Toitū Te Taiao
Sustainability Office

Greenhouse Gas Emission Inventory 2023

Inventory Scope: University Operations

Version 1.0

Level of Assurance: Reasonable all categories except category 3 student travel emissions which is limited.

University of Otago
Te Whare Wānanga o Otāgo
New Zealand

Acknowledgements

This report builds on the foundations laid in recent years by a team of staff spread across the organisation, and our key suppliers. Our efforts for 2023 reporting again relied on a range of staff and suppliers. In no particular order specific acknowledgement must be made of contributions by:

John Hurford - Procurement Officer

Quentin Johnson - Manager Divisional Finance

Dylan Henry - Food Service Manager

Greg Murray - Principal Analyst, Strategy Analytics and Reporting

Kevin Michael - Analyst, Strategy Analytics and Reporting

Hanh Dang - Analyst, Strategy Analytics and Reporting

Shane Jenkins - Energy Manager

Kelly Li - Energy Analyst

Emily Colquhoun - Waste Minimisation Coordinator, Waste Management NZ Ltd

Report prepared by: Gabriella Rutherford, Project Support Officer, Sustainability Office Craig Cliff, Net Carbon Zero Programme Manager, Sustainability Office	Signature and date: 21.03.24
Report authorised by: Stephen Willis, Chief Operating Officer	Signature and date

INDEPENDENT AUDIT OPINION
Toitū Vertification

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:	01/01/2023 to 31/12/2023
Inventory report:	2023 GHG Emissions Report 22.03.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 140643:2019 Standards will always detect a material misstatement when it exists. The procedures performed on a limited level of assurance vary in nature and timing from, and are less in extent compared to reasonable assurance, which is a high level of assurance. 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 ISO14064-1 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;
—recalculation of fuel emissions;
—reconciliation of biomass, LPG, electricity, business air travel, student air travel and food purchases
—retracing of other emissions.

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:
The opinion is unmodified.

VERIFICATION LEVEL OF ASSURANCE

	tCO_2e	Level of Assurance
Category 1	2,488.95	**Reasonable**
Category 2	4,275.00	**Reasonable**
Category 3, excluding student travel	10,060.82	**Reasonable**
Category 3, student travel	11,255.14	**Limited**
Category 4	5,822.87	**Reasonable**
Total inventory	**33,902.78**	

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 ISO14064-1:2018 and ISO14064-3:2019. 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:	Billy Ziemann
Position:	Verifier, Toitū Envirocare / Deilen Deri Consultancy Limited	Position:	Certifier, Toitū Envirocare
Signature:		Signature:	
Date verification audit:	12 & 13 March 2024		
Date opinion expressed:	3 April 2024	Date:	14 May 2024

Ko te reoreo a kea ki uta, ko te whakataki mai a toroa ki kai, he kotuku ki te raki, he kakapo ki te whenua

The voice of the kea is heard inland, the cry of the albatross is heard at sea, a kotuku in the sky, a kakapo on the ground | Everything has its rightful place

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Category 1

09 Stationary combustion - Biomass (Wood Fuel)

10 Stationary Combustion - Coal

11 Stationary Combustion - Diesel

12 Stationary Combustion - LPG

13 Mobile Combustion – Petrol and Diesel

14 Mobile Combustion – PCard Purchases

15 Fugitive Emissions – Refrigerants

Category 2

16 Electricity

17 Steam and MTHW – Coal and Biomass

18 Steam and MTHW – Natural Gas – Wellington Campus

Category 3

19 Business Travel – Air

20 Business Travel - Accommodation

21 Business Travel – Taxis

22 Business Travel - Private Mileage

23 Employee Commuting - Private vehicles

24 Employee Commuting - Public Transport

25 Student Commuting - Private Vehicles

26 Student Commuting - Public Transport

27 Student Travel - Air

28 Working from Home

Category 4

29 Transmission & Distribution Losses – Electricity

30 Steam and MTHW losses – Coal and Biomass

31 Steam and MTHW losses - Natural Gas

32 Purchased Goods & Services - Water

33 Purchased Goods & Services - Food

34 Waste from Operations - Waste to Landfill

35 Waste from Operations - Recycling & other

36 Waste from Operations - Waste Water Treatment

37 Freight Emissions

References

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 kilograms to calculate the quantity of greenhouse gas emissions resulting from 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
CNGP Carbon Neutral Government Programme
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
WFH Working from Home

Snapshot Report

Snap-shot Report on GHG Emissions Inventory

Travel drives year-on-year increase, masking other gains

In 2023, we entered a 'near normal', with activities on campus increasing back to near pre-pandemic levels.

Total emissions in 2023 of 33,903 tonnes of carbon dioxide equivalent (tCO2-e) were 31% below our 2019 base year. However, this was an increase of 9% from 2022. This increase was driven by an uptick in Business Travel (Air Travel and Accommodation), and Student Air Travel as international student numbers continued to recover post-COVID. It is hard to gauge how much business travel in 2023 was due to a backlog from previous years' border restrictions. The increase in accommodation suggests that staff are staying longer overseas when they do travel, indicating more trip-stacking and trip-chaining than may have been the norm pre-COVID. We will continue to monitor these patterns and ensure our people are supported.

While we did experience an increase in travel emissions, we have some material reductions to celebrate, all of which should be able to be sustained and built upon in future years. In 2022, Food emissions reached an all-time high, which was driven by higher meat purchases, due in part to colleges trialing a self-serve model for protein. The University reverted back to a staff serving model in 2023, and emissions in this category reduced by 30%.

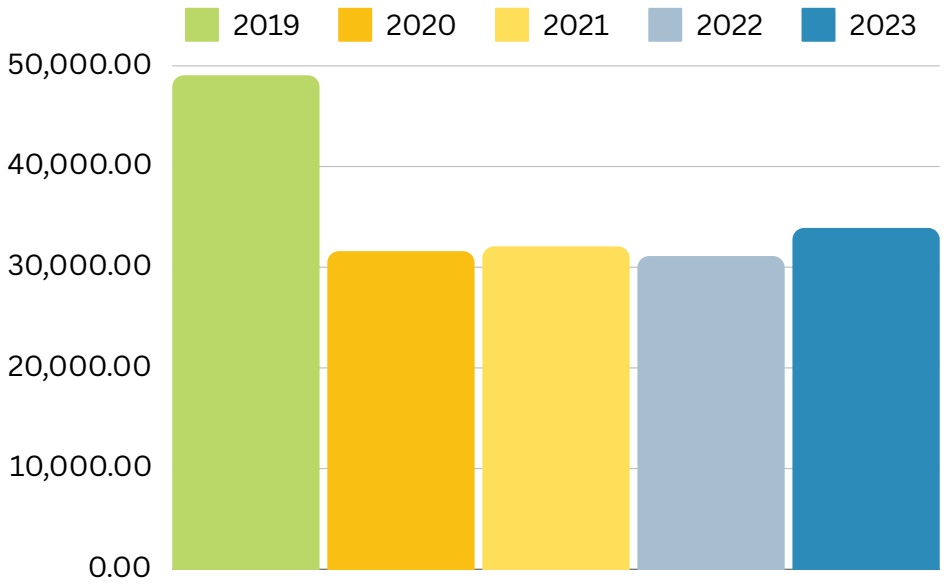
Another cause for celebration is decreasing Coal Boiler emissions by 97% from 2019 as we removed the last of the University's coal boilers from operations. For more information on our targets and how we will go about achieving them, please refer to our "Net Carbon Zero: Journey to 2030" document.

In 2023, we worked with our suppliers to gather data around Category 4 Freight emissions and have now successfully added this new scope into our reporting.

New and improved methodologies have been introduced for a number of categories, including Student Air Travel. In addition, the Carnegie Mellon Economic Input-Output Lifecycle Assessment, which was previously used to calculate spend-based emissions for a number of categories, has been replaced. This tool was based on USA data and hadn't been updated since 2002. In its place we are using factors from the Consumption Emissions Modelling Report by Market Economics Limited, originally prepared for Auckland City Council. This report from 2023 includes New Zealand based emission factors, which is a great improvement from the previous tool used.

Areas for improving the accuracy and completeness of our GHG reporting for 2024 include refrigerants and continuing with our work on freight to get more consumption- rather than spend-based data.

University of Otago GHG Emissions (tCO2-e)



Progress towards net zero and compliance with Carbon Neutral Government Programme

In 2019, the University of Otago committed to achieving net zero greenhouse gas emissions ("Net Carbon Zero") by 2030. University Council reconfirmed this commitment and agreed category-based emissions reduction targets, as part of reviewing the first version of the Programme Business Case, in November 2021. You can read more about these targets and how the University intends to meet them in our Journey to 2030 document online.

The Carbon Neutral Government Programme (CNGP) was announced in December 2020 at the same time as the New Zealand Government declared a climate emergency. The aim of the programme is to accelerate the reduction of greenhouse gas emissions (GHGs) within the public sector and have participant organisations reach carbon neutrality by 2025.

The CNGP is run by the Ministry for the Environment, with support from the Ministry for Business, Innovation and Employment and the Energy Efficiency and Conservation Authority (EECA).

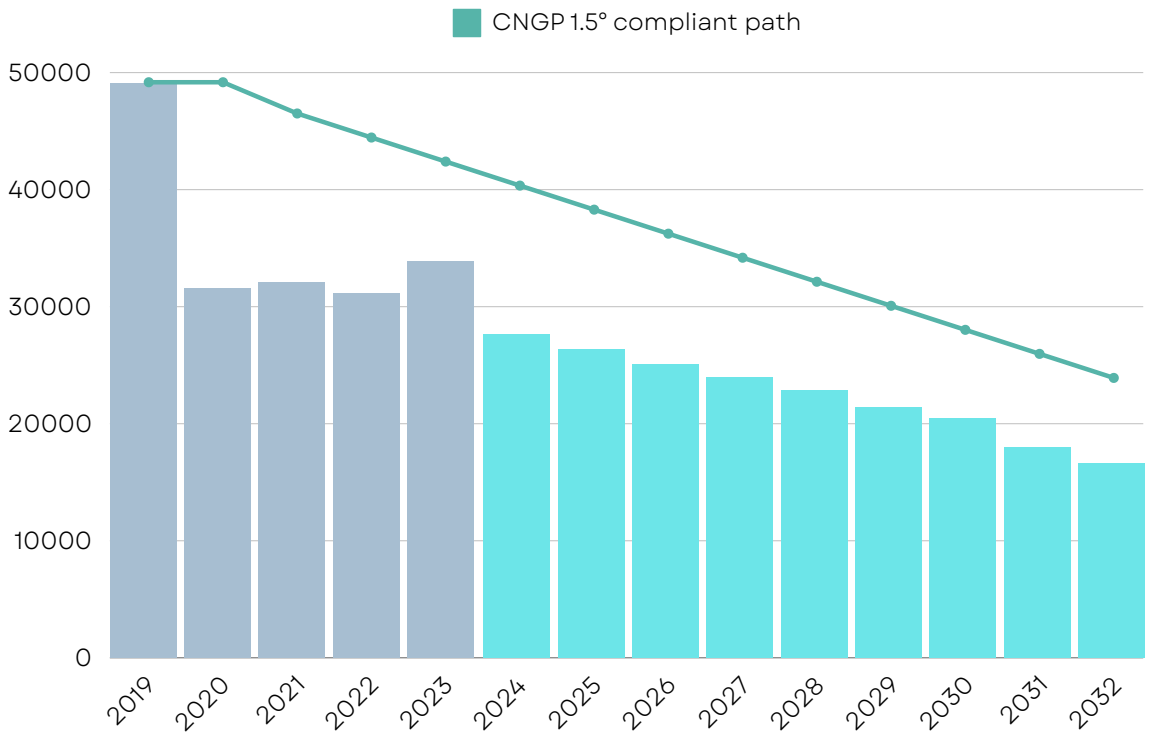
As a tertiary institution the University of Otago is in Tranche 3 of the programme, meaning it is encouraged to report by 2023. The University elected to voluntarily report its emissions and reduction targets in 2022 and met these requirements again in 2023.

The CNGP requires participating organisations to set targets for emissions reductions that are in line with what is required globally to keep warming to 1.5°C by the end of the century.

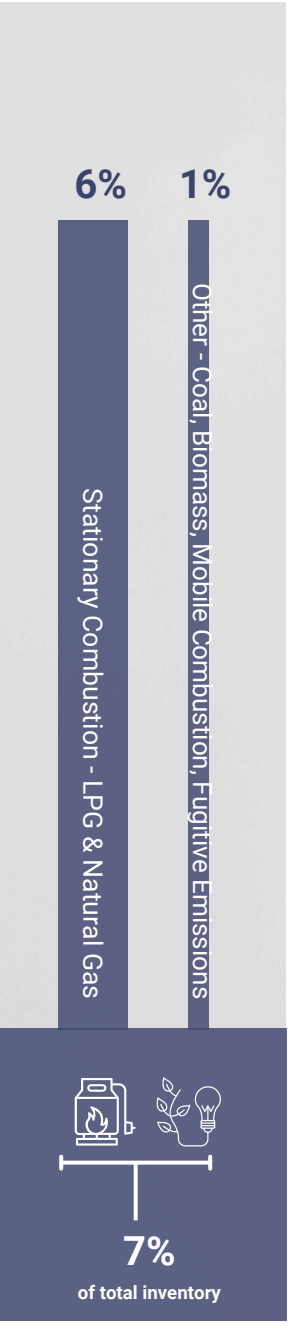
As the chart below shows, our emissions to date and our target emissions in future years are below how the CNGP defines a 1.5° compliant path. This demonstrates the University's commitment to do its fair share in terms of addressing climate change, demonstrate leadership while doing so, and also allows for a buffer if we encounter stronger headwinds than expected.

The CNGP is still to release guidance on offsetting. When released this may influence the University's approach to net emissions.

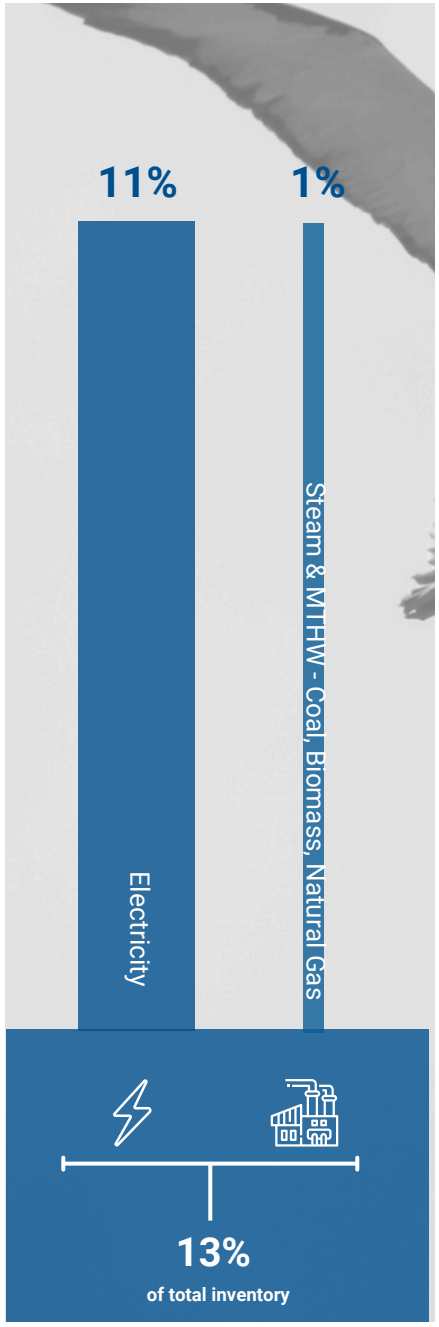
University of Otago Emission Targets vs CNGP Targets



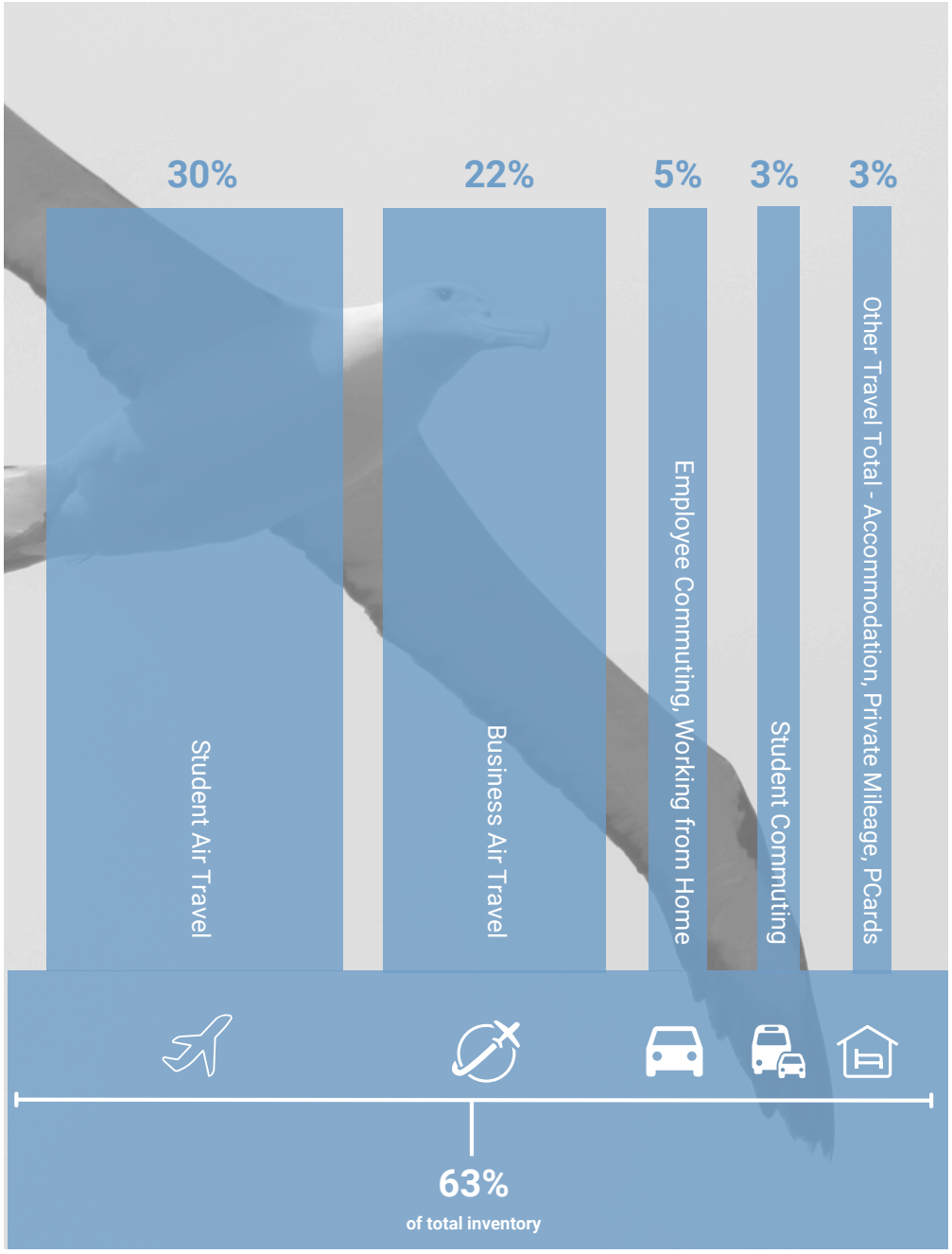
Category 1



Category 2



Category 3



Category 4

NB: Due to rounding, there may be slight disagreement between sum for emissions sources and categories.

Snap-shot Report on GHG Emissions Inventory

ISO Category	Activity Group	Activity	Input Unit	Activity data	2023 Emissions tCO2-e	2022 Emissions tCO2-e	2021 Emissions tCO2-e	2020 Emissions tCO2-e	2019 Emissions tCO2-e	Change compared to base year 2019 (%, +ve or -ve)	Annual change from 2022-2023 (%, +ve or -ve)
1	Biomass	Biomass - Wood chips and pellets - boilers	kWh / t	3,083,372	60.77	59.04	65.07	64.11	68.68	-11.52%	2.93%
1	Stationary combustion - coal	Coal boilers	Kg	23,550	47.34	37.77	701.49	1,383.74	1,558.59	-96.96%	25.33%
1	Stationary combustion - other	Diesel boilers	Litres	5,668	15.25	23.68	93.82	58.19	78.25	-80.52%	-35.62%
1	Stationary combustion - natural gas and LPG	LPG- bottled and reticulated	Kg / kWh	7,041/8,321,936	1,937.59	2,297.53	2,971.2	1,116.4	1,275.6	51.90%	-15.67%
1	Transport fuels - vehicle fleet	Mobile combustion- petrol and diesel (incl. marine)	Litres	97,257	265.68	243.04	184.39	156.57	212.85	24.82%	9.31%
1	Transport fuels - vehicle fleet	Mobile combustion- PCard purchases	NZ$	122,303	54.16	39.10	32.90	20.10	33.20	63.14%	38.52%
1	Refrigerants, medical and other gases	Fugitive Emissions- refrigerants	Kg	52	108.42	108.42	109.00	109.00	106.00	2.29%	0.00%
	Total Category 1				**2,489**	**2,809**	**4,158**	**2,908**	**3,332**		
2	Electricity use	Electricity	kWh	50,871,205	3,774.64	3,634.92	5,953.47	6,447.53	4,971.28	-24.07%	3.84%
2	Category 2 - other	Steam and MTHW - Coal	kWh	23,140	7.34	719.32	786.54	1,225.77	6,176.28	-99.88%	-98.98%
2	Category 2 - other	Steam and MTHW - Biomass	kWh	35,548,721	381.79	311.47	449.57	416.99	273.32	39.69%	22.58%
2	Category 2 - other	Steam and MTHW – Natural Gas – Wellington Campus	kWh	573,344	111.23	106.65	194.89	195.60	299.64	-62.88%	4.29%
	Total Category 2				**4,275**	**4,772**	**7,384**	**8,286**	**11,721**		
3	Air Travel	Business Travel- Air	Km (+ NZ$, Litres, time)	37,722,626	7,517.84	4,300.98	1,954.60	1,699.31	11,981.89	-37.26%	74.79%
3	Business travel other (eg. taxi, hotel)	Business Travel- Accommodation	Nights / NZ$	9,506 / 4,169,359	779.56	213.59	107.47	115.08	338.90	130.03%	264.98%
3	Business travel other (eg. taxi, hotel)	Business Travel- Taxis	NZ$	1,256,629	64.59	46.47	26.20	36.41	64.06	0.83%	39.01%
3	Business travel other (eg. taxi, hotel)	Business Travel - Private Mileage	Km / NZ$	428,014 / 79,228	112.25	114.87	95.64	63.03	136.41	-17.71%	-2.28%
3	Category 3 - other	Employee Commuting- Private vehicles	Km	6,302,002	1,435.98	1,701.33	1,251.28	1,320.27	1,746.90	-17.80%	-15.60%
3	Category 3 - other	Employee Commuting- Public transport	Km	844,690	116.64	141.56	85.63	76.41	84.42	38.16%	-17.61%
3	Category 3 - other	Student Commuting- Private vehicles	Km	7,386,816	962.7	918.15	878.38	755.12	956.91	0.60%	4.85%
3	Category 3 - other	Student Commuting- Public transport	Km	1,199,495	126.54	133.97	165.48	147.31	186.51	-32.15%	-5.55%
3	Air Travel	Student Travel - Air	Km	46,659,854	10,165.89	8,254.53	8,744.78	8,624.38	10,372.83	-2.00%	23.16%
3	Working from home	Working from home emissions	Days	93,038	33.96	39.09	72.42	88.80	20.37	-99.38%	-13.12%
	Total Category 3				**21,316**	**15,865**	**13,382**	**12,926**	**25,890**		
4	Electricity use (including line losses)	Transmission & Distribution Losses – Electricity	kWh	50,871,205	437.49	421.30	559.11	585.65	448.77	-2.51%	3.84%
4	Stationary combustion - coal	Steam and MTHW losses – Coal	kWh	23,140	0.37	35.97	39.33	61.29	308.81	-99.88%	-98.98%
4	Stationary combustion - other (eg. diesel)	Steam and MTHW losses - Biomass	kWh	35,548,721	19.09	15.57	22.48	20.85	13.67	39.65%	22.58%
4	Stationary combustion - natural gas and LPG	Steam and MTHW losses - Natural Gas	kWh	573,344	4.09	6.56	11.99	12.04	18.44	-77.83%	-37.72%
4	Category 4 - other	Purchased Goods and Services - Water	m3	270,176	9.97	9.95	14.13	10.48	8.41	18.54%	0.19%
4	Category 4 - other	Purchased Goods and Services - Food	Kg	1,102,793	3,922.74	5,622.33	4,969.05	4,503.80	4,575.20	-14.26%	-30.23%
4	Waste (emissions from all waste sources)	Waste from Operations - Waste to landfill	Kg	1,473,139	981.11	1,064.51	1,079.84	1,892.63	2,232.90	-56.06%	-7.83%
4	Waste (emissions from all waste sources)	Waste from Operations - Recycling and other	Kg	300,463	5.52	5.98	7.16	6.30	6.76	-18.32%	-7.64%
4	Waste (emissions from all waste sources)	Waste from Operations- wastewater treatment	m3	270,176	137.25	154.07	218.85	154.52	120.15	-18.19%	-7.49%
4	Freight	Freight	Documents / NZ$	6,982 / 2,554,988	305.23	327.84	224.77	225.92	388.57	-21.45%	-6.90%
	Total Category 4				**5,823**	**7,664**	**7,147**	**7,473**	**8,122**		
	Out of Scope Emissions				**15,043**	**12,324**	**12,407**	**11,318**	**7,876**		
	Total In-Scope Emissions				**33,903**	**31,110**	**32,071**	**31,594**	**49,064**	**30.90%**	**8.98%**

Snap-shot Report on GHG Emissions Inventory - Out of Scope Emissions

ISO Category	Activity Group	Activity	Activity data	2023 Emissions tCO2-e	2022 Emissions tCO2-e	2021 Emissions tCO2-e	2020 Emissions tCO2-e	2019 Emissions tCO2-e (Base-year)	Change compared to base year 2019 (%, +ve or -ve)	Annual change from 2022-2023 (%, +ve or -ve)
Biogenic Emissions	Stationary Combustion	Biomass - Wood chips and pellets - boilers	3,083,372	1,978.70	1,343	1,376	1,299	1,385	42.87%	47.38%
Biogenic Emissions	Steam & MTHW	Biomass	33,850,621	12,442.05	10,459	10,505	9,543	6,182	101.26%	18.97%
Biogenic Emissions	Losses in Steam & MTHW	Biomass	11,847.72	622.10	523	525	477	309	101.33%	18.97%
	Total out of scope emissions			**15,043**	**12,324**	**12,406**	**11,318**	**7,876**	**91.00%**	**22.06%**

University of Otago GHG Emissions Inventory 2023 in Rank Order

2023 Rank	Change in rank from 2019	Change in rank from 2022	Emission Source	Category	Emissions (tCO2-e)	% of Inventory
1	+1	(-)	Student Travel	Air Travel - All Categories	10,165.89	29.99%
2	-1	+3	Business Travel - Air	Air Travel - All Categories	7,515.20	22.17%
3	+2	(-)	Purchased Goods and Services	Food	3,922.74	11.57%
4	(-)	-2	Electricity	Electricity	3,774.64	11.13%
5	+4	(-)	Stationary Combustion	LPG	1,937.59	5.72%
6	+2	(-)	Employee Commuting	Private Vehicles	1,435.98	4.24%
7	-1	(-)	Waste from operations	Waste to Landfill	981.11	2.84%
8	(-)	(-)	Student Commuting	Private Vehicles	962.67	2.84%
9	+4	+4	Business Travel	Accommodation	779.56	2.30%
10	+2	(-)	Transmission and distribution losses	Electricity	437.49	1.29%
11	+3	(-)	Steam and MTHW	Biomass	381.79	1.13%
12	(-)	(-)	Freight	Freight	305.23	0.90%
13	-6	-1	Mobile Combustion	Petrol and Diesel	265.68	0.78%
14	+7	(-)	Waste from operations	Wastewater Treatment	137.25	0.40%
15	+2	+1	Student Commuting	Public Transport	126.54	0.37%
16	+8	-1	Employee Commuting	Public Transport	116.64	0.34%
17	+1	(-)	Business Travel	Private Mileage	112.25	0.33%
18	-3	+1	Steam and MTHW	Natural Gas	111.23	0.33%
19	+1	-1	Fugitive Emissions	Refrigerants	108.42	0.32%
20	(-)	+1	Business Travel	Taxis	64.59	0.19%
21	+2	-1	Stationary Combustion	Biomass	60.77	0.18%
22	+4	(-)	Mobile Combustion	PCard Purchases	57.19	0.16%
23	-17	+1	Stationary Combustion	Coal	47.34	0.14%
24	(-)	-1	Working from home	Working from home	33.96	0.10%
25	-3	+2	Steam and MTHW losses	Steam and MTHW losses - Biomass	19.09	0.06%
26	-5	(-)	Stationary Combustion	Diesel Boilers	15.25	0.04%
27	(-)	+1	Purchased Goods and Services	Water	9.97	0.03%
28	-26	-19	Steam and MTHW	Coal	7.34	0.02%
29	-1	+1	Waste from Operations	Recycling and other	5.52	0.02%
30	-4	-1	Steam and MTHW losses	Steam and MTHW losses - Natural Gas	4.09	0.01%
31	-18	-6	Steam and MTHW losses	Steam and MTHW losses - Coal	0.37	0.00%

Emissions by Scope†

Scope	Proportion of Inventory 2019 (rebaselined figures)	Proportion of Total Inventory 2020	Proportion of Total Inventory 2021	Proportion of Total Inventory 2022	Proportion of Total Inventory 2023
Scope 1	6.79%	9.20%	12.96%	9.03%	7.34%
Scope 2	23.89%	26.23%	23.03%	15.34%	12.61%
Scope 3	69.32%	64.57%	64.01%	75.63%	80.05%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100%**

† The University's GHG emissions reports for 2019 and 2020 used the three scopes as defined in the GHG Protocol. From 2021 onwards, our primary classification is the categories set out in ISO 14064-1 2018 (as per previous tables and graphics). However, as many are still familiar with GHG Protocol scopes, we continue to provide this table to support comprehension and year-on-year comparisons. For the University, Scope 3 correlates to Categories 3 and 4.

Emissions Liabilities as at 2023

Refrigerant	Type	Emission Factor	Total Charge (kg)	Liability (tCO2-e)
R22	HCFC	1,810	159.6	289
R410a	HFC	2,088	793.2	1,656
R407c	HFC	1,774	253.0	449
R134a	HFC	1,300	107.2	139
R404a	HFC	3,922	129.0	506
Total Liability				**3,039**

Emissions Key Performance Indicators

	2019		2020		2021		2022		2023	
Key Performance Indicator (KPI)	**Quantity**	**t CO2-e per KPI**	**Quantity**	**t CO2-e per KPI**	**Quantity**	**t CO2-e per KPI**	**Quantity**	**t CO2-e per KPI**	**Quantity**	**t CO2-e per KPI**
Floor Area (metres squared)	476,100	0.10	478,891	0.07	484,491	0.07	484,238	0.06	502,804	0.07
EFTS (Equivalent Full Time Student)*	18,915	2.59	18,722	1.69	19,603	1.64	19,174	1.62	18,960	1.79
FTE (Full Time Equivalent Staff)*	3,996	12.28	4,154	7.61	4,044	7.93	4,097	7.59	4077	8.32
Person (combined EFTS and FTE)*	22,911	2.14	22,876	1.38	23,647	1.36	23,271	1.34	23,037	1.47

*From the University of Otago Annual Report (2022)

GHG Emissions Inventory & Reporting Manual 2023

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

Inventory Scope: University Operations

Version 1.0

1 Introduction

This report is the fourth 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 2023.

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. We have engaged with suitably qualified external reviewers to verify the 2023 inventory, with 2019-2022 data referred to in this this reporting having previously been audited and verified.

Where the scope has been expanded or methodology amended from the 2022 GHG inventory, this is noted in the text.

2 Statement of Intent

This inventory forms part of the University of Otago's commitment to reducing the adverse impacts of climate change in line with The Paris Agreement (2015) and 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 measure of current performance which can be compared to our 2019 baseline and targets through to 2030 and beyond. 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 to make comparisons to their own emissions. The report will be made publicly available on the University's website alongside previous years' reports on the following page: https://www.otago.ac.nz/sustainability/net-carbon-zero/.

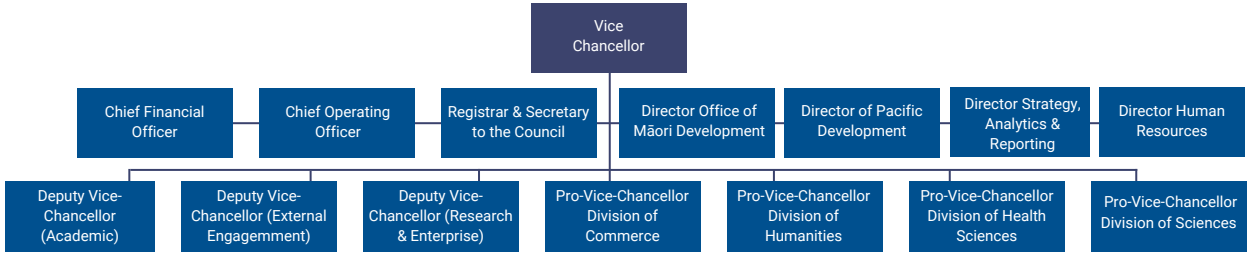
3 Audit of GHG Inventory

In 2021, we engaged Toitū Envirocare to audit and provide independent assurance for annual greenhouse gas reporting for three years in accordance with ISO 14064-1:2018 and the Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (2004).

This is also part of the University taking steps to ensure its reporting aligns with the requirements of the Carbon Neutral Government Programme.

4 Organisation description

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



The responsibilities in these divisions have effect across the geographical locations of the University. We provide education to almost 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.

5 Organisational Boundaries

The University of Otago has applied an operational control approach to compiling a GHG inventory. This allows the focus to be on those emission sources over which it has control and can therefore implement management actions consistent with strategic objectives. University of Otago operates across several New Zealand Campuses: Dunedin, Invercargill, Christchurch, Wellington and Auckland. The Dunedin campus is by far the largest. Christchurch and Wellington campuses traditionally share sites and facilities with District Health Boards.

5.1 Changes to organisational boundaries

There have been no changes to organisational boundaries from the 2022 report.

6 Organisational business units excluded from inventory

The following are specifically excluded from the 2022 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.

7 GHG emission source inclusions

The GHG emissions categories 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:

- Category 1: Direct GHG emissions from sources that are owned or controlled by the University of Otago.
- Category 2: Indirect GHG emissions such as electricity, heat and steam consumed by the University of Otago.
- Category 3: Other Indirect GHG emissions such as transportation.
- Category 4: Indirect emissions from products the University of Otago uses

Categories 5 and 6 have not been included in this inventory as they are not relevant to the University's operations. The emissions sources in Table 1 have been included in the 2023 GHG emissions inventory and in subsequent sections of this report you can find full details of calculation method, uncertainties and disclosures, and recommendations to improve reporting.

Table 1 Greenhouse Gas Emissions Source Inclusions

GHG Emission Source			
Category 1	Category 2	Category 3	Category 4
Stationary Combustion - Biofuel	Electricity	Business Travel - Air [new method for PCard & Reimbursements]	Electricity transmission & distribution losses
Stationary Combustion - Coal	Steam and MTHW - Coal & Biomass	Accommodation [new method for PCard, Accounts Payable, & Reimbursements]	Steam and MTHW - Losses from Steam and MTHW - Coal & Biomass
Stationary Combustion - Diesel	Steam and MTHW - Natural Gas Wellington	Business Travel - Taxi	Steam and MTHW - Losses from Steam and MTHW - Natural Gas
Stationary Combustion - LPG		Business Travel - Reimbursements (Private Mileage) [new method]	Purchased goods & services - Water
Mobile Combustion - Petrol, Diesel, Marine		Employee Commuting - Private Vehicles	Purchased goods & services - Food
Mobile Combustion - PCard Purchases [new method]		Employee Commuting - Public Transport	Waste from Operations - Waste to Landfill
Fugitive Emissions - Refridgerants		Student Commuting - Private Vehicles	Waste from Operations - Recycling & other
		Student Commuting - Public Transport	Waste from Operations - Wastewater Treatment
		Student Travel - Air [new method]	Freight [new inclusion in 2023]
		Working from Home Emissions	

8 GHG emission source exclusions

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

GHG emission source	Category	Reason for exclusion
Fugitive Emissions - Medical/Lab gasses	Category 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.
Business Travel – Rental Cars	Category 3	As per 2019-2022 inventories, 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 Combustion for Category 1. For this reason, emissions due to use of rental vehicles is not reported upon.
Business Travel – Public Transport	Category 3	Data was available in relation to expenditure on public transport purchased through Purchase Card (PCard) and Accounts Payable under the dissection code “Travel Other”. No mileage data was available, and expenditure often included other non-public transport related items. Items specifically mentioning “bus” or “train” totalled around NZD 22,000 in 2023. These emissions are considered de minimus and has therefore not been reported upon.
Purchased Goods and Services - Paper	Category 4	As per previous reporting years, 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.
Water (Auckland and Christchurch campuses)	Category 4	Data was not available for Christchurch and Auckland, however these amounts are considered de minimis.
Construction	Category 4	The University of Otago has an ongoing campus development programme, though this has slowed recently. 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.

Category 1

09 Stationary Combustion – Biomass (Wood Fuel)

3% from 2022

12% from 2019

Biomass Wood Fuel	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2 (out of scope)	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (Wood Chip) (kWh)	3,916,667	3,672,766	3,892,920	3,796,795	3,082,836			
Emission factor (Wood Chip) kg/kWh	0.01563	0.01545	0.01513	0.01053	0.01074	0.35	NA	NA
Emissions (Wood Chip)	61.22	56.74	58.90	39.98	33.11	1,078.99	NA	NA
Input Units (Wood Pellets) (Tonnes)	102	101	85	377	536.44			
Emission factor (Wood Pellets) kg/t	73.14	72.30	72.60	50.55	51.56	1,677.18	NA	NA
Emissions (Wood Pellets)	7.46	7.30	6.17	19.06	27.66	899.71	NA	NA
Total Emissions	**68.68**	**64.04**	**65.07**	**59.04**	**60.77**	**1,978.70**	**NA**	**NA**

** All 2019 figures in these tables are rebaselined as per the 2020 report, i.e. including all campuses, unless otherwise stated*

9.1 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 from suppliers. 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 (tCO2-e) have been reported in the inventory.

Biomass emission factors were updated in 2023, with the Wood Chip factor decreasing, and the Wood Pellet factor increasing slightly. Emissions in 2023 are up by 3 percent by 2022.

9.2 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.

9.3 Recommendations to improve reporting

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

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

10 Stationary Combustion - Coal

26% from 2022

97% from 2019

Coal	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (kg)	775,420	688,430	349,000	18,790	23,550			
Emission Factor	2.01	2.01	2.01	2.01	2.01	1.99	0.00580	0.00823
Total Emissions	**1,558.59**	**1,383.74**	**701.49**	**37.77**	**47.43**	**46.86**	**0.14**	**0.19**

10.1 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. Only the Invercargill boiler remained in use in 2023, with the last coal purchase in August. The replacement of this boiler means that emissions for this source should be zero in future years.

The total mass of coal was gathered from an annual report summarising all invoices. Coal was provided by a sole supplier. The coal supplied was deemed to be sub-bituminous according to the producer's website. Emission factors from the Stationary Combustion Fuel section under Table 3 of MfE Guidelines were used to calculate the total emissions.

10.2 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.

10.3 Recommendations to improve reporting

The University replaced the heating source at the Invercargill College of Education, meaning that there should be no Category 1 coal emissions from 2024.

11 Stationary Combustion - Diesel

↘ 36% from 2022
↘ 81% from 2019

Biomass Wood Fuel	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (Litres)	29,417	21,875	35,138	8,870	5,668			
Emission Factor	2.66	2.66	2.67	2.67	2.69	2.67	0.0102	0.00581
Emissions	**78.25**	**58.19**	**93.82**	**23.68**	**15.25**	**15.13**	**0.06**	**0.03**

11.1 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 the Stationary Combustion Fuel section under Table 3 of MfE Guidelines. The commercial category was seen as the most relevant to the use as back up in heating systems for campus. Diesel boilers and generators are primarily used as back-ups, and the reduction of consumption reflects the reduced call on these systems in 2023.

11.2 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.

11.3 Recommendations to improve reporting

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

12 Stationary Combustion - LPG

16% from 2022
52% from 2019

LPG	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units - LPG Bottled (kg)	13,010	12,328	13,893	12,508	7,041			
Emission Factor	3.03	3.03	3.03	3.03	2.97	2.96	0.00665	0.00126
Emissions (Bottled LPG)	**39.42**	**37.35**	**42.10**	**37.90**	**20.91**	**20.84**	**0.05**	**0.01**
Input Units - Reticulated LPG (kWh)	5,367,707	4,685,526	12,717,934	9,811,249	8,293,755			
Emission Factor	0.23	0.23	0.23031	0.23031	0.23	0.22999	0.00020	0.00012
Emissions (Reticulated LPG)	**1,236.13**	**1,079.08**	**2,929.07**	**2,259.63**	**1,916.68**	**1,913.96**	**1.66**	**1.00**
Total Emissions	**1,275.55**	**1,116.43**	**2,971.16**	**2,297.53**	**1,937.59**	**1,934.80**	**1.71**	**1.00**

12.1 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 for primary heating by 2030.

The data in relation to the use of LPG comes from three different suppliers. Genesis provides 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, the 2023 DEFRA emission factor was used to calculate the total emissions from reticulated gas (DEFRA, Gaseous Fuels).

The total amount of bottled gas was calculated manually from the invoices. This manual process excluded all non-fuel costs such as bottle rental. The emission factor for the commercial use of LPG from the Stationary Combustion Fuel section under 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.

In 2021 we saw a large increase in reticulated LPG usage and emissions due to the new and upgraded buildings at the Dunedin campus. In particular, the Eccles Building uses an LPG boiler to provide heat and steam. Fine-tuning of this system led to significant efficiency improvements in 2022, with this trend continuing in 2023. Investigations are underway to replace the boiler with a lower emissions solution. This work will also inform other LPG boiler replacement efforts across campus.

12.2 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 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.

12.3 Recommendations to improve reporting

The University is seeking to consolidate LPG suppliers, and this should simplify the reporting process.

13 Mobile Combustion - Petrol & Diesel

58% from 2022
36% from 2019

Petrol & Diesel	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input (Regular Petrol)	28,830	20,306	21,028	21,894	21,823			
Emission Factor (Regular Petrol)	2.45	2.45	2.46	2.46	2.46	2.35	0.0309	0.0710
Emissions (Regular Petrol)	70.63	49.75	51.73	53.86	53.68	51.28	0.67	1.55
Input (Premium Petrol)	10,082	7,662	8,529	5,323	890			
Emission Factor (Premium Petrol)	2.45	2.45	2.48	2.48	2.46	2.36	0.0309	0.0709
Emissions (Premium Petrol)	24.70	18.77	21.15	13.20	2.19	2.10	0.03	0.06
Subtotal Petrol Emissions	**95.33**	**68.52**	**72.88**	**67.06**	**55.87**	**53.38**	**0.70**	**1.61**
Input (Diesel)	36,997	29,626	35,321	37,492	45,703			
Emission Factor (Diesel)	2.69	2.69	2.69	2.69	2.71	2.67	0.00399	0.0378
Emissions (Diesel)	**99.52**	**79.69**	**95.01**	**100.85**	**123.86**	**122.03**	**0.18**	**1.73**
Input (Marine)	$56,403	$26,867	$48,208	25,553.28	25,553	28,841		
Emission Factor (Marine) ($ & L)	Cost basis	Cost basis	Cost basis	2.94	2.98	2.95	0.00753	0.0204
Emissions (Marine)	**18.00**	**8.36**	**16.5**	**75.13**	**85.95**	**85.08**	**0.22**	**0.59**
Total Emissions	**212.85**	**156.57**	**184.39**	**243.04**	**265.67**	**260.49**	**1.10**	**3.93**

** Now includes Marine Emissions as the calculation method converted from $/e to litres of fuel/emissions*

13.1 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 the Transport Fuel section under Table 4 of MfE Guidelines were used for Regular, Premium and Diesel fuels.

The slight increase in emissions in 2023 from 2019 levels is largely due to marine fuel. A cost-based emissions factor was used 2019-2022 as only financial expenditure being available for this source. In 2022, we switched to the more accurate litres-based emissions factor (light fuel oil in table 4 of the MfE guidelines) when this data became available for all vessels. The much higher emissions in 2022-23 despite a rationalised marine fleet suggests the cost basis was underestimating the emissions from fuel purchased previously.

13.2 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.

13.3 Recommendations to improve reporting

Inclusion of fuel card purchases and accounts payable data into reporting dashboards for departments to understanding year-to-date emissions and trends.

14 Mobile Combustion - Pcard Purchases

39% from 2022
63% from 2019

Biomass Wood Fuel	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2*	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (NZ$)	$104,048.56	$64,471.68	$95,797.01	$127,010.00	$122,302.87			
Emission factor	Cost basis	Cost basis	Cost basis	Cost basis	0.00044285			
Emissions	**33.20**	**20.10**	**32.90**	**39.10**	**54.16**	**NA**	**NA**	**NA**

14.1 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. Previously the Carnegie Mellon Cost input tool was used to calculate these emissions, however the tool no longer publicly exists. In replacement, the Consumption Emissions Modelling Report by Market Economics Limited for Auckland City Council, was used to allocate an emission factor (Other vehicle fuels and lubricants). As shown in the table above, although spending decreased in 2023 from 2022, emissions increased. This is due to the change in emission factor.

The University Procurement team compiled all PCard charges coded as fuel purchases for the year.

14.2 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.

Previously we used the cost input model, which is based on US data. Although we are still using a spend based emission factor, we have now moved to a NZ based factor from 2023 which has increased the accuracy of our reporting.

14.3 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.

15 Fugitive Emissions – Refrigerants

(-) from 2022
2% from 2019

Refrigerant		2019	2020	2021	2022	2023			
		Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Emission Factor	Estimated Leakage (kg)	Total Emissions (tCO2-e)
R22	HCFC	15	15	15	15	15	1760	8.181	15
R410A	HFC	57	61	61	61	61	1924	29.1519	61
R407C	HFC	13	13	13	13	13	1624	7.59	13
R134A	HFC	4	4	4	3	3	1300	2.633	3
R404A	HFC	16	16	16	16	16	3943	4.14	16
Total Emissions		**106**	**109**	**109**	**108**	**108**			**108**

16.1 Total Liability

Refridgerant		EF	Total Charge (kg)	Liability (tCO2-e)
R22	HCFC	1760	159.6	289
R410A	HFC	1924	793.19	1,656
R407C	HFC	1624	253	449
R134A	HFC	1300	107.2	139
R404A	HFC	3943	129	506
SF6			0	0
Total Liability				**3,039**

15.1 Category summary and calculation method:

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. 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 has recently transitioned to a new Integrated Workplace Management System (IWMS), and future developments should allow accurate recording of assets that contain f-gases and thus support reporting on this category in the future.

Continued Fugitive Emissions – Refrigerants

To support loading refrigerant data in this new system and our greenhouse gas reporting, a stocktake commenced in February 2024, but was not completed in time to inform our 2023 report.

The only substantive changes to the inventory since it was undertaken in early 2020 were due to the refurbishment of the Dental School, completion of the Eccles Building, and new equipment at the Mellor labs on the Dunedin campus (all occurred in 2020). The resulting changes to known refrigerant amounts (R410a only) were factored into 2020 figures. No material changes were identified for 2021 or 2022.

15.2 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. A detailed inventory is scheduled before the end of 2023 to coincide with the new IWMS.

15.3 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 maintenance recording to include the actual top-up value of any refrigerant used in servicing to support more accurate reporting.

Category 2

16 Electricity

4% from 2022
24% from 2019

Electricity	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (kWh)	45,193,469	53,729,383	51,769,270	48,988,107	50,871,205			
Emission factor (kg/kWh)	0.110	0.120	0.115	0.0742	0.0742	0.0721	0.00194	0.0002
Total Emissions	**4,971.28**	**6,447.53**	**5,953.46**	**3,634.92**	**3,774.64**	**3,667.81**	**98.69**	**10.17**

16.1 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 the Purchased electricity, heat and steam section on Table 9 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 and 2021 due in part to the increased usage at residential colleges and Uniflats over COVID Alert Levels 3 and 4. There were no lockdowns in 2022, which partly explains the 5% drop in electricity usage from 2021-2022. In addition, the University began using a new energy analytics platform in late 2021, which has led to efficiency gains. In 2023 the MfE Guide updated the electricity emission factors, leading to a 25% decrease in emissions from 2019, despite electricity usage increasing.

Looking beyond 2023, electricity will continue to make up a large 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 will remain a focus. The Government's efforts to drive the percentage of renewables in the National Grid towards 100% should also progressively reduce the emissions factor for grid sourced electricity, and we will also explore opportunities for more onsite renewable generation of electricity.

16.2 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 process of compiling the record from different sources can introduce errors.

16.3 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.

17 Steam and MTHW – Coal and Biomass

100% Coal from 2019
100% Coal from 2022
23% Biomass from 2022
40% Biomass from 2019

Coal & Biomass	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units – Coal (kWh)	17,681,864	3,634,471	2,456,410	2,246,460	23,140			
Emission Factor – Coal (kg/kWh)	0.3493	0.33726	0.32020	0.32020	0.3174	0.31568	0.0001	0.00159
Emissions - Coal	**6,176.28**	**1,225.77**	**786.54**	**719.32**	**7.34**	**7.30**	**0.17**	**2.74**
Input Units – Biomass (kWh)	17,486,769	26,989,325	29,713,741	29,579,609	35,548,721	tCO2 (out of scope)		
Emission Factor - Biomass (kg/kWh)	0.01563	0.01545	0.01513	0.01053	0.01074	0.35	NA	NA
Emissions - Biomass	**273.32**	**416.99**	**449.57**	**311.47**	**381.79**	**12,442.05**	**NA**	**NA**

17.1 Category summary and calculation method:

The Dunedin campus is supplied steam and medium temperature hot water (MTHW) by Pioneer Energy's district energy scheme. In early 2020, the boiler that supplies our campus was converted from coal- to biomass-fueled. For this reason, there is no coal consumption recorded for 2021 from the Dunedin campus, and this will continue in future years. From 2021-2022, all the coal in this category comes from the Christchurch School of Medicine, which was supplied heat and steam from the hospital's energy scheme and is based on figures provided by Te Whatu Ora. This scheme switched over from coal to biomass in February 2023, resulting in a decrease of emissions to 7.30 tCO2-e in 2023. The switch to biomass also led to a increase in kWh used in 2023, and a 23% increase in emissions from 2022.

For Dunedin, the amount of energy provided as steam and MTHW was based on monthly reports agreed between Pioneer Energy and the University Energy Management team. This now just reports on biomass use since coal has been removed from the Dunedin Campus. The remaining coal come from the Christchurch campus only.

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 2023 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). The Biomass DEFRA emission factor was updated and increased slightly in 2023 from the 2022 figure.

17.2 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.

17.3 Recommendations to improve reporting

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

18 Steam and MTHW – Natural Gas – Wellington Campus

4% from 2022
63% from 2019

Natural Gas	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units - Natural Gas-Wellington (kWh)	1,536,620	1,003,060	999,444	546,944	573,344			
Emissions factor (kg/kWh)	0.195	0.195	0.195	0.195	0.194	0.193	0.0005	0.00009
Emissions - Natural Gas	**299.64**	**195.60**	**194.89**	**106.65**	**111.23**	**110.66**	**0.29**	**0.05**

18.1 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 reports from the Capital and Coast District Health Board.

Emission factors from the Stationary Combustion Fuel section under Table 3 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. These affects were still in place for 2022 and 2023, with a small fraction of staff 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.

18.2 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.

18.3 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.

Category 3

19 Business Travel – Air

75% from 2022
37% from 2019

Air Travel	2019	2020	2021	2022	2023								
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	km	Emission Factor (EF) (kg CO2-e/km	Total Emissions (tCO2-e)	EF CO2 (kg CO2/km)	tCO2	EF CH4 (kg CO2/km)	tCH4	EF N2O (kg CO2/km)	tN2O
Domestic													
Economy	3,536.02	749.72	1773.05	1,825.95	8,714,243	0.306	2,666.56	0.300	2,614.27	0.0011	8.71	0.0044	34.86
Sub-Total	**3,536.02**	**749.72**	**1773.05**	**1,825.95**	**8,714,243**		**2,666.56**		**2,614.27**		**8.71**		**34.86**
Shorthaul													
Economy	1,084.73	134.14	19.79	398.13	5,324,802	0.151	804.05	0.150	798.72	0.00001	0.05	0.0008	5.32
Premium Economy	7.61	1.08	0.00	1.22	29,385	0.151	4.44	0.150	4.41	0.00001	0.00	0.0008	0.03
Business	9.29	2.52	0.00	10.75	48,973	0.227	11.12	0.225	11.02	0.00001	0.00	0.00112	0.05
First	0.59	0.98	0.00	1.29	6,714	0.227	1.52	0.225	1.51	0.00001	0.00	0.00112	0.01
Sub-Total	**1,102.21**	**138.72**	**19.79**	**411.38**	**5,409,87**		**821.12**		**815.66**		**0.05**		**5.41**
Longhaul													
Economy	5,438.61	570.93	67.84	1,442.01	21,257,221	0.148	3,146.07	0.147	3,124.81	0.00001	0.21	0.0007	21.26
Premium Economy	287.15	28.58	0	118.30	1,251,360	0.237	296.57	0.235	294.07	0.00001	0.01	0.00117	1.25
Business	654.7	32.76	0	278.19	752,398	0.429	322.78	0.427	321.27	0.00002	0.02	0.00212	1.5
First	13.2	0	0	3.01	18,396	0.591	10.87	0.589	10.84	0.00002	0.00	0.00293	0.04
Sub-Total	**6,393.66**	**632.27**	**67.84**	**1,841.50**	**23,279,375**		**3,776.29**		**3,750.99**		**0.24**		**24.05**
Charter Helicopter	NA	NA	NA	1.51	4.45	multiple	2.15	multiple	2.13	multiple	0	multiple	0.02
Charter Aeroplane	NA	NA	NA	1.24	219	2.56	0.49	2.23	0.49	0.0005	0.00011	0.0171	0.003745
Sub-Total	**NA**	**NA**	**NA**	**2.75**			**2.64**		**2.62**		**0.00**		**0.02**
Cost-basis													
P-Card	251.00	39.60	44.00	87.40	$72,595.61	Cost-basis	57.19	The Consumption Emissions Modelling does not provide breakdown of constituent gases					
Reimbursements	699	139	50.5	132.00	$246,315.11	Cost-basis	194.04	The Consumption Emissions Modelling does not provide breakdown of constituent gases					
Grand Total	**11,981.89**	**1,699.31**	**1,955.18**	**4,300.98**	**37,403,492**		**7,517.85**		**7,183.54**		**9.88**		**60.71**

Business Travel – Air

19.1 Category summary and calculation method:

Business air travel (primarily for staff, but also for some students, collaborators and suppliers) was the single largest source of emissions from University activity in 2019. The impact of COVID19 on both international and domestic flying was dramatic in 2020 and similar circumstances prevailed in 2021 (with even lower levels of international travel being offset by more domestic flying). As travel restrictions were removed, staff have been encouraged to use alternative modes to flights when possible, or to fly smarter through trip stacking or chaining when flying is unavoidable. In 2022, emissions successfully remained below our target of 5,500 tCO2-e per annum (46% of pre-pandemic levels). In 2023, Business Air Travel went over the target by 37%, this shows a need and opportunity to increase communications around trip-stacking and booking economy where possible.

In 2023 there are six sources of data, each with different formats and data availability: Orbit (University approved travel agent), Helloworld (University approved travel agent), PCard purchases, staff reimbursements, and charter helicopter and airplane flights paid for through accounts payable.

Orbit and Helloworld provide distance, flight class and flight category (long haul etc.). From there we can apply the appropriate emission factors as provided in the Domestic Air Travel section, the International Air Travel section, and the Helicopter section under Table 37, 42 and 43 of the MfE Guidelines. 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 from higher levels pre-pandemic. 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 previously used to estimate the emissions resulting from expenditure through PCards and reimbursements, however this tool has since been removed from online. The Consumption Modelling Report by Market Economics for Auckland Council provides NZ based spending-based emission factors, which have been used in our 2023 report.

A small number of charter flights on aeroplane and helicopter were made in 2023. Each vendor was contacted to advise the craft used and flight duration (helicopter) or volume of fuel used (flight) and relevant emissions factors from the MfE's guidance were used from Table 4 and 43.

19.2 Uncertainty and disclosures:

While charter flight emissions are currently de minimus, these flights are often for climate change-related research and thus we have elected to provide as much transparency as possible.

From moving away from the US based cost input model by Carnegie Mellon, to a NZ based model we have decreased some uncertainty around the accuracy of PCard and Reimbursement emissions, however it is still important to recognise the limitations of reporting with spend based emissions compared to km based activity data.

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.

19.3 Recommendations to improve reporting

Continue to reinforce the policy and guidelines to avoid PCard purchases/reimbursements in relation to air travel, noting that there will always be some instances that this method will still need to be used (eg short notice travel when already overseas).

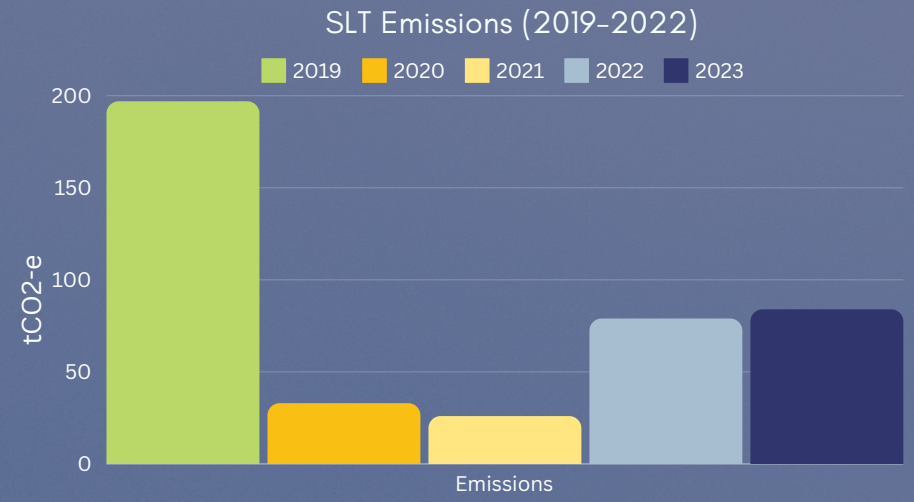
Develop departmental travel emissions dashboards to share in-year progress with decision makers.

Senior Leadership Air Travel Emissions

Last year we began including a section on Senior Leadership Team (SLT) air travel emissions to demonstrate leadership and increase transparency.

SLT air travel emissions as a percentage of total business air travel emissions have hovered between 1% and 2% between 2019 and 2023. While emissions in 2023 increased from the peak of the COVID-19 pandemic, they remained below half of 2019 levels (84 tCO2-e vs 197 tCO2-e).

The Sustainability Office will continue working with the SLT to ensure SLT and University-wide emissions are part of travel decision making.



SLT Emissions vs Total University Air Travel 2019-2022)

Years	SLT Air Travel tCO2-e	Total UoO Air Travel tCO2-e	% of Total
2019	197.44	11,981.89	1.64%
2020	33.29	1,699.31	1.96%
2021	25.92	1,955.18	1.33%
2022	74.41	4,300.98	1.73%
2023	84.16	7,515.20	1.12%

20 Business Travel – Accomodation

265% from 2022
130% from 2019

Accomodation	2019	2020	2021	2022	2023					
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2e)	Total Emissions (tCO2e)	Activity data	Emission Factor	Total Emissions (tCO2e)	tCO2	tCH4	tN2O
From travel booking	114.80	60.57	33.25	94.19	9506	Various	155.37	NA	NA	NA
Staff reimbursements (NZ$)	49.10	10.90	9.92	10.9	483,173.59	0.00014971	72.34	NA	NA	NA
PCard expenditure and Accounts Payable (NZ$	175.00	43.60	64.30	108.5	3,686,185.25	0.00014971	551.86	NA	NA	NA
Total Emissions	**338.90**	**115.08**	**107.47**	**213.59**			**779.56**	**NA**	**NA**	**NA**

20.1 Category summary and calculation method:

The emissions resulting from accommodation during business travel are based on data from travel agents (Orbit and Brooker), 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 the Accommodation section under Table 44 of MfE Guidance the number of rooms in each country was totaled and multiplied by the relevant emission factors where available. Only total emissions factors are available, therefore component GHG emissions are not reported. With COVID-19 travel restrictions easing in 2022, we saw an increase of 98% in accommodation emissions. As expected, this trend continued into 2023, with a 265% increase in emissions. This increase can be explained by looking at the increase in Business Air Travel emissions in 2023. It indicates a possible increase in staff choosing to trip-chain and to take longer trips to reduce the number of return flights, therefore leading to an increase in accommodation needs. Of a total of 45 countries visited in 2023, all but 14 (Denmark, Réunion, Samoa, Hawaii, Rarotonga, Tonga, Sweden, Norway, Bali, Cook Islands, Taiwan, Mauritius, Serbia, and Uruguay) had emission factors available. For the mentioned countries with no emission factors, the most appropriate near-by country emission factors were used as placeholders to ensure these emissions were being accounted for.

The expenditure on accommodation through PCard and Accounts Payable were totaled and the emissions estimated through the new Consumption Emissions Modelling Report by Market Economics for Auckland Council (Table 5, Accommodation). This was previously calculated using the Carnegie Mellon Cost input tool, this has since been removed online. This resulted in significantly higher emissions per dollar spent in 2023. PCard expenditure in 2022 was $2.16 million, meaning 2023 spend was 70% higher, while the change in emissions factors means the emissions for this expenditure appears 409% higher.

20.2 Uncertainty and disclosures:

Emission factors were available for the large majority of countries accommodation was booked in 2023. As international travel continues to increase post-2022, there are likely to be some countries not listed in the MfE guidance, however, the guidance continues to add more countries to the list with each update.

While accommodation emissions factor based on dollars spent from the Market Economics report is from 2023 and based in New Zealand, making it more current and more local than the previously used emissions factor, there will still be some degree of error. Emission factors vary widely from one country to another, and it is not clear what weighting different countries are given in the current tool.

20.3 Recommendations to improve reporting

To reduce the amount of accommodation booked through reimbursement and PCards OR ensure room nights is captured as part of the reimbursement/payment process to allow the more accurate nights-based method.

21 Business Travel – Taxis

39% from 2022
1% from 2019

Taxi	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Input Units NZ$	854,192.85	520,213.79	374,306.22	663,789.07	1,256,629.39			
Emission Factor	0.075	0.070	0.070	0.070	0.0514	0.0497	0.0005	0.00116
Total Emissions	**64.06**	**36.41**	**26.20**	**46.47**	**64.59**	**62.45**	**0.63**	**1.46**

21.1 Category summary and 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. Mileage data for PCard or Accounts Payable was not available so the cost-based emissions factors in the Passenger Vehicles section under Table 22 of MfE Guidance were used.

For taxi charge, the report provided estimated mileage as well as cost per trip. Using estimated mileage (38,348 km) and the MFE's recommended emission factor of 0.0514 kgCO2-e/km, this equates to 6.29 tCO2-e. Using the total cost ($120,836) and the emissions factor above yields 6.21 tCO2-e. For the sake of consistency, we have used the cost-based emissions factor for taxi charge as well.

21.2 Uncertainty and disclosures:

In some instances, a minibus shuttle or airport bus may have been used rather than a car. This may be the case for many airport transfers. 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.

21.3 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.

22 Business Travel – Private Mileage

↘ 2% from 2022
↘ 18% from 2019

Private Mileage	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Input Units (km)	505,219	237,851	360,899	433,477.20	507,241.99			
Emission Factor (kg/km)	0.27	0.27	0.265	0.265	0.223	0.214	0.00281	0.00645
Emissions (km)	**136.40**	**63.03**	**95.64**	**114.87**	**95.45**	**91.59**	**1.20**	**2.76**
Input Units (NZ$)					**79,228.49**			
Emission Factor (NZ$/e)	NA	NA	NA	NA	0.0002121	NA	NA	NA
Emissions (NZ$/e)					**16.80**			
Total Emissions	142.96	**71.44**	**95.64**	**114.87**	**112.25**	**91.59**	**1.20**	**2.76**

22.1 Category summary and calculation method:

This category covers mileage driven by staff in private vehicles and claimed back through the reimbursement process. A transaction report was produced from the finance system for reimbursements and the total kilometres calculated for transaction with the dissection code descriptions "Mileage Reimbursements" and "Travel Other".

The default emissions factor for private petrol car was applied based on Section 7.2, Table 17 of MfE Guidance where km distance was provided.

There were a number of transactions included in the report which were coded as "Mileage Reimbursements" but did not have a sum of kilometres travelled. To ensure that we included these items, we have instead used the spending data and have applied a spend based emission factor from the Consumption Emissions Modelling Report by Market Economics for Auckland Council (Table 5, Road passenger transport). Due to the availability of a local and recent emissions factor, 2023 is the first year we have added this additional spending into our inventory. The additional emissions is not considered material enough to warrant recalculating previous years' totals.

22.2 Uncertainty and disclosures:

Mileage data is likely to be more accurate than spend based data for calculating emissions. There may also be some miscoding in the finance system (for example, some of the zero km "mileage reimbursements" may not have been for travel), but the risk

22.3 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 (for example querying zero km mileage reimbursements when processing).

23 Employee Commuting – Private Vehicles

↘ 16% from 2022

↘ 18% from 2019

Private Commuting	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Total commuting private vehicle distance (km)	6,958,634.60	6,831,106.55	5,037,946.20	6,975,659.05	6,302,002.06			
Internal combustion engine (ICE) vehicles								
ICE vehicle - Petrol (Km)	NA	4,255,375.10	4,005,290.94	5,361,682.51	4,335,905.23			
Emission Factor	NA	0.270	0.265	0.265	0.252	0.241	0.00317	0.00728
Emissions – Petrol (tCO2-e)	NA	**1127.67**	**1061.40**	**1420.85**	**1,092.65**	**1,044.95**	**13.74**	**31.57**
ICE vehicle - Diesel (km)	NA	454,295.68	471,301.40	612,144.40	703,587.13			
Emission Factor	NA	0.270	0.270	0.270	0.268	0.264	0.0004	0.00374
Emissions - Diesel	NA	**122.66**	**127.25**	**165.28**	**188.56**	**185.75**	**0.28**	**2.63**
Total ICE vehicle distance (km)	6,472,997.39							
Emissions Factor	0.27							
ICE vehicle emissions	**1,734.76**	**1,250.33**	**1,188.65**	**1,586.12**	**1,281.21**	**1,230.70**	**14.03**	**34.20**
EV/Hybrids								
Hybrid Vehicles (km)	NA	287,581.67	274,445.16	509,480	726,868			
Emission Factor	NA	0.201	0.201	0.201	0.199	0.191	0.00250	0.00575
Hybrid Emissions	NA	**57.80**	**55.16**	**102.41**	**144.65**	**138.83**	**1.82**	**4.18**
EV Vehicles (km)	NA	375,106.52	286,908.70	492,352	535,641			
Emission Factor	NA	0.026	0.026	0.026	0.0189	0.0183	0.0005	0.00004
EV Emissions	NA	9.75	7.46	12.80	**10.12**	**9.80**	**0.27**	**0.02**
Total EV/Hybrid vehicles distance (km)	485,637.21							
Emission Factor	0.03							
Total EV/Hybrid Emissions	**12.14**	**67.56**	**62.62**	**115.21**	**154.77**	**148.63**	**2.08**	**4.20**
Total private vehicle emissions	**1,746.90**	**1,320.27**	**1,251.28**	**1,701.33**	**1,435.98**	**1,379.33**	**16.11**	**38.40**

23.1 Category summary and calculation method:

Emissions from staff commuting is primarily based on annual staff travel surveys, supported by employee address/census mapping and employee numbers. The 2022 survey had small adjustments from the 2021 survey so that questions aligned with our workplace travel planning partners, Dunedin City Council and Te Whatu Ora Southern. Further changes were made in the 2023 survey to ask for specific commuting distances rather than distance ranges to aid in more accurate reporting. Descriptions of previous methods can be found in the preceding greenhouse gas emissions reports.

For 2023, the total commute per campus is calculated by taking the average round trip distance and multiplying by the FTE for that campus and the commuting days for that campus (calculated by deducting average rate of working from home based on survey response from standard number of wording days in a year: 220 days). This total commute distance is then apportioned to each travel mode according to the staff travel survey results. Emissions are then calculated by applying the relevant emissions factors for private vehicles (assumed pre-2010 ICE/hybrid vehicles, 2000-<3000cc; post 2015 large EVs) (under the Passenger Vehicle section under Table 17 and 19 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.

23.2 Uncertainty and disclosures:

The following assumptions have been made in this calculation.

- That the staff travel surveys held in April 2019, April 2021, September 2022 and August 2023 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). The 2023 survey was deliberately slightly earlier (late winter) to test the seasonal variation. This did suggest some seasonal movement between public transport and active transport, but that private car use is likely to be less seasonal. These variations will continue to be tracked and assessed in subsequent surveys.
- 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.
- Low response rates from Invercargill and Auckland mean there is less certainty about commuting at these campuses, however these campuses have very small numbers of staff compared to other campuses.

23.3 Recommendations to improve reporting

Continue to work with our workplace travel planning partners to develop a consistent travel survey and commuting emissions calculation method.

Consider more frequent travel surveys to capture seasonal differences and/or targetted surveys to get higher response rates from smaller campuses.

24 Employee Commuting – Public Transport

18% from 2022
38% from 2019

Public Transport	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Distance (Km)	669,459.00	559,760.05	573,532.50	1,166,882.58	844,689.56			
Emission Factor	Various	Various	Various	Various	Various	Various	Various	Various
Emissions	**84.42**	**76.41**	**85.63**	**141.56**	**116.64**	**133.47**	**0.16**	**1.70**

24.1 Category summary and calculation method:

As for private vehicles, emissions from staff commuting via public transport were calculated using travel survey responses. Once the distance travelled on bus and train (Wellington only) was calculated using the same approach described above for private vehicles, these were multiplied by the relevant emissions factors (average bus emission factor for Dunedin, Invercargill, Christchurch and Auckland, and Wellington average bus emission factor for Wellington; average rail for train) from the Public Transport section under Table 27 of MfE guidance.

While the 2023 travel survey indicated an increase in bus use for Dunedin-based staff (mode share up 7% to 10%), overall distance travelled on public transport was lower in 2023. This may be due to moving to a more exact distance measure in the survey and/or the impact of smaller sample sizes from non-Dunedin campuses. With electric buses being introduced across most routes in Dunedin from 2024, we expect emissions from the category to drop, while working to further support staff to take public transport where appropriate.

24.2 Uncertainty and disclosures:

The following assumptions have been made in this calculation.

- That the staff travel surveys held in April 2019, April 2021, September 2022 and August 2023 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 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.
- Low response rates from Invercargill and Auckland mean there is less certainty about commuting at these campuses, however these campuses have very small numbers of staff compared to other campuses.
- The national average bus emissions factor may lead to an over reporting error in regions that have transitioned most buses to electric.

24.3 Recommendations to improve reporting

Work with our workplace travel planning partners to develop a consistent travel survey and commuting emissions calculation method.

Consider more frequent travel surveys to capture seasonal differences and/or targetted surveys to get higher response rates from smaller campuses.

Adapt reporting method as public transport system changes (eg greater electrification; potential for better data from travel cards, particularly once a national system is introduced).

25 Student Commuting – Private Vehicles

6% from 2022
1% from 2019

Private Commuting	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Distance Non Emitting (Km)	6,278,490	4,959,962	5,168,109.92	3,673,733.16	3,503,808.00			
Total emitting commuting distance (km)	3,646,160	2,877,558	3,360,334.94	7,280,305.46	7,386,816.00			
Internal combustion engine (ICE) vehicles								
ICE vehicle - Petrol (Km)	NA	NA	3,047,692.80	2,679,702.18	2,949,687			
Emission Factor	NA	NA	0.265	0.2650	0.252	0.241	0.00317	0.00728
Emissions – Petrol (tCO2-e)	NA	NA	**807.64**	**710.12**	**743.32**	**710.87**	**9.35**	**21.47**
ICE vehicle - Diesel (km)	NA	NA	178,672.81	527,448.15	613,570			
Emission Factor	NA	NA	0.270	0.270	0.268	0.264	0.0004	0.00374
Emissions - Diesel	NA	NA	**48.24**	**142.41**	**164.44**	**161.98**	**0.25**	**2.29**
Total ICE vehicle distance (km)	NA	NA						
Emissions Factor	NA	NA						
ICE vehicle emissions	NA	NA	**869.39**	**852.53**	**1067.25**	**1029.73**	**9.93**	**26.12**
EV/Hybrids								
Hybrid Vehicles (km)	NA	NA	108,681.47	277,013.	273,024			
Emission Factor	NA	NA	0.201	0.201	0.199	0.191	0.00250	0.00575
Hybrid Emissions	NA	NA	**21.84**	**55.68**	**54.33**	**52.15**	**0.68**	**1.57**
EV Vehicles (km)	NA	NA	25,287.86	104,991	30,825			
Emission Factor	NA	NA	0.026	0.026	0.0189	0.0183	0.0005	0.00004
EV Emissions	NA	NA	**0.66**	**2.73**	**0.58**	**0.56**	**0.02**	**0.00**
Total EV/Hybrid vehicles distance (km)	NA	NA						
Emission Factor	NA	NA						
Total EV/Hybrid Emissions	NA	NA	**22.50**	**58.41**	**54.91**	**52.71**	**0.70**	**1.57**
Total private vehicle emissions	**956.91**	**755.12**	**878.38**	**910.94**	**962.67**	**925.57**	**10.29**	**25.34**

25.1 Category summary and calculation method:

The approach for student commuting has been modelled on the previously developed method for staff commuting. The Strategy, Analysis and Reporting Office (SARO) provided for each calendar year:

- 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. In an effort to increase the response rate, in 2022 the travel survey questions were added to the academic experience survey that went to all students enrolled in semester 2. This significantly increased the number of responses received, and this same approach was taken in 2023. Unfortunately, the response rate for 2023 was lower, increasing the margin of error for this reporting.

The annual surveys asks students how many times the commute to campus in a typical week, as well as how far their one-way commute is (in the past, we relied on student address data and an assumption that students came to campus 6 times a week). Due to the proximity that the majority of Dunedin based students live to campus, many students responded that they commute to campus more than once a day, the majority via walking. Students who elect to drive between campus and home more than once a day was deemed a personal decision, outside the operational control of the university. As such, the number of commutes per week was capped at 6 round trips. Multiplying each respondents' number of commutes by the one-way distance and summing the results gave total average weekly commute distance. These distances were then divided amongst travel modes as responses to this question for the day the student completed the survey. Weekly commuting distance for each mode was then multiplied by the number of commuting weeks (standard year = 30 weeks; 2022 began with 6 weeks of online lectures which is the main reason 2023 emissions are higher) to give an annual distance. These distances were then divided by the response rate to get representative total for student population.

The distance per mode was then multiplied by the relevant emissions factors for private vehicles in the Passenger Vehicle section under Table 17 and 19 of MfE Guidance). Emissions from all other modes of transport were considered to be de minimus.

25.2 Uncertainty and disclosures:

The following assumptions have been made in this calculation.

- That students accurately responded to the survey questions. It is possible that some respondents misinterpreted questions relating to travel distance (responding with round trip distance rather than one-way, which would result in an over reporting error) or number of trips in a typical week (responding with number of round trips rather than one way trips, leading to under reporting).
- That the travel survey held in semester two accurately reflects travel mode splits throughout the academic year.
- That capping weekly round trip commutes to six is a fair reflection of a) student behaviour and b) what is within the University's operational control.

25.3 Recommendations to improve reporting

Consider adjusting the travel survey to eliminate potential confusion between one-way and round-trip distance and commutes. Make all travel questions that are required for emissions calculation mandatory questions within the survey and/or reduce the number of questions to increase chance students complete it.

26 Student Commuting – Public Transport

↘ 4% from 2022
↘ 31% from 2019

Public transport	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Distance (Km)	1,349,609	1,065,862	1,121,973	952,740	1,199,495			
Emission Factor	Various	Various	Various	Various	Various	Various	Various	Various
Emissions	**186.51**	**147.31**	**165.48**	**133.97**	**127.98**	**126.45**	**0.09**	**1.68**

26.1 Category summary and calculation method:

As for Private Vehicles, emissions from students commuting via public transport in 2023 was based on:

a) EFTS per campus enrolled as on-campus
b) Distance from home address to campus and number of weekly commutes from 2023 travel survey responses
c) Travel mode for the day the survey was completed
d) 30 commuting weeks based on standard academic year (noting 24 weeks in 2022 due to 6 weeks of online only teaching).

For buses, the total commuting distance was calculated by campus and the most appropriate emissions factor from the Public Transport section under Table 27 of MfE guidance was used (average bus for Dunedin, Invercargill, Christchurch and Auckland campuses, and the Wellington average bus emission factor for Wellington Campus). Only students in Wellington commuted by train, and the Wellington average rail emissions factor was used.

26.2 Uncertainty and disclosures:

The following assumptions have been made in this calculation.

- That students accurately responded to the survey questions. It is possible that some respondents misinterpreted questions relating to travel distance (responding with round trip distance rather than one-way, which would result in an over reporting error) or number of trips in a typical week (responding with number of round trips rather than one way trips, leading to under reporting).
- That the travel survey held in semester two accurately reflects travel mode splits throughout the academic year.

26.3 Recommendations to improve reporting

Consider adjusting the travel survey to eliminate potential confusion between one-way and round-trip distance and commutes. Make all travel questions that are required for emissions calculation mandatory questions within the survey.

27 Student Travel – Air

23% from 2022
-2% from 2019

Student Air Travel	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Input Units (Domestic Travel Distance) (km)	19,653,986	19,388,184	19,981,819	20,017,027	20,621,430			
Units of Emissions	tCO2-e	tCO2-e	tCO2-e	tCO2-e	tCO2-e	tCO2	tCH4	tN2O
Emission Factor	0.242	0.242	0.306	0.306	0.306	0.300	0.0011	0.0044
Emissions (Domestic)	**4,756.26**	**4,691.94**	**6,114.44**	**6,125.21**	**6,310.16**	**6,186.43**	**22.68**	**90.73**
Input Units (Short Haul Travel) (Km)	676,159	726,451	658,305	526,620	681,122			
Emission Factor	0.160	0.153	0.151	0.151	0.151	0.150	0.00001	0.0008
Emissions (Short Haul)	**108.19**	**111.15**	**99.4**	**79.52**	**102.85**	**102.17**	**0.01**	**0.54**
Input Units (Long Haul Travel) (Km)	33,793,714	26,173,242	17,100,943	13,850,016	25,357,302			
Emission Factor	0.163	0.146	0.148	0.148	0.148	0.147	0.00001	0.0007
Emissions (Long Haul)	**5508.38**	**3821.29**	**2530.94**	**2,049.80**	**3,752.88**	**3,727.52**	**0.25**	**17.75**
Total Distance	54,123,859	46,287,877	37,741,067	34,393,663	46,659,854			
Total Emissions	**10,372.83**	**8,624.38**	**8,744.78**	**8,254.53**	**10,165.89**	**10,016.12**	**22.94**	**109.03**

27.1 Category summary and calculation method:

The Strategy, Analysis and Reporting Office sourced data for students classed as active enrollments (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 return. For domestic students we have included the distance of one return journey between the airport nearest their home address and teaching campus per annum, reflecting getting to campus to study and then home again at the end of the academic year. 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. In 2023 we also modelled a more granular approach where the length of an international student's programme determines the number of flights per year - the difference in total number of flights was less than 3% so we have elected to retain the simpler approach.

This total distance for each class of air travel was then multiplied by the appropriate emissions factor from the Domestic and International Air Travel sections under Table 37 and 42 of the MfE Emission Guide to calculate total emissions.

The 2020-2022 calculations reflected reduced international student numbers due to the COVID-19 pandemic resulting in fewer international flights, which was partially offset by strong domestic enrollments from around New Zealand. 2023 emissions reflect an increase in international students post-COVID.

27.2 Uncertainty and disclosures:

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

The following assumptions have been made in calculating these emissions:

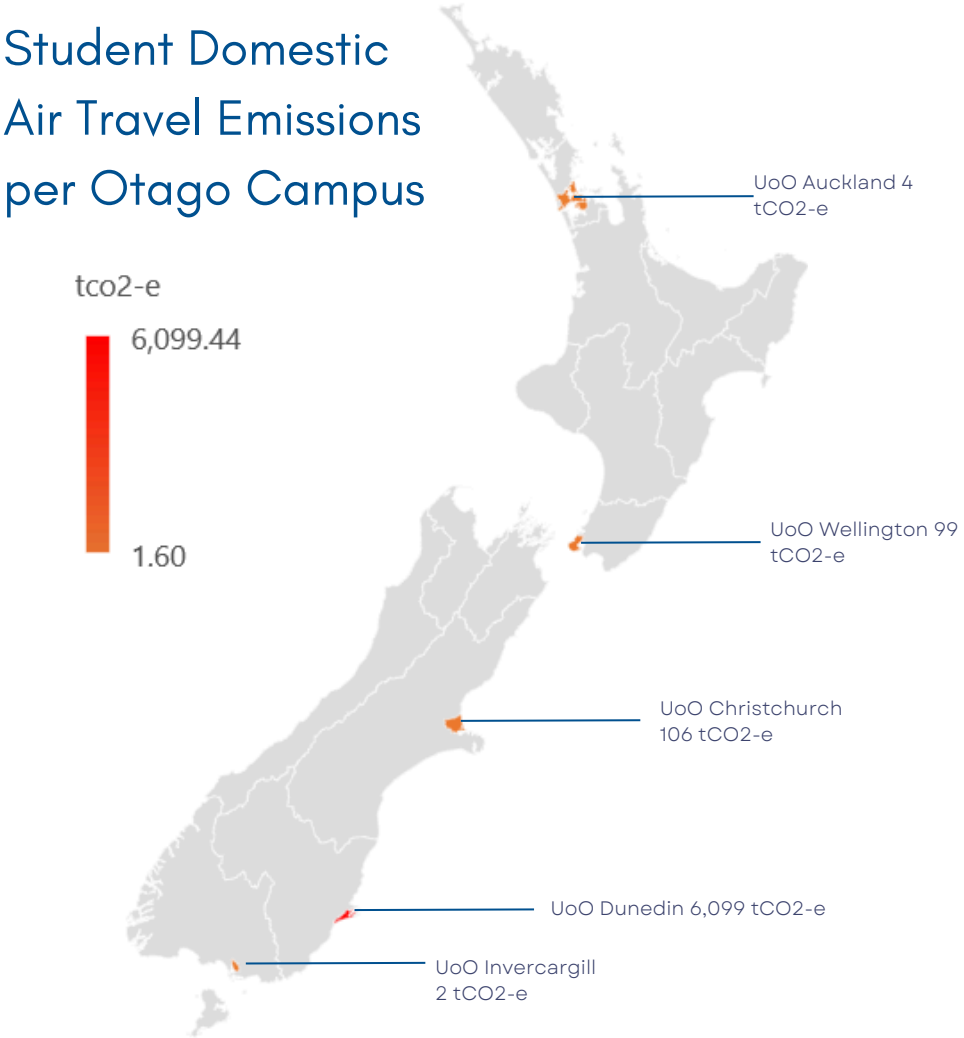
- That domestic students living more than 150km (great circle) from their study campus fly to and from their nearest airport and teaching campus every year. This may overstate the number of domestic students flying at the beginning and end of the year (eg when driving may be preferred due to the need to transport belongings). Sensitivity analysis undertaken as part of the 2020 report indicates increasing the distance between home address and campus to 300km would only reduce emissions by 4%.
- That international students fly the equivalent of a one-way trip from their home country to teaching campus. In years like 2020, 2021, and 2022 with significant border restrictions and Managed Isolation and Quarantine requirements, this was likely to overstate the total number of journeys. Sensitivity analysis in the 2020 report suggested if every international student flew a return trip home annually, emissions could be 56% higher. If only 10% of international students flew annually, but took return flights, this would result in 45% lower emissions from this category. As above, analysis in 2023 suggests only minor differences in emissions if the number of flights per annum was determined by the length of an international students' programme, rather than assuming a one-way flight for all students.
- We do not currently have data on what class international students fly. We assume that they fly economy class. Any flights above economy class would result in an under reporting error.
- We have excluded self-booked air travel undertaken by students during the year that may be required to fulfil aspects of their course (travel booked through the University's travel agents is captured under business air travel) as we do not currently have data on these flights. We intend to improve data on this form of travel and report on "self-funded course-related student travel" in the future.

Based on the above, the University feels it is taking a conservative approach to reporting the student air travel emissions that falls within its scope of operational control. Steps being taken by the University to reduce domestic air travel emissions, such as advocating for more interregional passenger rail and improved interregional bus services, would also have an impact on student flying considered out of scope of this inventory.

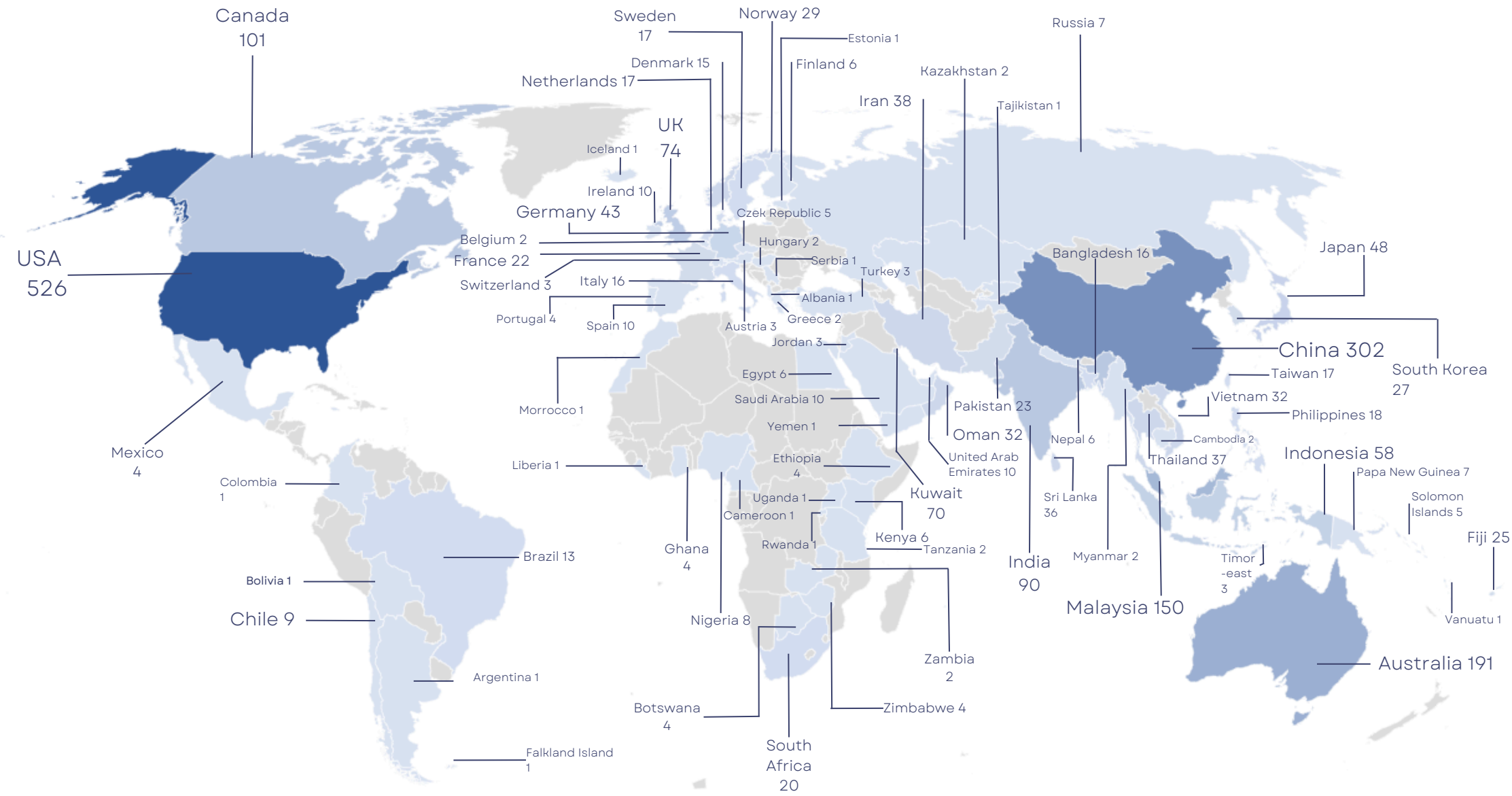
27.3 Recommendations to improve reporting

Continue to work with the Otago University Students Association to better understand student flying behaviour and identify options to improve data collection, reduce emissions and offset emissions when flying is necessary.

Work with departments that require students to self-fund travel (e.g. contact courses for distance students; electives for medical students) to include flights taken in this category.



Roll and Where our International Students Flew from in 2023



28 Working from Home

13% from 2022
67% from 2019

Working from Home	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Input units (Employee WFH per day)	45,683	199,111	162,377	87,636	93,038			
Emission Factor	0.446	0.446	0.446	0.446	0.365	0.354	0.00954	0.0008
Total Emissions	**20.37**	**88.80**	**72.42**	**39.09**	**33.96**	**32.94**	**0.89**	**0.07**

28.1 Category summary and calculation method:

Before 2021, the University of Otago had not previously included Working from Home (WFH) as a category in its greenhouse gas emissions reporting. When introducing this category in our 2021 report, we did not have staff survey data on working from home, so used assumptions, tested with department heads and Human Relations, to estimate the number of working from home days for each campus for 2019, 2020 and 2021.

In 2022 and 2023 we have included questions about working from home in our travel survey, including whether they worked from home on the day of the survey and how often they worked from home in a typical week. The typical week data was used for working from home emissions calculations. To account for different situations going on at each campus (such as the Wellington campus being more distributed due to an earthquake prone building), we have used campus-based working from home rates. This is then multiplied by 220 working days (the number of working days in a standard year), multiplied by FTE at each campus to give total number of days worked from home in 2023.

The total number of WFH days was then multiplied this by the MFE default WFH emissions factor under Table 14 of the MfE 2022 Guideline to calculate emissions for 2023.

The total number of working from home days increased in 2023, however was still well below COVID19 levels. Despite this increase in WFH days, emissions have decreased again in 2023 due to the MfE Guide lowering the emission factor. Emissions in 2023 emissions are still 67% higher than that of 2019, reflecting the general increase in, and acceptance of, employees working from home in certain roles.

We deducted the WFH days from staff commuting calculations to avoid double counting.

28.2 Uncertainty and disclosures:

Survey responses may be prone to over or under reporting of working from home, and not adequately capture seasonal trends. However, at present our HR and IT systems do not provide data to further inform our calculations.

- 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. 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 is 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).

28.3 Recommendations to improve reporting

To gain a more accurate data pool on WFH numbers to calculate the emissions for 2024, and potentially simplify the process, we will monitor the implementation of new working from home policy and use more detailed reporting if available.

Category 4

29 Transmission & Distribution Losses – Electricity

4% from 2022

3% from 2019

Electricity	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)		tCO2	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units (kWh)	45,193,469	53,729,383	51,769,270	48,988,107	50,871,205			
Emissions Factor (kg/kWh)	0.00993	0.0109	0.0108	0.00860	0.00860	0.00836	0.0002	0.00002
Total Emissions	**448.77**	**585.65**	**559.10**	**421.29**	**437.49**	**409.54**	**9.80**	**0.98**

29.1 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 the Transmission and distribution losses for electricity section under Table 12 of MfE Guideline. As with the changes in electricity emissions factors in the 2023 MfE guideline, we have elected to rebaseline transmission and distribution losses in 2019 to 2022 to reflect the revised figures from MfE. This has lowered historic emissions slightly.

29.2 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.

29.3 Recommendations to improve reporting

As stated in section 16.1.3

30 Steam and MTHW losses – Coal and Biomass

99% Coal from 2022
23% Biomass from 2022
100% Coal from 2019
40% Biomass from 2019

Coal & Biomass	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	CO2 (tCO2-e)	CH4 (tCO2-e)	N2O (tCO2-e)
Total Consumption Coal (kWh)	17,681,864	3,634,490	2,456,410	2,246,460	23,140			
Total Comsumption - Biomass (kWh)	17,486,769	26,989,325	29,713,741	29,579,609	35,548,721			
Input Units – emissions from coal consumption (tCO2-e)	6,176.28	1,225.77	786.54	719.32	7.34			
Input Units – emissions from biomass consumption (tCO2-e)	273.32	416.99	449.57	311.47	381.79	NA	NA	NA
Emission Factor	5% of calculated emissions from consumption	5% of calculated emissions from consumption	5% of calculated emissions from consumption	5% of calculated emissions from consumption	5% of calculated emissions from consumption	5% of calculated emissions from consumption	5% of calculated emissions from consumption	5% of calculated emissions from consumption
Emissions Coal	308.81	61.29	39.33	35.97	0.37	0.37	0.00	0.00
Emissions Biomass	13.67	20.85	22.48	15.57	19.09	NA	NA	NA
Total emissions	**322.48**	**82.14**	**61.81**	**51.54**	**19.46**	**0.37**	**0.00**	**0.00**

30.1 Category summary and 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. As per Steam and MTHW emissions in Category 2, coal losses emissions have decreased substantially (94% overall from 2019) due to the conversion of coal boilers to biomass that support our campuses.

30.2 Uncertainty and disclosures:

There is a high level of confidence in the consumption 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-CO2e) has been reported in the inventory.

30.3 Recommendations to improve reporting

Establish sufficient metering to measure actual losses.

31 Steam and MTHW - Natural Gas transmission and distribution losses

↘ 38% from 2022
↘ 78% from 2019

Natural Gas	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2* (Out of scope)	CH4 (tCO2-e)	N2O (tCO2-e)
Input Units – Natural Gas(kWh)	1,536,620	1,003,060	999,444	546,944	573,344			
Emission Factor (kgCO2-e/kWh)	0.012	0.012	0.012	0.012	0.00713	0.00006	0.00707	NA
Total Emissions	**18.44**	**12.04**	**11.99**	**6.56**	**4.09**	**0.03**	**4.05**	-

31.1 Category summary and 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. The MfE Guidance have lowered the emission factor for natural gas losses in 2023, leading to a 38% decrease in emissions, despite there being a slight increase in consumption. The transmission and distribution losses for reticulated gases emission factor can be found under Table 6 of the MfE Guide. There was also a decrease of 78% from 2019 emissions as consumption has lowered significantly due to the Wellington School of Medicine main building remaining largely vacant due to low earthquake rating.

31.2 Uncertainty and disclosures:

There is a reasonable level of confidence in this data due to the source being invoices from Te Whatu Ora 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

31.3 Recommendations to improve reporting

Discuss with Te Whatu Ora if they intend to install metering to measure actual losses.

32 Purchased Goods and Services - Water

(-) from 2022

20% from 2019

Water	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Input Units m3	268,780	338,124	455,941	320,983	270,176			
Emission Factor (kgCO2-e/m3)	0.031	0.031	0.031	0.031	0.0369	0.0359	0.0010	0.00008
Total Emissions	**8.41**	**10.48**	**14.13**	**9.95**	**9.97**	**9.70**	**0.27**	**0.02**

32.1 Category summary and 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 the calendar year. The units were 1,000 litres, which is the same as 1 m3. The emissions factors in the Water supply and wastewater treatment section under Table 65 of MfE Guidance were used.

This data includes Dunedin campus, the Wellington campus, and Invercargill.

Water usage in Dunedin in 2021 was abnormally high and efforts have been made to reduce the instances of leaks and water wastage. Usage returned to a more expected level in 2022 and continued to drop in 2023.

32.2 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.

Data was not available for Christchurch and Auckland, however these amounts are considered de minimis.

32.3 Recommendations to improve reporting

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

33 Purchased Goods and Services - Food

↘ 30% from 2022
↘ 14% from 2019

Food (new method)	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Input Units (Total kg)	NA	NA	1,042,608	1,037,350	1,102,793			
Emission Factor	NA	NA	Various	Various	Various	NA	NA	NA
Emissions	**4,575.20**	**4,503.80**	**4969.05**	**5,622.33**	**3,922.74**	**NA**	**NA**	**NA**

33.1 Category summary and calculation method:

From 2022, we gained access to a full breakdown of ingredients purchased (weight in kilograms) by the colleges and the central production kitchen that supplies Dunedin outlets. The calculation method from the 2021 reporting year was updated to reflect the availability of this data.

Using the 'Healthy and Climate-Friendly Eating Patterns in the New Zealand' database developed by Drew (2020) and updated by Auckland University, the appropriate emission factors were manually allocated to each ingredient for both the College Catering ingredient list, and the Union Central Production Kitchen list (which produces food for sale in University outlets, in-house catering and for Toroa College).

Colour codes were allocated to each slected ingredient emission factor to signify our degree of confidence, green being a reasonable match, orange representing the fact that the emission factor was imperfect (best available fit), and red which signified that the emission factor was unknown, and that a placeholder emission factor (average emissions factor for all "green" ingredients) was allocated. The kilograms of each ingredient were then multiplied by the relevant emissions factor and summed to get total emissions from purchased food.

In 2022, we saw a significant increase in food emissions, which was driven by higher meat purchases due to colleges trialling a self-serve model for protein. In 2023 the University reverted back to a staff serving model, and as expected, this has lowered the amount of meat purchased (see figure 33.1), and associated emissions, highlighting the importance of having emissions factors per ingredient so we know where to target for future reductions.

33.2 Uncertainty and disclosures:

We recognise that we are unable to obtain the emission factors for all ingredients, and therefore a placeholder emissions factor was used. We understand that these placeholder emissions may not always be accurate, but using a placeholder allows us to include these emissions, rather than avoiding them. It should be noted that only 1% of ingredients by weight used the 'average' placeholder emissions factor. Due to lower meat purchases in 2023, this placeholder factor dropped from 5.42 to 4.05 kgCO2e/kg.

Some of the emissions factors are older than others. Some better reflect the regions from which we source our ingredients than others. Tracking food emissions is an emerging field and we will continue to advocate for more timely and accurate emissions factors to support our work.

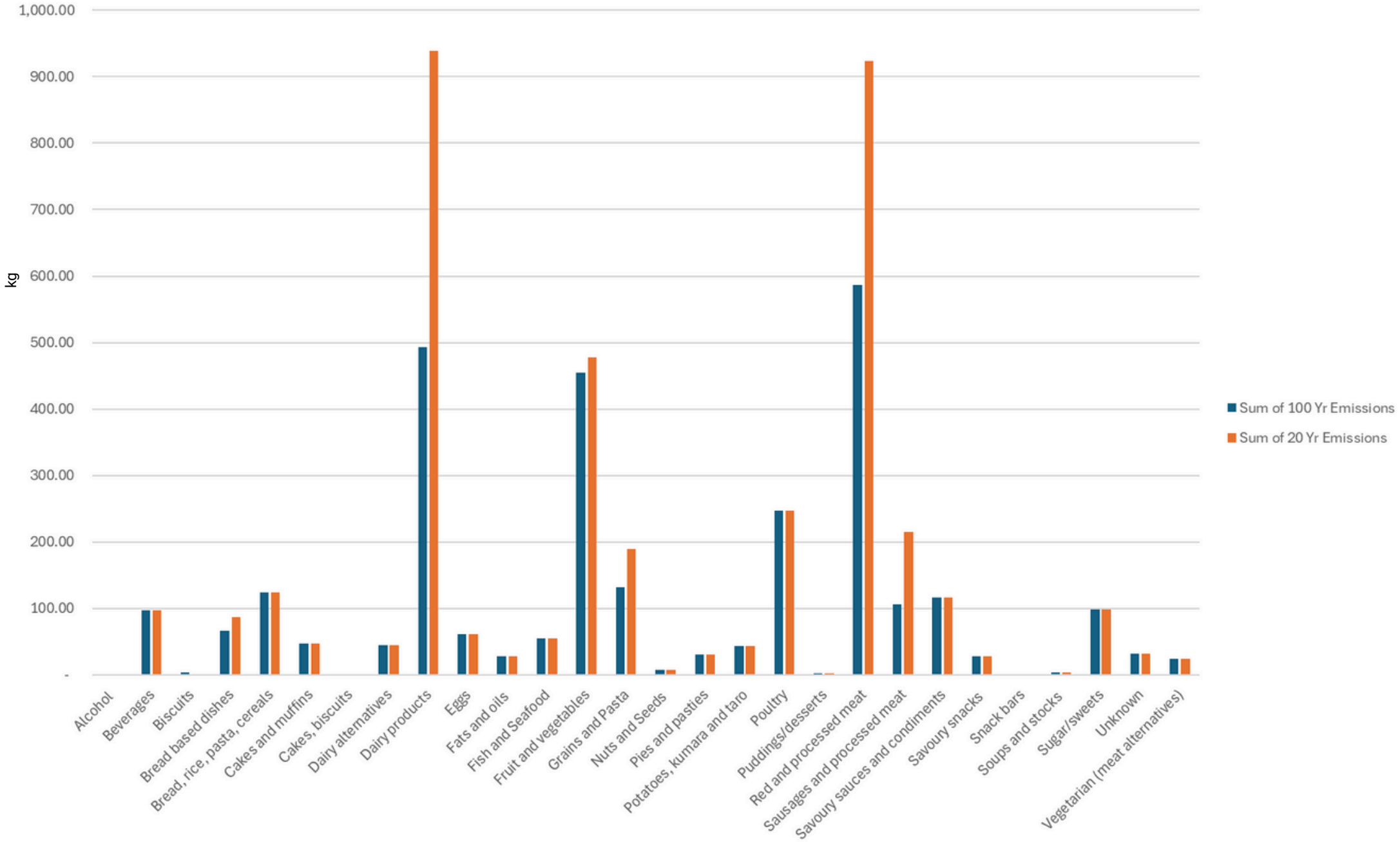
33.3 Recommendations to improve reporting

We all acknowledge this is a multi-year transition, starting with reasonably coarse-grained emissions factors and then refining factors and measurement as and when supported by research.

We have also advocated for MfE to include food emissions factors in its guidance document and offered to support them in this mahi.

Now that we ingredient based emissions, we can show the impact of different choices at the different stages (menu design, ingredient ordering, and food choice by diners). This allows us to support residential colleges and campus food outlets in becoming knowledgeable in food emissions to further support sustainable and mindful decision-making when ordering and designing menus. Having an emissions factor per ingredient also allows us to potentially trial food labelling with emissions per serve information and other awareness raising actions. Additionally, there is a lot of potential in this space for post-grad research in applied settings.

2023 Purchased Food Emission (tCO2-e) Summary



2023 vs 2022 Purchased Meat Summary

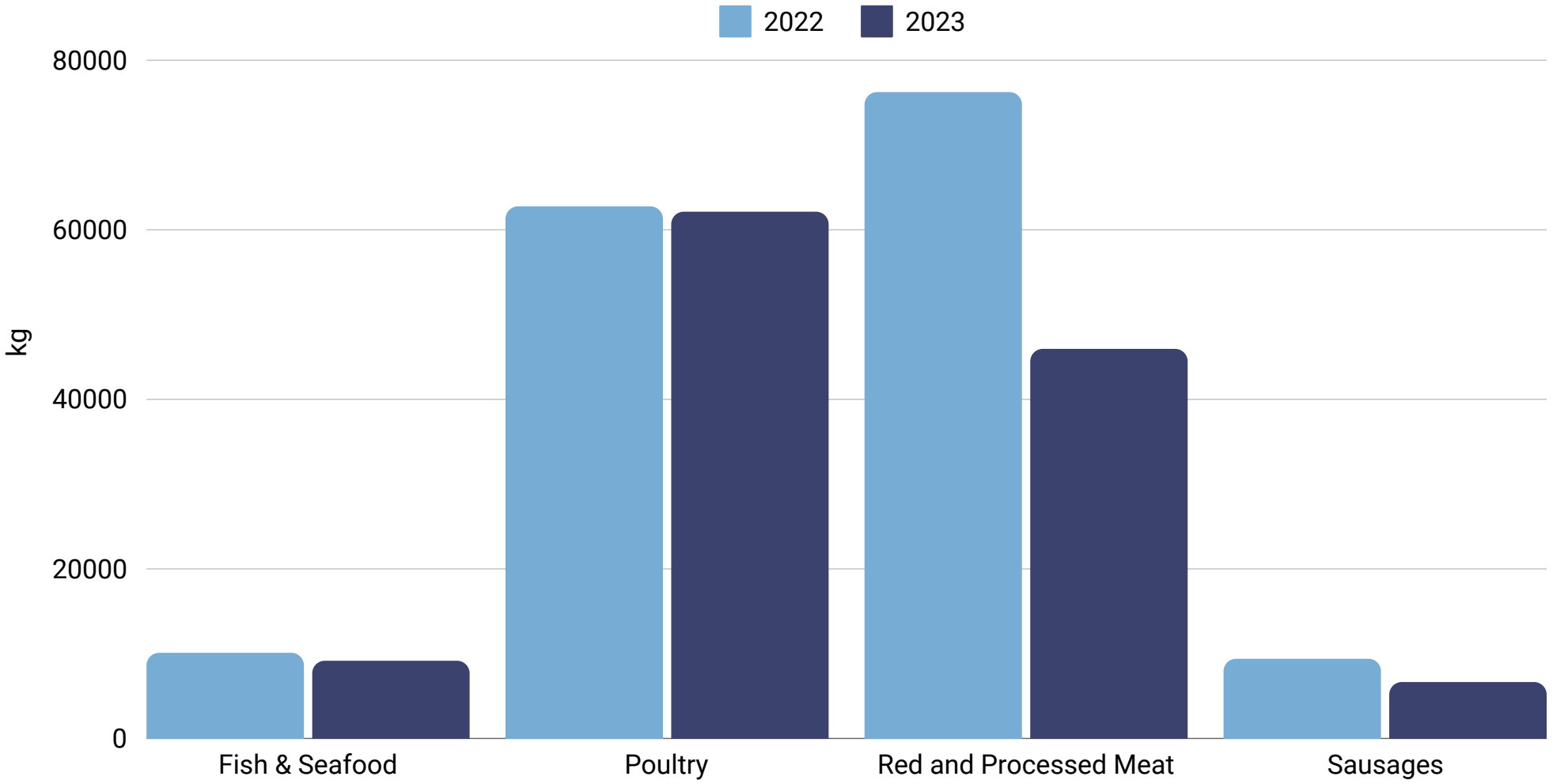


Figure 33.1

34 Waste from Operations – Waste to Landfill

↘ 8 from 2022
↘ 56% from 2019

Waste to landfill	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Input Units (Kg)	1,908,458	1,617,632	1,669,000	1,645,296	1,473,139			
Emission Factor	1.17	1.17	0.647	0.647	0.666	-	0.666	-
Total Emissions	**2,232.90**	**1,892.63**	**1,079.84**	**1,064.51**	**981.11**	**NA**	**981.11**	**NA**

34.1 Category summary and calculation method:

The data relating to waste to landfill is sourced from the Waste Management Environmental report, and is sent on a monthly basis.

The data for the report is collected from actual weights picked up on site. The emissions factor 'Office Waste' with gas recovery, in the Materials and Waste section under Table 73 of MfE Guidance (2023) were used for waste to landfill in 2023. This reflects that all landfills operating in localities where Otago has campuses now have gas recovery. We have elected to use the higher "Office Waste" emissions factor rather than the "General Waste" factor to be conservative.

34.2 Uncertainty and disclosures:

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

34.3 Recommendations to improve reporting

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

That the make up of organic waste that goes to landfill is assessed against Ministry for the Environment emissions factors to determine if the lower "General Waste" factor is more appropriate.

35 Waste from Operations - Recycling and other

8% from 2022
18% from 2019

Recycling and other	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Input Units (Kg)	273,995	323,541	366,067	333,900	300,463			
Emission Factor	Various	Various	Various	Various	Various			
Total Emissions	**6.76**	**6.30**	**7.11**	**5.98**	**5.52**	NA	NA	NA

35.1 Category summary and calculation method:

The data relating to recycling and other waste streams is sourced from the Waste Management Environmental report and is sent to us on a monthly basis. This data for the report is collected from actual weights picked up on site. The relevant emission factor from DEFRA 2023 guidelines are applied to each recycling type. Emissions in 2023 have reduced by 8% from 2022, and 18% from 2019.

35.2 Uncertainty and disclosures:

There is a high level of confidence in the data relating to glass and paper/cardboard. 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.

35.3 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.

36 Waste from Operations – Wastewater treatment

11% from 2022
12% from 2019

Wastewater treatment	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Input Units m3	268,780	338,124	455,941	320,983	270,176			
Emission Factor	0.457	0.457	0.480	0.48	0.508	0.0618	0.198	0.248
Total Emissions	**120.15**	**154.52**	**218.85**	**154.07**	**137.25**	**16.70**	**53.49**	**67.00**

36.1 Category summary and calculation method:

The emissions resulting from the treatment of wastewater were calculated based on reports from local authorities summarising the volume of water included in all invoices for the year. The units were 1,000 litres, which is the same as m3. The emissions factors in the Water supply and wastewater treatment section under Table 66 of MfE Guidance were used.

This data includes Dunedin campus, the Wellington campus, and Invercargill.

Water usage in Dunedin in 2021 was abnormally high and efforts have been made to reduce the instances of leaks and water wastage. Usage returned to a more expected level in 2022 and continued to drop in 2023.

36.2 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.

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.

Data was not available for Christchurch and Auckland, however these amounts are considered de minimis.

36.3 Recommendations to improve reporting

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

37 Freight Emissions

4% from 2022
21% from 2019

Freight	2019	2020	2021	2022	2023			
	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	Total Emissions (tCO2-e)	tCO2	tCH4	tN2O
Input Unit: Documents delivered	8,473	7,203	7,966	7,477	6,982			
Emission Factor	0.536	0.536	0.536	0.536	0.536	NA	NA	NA
Emissions	**4.54**	**3.86**	**4.27**	**4.00**	**7.74**			
Input Unit: NZ$	3,254,514	1,881,877	1,868,645	2,744,398	2,554,989			
Emission Factor $/e	0.118	0.118	0.118	0.118	0.118	NA	NA	NA
Emissions $/e	3.15	1.74	10.31	20.68	17.66			
Total Emissions	**388.57**	**225.92**	**224.77**	**316.53**	**305.23**	**NA**	**NA**	**NA**

36.1 Category summary and calculation method:

This is the first year that we are reporting on our Freight emissions in our report.

Through working with our courier suppliers, we were able to obtain emission reports from NZ Couriers (major freight provider) and NXP (stationary provider) from 2019-2023. As not all suppliers are able to provide carbon reports, we then gathered additional data from our finance system on total expenditure on freight through our other suppliers (excluding NZ Couriers), where we applied a spend-based emission factor to calculate emissions. The spend-based emission factor was derived from the Consumption Emissions Modelling Report by Market Economics for Auckland Council (Table 5, Postal and courier services).

36.2 Uncertainty and disclosures:

We do not currently capture freight that is included in the purchase price of items, except for NXP purchases and food (emissions factors are cradle-to-gate, thus include frieght). This could lead to an under-reporting error.

For the emissions calculated based on emissions reports from suppliers, there is reasonable confidence in the accuracy of this data.

For spend-based emissions, we recognise the limitations with cost-based emission factors, however the new Consumption Emissions Modelling report provides us with a means to capture these emissions rather than excluding it like previous years.

36.3 Recommendations to improve reporting

That we continue to work with other courier suppliers to gather more emission reports in future years, and on a regular basis.

E koekoe te tūī, e ketekete te kākā, e kūkū te kererū

The tui chatters, the kākā cackles, the kererū coos | Everybody has a voice which should be respected.

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