



UNIVERSITY OF CAPE TOWN

CARBON FOOTPRINT REPORT 2018

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Previous reports can be downloaded at <http://www.uct.ac.za/main/explore-uct/sustainability>

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A. INTRODUCTION AND BACKGROUND

About this report

This is the eighth carbon footprint report of the University of Cape Town, for the year 2018. The first report, for the year 2007, was completed in 2009, but encompassed Main Campus only and therefore cannot be considered as a baseline report. The first report with the same boundaries as this 2018 report, which extends to all campuses and uses the current methodology, the Greenhouse Gas Protocol, was for 2012, which can therefore be considered the baseline year.

This 2018 report covers the entire university across all campuses of 673 385 square metres (m²) and a total population of 35 673 students and staff.

The reporting process has two outputs this time around:

1. This detailed report for internal purposes that aims to report on the detailed findings and identify the best opportunities for emission reductions it may be decided that this report is also made available on UCT's website.
2. A fact sheet giving a high-level overview of the carbon footprint report digestible by a broader audience, to be available on UCT's website.

The key findings of the report will be communicated in various ways to the UCT community in an easily understandable manner, to ensure that the key message is shared and appreciated by the UCT community.

This detailed report includes Scope 1 (direct) and Scope 2 (indirect associated with purchased electricity) emission sources only whereas the reports from 2012 to 2016 included all scopes – Scope 1, 2 and 3 emissions, as per the GHG Protocol¹. Challenges encountered in previous years in gathering the data for the Scope 3 Indirect Emissions led to a decision to omit Scope 3 until information systems and data collection processes could be improved. Under the GHG Protocol, reporting on Scope 1 and Scope 2 emissions is compulsory, with indirect Scope 3 emissions being reported on a voluntary basis. However, Scope 3 emissions are considered material for UCT to report on and to target emission reductions under and thus it is important to develop a clear plan on how to collect Scope 3 data more effectively and report on this in future.

In 2019 UCT created a new post, namely the Director of Environmental Sustainability, which was filled in April 2019, located strategically in the Office of the Vice-Chancellor. The director is tasked with the integration of environmental sustainability in all spheres of the university and establishing leadership and enhanced governance in this sphere.

One of the first tasks of the new director has been to draft an Environmental Sustainability Strategy. Key components of the strategy are setting long-term goals, action planning, assigning responsibility, implementation and monitoring, and engaging UCT students and staff to support environmental sustainability. Reducing energy consumption and greenhouse gas (GHG) emissions form a significant

¹ Greenhouse Gas Protocol Initiative (no date) *A Corporate Accounting and Reporting Standard, Revised Edition*, developed for the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD), Geneva, Switzerland. <https://ghgprotocol.org/standards>

part of the strategy, and hence there is a continued and renewed emphasis placed on the value of this report with its findings.

What is a carbon footprint?

A carbon footprint can be defined as a measure of the greenhouse gas emissions that are directly and indirectly caused by an activity or are accumulated over the life stages of a product or service, expressed in carbon dioxide equivalents (CO₂e).

A carbon footprint is measured in tonnes of carbon dioxide equivalent (tCO₂e). The carbon dioxide equivalent (CO₂e) allows the different greenhouse gases to be compared on a like-for-like basis relative to one unit of CO₂. CO₂e is calculated by multiplying the emissions of each of the six greenhouse gases by its 100-year global warming potential (GWP).

A carbon footprint considers all six of the Kyoto Protocol greenhouse gases: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆).

(The Carbon Trust)

Why is reporting carbon emissions important for UCT?

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change. The IPCC in the Fifth Assessment Report, 2014 states that human influence on the climate system is clear and recent anthropogenic emissions of greenhouse gases are the highest in history. Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. (IPCC, 2014)

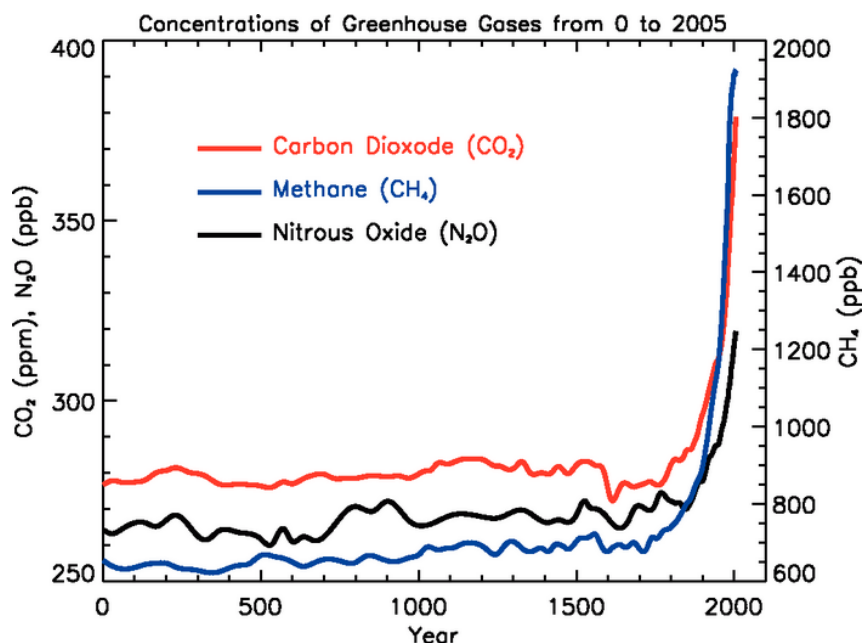


Figure 1: Source IPCC, 2007. Atmospheric concentrations of important long-lived greenhouse gases over the past 2 000 years. Increases since about 1750 are attributed to human activities in the industrial era. Concentration units are parts per million (ppm) or parts per billion (ppb), indicating the number of molecules of the greenhouse gas per million or billion air molecules, respectively, in an atmospheric sample.

The IPCC Special Report of 2018, which builds on the Fifth Assessment Report, states: “Temperature rise to date has already resulted in profound alterations to human and natural systems, including increases in droughts, floods, and some other types of extreme weather; sea level rise; and biodiversity loss – these changes are causing unprecedented risks to vulnerable persons and populations.” (IPCC, 2018) This highlights the broad extent of climate change impacts to both human and natural systems.

South Africa’s national Constitution provides fundamental rights that protect both human and natural systems – the environmental right to a healthy and safe environment. The university’s mission statement echoes this commitment within the context of the teaching and research roles of the institution, as well as engaged citizenship and socially responsive scholarship. UCT has identified strategic initiatives around the most critical issues of climate change, poverty and inequality, among others. Transdisciplinary research hubs have been established around these themes and key among these is the African Climate and Development Institute (ACDI), which aims to collaborate and innovate around Africa’s climate and development challenges.

Historically, UCT has made international and internal policy commitments to environmental sustainability since 1990, with the signing of the international environmental declaration, the Talloires Declaration in 1990; the adoption of the UCT Green Campus Policy Framework in 2009; and signing the ISCN-GULF² (International Sustainable Campus Network Global University Leader Forum) Sustainable Campus Charter in 2012, integrating sustainability in education, research, outreach, strategic planning and operations. Currently being drafted, the UCT Environmental Sustainability Strategy will build upon on these prior commitments and go further to translate them into annual plans and projects.

The Paris Agreement within the United Nations Framework Convention on Climate Change (UNFCCC), effective from 2016, was signed by 195 countries, and brings nations into common cause to undertake ambitious efforts to combat climate change³. The agreement’s central aim is to keep the increase in global average temperature to well below 2°C above pre-industrial levels; and to pursue efforts to limit the increase to 1.5°C, to substantially reduce the risks and impacts of climate change. South Africa has made commitments in terms of the agreement – South Africa’s nationally determined contribution (NDC) will result in an emissions trajectory that peaks between 2020 and 2025, plateaus for a decade, and declines in absolute terms thereafter. The recent UN Climate Action Summit in September 2019 called for increased ambition and accelerated action towards these objectives, with many countries and cities boosting their targets. The City of Cape Town has also committed itself to becoming a net zero emissions city by 2050.

In view of these policies and commitments, and the global, national and local context, UCT should play a leadership role in terms of setting and achieving ambitious greenhouse gas emissions reduction targets, if it wants to remain a leading institution. Measuring and reporting on UCT’s carbon emissions thus forms a key part of being transparent about its progress and being accountable to its community on this issue.

² <https://international-sustainable-campus-network.org/>

³ <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>

Methodology	<ul style="list-style-type: none"> - Greenhouse Gas Protocol – corporate accounting and reporting standard. - Emission factors are from the UK Government, Department for Business, Energy & Industrial Strategy⁴, except for electricity supply where the Eskom factor was used as described below. - Results are reported in metric tonnes of carbon dioxide equivalent – tCO₂e. - The quality of data for Scope 1 is based on measurements and therefore of high quality. Scope 2 data has improved to medium-high quality since data is being gathered from digital meters for the major portion of electricity supplied.
Inclusions	<ul style="list-style-type: none"> - The entire university across all campuses and properties. - Staff: 6 929 full-time equivalent (FTE). - Students: 28 744. - Electricity grid emission factor (Eskom Factor 1 estimate): 1.06 kgCO₂e/kWh⁵.
Exclusions	<ul style="list-style-type: none"> - Data of adequate quality is not currently available for many of the Scope 3 categories, therefore results for Scope 3 are not reported here. - The Greenhouse Gas Protocol requires carbon footprint calculations to include all direct emissions under Scope 1 and indirect emissions from purchased electricity under Scope 2 as compulsory reporting. Other activities under indirect emissions, Scope 3, are voluntarily reported.

Emission factors

Emission factors convert operational activity data (e.g. kilometres driven, kilowatt hours of purchased electricity) into a value indicating the greenhouse gas emissions generated by that activity, reported as carbon dioxide equivalent (CO₂e).

Electricity grid emission factor

The electricity grid emission factor is the total amount of greenhouse gases emitted per unit of electricity generated for and distributed by an electricity grid. South Africa has a carbon intensive grid due to the majority of power generation being coal-fired. In theory, the Eskom grid emission factor should decrease over time as efforts are made to reduce the environmental impact of producing electricity, and as renewable energy generation increases in South Africa through the national Renewable Energy Independent Power Producer Procurement Programme. However, the factor for this report has increased from 0.97 to 1.06 tCO₂e (year-on-year). The reason for the increase is not explained by Eskom and is counter intuitive. It is possible that transmission losses and decreasing coal-fired power plant efficiency, due to a lack of maintenance and investment, has led to this increase. A robust and transparent grid emission factor in South Africa remains a concern.

⁴ UK Government Conversion Factors for greenhouse gas (GHG) reporting. Emission factors obtained from <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018>

⁵ Eskom 2019 Integrated report and supplementary information. http://www.eskom.co.za/IR2019/Documents/Eskom_2019_integrated_report.pdf

Electricity emissions at UCT account for 95% of the total of Scope 1 and 2 emissions ($\pm 75\%$ when all three scopes are measured), therefore any change to the emission factor has a significant effect on overall results. For the reports from 2015 onwards, the footprint has used grid emission factors reported by Eskom in its annual Eskom Integrated Reports (IR) as per Table 1 below. The Eskom Integrated Reports are published in March each year and cover nine months of the preceding year, therefore the Eskom factor published in 2019 is used for the UCT 2018 report and so on. The table below shows the changes over time of the Eskom emission factors and the large increase for this report.

Table 1: Electricity grid emission factors

Eskom Integrated Report Year	Emission factor tonnes CO ₂ e/MWh	UCT Carbon Report year
2016	1.01	2015
2017	0.99	2016
2018	0.97	2017
2019	1.06	2018

B. RESULTS SUMMARY

The total emissions for Scope 1 and Scope 2 increased by 8.1% from 69 535 tCO₂e in 2017 to 75 187 tCO₂e (Table 3). The population increased by 0.9% in this period, while the floor area remained unchanged. Given that 95% of total emissions related to Scope 2 electricity purchased, these results are somewhat skewed by the 9% increase in the electricity grid emission factor produced by Eskom (Table 1, Figure 2). Therefore, it is more relevant to consider electricity consumed in kilowatt hours (kWh) than the related emissions. Electricity consumption decreased by -2.2% in 2018 compared to 2017, a positive result. Compared to the baseline year 2012, electricity consumption decreased by -1.7%, a very encouraging result given a concomitant increase in population of 16.6% (Figure 3).

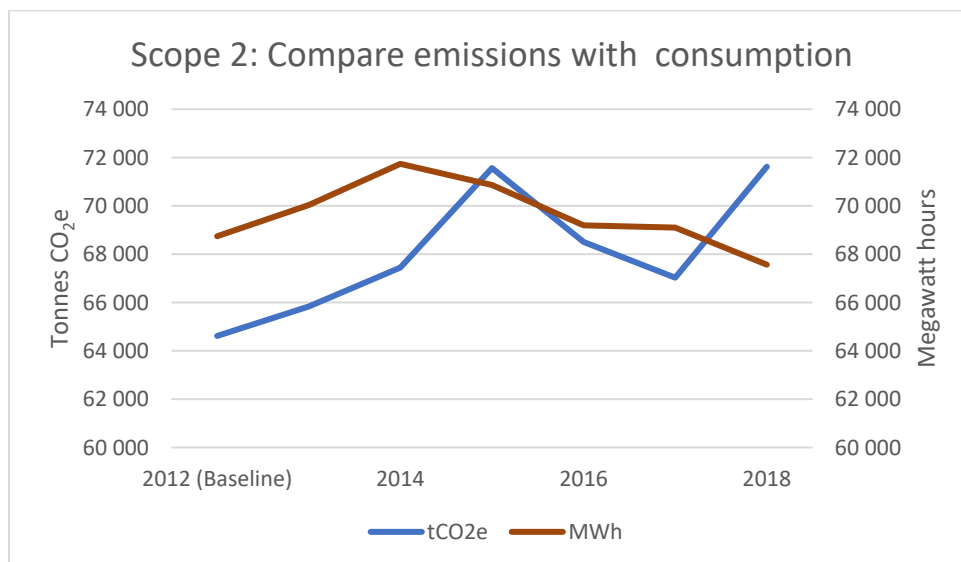


Figure 2: Comparing Scope 2 emissions with megawatt hours demonstrates the impact of the higher Eskom emission factor on the results.

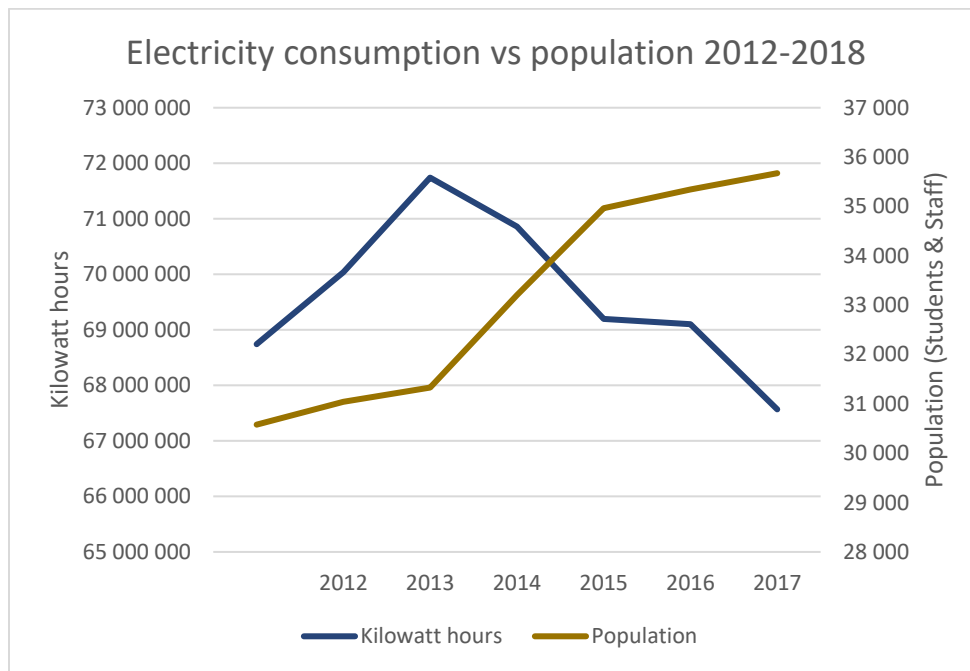


Figure 3: Electricity consumption (kWh) vs population 2012–2018.

The main contributors to the increase in emissions, reflected in Table 4, are electricity for Main Campus and Medical Campus (3 023 tCO₂e and 1 517 tCO₂e respectively); and refrigerant gases (1 205 tCO₂e).

Scope 1

Emissions from all Scope 1 activities increased significantly by 42.2% or 1 059 tCO₂e compared to 2017, from 2 507 tCO₂e to 3 565 tCO₂e. This increase is due to a major increase in refrigerants of 149% or 1 205 tCO₂e, one of the more concerning results in this report. The vehicle fleet emissions decreased by -2.5% or 18 tCO₂e; and Jammie Shuttle emissions decreased by -14.7% or 132 tCO₂e, a very positive result.

Scope 2

Scope 2 indirect emissions from the purchased electricity increased by 6.9% in 2018 due to the increase in the Eskom emission factor, with consumption in terms of kilowatt hours actually decreasing from 69 101 287 kWh to 67 567 353 kWh (-2.2%).

Table 2: Scope 2 emissions 2017 vs 2018

	2018 (tCO ₂ e)	Diff 2017 to 2018 (tCO ₂ e)	Change 2017–2018 (%)
Electricity: Main Campus	47 024	3 023	6.9
Electricity: Medical Campus	12 993	1 517	13.2
Electricity: Off-campus residences	9 585	-301	-3.0
Electricity: GSB	301	-26	-7.9
Electricity: Hiddingh	622	118	23.4
Electricity: ICTS on Main	1 096	262	31.4
TOTAL	71 621	4 593	10.8

Intensity metrics

Emissions per square metre increased by 8.1% to 0.112 tonnes CO₂e per square metre per annum, with the total building area unchanged, largely due to the increase in the electricity grid emission factor. The per capita emissions increased by 7.1% from 1.97 tCO₂e to 2.11 tCO₂e, also attributable to the increase in the electricity emission factor (Table 3).

The energy intensity per capita has improved consistently since 2012 (Figure 5), decreasing by -15.7% since 2012, and decreasing by -3% from 2017 to 2018, a positive result.

Table 3: Intensity metrics 2012–2018

INTENSITY METRICS (Scope 1 and 2 only)	2012	2013	2014	2015	2016	2017	2018	% change 2017–2018
Gross area m ²	649 404	672 858	705 653	706 125	706 125	*673 385	673 385	0.0
Tonnes CO ₂ e/m ² /annum	0.103	0.101	0.098	0.104	0.100	0.103	0.112	8.1
Population – Staff & Student FTE	30 579	31 041	31 329	33 204	34 965	35 343	35 673	0.9
CO ₂ e/person/annum	2.18	2.18	2.21	2.21	2.02	1.97	2.11	7.1
kWh/capita/annum	2 248	2 256	2 290	2 134	1 979	1 955	1 894	3.1

* Value for 2017 restated due to errors found by P&S in the floor area data; previously 708 267 m².

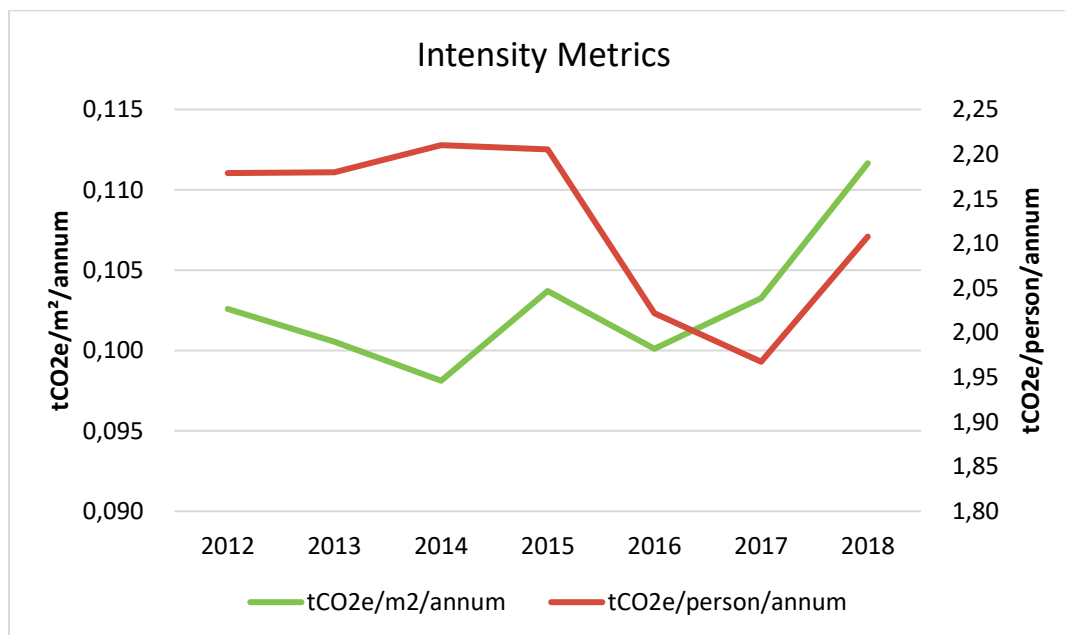


Figure 4: Intensity metrics for 2018.

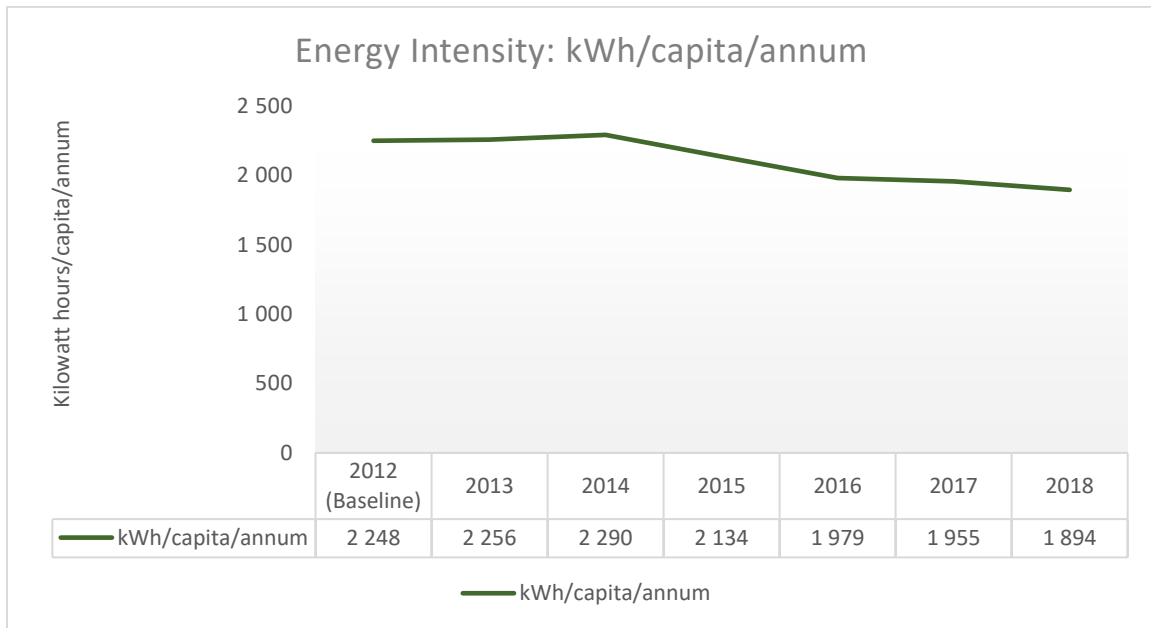


Figure 5: Energy intensity: kWh/capita/annum.

Intensity metrics are useful for benchmarking an organisation’s performance internally and against similar institutions. Benchmarking has been undertaken in some previous reports; however, due to the number of local variables (energy supply emissions factors, own energy production, climate zone, housing on campus or not) comparative benchmarking for universities can be problematic and has not been included in this report. The availability of appropriate methodologies should be revisited for future reports. For now, UCT should measure its performance against its own results year-on-year and against the baseline year, 2012.

Table 4: Comparative GHG emissions 2012–2018 (tonnes CO₂e)

CATEGORY	2012	2013	2014	2015	2016	2017	2018	Diff 2017 to 2018	Change 2017– 2018 %	Diff 2012– 2018 (tCO ₂ e)	Change 2012– 2018 %
Scope 1 Direct Emissions	2 005	1 823	1 792	1 658	2 188	2 507	3 565	1 059	42.2	1 560	77.8
Jammie Shuttle	1 076	1 068	1 006	861	790	902	769	-132	-14.7	-307	-28.5
UCT vehicle fleet	557	465	556	503	475	697	679	-18	-2.5	122	22.0
Liquefied petroleum gas (LPG)	372	289	230	160	191	102	105	3	3.1	-267	-71.8
Diesel for generators	NR	NR	NR	134	NR	NR	NR	NR	NR	NR	NR
Refrigerants ¹	NR	NR	NR	NR	733	807	2 012	1 205	149.4	NR	NR
Scope 2 Indirect Emissions purchased electricity	64 617	65 835	67 447	71 569	68 505	67 028	71 621	4 593	6.9	7004	10.8
Electricity: Main Campus	42 394	42 583	44 219	46 933	43 774	44 001	47 024	3 023	6.9	4 630	10.9
Electricity: Medical Campus	11 044	10 648	11 239	12 027	11 654	11 477	12 993	1 517	13.2	1 950	17.7
Electricity: Off-campus residences ²	9 702	10 729	10 149	10 850	10 633	9 885	9 585	-301	-3.0	-117	-1.2
Electricity: GSB	1 363	1 417	1 393	1 387	1 382	327	301	-26	-7.9	-1 061	-77.9
Electricity: Hiddingh ³	116	116	111	-	527	504	622	118	23.4	506	438.1
Electricity: ICTS on Main ⁴	-	342	335	372	534	834	1 096	262	31.4		
Scope 3 Other Direct Emissions		18 547	18 446	21 510	25 819	NR	NR				
Fuel and energy-related		409	341	581	890	NR	NR				
Business travel		385	124	262	228	NR	NR				
Business travel – airlines		2 021	2 628	3 996	7 255	NR	NR				
Employee commuting		8 566	8 217	8 465	9 071	NR	NR				
Purchased goods – food		6 485	6 549	7 128	7 022	NR	NR				
Purchased goods – paper		386	305	382	667	NR	NR				
Purchased goods – water		121	139	138	233	174	NR				
Waste		175	143	558	452	506	NR				
TOTAL Scope 1 & 2 emissions	66 623	67 658	69 239	73 227	70 693	69 535	75 187	5 652	8.1	8 563.9	12.9
TOTAL Scope 1, 2 & 3 emissions		86 205	87 685	94 736	96 513						

Notes:

1. The baseline year has been selected as 2012, as this was the first report that used the current methodology – the Greenhouse Gas Protocol – and with the same boundaries as the 2018 report, extending to all UCT campuses.
2. Scope 3 values for 2012 were reliant on student research, with an emphasis on the learning benefit. These values have been omitted from this table as they are less robust than those from subsequent years.

3. NR = Not Reported
4. Refrigerants became a new category in the 2016 report as data became available.
5. Floor area for Rochester Residence (accommodating over 300 students and staff) remains an estimate; to be updated by P&S.
6. Hiddingh electricity for 2015 was included in the Main Campus data.
7. The ICTS on Main facility was located on Upper Campus in 2012 and was later housed in a building off campus, with a digital metering system.
8. The figures are rounded either up or down number to the nearest whole number to avoid decimals in this table.

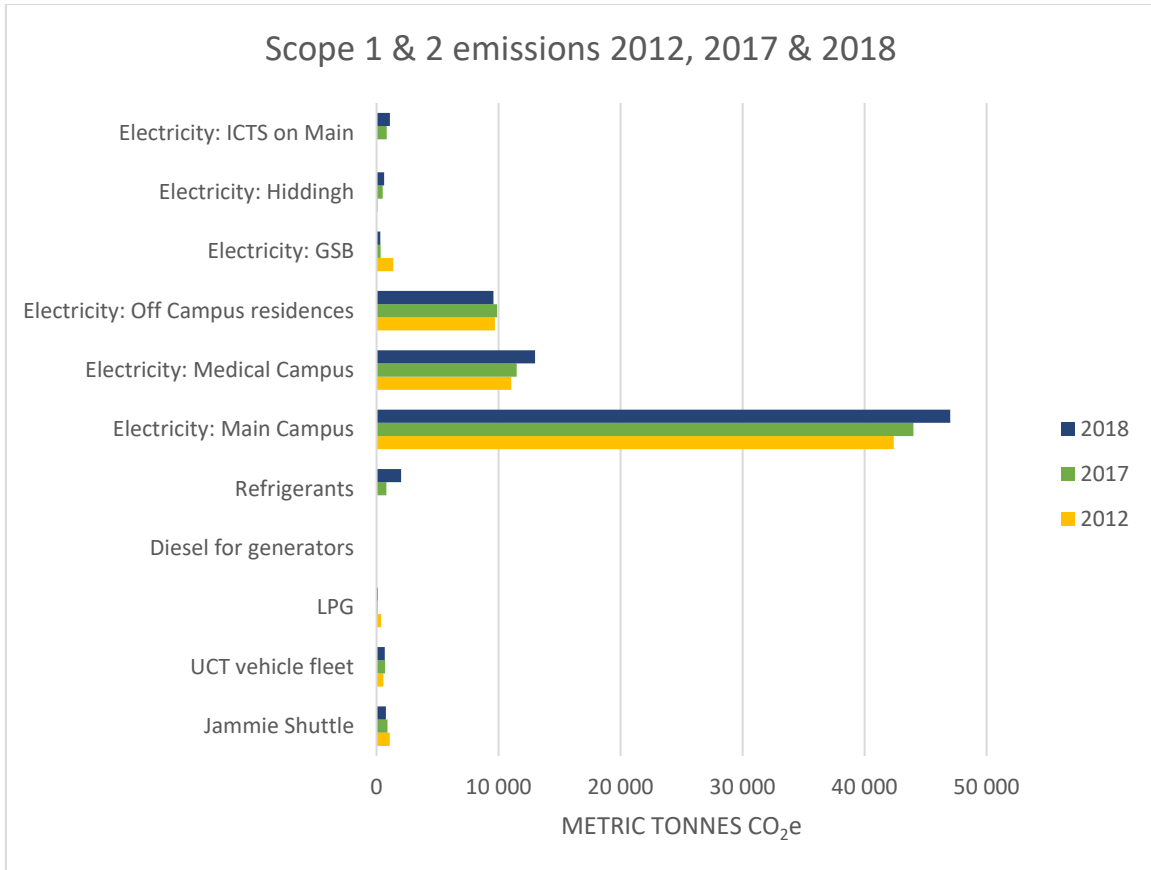


Figure 6: Scope 1 & 2 emissions 2012–2018.

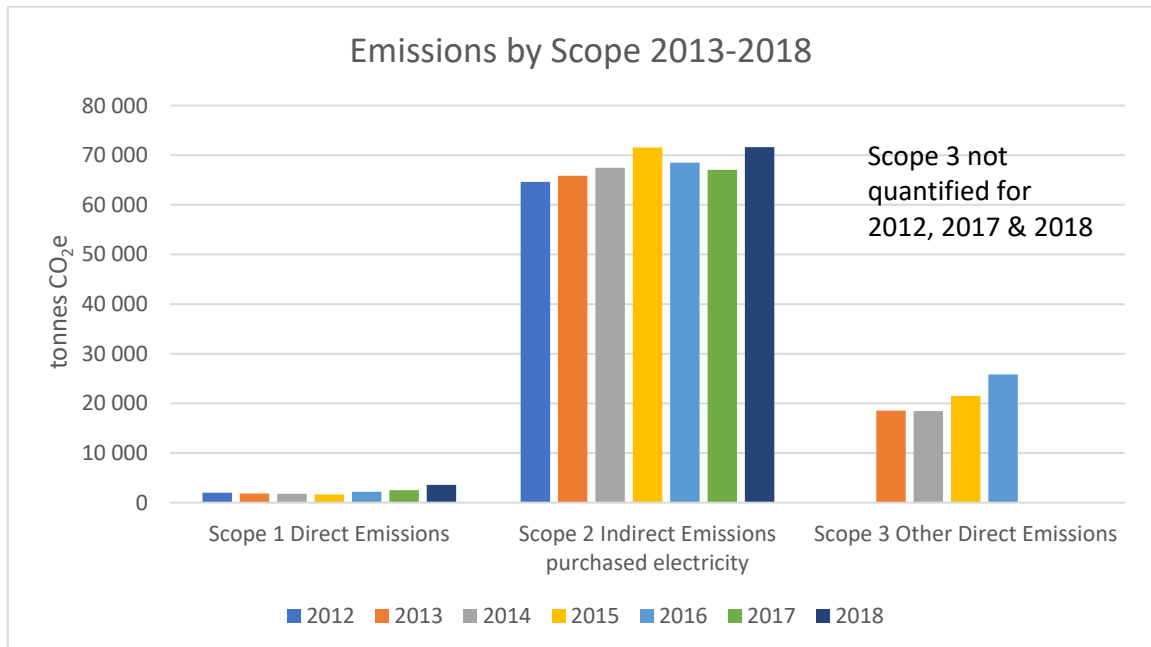


Figure 7: Emissions by scope 2012–2018.

C. EMISSIONS BY SCOPE

SCOPE 1 – DIRECT EMISSIONS

Table 5: Scope 1 Direct Emissions 2018

Description	Units	Consumption	Tonnes CO ₂ e
Total emissions from transport service (Jammie)			769
	Litres of diesel (100% mineral)	287 971	769
Total fugitive emissions from refrigerants			2 012
	Kg of R22	269	487
	Kg of R410A	152	318
	Kg of R134a	446	638
	Kg of 407C	4	7
	Kg of R507A	141	561
Total emissions from vehicle fleet			679
	Litres of petrol	164 717	299
	Litres of diesel	111 416	380
LPG			105
Medical	Kg of LPG	26 522	78
Main Campus	Kg of LPG	787	2
Residences	Kg of LPG	8 328	24
Hiddingh Campus	Kg of LPG	48	0
TOTAL SCOPE 1 DIRECT EMISSIONS			3 565

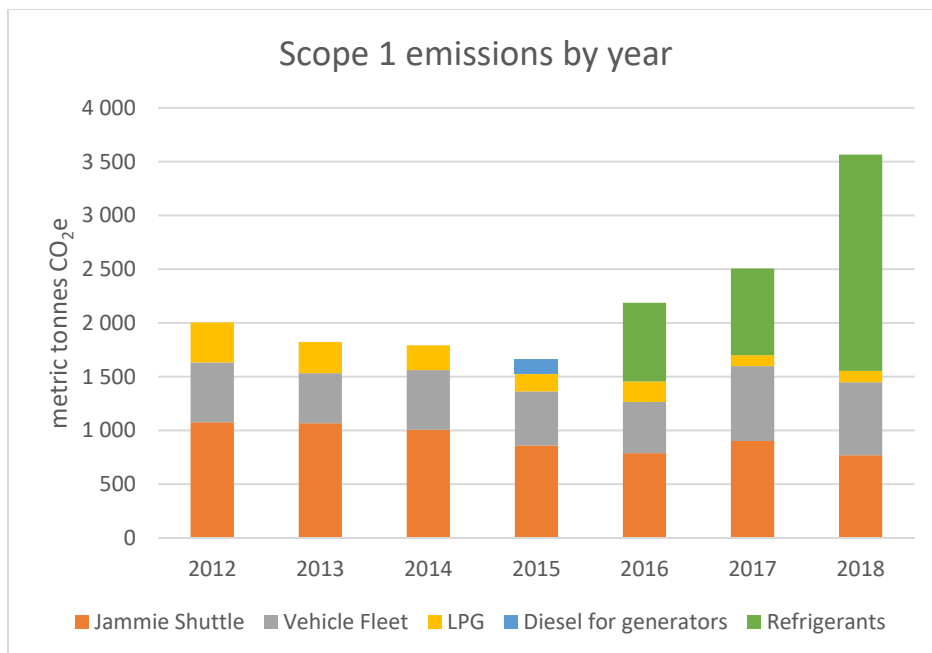


Figure 8: Scope 1 emissions 2012–2018.

Overall trends in Scope 1 emissions from 2012–2018, reflected in Figure 7, highlight the large increase in emissions from the use of refrigerant gases compared to 2017, discussed below. Jammie Shuttle emissions have declined over the years, while vehicle fleet emissions have fluctuated. A decline in the use of LPG is evident.

JAMMIE SHUTTLE

In 2017 UCT renewed the Jammie Shuttle bus fleet with higher specification buses with European emission standards Euro 3 to Euro 5. These buses are designed to produce lower emissions of carbon monoxide (CO), nitrous oxide (NOx) and particulate matter (PM). A fleet of 18 Scania buses began operating in January 2017, while nine Volare midi-buses arrived in March 2017. The buses are leased for a seven-year period⁶.

Data collection and quality

Data for the diesel fuel used by Jammie Shuttles was submitted by the Transport Office, with a monthly breakdown of litres used.

In terms of passenger numbers, no data is currently available. Automated tracking of shuttle passengers should be investigated to contribute to transport planning and to reporting on Scope 3 commuting emissions⁷.

⁶ Although the buses could be considered part of UCT's vehicle fleet, it is considered useful in terms of management and mitigation strategies to keep Jammie Shuttle data as a separate category.

⁷ Pers. Comm. Clive Lippert, Manager: UCT Transport Services

Results and findings

Jammie Shuttle emissions decreased by a significant -14.7% compared to 2018. The shuttle service is reported to have been interrupted for only one week in September 2018 due to drivers striking. Therefore, the decrease appears to be a positive result that could be attributed to increased efficiency of the new buses and shorter routes travelled. Figure 8 reflects lower emissions in 2015 and 2016, attributed to interruption of the service due to student protests. Lower emissions for 2016 may also be a result of the changes in infrastructure on Upper Campus – the new North and South bus stops came into operation at the beginning of 2016, so that the buses stopped traversing Madiba Circle, shortening the route. There was an absence of interruptions to the service in 2017, resulting in higher fuel use.

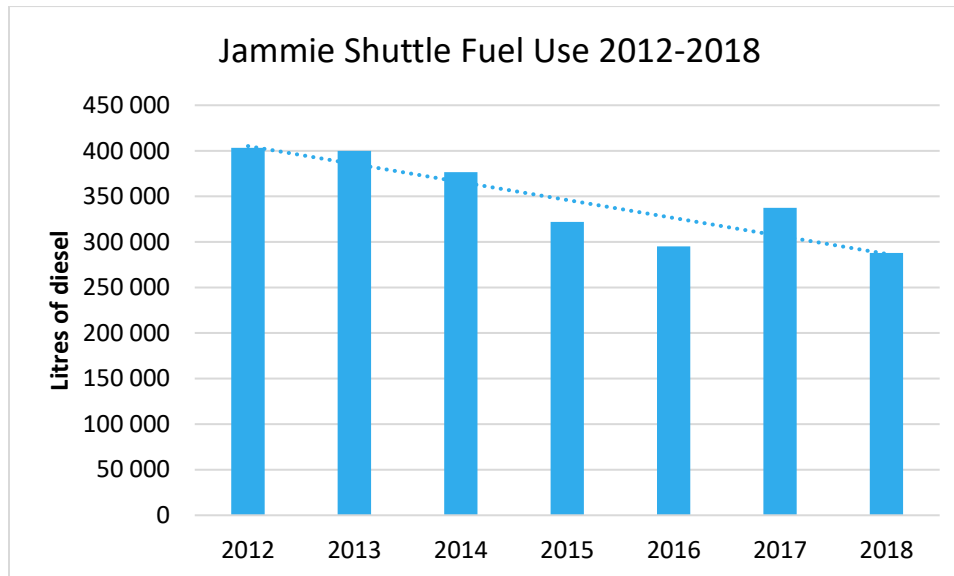


Figure 9: Jammie Shuttle fuel use 2012–2018.

REFRIGERANT GASES

Refrigerant gases are extremely potent greenhouse gases that have a negative impact on the environment by both destroying atmospheric ozone gas, critical to all forms of life, and contributing to global warming. The refrigerants in common use today have a much higher global warming potential (GWP) than carbon dioxide, which has a GWP of one. The refrigerants used at UCT have GWPs of between 1 430 and 3 985. As per the Montreal Protocol⁸ commitments, countries have banned the use of refrigerants with high ozone-depleting chlorofluorocarbons (CFCs), and consequently replaced them with hydrochlorofluorocarbons (HCFCs). Currently, developing countries are phasing out HCFCs, resulting in a rapid increase in the use of hydrofluorocarbons (HFCs) as a replacement⁹ (IFC, 2017). An alternative to HFCs, natural refrigerants (i.e. hydrocarbons) have very low global warming potentials of between 0 and 6.

⁸ Montreal Protocol: the international agreement on the overall scope and timescales for phase-out of ozone-depleting substances (ODS).

⁹ In South Africa, the Air Quality Act, 39 of 2004, published by the Department of Environmental Affairs, came into effect on May 8, 2014. These regulations aim to define the management and phasing out of ODSs in South Africa. These regulations prohibit the use of refrigerants containing hydrochlorofluorocarbons (HCFC-22) in the construction, assembly, or installation of any new refrigeration or air-conditioning systems or equipment from January 1, 2015, onwards.

The parties to the Montreal Protocol reached agreement in 2016 in Kigali, Rwanda to phase down HFCs¹⁰. The Kigali Amendment to the Montreal Protocol, adding HFCs to the list of substances to be phased down under the Montreal Protocol, was ratified by South Africa in August 2019, among 75 other countries. HFCs are commonly used alternatives to ozone-depleting substances (ODS) and while not ozone-depleting substances, HFCs are greenhouse gases which can have high or very high global warming potentials. The Kigali Amendment deals with the phase-down of the production and consumption of HFCs, starting in 2024 (UNEP, 2016).

Besides staying ahead of legislation, the benefits to UCT of improving refrigerant management practices can include cutting annual refrigerant costs, increasing the energy efficiency of existing systems, decreasing emissions of HCFCs and HFCs, as well as indirect emissions of carbon dioxide, because of reduced energy use¹¹.

Reporting accounts for gases leaked into the atmosphere from gas in air conditioning, heat pumps and refrigeration equipment. Table 6 below includes the 100-year time horizon global warming potentials (GWP) of refrigerants used at UCT.

Data collection and quality

Certain challenges were experienced with the data gathering for refrigerant gases: incomplete and inaccurate data sets; and delays due to locating the relevant UCT data holders. Data gathering for this activity is more complex due to the multiple data holders (different campus and residence managers) and multiple service providers for each precinct. It is recommended that submission of data be embedded in service-level agreements, ensuring data quality and reporting timeframes. Quarterly or monthly, rather than annual, submission of data to UCT managers may improve the collection process.

Records of the amount (kilograms), types of gas refills to equipment, and in most cases the building where the equipment servicing took place, were obtained from the service providers and are considered to be of reasonably high quality.¹² The refrigerant types used at UCT are shown in Figure 10 below. The methodology selected excludes gas quantities contained in newly installed equipment and only accounts for fugitive emissions from equipment (leaks).

No data has been collected on the gases used in fire suppression systems at UCT, and this should be reviewed in future.

Results and findings

Emissions from gas refills increased significantly by 149.4% compared to 2017, from 807 tCO₂e to 2 012 tCO₂e. The total weight of gases used increased by 170% from 375 kilograms in 2017 to 1 012.6 kilograms in 2018 (Figure 11). The number of service events increased by approximately 30% compared

¹⁰ From 1 January 2019, when the Kigali Amendment comes into force, HFCs and HFC blends will be both Kyoto Protocol and Montreal Protocol gases.

¹¹ When a system is low on refrigerant, the motor must work harder to provide the necessary heat exchange and cooling, thus requiring more energy than if the equipment is properly charged.

¹² Recovery and recycling of HCFCs and other ozone-depleting substances is mandatory in terms of the National Environmental Management: Air Quality Act, 2004 and the 2014 regulations regarding the phasing out and management of ozone-depleting substances.

to 2017, which is not fully understood. It is possible that the increase indicates more frequent leaks from ageing equipment. The 2018 data sets include the same service providers as 2017, and there does not appear to be more complete data in 2018. Efforts to understand this trend are needed.

In terms of gas types used, a shift away from the refrigerant R22 is evident, declining from 61% of the total weight in 2016 to 27% in 2018. This refrigerant is being phased out due to its high ozone depleting potential (ODP), with a total phase-out being implemented by 2030 in terms of the Montreal Protocol. The greatest proportion of gas in 2018 was R134a (44%), up from 23% in 2016 (Table 6; Figure 10).

Table 6: Changes in refrigerants 2017–2018

Type	Refrigerant Name	2017 (tCO ₂ e)	2018 (tCO ₂ e)	Difference (tCO ₂ e)	% change	% of total gases used in 2018	GWP 100-year ¹³ (kgCO ₂ e)	ODP
HCFC	R22	349	487	138	40	27	1 810	0.05
HFC	R410A	126	318	192	153	15	2 088	0
HFC	R134a	56	638	582	1 032	44	1 430	0
HFC	R407C	43	7	-36	-84	0	1 774	0
HFC	R507A	233	561	329	141	14	3 985	0
TOTAL		807	2012	1 205	149	100		

It is important to engage in the promotion of alternatives at the earliest stage to avoid escalating costs of hydrochlorofluorocarbon (HCFC) refrigerant types that are being phased out. Further, to reduce greenhouse gas emissions, a shift towards refrigerants with lower global warming potential (GWP) is required, aligning with best practice.

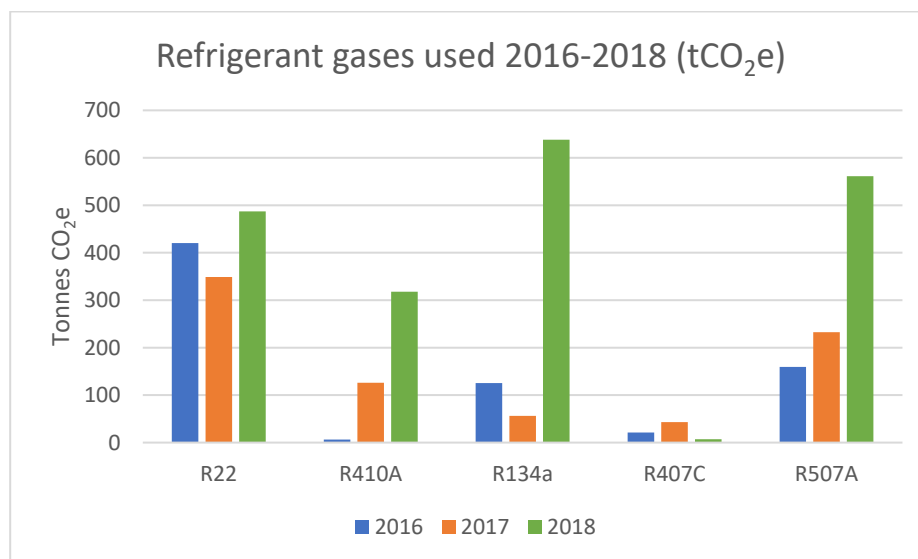


Figure 10: Refrigerant gases used 2016–2018.

¹³ The GWPs of the Kyoto Protocol and Montreal Protocol listed gases are based on the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) over a 100-year period.

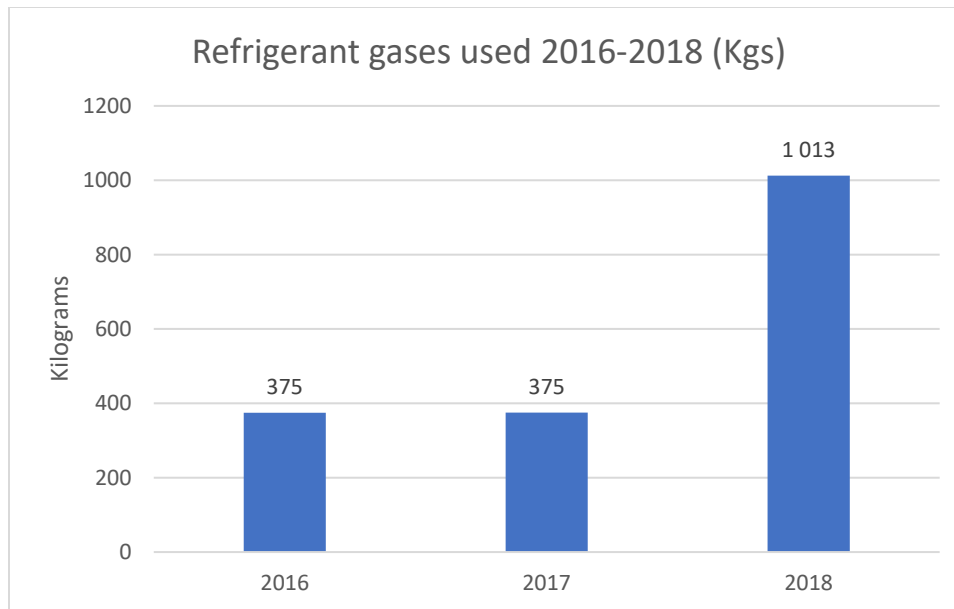


Figure 11: Quantity of refrigerant gases used 2016–2018 (Kgs).

VEHICLE FLEET

Data collection and quality

The primary data set was provided by the Procurement department for the third-party service providers Absa Vehicle Management (UCT-owned) and Bidvest (leased vehicles) for 2017 and 2018. A further data set was provided from the SAP system including fuel purchases made by UCT departments and staff members. Unfortunately, this dataset did not include two key metrics – litres of fuel and type of fuel (petrol or diesel), therefore the rand value was converted to litres of fuel using the AA rates for petrol and diesel for 2018. The proportion of petrol to diesel was determined by using the same split as the Absa and Bidvest figures (diesel 40% of total spend). The reliability and quality of the SAP data set is low¹⁴.

Results and findings

Overall emissions from the vehicle fleet fuel decreased by -2.5% compared to 2017 (Table 4); however, trends within subsets of this data were mixed. The Absa fuel purchases decreased significantly by -23%, while the Bidvest diesel figure decreased by -11% and petrol increased by 10%. By contrast, the amount of fuel purchased in the SAP data set (UCT departments and academics) increased significantly by 247% over 2017, which may be due to low data quality. If the large increase in the 2018 SAP data is due to a more complete data set than in 2017, the actual decrease in fuel purchases may be far greater than -2.5%. Bidvest vehicles were leased during 2016, which may account for the uptick visible in the graph to an extent (Figure 12).

¹⁴ Data entry into the UCT SAP system is inconsistent, being done by numerous departmental purchasers and individual staff, making this data source unreliable and of low quality.

Analysis of trends for this activity might be informed by comparing the size of the vehicle fleet year-on-year; however, the long-term data quality of the fleet list is considered unreliable. Efforts should be made to improve this data in future reporting. The data for 2017 and 2018 is more reliable and reflects that there was little change to the total number of vehicles between 2017 and 2018 (208 vs 214 UCT-owned vehicles).

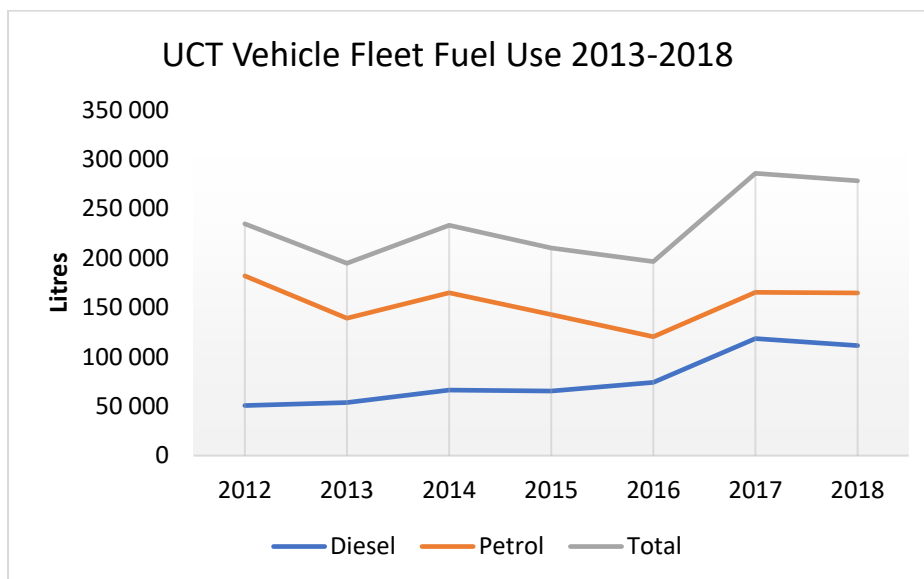


Figure 12: UCT vehicle fleet fuel use (includes Absa card data only for 2013–2016).

LIQUEFIED PETROLEUM GAS

Emissions from the use of liquefied petroleum gas (LPG) increased by 3% or 3 tCO₂e. The use of LPG has been declining consistently in recent years, due to the use of heat pumps for water heating instead of LPG-fuelled heaters (Figure 12). For the residences, a 24% increase in the purchase of LPG compared to 2017 is found. Of the total LPG purchased, around 23% was for the residences, 74% for the Faculty of Health Sciences, the remainder for Upper Campus (2%) and the Hiddingh Campus.

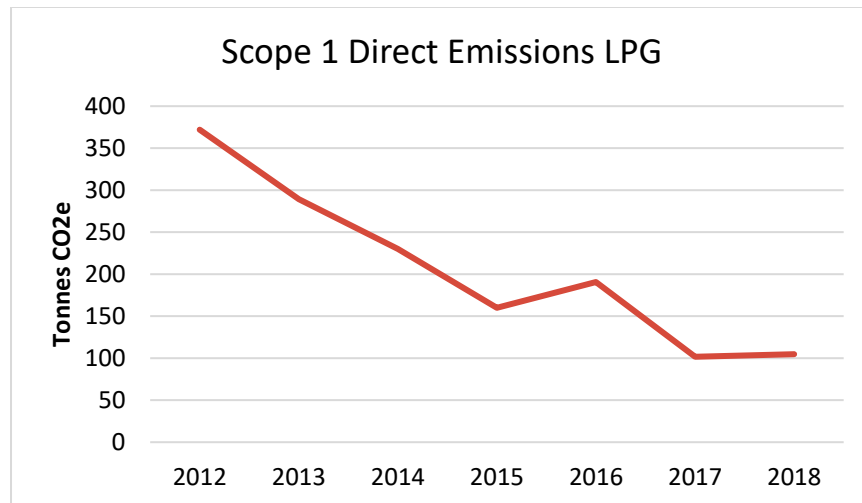


Figure 13: Emissions from LPG usage 2012–2018.

DIESEL FOR GENERATORS (STATIONARY COMBUSTION)

There were no nationwide planned power outages in 2018, so a figure in the category of diesel fuel for generators has not been included. With load shedding continuing during 2019 and expected to continue for some years, more efficient generator back-up solutions are being explored for the whole of UCT. Solar photovoltaic (PV) energy is unfortunately not a possible solution for back-up power (PV systems of large city customers typically must be shut down by law when there is load shedding). Batteries are also not a viable solution for back-up power for users the size of UCT¹⁵.

¹⁵ The charging current required means that the supply to UCT has to almost double after a load-shedding event to allow for massive battery system to recharge for the next load-shedding event later that day or the following day.

SCOPE 2 – INDIRECT EMISSIONS FROM PURCHASED ELECTRICITY

Data collection and quality

From 2014 onwards, UCT invested in an extensive system of digital electricity meters at building or transformer level across the Main and Medical campuses, with the first data set being available for the 2016 Carbon Footprint Report. External consultants were also appointed to monitor and report on electricity consumption. However, unreliable municipal billing data, captured manually within the P&S finance department, is still used for off-campus residences and some off-campus administrative properties.

The dataset provided for the Graduate School of Business (GSB) is for the entire Breakwater Lodge complex at the V&A Waterfront, including the hotel facilities not attributable to UCT. The allocation of electricity consumption to the GSB is determined from a metering system and is 14.5% of the total consumption for the complex.¹⁶

It is important to note that electricity emissions have been calculated using the updated factor published by Eskom (Eskom, 2019), which increased significantly by 9%. It is therefore more relevant to consider the results in terms of electricity consumed in kilowatt hours (kWh) than the related emissions (Tables 7 and 8).

Table 7: Electricity consumption in kilowatt hours 2012–2018

Location	2012 (Baseline)	2013	2014	2015	2016	2017	2018
Main Campus	45 099 590	45 300 860	47 041 102	46 468 176	44 216 343	45 361 862	44 362 046
Medical Campus	11 748 434	11 327 625	11 956 697	11 907 690	11 772 167	11 831 500	12 257 939
Off-campus residences	10 321 043	11 413 739	10 786 078	10 742 859	10 740 748	10 191 196	9 042 415
GSB¹⁶	1 449 791	1 507 070	1 481 849	1 373 429	1 396 321	337 287	284 413
Hiddingh	122 890	123 931	118 609	-	532 801	519 313	586 386
ICTS on Main	0	363 879	356 165	367 960	539 071	860 129	1 034 155
TOTAL	68 741 748	70 037 104	71 740 500	70 860 114	69 197 451	69 101 287	67 567 353

¹⁶ Until 2017, an allocation approach based on floor area was used to determine the GSB's share of electricity consumption. A new metering system was installed allowing a more accurate allocation, significantly reducing the amount attributed to the GSB from 46% to only 14.5%.

Table 8: Electricity consumption (kilowatt hours)

Location	2012	2017	2018	Diff '17 – '18	% change '17-'18	% change '12-'18
Main Campus	45 099 590	45 361 862	44 362 046	-999 816	-2.2	-1.6
Medical Campus	11 748 434	11 831 500	12 257 939	426 439	3.6	4.3
Off-campus residences	10 321 043	10 191 196	9 042 415	-1 148 781	-11.3	-12.4
GSB	1 449 791	337 287	284 413	-52 874	-15.7	-80.4
Hiddingh	122 890	519 313	586 386	67 073	12.9	377.2
ICTS on Main	*	860 129	1 034 155	174 026	20.2	*
TOTAL	68 743 760	69 101 287	67 567 353	-1 533 934	-2.2	-1.7

* ICTS was on Upper Campus in 2012, therefore consumption was included in that figure.

Scope 2 results and findings

- Overall Scope 2 emissions **increased** by 6.9% over 2017, from 67 028 to 71 621 tCO₂e, however actual consumption decreased by -2.2%, a positive result given the increased population over the years (Table 4).
- Main Campus** electricity consumption **decreased** by -2.2% compared to 2017 or -999 816 kWh. This is a very positive result as the consumption has fallen below the baseline year of 2012 despite increased population and floor area (45 099 590 kWh vs 44 362 046 kWh).
- Medical Campus** electricity consumption increased by 3.6% or **426 439** kWh over 2017. This is the most significant contributor to electricity consumption increases (Table 8). Reasons for this increase are reported to be the installation of additional heating, ventilation and air-conditioning (HVAC) systems.
- Off-campus residences** emissions **decreased** by -3% or 301 tCO₂e, with actual consumption decreasing by a significant -11.3%, or -1 148 781 kWh, following a decrease in the previous year. This is likely due to stringent water restrictions being in place, resulting in less hot water being used. This accounts for the largest decrease in UCT's emissions year-on-year.
- A positive result was found for the **GSB** in 2018, with a **decrease** in emissions of -7.9% and a decrease in consumption of a significant -15.7%. This is due to LED lighting retrofits.¹⁷
- Electricity consumption at the **Hiddingh Campus** increased by almost 13% in 2018, apparently due to an HVAC system being installed in the library and large new extraction fans to the workshop area.
- As in 2017, a large **increase** in consumption was found at the **ICTS on Main** facility (Information and Communication Technology Services) of 20% or 174 026 kWh. A further major increase in IT

¹⁷ Juanita Booth/Bernard Joubert, GSB Facilities Management.

infrastructure occurred in 2018, for the research arenas of radio astronomy and genomics with regional computer resources being installed.

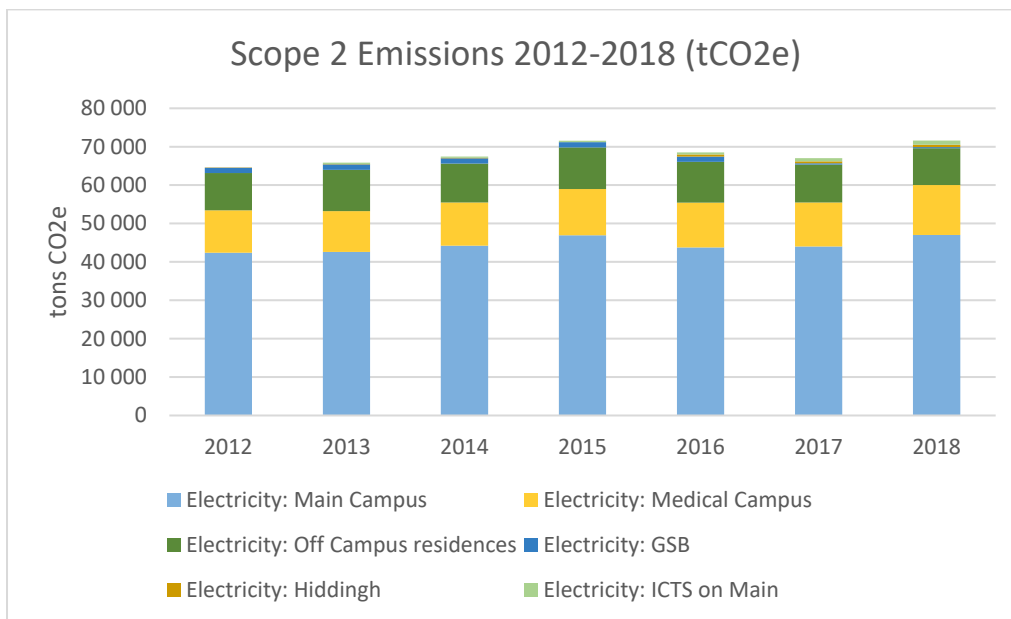


Figure 14: Scope 2 Emissions 2012–2018.

Figure 14 shows an increase in emissions from electricity for 2018 due to the increase in the Eskom emission factor from 0.97 to 1.06 tCO₂e.

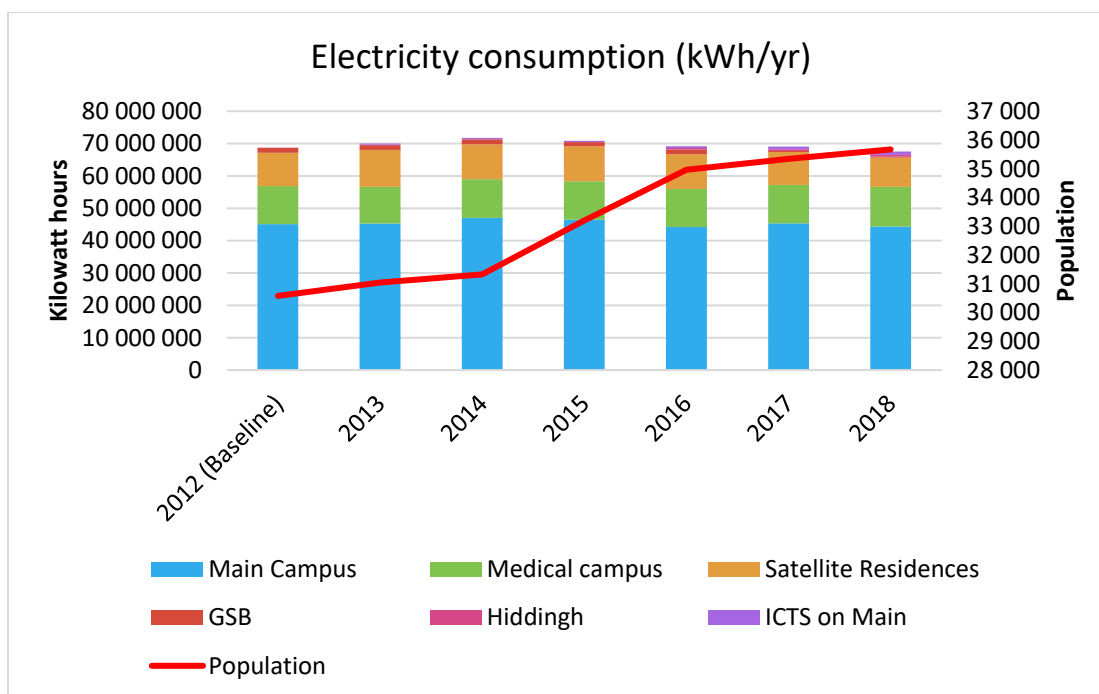


Figure 15: Electricity consumption (kWh) and population.

As shown in Figure 15, actual electricity consumption has been decreasing slightly from 2017 (by 2.2%) and 2012 (by 1.7%) against a significant increase in campus population, a positive trend.

SCOPE 3 – ALL OTHER INDIRECT EMISSIONS

Scope 3 is an optional reporting category dealing with all other indirect emissions that occur from sources not owned or controlled by the entity (GHG Protocol, 2013), such as business travel, commuting by students and staff, goods purchased, and solid waste generated. It is accepted in terms of the GHG Protocol methodology that data accuracy for Scope 3 activities may be lower and the objective of the inventory may be more about the relative magnitude of Scope 3 activities.

The categories of indirect emissions at UCT that have been selected for reporting are business travel by land and air; commuting by staff and students; purchased goods such as food, water and paper; and the production of solid waste. UCT started to report Scope 3 emissions in 2012 and these were included until the 2016 report, where Scope 3 emissions amounted to a significant 26% of total emissions. Due to ongoing difficulties in obtaining reliable data for Scope 3 activities, these emissions were omitted from the 2017 report and this report. There are presently concerted efforts under way within P&S to improve information systems by adopting an Integrated Workplace Management System (IWMS) that will manage real estate, people, processes and technologies in an integrated platform. This should ensure that a large proportion of the data contributing to the carbon footprint assessment is more readily accessible and likely to be more reliable. However, the IWMS project will take about three years. It is therefore expected that Scope 3 emissions, with improved data quality, will once again be included in UCT's reports within a few years.

As recommended in the previous report, it is important for UCT to facilitate a process to explore the relevance and merits of measuring and managing the indirect Scope 3 emissions in its value chain.

D. THE REPORTING PROCESS

The reporting process was led by the new Director of Environmental Sustainability who liaised with the data holders directly. However, similar challenges were experienced with delays in data gathering and data quality issues, in many cases due to staff changes at UCT.

Recommendations for improvement include briefing of the senior managers of data holders at the start of the process; and making the provision of accurate and timeous data part of the key performance indicators of the facilities managers. Further, including data reporting in the service-level agreements of the university's service providers should streamline the process. Automated systems for data collection are also being evaluated, including adjusting or adding additional reporting elements within SAP and other systems where data is held.

Appendix 1 contains a list of all data sets required for the carbon footprint, their source (department) and the required metric.

High-level recommendations to improve future reporting

General

- Coordination and alignment of reporting processes across the university (within P&S, Student Housing and Finance).
- Critical evaluation of Scope 3 categories to determine which of these are material to reporting.

Activity specific recommendations to improve reporting were made in the previous report and are repeated below where they remain relevant:

- Submission of refrigerant gas data to be embedded in service-level agreements, ensuring data quality and reporting timeframes.
- Records of fuel purchases for the vehicle fleet should include the type and quantity of fuel purchased, either diesel or petrol.
- Ongoing expansion of the installation of digital metering for electricity consumption.
- Establishing service-level agreements with all service providers in the value chain requiring reporting of the data for Scope 3 emissions.
- Data for hired cars and staff mileage reimbursements should include the kilometres travelled.
- For air travel data, the SAP system needs to be modified to include a column for “Departure City” and “Destination City” from which the kilometres travelled can be calculated. The preferred travel agencies should be required to provide annual reports that are aligned with UCT’s emissions reporting data requirements.
- Official annual commuting surveys need to be conducted to track commuting transport modes, provide evidence to support behaviour change to lower carbon modes of transport, and contribute to transport planning.

E. RECOMMENDATIONS FOR MITIGATION OF EMISSIONS

Since the previous report, there has been an absence of UCT staff dedicated to sustainability and carbon reporting, therefore most of the recommendations made in the 2017 report have not been taken up and remain relevant. With the new Director of Environmental Sustainability now in place at UCT, there will be a more programmatic approach towards reducing emissions year-on-year.

Having invested in ongoing carbon footprint reporting since 2012, UCT is now well placed to focus on mitigating emissions that would both reduce operational costs and provide a good return on investment. The most critical actions are to enhance energy efficiency (lighting, ventilation and air conditioning), installing renewable energy in the form of solar PV systems and targeting lower GWP refrigerants. Operational savings should be considered in capital allocation budgets to enhance the business case of these investments.

SCOPE 1: DIRECT EMISSIONS

Refrigerant gases

- Shift to the procurement of refrigerants with lower ozone depleting potential and global warming potential to achieve best practice and stay ahead of legislative requirements for phasing out certain gases.
- A long-term plan and standard operating procedure need to be developed for the responsible use of refrigerants that sees a steady decrease in the greenhouse gas emissions from refrigerants.

Vehicle fleet and Jammie Shuttle

- Future-proof the vehicle fleet, including buses, by changing to electric vehicles as soon as feasible.
- Investigate the feasibility of installing solar-powered charging stations for electric vehicles (UCT vehicle fleet, staff and student vehicles).
- For leased vehicles, use procurement process on lease renewal to require low emissions/ electric vehicles.
- Work towards improved data and analytics of patterns of use and mileage for the Jammie Shuttle service.

SCOPE 2: PURCHASED ELECTRICITY

Electricity consumption

- Review investments to date in energy efficient equipment (air-conditioning chillers, elevators, lighting and lighting sensors) and set new targets and priorities.
- Invest in a programme of electricity efficiency measures to save operational costs and emissions, including shading, insulation, natural light and other passive design solutions.
- Conduct feasibility studies into the economic viability of renewable energy generation on site and to access funding. This mitigation measure has multiple benefits – reducing emissions, contributing to energy security and having significant educational and reputational value. Solar PV systems are currently being planned for implementation to reduce overall energy consumption and carbon emissions by about 20% over the next five to 10 years.
- Invest in an effective communication campaign to the UCT community about electricity consumption trends via digital dashboards and other media.

F. CONCLUSION

While emissions increased in 2018 compared to 2017, this was largely due to the increase in the Eskom emission factor. A positive trend has emerged in terms of electricity consumption (accounting for 95% of the total Scope 1 and 2 emissions) which has declined gradually since 2014 and has continued to do so, albeit slightly. By contrast, Scope 1 direct emissions have increased sharply since reporting began (2016) and the substantial year-on-year increase for 2018 is a concern. Data gathering systems for refrigerants, as well as the investigation of alternative refrigerants with lower global warming potential, requires attention and prioritisation.

UCT has done well to maintain reporting on its carbon emissions for the past seven years; however, there has been little focus on actively reducing emissions.

A new era has begun for sustainability at UCT, with the establishment of the new post of Director: Environmental Sustainability. There is an expectation of stronger leadership and enhanced governance around campus sustainability, including carbon emissions monitoring and reduction strategies. Along with the key initiative of drafting an environmental sustainability strategy, which will involve setting long-term goals, and engaging the UCT students and staff to support environmental sustainability, UCT is urged to play a leadership role in terms of setting and achieving ambitious greenhouse gas and energy targets.

Globally, the language of climate change is shifting to “climate emergency, crisis or breakdown”. There is growing recognition that the pace of climate action must be accelerated. At the UN Climate Action Summit of 2019, the phrase “Increased Ambition, Accelerated Action” came to the fore.

Key priorities for UCT are:

1. Improvement of emissions data systems, data gathering processes and data analysis, including a more centralised approach to data collection.
2. Developing and prioritising emissions reduction actions based on the results.
3. Setting annual targets for emission reductions that support the strategy's long-term goal of Net Zero emissions by 2050.
4. Facilitating a process to explore and review the relevance and merits of measuring and managing the indirect Scope 3 emissions in its value chain.

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Useful websites:

UK Government Conversion Factors for greenhouse gas (GHG) reporting. Emission factors obtained from:
<https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018>

Greenhouse Gas Protocol: <http://www.ghgprotocol.org/>

International Sustainable Campus Network (ISCN): <http://www.international-sustainable-campus-network.org/>

Refrigerants: https://en.wikipedia.org/wiki/List_of_refrigerants

UN Climate Action Summit 2019: https://www.un.org/en/climatechange/assets/pdf/CAS_main_release.pdf

The Carbon Trust: <https://www.carbontrust.com/resources/guides/carbon-footprinting-and-reporting/carbon-footprinting/>

APPENDIX 1: LIST OF DATA REQUIRED, SOURCES AND METRICS

CATEGORY/SECTOR	DESIGNATION	METRIC
Electricity: GSB	GSB Finance Dept	Kilowatt hours
Water: GSB	GSB Finance Dept	Kilolitres
E-Waste (ICTS)	ICTS	Kilograms
Video Conferencing	ICTS	Hours
Paper Products – print paper ICTS	ICTS	Sheets
Commuting	n/a	Kilometres travelled per mode
Paper Products (Campus copy centres)	Nashua	Sheets
Transport: Jammie Shuttle	P&S Transport Manager	Litres fuel/passengers
Water: Main Campus; Medical	P&S Finance	Kilolitres
Water: Hiddingh Campus	P&S Finance	Kilolitres
Solid Waste	P&S: Custodial and Estates	Tons Wet/Dry
Electricity: Main & Medical campuses	P&S: Maintenance & Operation	Kilowatt hours
LPG	P&S: Vendor Management	Kilograms
Hazardous Waste: Medical/Chemical	P&S: Environmental Risk Officer	Litres/kilograms
E-Waste	P&S: Environmental Risk Officer	Kilograms
Printer cartridges (Green Office)	P&S: Environmental Risk Officer	Kilograms
Electricity: Hiddingh Campus	P&S: Finance	kWh
Paper Products – custodial	P&S: Finance	Rolls
Building List & Areas	P&S: Physical Planning Unit	Metres squared
Transport: Hired cars	Procurement	Kilometres
Transport: UCT Vehicle Fleet	Procurement	Litres fuel; diesel/petrol
Transport: Staff reimbursements	Procurement	Kilometres
Air travel	Procurement	Kilometres
Population data	Registrar's office	Students & staff (FTE)
Electricity: Off-campus Residences	Student Housing	Kilowatt hours
Water: Off-campus Residences	Student Housing	Kilolitres
Food supply: Residences	Student Housing	Number of meals served
Food supply: Vendors	No information source	Number of meals served