Greenhouse Gas Inventory - 2020

Version 1.1 September 2022

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

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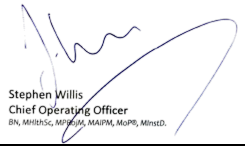
Whatungarongaro te tangata, toitū te whenua

While people come and go, the land endures

Report prepared by: Net Carbon Zero Programme Manager	Signature and date:  7 September 2022
Report authorised by: Chief Operating Officer	Signature and date:  29/9/22

Version Control

- Version 1.0 – December 2021 – internal audit only – approved for release online February 2022.
- Version 1.1 – September 2022 – verified by Toitū, with updates from version 1.0 to marine combustion, electricity & transmission & distribution losses, natural gas and losses, student air travel, private mileage and working from home.

Acknowledgements

This report builds on the foundations laid in 2020 by a team of staff spread across the organisation who went above and beyond their usual jobs to assist. Our efforts to increase the scope of our emissions reporting in 2021 again relied on a range of staff.

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

John Hurford - Procurement Officer

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Gary McNeil - Catering Manager

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7 September 2022

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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.
MTHW	Medium temperature hot water
N2O	Nitrous Oxide
NA	Not Available. For example, when emission factors are not available for all Greenhouse Gases.
PCard	Purchase Card – a University-issued credit card
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 2020

Scope: reporting on a larger scope to tell a more complete story

Building off the work done on the 2019 Greenhouse Gas Emissions Report, we have increased the scope of emissions categories we report on to include:

a) All of our New Zealand-based campuses (as opposed to the 2019 report which focussed only on our Dunedin campus and any centrally-managed activities such as travel bookings.
b) Student air travel and student commuting to campus (out of scope in the 2019 report while we developed the methodology to measure and sourced the necessary data
c) Staff working from home.

As a result, we have rebaselined the University's emissions in 2019 to include some new categories and increased other categories such as electricity and employee commuting to account for the activities at non-Dunedin campuses that were not captured in our original 2019 report.

This increased our emissions in 2019 from nearly 35,000 t CO2-e to 47,944 t CO2-e.

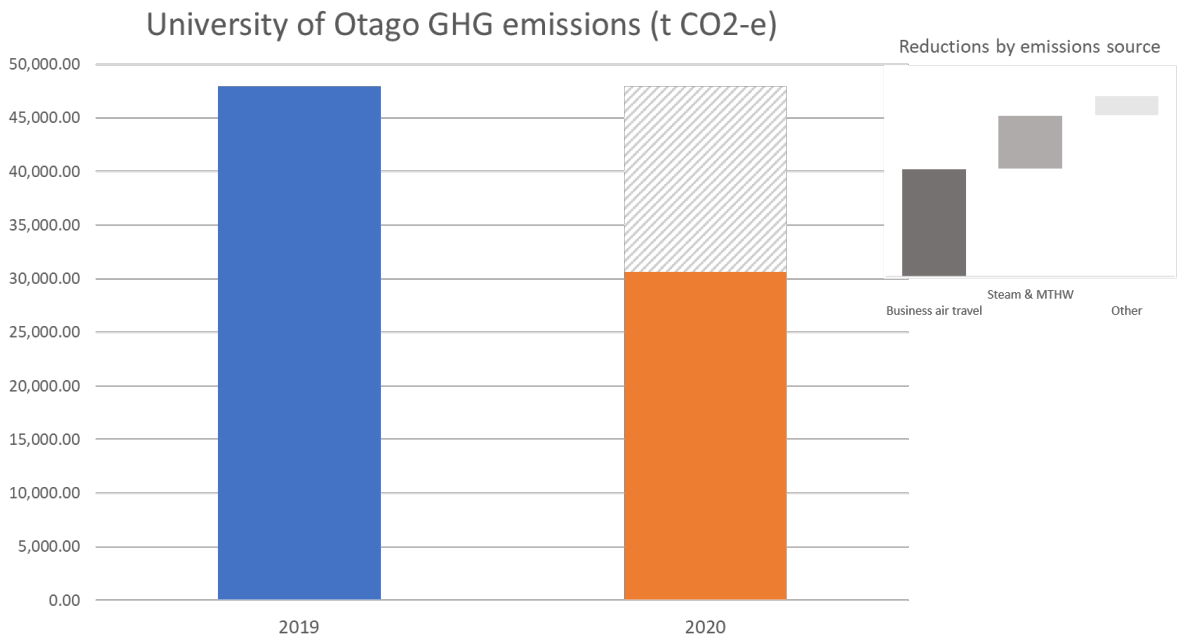
Notably, Student Air Travel emissions is now our number 1 emissions category.

Emissions down in 2020 thanks to positive action and external shocks

The University of Otago's Greenhouse Gas (GHG) emissions dropped by 36% between 2020 and 2019. Approximately 80% of this reduction can be attributed to two factors:

a) removing coal as a fuel from the district energy scheme that supplies the Dunedin campus with steam and medium temperature hot water (MTHW); and

b) reduced staff air travel due to COVID-19.



a) Steam and MTHW System for the Dunedin campus

Pioneer Energy operates the district energy scheme and our campus was being supplied steam and MTHW fed by a coal-fired boiler. We negotiated with Pioneer for this to be converted to biomass-fed, and this took place in early 2021. When factoring in the increase in biomass consumed and losses from the Steam and MTHW system, the difference between emissions in 2019 and 2020 for this energy source was a reduction in over 5,000 tonnes of carbon dioxide equivalent (t CO2-e).

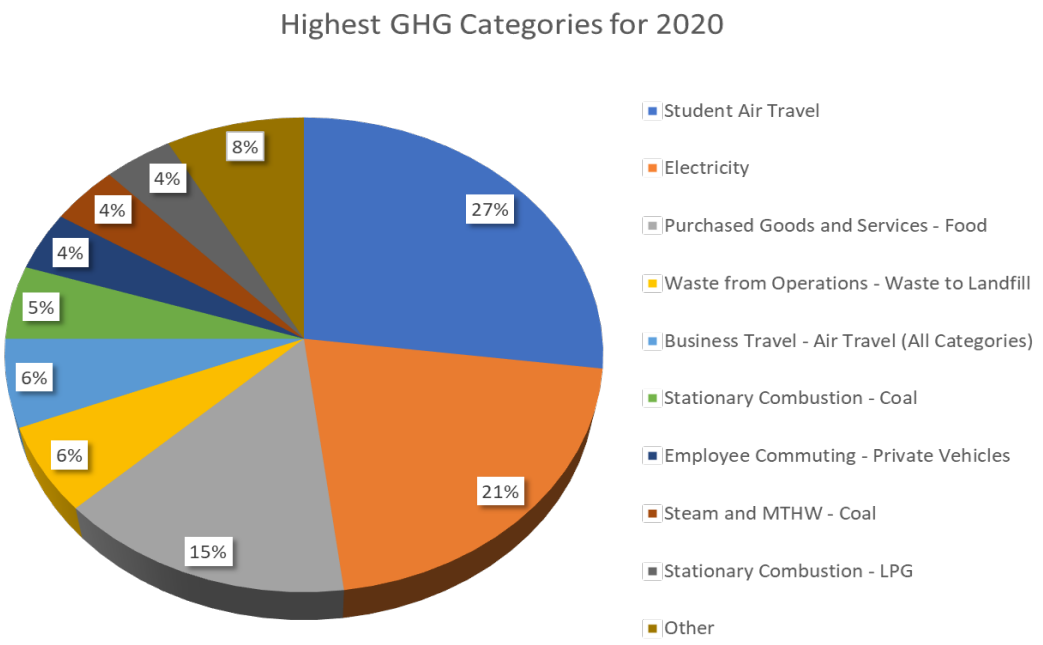
7 September 2022

b) Reduced staff air travel due to the impact of the COVID-19 global pandemic

'Business travel – air travel' was the University's biggest emissions category in 2019, but border restrictions from March 2020 onwards saw staff international air travel drop by 90%, while domestic air travel also reduced by 80% reflecting the reduced internal movements during and following the first Alert Level 4 "lockdown". While the emergence of new variants in 2021 has demonstrated that it is difficult to forecast what restrictions might look like in the future, the University is committed to ensuring air travel emissions do not bounce back to 2019 levels.

COVID-19 also impacted other categories, such as accommodation, mobile combustion and commuting to campus, and may have masked the impact of other operational or behaviour changes among staff and students.

Interestingly, the University's electricity usage overall increased, leading to 7% higher GHG emissions for this category, despite our campuses seeing low levels of occupancy during Alert Levels 3 and 4. This reflects the fact electricity usage in our residential colleges and uniflats increases during lockdowns, and electricity use in many on-campus facilities does not scale down directly with occupancy. In 2021 we went live with an energy analytics system which has equipped us with better insights about where and how to tackle energy inefficiencies in our largest electricity-consuming buildings and this should show through in future GHG reports.


Highest GHG Categories for 2020
27%
21%
15%
6%
6%
5%
4%
4%
4%
8%
Student Air Travel
Electricity
Purchased Goods and Services - Food
Waste from Operations - Waste to Landfill
Business Travel - Air Travel (All Categories)
Stationary Combustion - Coal
Employee Commuting - Private Vehicles
Steam and MTHW - Coal
Stationary Combustion - LPG
Other

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University of Otago GHG Emissions Inventory 2020 by Scope

Emission Source	Category	2019 Emissions Reported (tCO2e) [1]	2019 Emissions Rebaselined [2] (2019) (tCO2e)	2020 Emissions (tCO2e)	% Difference (rebaselined 2019 to 2020)	Proportion of Total 2020 Inventory
Scope 1						
Stationary Combustion	Biomass	66	69	64	-7%	0%
Stationary Combustion	Coal	1,559	1,559	1,384	-11%	5%
Stationary Combustion	Diesel	78	78	58	-26%	0%
Stationary Combustion	LPG	1,276	1,276	1,116	-12%	4%
Mobile Combustion	Road Vehicles	226	194	148	-24%	1%
Mobile Combustion	Marine	17	18	8	-54%	0%
Fugitive Emissions	Refrigerants	106	106	109	+3%	0%
Total Scope 1		**3,328**	**3,332**	**2,908**	**-13%**	**10%**
Scope 2						
Electricity	Electricity	4,628	4,971	6,448	+29%	21%
Steam & MTHW	Coal	5,257	6,176	1,226	-80%	4%
Steam & MTHW	Biomass	273	273	417	+53%	1%
Steam & MTHW	Natural Gas (Wellington)	NA	300	195	-35%	1%
Total Scope 2		**10,158**	**11,721**	**8,286.**	**29%**	**36%**
Scope 3						
Transmission & Distribution Losses	Electricity	350	538	591	+6%%	3%
Steam & MTHW Losses	Coal	263	309	61	-80%	0%
Steam & MTHW Losses	Biomass	14	14	21	+53%	0%
Steam & MTHW Losses	Natural Gas (Wellington)	NA	18	12	-35%	1%
Business Travel	Air Travel (All Categories)	11,894	11,982	1,699	-86%	6%
Business Travel	Accommodation	269	338	115	-66%	0%
Business Travel	Taxis and Shuttles	82	64	36	-43%	0%
Business Travel	Private Mileage	142	136	71	-48%	0%
Student Travel	Air Travel (All Categories)	NA	9,553	7,963	-29%	30%
Employee Commuting	Public Transport	47	84	76	-9%	0%
Employee Commuting	Private Vehicles	1,434	1,747	1,320	-24%	4%
Student Commuting	Public Transport	NA	187	147	-21%	0%
Student Commuting	Private Vehicles	NA	957	755	-21%	2%

Emission Source	Category	2019 Emissions	2019 Emissions Rebaselined (tCO2e)	2020 Emissions (tCO2e)	% Difference

[1] As reported in our 2019 Greenhouse Gas Inventory, available online at https://www.otago.ac.nz/sustainability/net-carbon-zero/. NB: this inventory was focussed on the University's main campus at Dunedin and services run out of Dunedin such as travel bookings.

[2] In the process of preparing this report, 2019's figures have been re-baselined include data for all of the University's campuses (some of which was excluded from the 2019 report), in line with the University's Policy on Changes to base year figures (see Appendix B).

		Reported (tCO2e)				Proportion of Total Inventory
Scope 3 continued…						
Purchased Goods and Services	Water	82[3]	8	10	+25%	0%
Purchased Goods and Services	Food	4,541	4,575	4,504	-2%	15%
Waste from operations	Recycling and other	7	7	6	-7%	0%
Waste from operations	Wastewater processing	118	120	155	+29%	1%
Waste from operations	Waste to landfill	2,233	2,233	1,893	-15%	6%
Waste from operations	Wastewater processing	118	120	155	+29%	1%
Working from home emissions	Working from home	-	20	89	+335%	0%
Total Scope 3		21,476	32,891	19,518	-29%%	69%
Total Emissions (all Scopes)		**34,962**	**47,944**	**30,711**	**36%**	**100%**

Out of Scope Emission Sources	Emissions Reported (2019) (tCO2e)	Emissions Rebaselined (2019) (tCO2e)	Emissions 2020 (tCO2e)	% Difference
Stationary Combustion - Biomass	1,385	1,385	1,299	-6%
Steam & MTHW - Biomass	6,182	6,182	9,543	+54%
Losses in Steam & MTHW - Biomass	309	309	477	+54%
Total Out of Scope Emissions	**7,876**	**7,876**	**11,318**	

University of Otago GHG Emissions Inventory 2020 in Rank Order

[3] The 2019 report contained an error with reference to the reported figure for this emissions category. Refer to Section 11.13 for more detail.

2020 Rank	Change in rank from 2019[4]	Emission Source	Category	Emissions (tCO2-e)	% of Inventory
1	(↑1)	Student Travel	Air Travel (All Categories)	7963	26.92%
2	(↑2)	Electricity	Electricity	6447	21%
3	(↑2)	Purchased Goods and Services	Food	4504	15.23%
4	(↑2)	Waste from operations	Waste to Landfill	1893	6.40%
5	(↓4)	Business Travel	Air Travel (All Categories)	1699	5.75%
6	(↑1)	Stationary Combustion	Coal	1384	4.48%
7	(↑1)	Employee Commuting	Private Vehicles	1320	4.46%
8	(↓6)	Steam & MTHW	Coal	1226	4.14%
9	(-)	Stationary Combustion	LPG	1116	3.77%
10	(-)	Student Commuting	Private Vehicles	755	2.55%
11	(-)	Transmission & Distribution Losses	Electricity	591	2.00%
12	(-)	Steam & MTHW	Biomass	417	1.41%
13	(↑2)	Natural Gas	Natural Gas (Wellington)	195	0.66%
14	(↑5)	Waste from Operations	Waste Water Processing	154	0.50%
15	(↑1)	Mobile Combustion	Road Vehicles	148	0.50%
16	(↑1)	Student Commuting	Public Transport	147	0.50%
17	(↓4)	Business Travel	Accommodation	115	0.39%
18	(↑2)	Fugitive Emissions	Refrigerants	109	0.37%
19	(-)	Working from Home Emissions	Working from Home	89	0.29%
20	(↑5)	Employee Commuting	Public Transport	76	0.26%
21	(↓2)	Business Travel	Private Mileage	71	0.24%
21	(↑2)	Stationary Combustion	Biomass	64	0.22%
23	(↓8)	Steam & MTHW Losses	Coal	61	0.21%
24	(↓1)	Stationary Combustion	Diesel	58	0.20%
25	(↓3)	Business Travel	Taxi and Shuttles	36	0.12%
26	(↓2)	Steam & MTHW Losses	Biomass	21	0.07%
27	(↓1)	Natural Gas Losses	Natural Gas (Wellington)	12	0.04%
28	(↑1)	Purchased Goods and Services	Water	10	0.04%
29	(↓2)	Mobile Combustion	Marine	8.36	0.03%
32	(-)	Waste from Operations	Recycling and Other	6	0.02%

[4] Using rebaselined 2019 figures and consolidating categories as per 2020 report to allow like-for-like comparisons.

Emissions by Scope

Scope	Proportion of Inventory 2019 (rebaselined figures)	Proportion of Total Inventory 2020
Scope 1	6.95%	9.47%
Scope 2	24.45%	26.98%
Scope 3	68.60%	63.55%
Total	**100.00%**	**100.0%**

Emissions Liabilities as at 2020

Refrigerant	Type	Emissions Factor	Total Charge (kg)	Liability (t CO2-e)
R22	HCFC	1,810	159.6	289
R410a	HFC	2,088	793.2	1,656
R407c	HFC	1,774	253	449
R134a	HFC	1,430	107.2	153
R404a	HFC	3,922	129	506
Total Liability				**3,053**

See Section 9.8 for more detail on fugitive emissions from refrigerants.

Emissions Key Performance Indicators

	2019 (rebaselined)		2020	
Key Performance Indicator (KPI)	Quantity	t CO2-e per KPI	Quantity	t CO2-e per KPI
Floor Area (metres squared)[5]	476,100	0.10	478,891	0.06
EFTS (Equivalent Full Time Student)[6]	18,915	2.53	18,722	1.64
FTE (Full Time Equivalent Staff)[7]	3,996	12.00	4,154	7.39
Person (combined EFTS and FTE)	22,911	2.09	22,876	1.34

[5] From Space Usage Reports for the given year. NB 2019 m2 has been re-baselined to include all campuses.
[6] From Annual Report for the given year.
[7] From Annual Report for the given year.

Introduction

This report is the second comprehensive annual greenhouse gas (GHG) emissions inventory report for the University of Otago, building from the foundation of the 2019 GHG inventory. 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 2020.

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. As noted in section 3 below, an earlier version of this report dated December 2021 was published online that had only been internally reviewed. This was while we went through the process of engaging suitably qualified external reviewers to verify our GHG reporting for the next three years, beginning with 2021 reporting, which included reviewing 2019 and 2020 data.data. This version incorporates minor improvements and corrections identified through this audit process with Toitū Envirocare in July 2022 so that reported amounts are consistent with the 2021 report.

Where the scope has been expanded or methodology amended from the 2019 GHG inventory, this is noted in the text. Original and re-baselined 2019 figures for each category are provided in table in the snapshot at the beginning of this report to assist those reading the 2019 and 2020 reports comparatively.

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 United Nations Framework Convention on Climate Change (UNFCCC). This is evident in the target to reach net zero GHG emissions by 2030, with related emissions reduction targets by category to be realised through the Net Carbon Zero Programme in a manner befitting a research-led university with an international reputation for excellence.

This inventory is part of establishing an accurate and comprehensive baseline on which to plan action through to 2030 and beyond, and measuring progress year on year. 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 and other organisations such as universities to make comparisons to their own emissions.

The report will therefore be made publicly available on the University's website on the following page: https://www.otago.ac.nz/sustainability/net-carbon-zero/.

Audit of GHG Inventory

In 2020, we engaged Deloitte, a third-party independent assurance provider, to audit our inaugural Greenhouse Gas Inventory in accordance with ISO 14064-1:2018 and the Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (2004).

Quality assurance of the 2020 inventory was initially been completed in-house, using expertise from our Risk, Assurance & Compliance office, Strategy, Analytics & Reporting office and Sustainability office, and version 1.0

Subsequently, the University engaged Toitū Envirocare to provide verification services in relation to our Greenhouse Gas Reporting. The audit of our 2021 reporting included a review of 2019 and 2020 reporting. This audit identified a small number of improvements that could be made to 2019 and 2020 emissions calculations, such as using the economy rather than average emissions factors for international flights in the Student Air Travel category and eliminating double counting of emissions in our Mobile Combustion – Marine category. This version incorporates these improvements so that reported figures for 2019 and are consistent with those in the 2021 report. Please refer to the 2021 report on our website for more details and the independent assurance statement from Toitū Envirocare.

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.

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 1).

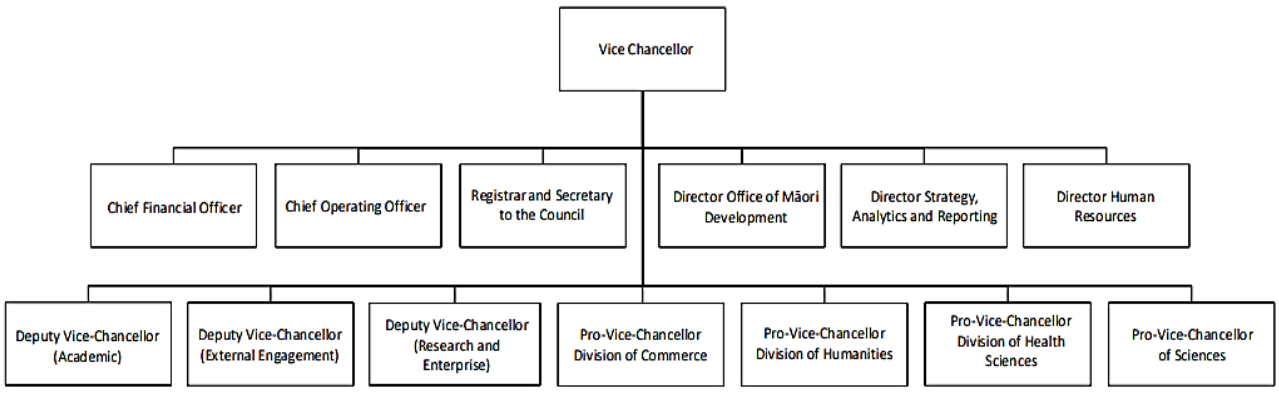

Figure 1 University of Otago central organisation structure

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

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 4,100 full time equivalent staff.

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 share sites and facilities with District Health Boards.

5.1 Changes to Organisational boundaries and rebaselining 2019

Due to data limitations, the Scope of the 2019 inventory was limited to the University of Otago owned activities on the Dunedin Campus, including centralised services provided in Dunedin that produced emissions as a result of activity on other campuses. Activities on other campuses, that were not centralised, were excluded from the 2019 inventory.

Student commuting or air travel (other than where this was directly paid for by the University) was also excluded due to a lack of data and agreed methodologies.

Those limitations have been removed and the Scope of the 2020 inventory (this report) has been increased to include emissions related to:

- all of the University's New Zealand campuses
- student air travel and student commuting (see relevant categories for descriptions of the methodologies used).

In addition, any errors identified in 2019 calculations have been corrected in the rebaselined figure and noted in the relevant sections (see 11.5.1).

As a result, the 2019 emissions totals have been re-baselined according to the base year changes policy (see Appendix B), which is based on guidance in the ISO standard and GHG Protocol. The impact on total emissions as a result of this restatement was an increase from 34,962 tCO2-e to 47,944 tCO2-e.

Organisational business units excluded from inventory

The following are specifically excluded from the 2020 report:

- 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.

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 2020 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	**Scope 2**
9.1 Stationary Combustion - Biomass (wood fuel)	10.1 Electricity
9.2 Stationary Combustion - Coal	10.2 Steam and MTHW- Coal and Biomass
9.3 Stationary Combustion - Diesel (non-transport)	10.3 Steam and MTHW – Natural Gas (Wellington)
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 3	
11.1 Electricity transmission & distribution losses	11.10 Student commuting – Private vehicles
11.2 Steam and MTHW- Losses from Steam & MTHW – Coal and Biomass	11.11 Student commuting- Public Transport
11.3 Steam and MTHW- Losses from Steam & MTHW – Natural Gas	11.12 Student Travel – Air
11.4 Business Travel – Air	11.13 Purchased Goods and Services- Water

11.5 Accommodation	11.14 Purchased Goods and Services- Food
11.6 Business Travel –Taxi	11.15 Waste from Operations- Waste to landfill
11.7 Business Travel –Reimbursements (Private Mileage)	11.16 Waste from Operations - Recycling and other
11.8 Employee commuting- Private vehicles	11.17 Waste from Operations- Wastewater treatment
11.9 Employee commuting- Public Transport	11.18 Working from Home Emissions

GHG emission source exclusions

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

Table 2 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	While we capture emissions from our own vehicles, some of which are used for freight, we do not have systems in place to collect data on mobile combustion emissions from our supply chain. We will work with our suppliers to ensure we can capture material Scope 3 emissions related to freight in the future.
Business Travel – Rental Cars	Scope 3	As per 2019 inventory, there is a high probability calculating emissions from rental car mileage (using emissions factors from MfE Guidelines) 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 is not reported upon.
Business Travel – Public Transport	Scope 3	Data was available in relation to expenditure on public transport purchased through Purchase Card (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 has not been reported upon for 2019 and 2020.
Purchased Goods and Services - Paper	Scope 3	As per 2019, records from suppliers demonstrate that 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 programme. While we are working with architects and the New Zealand Green Building Council to establish an 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.


Scope 1

9.1 Stationary Combustion - Biomass (Wood Fuel)

6.7% from 2019

Biomass (Wood Fuel)	2019[8] Total Emissions (tCO2-e)	tCO2* (Out of scope)	2020 Total Emissions (tCO2-e)	tCO2* (Out of scope)	tCH4	tN2O
Input Units (Wood Chip) (kWh)	3,916,667		3,672,766			
Emission Factor (Wood Chip) kg/kWh	0.02	0.35	0.02	0.35	NA	NA
Emissions (Wood Chip)	61.22	1384.82	56.74	1,298.58	NA	NA
Input Units (Wood Pellet) (Tonnes)	102		101			
Emission Factor (Wood Pellet) kg/t	73.14	0.35	72.3	0.35	NA	NA
Emissions (Wood Pellet)	7.46	0.036	7.3	0.035	NA	NA
Total Emissions	**68.68**	**1,384.86**	**64.05**	**1,298.62**	**NA**	**NA**

9.1.1 Category summary and calculation method:

This category captures the wood chips and wood pellets the University combusts in its own boilers across its campuses.

The total mass of biomass was gathered from an annual report prepared by the University's Energy team summarising all invoices. Emission factors from DEFRA were used.

It should be noted that carbon dioxide emitted from the combustion of wood fuel is biogenic and treated as carbon neutral and out of scope. However, the combustion of biofuels generates anthropogenic methane and nitrous oxide. DEFRA emission factors only provide the total tCO2e, but not a breakdown of the other GHGs. Therefore, only the total emissions (t-CO2- e) has been reported in the inventory.

The slight reduction in emissions from 2019 is likely to be related to lower occupancy of buildings due to COVID-19 in 2020. We expect this category to increase in future years as we convert the last of our coal-fired boilers to biomass, resulting in a net reduction in emissions.

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.

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.

[8] All 2019 figures are rebaselined, i.e. including all campuses, unless otherwise stated.

Develop a method to calculate the constituent greenhouse gases as a result of biomass.

9.2 Stationary Combustion – Coal

11.2% from 2019

	2019 Total Emissions (tCO2-e)	2020 Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (kg)	775,420	688,430			
Emission Factor	2.01	2.01	1.99	0.0051	0.0092
Total Emissions	**1558.59**	**1383.74**	**1369.98**	**3.54**	**6.33**

9.2.1 Category summary and calculation method:

This category captures the coal the University uses in its own boilers across its campuses. In 2019, these included boilers at a residential college, a research facility and the Invercargill College of Education campus. The University is working to eliminate the use of coal through conversion of boilers to biomass, electrification of heating (heat pumps) or, in the case of the research facility, decommissioning completely.

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

We are targeting no coal being used in any of our facilities by the end of 2022. Once this has been achieved, it will no longer need to be reported on in the future.

9.3 Stationary Combustion - Diesel

25.6% from 2019

	2019 Total Emissions (tCO2-e)	2020 Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (Litres)	29,417	21,875			
Emission Factor	2.66	2.66	2.65	0.0091	0.0065
Total Emissions	**78.25**	**58.19**	**57.97**	**0.20**	**0.14**

9.3.1 Category summary and calculation Method:

Emissions from diesel used in our boilers and generators 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 to the use as back up in heating systems for campus.

The University aims to eliminate the use of fossil fuels for energy on our campuses before 2030.

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

12.5% from 2019

	2019 Total Emissions (tCO2-e)	2020 Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units - LPG Bottled (kg)	13,010.10	12,327.90			
Emission Factor	3.03	3.03	3.02	0.0059	0.0014
Emissions (Bottled LPG)	39.42	37.35	37.23	0.073	0.017
Input Units - Reticulated LPG (kWh)	5,367,707	4,685,526			
Emission Factor	0.23	0.23	0.23	0.00017	0.00015
Emissions (Reticulated LPG)	1236.13	1079.08	1077.62	0.80	0.70
Total Emissions	**1,275.55**	**1,116.43**	**1,114.85**	**0.87**	**0.72**

9.4.1 Category summary and calculation Method:

The University uses LPG for heating, cooking and in some laboratories. We are seeking to eliminate the use of this fossil fuel by 2030. The reduction in 2020 is likely to be driven by COVID-19, but we are actively investigating ways to transition LPG-heated buildings onto lower emissions systems.

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 3 of MfE Guidelines was then applied to calculate the total emissions due to consumption of bottles LPG.

The bottled and reticulated emissions were 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. 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 Purchase Card (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

23.9% from 2019

	2019	2020			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	CO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input (Regular Petrol)	28,830	20,306			
Emission Factor (Regular Petrol)	2.45	2.45	2.35	0.028	0.080
Emissions (Regular Petrol)	70.63	49.75	47.72	0.56	1.62
Input (Premium Petrol)	10,082	7,662			
Emission Factor (Premium Petrol)	2.45	2.45	2.34	0.028	0.080
Emissions (Premium Petrol)	24.70	18.77	17.93	0.21	0.61
Subtotal Petrol Emissions	95.33	68.52	65.65	0.77	2.23
Input (Diesel)	36,997	29,626			
Emission Factor (Diesel)	2.69	2.69	2.65	0.0035	0.042
Emissions (Diesel)	99.52	79.69	78.51	0.11	1.25
Total Emissions	**194.86**	**148.22**	**144.16**	**0.88**	**3.48**

9.5.1 Category summary and calculation method:

This category represents the fuel consumed directly by the University in vehicles in the course of its business.

The University Procurement team supplied a record of all Fuel Card and Accounts Payable transactions 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 4 of MfE Guidelines were used for Regular, Premium and Diesel fuels.

The reduction in emissions is likely to be influenced by COVID-19, which saw less travel. We expect greater fuel efficiency of internal combustion vehicles and more use of electric and plug-in hybrid vehicles to drive this emissions category down in the coming years.

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

53.6% from 2019

	2019	2020			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	CO2	CH4	N2O
Input Units (NZ$)	$56,402.81	$26,867.32			
Emission Factor	Cost Basis	Cost Basis			
Total Emissions	**18**	**8.36**	**NA**	**NA**	**NA**

9.6.1 Category summary and calculation method:

The University licenses 13 different vessels. 10 of these are part of the university operations and are in scope of this inventory. The other three vessels are licensed on behalf of the New Zealand Whale and Dolphin Trust and are out of scope.

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.

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

39.5% from 2019

	2019	2020			
	Total Emissions	Total Emissions	CO2	CH4	N2O
Input Units (NZ$)	$104,048.56	$64,471.68			
Emission Factor	Cost Basis	Cost Basis			
Total Emissions	**33.2**	**20.1**	**NA**	**NA**	**NA**

9.7.1 Category summary and calculation method:

Some fuel for vehicles 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 for the year. 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 miscoded 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 is 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

↑ 3.2% from 2019

	2019	2020			
Refrigerant	Emissions (t CO2-e)		Emissions Factor	Estimated Leakage (kg)	Emissions (t CO2-e)
R22	15	HCFC	1810	8.181	15
R410A	57	HFC	2088	29.1519	61
R407C	13	HFC	1774	7.59	13
R134A	4	HFC	1430	2.633	4
R404A	16	HFC	3922	4.14	16
Total Emissions	**106**				**109**

9.8.1 Total Liability

↑ 9.6% from 2019

Refrigerant		EF	Total Charge (kg)	Liability (t CO2-e)
R22	HCFC	1810	159.6	289
R410a	HFC	2088	793.19	1,656
R407c	HFC	1774	253	449
R134a	HFC	1430	107.2	153
R404a	HFC	3922	129	506
SF6			0	0
Total Liability				**3,053**

9.8.2 Category summary and calculation method:

The University uses refrigerant gases in equipment such as heat pumps and chiller units. If emitted into the atmosphere, these gases have significant warming impacts.

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 in early 2020. 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.

The University is currently preparing to transition to a new Integrated Workplace Management System (IWMS) that will accurately record assets that contain f-gases and thus support reporting on this category in the future. Given fugitive emissions made up 0.3% of the 2019 inventory, it was decided that a detailed stocktake would be undertaken in 2022, once it was known what fields the new IWMS could hold, at which time business processes will be introduced to ensure data is accurate, up to date and supports greenhouse gas emissions reporting.

However, the refurbishment of the Dental School, completion of the Eccles Building, and new equipment at the Mellor labs on the Dunedin campus following to the early 2020 review, and the resulting changes to known refrigerant amounts (R410a only) have been factored into 2020 figures. These three buildings account for the total change in figures from 2019 to 2020.

The old units from the dental school refurbishment were disposed of by contractors in accordance with statutory requirements.

9.8.3 Uncertainty and disclosures:

The inventory is known to be incomplete. There are 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 in 2020.

9.8.4 Recommendations to improve reporting

As above, a fuller inventory needs to be completed to confirm the total number of items and the total charge, with the data held and maintained in the IWMS. Adapt the maintenance recording to include the actual top-up value of any refrigerant used in servicing.


Scope 2

10.1 Electricity ↑ 29.70 from 2019

	2019 Total Emissions (tCO2-e)	2020 Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (kWh)	45,193,469	53,729,383			
Emission Factor (kg/kWh)	0.110	0.120	0.117	0.0028	0.00022
Total Emissions	**4971.28**	**6447.53**	**6286.34**	**150.44**	**10.75**

10.1.1 Category summary and calculation method:

The University sources electricity from the National Grid from three retailers (Meridian Energy, Pioneer and Trust Power).

Emissions from electricity are based on actual consumption of electricity from meter readings, and confirmed by invoice checking from the three suppliers, and 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.

Electricity usage increased in 2020 due in part to the increased usage at residential colleges and uniflats over COVID Alert Levels 3 and 4. Looking ahead, electricity will continue to make up a large, and growing, proportion of our total energy mix, as we transition away from fossil fuels for heating and mobile combustion. Increasing the efficiency of our electricity usage is our current focus, particularly as Government targets to drive the percentage of renewables in the National Grid towards 100% should progressively reduce the emissions factor for grid-sourced electricity.

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

74.5% from 2019

	2019 Total Emissions (tCO2-e)	tCO2*	2020 Total Emission (tCO2-e)	tCO2	CH4 (tCO2-e)	TN2O (tCO2-e)
Input Units – Coal (kWh)	17,681,864		3,634,471			
Emission Factor – Coal (kg/kWh)	0.3493	0.34563	0.33726	0.33365	0.00137	0.00224
Emissions - Coal	6,176.28	6,111.38	1,225.77	1,212.65	4.98	8.14

	2019 Total Emissions (tCO2-e)	tCO2*	2020 Total Emissions (tCO2-e)	tCO2* (Out of scope)	CH4 (tCO2-e)	N20 (tCO2-e)
Input Units – Biomass (kWh)	17,486,769		26,989,325			
Emission Factor – Biomass (kg/kWh)	0.01563	0.35357	0.01545	0.35357	NA	NA
Emissions -Biomass	273.32	6,182.80	416.99	9,542.62	NA	NA

10.2.1 Category summary and calculation method:

The Dunedin campus is supplied steam and medium temperature hot water by Pioneer Energy's district energy scheme. In early 2020, the boiler that supplies our campus was converted from coal to biomass-fuelled. As such, there should be no coal-related emissions from this category in future years.

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 (tCO2-e).

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 and treated as carbon neutral and *out of scope* of the inventory. However, the combustion of biofuels generates anthropogenic methane and nitrous oxide. DEFRA emission factors only provide the total tCO2e, but not a breakdown of the other GHGs. Therefore, only the total emissions (t-CO2- e) has been reported in the inventory.

10.2.3 Recommendations to improve reporting

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

10.3 Steam and MTHW – Natural Gas – Wellington Campus

34.7% from 2019

	2019 Total Emissions[9] (tCO2-e)	2020 Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units - Natural Gas- Wellington (kWh)	1,536,620	926,463			
Emission Factor - Natural Gas (kg/kWh)	0.195	0.195	0.194	0.000405	0.00009666
Emissions - Natural Gas	299.64	195.60	179.92	0.38	0.09

10.3.1 Category summary and calculation Method:

The Wellington campus, located on the wider Wellington hospital campus in Newtown, is provided heat via the hospital's natural gas-powered system. The amount of energy provided was based on monthly reports from the Capital and Coast District Health Board.

Emission factors from Section 3.2 of MfE Guidelines for stationary combustion of natural gas were applied to provide the emission.

The reduction in emissions in 2020 is likely due to the impact of Alert Levels 3 and 4 and reduced occupancy. In August 2021, the main building of the Wellington campus was closed due to earthquake risk. Since that time, a fraction of staff have been making use of the campus with others working from alternative facilities or home. The long-term solution for the Wellington campus will include eliminating reliance on this fossil fuel.

10.3.2 Uncertainty and disclosures:

This emissions category was not reported on in the 2019 inventory as it was outside the scope of that exercise (non-Dunedin campus).

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.

10.3.3 Recommendations to improve reporting

Establish a method to integrate Wellington emissions into monthly and real-time reporting module, noting that the scope of capital development at the Wellington campus may include changing fuel sources.

[9] Wellington campus energy was excluded from the scope of the 2019 GHG Inventory, but has been calculated as part of preparing this report to rebaseline 2019 and include all relevant emissions across all New Zealand based campuses.


Scope 3

11.1 Transmission & Distribution Losses – Electricity

↑9.90% from 2019

	2019 Total Emissions (tCO2-e)	2020 Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (kWh)	45,193,469	53,729,383			
Emissions Factor (kg/kWh)	0.0119	0.0110	0.0107	0.0003	0.000021
Total Emissions	**537.80**	**591.02**	**574.90**	**16.12**	**1.13**

11.1.1 Category summary and 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.

While emissions from electricity (scope 2) only increased by 7%, the transmission and distribution losses increased by 21% due to the increase in the MfE's emissions factor by 15% between 2019 and 2020.

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

74.5% from 2019

	2019	2020			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Input Units – Coal (tCO2-e)	6,176.28	1,225.77			
Input Units – Biomass (tCO2-e)	273.32	416.99			
Emission Factor	5% of Total Energy	5% of Total Energy			
Emissions Coal	308.81	61.29	17.17	0.071	0.12
Emissions Biomass	13.67	20.85	NA	NA	NA
Total emissions	**322.48**	**82.14**	**17.17**	**0.07**	**0.12**

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 transmission 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 and treated as carbon neutral and out of scope. However, the combustion of biofuels generates anthropogenic methane and nitrous oxide. DEFRA emission factors only provide the total tCO2e, but not a breakdown of the other GHGs. Therefore, only the total emissions (t-CO2- e) has been reported in the inventory.

11.2.3 Recommendations to improve reporting

Establish sufficient metering to measure actual losses.

11.3 Steam and MTHW - Natural Gas transmission and distribution losses

34.7% from 2019

	2019	2020			
	Total Emissions(tCO2-e)	Total Emissions(tCO2-e)	tCO2	tCH4	tN2O
Input Units – Natural Gas(kWh)	1,536,620	1,003,060			
Emission Factor (kgCO2-e/kWh)	0.012	0.012			
Total Emissions	**18.44**	**12.04**	**0.00**	**0.44**	**0.00**

11.3.1 Calculation Method:

Emissions due to losses in distribution of MTHW and Steam from Natural Gas heated system in Wellington are calculated based on the total kWh of energy supplied. MFE provides a transmission and distribution losses emissions factor for natural gas. Notably, this reduced by almost half from its 2019 guidance (0.0228 tCO2-e/KWh, based on 2016 data) and 2020 (0.012 based on 2018 data). As such, we have elected to use the figure from 2020 guidance as it most closely relates to the time periods we are measuring.

11.3.2 Uncertainty and disclosures:

There is a reasonable level of confidence in this data due to the source being invoices from the Capital and Coast DHB based on 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 system.

11.3.3 Recommendations to improve reporting

Discuss with CCDHB if they intend to install metering to measure actual losses.

11.4 Business Travel – Air

86.0% from 2019

	2019		2020								
	km	tCO2-e	km	Emissions Factor (EF) total emissions	tCO2-e	EF CO2	tCO2	EF CH4	CH4 (tCO2-e)	EF N2O	N2O (tCO2-e)
Domestic											
Economy	14,611,642	3,536.02	3,098,002	0.242	749.72	0.238	737.23	0.0009	2.79	0.003	9.29
Sub-Total	**14,611,642**	**3,536.02**	**3,098,002**		**749.72**		**737.23**		**2.79**		**9.29**
Short haul											
Economy	6,779,538	1,085.00	876,703	0.153	134.14	0.152	133.26	0.00001	0.01	0.001	0.88
Premium Economy	47,542	7.61	6,915	0.156	1.08	0.155	1.07	0.00001	0.00	0.001	0.01
Business	38,709	9.29	11,019	0.229	2.52	0.228	2.51	0.00001	0.00	0.001	0.01
First	3,625	0.59	6,278	0.156	0.98	0.155	0.97	0.00001	0.00	0.001	0.01
Sub-Total	**6,869,414**	**1,102.21**	**900,915**		**138.72**		**137.82**		**0.01**		**0.90**
Long haul											
Economy	33,365,725	5,438.61	3,910,477	0.146	570.93	0.145	567.02	0.00001	0.04	0.001	3.91
Premium Economy	1,104,408	287.15	122,132	0.234	28.58	0.233	28.46	0.00001	0.00	0.001	0.12
First	20,284	13.20	0	0.585	0.00	0.582	0.00	0.00002	0.00	0.003	0.00
Business	1,387,078	654.70	77,256	0.424	32.76	0.422	32.60	0.00002	0.00	0.002	0.15
Sub-Total	**35,877,494**	**6,393.66**	**4,109,865**		**632.27**		**623.08**		**0.04**		**4.19**
Cost Basis	**NZ$**	**tCO2-e**	**NZ$**		**tCO2-e**						
PCard	248,162	251	40,157	See below	39.6	NA - Carnegie Mellon tool does not provide breakdown of constituent gases					
Reimbursements	364,659	699	141,282	See below	139	NA - Carnegie Mellon tool does not provide breakdown of constituent gases					
Total	**57,358,550**	**11,981.89**	**8,108,782**		**1,699.30**		**1,503.22**		**2.84**		**14.38**

11.4.1 Category summary and calculation method:

University-funded air travel (primarily for staff, but also for some students and suppliers) was the single largest source of emissions from University activity in 2019. The impact of COVID-19 on both international and domestic flying was dramatic. The challenge is now to ensure that air travel emissions do not bounce all the way back to the 2019 peak, but remain below 50% of that annually. This will be achieved by using alternatives to flying that we are all now familiar with and flying smarter (trip chaining, avoiding stop-overs) when this is unavoidable.

There are five sources of data, each with different formats and data availability: Orbit, Hello World, Air New Zealand (portal discontinued in 2020), 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 7.5 of MfE Guidelines.

Data from Air New Zealand also included fees and add-on costs that were not emissions related. These costs 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. We note that purchase of air travel on PCard is contrary to University of Otago Policy and enforcement of this policy has seen a decline in this purchase method in recent years. The PCard transaction report provides cost data, but does not provide the distance, emissions category or flight class. 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 than 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.

11.4.2 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 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.

11.4.3 Recommendations to improve reporting

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

11.5 Business Travel - Accommodation

64.9% from 2019

	2019	2020					
	Total Emissions (tCO2e)	Inputs	Emissions Factor	Total Emissions (tCO2e)	tCO2	tCH4	tN2O
From travel booking	114.80	3,423 hotel nights	Various	60.57	NA	NA	NA
Staff reimbursements (NZ$)	49.10	$215,449.81	Cost Basis	10.90	NA	NA	NA
PCard expenditure and Accounts Payable (NZ$)	175.00	$864,934.96	Cost Basis	43.60	NA	NA	NA
Total Emissions	**338.90**			**115.07**			

11.5.1 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 7.6 Table 42 of MfE Guidance the number of rooms in each country was totalled and multiplied by the relevant emission factors where available. Only total emissions factors 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.

NB: An error was found in the calculation of emissions from accommodation for 2019 in the previous GHG Inventory. For Orbit room bookings, the use of the COUNT rather than SUM function meant room nights were understated, and emissions factors for some countries had been transposed. This under-reported the emissions from accommodation by 52 tCO2-e. The base year figure has been updated to reflect the true emissions from 2019 accommodation bookings.

11.5.2 Uncertainty and disclosures:

Emission factors were not available for all countries. In total 41 nights from 5 countries were not accounted for. These countries are Samoa, Fiji, Sweden, Laos and Tanzania. 15 of the unaccounted-for nights are within the Pacific Region. 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.

11.5.3 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.

11.6 Business Travel – Taxis

43.2% from 2019

	2019 Total Emissions(tCO2-e)	2020 Total Emissions(tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units NZ$	854,192.85	520,213.79			
Emission Factor	0.075	0.07	0.069	0.0001	0.001
Total Emissions	**64.06**	**36.41**	**35.89**	**0.052**	**0.52**

11.6.1 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 7.2, Table 21 of MfE Guidance were used.

11.6.2 Uncertainty and disclosures:

In some instances, a minibus 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.

11.6.3 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.

11.7 Business Travel – Private Mileage

47.6% from 2019

	2019 Total Emissions(tCO2-e)	2020 Total Emissions(tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (km)	505,219	237,852			
Emission Factor (kg/km)	0.27	0.27	0.25	0.003	0.009
Total Emissions	**136.41**	**63.03**	**60.18**	**0.71**	**2.14**

11.7.1 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 7.2, Table 16 of MfE Guidance.

11.7.2 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.

11.7.3 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.

11.8 Employee Commuting – Private Vehicles

24.4 % from 2019

	2019	2020			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Total commuting distance (km)	6,958,634.60	6,831,106.55			
Internal combustion engine (ICE) vehicles					
ICE vehicle - Petrol (Km)	NA	4,255,375.10			
Emissions Factor	NA	0.27	0.25	0.003	0.009
Emissions – Petrol (tCO2-e)	NA	1127.67	1076.604	12.76	38.30
ICE vehicle - Diesel (km)	NA	454,295.68			
Emission Factor	NA	0.27	0.27	0.0004	0.004
Emissions - Diesel	NA	122.65	120.85	0.18	1.81
Total ICE vehicle distance (km)	6,472,997.39				
Emissions Factor	0.27				
ICE vehicle emissions	1734.76	1250.34	1197.45	12.94	40.11
EV/Hybrids					
Hybrid Vehicles (km)	NA	287,581.67			
Emission Factor	NA	0.20	0.19	0.002	0.007
Hybrid Emissions	NA	57.80	55.50	0.57	2.01
EV Vehicles (km)	NA	375,106.52			
Emission Factor	NA	0.026	0.025	0.001	0.00004
EV Emissions	NA	9.75	9.37	0.37	0.015
Total EV/Hybrid vehicles distance (km)	485,637.21				
Emission Factor	0.03				
Total EV/Hybrid Emissions	12.14	67.55	64.88	0.95	2.02
Total private vehicle emissions	**1746.90**	**1320.27**	**1262.33**	**13.90**	**42.14**

11.8.1 Calculation Method

Emissions from staff commuting have been based on two primary sources of data- census mapping and staff travel surveys from 2019 and 2021. 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 meshblock 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 FTE staff (not number of staff), by five working days and by 44 working weeks for 2019 and 36 weeks in 2020 to reflect reduced commuting due to time in Alert Levels 4 and 3, to provide an estimate of the total commuting distance for the year in kilometres.

The 2019 and 2021 staff travel surveys used slightly different approaches, and thus different levels of granularity about travel modes were available. The 2019 survey was issued to Dunedin based staff only and 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.

The 2021 survey went to all staff and differentiated between petrol, diesel, hybrid and EVs, and thus allows a more granular selection of emissions factor. For 2019, 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).

The total commuting distance for the year was then divided proportionally according to the relevant staff survey to provide a total distance per travel mode. The distance per mode was then multiplied by the relevant emissions factors for private vehicles (Section 7.2, Table 16 of MfE Guidance).

Emissions from public transport are covered in the next section. Emissions from all other modes of transport were considered to be de minimus (using the above method, we estimate emissions from e-bike and e-scooter commuting to be c.0.3tCO2-e in 2020).

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 may produce an under-reporting error.
- That the staff travel surveys held in April 2019 and April 2021 are representative across the whole year and provide an acceptable proxy for 2020 travel mode splits (and in the case of non-Dunedin campuses, 2019 mode splits as well).
- 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 in 2019 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.

The following table summarises sensitivity analysis for 2020 emissions totals.

Sensitivity analysis: 2020 emissions from staff commuting in private vehicles

	Base case	Scenario 1: 10% of private vehicle journeys are replaced by active transport	Scenario 2: Distance increased 10% to account for potential under reporting via straight line distance	Scenario 3: Staff work from home 20% of the week
Total commuting distance (km)	6,831,107	6,831,107	7,514,217	4,554,071
Total Emitting distance	5,217,303	4,695,573	5,739,033	3,478,202
Total private vehicle emissions	1,280	1,152	1,346	816
Difference (tCO2-e)		-128	66	-464
Difference (%)		-10%	5.2%	-36.3%

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.

11.9 Employee Commuting – Public Transport

9.4 % from 2019

	2019 Total Emissions (tCO2e)	2020 Total Emissions (tCO2e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Distance (Km)	699,459	559,760			
Emission Factor	1.087	Various	Various	Various	Various
Emissions (Mean occupancy 8.62)	91.05	**76.41**	**75.29**	**0.00**	**1.13**

11.9.1 Calculation Method

Emissions from staff commuting have been based on two primary sources of data- census mapping and staff travel surveys (conducted in 2019 and 2021). 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 meshblock used for census data, to the campus centroid. The number of staff resident in each meshblock 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 staff FTE for each campus (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 and 36 working weeks for 2020 to allow for reduced commuting due to COVID Alert Levels 4 and 3.

The 2019 staff travel survey was only for the Dunedin campus and had approximately 1000 responses. It provided a breakdown of modes of transport to work. There was a total of 4.6% of respondents who 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 2021 staff and student travel covered all campuses. The travel mode responses for non-Dunedin based staff in the 2021 survey were used to calculate 2019 travel emissions.

The total commuting distance was then multiplied by the percentage of staff using public transport (e.g., 4.6% of Dunedin based staff for 2019) to identify an approximation to the total

commuting distance by bus. The emission factors per km in a diesel bus from Table 26, Section 7.3 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. (NB: the MfE guidance provides Wellington and National average emission factors based on available data. We have used the Wellington average for Wellington commuting and the national average for all other campuses.)

11.9.2 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 surveys held in April 2019 and April 2021 are representative across the whole year and provide an acceptable proxy for 2020 travel mode splits (and in the case of non-Dunedin campuses, 2019 mode splits as well).
- 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.

11.9.3 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 in Dunedin has undergone some recent changes (Bee Card introduced, one single fare no matter the journey, hybrid and electric buses) and others are mooted such as trialling a commuter train, and a nationally consistent transport card system. The reporting methods for this category will need to adapt to best align with the current state of public transport options and available data for each campus.

11.10 Student Commuting – Private Vehicles

21.1% from 2019

	Total Emissions	Total Emissions	CO2	CH4 (tCO2-e)	N2O (tCO2-e)
Distance Non Emitting (Km)	6,278,490	4,959,962			
Emission Factor	NA	NA	NA	NA	NA
Emissions	0	0	0	0	0
Distance Emitting (Non EV) (Km)	3,646,160	2,877,558			
Emissions Factor	Various	Various	Various	Various	Various
Total Emissions	**956.91**	**755.12**	**721.01**	**8.52**	**25.62**

11.10.1 Calculation Method

The approach for student commuting has been modelled on the previously developed for staff commuting. The Strategy, Analysis and Reporting Office (SARO) provided for both 2019 and 2020:

- total effective full-time students enrolled as on-campus (as opposed to distance) for each of our 5 main campuses, and calculated the distance to campus
- an assessment of distance from home address to campus of study (straight-line distance; where the supplied address did not match a record in LINZ's database of New Zealand's street addresses, or the address was more than 100km from campus, these entries were excluded).

The 2021 travel survey went out to all enrolled students, with around a 10% response rate. To account for students who live close to campus being under-represented by the survey sample, mode splits were developed for those living 0-1km, 1-2km, 2-5km, 5-10km, 10-20km and 20+km from campus and applied to that cohort of students from the data supplied by SARO. The midpoint of each distance from campus group was then doubled to give estimated total daily commute for that group (i.e. 1, 3, 7, 15, 30 and 40km respectively).

The number of days a student could be expected on campus, based on advice from SARO:

- 2019: 180 days (2 x 15 week semesters x 6 days/week to campus), which is 81% of staff days on campus assumed in staff commuting
- 2020: 144 days (24 weeks [reflecting 6 weeks with no commuting while in lockdowns] x 6 days/week to campus), which is 80% of staff days on campus assumed in staff commuting.

The total travel distance per mode was calculated by multiplying the roundtrip distance to campus by total EFTs for that category multiplied by number of days on campus.

The distance per mode was then multiplied by the relevant emissions factors for private vehicles (Section 7.2, Table 16 of MfE Guidance).

In the absence of any other available data, the 2021 travel survey was used to supply travel mode splits for 2019 and 2020.

Emissions from public transport are covered in the next section. Emissions from all other modes of transport were considered to be de minimus.

11.10.2Uncertainty 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 travel survey held April 2021, normalised for distance students live from campus, are representative across the whole year and provide an acceptable proxy for 2020 & 2019 travel mode splits.
- That students will come to campus on average 6 times per week during the semester, and that time students choose not to come to campus (e.g. no scheduled classes on a given day, or attending lectures online), or spend off-site (e.g. on field trips, doing field work or attending conferences - some of which may be captured in other emissions categories, e.g. mobile combustion), is de minimus. This may produce an over-reporting error.

The following table summarises sensitivity analysis for 2020 emissions totals.

Sensitivity analysis: 2020 emissions from student commuting in private vehicles

	Base case	Scenario 1: 10% of private vehicle journeys are replaced by active transport	Scenario 2: Distance increased 10% to account for potential under reporting via straight line distance	Scenario 3: Students only come to campus 4 days a week (cf 6)
Total commuting distance (km)	7,918,640	7,918,640	8,710,504	5,279,093
Total emitting distance (km)	2,958,677	2,662,810	2,929,091	1,972,452
Total private vehicle emissions (tCO2-e)	757	681	833	505
Difference (tCO2-e)		-76	76	-252
Difference (%)		-10%	10%	-33%

11.10.3Recommendations to improve reporting

Consider adjusting the travel survey to students to provide data on the number of days students come to campus, or find an alternative data source to estimate this figure. Ways to increase the number of students who respond to the survey should also be explored.

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

11.11 Student Commuting – Public Transport

21.0% from 2019

	Total Emissions	Total Emissions	CO2	CH4 (tCO2-e)	N2O (tCO2-e)
Distance (Km)	1,349,609	1,065,862			
Emission Factor	Various	Various	Various	Various	Various
Emissions	**186.51**	**147.31**	**145.13**	**0.01**	**2.18**

11.11.1 Calculation Method

As for Private Vehicles, emissions from students commuting via public transport was based on:

a) EFTS per campus enrolled as on-campus
b) Distance from home address to campus calculated as a straight-line distance, with students grouped
c) Proportion of students (per distance from campus group) using public transport as per 2021 travel survey

The total commuting distance was then multiplied by the percentage of staff using public transport (e.g., 4.6% of Dunedin based staff for 2019) to identify an approximation to the total commuting distance by bus. The emission factors per km in a diesel bus from Table 26, Section 7.3 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. (NB: the MfE guidance provides Wellington and National average emission factors based on available data. We have used the Wellington average for Wellington commuting and the national average for all other campuses.)

11.11.2 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 travel survey held April 2021, normalised for distance students live from campus, are representative across the whole year and provide an acceptable proxy for 2020 & 2019 travel mode splits.
- That students will come to campus on average 6 times per week during the semester, and that time students choose not to come to campus (e.g. no scheduled classes on a given day, or attending lectures online), or spend off-site (e.g. on field trips, doing field work or attending conferences - some of which may be captured in other emissions categories, e.g. mobile combustion), is de minimus. This may produce an over-reporting error.

11.11.3Recommendations to improve reporting

Consider adjusting the travel survey to students to provide data on the number of days students come to campus, or find an alternative data source to estimate this figure. Ways to increase the number of students who respond to the survey should also be explored.

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

11.12 Student Travel – Air

16.6% from 2019

	2019 Total Emissions	2020 Total Emissions	CO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (Domestic Travel Distance) (km)	16,264,589	16,655,591			
Units of Emissions	tCO2-e	tCO2-e	tCO2	tCH4	tN2O
Emission Factor	0.242	0.242	0.238	0.0009	0.003
Emissions	3,936.03	4,030.65	3,964.03	14.99	49.97
Input Units (Short Haul Travel) (Km)	676,159	726,451			
Emission Factor	0.160	0.153	0.155	0.00001	0.001
Emissions	108.19	111.15	112.6	0.01	0.73
Input Units (Long Haul Travel) (Km)	33,793,714	26,173,242			
Emission Factor	0.163	0.146	0.19	0.00001	0.001
Emissions	5,508.38	3,821.29	4,972.92	0.26	26.17
Total Distance	50,734,462	43,555,285			
Total Emissions	9,552.59	7,963.09	9,049.55	15.26	76.87

11.12.1 Calculation Method

The Strategy, Analysis and Reporting Office sourced data for students classed as active enrolments (not final exam only) for the given academic year. Distance students were excluded.

Domestically located students are assumed to fly if the flying (great circle) distance is over 300 km. For domestic students we have included the distance of one return journey between their home address and teaching campus per annum. Any flights taken between the beginning and end of the year are outside of the University's operational control and therefore considered out of scope.

All international flights are assumed to travel to Auckland, from which we assume there is an AKL transit flight to take international students to the teaching campus. For international points of departure, the nearest international airport was selected as actual points of departure could not be ascertained.

Students are assumed to fly one journey between home address and teaching campus (or vice versa) per annum. This reflects that many students will not return home every year (even before considering the impact of border restrictions from COVID-19).

This total distance for each class of air travel was then multiplied by the appropriate emissions factor (MfE 2020 Table 36) to calculate total emissions.

11.12.2Uncertainty and disclosures

As stated above, the actual flights taken by students are unknown.

The following assumptions have been made in calculating these emissions:

- That domestic students living more than 150km from their study campus fly to and from their nearest airport and teaching campus every year. This may overstate the number of domestic students flying at the beginning and end of the year (eg when driving may be preferred due to the need to transport belongings).
- That international students fly the equivalent of a one-way trip from their home country to teaching campus. In years like 2020 and 2021, with significant border restrictions and Managed Isolation and Quarantine requirements, this is likely to overstate the total number of journeys. As travel restrictions ease, this may understate the number of journeys.

The following table summarises sensitivity analysis undertaken to see the impact of changes to key assumptions for 2020 emissions.

Sensitivity analysis: 2020 emissions for student air travel

	Base case	Scenario 1: Students only fly if they live 300km from their campus (cf 150km)	Scenario 2: International students fly return trip annually (cf one way)	Scenario 3: Only 10% of international students flew in 2020, but they flew a return trip
Input Units (Domestic Travel Distance) (km)	16,655,591.40	15,097,338	16,655,591	16,655,591
Emissions (tCO2e)	4,030.65	3,653.56	4,030.65	4,030.65
Input Units (Short Haul Travel) (Km)	726,451.33	726,451.33	1,452,902.66	145290.27
Emissions (tCO2e)	113.33	113.33	226.65	22.67
Input Units (Long Haul Travel) (Km)	26,173,241.96	26,173,241.96	52,346,483.92	5,234,648.39
Emissions (tCO2e)	4,999.09	4,999.09	9,998.18	999.82
Total Emissions (tCO2e)	9,143.07	8,765.97	14,255.48	5,053.14
Difference from base case (tCO2e)		-377	5,112	-4,090
Variation from base case (%)		-4%	56%	-45%

This analysis demonstrates the materiality of changing assumptions, particularly with respect to international air travel by students. The base case reflects an appropriately conservative assessment for 2020, but more data on students actual flying behaviour will provide greater confidence in reported figures.

11.12.3Recommendations to improve reporting

Consider ways to get more accurate data on student air travel behaviour, as part of a wider piece of work to:

a) support domestic students to avoid flying and take lower emissions travel options where feasible

b) support students to minimise emissions when flying (e.g. direct flights versus multiple stops)
c) support students to offset their essential travel to reach and return from their teaching campus or provide the offsetting mechanism directly.

11.13 Purchased Goods and Services- Water ↑ 24.6% from 2019

	2019 Total Emissions (tCO2-e)	2020 Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units m3	268,780	338,124			
Emission Factor (kgCO2-e/m3)	0.031	0.031	0.03	0.0014	0.00003
Total Emissions	**8.41**	**10.48**	**10.14**	**0.47**	**0.01**

11.13.1 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 9.2, Table 63 of MfE Guidance were used.

11.13.2 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 has been excluded as it is not a University owned facility and as such is out of scope of this report.

11.13.3 Recommendations to improve reporting

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

11.14 Purchased Goods and Services - Food

1.6% from 2019

	2019	2020			
Residential colleges	**Total Emissions (tCO2-e)**	**Total Emissions (tCO2-e)**	**tCO2**	**tCH4**	**tN2O**
Input Units (Total Number of Dietary Days)	682,290	676,000			
Emission Factor	6.6	6.6	NA	NA	NA
Emissions	4,503.1	4,461.6	NA	NA	NA
Retail outlets/events					
Input Units(Cost Basis NZ$)	$2,79,9076	$1,679,486			
Emission Factor	Cost Basis	Cost Basis	NA	NA	NA
Emissions	72.1	42.2			
Total Emissions	**4575.2**	**4,503.8**	**NA**	**NA**	**NA**

11.14.1 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. Given 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 was 2565 in 2019. They are resident for an estimated 266 days 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 similarly 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.

11.14.2 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 overestimating 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 overestimating 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 overestimating 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.

The following table summarises sensitivity analysis undertaken on the total emissions from food for residential colleges based on changes to the assumptions stated above.

Sensitivity analysis: residential college food purchases

	Base case	Scenario 1: 1 meat-free day/week reduces emissions daily average emissions by 11%	Scenario 2: lower food waste and less meat than average diet results in 5.0kg/day	Scenario 3: 10% of students don't eat at college per day	Scenario 4: Provision of snacks & meal choice means emissions are 20% higher than average diet.
Input Units (Total Number of Dietary Days)	676,000	676,000	676,000	608,400	676,000
Emissions Factor (kgCO2-e/day)	6.6	5.874	5	6.6	7.92
Emissions (tCO2-e)	4,462	3,971	3,380	4,015	5,354
Difference from base case (tCO2-e)		-491	-1082	-446	892
Variation from base case (%)		-11%	-24%	-10%	20%

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 and cost of 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.

11.14.3 Recommendations to improve reporting

The University now uses the same food ordering and menu management IT system (JAMIX) across its college kitchens and Union outlets. This system enables output of all ingredients purchased and, in time, should support emissions factors to be loaded directly into the system, such that accurate emissions reporting is possible for an individual meal, or daily, weekly or annual food ordered/prepared. There may be some limitations for NZ-specific emissions factors for some ingredients, which could be enhanced through further research.

11.15 Waste from Operations- Waste to Landfill

15.2% from 2019

	2019 Total Emissions (tCO2-e)	2020 Total Emissions(tCO2-e)	tCO2	tCH4	tN2O
Input Units (Kg)	1,908,458	1,617,632			
Emission Factor	1.17	1.17			
Total Emissions	**2,232.90**	**1,892.63**	**NA**	**NA**	**NA**

11.15.1 Calculation 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 10.3, Table 79 of MfE Guidance were used for general waste for which the composition was not known.

11.15.2 Uncertainty and disclosures:

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

11.15.3 Recommendations to improve reporting

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

11.16 Waste from Operations - Recycling and other

6.8 % from 2019

	2019	2020			
	Total Emissions(tCO_2e-2)	Total Emissions(tCO_2-e)	tCO_2	tCH_4	tN_2O
Input Units (Kg)	273,995	323,541			
Emission Factor	Various	Various			
Total Emissions	**6.76**	**6.30**	**NA**	**NA**	**NA**

11.16.1 Calculation 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. In 2020, the Waste Management Area 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.

11.16.2 Uncertainty 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 clippings 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.

11.16.3 Recommendations 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.

11.17 Waste from Operations- Wastewater treatment

↑ 28.6% from 2019

	2019 Total Emissions	2020 Total Emissions	CO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units m3	268,780	338,124			
Emission Factor	0.45	0.46	0.08	0.15	0.23
Total Emissions	**120.15**	**154.52**	**26.04**	**52.07**	**76.11**

11.17.1 Calculation 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 as m^3. The emissions factors in Section 9.3, Table 64 of MfE Guidance were used.

11.17.2 Uncertainty 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.

11.17.3 Recommendations to improve reporting

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

11.18 Working from Home Emissions

355.95% from 2019

	2019 Total Emissions	2020 Total Emissions	CO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (Employee WFH per day)	45,683	199,111			
Emission Factor	0.446	0.446	0.429	0.0170	0.00061
Total Emissions	**20.37**	**88.90**	**85.42**	**3.38**	**0.12**

11.18.1 Calculation Method:

The University of Otago had not previously included Working from Home (WFH) as a category in its greenhouse gas emissions reporting. However, the Carbon Neutral Government Programme (CNGP) provided guidance on calculating emissions for participating agencies in October 2021, which included that agencies must report on emissions from staff working from home.

The University undertook work in 2022 to calculate staff working from home emissions for 2019, 2020 and 2021, which was then audited by Toitu. We subsequently added this emissions source into version 1.1 of the 2020 report.

Whilst we did not have precise data on WFH numbers in prior years, we do know the time periods in which each campus was impacted by COVID-19 alert levels. We came up with assumed levels of working from home for staff at each campus under different alert levels (%staff working from home) and multipled this by the number of staff per campus and working days in each period to give total days worked from home by staff in each year. This was then multiplied by the default working from home emissions factor in the MfE's 2022 guide.

It should be noted that increased working from home is likely to reduce commuting to campus (emissions calculation underpinned by assumptions) and may have muted impacts on other categories such as campus-based energy,water consumption and waste to landfill (emissions calculation based on actual consumption metrics).

A high-level analysis of the average commuting emissions per staff FTE that shows for all of our campuses this figure is higher than 0.446 kg CO2-e per day (or the with heating factor of 0.908 kg CO2-e), meaning more working from home is likely to reduce our overall GHG emissions. Given the importance of in-person delivery and outstanding campus experiences, further promotion of Working From Home as an emissions reductions measure would need to consider negative impacts on other key strategic objectives

11.18.2Uncertainty and disclosures:

We currently lack reliable data on the number of staff working from home due to a number of challenges. The first being that our HR and IT systems are not set up to support this kind of reporting.

- While some teams have formalised working from home arrangements with staff (for example, employee to work from home on two specified days per week), others do not, and those agreements that do exist are not held centrally. Therefore it is difficult to collate this information
- Staff working from home may use a variety of ways to connect and access documents (VPN, One Drive, SharePoint), and it may be difficult to distinguish from staff working on campus using the same tools. The nature of some work may mean that network usage is an insufficient indicator of where and when staff are working (for example, academic staff may undertake reading, writing and marking tasks “offline”; many operational staff are not office based).

11.18.3 Recommendations to improve reporting

To gain a more accurate data pool on WFH numbers to calculate the emissions, and potentially simplify the process, we will:

- Include WFH question(s) into the 2022 Workplace Travel Survey
- Discuss with HR and IT teams ways in which they can provide supporting information for future calculations, if required.

12 References

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Drew, J. (2017). *Healthy & Climate-friendly Eating Patterns for New Zealand* [Bachelor of Medical Science with Honours, University of Otago]. https://ourarchive.otago.ac.nz/bitstream/handle/10523/8058/DrewJonathanM2017BMedSc%28Hons%29.pdf?sequence=1&isAllowed=y

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Ministry for the Environment. (2020). *Measuring Emissions: A Guide for Organisations: 2020 Detailed Guide.* Wellington: Ministry for the Environment. https://environment.govt.nz/assets/Publications/Files/Measuring-Emissions-Detailed-Guide-2020.pdf

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Appendix A: 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 of 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- Waste to landfill	Graham Musgrave- Waste and Recycling Manager Andrina Grigg- Waste Minimisation Coordinator
11.12 Waste from Operations- Recycling and other	Graham Musgrave- Waste and Recycling Manager Andrina Grigg- Waste Minimisation Coordinator
11.13 Waste from Operations- Waste-water treatment	Pamela Bedford- Dunedin City Council

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 is 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.

Base Year and Periodic reviews

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.

The methodology has been reviewed as part of preparing this second comprehensive Greenhouse Gas Emissions Report.

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 B- Base year recalculation policy

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.

Note on base year (2019) recalculations as part of preparing this report

The following factors have influenced the need to rebaseline 2019 emissions figures for some categories:

- The inclusion of all New Zealand campuses, rather than just Dunedin (and data centrally held in Dunedin. This impacted categories such as Electricity, Natural Gas and Employee Commuting.
- The bringing new categories in scope, namely student air travel and student commuting.
- Refinement of calculation methodologies, namely standardising the date at which expenditure is converted into USD for use in the Carnegie Mellon tool. This lead to minor adjustments in 2019 figures that used this tool, such as: Mobile Combustion – Pcard purchases, Air Travel – Pcard and Reimbursements.
- Minor calculation errors that were detected in the course of preparing this report:
    - Accommodation - error in total room nights from one travel agent (see 11.5.1)
    - Purchased Goods and Services – Water - transposition error that overstated the emissions in the summary table in 2019 report only.

While some of these changes in isolation do not meet the materiality threshold, we have determined that it is appropriate to make our base year figures as correct as possible at this time, after which recalculation should be kept to a minimum.

Appendix C- Verification letters for 2019 and 2020 emissions

INDEPENDENT AUDIT OPINION
Toitū Verification

TO THE INTENDED USERS

Organisation subject to audit:	University of Otago
Audit Criteria:	ISO 14064-1:2018 ISO 14064-3:2019 Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (2004)
Responsible Party:	University of Otago
Intended users:	University of Otago staff
Registered address:	364 Leith Walk, Dunedin North, Dunedin, 9016, New Zealand
Inventory period:	01/01/2019 to 31/12/2019
Inventory report:	University of Otago 2021 GHG Emission Report - as at 7 Sept 2022.pdf

We have reviewed the greenhouse gas emissions inventory report ("the inventory report") for the above named Responsible Party for the stated inventory period.

RESPONSIBLE PARTY'S RESPONSIBILITIES

The Management of the Responsible Party is responsible for the preparation of the GHG statement in accordance with ISO 14064-1:2018. This responsibility includes the design, implementation, and maintenance of internal controls relevant to the preparation of a GHG statement that is free from material misstatement.

VERIFIERS' RESPONSIBILITIES

Our responsibility as verifiers is to express a verification opinion to the agreed level of assurance on the GHG statement, based on the evidence we have obtained and in accordance with the audit criteria. We conducted our verification engagement as agreed in the audit letter, which define the scope, objectives, criteria and level of assurance of the verification.

The International Standard ISO 14064-3:2019 requires that we comply with ethical requirements and plan and perform the verification to obtain the agreed level of assurance that the GHG emissions, removals and storage in the GHG statement are free from material misstatement.

Reasonable assurance is a high level of assurance, but is not a guarantee that an audit carried out in accordance with the ISO 14064-3:2019 Standards will always detect a material misstatement when it exists. Misstatements are differences or omissions of amounts or disclosures, and can arise from fraud or error. Misstatements are considered material if, individually or in the aggregate, they could reasonably be expected to influence the decisions of readers, taken on the basis of the information we audited.

GHG quantification is subject to inherent uncertainty because of incomplete scientific knowledge used to determine emissions factors and the values needed to combine emissions of different gases.

BASIS OF VERIFICATION OPINION

Our responsibility is to express an assurance opinion on the GHG statement based on the evidence we have obtained. We conducted our assurance engagement as agreed in the Contract which defines the scope, objectives, criteria, and level of assurance of the verification.
We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

VERIFICATION

We have undertaken a verification engagement relating to the Greenhouse Gas Emissions Inventory Report (the 'Inventory Report')/Emissions Inventory and Management Report of the organisation listed at the top of this statement and described in the emissions inventory report for the period stated above.
The Inventory Report provides information about the greenhouse gas emissions of the organisation for the defined measurement period 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).

VERIFICATION STRATEGY

Our verification strategy used a combined data and controls testing approach. Evidence-gathering procedures included but were not limited to:

— activities to inspect the completeness of the inventory;
— interviews of site personnel to confirm operational behaviour and standard operating procedures;
— reperforming calculations for staff and employee commuting, WFH and purchased goods: food;

— sampling of power and fuel records to confirm accuracy of source data into calculations;
— verification of emissions factors;
— reconciliation of business air travel and accommodation
The data examined during the verification were historical in nature.

QUALIFICATIONS TO VERIFICATION OPINION

The following qualifications have been raised in relation to the verification opinion: No site visits could be undertaken to confirm activities. A site visit will be performed at next verification.
Category 4 emission sources for purchased goods & services: Food are heavily assumptions based, using dollar spend data and average NZ meals to estimate emissions.

VERIFICATION LEVEL OF ASSURANCE

	tCO_2e	**Level of Assurance**
Category 1	3,332.00	**Reasonable**
Category 2	11,720.52	**Reasonable**
Category 3 All emission sources other than those in limited	14,352.99	**Reasonable**
Category 3: Student Commuting, Student Air Travel	10,696.01	**Limited**
Category 4: All emission sources other than those in Limited	3,267.31	**Reasonable**
Category 4: Purchased Goods: Food, Working From Home	4,575.21	**Limited**
Category 5	0.00	
Category 6	0.00	
Total inventory	**47,944.04**	

RESPONSIBLE PARTY'S GREENHOUSE GAS ASSERTION (CERTIFICATION CLAIM)

University of Otago has measured its greenhouse gas emissions in accordance with ISO 14064-1:2018 and the Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (2004) in respect of the operational emissions of its organisation.

VERIFICATION CONCLUSION

EMISSIONS - REASONABLE ASSURANCE
We have obtained all the information and explanations we have required. In our opinion, the emissions, removals and storage defined in the inventory report, in all material respects:

- comply with ISO 14064-1:2018 ; and
- provide a true and fair view of the emissions inventory of the Responsible Party for the stated inventory period.

EMISSIONS - LIMITED ASSURANCE

Based on the procedures we have performed and the evidence we have obtained, nothing has come to our attention that causes us to believe that the emissions, removals and storage defined in the inventory report:

- do not comply with ISO 14064-1:2018 ; and
- do not provide a true and fair view of the emissions inventory of the Responsible Party for the stated inventory period.

OTHER INFORMATION

The responsible party is responsible for the provision of Other Information. The Other Information may include emissions management and reduction plan and purchase of carbon credits, but does not include the information we verified, and our auditor's opinion thereon. Our opinion on the information we verified does not cover the Other Information and we do not express any form of audit opinion or assurance conclusion thereon. Our responsibility is to read and review the Other Information and consider it in terms of the ISO 14064-1: 2018 and ISO 14064-3: 2019. In doing so, we consider whether the Other Information is materially inconsistent with the information we verified or our knowledge obtained during the verification.

Verified by:		**Authorised by:**	
Name:	Natalie Clee	Name:	Sonia Groes-Petrie
Position:	Verifier, Toitū Envirocare / Deilen Deri Consultancy Limited	Position:	Certifier, Toitū Envirocare
Signature:		Signature:	
Date verification audit:	11-13 July 2022	Date:	07 September 2022
Date opinion expressed:	28 August 2022		

INDEPENDENT AUDIT OPINION
Toitū Verification

TO THE INTENDED USERS

Organisation subject to audit:	University of Otago
Audit Criteria:	ISO 14064-1:2018 ISO 14064-3:2019 Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (2004)
Responsible Party:	University of Otago
Intended users:	University of Otago staff
Registered address:	364 Leith Walk, Dunedin North, Dunedin, 9016, New Zealand
Inventory period:	01/01/2020 to 31/12/2020
Inventory report:	University of Otago 2021 GHG Emission Report - as at 7 Sept 2022.pdf

We have reviewed the greenhouse gas emissions inventory report ("the inventory report") for the above named Responsible Party for the stated inventory period.

RESPONSIBLE PARTY'S RESPONSIBILITIES

The Management of the Responsible Party is responsible for the preparation of the GHG statement in accordance with ISO 14064-1:2018. This responsibility includes the design, implementation and maintenance of internal controls relevant to the preparation of a GHG statement that is free from material misstatement.

VERIFIERS' RESPONSIBILITIES

Our responsibility as verifiers is to express a verification opinion to the agreed level of assurance on the GHG statement, based on the evidence we have obtained and in accordance

with the audit criteria. We conducted our verification engagement as agreed in the audit letter, which define the scope, objectives, criteria and level of assurance of the verification.
The International Standard ISO 14064-3:2019 requires that we comply with ethical requirements and plan and perform the verification to obtain the agreed level of assurance that the GHG emissions, removals and storage in the GHG statement are free from material misstatement.

Reasonable assurance is a high level of assurance, but is not a guarantee that an audit carried out in accordance with the ISO 14064-3:2019 Standards will always detect a material misstatement when it exists. Misstatements are differences or omissions of amounts or disclosures, and can arise from fraud or error. Misstatements are considered material if, individually or in the aggregate, they could reasonably be expected to influence the decisions of readers, taken on the basis of the information we audited.

GHG quantification is subject to inherent uncertainty because of incomplete scientific knowledge used to determine emissions factors and the values needed to combine emissions of different gases.

BASIS OF VERIFICATION OPINION

Our responsibility is to express an assurance opinion on the GHG statement based on the evidence we have obtained. We conducted our assurance engagement as agreed in the Contract which defines the scope, objectives, criteria and level of assurance of the verification.
We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

VERIFICATION

We have undertaken a verification engagement relating to the Greenhouse Gas Emissions Inventory Report (the 'Inventory Report')/Emissions Inventory and Management Report of the organisation listed at the top of this statement and described in the emissions inventory report for the period stated above.
The Inventory Report provides information about the greenhouse gas emissions of the organisation for the defined measurement period 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).

VERIFICATION STRATEGY

Our verification strategy used a combined data and controls testing approach. Evidence-gathering procedures included but were not limited to:

- activities to inspect the completeness of the inventory;
- interviews of site personnel to confirm operational behaviour and standard operating procedures;
- reperforming calculations for staff and employee commuting, WFH and purchased goods: food;

- sampling of power and fuel records to confirm accuracy of source data into calculations; — verification of emissions factors;
- reconciliation of business air travel and accommodation

The data examined during the verification were historical in nature.

QUALIFICATIONS TO VERIFICATION OPINION

The following qualifications have been raised in relation to the verification opinion:
No site visits could be undertaken to confirm activities. A site visit will be performed at next verification.

Category 4 emission sources for purchased goods & services : Food are heavily assumptions based, using dollar spend data and average NZ meals to estimate emissions.

VERIFICATION LEVEL OF ASSURANCE

	tCO_2e	Level of Assurance
Category 1	2,908.00	**Reasonable**
Category 2	8,286.00	**Reasonable**
Category 3 All emission sources other than those in Limited	3,308.30	**Reasonable**
Category 3: Student Commuting, Student Air Travel	8,867.70	**Limited**
Category 4: All emission sources other than those in Limited	2,749.40	**Reasonable**
Category 4: Purchased Goods: Food, Working From Home	4,592.60	**Limited**
Category 5	0.00	
Category 6	0.00	
Total inventory	**30,712.00**	

RESPONSIBLE PARTY'S GREENHOUSE GAS ASSERTION (CERTIFICATION CLAIM)

University of Otago has measured its greenhouse gas emissions in accordance with ISO 14064-1:2018 and the Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (2004) in respect of the operational emissions of its organisation.

VERIFICATION CONCLUSION

EMISSIONS - REASONABLE ASSURANCE
We have obtained all the information and explanations we have required. In our opinion, the emissions, removals and storage defined in the inventory report, in all material respects:

- comply with ISO 14064-1:2018 ; and

- provide a true and fair view of the emissions inventory of the Responsible Party for the stated inventory period.

EMISSIONS - LIMITED ASSURANCE

Based on the procedures we have performed and the evidence we have obtained, nothing has come to our attention that causes us to believe that the emissions, removals and storage defined in the inventory report:

- do not comply with ISO 14064-1:2018 ; and
- do not provide a true and fair view of the emissions inventory of the Responsible Party for the stated inventory period.

OTHER INFORMATION

The responsible party is responsible for the provision of Other Information. The Other Information may include emissions management and reduction plan and purchase of carbon credits, but does not include the information we verified, and our auditor's opinion thereon. Our opinion on the information we verified does not cover the Other Information and we do not express any form of audit opinion or assurance conclusion thereon. Our responsibility is to read and review the Other Information and consider it in terms of the ISO 14064-1: 2018 and ISO 14064-3: 2019. In doing so, we consider whether the Other Information is materially inconsistent with the information we verified, or our knowledge obtained during the verification.

Verified by:		**Authorised by:**	
Name:	Natalie Clee	Name:	Sonia Groes-Petrie
Position:	Verifier, Toitū Envirocare / Deilen Deri Consultancy Limited	Position:	Certifier, Toitū Envirocare
Signature:		Signature:	
Date verification audit:	11-13 July 2022	Date:	07 September 2022
Date opinion expressed:	28 August 2022		