UCT's d-school Afrika building received it's 6-Star Green Star rating in 2022; Photo credit: Paris Brummer and d-school Afrika

Carbon Footprint Assessment Report

Year of assessment: 2022

Report Issued: April 2024 (Rev 0)

PROJECT TEAM

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GLOSSARY OF TERMS

Capex	Capital Expenditure
CO_2e	Carbon Dioxide Equivalent
Covid-19	Coronavirus Disease 2019
DEFRA	Department of Environment, Food and Rural Affairs (UK)
DFFE	Department of Forestry, Fisheries and Environment (SA)
GHG	Greenhouse Gas
GSB	Graduate School of Business
HVAC	Heating, Ventilation And Cooling
IPCC	Intergovernmental Panel on Climate Change
LPG	Liquid Petroleum Gas
$kgCO_2e$	Kilograms of Carbon Dioxide Equivalent
kWh	Kilowatt Hours
NGER	National Greenhouse Gas Emissions Reporting
tCO_2e	Tonnes of Carbon Dioxide Equivalent

1. EXECUTIVE SUMMARY

This report provides the 2022 financial year carbon footprint report of the University of Cape Town (UCT). The scope covers all of the campuses and facilities under UCT's operational control as well as the emission-generating activities of its students and staff. Emissions are reported as Scope 1 (direct emissions), Scope 2 (indirect emissions from purchased electricity) and Scope 3 (other indirect emissions). Emissions are reported in accordance with the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard; the most widely recognised global methodology for greenhouse gas accounting and reporting.

1.1. Results

The results of UCT's two previous greenhouse gas assessments showed the clear impact that the Covid-19 pandemic had on campus operations. Overall emissions decreased significantly, especially those associated with travel. As operations at UCT normalised after the lifting of Covid-19 restrictions between 2021 and 2022, so did most of the institution's greenhouse gas emissions. Total emissions increased 31% between 2021 and 2022. Scope 2 and Scope 3 emissions each contributed almost half of UCT's total footprint during 2022, with 3% of emissions arising from Scope 1 sources.

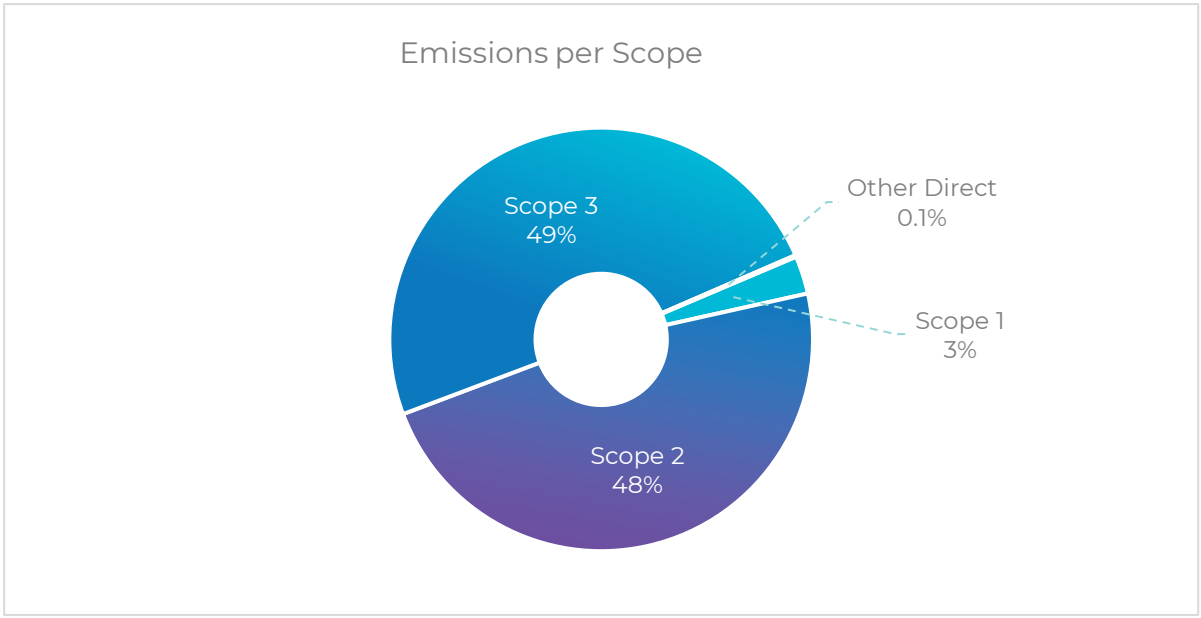

Figure 1.1: UCT 2022 Carbon Footprint Emissions by Scope

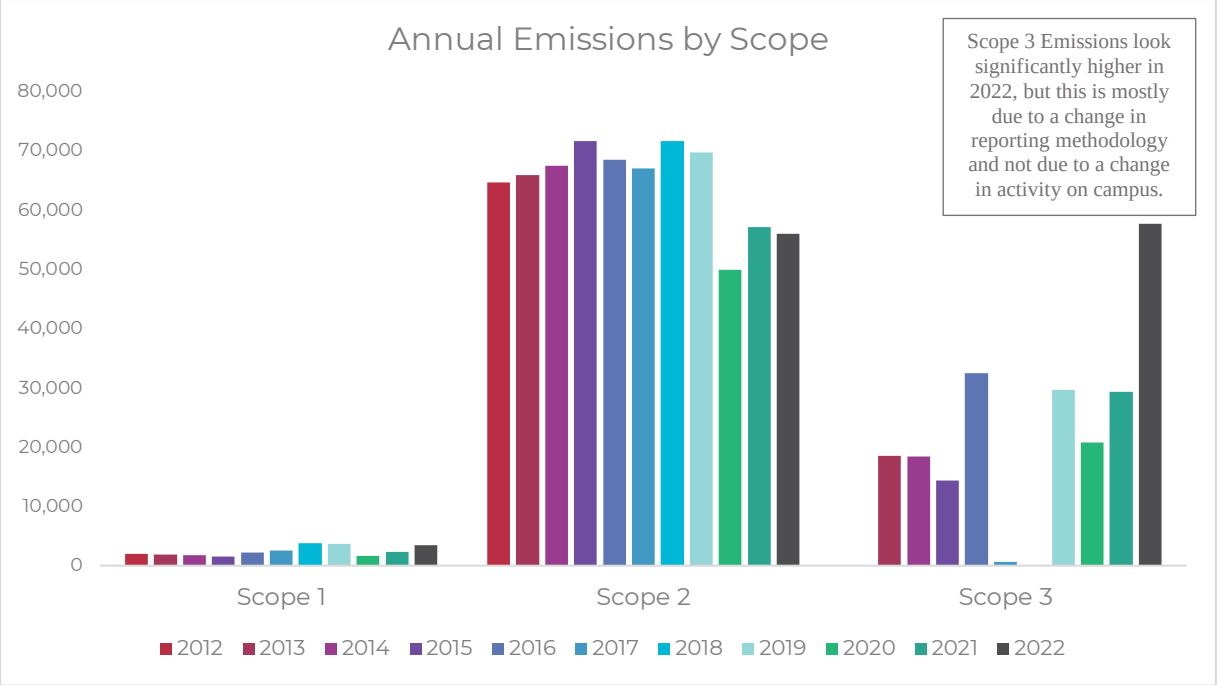

Figure 1.2: Annual Emissions by Scope

Scope 1

Emission results have shifted from representing the impact of Covid-19, to reflecting the state of load shedding in South Africa. Stationary combustion emissions arising from the use of diesel in generators increased 372% between 2021 and 2022, as more back-up power was required and additional equipment was installed on UCT's campuses. Shuttle activity has also increased significantly as on-campus attendance improved into 2022. Refer to the detailed analysis per scope to see these fluctuations in more detail.

Scope 2

Although activity has largely returned to pre-Covid levels, Scope 2 emissions arising from purchased grid electricity in 2022 are slightly lower than they were in 2021. There are three reasons for this: load shedding, a slightly lower emission factor and possibly also data-accuracy for UCT's Graduate School of Business which reported lower than expected consumption for 2022. Although Scope 2 provides UCT with a carbon management challenge, it also provides the greatest opportunity of all emission sources for UCT to implement emission reduction initiatives that can significantly impact the overall carbon footprint.

Scope 3

Indirect emissions are reported in Scope 3 and are divided into 15 categories. UCT now reports 6 of the categories, based on relevance and access to data. Within the category "Purchased Goods and Services", UCT reports three sub-categories: Water Consumption, Paper Purchased and Food Provisions.

The most significant change to UCT's emissions in 2022 is the adoption of best practice greenhouse gas accounting in terms of indirect upstream emissions associated with the extraction, processing and transportation of fuels, referred to as Well-to-Tank (WTT) emissions. Although a portion of these emissions were included in past assessments, the boundary has been increased as encouraged by industry best practice. Prior to 2022, Scope 3 Category 3 "Fuel- and Energy-Related Activities" emissions included the WTT emissions associated with activities reported in Scope 1, emissions associated with electricity lost to transmission and distribution through the municipal grid, as well as WTT emissions associated with

fuels used for business travel activities. This 2022 inventory includes the additional sources of WTT emissions arising from electricity generation, WTT emissions arising from electricity lost to transmission and distribution through the municipal grid, as well as WTT emissions associated with fuels used for staff and student commuting. As such, total Scope 3 emissions have increased. They are illustrated later in this report in two ways: as measured, and a like-for-like comparison based on the historic scope.

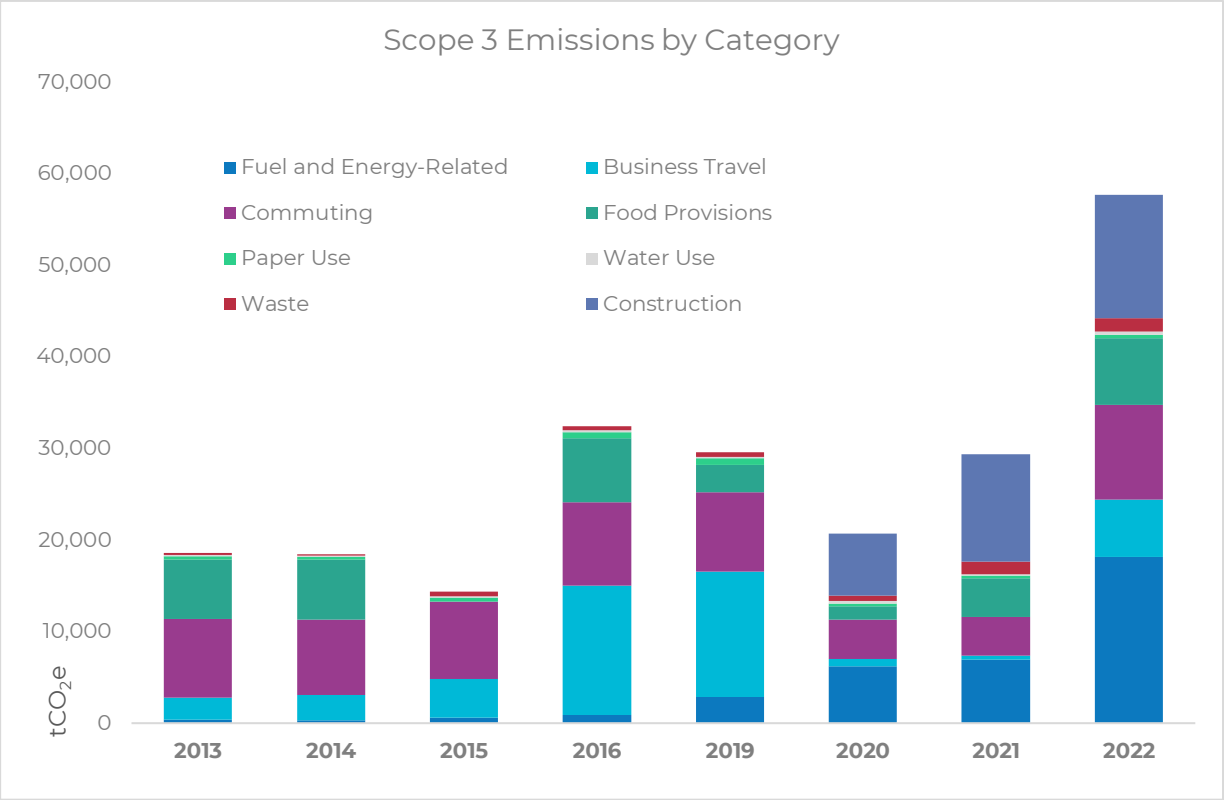

Figure 1.3: Annual Scope 3 Emissions per Financial Year, by emissions category.
Note: Scope 3 emissions were not reported in 2012 or 2018, while minimal sources were reported in 2017.

1.2. Targets

UCT has set the following target: to be a Net Zero emissions campus by 2050 (Scope 1 and 2), which requires roughly a 2 – 5% reduction in emissions per annum from 2020. So far UCT averages a 7.5% increase in emissions per year since 2020 as discussed below, but this must be viewed in the context of the post covid restrictions and return to campus. The longer term perspective since 2012 should also be understood, where these 2022 emissions are 11% lower than these emissions from 2012 (Table 1.2).

Due to the impact of Covid-19 which caused decreased activity throughout UCT, the 2020 emissions were relatively low. As expected, activity began to normalise the following year and consequently these emissions increased by 16% in 2021. With most activity returning to pre-Covid levels, UCT saw a 1% decrease in emissions between 2021 and 2022. This leaves UCT at an overall 15% increase in Scope 1 and 2 emissions since 2020, averaging a 7.5% increase in emissions per year since 2020.

Scope 1, 2 and Other Direct Emissions (tCO_2e)				
2020	**2021**	**% Change 2020 vs 2021**	**2022**	**% Change 2021 vs 2022**
51 767	59 832	**+16%**	59 506	**-1%**

Table 1.1: Annual % change in Scope 1, 2 and Other Direct Emissions since 2020

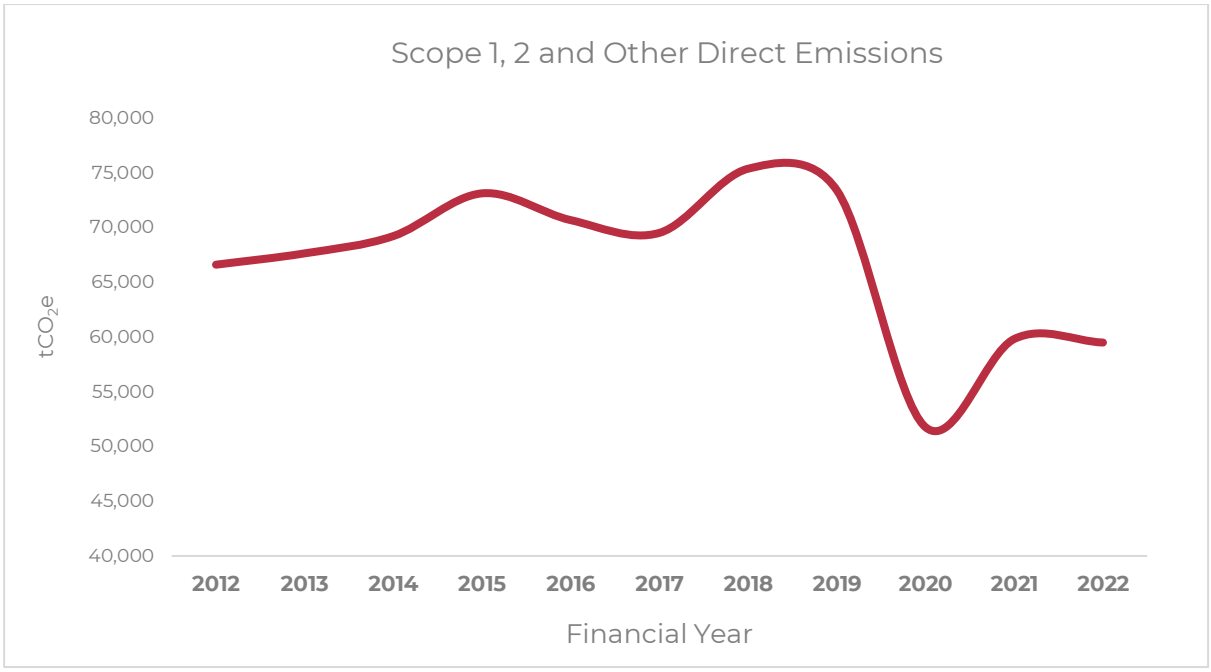

Figure 1.4: Annual Fluctuations in Scope 1, 2 and Other Direct Emissions

Due to regular annual reporting of emissions since 2012, UCT is also able to track progress since that initial baseline assessment year. The following table indicates the current reduction of 11% in Scope 1, 2 and Other Direct emissions since 2012:

Emissions	tCO_2e		% Change
	2012	2022	2012 vs 2022
Scope 1, 2 and Other Direct	66 622	59 506	-11%

Table 1.2: Reduction in Scope 1, 2 and Other Direct Emissions since 2012

1.3. Recommendations

There are various recommendations regarding carbon management and data management, which are detailed in the section "Recommendations" toward the end of this report. However, these will typically require additional capacity/resources to address.

Data Management
There are still good opportunities for UCT to improve data quality and, therefore, the accuracy of emission results. Scope 1 data quality has improved relative to 2021. Scope 2 data completeness can be improved through clear allocation of electricity use per erf under UCT's operational control. Scope 3 data pertaining to air travel and car hire can be improved by logging flight routes, and vehicle types and distances travelled respectively, rather than travel expenditure.

Carbon Management
Carbon management strategies should focus on the greatest source of emissions over which UCT has operational control, which is currently the electricity consumption at Main Campus. Solar panels are installed at three locations across UCT's campuses which have already reduced emissions by 51 tCO_2e in

2022. Further rollout of solar PV will have an increasing positive impact on emissions over time. Additional recommendations regarding data and carbon management are discussed in Section 5.

2. INTRODUCTION

GCX was appointed by UCT to undertake the institution's 2022 financial year greenhouse gas assessment. This assessment follows annual consecutive inventories that have been measured since 2012. Using an Excel-based log, GCX indicated what data was required for the calculation of UCT's 2022 carbon footprint. The required data was collected by UCT from the relevant institutional departments and uploaded to an online filing system shared with GCX. Upon receipt of each data set, GCX reviewed and queried it to ensure it was applicable and comprehensive based on previous years' collections. Some updates were made where necessary. The following report discusses and illustrates UCT's greenhouse gas inventory results, followed by details of the methodology, assumptions and limitations, as well as recommendations for carbon management and data management at UCT going forward. Further details including all GHG Protocol reporting requirements, tables, figures and activity data was provided in the a report spreadsheet "*GCX_UCT_CFA Report_2022.xlsx*" which is for internal use only and not published.

2.1. Boundaries

2.1.1. Temporal Boundary

An organisational carbon footprint covers a selected 12 month period. This assessment covers UCT's most recent financial year: 1 January – 31 December 2022.

2.1.2. Organisational Boundary

Emissions were consolidated using the operational control approach. Operational control exists when a company has the full authority to implement operating policies at the operation of the GHG emitting activities. UCT maintained the same organisational boundary as previous assessments, which encompasses 6 primary components as tabulated below. At the Graduate School of Business, UCT has operational control of the business school and conference centre, but the Protea Breakwater Lodge Hotel is under the operational control of a separate hotel operator. The UCT facilities on site are metered as part of the Protea Breakwater Lodge Hotel facility.

Facilities Included
Main Campus
Medical Campus
Off Campus Residences & Other Admin Buildings
Graduate School of Business
Hiddingh Campus
ICTS on Main

Table 2: UCT Organisational Boundary

The number of employed staff and enrolled students at UCT fluctuates annually and the final audited figures for the periods measured in this assessment were as follows:

Group	Population
Students	29 215
Staff	4 846
Total	**34 061**

Table 3: Populations of Students and Staff per Reporting Period

2.1.3. Operational Boundary

The diagram below outlines the extensive direct and indirect emission sources that can form the operational boundaries of an organisational carbon footprint. The footprint boundary was consolidated using the operational control approach. This apportions all activities and associated emissions under UCT's operational control into Scope 1 and 2, and those not under UCT's operational control into Scope 3.

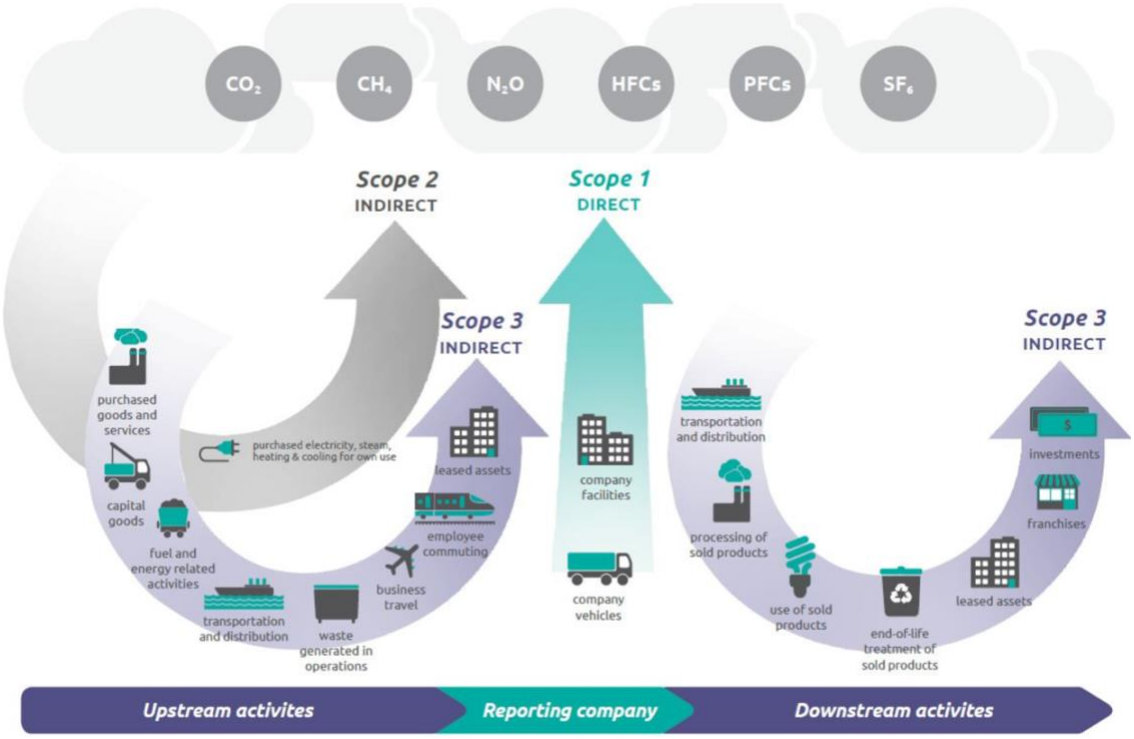

Figure 2: Operational Boundaries by Scope, Activity and Greenhouse Gas
Source: WRI, WBCSD GHG Protocol Corporate Accounting and Reporting Standard, Revised Edition, 2004

The following table lists all of the potential sources in the figure above, and indicates the complete operational boundary encompassed in this UCT carbon footprint assessment.

SCOPE 1			
Source	**Source Category**	**Explanation**	**Boundary**
Direct Emissions on site	Mobile Combustion	Fuel combusted in Company owned/controlled vehicles	✓
	Stationary Combustion	Fuel combusted onsite on company owned/controlled equipment	✓
	Fugitive emissions	Intentional or unintentional release of GHG	✓
	Process Emissions	GHG emissions from physical or chemical processing	NA
	Waste treatment emissions	Methane or other GHG emissions from waste processing. Company owned/controlled Waste Water treatment, landfills etc.	NA
Scope 2			
Source	**Source Category**	**Explanation**	
Indirect emissions from energy use	Purchase of Energy (heat, steam, Electricity) generated off site		✓
Out of Scopes			
Source	**Source Category**	**Explanation**	
Emissions on site	Fugitive emissions	Intentional or unintentional release of GHGs not included under the Kyoto Protocol	✓
	Biofuels	CO2 only. CH4 and N20 reported in Scope 1	NA
Scope 3			
Source	**Source Category**	**Explanation**	
Upstream Emissions	Purchased Goods and Services	Embedded emissions in purchased goods and services: Water Consumption, Paper Purchased, Food Provisions.	✓
	Capital Goods	Embedded emissions in purchased capital goods and equiment: Construction.	✓
	Fuel and energy related sources (not included in Scope 1&2)	T&D losses of purchased electricity, emissions from energy generated that is sold to end users, upstream emissions of purchased fuels & energy	✓
	Upstream transport and distribution	Transportation of goods/products to the company by a 3rd party. Transport of goods between company facilities by a 3rd party	X
	Waste generated in operations	Emissions from waste treatment at sites not owned by the company. Can include waste transport	✓
	Business travel	Transport of employees for the purposes of business activities	✓
	Employee Commuting	Emissions from transport of employees between home and work in vehicles not owned by the company	✓
	Upstream leased assets	Operation of leased assets by the company and not reported in Scope 1&2	NA
Downstream Emissions	Downstream Transport and distribution	Transportation of products sold by the reporting company, between the company and the end consumer. Transport is carried out by a 3rd party in vehicles not owned by the company and is not paid for by the reporting company	X
	Processing of sold products	Processing of intermediate product sold by the company	X
	Use of sold products	Emissions as a result of end use of products (Products that directly consume Electricity, emit GHGs or form GHGs from their use)	X
	End of life treatment of sold products	Waste disposal and treatment of EoL products	X
	Downstream leased assets	Operation of leased assets owned by the company and leased to other entities	X
	Franchises	Operation of franchises	NA
	Investments	Applicable to development, and private financial institutions. Operation of investments	X

Table 4: UCT 2022 Carbon Footprint Operational Boundary

3. RESULTS SUMMARY

3.1. Absolute Emissions

UCT's 2022 results are tabulated below, alongside 2021 results for an annual comparison.

SCOPE	CATEGORY	tCO_2e		% Change	% of Total
		2021	2022	2021 vs 2022	2022
SCOPE 1	UCT-owned vehicles: UCT Shuttle	547	907	66%	0.8%
	UCT-owned vehicles: Vehicle Fleet	612	528	-14%	0.5%
	Fugitive Emissions (Kyoto gases)	919	867	-6%	0.7%
	Stationary Combustion: LPG	40	48	21%	0.04%
	Stationary Combustion: Diesel for Generators	223	1 052	372%	0.9%
SUB-TOTAL SCOPE 1		**2 340**	**3 402**	**45%**	**3%**
SCOPE 2	Electricity: Main Campus	31 077	32 698	5%	28%
	Electricity: Medical Campus	11 475	10 613	-8%	9.1%
	Electricity: Off Campus residences	12 202	11 054	-9%	9.4%
	Electricity: GSB	611	99	-84%	0.1%
	Electricity: Hiddingh	464	508	10%	0.4%
	Electricity: ICTS on Main	1 241	988	-20%	1%
SUB-TOTAL SCOPE 2		**57 069**	**55 959**	**-2%**	**49%**
SCOPE 3	Category 3: Fuel and Energy-Related Activities	6 920	18 138	162%	15%
	Category 6: Business Travel - Land	42	332	689%	0.3%
	Category 6: Business Travel - Air	395	5 946	1406%	5%
	Category 7: Commuting	4 219	10 327	145%	9%
	Category 1: Purchased Goods & Services: Food	4 253	7 254	71%	6.2%
	Category 1: Purchased Goods & Services: Paper	249	355	42%	0.3%
	Category 1: Purchased Goods & Services: Water	147	365	148%	0.3%
	Category 5: Waste Generated in Operations	1 384	1 484	7%	1.3%
	Category 2: Capital Goods: Construction	11 758	13 493	15%	12%
SUB-TOTAL SCOPE 3		**29 366**	**57 692**	**96%**	**48%**
OTHER DIRECT	Fugitive Emissions (non-Kyoto gases)	424	144	-66%	0.1%
TOTAL EMISSIONS		**89 198**	**117 198**	**31%**	**100%**

Table 5: UCT 2022 Carbon Footprint Results Summary

UCT's 2021 results have been updated with the appropriate Eskom emission factor (Eskom AR22), which was not available at the time of that assessment. To date, UCT's Scope 3 category "Fuel- and Energy-Related Activities" has included the Well-to-Tank emissions associated with fuels combusted as reported in Scope 1, fuels used for business travel, as well as electricity-related Transmission and Distribution losses. As per industry best practice, the category now also includes Well-to-Tank emissions associated with energy generation and Well-to-Tank emissions associated with the generation of electricity lost during Transmission & Distribution. Also reported for the first time are WTT emissions associated with fuels used for commuting, which are reported within Scope 3 category 7. This has meant that the scope 3 emissions value has almost doubled mostly due to this change in methodology, and not due to any change in actual activity on campus. This, along with increased business travel and generator fuel use, is the primary reason for the significant 31% increase in overall emissions between 2021 and 2022.

Avoided Emissions
This is the first year that UCT has reported the use of renewable electricity. Although a small amount was generated in 2021, the data related to it was unavailable. Thanks to the generation of 50,510 kWh of renewable electricity from solar panels installed at three locations at UCT-controlled facilities, Scope 2 emissions in 2022 were reduced by 51 tonnes of CO_2e.

Emissions by Scope
The 2022 financial year's emissions are displayed by Scope in the pie chart below, showing the significant impact of Scope 2 and 3 on the institution's carbon footprint with 3% of emissions arising from Scope 1.

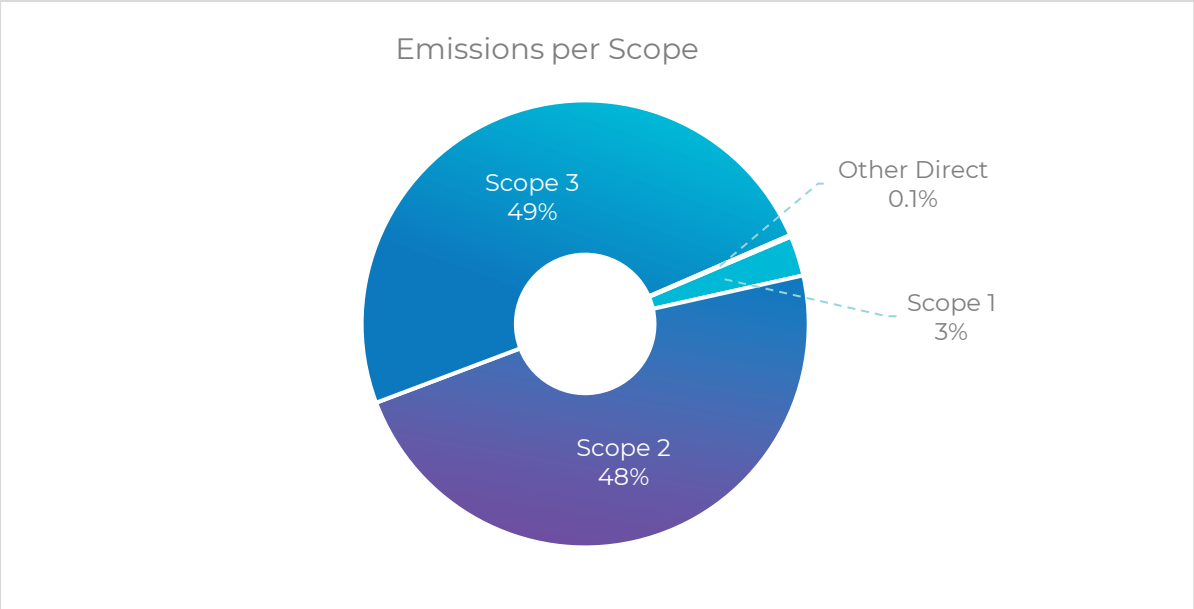

Figure 3: UCT's 2022 Total Carbon Footprint Emissions per Scope

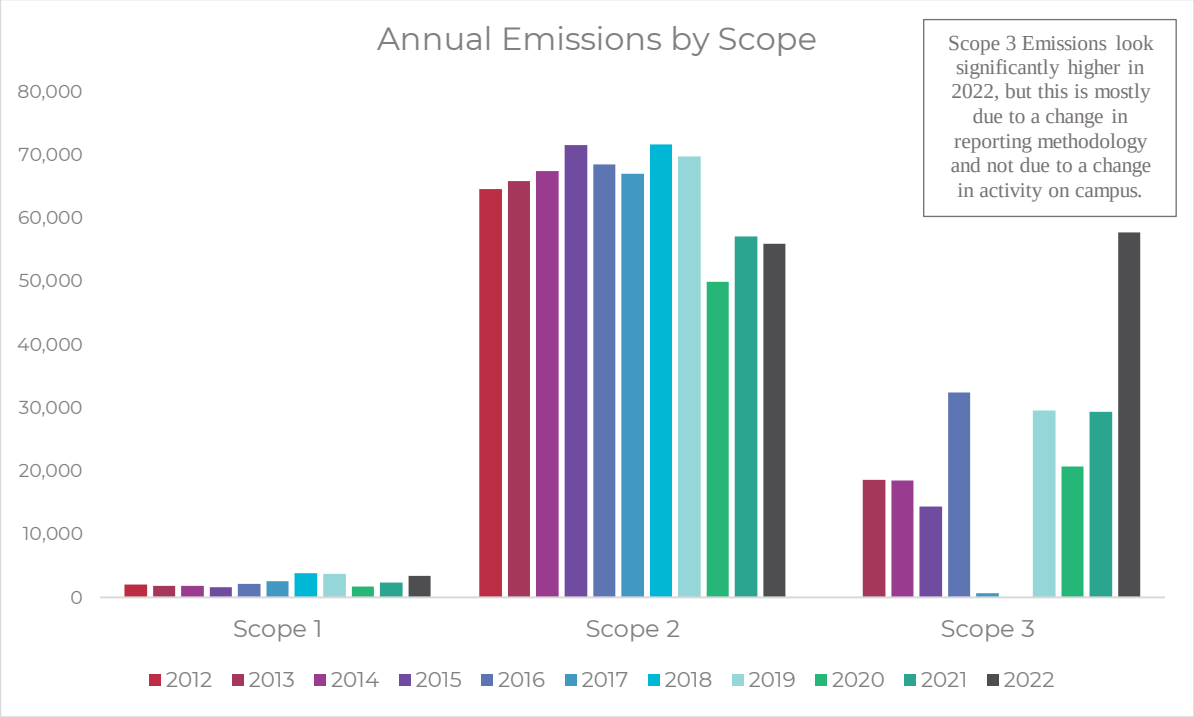

Figure 4: Annual Emissions by Scope

3.2. Intensity Metrics

There can be notable fluctuations in Scope 3 emissions, across different organisations and within the same institution year-on-year, due to changes in data availability or through broadening the boundary of Scope 3 categories included in an assessment. Therefore, tracking emission fluctuations over time is best conducted by reviewing only Scope 1, 2 and Other Direct emissions (fugitive emissions from non-Kyoto gases). Emission intensity results are compared with UCT's 2012 assessment in the table below, which shows a 13% decrease in emissions per square metre, and a 20% reduction in emissions per capita.

Intensity Metrics	Financial year		% Change
	2012	2022	2012 vs 2022
Gross Area (m^2)	649 494	665 325	2%
tCO_2e / m^2 / annum	0.103	0.089	-13%
Population	30 579	34 061	11%
tCO_2e / capita / annum	2.180	1.75	-20%

Table 6: UCT 2012 and 2022 Intensity Metrics Comparison

The figure below illustrates the annual tracking of these metrics since UCT began measuring emissions in 2012. Emissions per square metre are illustrated on the left axis, while emissions per capita are shown on the right. Both metrics dropped in 2020 due to Covid-19 and rose thereafter, although both remain below pre-Covid levels.

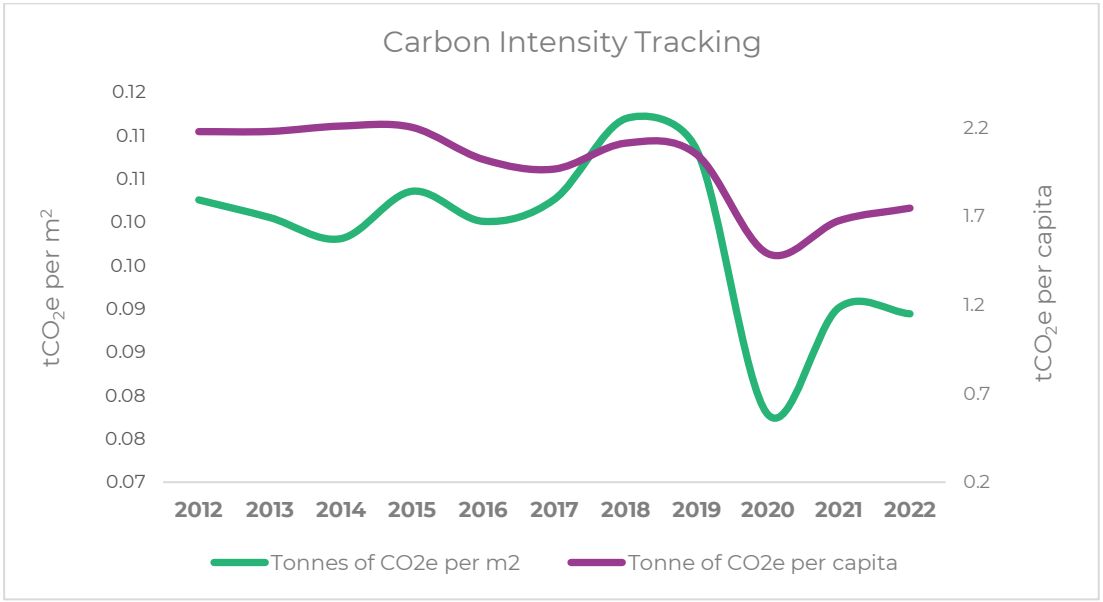

Figure 5: Annual Fluctuations in GHG Emissions Intensity Metrics

3.3. Scope 1

The figure below provides a breakdown of UCT's Scope 1 emissions per source. Direct emissions have normalised to pre-Covid levels, although there is also a significant increase in stationary combustion emissions related to diesel used in generators. Fugitive emissions from refrigerant gas refills continues to contribute a large portion of direct emissions at 29% in 2022. The sections below expand on the results of each Scope 1 emission source for the 2022 financial year.

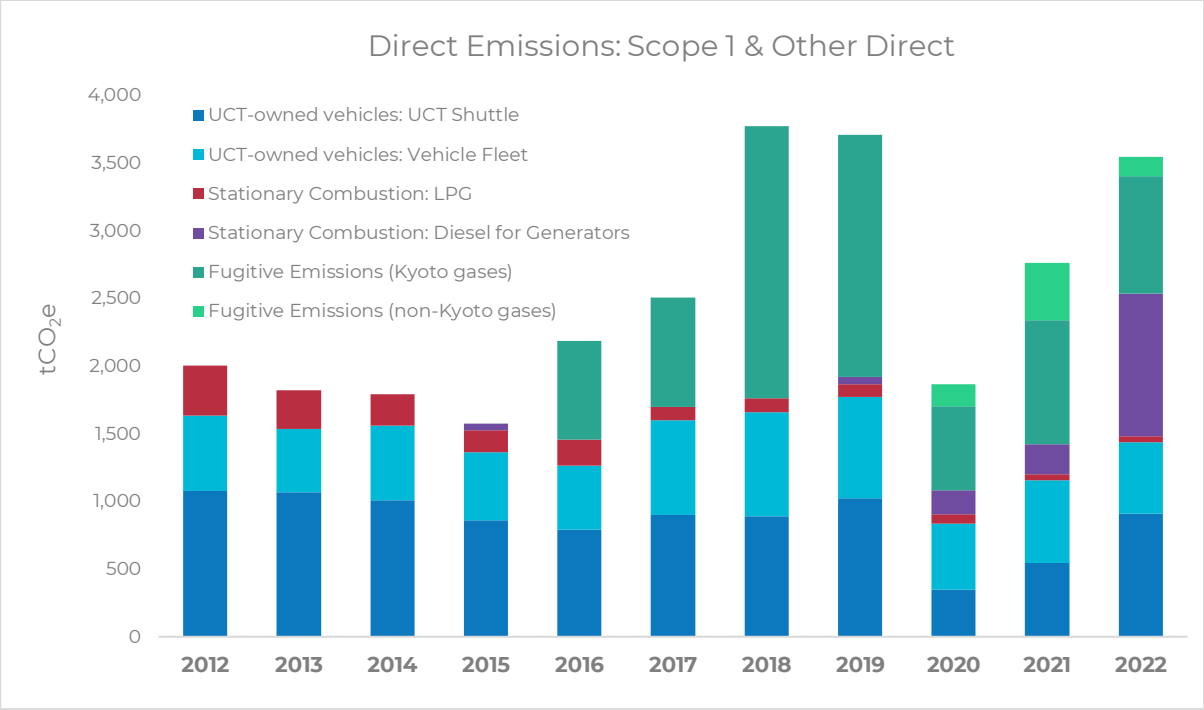

Figure 6: Annual Fluctuations in Scope 1 (Direct) GHG Emissions per Source

SCOPE 1	tCO₂e										
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
UCT Shuttle	1076	1068	1006	861	790	902	889	1025	348	547	907
Vehicle Fleet	557	465	556	503	475	697	769	748	486	612	528
Fugitive Emissions	-	-	-	-	733	807	2 012	1 793	782	1342	1011
LPG	372	289	230	160	191	102	105	95	71	40	48
Diesel	-	-	-	53	-	-	-	50	177	223	1052
TOTAL	2 005	1 823	1 792	1 577	2 188	2 507	3 774	3 711	1 864	2 763	3 547

Table 7: Annual Scope 1 GHG Emissions per Source

3.3.1. Shuttle Emissions

UCT Shuttle emissions arise from the mobile combustion of fuel in its shuttle fleet vehicles, which help to transport students and staff to and from campuses. The fleet includes 28 buses and 3 minibuses. Emissions are reported separately for UCT's vehicle fleet and the UCT shuttle fleet, as this will aid the institution's carbon management strategy. In 2022 the shuttle fleet required a total of 337,307 litres of diesel, which resulted in 907 tonnes of CO_2e emissions. The figure below illustrates how shuttle activity has started to normalise after the sharp decline during 2020 and 2021.

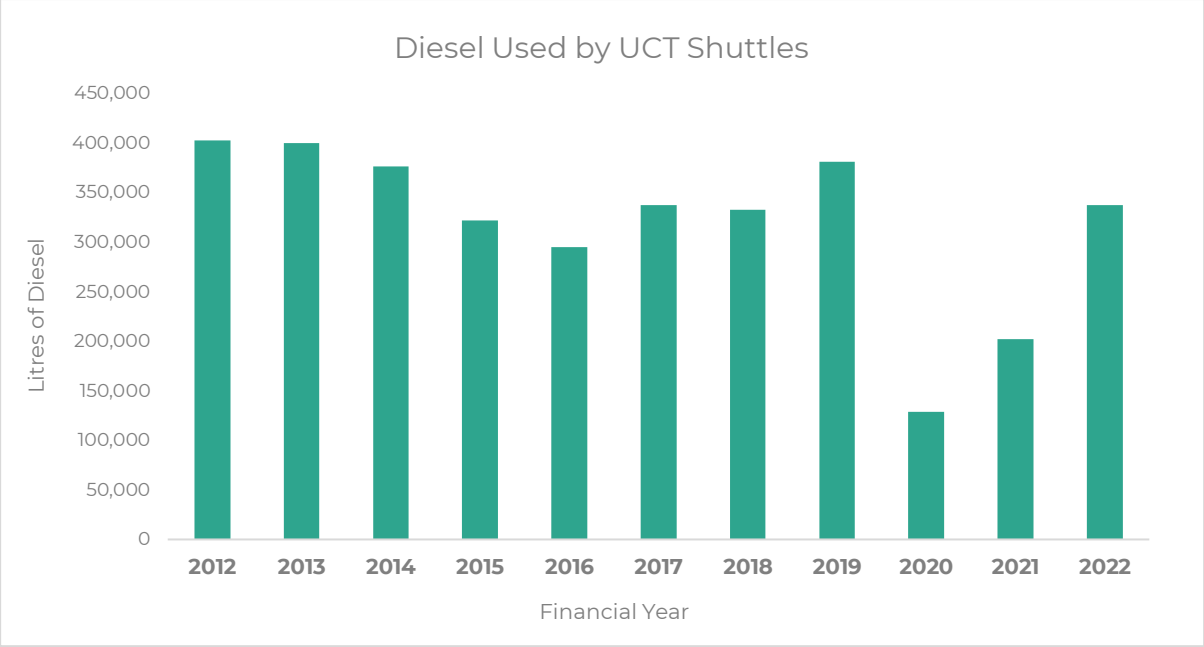

Figure 7: UCT Shuttle Fuel Use per Annum

3.3.2. Vehicle Fleet Emissions

UCT's fleet of various vehicle types, which utilise both petrol and diesel, required a total of 86,104 litres of diesel and 123,041 litres of petrol during 2022. This mobile combustion resulted in 528 tonnes of CO_2e of direct emissions. Although this contributes 15% of direct emissions, fleet emissions have decreased by 14% relative to 2021.

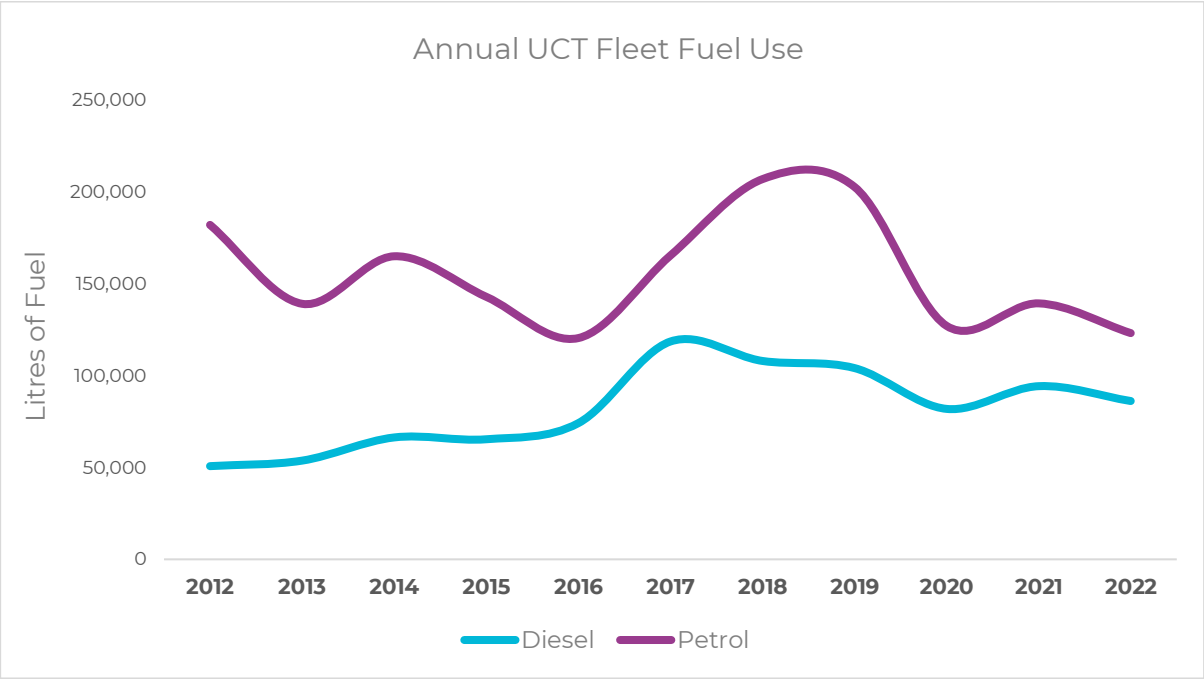

Figure 8: UCT Vehicle Fleet Fuel Use per Annum

3.3.3. Refrigerant Gas Emissions

Fugitive refrigerant gas emissions refers to various types of gases used in HVAC, air-conditioning, refrigeration systems and heat pumps that escape into the atmosphere due to system leaks. Refrigerant gases have high global warming potentials, which means they have a negative impact on the atmosphere and easily raise total greenhouse emissions in an inventory such as UCT's. HCFCs such as R22 (freon) are ozone depleting substances which should be avoided for use in air-conditioning systems. UCT's use of R22 has declined over time while the use of HFC's such as R410A has increased in recent years.

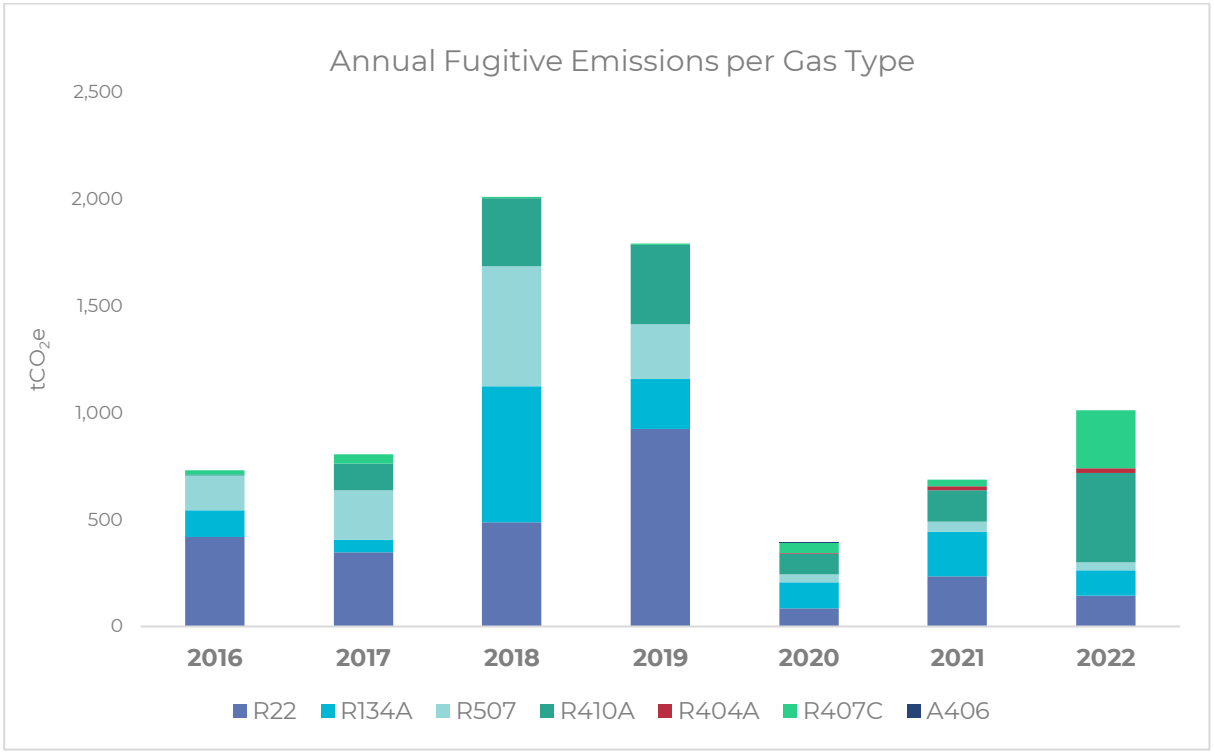

Figure 9: Annual Fugitive Emissions per Gas Type

3.3.4. Stationary Combustion Emissions

When fuel is combusted for the purpose of energy generation in stationary (non-mobile) equipment such as generators or cooking equipment, greenhouse gases are released into the atmosphere. UCT makes use of LPG (Liquid Petroleum Gas) in cooking equipment and water heaters, as well as diesel in back-up power generators.

The figure below illustrates the impact of load shedding on UCT's diesel use in generators. Over the course of 2022 South Africa experienced 3,773 hours of load shedding. UCT required 395,751 litres of diesel to provide back-up power when needed. The increased consumption also reflects the use of additional equipment as the institution procured more generators during the year.

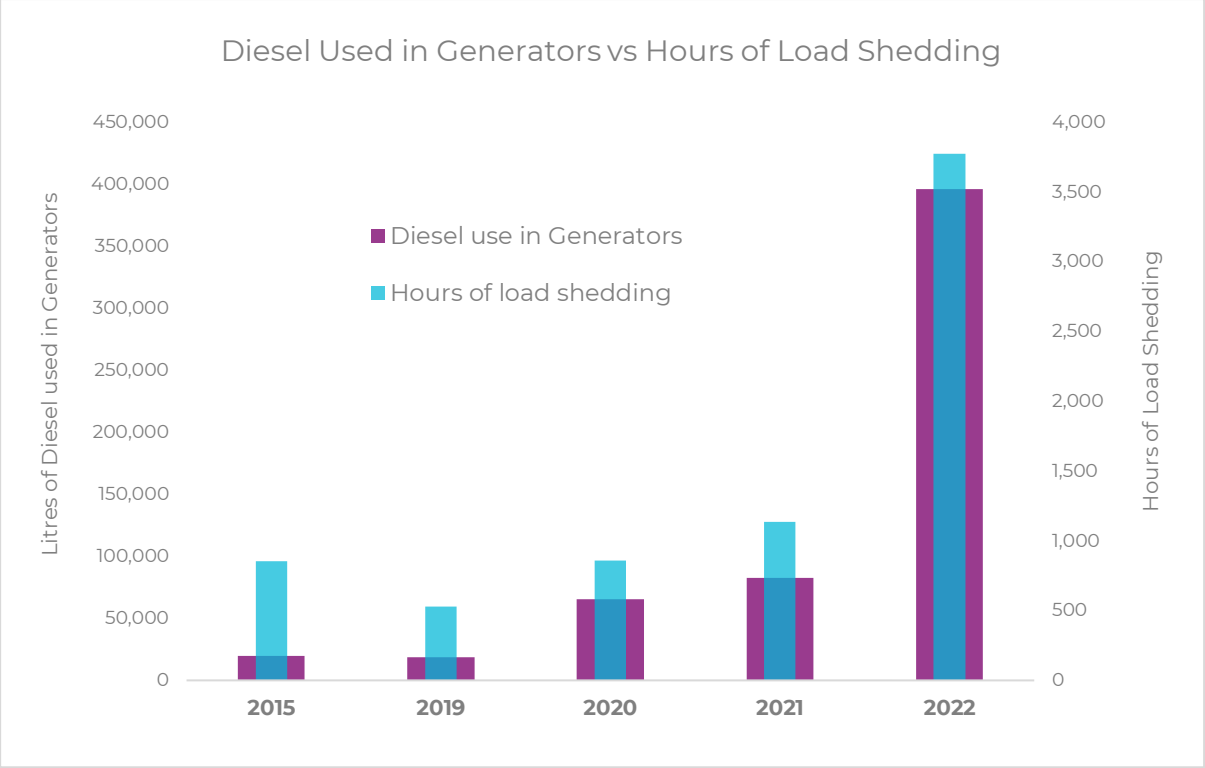

Figure 10: Annual Diesel Consumption and Hours of Load Shedding

Aside from generators, UCT also utilises LPG. Where LPG was purchased by UCT, the associated emissions are reported as stationary combustion emissions. With UCT's shift from LPG water heaters to heat pumps, and more centralised cooking practices, LPG use has steadily declined year-on-year. With a slight increase in 2022, emissions arising from the stationary combustion of LPG totalled 48 tonnes of CO_2e, which contributed only 1.4% to direct emissions.

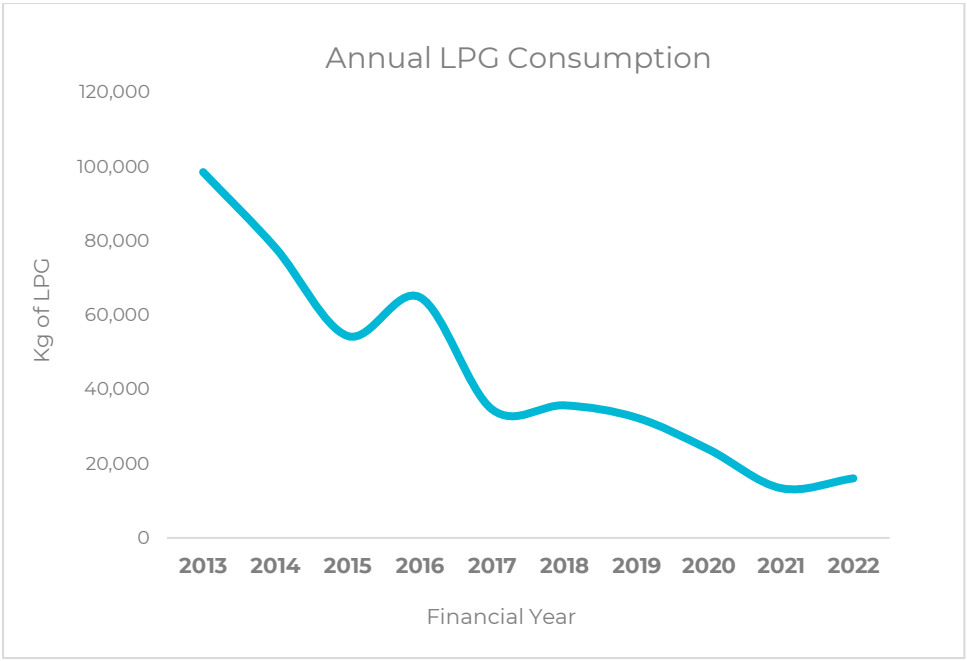

Figure 11: Annual LPG Consumption

3.4. Scope 2

Scope 2 emissions are indirect greenhouse gas emissions associated with the production of purchased electricity. Although UCT does not produce these emissions, the institution does have operational control over the quantity of electricity used. Emission results are determined based on annual emission factors released by Eskom. UCT's 2022 Scope 2 emissions are derived from an emission factor of 1.01 $kgCO_2e$ per kWh (Eskom Annual Report 2023). The 2021 results have been updated with Eskom's AR22 emission factor, which was not available at the time of UCT's previous assessment. The figure below illustrates Scope 2 emissions per UCT campus / facility during each financial year to date.

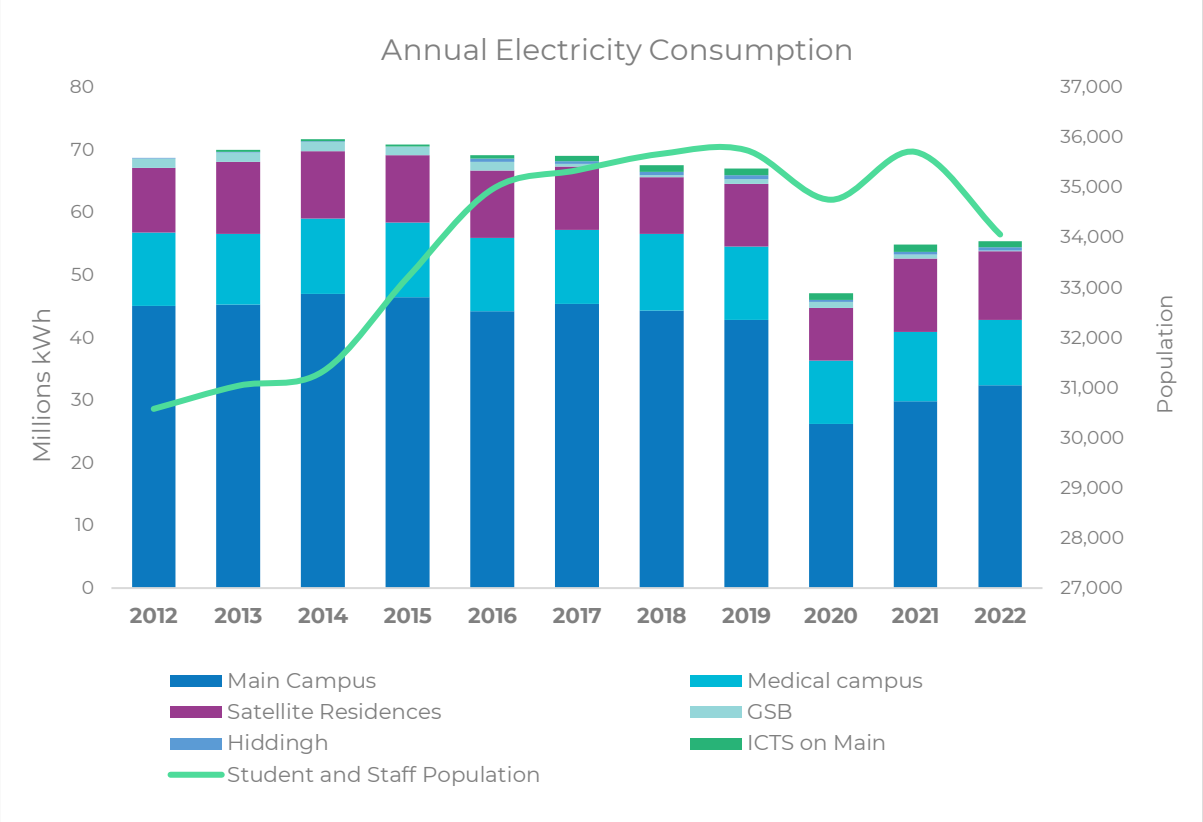

Figure 12: Annual Electricity Consumption Fluctuations per Campus vs UCT Population

This figure shows a slight increase in total kWh of electricity consumed between 2021 and 2022. Higher consumption was expected considering the return to normal activity levels. However, it is still lower than anticipated due to load shedding and minor challenges with data quality. The table below lists the associated emissions per year, which shows that although consumption has increased slightly, emissions have actually decreased due to the lower Eskom grid emission factor in 2022.

Campus	tCO_2e										
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Main Campus	42 394	42 583	44 226	46 933	43 774	44 001	47 024	44 512	27 750	31 077	32 698
Medical campus	11 044	10 648	11 241	12 027	11 654	11 477	12 993	12 238	10 734	11 475	10 613
Satellite Residences	9 702	10 729	10 141	10 850	10 633	9 885	9 585	10 375	8 980	12 202	11 054
GSB	1 363	1 417	1 393	1 387	1 382	327	301	839	980	611	99
Hiddingh	116	116	112	0	527	504	622	602	381	464	508
ICTS on Main	0	342	335	372	534	834	1 096	1 141	1 076	1 241	988
Total tCO_2e	**64 617**	**65 835**	**67 447**	**71 569**	**68 505**	**67 028**	**71 621**	**69 706**	**49 902**	**57 069**	**55 959**

Table 8: Annual Scope 2 Emissions per Facility

Main Campus continues to contribute the largest share of Scope 2 emissions at 58%. It also makes up 28% of total 2022 greenhouse gas emissions. As such, this should be a primary focus in UCT's carbon management strategy. Although Scope 2 provides UCT with a carbon management challenge, it also provides the greatest opportunity of all emission sources for UCT to implement emission reduction initiatives that can significantly impact the overall carbon footprint.

Population numbers referred to in this report reflect the number of enrolments at UCT. This assessment sees interesting trends in population relative to energy use. Electricity use remained relatively steady between 2021 and 2022 even though the staff and student population decreased from 35,709 to 34,061 in 2022.

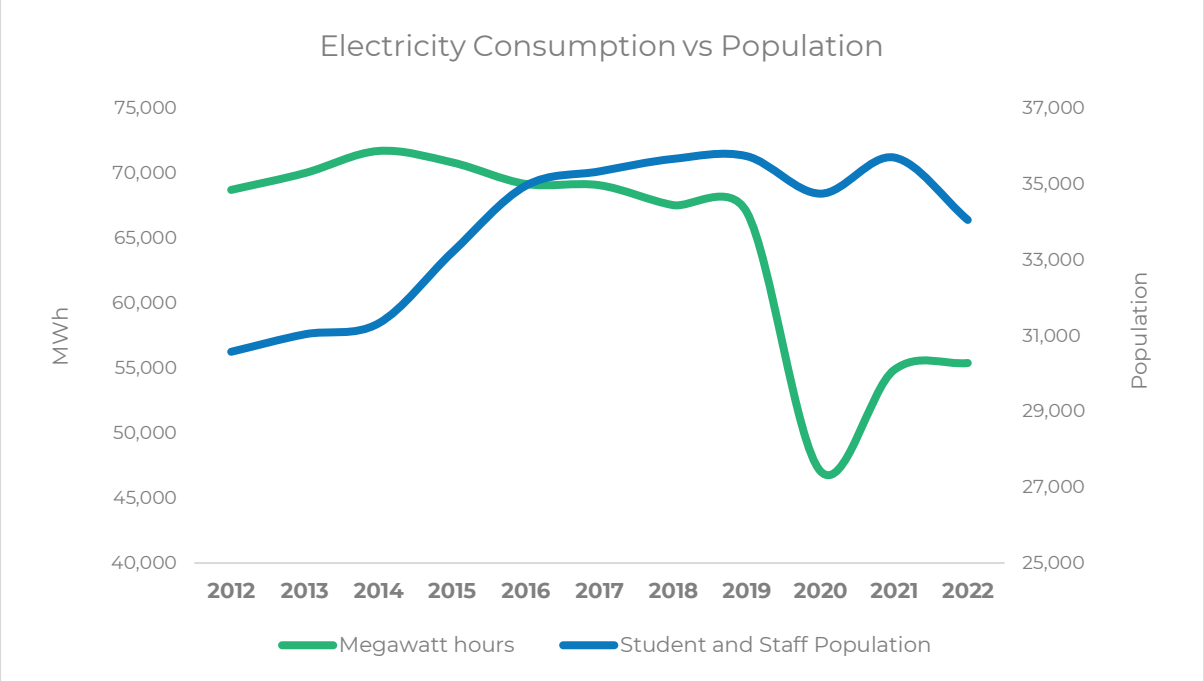

Figure 13: Annual Fluctuations in Electricity Consumption vs Population

3.5. Scope 3

Indirect emission sources arising from activities upstream and downstream from an organisation are reported within the 15 categories of Scope 3. Unlike Scope 1 and 2 sources, reporting Scope 3 emissions is optional. However, there is value in accounting for these. Certain categories would be considered relevant to an organisation's carbon footprint, depending on the nature of the business or activities that they conduct. UCT currently reports 6 of these categories (where food, water and paper supply fall into the same category "Purchased Goods and Services"), which is a robust boundary and encompasses some material emissions-generating activities. The results for 2022 are discussed below.

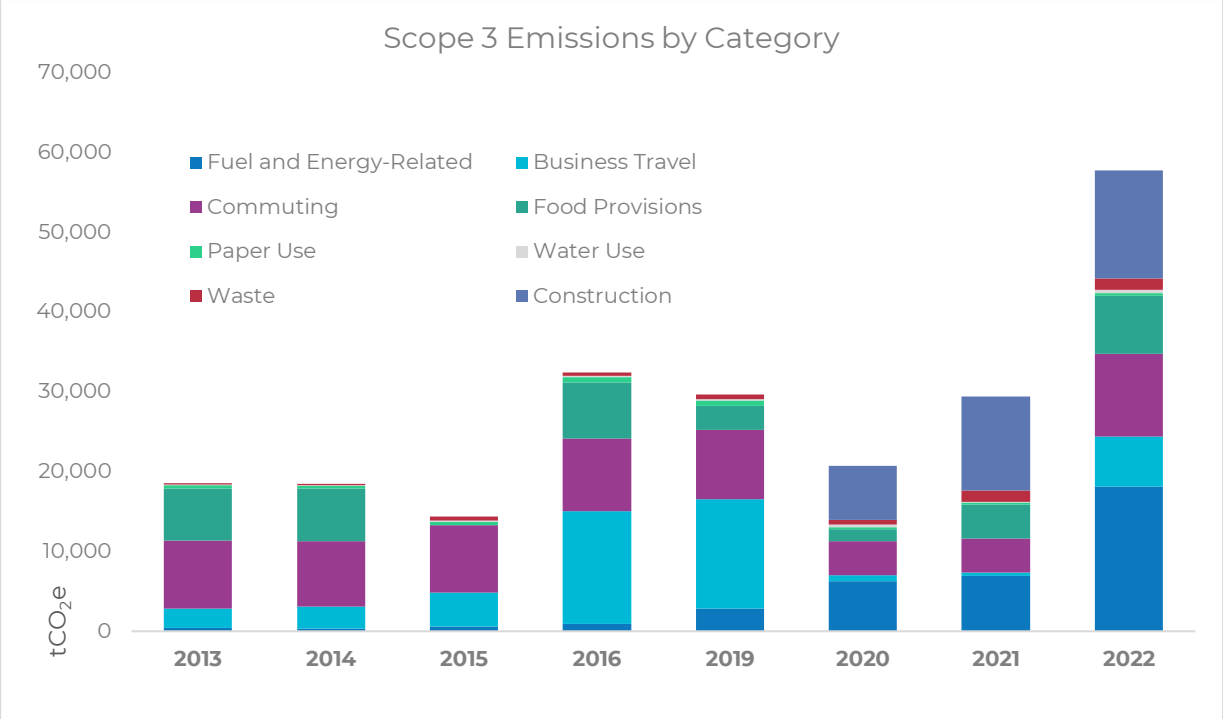

Figure 14: Annual Scope 3 Emission Fluctuations per Emission Category
Note: Scope 3 emissions were not reported in 2012 or 2018, while minimal sources were reported in 2017

The most significant change to UCT's emissions in 2022 is the adoption of best practice greenhouse gas accounting in terms of indirect upstream emissions associated with the extraction, processing and transportation of fuels, referred to as Well-to-Tank (WTT) emissions. Although a portion of these emissions were included in past assessments, the boundary has been increased as encouraged by industry best practice. Prior to 2022, Scope 3 Category 3 "Fuel- and Energy-Related Activities" emissions included the WTT emissions associated with activities reported in Scope 1, emissions associated with electricity lost to transmission and distribution through the municipal grid, as well as WTT emissions associated with fuels used for business travel activities. This 2022 inventory includes the additional sources of WTT emissions arising from electricity generation, WTT emissions arising from electricity lost to transmission and distribution through the municipal grid, as well as WTT emissions associated with fuels used for staff and student commuting. This is the primary reason for the 49% increase in Scope 3 emissions relative to 2021.

Scope 3	tCO_2e							
	2013	2014	2015	2016	2019	2020	2021	2022
Fuel and Energy-Related	409	341	581	890	2 842	6 232	6 920	**18 138**
Business Travel - Land	385	124	262	228	304	48	42	332
Business Travel - Air	2 021	2 628	3 996	13 902	13 424	763	395	5 946
Commuting	8 566	8 217	8 465	9 071	8 671	4 245	4 219	**10 327**
Food Provisions	6 485	6 549	0	7 022	2 970	1 467	4 253	7 254
Paper Purchased	386	305	382	667	708	271	249	355
Water Consumption	121	139	138	194	179	321	147	365
Waste Generated	175	143	558	452	506	584	1 384	1 484
Construction	-	-	-	-	-	6 798	11 758	13 493
TOTAL	**18 547**	**18 446**	**14 382**	**32 427**	**29 605**	**20 729**	**29 366**	**57 692**

Table 9.1: Scope 3 Summary based on updated boundary

Due to the expansion of the Scope 3 boundary it may be unclear how the actual Fuel- and Energy-Related Activity and Commuting emissions have changed. An adjusted table below, with the additional boundary emissions removed, provides a like-for-like comparison of those categories.

Scope 3	tCO_2e							
	2013	2014	2015	2016	2019	2020	2021	2022
Fuel and Energy-Related	409	341	581	890	2 842	6 232	6 920	**7 176**
Business Travel - Land	385	124	262	228	304	48	42	332
Business Travel - Air	2 021	2 628	3 996	13 902	13 424	763	395	5 946
Commuting	8 566	8 217	8 465	9 071	8 671	4 245	4 219	**8 044**
Food Provisions	6 485	6 549	0	7 022	2 970	1 467	4 253	7 254
Paper Purchased	386	305	382	667	708	271	249	355
Water Consumption	121	139	138	194	179	321	147	365
Waste Generated	175	143	558	452	506	584	1 384	1 484
Construction	-	-	-	-	-	6 798	11 758	13 493
TOTAL	**18 547**	**18 446**	**14 382**	**32 427**	**29 605**	**20 729**	**29 366**	**44 448**

Table 9.2: Scope 3 Summary based on historic boundary

3.5.1. Fuel- and Energy-Related Emissions

This category includes emissions related to the upstream production and transport of the fuels and energy purchased and consumed by UCT, referred to as “Well-to-Tank” (WTT) emissions for fuels consumed, as well as “Transmission and Distribution Loss” emissions related to electricity consumed. As discussed above, the scope has increased to include WTT emissions associated with electricity generation and electricity lost during transmission and distribution within the municipal grid, and WTT emissions associated with commuting. The results in this category are entirely dependent on the activity, so when electricity use, business travel and commuting activity decrease, the emissions in this category will decrease accordingly.

3.5.2. Construction Emissions

This is the second assessment in which UCT has reported emissions associated with construction. This category covers the upstream embedded greenhouse gas emissions in the materials used to construct UCT’s capital goods. Although this has raised the overall carbon footprint, it also provides a new opportunity for implementing and tracking emission reductions. The quantified result is based on secondary expenditure data and, as such, should be considered a general estimate of emissions. Ideally primary data will be logged in the form of material quantities to enable more accurate quantification of construction emissions, and to account for any green building practices.

3.5.3. Purchased Goods and Services Emissions

Food Provisions
UCT food supply activity includes food that is supplied to first-tier residences by the number of breakfasts, lunches and dinners, as well as bakery and food items supplied by vendors that operate on campus. Based on the data provided, upstream emissions embedded within food provisions increased 71% between 2021 and 2022, mostly due to improved data quality from the current year.

Water Consumption
Water data was supplied via SAP, in addition to consumption data from UCT's Graduate School of Business, which is consistent with the breakdown provided in previous years. A comprehensive water metering system has been installed and UCT is working on establishing accurate readings across the system. GCX continues to apply a more appropriate, higher South African emission factor for water supply, compared to assessments prior to 2020, which is updated annually based on updated to Eskom's grid emission factor. Water use emissions increased from 147 tCO_2e in 2021 to 365 tCO_2e in 2022.

Paper Purchased
UCT purchases office paper and custodial paper, as well as paper and books used for exams. Greenhouse gas emissions are embodied in these papers during the production and transportation of the material. Paper use emissions increased 42% between 2021 and 2022 as campus attendance normalised.

3.5.4. Commuting Emissions: Staff and Students

Commuting Emissions are based on a survey taken in 2014. However, the data is updated based on the following factors: updated populations of students and staff and adjustments to reflect a decline in train travel with a consequent increase in minibus taxi travel in recent years. As expected, due to many students remaining at home during 2020 and much of 2021, emissions dropped during those years and have increased into 2022. The increase is exaggerated by the addition of WTT emissions to this category's total.

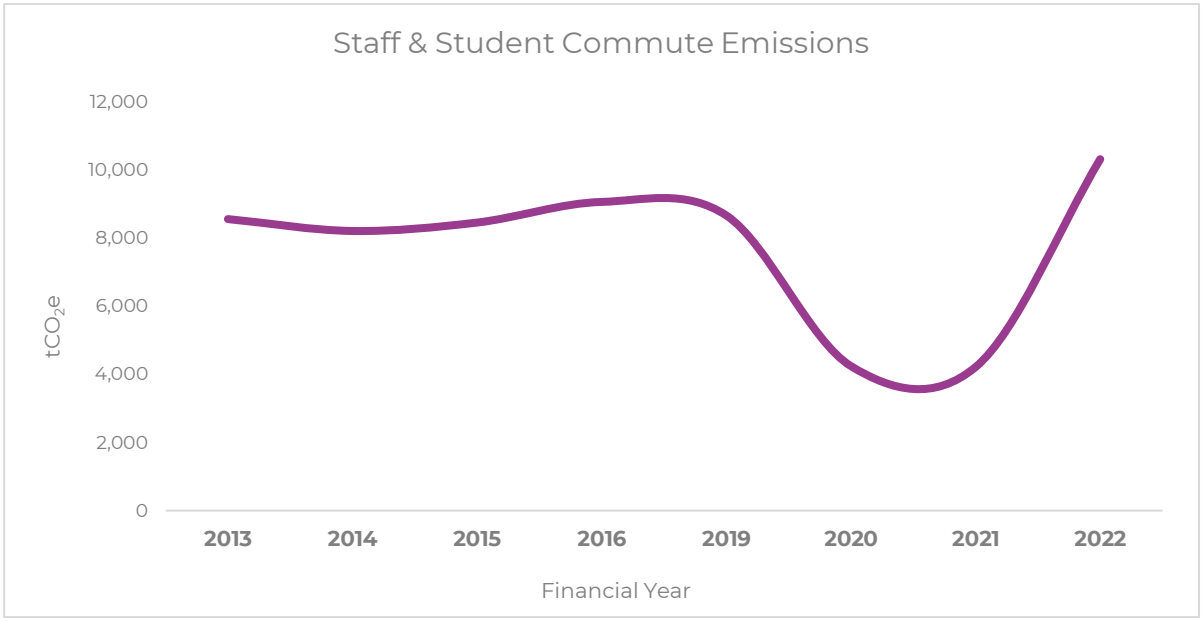

Figure 15: Annual Commuting Emissions Fluctuations

3.5.5. Business Travel Emissions

The international impact that Covid-19 had on travel is evident in the results of UCT's Scope 3 business travel emission results for 2020 and 2021. The figure below illustrates how the 2022 activity started returning to UCT's regular travel practices, although it has not reached the same level as those seen in the years prior to 2020.

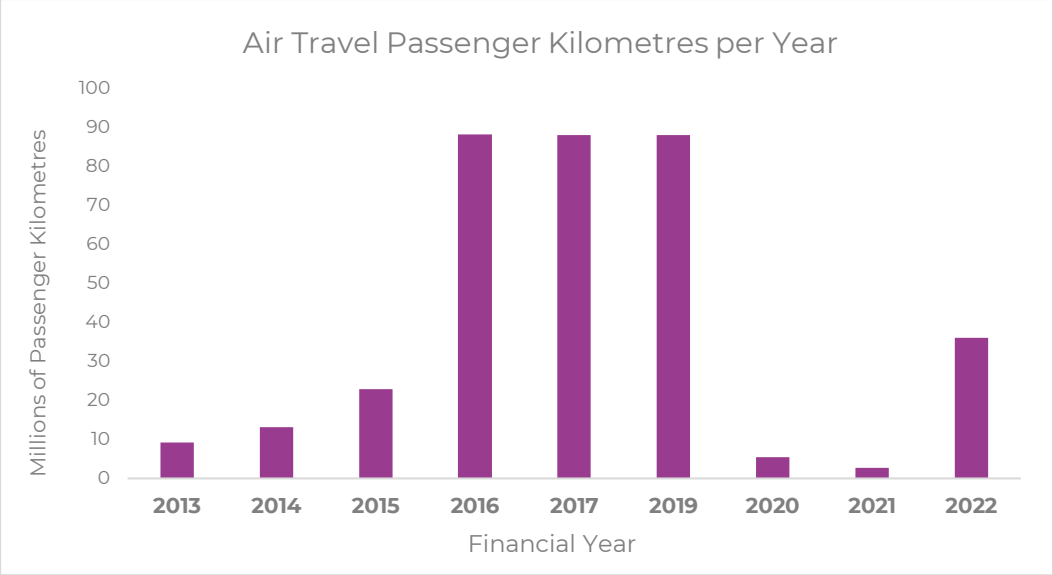

Figure 16: Annual Air Travel Emission Fluctuations

3.5.6. Waste Generated Emissions

Indirect emissions from waste generation occur due to disposal, treatment method and transport of waste types. In 2022, 78% of UCT's waste generated was sent to landfill, which is consistent with previous years. Currently the university has several recycling initiatives in place which reduce overall emissions from this source. Total waste emissions increased 7% between 2021 and 2022.

4. TARGETS

UCT has set the following targets:

- **Target 1**: Net Zero emissions by 2050 (Scope 1 and 2)
- **Target 2**: 2 – 5% reductions in emissions per annum from 2020 (to reach Target 1)

Due to the impact of Covid-19 which caused decreased activity throughout UCT, the 2020 emissions were relatively low. As expected, activity began to normalise the following year and consequently these emissions increased by 16% in 2021. With most activity returning to pre-Covid levels, UCT saw a 1% decrease in emissions between 2021 and 2022. This leaves UCT at an overall 15% increase in Scope 1 and 2 emissions since 2020, averaging a 7.5% increase in emissions per year since 2020.

Scope 1, 2 and Other Direct Emissions				
2020	2021	% Change 2020 vs 2021	2022	% Change 2021 vs 2022
51 767	59 832	**+16%**	59 506	**-1%**

Table 10: Annual % change in Scope 1, 2 and Other Direct Emissions since 2020

Due to UCT's practice of annual carbon footprint measurement since 2012, it is also possible to track the changes in Scope 1, 2 and Other Direct emissions since that initial assessment year. The trend below clearly illustrates the impact of Covid-19 on 2020 and 2021 emissions, followed by a slight normalisation into 2022.

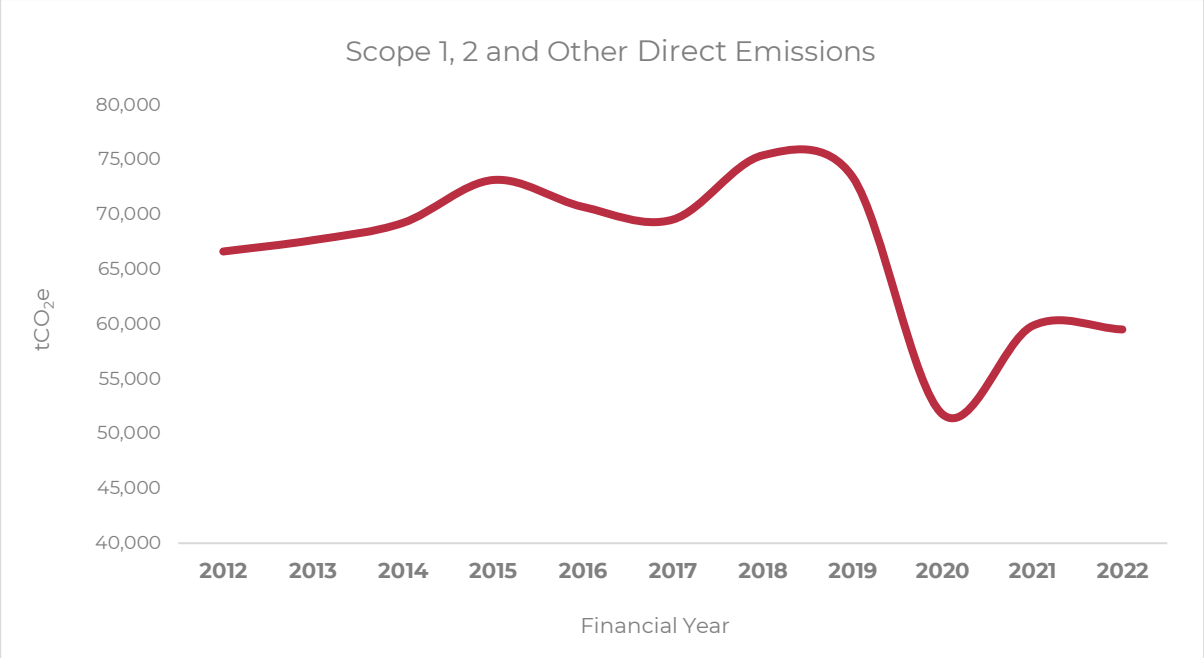

Figure 17: Annual Fluctuation in Scope 1, 2 and Other Direct Emissions

Looking at the change in emissions since UCT's first assessment, the institution's greenhouse gas emissions have declined by 11% since 2012. This should take into account that generator diesel emissions were not reported until 2015 and fugitive refrigerant gas emissions were not reported until 2016. However, the majority of these emissions arise from Scope 2, which has been reported relatively consistently throughout the years.

Emissions	tCO_2e		% Change
	2012	2022	2012 vs 2022
Scope 1, 2 and Other Direct	66 622	59 506	-11%

Table 11: Percentage Change in Emissions since 2012

Renewable Electricity at UCT

Thanks to the generation of 50,510 kWh of renewable electricity from solar panels installed at three locations at UCT-controlled facilities, Scope 2 emissions have been reduced by 51 tonnes of CO_2e in 2022. Scope 2 provides the greatest opportunity for emission reductions at UCT and the most effective approach for the institution to maintain its reduction target. Further solar PV installations are being considered and the impact will be tracked in all UCT greenhouse gas inventories going forward.

5. RECOMMENDATIONS

5.1. Carbon Management

Carbon footprint assessment results can inform where an organisation should focus its reduction efforts, in terms of emission sources and facilities. There are certain parameters that should be taken into account, including:

- The relative contribution of an emission source to UCT's overall carbon footprint
- The control that UCT has over an emissions-generating activity
- Confidence in the existing data and results

Scope 2

Scope 2 emissions amounted to 55,959 tCO_2e which contributed 49% of UCT's most recent greenhouse gas inventory. Of this, 58% are accounted for by electricity consumption on Main Campus. **Electricity consumption at Main Campus still offers the greatest opportunity for emission reductions within UCT's carbon footprint**. Although these are indirect emissions which take place off-site, the consumption of grid electricity at the facilities within the assessment boundary is under UCT's operational control. Although some improvements can be made in terms of clarifying the Scope 2 boundary, data quality and completeness is relatively robust. With the rollout of various solar PV installations on UCT campuses, future inventories will continue to take into account avoided emissions related to the use of renewable energy. If UCT continues on a journey to transition from grid to renewable electricity use, combined with energy efficiency initiatives throughout its campuses for lighting and air conditioning, these avoided emissions will further displace Scope 2 emissions over time.

Scope 1 and 3
Although Scope 1 contributes a smaller portion of UCT's total carbon footprint, there are still opportunities for reducing emissions, as well as reducing the institution's overall environmental impact.

Shuttle and vehicle fleets:
UCT has investigated the feasibility of converting UCT's shuttle bus fleet to electric buses in a detailed technical study – it was found that currently this is not environmentally, technically and financially feasible, but this should be reviewed as the EV market grows in SA. UCT will at some point also do a more detailed investigation on the passenger vehicle fleet. These kinds of initiatives, if implemented, would be run alongside the installation of solar energy infrastructure, such that electric vehicles are charged on-site via solar PV. UCT can also focus on route and driving efficiency to reduce overall fuel consumption.

Fugitive refrigerant gases:

UCT should aim to completely phase out the use of R22 and any other HCFC gases for refrigeration or air-conditioning purposes due to their ozone-depleting qualities. Although they are not ozone-depleting substances, HFCs also have very high global warming potentials, which means that even small gas refills in air-conditioning systems can significantly increase UCT's Scope 1 emissions. Alternative, climate-friendly refrigerant gases should be considered such as hydrocarbons, ammonia or carbon dioxide.

Paper use:

The majority (76%) of paper in 2022 was for office use rather than custodial, and this is where UCT can focus on reducing paper use. Overall the contribution of total paper emissions to UCT's footprint is less than 1%, so these efforts would be in light of the broader environmental impact of paper use, more than its impact on the atmosphere. By using recycled paper, these emissions can be reduced significantly.

Waste generation:

78% of UCT's waste is sent to landfill. Although waste emissions only contribute 1.5% of total greenhouse

gas emissions, the amount of material sent to landfill is contributing to South Africa's overfilled landfill crisis, which UCT can help mitigate by investigating alternative waste management solutions.

5.2. Data Management

The following recommendations offer suggestions to improve data quality and access for future greenhouse gas assessments. Refer to Appendix A – "Methodology" for the current system of data management as it was applied to the 2022 inventory. Data confidence can be improved by allowing more time for the data querying process. UCT can consider beginning the process of data collection earlier in the year to allocate more time to data scrutiny going forward.

Electricity consumption: The boundary of facilities included in this assessment was drawn as accurately as possible with the information provided. However, campus-level electricity data does not show exactly which erfs are included. Although a Master Erven and Property Areas lists were provided, it is not entirely clear which of the erfs are covered in the campus-level data, and the erf lists don't completely align. Various facilities were not assigned an area metric (m^2). Ideally UCT will develop a comprehensive list of erf numbers where electricity consumption is under UCT's operational control, and submit consumption data at an erf level. Currently this is being considered as part of an existing 5-year data management plan by UCT. For this 2022 inventory, data provided for electricity use at GSB seemed too low. Although it was queried, further investigation is required to confirm its accuracy. Diesel used in generators: Data quality has improved significantly through the submission of an Excel-based data log of fuel purchases. Previous assessments relied on incomplete PDF invoice collections and the conversion of fuel expenditure to fuel quantities based on diesel prices at the time.

Business Travel: Data was provided in the form of SAP general ledgers, which log information including expenditure. However, no travel distances or routes are logged, and this information is required for greenhouse gas emission calculations. UCT should implement a system for logging all flight routes and flight classes for air travel, as well as distances or fuel quantities related to business travel by road.

Construction: The data provided for this second assessment of UCT's construction footprint was well documented. However, accounting for construction emissions based on expenditure provides a very broad estimate of the actual impact. Since this source contributes a material portion of UCT's greenhouse gas emissions and 25% of Scope 3 emissions, improving the quality of this data can help UCT to better understand and manage this source of emissions in future. Ideally, UCT will collect data that includes the types and quantities (by weight) of materials used for construction, for future assessments.

Food supply: Emission factors are derived from a pertinent UCT-based study that focused on specific catering items at the university. This provides high specificity but the study should be conducted again to obtain more up-to-date results rather than referring to emission factors developed in 2013 which no longer reflect the exact procurement processes currently followed at the institution. UCT should also obtain more accurate information regarding the number of food vendors operating on campus during each financial year. Ideally data will be submitted by all vendors to cover the sale volumes from each. Data should also be disaggregated as it was is past data sets, by the number of breakfasts, lunches and dinners provided.

Commute survey: UCT should conduct a new survey of staff and students to obtain a more updated breakdown of travel to and from campus. The survey can also be expanded to ask additional questions that will further inform emissions estimates to include emissions from home working where relevant.

Water Use: A water metering system has been installed, although GCX has suggested that due to notable annual fluctuations in reported water use that does not align with other activity changes, UCT should investigate the accuracy of data outputs from this system.

APPENDIX A - METHODOLOGY

The operational control approach was used to consolidate all emissions within the specified boundary. Carbon emissions were measured in accordance with the GHG Protocol Corporate Standard (WRI & WBCSD, 2004).

As per the GHG Protocol, all Scope 1 and Scope 2 emissions were included in the report. Emissions from non-Kyoto gases (such as Freon/R22) were measured and classified as out of scope Product Use Emissions. Although optional, selected Scope 3 emissions were also included.

All emissions were expressed as CO_2 equivalents (CO_2e), and account for carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

All emission factors used were from UK Government GHG Conversion Factors for Company Reporting V1.1, 2022, using IPCC AR4 (2007) GWPs unless stated otherwise. All emission factors applied are listed on the accompanying Excel report: *GCX_UCT_CFA Report_FY22.xlsx*.

All activity data was submitted to GCX by UCT. Where the data required for calculating greenhouse gas emissions was not readily available in the submitted activity data, GCX analysed the relevant data set to isolate the consumption data required. Various assumptions were made to reach a best estimate of final consumption values. Assumptions are listed in Appendix B.

SCOPE 1

Stationary combustion

Emissions associated with stationary combustion relate to diesel purchased for use in generators to supply energy on site, as well as LPG purchased for use at various locations. Diesel data was provided in the form of fuel quantities purchased during 2022. LPG data was supplied as the total kilograms of gas purchased during 2022. Emission factors applied to estimate the associated greenhouse gas emissions are sourced from the latest Methodological Guidelines for Quantification of GHG Emissions, October 2022 (DFFE, South Africa) Tier 2 Country-Specific with Global Warming Potentials from the IPCC AR5 for stationary combustion per fuel type. These emission factors were selected in order to align with UCT's annual NGER Regulations submission results.

Fugitive Emissions

Fugitive emissions from refrigerant gases that escaped from air-conditioning systems are reported in Scope 1, except for emissions associated with refills of R22 gas, which is not a Kyoto gas and is reported out of scopes. Several different refrigerant gas types were refilled during each reporting period. Refills are conducted by various service providers across UCT facilities. The emission factors / Global Warming Potentials applied to estimate the associated CO_2 equivalent emissions were sourced from UK Government Conversion Factors for Greenhouse Gas (GHG) Reporting V1.1, 2022, AR4.

Vehicle Fleet

As opposed to UCT's previous assessment period, for which expenditure data was provided to estimate fleet emissions, actual fuel consumption figures were made available for UCT's 2022 fleet activity, pertaining to diesel and petrol used in UCT-owned and long-term leased vehicles. It was confirmed historically that the SAP reports submitted did include Bidvest vehicle activity. However, it is now thought that it may have also contained the ABSA vehicle activity, which was reported additionally. As such, fleet emissions may have been overestimated in prior years. Eqstra vehicles data was submitted separately for 2022, which also provided fuel quantities per fuel type. No data is available related to the quantities of lubricant used in these vehicles and this is a noted exclusion from the operational boundary. Where petrol use was reported within "UCT Shuttle" data, it is known to have been used in non-shuttle vehicles. As such, the petrol is reported along with the quantities mentioned above, as part of the vehicle fleet.

Emission factors applied to estimate the associated greenhouse gas emissions are sourced from the latest Methodological Guidelines for Quantification of GHG Emissions, October 2022 (DFFE, South Africa) Tier 2 Country-Specific with Global Warming Potentials from the IPCC AR5, for mobile combustion per fuel type.

UCT Shuttle

Emissions are reported separately for UCT's vehicle fleet and the UCT shuttle fleet as this will aid the institution's carbon management strategy. UCT's shuttle fleet still includes 33 vehicles. The fuel consumption data provided covers all 33 vehicles. Data was provided as the quantity of diesel used during the reporting period. The petrol reported on this submission is utilised in 2 UCT non-shuttle vehicles and the associated emissions are reported in the category "UCT Fleet". Emission factors applied to estimate the associated greenhouse gas emissions are sourced from the latest Methodological Guidelines for Quantification of GHG Emissions, October 2022 (DFFE, South Africa) Tier 2 Country-Specific with Global Warming Potentials from the IPCC AR5, for mobile combustion per fuel type.

Renewable Electricity

This is the first time that UCT is reporting the use of renewable electricity within the institution's greenhouse gas inventory. The on-site generation of electricity must be reported in Scope 1. At UCT this relates to on-site solar installations at three locations. There are no associated direct emissions. However, the "avoided Scope 2 emissions" are reported outside of Scopes for reference, as the energy is utilised by UCT facilities which would otherwise have required grid electricity.

SCOPE 2

Purchased Electricity

This scope covers all electricity consumption under UCT's operational control. Data was provided by Terra Firma Solutions for most campuses, while separate data was provided for ICTS and GSB. A SAP and a P&S report were provided for all other Erfs such as residences and all other UCT admin buildings. UCT confirmed that the organisational boundary has not changed relative to 2021. As such, the same erfs were included in the footprint boundary. SAP data includes many reversals, which are listed in the comments section of UCT's SAP data report. Taking these into account would require an extensive manual process of updating several figures per erf. Due to the time required, the existing figures are applied. Therefore, results are slightly over estimated.

UCT has 100% operational control of its Graduate School of Business and Conference Centre located at the V&A Waterfront. The facility is metered as part of the Protea Breakwater Lodge Hotel. In order to apportion electricity consumption between the hotel and the university, the following methodology was applied: Consolidated electricity consumption is provided for the three facilities, along with total expenditure. Although the actual consumption is not metered separately per facility, the billing is separated and this was used to determine a best estimate of the % split in consumption between the facilities. Some of the guests at the Breakwater Lodge are UCT students and academics. As such, UCT is considered to have operational control of any associated electricity consumption at that facility. The hotel has provided an updated estimated % breakdown of hotel visitors for 2022. UCT has accounted for their control of electricity use at the hotel based on the combined % of UCT student and academic visitors. The guest attendance during 2022 was as follows:

- UCT Students & Academics: 13%
- Other Hotel Guests: 87% "

Selected facilities are excluded from the total floor area metric as UCT is considered to have little operational control over activity (and therefore, associated emissions) at these locations: Red Cross Hospital, Groote Schuur, Field Stations, Sports Science Institute, Valkenberg Manor House & Wild Fig, Montebello. As such, electricity consumption for these facilities was not provided and is not included in the assessment.

To date, UCT's assessments have applied Eskom's financial year factor to the prior calendar year's data, which is the most appropriate option because Eskom's financial year runs from 1 April to 31 March annually. For example: Eskom's AR 2021 factor (based on their financial year 1 April 2020 - 31 March 2021) is applied to UCT's 2020 data. The majority of the months in that Eskom financial year fall in 2020 and are, therefore, most applicable to UCT's 2020 data. Scope 2 emissions associated with electricity consumption during UCT's 2022 financial year were measured by applying the emission factor from Eskom's 2023 Annual Report, which is 1.01 $kgCO_2e$ per kWh.

Eskom Factor 1 and Factor 2: All UCT assessments prior to 2020 have been based on the Eskom emission Factor 1 "total energy sold". GCX recommended switching to Eskom's Factor 2: "total energy generated". This is because Factor 2 is calculated using national energy results that exclude Eskom's own consumption, thus avoiding double counting in the calculation of the emission factor. Factor 2 has been applied to all subsequent assessments (FY2020 onwards). Scope 2 emissions were calculated and reported on UCT's Excel-based report using both the location-based and market-based methods. This is in accordance with GHG Protocol Corporate Standard's "Scope 2 Guidance" (January 2015). No contractual instruments were purchased during the reporting periods and since South Africa currently has no official residual mix factor, both the location-based and market-based totals are the same.

SCOPE 3

Category 1: Purchased Goods and Services: Paper

This category includes the embedded emissions within purchased paper during the financial year. UCT's paper use includes custodial paper as well as office paper use. For custodial paper use, only 7 months of data were available from the 2022 financial year. The data was extrapolated to cover the full 12 month period, assuming that the monthly average paper use is a reasonable estimate of the unavailable monthly totals. Although data was provided in the form of a SAP report where the general ledger listed various purchases related to paper and stationary, it only provided expenditure data and no information related to paper quantities or weights. Therefore, additional data was requested as follows:

Numbers of paper reams or towels or bales related to each paper category: Reams of paper used at ICTS, custodial paper bales and towels from Campus Cleaning Services, and reams of paper procured from suppliers. All reported units were converted to kilograms of paper. The emission factor applied to calculate emissions associated with paper use is from Mondi Rotatrim August 2019. To estimate embedded emissions within custodial paper used, an emission factor has been applied from UK Government Conversion Factors for greenhouse gas (GHG) reporting V1.1, 2022, AR4 for paper material use.

Category 1: Purchased Goods and Services: Water

A SAP report was provided covering all UCT water consumption, excluding the GSB, in kilolitres consumed. No filtering or unit conversions or assumptions were required. A separate report was provided for the GSB. Although this is a Scope 3 source, to account for partial control of water consumption at BWL, consumption was apportioned based on the floor area of each facility (BWL, CC and GSB) in line with the method applied in previous assessments. UCT confirm that data provided in C7-1 and C7-3 covers all UCT water consumption for 2022. C7-2 is a code reserved from digital water meter readings.

Category 1: Purchased Goods and Services: Food Provisions

The data submitted for the number of meals provided at Residences during 2022 is consolidated, rather than detailing the number of breakfasts, lunches and dinners as in 2021 and prior. To estimate the quantity of each meal type, the consolidated total meal number was apportioned to number of breakfasts, lunches and dinners based on the % split present in 2021, assuming similar activity in 2022. Food Supply emissions are calculated based on emission factors from a UCT student alumni dissertation: *Gravenor, M. (2013), Food Sustainability at UCT: An exploratory investigation into the University of Cape Town's food system and its relation to the institutional carbon footprint, Minor dissertation towards a Master of Science specialising in Climate Change and Sustainable Development, University of Cape Town*. First Tier Residences are contracted by UCT Properties and Services, who provided meal provision data. The residences also supply students with meal vouchers which they redeem on campus from the campus food vendors. Therefore, although

voucher figures are provided by Food & Connect (Residences food), emissions are reported alongside those from food supply via campus vendors. They are removed from the residence food supply emissions, to avoid double counting. Information on Halaal meals was not provided because the data provider no longer provides those meals at residences. Campus Food Vendors data is provided by the primary vendor, Food & Connect. No data is provided for the balance of the vendors. 2019 Campus Food Vendors data from Food & Connect was broken into Hot meals, Sandwiches, Wraps, Hot Chips, Burgers, Double hot dog, Mac & Cheese and Butter Chicken. F&C explained a general move away from meal of the day / plated meals. Data is now provided as "Bakery Items" and "Food Items" as per UCT's 2020 and 2021 assessments. For the 2019 assessment it was assumed that Food & Connect provided approximately one third of all meals on campus. In 2020 after the state of emergency was declared, all stores closed for the remainder of the year. It was assumed that the data provided represents close to 100% of activity. In 2021, 50% of vendors were trading (from April 2021) which means there were only 3 or 4 vendors trading. For the purpose of accounting for food supply emissions, GCX assumed Food & Connect was, on average, one of 3 main vendors operating on campus for the majority of 2021. This has not changed since and is assumed to reflect 2022 activity as well. As such, emissions are extrapolated to represent all 3 vendors' activity in 2022.

Category 2: Capital Goods: Construction

In the absence of primary material quantities data, UCT was able to submit secondary expenditure figures for construction-related activities during 2022. Rands spent were converted to Euros based on the exchange rate at the time of the assessment (see the tab "EF"). An emission factor from EXIOBASE (Climatiq) Construction Work: South Africa, 2019, AR5 was applied to estimate the associated embodied emissions within the capital goods constructed during the reporting year. UCT is still working on obtaining more primary data such as construction material types and quantities. In the absence of this data, green building practices cannot be accounted for in greenhouse gas emission calculations.

Category 3: Fuel- and Energy-Generating Activities

This category covers Fuel- and Energy-Related Activities that are not included in Scope 1 or 2. It includes Well-to-Tank emissions associated with the fuel used in generators, LPG used in equipment and fuels used in UCT's vehicle and shuttle fleets. It also includes emissions associated with transmission and distribution losses within the electricity grid, Well-to-Tank emissions associated with the generation of electricity and the generation of electricity lost during transmission and distribution. Emissions associated with Transmission and Distribution losses are calculated using a factor of 0.118 $kgCO_2e$ per kWh, derived from Eskom's AR23 based on the overall energy losses on Eskom's networks, which came to 11.76% during their financial year.

Category 5: Waste generated in operations

A detailed waste report was provided along with PDF certificates from Cape e-Waste Recyclers to confirm the quantities of recycled eWaste. To estimate emissions associated with general waste to landfill, an emission factor is applied from *Friedrich & Troy 2012: GHG emission factors developed for the collection, transport and landfilling of municipal waste in South African municipalities*. *Waste Management, Vol. 33: Issue 4*, which is updated annually to account for updates to Eskom's grid emission factor. Emission factors for recycled waste are from UK Government GHG Conversion Factors for Company Reporting 2022 V1.1, AR4.

Category 6: Business travel.

Flight information was supplied in a SAP report where the general ledger provided expenditure data rather than actual distances travelled or flight routes. The report includes many non-flight expenses linked to local and foreign air travel, and related payments such as accommodation, taxes, services fees, etc, which were filtered out based on various assumptions. Flight routes or distances were not provided. Therefore it is not possible to correctly apply DEFRA methodology for flights distance categories. UCT had an economy-only flights policy during 2022. There may have been an occasional business class flight which would have required approval, but it can be assumed that more than 99% of flights were economy class. The general ledger for foreign flights contained some local flights. However, data was processed and

reported in the categories provided. To apply an up-to-date metric for converting expenditure to distances travelled, airline ticket prices were averaged to determine an estimated average cost per kilometre for local and international flights. One-way flights between Cape Town and Johannesburg were averaged to estimate the cost per km for local flights, while one-way flights between Johannesburg and London we averaged to estimate the cost per km for foreign travel. Car hire data was also provided in SAP reports: separate general ledgers were provided for UCT car hire and for UCT staff reimbursements and allowances. These reports included additional expenditure which needed to be filtered out to arrive at actual Rands spent on car hire. Car rental Rands / Km were previously derived from actual distance travelled data from Bidvest. Bidvest data was not provided for this assessment. Therefore, the cost per kilometre travelled is based on South Africa's 2022 Automobile Association rate.

Staff reimbursements: one general ledger was provided covering staff travel reimbursements, as well as travel allowances. Data was only available as travel expenditure, no distances or vehicle types were available. Data was filtered for food allowances, and by cost per km to isolate reimbursements expenditure. Allowances are filtered as all entries that contain "travel" and exclude travel at the reimbursements cost per km to prevent double counting.

Category 7: Employee Commute

In the interest of comparability, and in the absence of an updated survey, the methodology applied in 2019, 2020 and 2021 is maintained in this assessment. Data is based on the UCT Information Systems survey undertaken in 2014. The survey reflects commuting activity of students and staff at upper campus. Figures are extrapolated to reflect the full UCT commuting population for each year. The modal % split is maintained, however UCT request an adjustment to reflect the general shift from staff and student commuting via train to commuting via taxi. These percentages were adjusted in UCT's previous assessment to represent the increase in travel by taxi and the decrease in travel by train, without affecting the proportions of the other travel modes per year. Total persons commuting is based on staff and student population figures for 2022. Commuting in UCT shuttles is excluded as the associated emissions are reported in Scope 1 as UCT-owned and controlled vehicles. It is assumed that the average minibus taxi has a capacity of 8 people. As such, the emission factor for minibus taxi travel is derived from that for a large petrol vehicle, divided by 8. Student and staff populations commuting to campus were reduced for UCT's 2020 and 2021 assessments, based on detailed attendance schedules, to account for the impact of Covid on commuting. These adjustments were removed for UCT's 2022 assessment because commuting has mostly normalised for this reporting period. The category also includes the Well-to-Tank emissions associated with the fuel used for employee commuting for each mode of travel. Emissions do not include home working emissions and this is a noted exclusion from the 2022 inventory

Organisational Boundary

UCT confirm that all properties with 0m^2 reported on the D1 properties list are not under UCT's operational control. Where electricity data has been provided for a campus or an erf number, it has been confirmed that the consumption is under UCT's operational control. Where m^2 are provided for an erf that is not under UCT's operational control, it has been removed from the total m^2 metric.

APPENDIX B – ASSUMPTIONS & LIMITATIONS

It is often necessary to make assumptions and extrapolations based on the available data. Please take note of some of the key assumptions, extrapolations and limitations listed below:

It was assumed that all data submitted to GCX by UCT was accurate, precise and complete unless stated otherwise.

Scope 2

Where electricity consumption data is provided by SAP or P and S for an Erf at Upper Campus, Middle Campus, Lower Campus, Medical Campus or Hiddingh, it is assumed that the electricity consumption at the erf is accounted for by UCT's metering through TFS and the data provided for those precincts.

Where partial data was available for a property and the remaining months were unavailable, they were estimated based on the average of existing months of data.

Where data was unavailable for a property that is owned by UCT, where electricity use is not listed as a service type on UCT's Master Erven, or properties that are listed as "leased", it is assumed that electricity consumption is not under UCT's operational control (for example, the property is leased out) and, as such, the associated emissions are excluded from Scope 2.

Where 2022 data was unavailable for a Residence or Other Admin Building that is still listed on the UCT Master Erven or D1 Property Areas list, consumption is estimated based on the most recent available data as a best estimate.

Scope 3

Flights: since the SAP report provided included many non-flight expenses, actual flight records were isolated by filtering out certain key words, mostly aligned with the 2019 method applied. Records including the following words were filtered out: "baggage", "accom", "uber", "transfer", "change", "fee", "hire", "insurance", "shuttle", "tax", "serv".

Staff reimbursements: it is assumed that all general ledger records where "net price" (cost per km) is logged at R3.82 and R4.18, and no other records on the ledger reflect staff reimbursements.

Travel allowances: it is assumed that all entries on the general ledger, aside from staff reimbursements, that are not labelled "travel" do not reflect travel allowances.

Commute: travel by car is assumed to be conducted on average by medium petrol cars. It is assumed that the average minibus taxi has an 8 person capacity.

Emissions related to paper used for exam books and papers have been based on estimated data to date, using assumptions regarding average usage per student. The adjustments made to these figures in 2020 and 2021 to account for the impact of Covid, have been removed because activity has normalised across UCT's campuses in 2022.

It is assumed that an average toilet roll weighs 150 grams. The average weight of hand towels utilised at UCT is based on that used in 2019, which was 0.2 kg each.

Hired cars: vehicle types are not known. In order to apply an emission factor it is assumed that they are mostly medium-sized petrol vehicles.

Staff reimbursements and travel allowances: vehicle types are not known. In order to apply an emission factor they are assumed to be mostly medium sized with unknown fuel type.

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