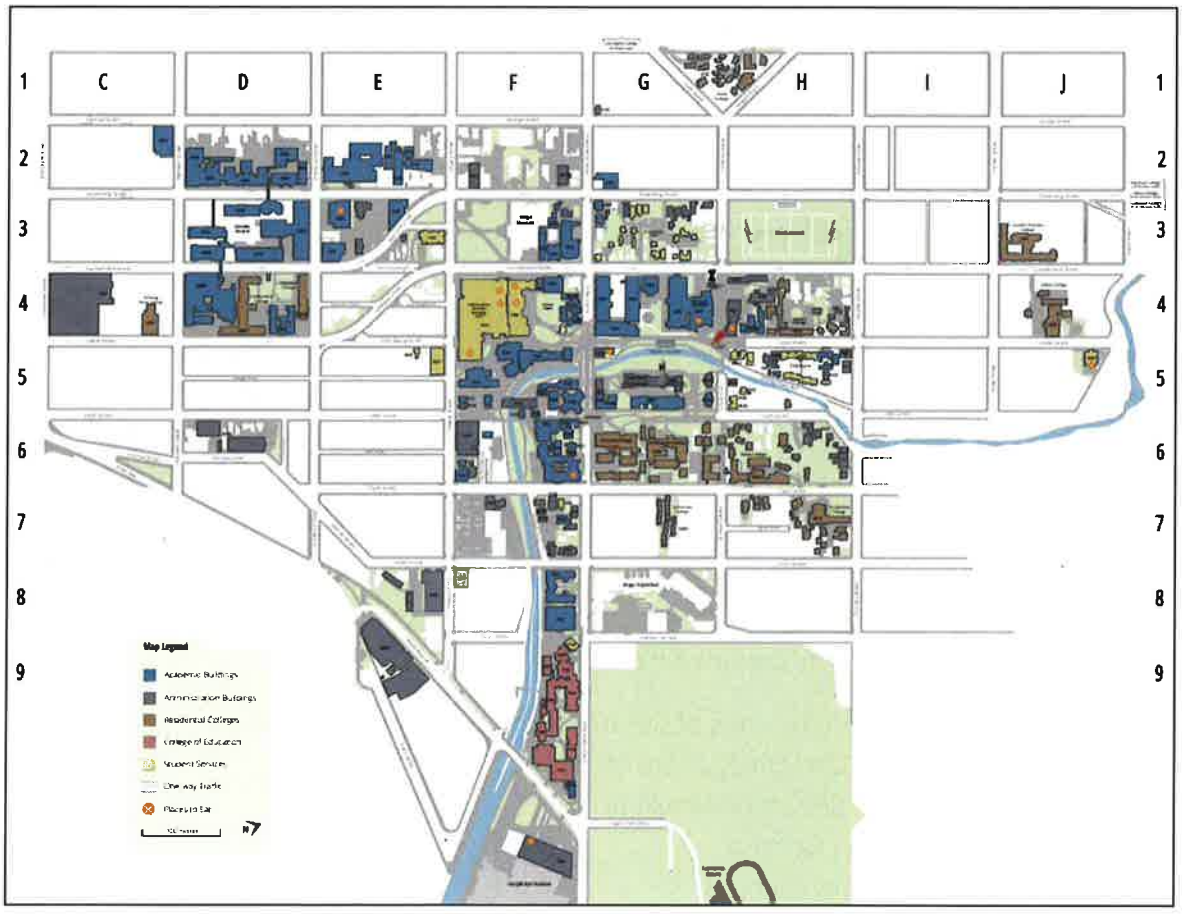


Figure 1 University of Otago Dunedin Campus Map

The University of Otago is governed by the University Council. This Council is led by the Chancellor. The operation of the University is led by the Vice Chancellor and structured in divisions that sit across several locations. The organisation diagram below describes these divisions (Figure 2).

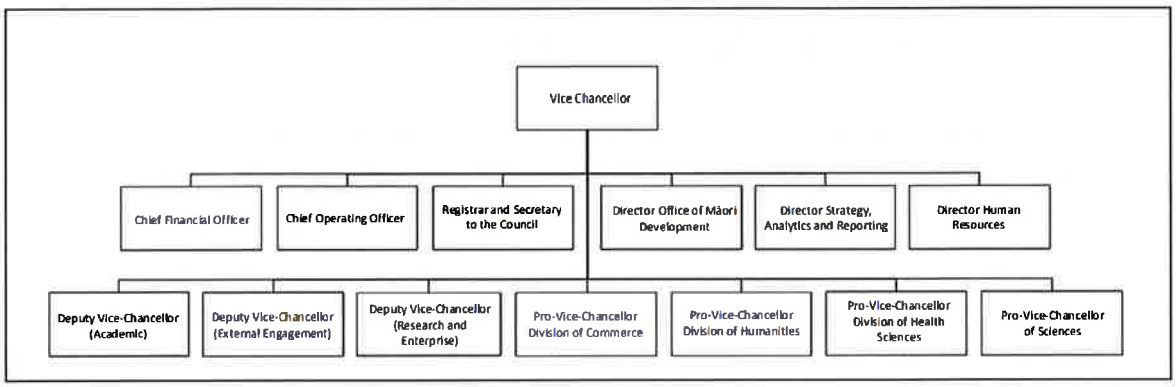


Figure 2 University of Otago central organisation structure

The responsibilities in these divisions have effect across the geographical locations of the University.

6 Organisational business units excluded from inventory

Reliable and complete data is not available for all emission sources across all campuses. Therefore, while this report primarily focusses on the Dunedin based activities, it must be acknowledged that centralised services provided in Dunedin produce emissions as a result of the activity on other campuses. It should also be recognised that it is difficult to separate some activities across campuses. Therefore, this report accounts for emissions produced as a result of activity on other campuses, but accounted for in Dunedin. Where this is the case it will be noted in the relevant sections of this report. For example, emissions due to business travel are the total emissions across all campuses. Appendix A provides a matrix identifying which emission categories are reported on at which locations. The intention is to improve data across all campuses so that by 2021 we will be able to report all categories across all campuses

The following are specifically excluded from the 2019 report:

- Activity undertaken by units of the University based outside of Dunedin:
  - Auckland Campus (Queens Street)
  - Auckland Campus (Manukau)
  - Wellington Campus
  - Christchurch Campus
  - Invercargill Campus
- Activity undertaken by the affiliated residential colleges that are not owned or operated by the University:
  - Knox College
  - St Margaret's College
  - Salmond College

- Activity undertaken by contractors or consultants to the University unless the University has agreed to pay for an activity directly. For example, where the University has agreed to pay for a contractor's flight.

7 GHG emission source inclusions

The GHG emissions sources included in this inventory were identified with reference to the methodology in the *GHG Protocol* and *ISO14064-1:2018* standards. As adapted from the *GHG Protocol*, these emissions were classified under the following categories:

- **Direct GHG emissions (Scope 1):** emissions from sources that are owned or controlled by the University of Otago.
- **Indirect GHG emissions (Scope 2):** emissions from the generation of purchased electricity, heat and steam consumed by the University of Otago.
- **Other Indirect GHG emissions (Scope 3):** emissions that occur as a consequence of the University of Otago's activities, but from sources not owned or controlled by the company.

The emissions sources in Table 1 have been included in the 2019 GHG emissions inventory and link to the appropriate section of this report to find full details of calculation method, uncertainties and disclosures, and recommendations to improve reporting.

Table 1 Greenhouse Gas Inclusions

GHG emission source
Scope 1
9.1 Stationary Combustion - Biomass (wood fuel)
9.2 Stationary Combustion - Coal
9.3 Stationary Combustion - Diesel (non-transport)
9.4 Stationary Combustion - LPG (non-transport)
9.5 Mobile Combustion- Petrol and Diesel
9.6 Mobile Combustion- Marine
9.7 Mobile combustion- PCard Purchases
9.8 Fugitive Emissions - Refrigerants
Scope 2
10.1 Electricity
10.2 Steam and MTHW- Coal and Biomass
Scope 3
11.1 Electricity transmission & distribution losses
11.2 Losses from Steam & MTHW – Coal and Biomass
11.3 Business Travel – Air
11.4 Business Travel –Accommodation
11.5 Business Travel –Taxi
11.6 Business Travel –Reimbursements
11.7 Employee commuting- Private vehicles
11.8 Employee commuting- Public Transport
11.9 Purchased Goods and Services- Water
11.10 Purchased Goods and Services- Food
11.11 Waste from Operations- Recycling and other
11.12 Waste from Operations- Wastewater treatment
11.13 Waste from Operations- Waste to landfill

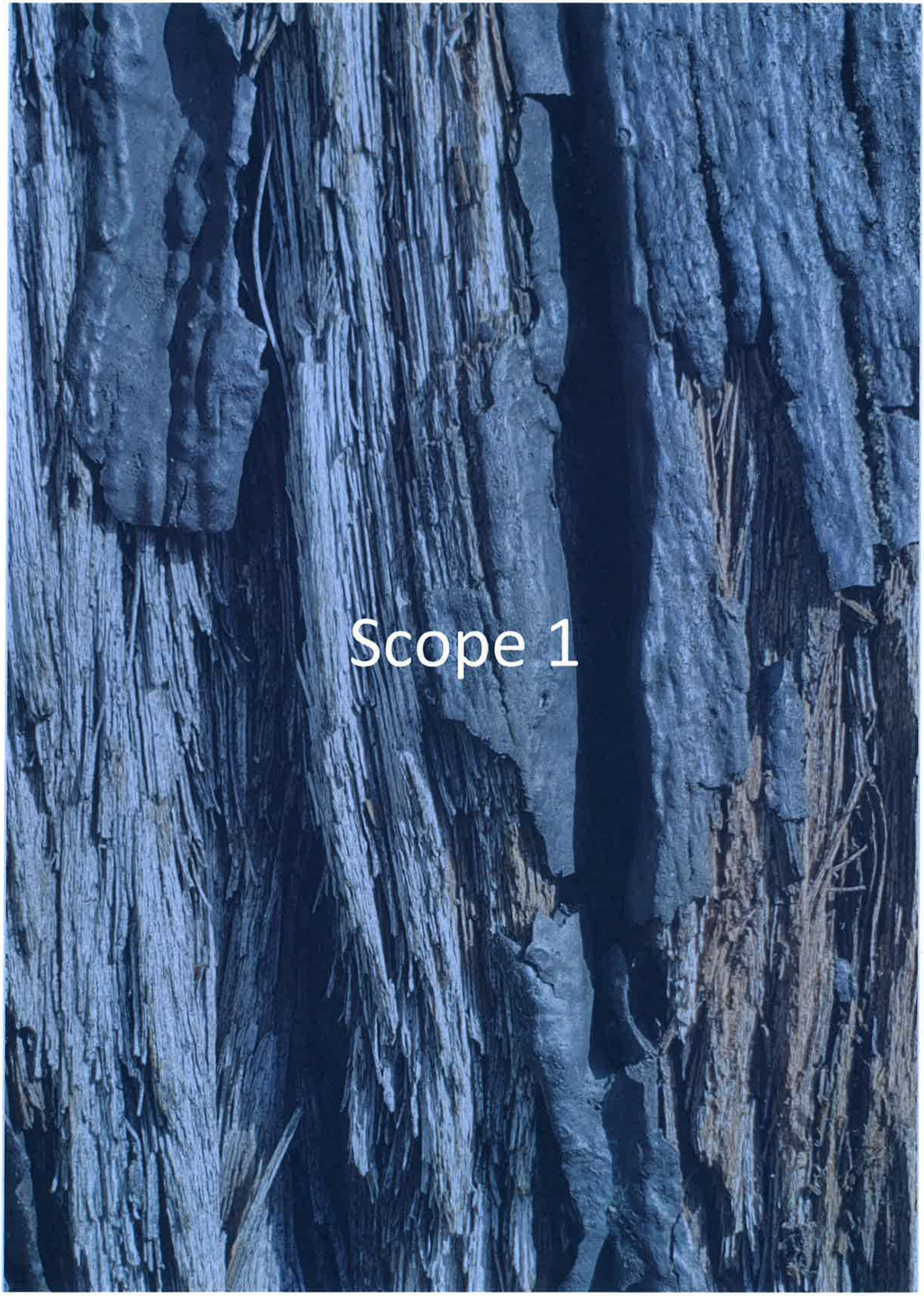
8 GHG emission source exclusions

The following GHG emission sources have been excluded from this report for the reasons described below.

Table 1 Greenhouse Gas Exclusions

GHG emission source	Scope	Reasons for exclusion
Fugitive Emissions- Lab gasses	Scope 1	The systems to collect this data are not yet in place. While it was identified that the Medical and Dental schools use some N20, no centralised record of consumption is yet available.
Mobile Combustion- Freight	Scope 3	The systems to collect this data are not yet in place. Distance travelled and vehicle used will be particularly difficult to ascertain.
Student Commuting- Public and Private	Scope 3	The method of calculating the emissions due to student commuting will follow the methodology used to calculate the employee emissions due to commuting. The last student travel survey was conducted in 2014 and there is a lack of information available on its validity e.g. the total number of responses. For this reason a more recent travel survey is required. Due to the current response to COVID19 conducting a student travel survey would not provide relevant data. Therefore, emissions due to student commuting will not be reported on for 2019.
Business Travel – Rental Cars	Scope 3	Initially, rental use was to be calculated using Section 6.2, Table 18, of MfE Guidelines where mileage information was available. This is the case for both Thrift and Hertz rental vehicles. However, there is a high probability that this would represent double reporting as the fuel purchased while using those vehicles would have been recorded within the Mobile Combustions categories of Scope 1. For this reason, emissions due to use of rental vehicles will not be reported upon for 2019. Vehicle rental that does not have mileage information, such as PCard and Accounts payable were to be estimated using the Carnegie-Mellon Cost input tool . However, when comparing the emissions based on cost to the emission from mileage this seems to drastically under report emissions. For this reason, the methods available do not offer a complete or accurate account of emissions due to vehicle rental and have been excluded for 2019. Given that the estimate was in the region of 100 tCO2- e this is not material to the inventory.
Business Travel – Public Transport	Scope 3	Data was available in relation to expenditure on public transport purchased through PCard and Accounts payable. No mileage data was available. No suitable category was found in the Carnegie-Mellon Cost input tool. Therefore, Business travel in public transport will not be reported upon for 2019.
Purchased Goods and Services- Paper	Scope 3	Records from three suppliers were retrieved that described spending on paper products such as printer paper. Almost all the products purchased were certified carbon neutral (>99%). Therefore, the residual emissions due to purchase of paper are deemed de minimus and are not reported on.
Construction	Scope 3	The University of Otago has an extensive campus development project. While we are working with architects and the New Zealand Green Building Council to establish and efficient and effective way to account for emission resulting from building activity we do not yet have a

		solution. Therefore, we have excluded emissions due to construction from the scope of this inventory
Green Waste composting	Scope 3	We have a composting site that is used to dispose of garden waste from the Dunedin grounds. There is currently no record of the amount of green waste taken to this site. Therefore, we do not have the ability to report on emission due to composting of green waste. We have established a method of collecting this data and will be able to report on emissions from 2020 onwards.


Scope 1

9.1 Stationary Combustion - Biomass (wood fuel)

Biomass (Wood Fuel)	Total Emissions	CO_2[4]	CH_4	N_2O
Input units(wood chip)	3,916,667 kWh			
Emission factor (wood chip)	0.01563	0.35357	NA	NA
Units of Emissions (wood chip)	t CO2e	t CO2	t CH4	t N2O
Emissions (wood chip)	61.22	1384.82	NA	NA
Input units(wood pellet)	102 tonnes			
Emission factor (wood pellet)	73.14	0.34941	NA	NA
Units of Emissions (wood pellet)	t CO2e	t CO2	t CH4	t N2O
Emissions (wood pellet)	4.83	0.036	NA	NA
Total Emissions	**66.05**	**1384.85**	**NA**	**NA**

9.1.1 Calculation Method:

Emissions from burning biomass (wood fuel) were based on quantities drawn from invoices by the University of Otago, Procurement Team. These invoices provide a total amount of fuel provided. The invoices came from four suppliers: Pioneer energy, Bunnings, Allen's and Azwood.

Fuel delivered by Pioneer Energy as **Wood Chip** was measured in Gigajoules. This was converted to kWh (1GJ=277.78kWh). As MfE emission factors relate to weight rather than energy, the DEFRA emission factor for biomass (woodchip) per kWh was then applied to the year's total.

Wood pellets came from the other three suppliers and were measured by weight (kg/tonnes). The total quantity delivered was calculated based on invoiced amounts. The DEFRA emission factor for wood pellets was applied to the total quantity delivered.

9.1.2 Uncertainty and disclosures:

As this total is based on invoices that are checked through the financial approval processes, there is a high level of confidence in this data.

It should be noted that carbon dioxide emitted from the combustion of wood fuel is biogenic. It is therefore treated as carbon neutral. However, the combustion of biofuels generates anthropogenic methane and nitrous oxide. DEFRA emission factors only provide the total t CO2e, but not a breakdown of the other GHGs. Therefore, only the total emissions (t-CO2- e) has been reported in the inventory. CO_2 released as a result of combustion of biomass is reported separately as *Out of Scope* in the inventory.

9.1.3 Recommendations to improve reporting

To include biomass in an automated invoicing system that provides a periodic emission report throughout the year from all suppliers.

[4] Reported as *Out of Scope* in inventory.

Develop a method to calculate the component Greenhouse gases as a result of biomass.

Reduce the number of suppliers of biomass fuel.

9.2 Stationary Combustion -Coal

	Total Emissions	CO_2	CH_4	N_2O
Input units (KG)	775,420			
Emission factor	2.01	1.99	0.00514	0.0092
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Total Emissions	**1,559**	**1,543.09**	**3.99**	**7.13**

9.2.1 Calculation Method:

The total mass of coal was gathered from an annual report summarising all invoices. This report was provided by the sole supplier. The Coal supplied was deemed to be Sub-bituminous according to the producer's website. Emission factors from Section 3.2 of MfE Guidelines were used to calculate the total emissions.

9.2.2 Uncertainty and disclosures:

As this total is based on invoices that are checked through the financial approval processes, there is a high level of confidence in this data.

9.2.3 Recommendations to improve reporting

It is anticipated that coal will no longer be used in any of our facilities within the next two years. Therefore it will not be reported on in the future.

9.3 Stationary Combustion -Diesel

	Total Emissions	CO_2	CH_4	N_2O
Input units	29,417 Litres			
Emission factor	2.66	2.65	0.00907	0.0065
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Total Emissions	**78.25**	**77.957**	**0.267**	**0.191**

9.3.1 Calculation Method:

Emissions from Diesel used in our boilers is based on data drawn from invoices from the sole supplier. Invoices are identified through an inquiry in the finance system and then downloaded to provide the number of litres on each.

The emission factors used are selected from Section 3.2 of MfE Guidelines. The commercial category was seen as the most relevant in to the use as back up in heating systems for campus.

9.3.2 Uncertainty and disclosures:

As this fuel is purchased in bulk tanks some of that purchase may be used in the year following the purchase. As this error occurs at both ends of the financial year they will represent an accurate account over time.

9.3.3 Recommendations to improve reporting

That diesel invoices be added to the automated system and include the volume in the data gathered.

9.4 Stationary Combustion –LPG

	Total Emissions	CO_2	CH_4	N_2O
Input units (Bottled LPG)	13,010.10 kg			
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Emission factor	3.03	3.02	0.00594	0.0014
Emissions (Bottled LPG)	39.42	39.291	0.077	0.018
Input units (Reticulated LPG)	5,367,707 kWh			
Emission factor	0.23029	0.22999	0.00015	0.00015
Emissions (Reticulated LPG)	1,236.13	1,234.519	0.805	0.805
Total Emissions	**1275.55**	**1273.81**	**0.882**	**0.823**

9.4.1 Calculation Method:

The data in relation to the use of LPG comes from three different suppliers. Genesis provide reticulated LPG. This consumption is reported based on a report from meter reading and is in kWhs. Rock Gas and OnGas provide LPG bottles gas. This is reported in kg from approved invoices.

The total reticulated gas consumed was calculated from the consumption reports. As MfE guidelines do not provide an emission factor in kWh therefore the DEFRA emission factor was used to calculate the total emissions from reticulated gas.

The total amount of bottled gas was calculated manually from the invoices. This manual mass based process excluded all non-fuel costs such as bottle rental. The emission factor for the commercial use of LPG from Section 3.2 table 4 of MfE Guidelines was then applied to calculate the total emissions due to consumption of bottles LPG.

The bottled and reticulated emissions where then combined to provide the total.

9.4.2 Uncertainty and disclosures:

As this data is based on invoiced amount and includes detail of residual LPG in collected bottles there is a high level of confidence in its reliability. However, the calculation is very manual and prone to calculation errors. Several errors were identified and corrected in the peer review process. The addition of LPG supply to an automated system that collects the required data from the invoices and provided reporting throughout the year would reduce the likelihood of these errors.

There is the possibility that some small LPG bottles used for cooking in field work or remote locations have been filled in garages and paid for by PCard. This was not apparent in the PCard transactions relating to fuel and is unlikely to be material to the inventory.

9.4.3 Recommendations to improve reporting

It is not clear why three providers of LPG are required. Reducing to one provider of bottled LPG and one provider of reticulated LPG would seem appropriate.

9.5 Mobile Combustion- Petrol and Diesel

	Total Emissions	CO_2	CH_4	N_2O
Input (regular petrol)	28,830 Litres			
Emission Factors (regular petrol)	2.4500	2.3500	0.0276	0.0797
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Emissions (regular petrol)	70.63	67.749	0.796	2.298
Input (premium petrol)	10,082 Litres			
Emission Factors (premium petrol)	2.4500	2.3400	0.0277	0.0801
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Emissions (premium petrol)	24.70	23.592	0.279	0.807
Subtotal Petrol Emissions	95.33	91.341	1.075	3.105
Input (Diesel)	36,997 Litres			
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Emission Factors (Diesel)	2.6900	2.6500	0.00354	0.0422
Subtotal Diesel Emissions	99.52	98.041	0.130	1.561
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Total Emissions	**194.85**	**189.384**	**1.205**	**4.666**

9.5.1 Calculation Method:

University of Otago Procurement team supplied a record of all fuel card and accounts payable transitions for fuel. When cross referenced all mobile diesel and petrol were captured by fuel cards (except Marine which was captured in accounts payable). The total volume of fuel in litres was calculated for each fuel type and class.

Emission factors from Section 3.3 table 5 of MfE Guidelines were used for Regular, Premium and Diesel fuels.

9.5.2 Uncertainty and disclosures:

As all records are cross checked as they are approved in the finance system there is a high level of confidence in this calculation. It is known that some fuel is purchased on PCard rather than fuel cards. The emissions resulting from that expenditure is captured in the separate emission category for *Mobile combustion-PCard purchases*.

There may also be a small amount of fuel that is purchased by staff and is reimbursed through expenses. This is more appropriately accounted for as business travel and is captured in the reimbursement category.

9.5.3 Recommendations to improve reporting

Explore the possible level of fuel expenditure through reimbursements.

9.6 Mobile Combustion- Marine

	Total Emissions	CO_2	CH_4	N_2O
Input units	NZ$			
Emission factor	Cost input basis			
Units of Emissions	tCO_2e	tCO2	tCH4	tN2O
Total Emissions	16.8	NA	NA	NA

9.6.1 Calculation Method:

Some fuel is purchased through accounts payable. This includes the fuel purchased for the University maritime fleet. The University licenses 13 different vessels. 10 of these are part of the university operations and are in scope of this inventory. Three vessels are licensed on behalf of the New Zealand Whale and Dolphin Trust. These are out of scope for this inventory. There are three vessels (Typhoon, Polaris II, Beryl Berwin) whose fuel is purchased through accounts payable. There is no mileage, volume, and incomplete fuel type data available for this spending. Therefore the Carnegie Mellon Cost input tool was selected to account for the emissions. All of the other vessels are small crafts and their fuel is purchased either through fuel cards or PCard rather than on account. Those emissions are accounted for within the mobile emissions categories for petrol and diesel.

The relevant transactions were filtered from the accounts payable list which was coded to fuel purchases. The total financial value was calculated and converted to US$ to input into the online tool.

9.6.2 Uncertainty and disclosures:

While there is a high level of confidence that the fuel expenditure category identifies appropriate spending. The relatively small number of transactions allows for manual check of the narrative columns in the data.

The cost input model is based on US data. As fuel prices are significantly lower there than in NZ, the emissions are likely to be over reported in this estimation. A New Zealand cost input model was not available.

The cost based method is based on 2002 expenditure data and is potentially considerably out of date.

While some emissions due to marine activity are undoubtedly missed in this calculation, particularly for the small vessels, there is a high level of confidence that they will be captured in other mobile combustion categories. This is such a small amount that it will not be material to the inventory.

9.6.3 Recommendations to improve reporting

As the vessel fleet is now under more centralised management the monitoring of fuel expenditure will become simpler. This will allow the emissions to be calculated more accurately and the activity guided in a manner to reduce emissions.

9.7 Mobile combustion- PCard Purchases

	Total Emissions	CO_2	CH_4	N_2O
Input units	NZ$			
Emission factor	Cost basis			
Units of Emissions	tCO2e	tCO2	tCH4	tN2O
Total Emissions	**30.6**	**NA**	**NA**	**NA**

9.7.1 Calculation Method:

Some fuel is purchased on PCard rather than fuel cards or on account. There is no mileage, volume, nor fuel type data available for this spending. Therefore the Carnegie Mellon Cost input tool was selected to account for the emissions.

The University Procurement team compiled all PCard charges coded as fuel purchases in 2019. The total financial value was calculated and converted to US$ to input into the online tool.

9.7.2 Uncertainty and disclosures:

While there is a high level of confidence that the fuel expenditure category identifies appropriate spending, there is no way to gauge the number of items that have either been miss-coded as fuel when they are not or coded as something else. Given that all transactions are of a relatively small value, there would have to be an exceptional number of errors for it to be material. This level of error would be identified in the quality systems in place for procurement and finance processes.

The cost input model is based on US data. As fuel prices are significantly lower there than in NZ this the emission are likely to be over reported in this estimation. A New Zealand cost input model was not available.

The cost based method is based on 2002 expenditure data and is potentially considerably out of date.

9.7.3 Recommendations to improve reporting

While there will always be fuel spending on PCard, it would be more manageable to report on emissions and likely more cost effective to buy a higher percentage of fuel through Fuel Cards/accounts. There may be the opportunity to ensure fuel cards are more readily available if fleet management is centralised.

9.8 Fugitive Emissions-Refrigerants

Refrigerant		EF	Estimated Leakage (kg)	Emissions (t CO2-e)
R22	HCFC	1810	8.181	15
R410a	HFC	2088	27.5379	57
R407c	HFC	1774	7.59	13
R134a	HFC	1430	2.633	4
R404a	HFC	3922	4.14	16
Total Emissions				**106**

9.8.1 Total Liability

Refrigerant		EF	Total Charge (kg)	liability (t CO2-e)
R22	HCFC	1810	159.6	289
R410a	HFC	2088	665.39	1389
R407c	HFC	1774	253	449
R134a	HFC	1430	107.2	153
R404a	HFC	3922	129	506
SF6			0	0
Total Liability				**2786**

9.8.2 Calculation Method:

For refrigerants the emissions due to leakage, disposal and the total liability should all stock be released must be calculated.

An inventory of all machinery that contains refrigerants was compiled by the Building Information and Compliance Manager. This mainly consists of heat pumps and chilling units. This included a record of the contractor who maintains the machinery, but did not record the volume or specification of refrigerant used to top up during services. It did include the type of refrigerant, total charge of refrigerant (some estimated) and the category of the machinery. It was found that there was no SF6 within the operational boundaries of the inventory. The size for electrical equipment that uses SF6 is likely used by our electricity suppliers, but is not within the scope of this report.

Method B.1 in Appendix B of MfE Guidelines was used to calculate the operational emissions. Each piece of machinery was categorised. In the absence of default leakage rates in the MfE guidelines the categories described by DEFRA in the UK government guidelines were used (Appendix C). This provided the default leakage rates for each category of machinery. For each piece of machinery that default leakage rate was applied to the total charge of refrigerant, and then an emission factor for each refrigerant category. This provided the total emissions from operations for the year. Emission factors were taken from DEFRA guidelines.

The total charge of each category of refrigerant was calculated and multiplied by the relevant EF for that refrigerant to provide the total liability.

No machinery on the inventory was disposed of in 2019 that carried refrigerant gases. Therefore, there were no emissions due to disposal.

9.8.3 Uncertainty and disclosures:

The inventory is known to be incomplete. There is likely to be appliances such as small fridges in staff rooms that have been bought by individual departments and are not maintained through the property services team. Given that these are small and sealed units their omission from the operational emissions is not seen as material to the inventory.

The total charge for a small number of items on the inventory were estimated. These were all smaller pieces of machinery in the 3-5kg range. The total charge was estimated by a qualified refrigeration engineer (the Building Information and Compliance Manager) as a site visit was not considered an essential service during COVID19 Level 4 restrictions.

9.8.4 Recommendations to improve reporting

Complete a fuller inventory to confirm the total number of items and the total charge. Adapt the maintenance recording to include the actual top-up value of any refrigerant used in servicing.


Scope 2

10.1 Electricity

	Total Emissions	CO_2	CH_4	N_2O
Input units kWh	47,373,518.01			
Emission factor (Kg/kWh)	0.0977	0.0932	0.00439	0.0000861
Units of Emissions	tCO2e	tCO2	tCH4	tN2O
Total Emissions	**4,628.39**	**4,415.21**	**207.97**	**4.08**

10.1.1 Calculation Method:

Emissions from electricity are based on actual consumption of electricity from meter readings, and confirmed by invoice checking from the three suppliers (Meridian energy, Pioneer and Trust Power). The emission factors used are from Section 5.2 of MfE Guidelines. The data is gathered by the University of Otago Energy team and via invoice management by Energy Link.

10.1.2 Uncertainty and disclosures:

There is a high level of confidence in this data due to the source being actual consumption data and checked routinely through the processing of invoices for payment. However, in the process of compiling the record from different sources, some errors were created in transfer from source. These errors have since been amended.

10.1.3 Recommendations to improve reporting

That the electricity data be captured and compiled throughout the year into a dashboard to see progress to targets throughout the year.

That the invoices be processed through an automated system to provide the dashboard data mentioned above.

10.2 Steam and MTHW – Coal and Biomass

	Total Emissions	CO_2[5]	CH_4	N_2O
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Input units (Coal)	15,051,010 KWh			
Emission factor (Coal)	0.34930	0.34563	0.00098	0.00269
Emissions (Coal)	5,257	5,202.081	14.750	40.49
Input units (Biomass)	17,486,769 KWh			
Emission factor (Biomass)	0.01563	0.35357	NA	NA
Emissions (Biomass)	273	6182.80	NA	NA
Total Emissions	**5,530**	**11,384.88**		

10.2.1 Calculation Method:

The amount of energy provided as steam and medium temperature hot water (MTHW) was based on monthly reports agreed between Pioneer Energy and the University Energy Management team. These provided a split between energy generated by burning coal and energy generated by burning biomass. The amount of condensate returned back to the reticulated system was also provided. The condensate is not energy consumed by University of Otago, but rather energy returned to Pioneer. As such it is excluded from the emission calculations.

Emission factors from DEFRA guidelines for combustion of solid fuels were applied to provide the emission resulting from each fuel source used. These guidelines provided emission factors for component greenhouse gases for coal, but only the total emissions for Biomass (t CO2e).

10.2.2 Uncertainty and disclosures:

As this total is based on invoices that are checked through the financial approval processes, there is a high level of confidence in this data.

It should be noted that carbon dioxide emitted from the combustion of wood fuel is biogenic. It is therefore treated as carbon neutral. However, the combustion of biofuels generates anthropogenic methane and nitrous oxide. DEFRA emission factors only provide the total t CO2e, but not a breakdown of the other GHGs. Therefore, only the total emissions (t-CO2- e) has been reported in the inventory. CO_2 released as a result of combustion of biomass is reported separately as *Out of Scope* in the inventory.

10.2.3 Recommendations to improve reporting

Establish a method to report on the component GHGs for biomass.

[5] Reported as *out of scope* in inventory


Scope 3

11.1 Transmission & distribution losses – Electricity

	Total Emissions	CO_2	CH_4	N_2O
Input units kWh	47,373,518.01			
Emission factor	0.0074	0.00706	0.000333	0.00000653
Units of Emissions	t-CO2e	tCO2	t CH4	t N2O
Total Emissions	**350.6**	**334.5**	**15.8**	**0.3**

11.1.1 Calculation Method:

Emissions due to losses in transmission and distribution of electricity are calculated based on the total kWh of electricity consumed. The Emission factors used are from Section 5.3 of MfE Guidelines.

11.1.2 Uncertainty and disclosures:

There is a high level of confidence in this data due to the source being actual consumption data and checked routinely through the processing of invoices for payment

11.1.3 Recommendations to improve reporting

As stated in section 10.1

11.2 Steam and MTHW losses – Coal and Biomass

	Total Emissions	CO_2	CH_4	N_2O
Input units Coal	5,257 t CO2e			
Input units Biomass	273 t CO2e			
Emission factor	5% of total energy.			
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Emissions Coal	263	260.104	0.737	0.002
Emissions Biomass	**14**	**309.14**	**NA**	**NA**

11.2.1 Calculation Method:

Emissions due to losses in distribution of MTHW and Steam are calculated based on the total kWh of energy supplied. 5% losses were used based on DEFRA guidelines for transition and distribution.

11.2.2 Uncertainty and disclosures:

There is a high level of confidence in this data due to the source being actual consumption data and checked routinely through the processing of invoices for payment.

However, the accuracy would be improved if the actual % loss was known for the local systems.

It should be noted that carbon dioxide emitted from the combustion of wood fuel is biogenic. It is therefore treated as carbon neutral. However, the combustion of biofuels generates anthropogenic methane and nitrous oxide. DEFRA emission factors only provide the total t CO2e, but not a breakdown of the other GHGs. Therefore, only the total emissions (t-CO2- e) has been reported in the inventory. CO_2 released as a result of combustion of biomass is reported separately as *Out of Scope* in the inventory.

11.2.3 Recommendations to improve reporting

Establish sufficient metering to measure actual losses.

11.3 Business Travel – Air

	km	t CO2- e/km	t CO2-e	t CO2/km	t CO2	t CH4/km	t CH4	t N2O/km	t N2O
Domestic									
Economy	14,611,641	0.2420	3,536	0.23800	3,477.571	0.00090	13.150	0.00300	43.835
Sub-Total	**14,611,641**		**3,536**		**3,477.571**		**13.150**		**43.835**
Short haul									
Economy	6,779,537	0.1600	1,084	0.15900	1,077.946	0.00001	0.068	0.00100	6.780
Premium Economy	47,542	0.1600	7	0.15900	7.559	0.00001	0	0.00100	0.048
Business	38,709	0.2400	9	0.23800	9.213	0.00001	0	0.00100	0.039
First	3,625	0.1620	0.587	0.16200	0.587	0.00001	0	0.00100	0.004
Sub-Total	**6,869,414**		**1,102**		**1,095.306**		**0.069**		**6.869**
Long-haul									
Economy	33,365,725	0.1630	5,438	0.16200	5,405.247	0.00001	0.334	0.00100	33.366
Premium Economy	1,104,408	0.2600	287	0.25900	286.042	0.00001	0.011	0.00100	1.104
First Class	20,284	0.6510	13	0.64800	13.144	0.00002	0.000	0.00300	0.061
Business	1,387,078	0.4720	655	0.47000	651.926	0.00002	0.027	0.00200	2.774
Sub-total	**35,877,494**		**6,394**		**6,356.360**		**0.373**		**37.305**
Cost Basis									
PCard	NA		230		NA		NA		NA
Reimbursements	NA		632		NA		NA		NA
Total	**57,358,550**		**11,894**		**10,929.236**		**13.592**		**88.009**

11.3.1 Calculation Method:

There are five sources of data, each with different formats and data availability: Orbit, Hello World, Air New Zealand, PCard purchases, and staff reimbursements. Orbit, Hello World, and Air New Zealand all provide distance, flight class and flight category (long haul etc). From there we can apply the appropriate emission factors as provided in the Section 6.4 of MfE Guidelines.

Data from Air New Zealand also included fees and add-on costs that were not emissions related. These cost were filtered out of the report before the calculation began.

Travel agents offer staff the same discounted rates for personal travel and where a family member is accompanying a staff member. This is not a business cost and all such transactions were excluded from the reports before calculations began.

A finance report on PCard transactions captures purchases related to Air travel. This report provides cost data, but does not provide the distance, emissions category or flight class. This is contrary to University of Otago Policy. Enforcement of this policy has seen a decline in this purchase method in recent years. There were many travel associated costs included in the report that were not relevant to emissions. Therefore, the report was filtered to exclude Koru club memberships, taxi, excess baggage, and parking. All transactions less that NZ$100 were assumed to not be flight bookings and also filtered from the data.

A finance report on staff reimbursements related to business travel was produced by the finance department. This was filtered to show reimbursements for staff who had purchased domestic and international flights.

The Carnegie Mellon Cost input model was used to estimate the emissions resulting from expenditure through PCards and reimbursements.

11.3.1 Uncertainty and disclosures:

While the cost input model provides an adequate estimate of the emissions due to air travel it is based on USA data. Factors such as average flight distance, average seating per aircraft, fuel prices, flight ticket prices, age and type of aircraft all contribute to the emissions and are likely to vary between USA and NZ.

It is also possible that some items under NZ$100 were flights purchases of short flights. Due to the small number of transactions and the short distance that would have been available at that price this is not seen as material to the inventory.

The cost based method is based on 2002 expenditure data and is potentially considerably out of date.

11.3.2 Recommendations to improve reporting

To further reinforce the policy and guidelines to avoid PCard purchases in relation to air travel.

11.4 Business Travel –Accommodation

	Total Emissions	CO_2	CH_4	N_2O
Input units (hotel nights)	4,193			
Emission factor	Various	NA	NA	NA
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Total Emissions	60	NA	NA	NA
Input Units	Cost basis NZ$			
Emissions from staff reimbursements	46	NA	NA	NA
Emissions from PCard expenditure and accounts payable	163	NA	NA	NA
Total Emissions	269	NA	NA	NA

11.4.1 Calculation Method:

The emissions resulting from accommodation during business travel are based on data from travel agents (Orbit and Brooker), Executive Residence (accommodation for staff visiting Dunedin campus), accounts payable, PCard transactions, and staff reimbursements. Travel agents provide an annual report that provides the number of nights booked in a hotel and the country in which it is located. Based on Section 6.5, Table 33 of MfE Guidance the number of rooms in each country was totalled and multiplied by the relevant emission factors where available. Only total emissions factor are available, therefore component GHG emissions are not reported.

The expenditure on accommodation through PCard and accounts payable were totalled and the emissions estimated through the Carnegie Mellon Cost input tool.

The two sets of emissions were combined to provide the total emissions due to business travel accommodation.

11.4.2 Uncertainty and disclosures:

Emission factors were not available for all countries. In total 69 nights were not accounted for. Only 11 of these nights were outside of the pacific region. All of the others were in pacific islands (Tonga, Fiji and Samoa). This is a very small proportion of the total accommodation activity and is not material to the inventory, therefore is treated as de minimus.

While the cost input model provides an adequate estimate of the emissions due to accommodation it is based on USA data which is likely to vary from the data for the wide range of countries in which the accommodation is located. The cost based method is based on 2002 expenditure data and is potentially considerably out of date. The emission factors vary widely from one country to another, the cost input tool does not allow for this.

11.4.3 Recommendations to improve reporting

To establish emissions factors for hotels in the pacific islands.

To reduce the amount of accommodation booked through reimbursement and PCards. To allow the more accurate nights based method to be used rather than the cost input tool.

11.5 Business Travel –Taxi

	Total Emissions	CO_2	CH_4	N_2O
Input units	NZ$			
Emission factor	0.31300	0.29900	0.00140	0.00003
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Total Emissions	**82**	**78.728**	**0.369**	**0.008**

11.5.1 Calculation Method:

The emissions resulting from business travel in taxi and shuttle services was calculated based on data from PCard, accounts payable and taxi charge cards. No mileage data was available so the cost based emissions factors in Section 6.2, Table 19 of MfE Guidance were used.

11.5.2 Uncertainty and disclosures:

In some instances a mini bus shuttle may have been used rather than a car. This may be the case for many airport shuttles. As we do not have mileage, vehicle size or occupancy we cannot calculate the emissions for these shuttle vehicles more accurately. Given the total emissions in this category is less than 1% of the total inventory this inaccuracy is not seen as material to the inventory.

As taxi travel paid through staff reimbursements could not be separated from the reimbursements for rental cars they are not included in the inventory. This is seen as de minimus.

11.5.3 Recommendations to improve reporting

There are many airport shuttles from the three main campuses. Through collaboration with the service providers it may be possible to estimate the emissions for each of these shuttle trips based on average occupancy, usual trip distance and usual vehicles/fuel used per 100km as per methodology suggested for public transport. This would also require the ability to filter airport shuttles from finance reports.

11.6 Business Travel –Private Mileage

	Total Emissions	CO_2	CH_4	N_2O
Input units (KM)	533,449 KM			
Emission factor	0.268	0.257	0.003	0.009
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Total Emissions	142	135.984	1.587	4.762

11.6.1 Calculation Method:

There were several categories of business travel spending incurred through staff reimbursements. *Air fares* (domestic and international) were calculated through the Carnegie Mellon Cost input tool and accounted for in 11.5 Business Travel – Air category of this report.

Accommodation was calculated through the Carnegie Mellon Cost input tool and accounted for in 11.4 Business Travel –Accommodation category of this report.

The data for *Taxi and Car Rental* did not allow these two categories to be subdivided. Taxis are in scope, while car rental is excluded from the inventory as the emissions are already included in 9.5 Mobile Combustion- Petrol and Diesel. Mileage data was not consistently inputted. Therefore, there was not an adequate method to account for these emissions. As the spending in this subcategory is very small it was seen as de minimus.

The *Travel- Other* category did not provide enough detail to assign costs to specific emission categories, so the transactions which had associated mileage were combined with Mileage Reimbursements.

The Mileage Reimbursement category provided both cost and mileage data. However the mileage data was not included for a significant number of transactions. There was not a relevant category in the Carnegie Mellon Cost input tool on which to base a cost based estimate. Therefore, the mileage from *Mileage Reimbursement* where available was combined with the mileage from *Travel-Other* where available, and the default emissions factor for private petrol car applied based on Section 6.2, Table 17 of MfE Guidance.

11.6.2 Uncertainty and disclosures:

While the cost input model provides an adequate estimate of the emissions due to private mileage it is based on USA data. Factors such as average vehicle age and type and fuel cost are likely to vary between USA and NZ.

The cost based method is based on 2002 expenditure data and is potentially considerably out of date.

It is known that not all mileage in private vehicles was captured as the mileage data was not inputted into the transaction. This is believed to be de minimus.

11.6.3 Recommendations to improve reporting

As reimbursements are generally inconvenient for staff, and there are a significant number of other payment methods available, reimbursement represents a relatively small proportion of travel spending.

More complete reporting of mileage on reimbursement would capture private car mileage more completely.

Finding a more current and NZ based cost based model would increase accuracy in many categories.

11.7 Employee Commuting- Private vehicles

Employee Commuting	Total Emissions	CO2	CH4	N2O
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Non EV vehicles	5,320,017 km	5,320,017 km	5,320,017 km	5,320,017 km
Emission factor	0.27	0.257	0.003	0.009
Non EV Emissions	1,425.76	1,367.24	15.96	47.88
EV vehicles	327,385 km	327,385 km	327,385 km	327,385 km
Emission factor	0.03	0.024	0.001	0.00002
EV Emissions	8.18	7.85725511	0.32738563	0.006547713
Total Emissions	**1,434**	**1,375.10**	**16.29**	**47.89**

11.7.1 Calculation Method

Emissions from staff commuting have been based on two primary sources of data- census mapping and the 2019 staff travel survey. The Mean travel distance to work was calculated with the assistance of the Strategic Resources Planner in the Campus Development Team. The distribution of staff was mapped on a GIS system according to the census meshblock in which their residential address was located. The distance from home to work was estimated based on a straight line from the centroid of the mesh block used for census data, to the campus centroid. The number of staff resident in each mesh block was then calculated using the residential address they have listed in their staff record. This was used as a basis to multiply the commuting distance from each meshblock centroid by the number of staff resident in that meshblock to provide a total commuting distance per meshblock. The total commuting distance to campus per day was calculated as the Sum of the commuting distance for all meshblocks, then doubled to include the return journey. This total was then divided by the total number of staff who were plotted on the GIS system (not FTE) to provide a mean daily commute.

The mean was then multiplied by the total Dunedin based FTE staff (not number of staff), by five working days and by 44 working weeks to provide an estimate of the total commuting distance for 2019 in kilometres.

The 2019 staff travel survey had approximately 1,000 responses. It provided a breakdown of modes of transport to work. In total there were 65% of staff using non electric vehicles (EVs) and 4% of staff using EVs. Emissions factors to calculate emissions from travel in public transport were not available (sections 6.3 of MfE guidance) and are likely to be de minimus. Emissions from all other modes of transport were considered to be de minimus.

The total commuting distance for 2019 was then divided proportionally according to the staff survey (65% non-EV, 4% EV) to provide a total distance per travel mode. The distance per mode was then multiplied by the default emissions factors for private vehicles (Section 6.2, Table 17 of MfE Guidance). The assumption was made that the majority of private vehicles were petrol. No data was available to differentiate between the range of non-EV vehicles (e.g. diesel or hybrid). Total CO_2–e and the component GHGs were reported on.

11.7.2 Uncertainty and disclosures

The following assumptions have been made in this calculation.

- That the straight line distance to campus is an acceptable proxy for the actual travel distance. This may produce an under-reporting error.
- That the staff travel survey held in April 2019 is representative across the whole year.
- That all staff travel to work on campus rather than work from home. This may produce an over reporting error.
- That the number of days per year that staff work off campus, such as conference attendance, is a de minimus factor. This may produce an over reporting error.
- That the number of staff driving hybrid or diesel vehicles is small enough to be generalised as all driving petrol vehicles. This may produce either an over or under reporting error.
- That shared transport in non-EV vehicle did not create significant double counting of the same vehicle e.g. the driver and the passenger both responded to the survey. This may produce an over reporting error.

11.7.3 Recommendations to improve reporting

In future travel surveys the breakdown of different non-EVs should match to categories used by the MfE to provide suitable emissions factors.

Adaptations to the GIS system to provide data based on shortest drive to campus rather than travel in a straight line should be explored.

That the wording of future travel surveys differentiates the number of passenger car sharing.

11.8 Employee Commuting- Public Transport

	Total Emissions	CO2	CH4	N2O
Input units (Km)	**376,493 km**			
Emission factor	1.087	1.069	0.001	0.017
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Total Emissions (8.62 mean occupancy)	**47**	**47**	**0.044**	**0.743**

11.8.1 Calculation Method

Emissions from staff commuting have been based on two primary sources of data- census mapping and the 2019 staff travel survey. The mean travel distance to work was calculated with the assistance of the Strategic Resources Planner in the Campus Development Team. The distribution of staff was mapped on a GIS system according to the census meshblock in which their residential address was located. The distance from home to work was estimated based on a straight line from the centroid of the mesh block used for census data, to the campus centroid. The number of staff resident in each mesh block was then calculated using the residential address they have listed in their staff record. This was used as a basis to multiply the commuting distance from each meshblock centroid by the number of staff resident in that meshblock to provide a total commuting distance per meshblock. The total commuting distance to campus per day was calculated as the Sum of the commuting distance for all meshblocks, then doubled to include the return journey. This total was then divided by the total number of staff who were plotted on the GIS system (not FTE) to provide a mean daily commute.

The mean was then multiplied by the total Dunedin based FTE staff (not number of staff), by five working days and by 44 working weeks to provide an estimate of the total commuting distance for 2019 in kilometres

The 2019 staff travel survey had approximately 1000 responses. It provided a breakdown of modes of transport to work. There was a total of 4.6% of respondents travelled to work on a bus. Based on information from Otago Regional Council, Team Leader, Public Transport it was determined that the existing bus fleet was made up of vehicles in the ≥12,000 kg Diesel category, and had an average of 8.62 passengers on board. This average includes all trips at all times across the whole network. Data specific to the campus or during commuting times was not available.

The total commuting distance for 2019 was then multiplied by 4.6% to identify an approximation to the total commuting distance by bus. The emission factors per km in a diesel bus from Table 24, Section 6.3 of MfE guidance was applied to establish the total emissions for the bus over the total distance. This was then divided by the average occupancy to provide an emission total for an individual passenger rather than the whole vehicle.

11.8.2 Uncertainty and disclosures

The following assumptions have been made in this calculation.

- That the straight line distance to campus is an acceptable proxy for the actual travel distance. This is may produce an under-reporting error.
- That the staff travel survey held in April 2019 is representative across the whole year.
- That all staff travel to work on campus rather than work from home. This may produce an over reporting error.
- That the number of days per year that staff work off campus, such as conference attendance, is a de minimus factor. This may produce an over reporting error.

11.8.3 Recommendations to improve reporting

Adaptations to the GIS system to provide data based on shortest drive to campus rather than travel in a straight line should be explored.

The local public transport system is about to undergo significant changes such as trialling a commuter train, one single fare no matter the journey, hybrid and electric busses, and a new transport card system. The reporting methods for this category will likely change in the next 12 months as a result. The proportion of staff using public transport to commute may also change, so another travel survey will be required.

11.9 Purchased Goods and Services- Water

	Total Emissions	CO_2	CH_4	N_2O
Input units (m^3)	263,303			
Emission factor	0.31300	0.29900	0.00140	0.00003
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Total Emissions	82	78.728	0.369	0.008

11.9.1 Calculation Method:

The emissions resulting from the supply of water were calculated based on a report from the local authority summarising the volume of water included in all invoices for 2019. The units were 1,000 litres, which is the same as 1 m^3. The emissions factors in Section 8.2, Table 53 of MfE Guidance were used.

11.9.2 Uncertainty and disclosures:

There is a high level of confidence in this data due to the source being actual consumption data and checked routinely through the processing of invoices for payment.

Water from St Margaret's Residential College was included in the initial data report. This exploded as it is not a university owned facility and as such is out of scope of this report.

11.9.3 Recommendations to improve reporting

That the water usage invoices be captured in an automatic reporting system.

11.10 Purchased Goods and Services- Food

	Total Emissions	CO_2	CH_4	N_2O
Input units (Total number of dietary days)	682,290			
Emission factor		NA	NA	NA
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Emissions	4,503	NA	NA	NA
Input units (cost basis)	NZ$			
Emission factor	Cost Basis	NA	NA	NA
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Emissions	38			
Total Emissions	4,541	NA	NA	NA

11.10.1 Calculation Method:

The emissions resulting from the purchase of food fall into two main categories: food for consumption by students in residential colleges and food for sale in retail outlets or events. Give the emphasis on the residential experience at Otago the food purchases for over 2500 residents in colleges is by far the more significant of the two.

Emissions due to preparation and waste are captured in stationary combustion and operational waste emissions categories. This category captures the emissions up to the food arriving on campus. For the emissions relating to catering in residential colleges three methods were explored as options: using the Carnegie Mellon Cost input tool, estimating the emissions based on the inventory of quantities of food purchased, or estimation based on emissions per day per resident. The estimation based on the inventory and on a per day per resident method were both seen as more accurate than the cost input model. The inventory based method would require a significant manual calculation as the data is not structured in a way that could be automated. Therefore, a per resident, per day basis was selected.

This method is based on the work of Jonathan Drew who developed a New Zealand based emissions model which differentiated emissions from both New Zealand food supply and production, and a range of dietary choices (Drew, 2017; Drew et al., 2020). While it is likely that the diet provided to students in residential colleges is a healthier range of options than the average New Zealand diet, and therefore likely a lower emissions diet, there was not a nutrition policy statement to support this claim. Due to the many choices on the menu it was not possible to confirm it by menu choices either. Therefore, the emissions for the typical New Zealand Daily diet were adopted. Based on the New Zealand Food Emissions Database developed by (Drew et al., 2020) this was estimated to be 6.6kgCO_2-e per person per day.

The total number of residents in the colleges is 2565. They are resident for an estimated 266 day per year. Thus a total of 682,290 dietary days in 2019. It was noted that residents do not always use the catering services provided and this is anticipated by the catering staff who only produce meals for the percentage of residents they expect to turn up. This percentage varies

across colleges, but averages at 65% for breakfasts, 87% for lunches and 90% for dinners. Missed meals such as these are a common occurrence in the general population and are included in the estimated daily emissions figure. The average percentages of missed meals at breakfast is in line with the New Zealand National Nutrition Survey (University of Otago & Ministry of Health, 2011). While there was no specific data in the New Zealand National Nutrition Survey to inform the percentage of missed meals at lunch and dinner within the general population, it is fair to assume that the residents are behaving similar to the general population for these meals, as they are for breakfasts. Therefore, there is no adjustment required to account for missed meals as this behaviour is already adequately captured in the daily emissions factor for the typical New Zealand diet.

The emissions produced as a result of food purchased for sale through retail and events was estimated based on the Carnegie Mellon Cost input tool.

11.10.2 Uncertainty and disclosures:

There are several assumptions made in the estimation and use of the daily emissions for the typical New Zealand diet. These are covered in detail in Drew (2017). In summary:

- We are assuming that the student intake is similar to the average NZ intake. The student intake may be slightly healthier and may have slightly lower emissions which means we might be over estimating the University GHG emissions.
- We are missing the GHG emissions from some snacks which would be included in the daily emissions estimates for the typical New Zealand diet. Evening snacks (toast) are part of the catering, but we still may be slightly over estimating the University GHG emissions.
- There is the assumption that the number of skipped lunches and dinners is similar between the national nutrition survey and the University's data. If students miss more of these meals than the general population we may be slightly over estimating the University GHG emissions.
- The estimation of emission for the typical diet was based in Life Cycle Analysis (LCA) of the food items. 60% of the food items did not have New Zealand specific LCA. These items were predominantly based in UK LCAs. This may introduce errors due to country specific difference.
- The New Zealand National Nutrition Survey is the most current data, but is over ten years old (University of Otago & Ministry of Health, 2011). Some dietary behaviour may have changed in that time.

While the Carnegie Mellon Cost input tool provides an adequate estimate of the emissions due to food purchases it is based on USA data. Factors such as average transport distance, food choices, portion size, cost for ingredients all contribute to the emissions and are likely to vary between USA and NZ. The cost input tool is based on 2002 expenditure data and is potentially considerably out of date.

11.10.3 Recommendations to improve reporting

Develop a food group based method that would provide an estimate of emissions based on actual food purchased. This is subject to a BMedSc(Hons) project and scholarship in 2021.

Develop an estimated emission factor per day based on the typical student diet in residence rather than the general population. This is likely to be a lower level of emissions than the factor used above.

11.11 Waste from Operations- Recycling and other

	Total Emissions	CO_2	CH_4	N_2O
Input units	274 tonnes			
Emission factor	Various			
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Total Emissions	6.76	NA	NA	NA

11.11.1Calculation Method:

The data relating to recycling and other waste streams is sourced from the Waste Management Environmental report. This data for the report is collected from actual weights picked up on site.

Several streams were identified and the relevant emission factor from DEFRA guidelines applied. The exact composition of the mixed waste category was not known. Waste management Areas manager supplied information about the usual composition of mixed recycling being sorted at their sorting plant: 60% mixed paper, 30% mixed Plastic, 10% Mixed Cans. The quantities for mixed recycling were then subdivided accordingly and the most appropriate emission factors applied.

Emissions from all streams (excluding General Waste) were then added to provide the total emissions for this category.

11.11.2Uncertainty and disclosures:

There is a high level of confidence in the data relating to glass, paper/card, and ash. These relate directly to actual weights of material collected.

It is known that some organic waste from campus gardens such as clipping and grass cuttings is directed to a compost site owned by the university and then brought back to campus as compost. No data is available for this waste.

There is a high level of confidence in the total quantity of mixed recyclable waste. However, the division of this mixed waste into categories (Glass, Plastic and Cans) is based on an estimate of the normal composition of mixed waste at the sorting plant. This does not necessarily relate directly to the composition of waste on campus. Indeed there may be significant differences throughout the university. For example, the composition of mixed recycling in residential colleges is likely to differ from the composition in teaching spaces.

11.11.3Recommendations to improve reporting

To establish a system to account for the waste going to the university owned composting facility

To conduct waste audits on campus to establish the composition of mixed recycling at a more local level. This is likely to be done in collaboration with students as a research project.

11.12 Waste from Operations- Wastewater treatment

	Total Emissions	CO_2	CH_4	N_2O
Input units (m^3)	263,303			
Emission factor	0.44700	0.07700	0.15100	0.21800
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Total Emissions	118	20.274	39.759	57.400

11.12.1Calculation Method:

The emissions resulting from the treatment of wastewater were calculated based on a report from the local authority summarising the volume of water included in all invoices for 2019. The units were 1,000 litres, which is the same and m^3. The emissions factors in Section 8.3, Table 54 of MfE Guidance were used.

11.12.2Uncertainty and disclosures:

There is a high level of confidence in this data due to the source being based on actual consumption data and checked routinely through the processing of invoices for payment.

11.12.3Recommendations to improve reporting

That the water usage invoices be captured in an automatic reporting system

11.13 Waste from Operations- Waste to Landfill

	Total Emissions	CO_2	CH_4	N_2O
Input units (kg)	1,908,000			
Emission factor	1.17		1.17	
Units of Emissions	t CO2e	t CO2	t CH4	t N2O
Total Emissions	2,232	NA	2,232.360	NA

11.13.1Calculation Method:

The data relating to waste to landfill is sourced from the Waste Management Environmental report. The data for the report is collected from actual weights picked up on site.

The emissions factors in Section 9.3, Table 65 of MfE Guidance were used for general waste for which the composition was not known.

11.13.2Uncertainty and disclosures:

There is a high level of confidence in the data as it relates directly to actual weights of material collected.

11.13.3Recommendations to improve reporting

That the waste data is captured in an automatic and live report with other emission sources.

12 References

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University of Otago, & Ministry of Health. (2011). *A Focus on Nutrition: Key findings from the 2008/09 NZ Adult Nutrition Survey*. Ministry of Health. https://www.health.govt.nz/publication/focus-nutrition-key-findings-2008-09-nz-adult-nutrition-survey

Appendix A: Scope of inventory by location and category

		Dunedin Campus	Dunedin Residential Colleges	Invercargill Campus	Auckland (Queens Street)	Auckland (Manukau)	Wellington Campus	Christchurch Campus
Scope 1								
Stationary Combustion	Biomass	✓	✓					
Stationary Combustion	Coal	✓	✓					
Stationary Combustion	Diesel	✓	✓					
Stationary Combustion	LPG	✓	✓					
Mobile Combustion	Diesel	✓	✓	✓	✓	✓	✓	✓
Mobile Combustion	Marine	✓	✓	✓	✓	✓	✓	✓
Mobile Combustion	Petrol	✓	✓	✓	✓	✓	✓	✓
Mobile Combustion	PCard Purchases	✓	✓	✓	✓	✓	✓	✓
Fugitive Emissions	Refrigerants	✓	✓					
Scope 2								
Electricity	Electricity	✓	✓					
Steam & MTHW	Coal	✓	✓					
Steam & MTHW	Biomass	✓	✓					
Scope 3								
Transmission & distribution losses	Electricity	✓	✓					
Steam & MTHW losses	Coal	✓	✓					
Steam & MTHW losses	Biomass	✓	✓					
Business Travel	Air Travel (Domestic)	✓	✓	✓	✓	✓	✓	✓
Business Travel	Air Travel (Short Haul international)	✓	✓	✓	✓	✓	✓	✓
Business Travel	Air Travel (Long Haul International)	✓	✓	✓	✓	✓	✓	✓
Business Travel	Air Travel (PCard Purchases)	✓	✓	✓	✓	✓	✓	✓
Business Travel	Accommodation	✓	✓	✓	✓	✓	✓	✓

Business Travel	Taxi and shuttles	✓	✓	✓	✓	✓	✓	✓
Business Travel	Reimbursements	✓	✓	✓	✓	✓	✓	✓
Employee Commuting	Public Transport	✓	✓					
Employee Commuting	Private Vehicles	✓	✓					
Purchased Goods and Services	Water	✓	✓					
Purchased Goods and Services	Food	✓	✓					
Waste from operations	Recycling and other	✓	✓					part
Waste from operations	Waste water processing	✓	✓					
Waste from operations	Waste to landfill	✓	✓	part				part

Appendix B: GHG Inventory Quality Management -ISO 141064-1 2018 (Section 8)

Establishment and maintenance of GHG information management procedures -ISO 141064-1 2018 (8.1.1)

As the person responsible for the implementation of the Sustainability Strategic Framework across the institution the Head of Sustainability, is responsible for the compilation of the GHG inventory and report. This responsibility extends to implementing an effective information management system that aligns with ISO141064-1 2018 (8.1).

The University of Otago developed procedures for the measurement of GHG emissions in 2020. There are guidelines embedded in this report for each emission source. These guidelines ensure measurement and reporting of GHG emissions that will increase understanding of emissions, allow transparency in disclosure and reduction of emissions, and guide organisational decisions making.

These procedures are in line with ISO14064-1 and the GHG Protocol in that they: ensure consistency with the intended use of the inventory, provide routine and consistent checks for completeness and accuracy, identify and address errors and omissions, and manage and store documentation in a safe and accessible manner. The report itself will provide transparency of GHG emission performance by being openly available online.

The key procedures are as follows:

- Source data is collected from third party suppliers, University of Otago finance system or energy management system.
- The raw data is collated by the sustainability office and archived in a cloud based folder for later access and collaborative work. The records will be stored in accordance with the University's Record Management Policy for no less than 10 years.
- Emission factors and conversion factors are embedded in the guidelines and updated annually as the report is compiled.
- The GHG inventory is compiled using activity data and emission factors where possible. Where data is not available a cost based calculation model is used
- Emission factors are sourced as locally as possible. Therefore Ministry for the Environment (MfE) guidelines are seen as the preferred source. DEFRA is a secondary choice where NZ specific factors are not available.
- Calculations are peer reviewed and the inventory and report independently audited to identify and rectify any errors
- The report is openly accessible and reviewed by senior leadership to identify opportunities to reduce emissions

Documented consideration in GHG information management procedures-ISO 141064-1 2018 (8.1.2)

Key to systematically producing accurate, consistent, complete and relevant reporting is the capability of the staff responsible for the gathering source data. The list below describes how specialist skills have been accessed to provide the source data for each emission category. Responsibilities for collating and reporting will be reviewed annually to account for changing

roles, data sources, capacity and capability. While no formal training specific to the compilation of this inventory has been undertaken this year, all staff compiling data have relevant specific skills within their own field. Support for compiling the inventory in a University context has been gained through Sustainable tertiary Education NZ (STENZ), Australasian Campuses Towards Sustainability (ACTS) and the Sustainability Tracking, Assessment & Rating System (STARS).

Category	Responsible
9.1 Stationary Combustion - Biomass (wood fuel)	Shane Jenkins- Energy Manager
9.2 Stationary Combustion - Coal	Shane Jenkins- Energy Manager
9.3 Stationary Combustion - Diesel (non-transport)	Shane Jenkins- Energy Manager
9.4 Stationary Combustion - LPG (non-transport)	Shane Jenkins- Energy Manager
9.5 Mobile Combustion- Petrol and Diesel	John Hurford- Procurement Officer
9.6 Mobile Combustion- Marine	John Hurford- Procurement Officer
9.7 Mobile combustion- PCard Purchases	John Hurford- Procurement Officer
9.8 Fugitive Emissions - Refrigerants	Rob Wilks -Building Information and Compliance Manager
10.1 Electricity	Shane Jenkins- Energy Manager
10.2 Steam and MTHW- Coal and Biomass	Shane Jenkins- Energy Manager
11.1 Electricity transmission & distribution losses	Shane Jenkins- Energy Manager
11.2 Losses from Steam & MTHW – Coal and Biomass	Shane Jenkins- Energy Manager
11.3 Business Travel – Air	John Hurford- Procurement Officer
11.4 Business Travel –Accommodation	John Hurford- Procurement Officer
11.5 Business Travel –Taxi	John Hurford- Procurement Officer
11.6 Business Travel –Reimbursements	John Hurford- Procurement Officer
11.7 Employee commuting- Private vehicles	Kevin Wood- Strategic Resource Planner
11.8 Employee commuting- Public Transport	Kevin Wood- Strategic Resource Planner Julian Phillips- Team Leader Public Transport, Otago Regional Council
11.9 Purchased Goods and Services- Water	Pamela Bedford, Dunedin City Council
11.10 Purchased Goods and Services- Food	Gary McNeil- Catering Manager Alex Macmillan-Associate Professor Environmental Health Cristina Cleghorn- Research Fellow Jono Drew- Post Graduate Student
11.11 Waste from Operations- Recycling and other	Graham Musgrave- Waste and Recycling Manager Andrina Grigg- Waste Minimisation Coordinator
11.12 Waste from Operations- Waste-water treatment	Pamela Bedford- Dunedin City Council
11.13 Waste from Operations- Waste to landfill	Graham Musgrave- Waste and Recycling Manager Andrina Grigg- Waste Minimisation Coordinator

The reliability and consistency of source data provided by University staff is subject to several institutional procedures to identify fraud, misstatements or unethical behaviour.

Responsibility for these internal audits to detect fraud lies with our Office of Risk, Assurance, and Compliance and the Audit and Risk Committee. An annual suspicious transactions review and an annual audit plan is agreed with the Audit and Risk Committee. In 2019 the areas of focus were payroll, supply chain, procurement and legal compliance. It has been identified

that there is potential to add specific internal audit actions in relation to emissions reporting. External audit process is annual as described in our Annual Report

Financial misstatement is covered within finance audits. Emissions data is indirectly subject to this through data collected from financial processes. The University of Otago has robust policies and processes relevant to intentional misstatements that relate to emissions data. These include: Guidance and policy around the use of Purchase Cards, Guidance and policy around travel and a Fraud Policy. Training is also offered by the financial services division to reinforce many of these policies and procedures.

We have an Ethical Behaviour Policy for training, this is provided by the Office of Risk Assurance and Compliance.

Identification of Operational boundaries, emission sources and quantification method

The university wants to measure and reduce its GHG emissions across as wide a scope of emissions and facilities as possible. As these facilities are wholly owned and operated by the University an operational control model is most relevant.

The list of emissions was based on inventories from other NZ universities to allow for more straightforward comparisons. In addition, due to the high proportion of students in University owned residences the emissions due to food purchased was included.

The most locally relevant quantification methods were preferred. Therefore the primary guidance came from MfE guidelines. The second source of guidance was the DEFRA guidelines. In the absence of relevant guidance on quantification method from either MfE or DEFRA, the best fit approach was sought on an emission by emission basis.

The boundaries, sources and quantification methods will be reviewed annually as the property portfolio changes, and changes in process or technology allow wider reporting. A programme of work to review and improve our supply chain processes is likely to enhance and simplify emission reporting in the next two years.

Document retention and record keeping -ISO 141064-1 2018 (8.2)

The raw data is collated by the sustainability office and archived in a cloud based drive for later access and collaborative work. The records will be stored in accordance with the University's Record Management Policy for no less than 10 years.

Given the diversity of emission sources reported upon, a single data collection system would be complex and expensive, without necessarily adding significant value to the purpose of GHG reporting. For energy source emissions the university adopting an automated system that will provide the most up to date emissions data. This will be in place for 2020 reporting.

Assessing uncertainty-ISO 141064-1 2018 (8.3)

The level of uncertainty involved in compiling the GHG inventory is addressed for each emission source. Opportunities to increase the level of certainty in future reporting are also identified.

Use, maintenance and calibration of measurement equipment was the responsibility of the third party service providers. For example, electric meters are the responsibility of the electricity provider, and are therefore out of scope of quality management responsibilities of the University.

Periodic reviews

As 2019 is the base year there has not been an opportunity for period reviews of the quality management processes or the technical aspects of this report.

2019 has been selected as a base year for the following reasons:

- Significant changes in staff have resulted in changes to reporting scope and methods
- Much of the data for the broader scope of this inventory was not available prior to 2019, so has no earlier base year to reference.

Through the Sustainability Tracking, Assessment & Rating System (STARS) the report will be peer reviewed by a sustainability professional at another University. This will identify opportunities for improvement.

Appendix C- Base year recalculation

Base year data may need to be revised when material changes occur and have an impact on calculated emissions. When changes are estimated to represent more than 5% of scope 1,2 or 3 emissions, or when there are significant changes to our reporting boundaries or calculation methodologies, or significant errors are discovered, we will recalculate the base year data and disclose previously stated data in a footnote.

Increased activity is not a reason to recalculate base year emissions. KPIs based on emissions per FTE, EFTS or floor space, provide a year to year comparison that allows for different levels of activity.