UNIVERSITY OF CAPE TOWN
CARBON FOOTPRINT REPORT 2012

Analysis carried out by:
ENERGY RESEARCH CENTRE, UCT

Data gathering and calculations carried out by students of
INFORMATION SYSTEMS (INF3011F) COMMERCE FACULTY

This Report has been compiled by Sandra Rippon, independent Sustainability Consultant to UCT Properties and Services, and reviewed by the ERC.

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1 INTRODUCTION

The University of Cape Town (UCT) has made International commitments to a sustainable campus and adopted internal policies, which give rise to the need to measure, monitor and mitigate the carbon footprint of the institution (Refer Box 1). Carbon footprinting is considered to be a critical step in achieving sustainability goals at UCT, and the practice has been widely adopted by universities internationally. A first, baseline report was compiled in 2009 by the Energy Research Centre (ERC), UCT and this report describes the second UCT carbon footprint study, undertaken by students of the Information Systems Department and reviewed by the ERC. The reporting period for this study is the calendar year of 2012.

Box 1: UCT's COMMITMENTS TO SUSTAINABILITY

1990	International ***Talloires Declaration*** signed by VC Saunders
2001	Recommitment to the implementation of Talloires by VC Ndebele
2008	***Green Campus Policy Framework*** adopted by UCT Council and Senate
2009	***Green Campus Action Plan*** developed by Properties and Services
2012	ISCN-GULF ***Sustainable Campus Charter*** signed by VC Price
2012	First Report submitted in terms of the ISCN-GULF Sustainable Campus Charter

Reduction of carbon emissions is identified as a key strategy by UCT's *Green Campus Policy Framework*, formally adopted by the UCT Council and Senate in 2008. The Framework highlights the need for a Green Campus Plan to have '*as its main strategy the reduction of the university's carbon footprint through targeted objectives for energy savings, reducing carbon emissions, recycling and water conservation*' (Hall, 2008). The Framework also calls for the setting of targets and milestones, which has not yet occurred:

> "*Following the adoption of the policy framework, specific milestones and delivery targets should be adopted for the areas identified and by the appropriate agencies within the university*".

In terms of international commitments, the most recent and arguably the most significant, is that made in terms of the *ISCN-GULF Sustainable Campus Charter*. UCT is a participant in the Global University Leadership Forum (GULF), a small group of 25 chief executives of leading universities that contributes to shaping the agenda of the World Economic Forum. UCT is at present the only African university invited to join this group. The GULF community has helped to advance programmes such as the International Sustainable Campus Network (ISCN), which provides a global forum to support universities in the exchange of information and best practices for achieving sustainable campus operations, as well as integrating sustainability in research and teaching. The *ISCN-GULF Sustainable Campus Charter* was developed in 2009 and officially signed by the Vice-Chancellor Dr Max Price in 2012. Signing the Charter commits an institution to set their own, concrete targets against shared Charter principles, and reporting transparently on progress against those targets. UCT submitted its first report in terms of the Charter in 2012, which includes the baseline carbon footprint reported in 2009 (UCT, 2012).

The Charter comprises three principles, and incorporates the practice of carbon footprinting in Principle 2:

- **Principle 1**: Sustainability Performance of Buildings on Campus
- **Principle 2**: Campus-wide Master Planning and Target Setting e.g. Carbon Footprint

- **Principle 3**: Integration of Facilities, Research, and Education e.g. sustainability in the curriculum and research.

The incorporation of the carbon footprinting study into the Information Systems INF3011F curriculum, addresses Principle 3.

1.1 What is a Carbon Footprint?

A carbon footprint can broadly 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 CO_2-eq (ERC, 2010).

There are a total of 18 greenhouse gases with different global warming potentials, but under the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto protocol, only the following set of gasses is considered for the purposes of carbon accounting, with others being regulated elsewhere (ERC,2010):

- Carbon dioxide, CO_2
- Methane, CH_4
- Nitrous Oxide, N_2O
- Hydrofluorocarbons, HFCs
- Perfluorocarbons, PFCs
- Sulphur dioxide, SF6.

1.2 Background to Carbon Footprinting at UCT

In 2009, the Energy Research Centre at UCT completed the first carbon footprint report for UCT using data for the year 2007, the task having taken two years by ERC Interns with funding from UNITAR Climate Change Capacity Development. Efforts to update the footprint since then have been hampered by a lack of capacity and funding. With the aim of simplifying and standardising the process, an evaluation of available Carbon Footprinting software was undertaken by the author during 2012 with input from the ERC and Information Systems Department. While a preferred option was selected by Properties and Services (P&S), the funding of the annual software license proved to be an obstacle. Therefore it was decided to involve the students of the 3rd year Information Systems course to undertake the carbon footprinting process for their semester group projects, without specialised software. While it is acknowledged that the results may not be as reliable without specialised software and without having introduced a standardised reporting protocol internally, it was considered preferable to have some indication of the current status of Greenhouse Gas emissions at UCT.

The UCT Carbon Footprint report by the ERC (2010) highlighted the lack of visibility and accessibility of data required to calculate the footprint throughout the organisation. When the footprinting process commenced in 2013, it was acknowledged that the challenges identified in the 2009 report remained unchanged. This difficulty in identifying data holders with such a large and dispersed institution, the lack of standardized data capturing practices and a central database was the impetus behind the ongoing initiative to establish a formalised data capture system, making data available to a range of stakeholders wanting to analyse this data, including the administration, the students and the public.

This report presents the results of the university's second carbon footprint analysis, and compares the university's carbon footprint both with the baseline study in 2009, and the footprint of other academic institutions, both locally and internationally.

2 OVERALL METHODOLOGY

The methodology used for this carbon footprint study is the *GHG Protocol*, which is suitable for companies, organisations and universities. This methodology differs from that used in the 2009 carbon footprint study, which was a methodological framework developed by the ERC specifically for UCT, comprising a different grouping of components of the carbon footprint to that of the GHG Protocol. Since this is the most widely used international accounting tool, alignment with the GHG Protocol, was considered appropriate for this study. This study included most of the same components as the 2009 study for the purpose of comparison, even though some components are not significant and contribute less than 0.5% to the overall emissions. In future carbon footprinting exercises, the inclusion of these components of minor significance should be reviewed. One major difference between the two reports is the inclusion of food supply emissions in this study, which was identified as a gap in the previous study.

The components of the footprint were divided among 5 groups of Information Systems students and each group produced a separate report for that component (Refer to list of project reports in the References section below). This report draws together their findings to determine the total carbon footprint for all campuses of the university. While the key focus of the student projects was the calculation of UCT's carbon footprint, the data collection process was also considered important and students were asked to provide recommendations to improve the process.

Data was gathered from a range of internal sources, which can be found in Appendix 1. Some data was gathered by the UCT Sustainability Coordinator, Sandra Rippon, and passed on to the Information Systems Course Coordinator, while in some cases the students approached the data holders directly. Some interviews with data holders were conducted by the students.

As anticipated, obtaining data timeously and in a useable format was a challenging part of the exercise. The data exists in a range of formats, including Excel spreadsheets, screen 'snapshots' from energy management software, and text in emails. In addition, the content and format of the Excel spreadsheets was varied, in some cases containing summary data for the year for the entity, while in others for example, the satellite Residences, data had to be aggregated by the students, requiring extensive processing in order to generate the required graphs.

Emission Factors

In general, unless stated otherwise, this study calculated emissions using the most up-to-date 2012 emissions factors from the UK Department for Environment, Food and Rural Affairs (Defra). The factors used in the 2009 report were typically from the International Panel for Climate Change (IPCC) for 2006 (Tier 1). The Eskom factor of 0.94 tons CO_2e/MWh was used for all electricity related emissions.

Entity Relationship Diagrams

Students were required to produce a diagram entitled an Entity Relationship Diagram (ERD) representing the optimal solution for data collection for reporting on carbon emissions at UCT. The ERD is in effect a conceptual diagram for the design and implementation of a centralized database. Its primary use is to ensure that the interactions and data flows can be mapped and normalized in order to ensure a well-structured central database. These diagrams have not been included in this report, but can be found in the individual student reports. With additional development, the diagrams could contribute to future efforts to improve the annual process of updating the footprint and, ultimately, the development of a software system for simpler, more effective, management of UCT's annual footprinting process.

3 CARBON FOOTPRINT RESULTS

The total emissions recorded for 2012 are 82,704 tons CO_2-eq/yr with the inclusion of food supply. Compared to the 2007 result of 84,925 tons CO_2-eq/yr without food supply, the result is 76,704 tons CO_2-eq/yr, a reduction of 9.7%. Table 1 below tabulates the results according to the GHG Protocol, while Table 2 compares the result with the previous study and is tabulated in the same groupings as the 2009 report. Food supply is included for the first time, reflected in Table 1, but not included in Table 2, for the purposes of comparison with the baseline footprint.

Two key factors should be considered when comparing these 2007 and 2012 results:

1. The population, including student and staff (FTE) of the university increased from 26,062 to 30,579, an increase of 17.3%
2. The floor area has been increased by new developments such as the Middle Campus Economics (9254m²) and Student Administration (Masingene) (3405m²) buildings and the Obz Square Residence (29,066m²). The Building area used in the 2007 study was, according to spreadsheets provided by the ERC, only 380,998m²and in 2012 the figure was 649,404m². The reason for this large difference is not clear; however the increase in floor area may be due to a more complete Schedule of Building Areas compiled by P&S being made available in for this study.

Table 1: Carbon Footprint for 2012 according to GHG Protocol

CATEGORY	SOURCE	EMISSIONS tons CO2-eq/yr		% of Total
Scope 1: Direct emissions		**1 076**		**1.3**
	UCT vehicle Fleet		745	0.9
	LPG		331	0.4
Scope 2: Indirect emissions from purchased electricity		**59 803**		**72.3**
	Electricity: Main Campus		37 366	45.2
	Electricity: Medical campus		11 044	13.4
	Electricity: GSB		1 363	1.6
	Electricity: Satellite Residences		9 914	12.0
	Electricity: Hiddingh		116	0.1
Scope 3: Other indirect emissions		**21 825**		**26.4**
	Staff and Student commuting		11 676	14.1
	Food (Residences and food vendors)		6 000	7.3
	Official flights		3 592	4.3
	Paper products		211	0.3
	Water supply		182	0.2
	Non-recycled waste		110	0.1
	LPG		41	0.1
	Recycled Waste		12	0.0
	TOTAL		**82 704**	

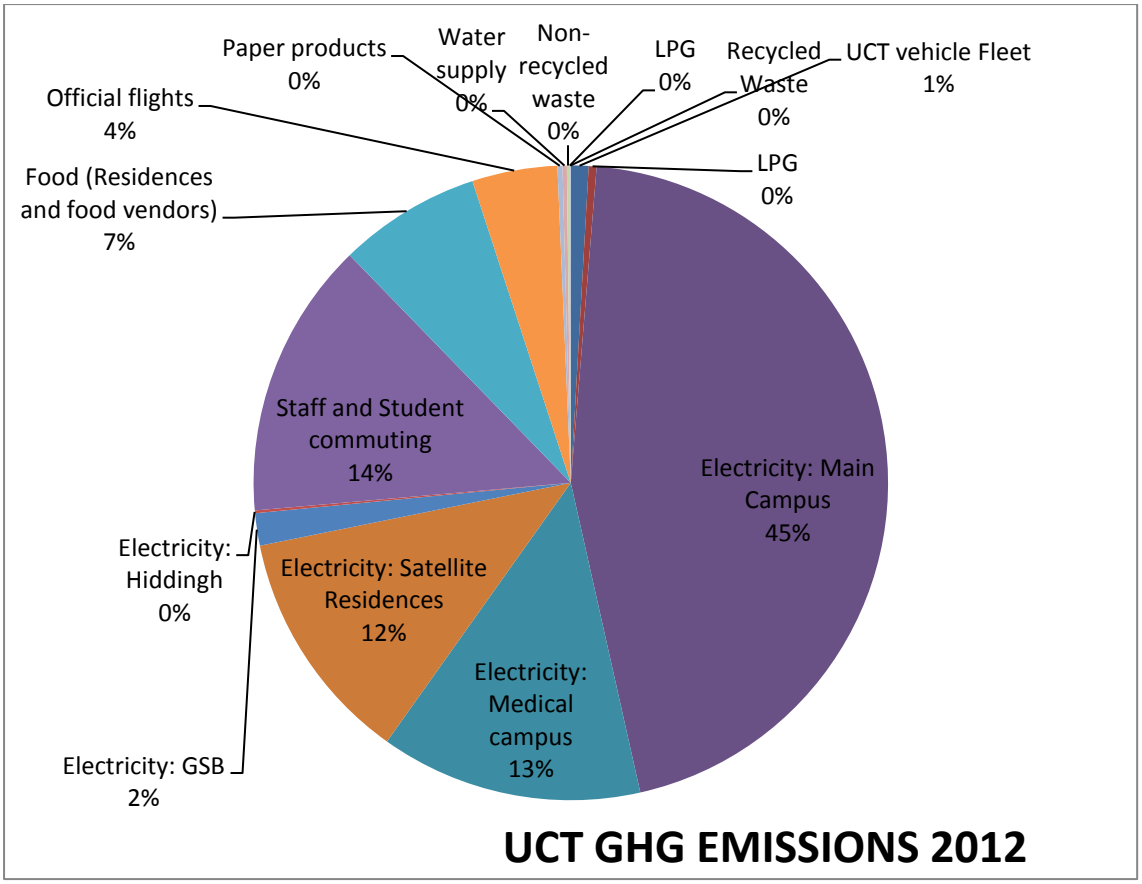

Figure 1: UCT GHG Emissions 2012

Table 2: Comparison of 2007 and 2012 Carbon Footprints

		2007	2012		
CATEGORY	**EMISSIONS SOURCE**	**EMISSIONS tons CO2-eq/yr**	**EMISSIONS tons CO2-eq/yr**	**% of Total**	**% Change**
Energy	Electricity: Main Campus	48 062	37 366	48.7	-22.3
	Electricity: Medical campus	11 811	11 044	14.4	-6.5
	Electricity: GSB	1 518	1 363	1.8	-10.2
	Electricity: Satellite Residences	6 937	9 914	12.9	42.9
	Electricity: Hiddingh	0	116	0.2	
	LPG	755	373	0.5	50.6
Transport	Staff and Student commuting	11 837	11 676	15.2	-1.4
	UCT vehicle Fleet	425	745	1.0	75.3
	Official flights	1 790	3 592	4.7	100.6
Goods & Services	Paper products	279	211	0.3	-24.2
	Water supply	0	182	0.2	
	Wastewater	113	0		
	Non-recycled waste	595	110	0.1	-81.6
	Recycled Waste	0	12	0.0	
	TOTAL	84 925	**76 704**		**-9.7**

3.1 Scope 1: Direct Emissions from Owned/Controlled Operations

There are two components to direct emissions at UCT – the UCT-owned vehicle fleet and the use of LPG gas for research in laboratories. All Scope 1 emissions account for only 1.3% of the total carbon footprint, with the vehicle fleet comprising 0.99% of this amount.

Vehicle fleet data
UCT's vehicle fleet consists of vehicles owned by the university. Fuel for these vehicles is either processed through the Bankfin fuel system or a UCT staff member buys fuel at their own expense and is then reimbursed by the university. The data for the UCT vehicle fleet was provided by Procurement & Payment Services, including Bankfin data, and fuel reimbursement to staff members extracted from the SAP software system. The results show a significant increase of 75.3% compared to 2009. The reason for this is not clear and requires further research and analysis.

Liquid Petroleum Gas (LPG)
LPG is used at UCT for research purposes, such as fuelling laboratory burners and heaters and for cooking in residence kitchens. Quantities of LPG were supplied by Procurement & Payment Services. For the period a total of 104,590kg was ordered for the bulk LPG tanks located at the Medical School and Upper Campus, and 5,760kg for the satellite residences. Scope 1 LPG emissions contribute 0.4% of the total carbon footprint. Scope 3 emissions for LPG are the indirect emissions that need to be reported when using LPG in Scope 1 according to Defra. The amount of LPG emissions has reduced by 50.6% from 2007 to 2013. Reasons for this are not clear; however poor data capture is suspected.

3.2 Scope 2: Indirect emissions from the use of purchased electricity

Electricity data for Main Campus (Upper, Middle and Lower) and for the Medical campus were provided in the form of screen snapshots from the internet based electricity metering system managed by Properties and Services. The data for all other areas was provided in Excel spreadsheets based on the billing information. The Graduate School of Business (GSB) Accounts department also captured the kWhs in their spreadsheet.

Electricity emissions account for 72.3% of the UCT Carbon Footprint, with Main campus contributing 37,366 tons CO_2-eq/yr, which is 45.2% of the total emissions; Medical campus 13.4%, satellite Residences (off-campus) 12%; the Graduate School of Business 1.6% and Hiddingh Arts campus 0.14%. Electricity consumption contributed a total of 68 300 tons to the university's carbon footprint in 2007, and 59,803 tons in 2012, a 12% reduction. The total tons CO_2-eq has reduced significantly compared to the first report in 2009. This change is due in part to retrofitting with energy efficiency new technologies; and although a change in emission factors contributes approximately 11% of the apparent reduction, the population has increased by 17.3% and the floor area has increased; therefore the result is positive. The greatest reduction in electricity occurred for Main Campus, reduced by 22.3%, GSB by 10.2% and Medical campus, reduced by 6.5%.

André Theys, Engineering Manager of UCT's Properties and Services department reported the following about the retrofitting of new technologies that has contributed to the reduced electricity consumption:

- Ongoing electrical lighting retrofitting to replace or relamp with more modern and efficient lighting and replacing old magnetic lighting ballasts with electronic ballasts.
- All older T12 installations have been converted to T8 electronic ballast combinations.

- All newer decorative lighting in new projects are specified as T5 and all downlighters are specified as compact fluorescents; no dichroic halogen lamps are used;
- All electric (and gas) hot water cylinders have been or are being replaced with industrial/commercial grade heat pumps.
- A substantial number of chiller plants have been replaced, all with much higher efficiency than that of the original chillers, some in excess of 40 years old. This is ongoing as equipment reaches end-of-life.
- Four new chillers have been installed that produce hot water while cooling. These have given significant energy savings at the MCB, Zoology and Barnard Fuller buildings.
- The regular service and planned maintenance of HVAC plants has been improved since 2007, to optimise energy use.
- A cost drivers report was prepared by P&S in September 2012 – this confirmed a decrease in average energy usage rate from 336 VA/GSM in 2005 to 296 VA/GSM in 2011, while increasing GSM (real estate) by 10.4% for the same period.

A further factor contributing to lower recorded emissions is the change in the emission factor used in the 2009 Report. This was 1.054kg CO_2/kWh, while in this calculation the more up-to-date factor from Eskom of 0.94 tons CO_2e/MWh was used, an emission factor which is 11% lower than in the previous study.

A significant change was recorded for the satellite residences (42.9% higher), likely due to increase in availability of data and an increase in floor area. The 2009 Report contained an estimate for electricity consumption at UCT's residences, while this report includes the data provided for all these satellite residences. In terms of floor area, the large, new Obz Square residence in Observatory was built in 2011 with 880 rooms, contributing around 23% of emissions for satellite residences and is likely a contributor to the increase in emissions seen from 2007 through to 2013.

3.3 Scope 3: Other indirect GHG emissions

Scope 3 is an optional reporting category that allows for the reporting of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the entity, but occur from sources not owned or controlled by the entity (GHG Protocol, 2013). The GHG Protocol guidelines acknowledge that data availability and reliability may influence which scope 3 activities are included in the inventory, and that data accuracy may be lower. The objective of the scope 3 inventory may be more about understanding the relative magnitude of and possible changes to scope 3 activities. Thus emission estimates are acceptable as long as there is transparency with regard to the estimation approach.

Components of Scope 3 identified for UCT include staff and student commuting, food supply, official flights, paper products, water supply, and waste disposal and recycling. The food supply activity has been added to the scope 3 inventory for the first time. Scope 3 emissions account for a relatively high proportion of 26.4% of the total carbon footprint, with staff and student commuting largest portion at 14%, and food being the second highest component in Scope 3 at almost 7.4%.

Staff and student commuting

Staff and student commuting comprises the use of the Jammie Shuttle, private car use, hired cars and public transport use by students and staff. To estimate the split between modes of transport, the students conducted a paper-based survey; however only a total of 163 out of 25695 students and 32 out of 4884 staff members participated in the survey. Averaging methods were used to

account for the entire staff and student body for each area. For the Jammie shuttle, the fuel report provided by UCT's properties and services was used to calculate the emissions.

The emissions from staff and student commuting contribute 14.1% to the total carbon footprint. Compared to the 2009 report, these emissions have reduced slightly by 1.4%; however the population has increased by 17% since 2007. Of the total emissions for commuting of 11,324 tons CO_2-eq, it is estimated that the Jammie Shuttles have a total carbon emission of 1079 tons CO_2-eq per annum, compared with 802.8 tons CO_2-eq in 2007 (ERC, 2010). The number of users of the Jamie Shuttle for the year 2012 for both staff and students amounted to 4 804 165, an increase of 316 239 since 2011 (UCT, 2012).

Official Flights

Official Flights data was obtained from Procurement & Payment Services and from the various travel agencies directly. The spreadsheets obtained listed the destination of international and local flights, and the total rand value, but not the distance travelled. The detailed data contained over 8000 different flights listed along with their destinations, and time constraints for completion of the student projects did not permit the calculation of the exact distance travelled for all the flights. The students developed a method of estimation to arrive at a result. Common occurring destinations (domestic and international separately) were selected and an average of the distance from South Africa to these destinations calculated; the average cost for a flight ticket from Cape Town to these destinations was calculated; the average ticket cost was then divided by the total money spent on flights, the result being the total number of trips taken for the year. This total number of trips was then multiplied by the averaged distances obtained and gave the estimated total distance travelled (Green Initiative, 2013).

Results show a massive increase in emissions of more than 100% compared to the 2009 footprint. This study used a different methodological approach to the 2009 report and one that covers more of the indirect emissions associated with this activity data, attributing to the higher emissions result. The degree of estimations included in the calculation was however high and efforts to develop and refine this methodology are needed for the next footprint calculation.

Paper products

The category includes printing and photocopy paper, toilet paper and paper towels. It was anticipated that being a university, paper would be a significant contributor; however findings show the percentage of the overall footprint is only 0.26%. Data for printing and photocopy paper was received from the ICTS Department for printers and copiers under their control, and from the campus copy centres, resulting in a total number of paper sheets for the year of 63,240,680**.** Nashua run these copy centres and reported an average of approximately 1,680,000 sheets of paper a month, totalling 20,160,000 per annum, for all paper types, typically 80gsm, and the majority double-sided. Nashua is responsible for bulk printing, certain student areas, and some departmental devices. It is expected that this result is an underestimation due to the difficulty of obtaining data on the use of paper across campus. Paper is not purchased centrally at UCT, but by each department or research unit.

For paper products such as toilet paper and paper towels, data was received from the custodial service providers, Supercare and Metro as the amount of these products ordered by them. The result shows a 24% decrease in these emissions, and the percentage of the total footprint is low at 0.26%.

Water supply and wastewater
Water supply data was readily available from the municipal utility bills and provided by the Finance Department within Properties and Services. The emissions amount to 181.72 tons of CO_2-eq/yr, or 0.24% of the total footprint. In the 2009 report, water supply was not included.

The 2009 ERC report calculated the contribution of wastewater at 113.1 tonnes of CO_2-eq per annum for 2007, 0.13% of the total footprint. The IPCC 2006 method for estimating CH_4 emissions from wastewater was used, together with an average Chemical Oxygen Demand of 58 mg/l for all Western Cape wastewater treatment plants. The students reporting on this aspect in 2013 did not calculate wastewater treatment; but rather the treatment of potable water before supply. The results are not comparable, and in addition the contribution to the total footprint is likely to be less than 0.5%, and have therefore been omitted from the calculation.

LPG
Scope 3 LPG emissions are those associated with the extraction and transport of primary fuels as well as the refining, distribution, storage and retail of finished fuels purchased. These emissions contribute 0.1% to the total footprint.

Solid waste
Solid waste has been one of the most active areas of campus sustainability for some years, and has been the focus of efforts by the student movement, the Green Campus Initiative (GCI) in partnership with P&S. Initially a 4-bin system was established in 2008/9 and subsequently this was altered to a 2-bin system in 2012 to simplify separation of waste. Data has been reported by the service provider Wasteman since 2009, and although consistency and frequency of reporting have been problematic, in the last year good progress has been made in terms of regular reporting. The service provider has now launched an interactive website to make this data available to anyone at UCT. Waste is measured as 'Wet' (non-recyclable) or 'Dry' – (recyclable) and submitted monthly to P&S. At this stage no independent verification of data is undertaken. A total of 595.1 tons of CO_2-eq for non-recycled waste was reported in 2009, compared to only 109.73 tons for 2012, a significant reduction of 81.5%. This is likely to be the result of behavioral change brought about by awareness-raising efforts of the GCI students and the provision of infrastructure by P&S. While the proportion of the overall carbon footprint appears insignificant at 0.14% for non-recycled waste, this measurement does not account for the embodied energy that is lost when materials are disposed of in a landfill site, rather than being reclaimed.

There are significant differences in the methodology between this report and the baseline study. The 2009 footprint calculations used the IPCC 2006 method for estimating the generation of potential CH_4 emissions from solid waste, and it only recorded emissions associated with the Wet waste that is taken to the landfill. In 2009 there were only a few months of data available from which the emissions were extrapolated. The results for this report are derived using the Defra factor and from detailed monthly waste volumes for the entire period 2009 to 2012, and are therefore more reliable. This report includes Recycled waste as a separate component, which has a much lower emission factor than non-recycled waste that accounts for the transportation and processing of this waste.

Two categories of solid waste that presented some difficulties are e-Waste and Hazardous waste. While data was available for these waste types, methodologies, metrics and emission factors were uncertain and therefore these wastes were omitted from the calculations. Further detail is provided below in the section on Quality Control and Uncertainty.

Food supply
The footprint of food supply at UCT was not calculated in the 2009 report or as part of the student projects in 2013. A master's student, Muriel Gravenor, completed her MSc dissertation on food sustainability at UCT in early 2013, and the results have been incorporated into this report. The food related emissions are shown in Table 1: *Carbon Footprint 2012 according to GHG Protocol*, but have been omitted for purposes of comparison with the 2009 footprint in Table 2: *Comparison of 2009 Footprint with 2012*.

The food system at UCT consists of two independent parts: the residence food system, which feeds 4,100 Residence students in 17 residences between one and three meals per day; and the campus food system, which is operational during weekdays and feeds up to 25,000 students (including residence students) and up to 5,000 staff on all six campuses. The catering at residences is out-sourced to a single service provider Fedics, whereas the campus food system consists of a multitude of small- to medium-scale food service providers, or vendors, also contracted by UCT. Given these complexities, certain assumptions and extrapolations were required. The figures for the campus food system were calculated from 2012 sales data provided by a major campus food outlet and from a survey (Nov-Dec 2012) directed at those who purchase food on campus, hence the range in the figures (Gravenor, 2013).

Results from Gravenor (2013) show a:

- total footprint from food for UCT: 5,700-7,000 tons CO_2-eq /a;
- which includes the residence system (±3,600 tons CO_2-eq /a) and
- the campus food system (1,800-3,400 tons CO_2-eq /a)

Given the uncertainties and wide range of the results, an amount of 6000 tons CO_2-eq per annum was included in this report. This amounts to 7.4% of the total carbon footprint, making this component the third highest after electricity and transport. Efforts to develop more accurate measurement methodologies should be pursued in future.

4 QUALITY CONTROL AND UNCERTAINTY

The quality of the data supplied has a significant impact on the analysis performed on the results. A qualitative analysis of the data was used for this study, giving an indication of the confidence levels in the results shown in this report.

Three confidence levels were used in this analysis:

- Low – High uncertainty in data quality
- Medium – Some uncertainty in the quality of the data
- High – Very low uncertainty in the quality of the data

Scope 1: Vehicle Fleet and LPG
The Bankfin system data used contains the exact number of litres of fuel filled per vehicle and the fuel type (petrol/diesel) and so there is a **high** confidence level.

For the staff reimbursements data a **medium** confidence level has been assigned since the exact amount of fuel purchased for each vehicle was not available, however the total distance travelled for each claim is recorded.

There is a **medium** confidence in the quality of the data supplied for LPG, due to the large decrease in the result, which may indicate missing data.

Scope 2: Electricity

Data for Main Campus (Upper, Middle and Lower) and for the Medical campus (Health Sciences Faculty) were provided in the form of screen snapshots from the internet based electricity metering system managed by Properties and Services, and therefore the confidence level is **high**.

Data for the GSB was provided in Excel spreadsheet format from the GSB Accounts department. Although the data set was clear and complete, a **medium** confidence level is assigned since an apportionment of electricity was consumption made. A single meter measures both the GSB and Breakwater Lodge hotel, which offers accommodation for tourists. As for the 2009 Report, only 46% of the electricity usage measured for the campus was allocated to UCT's carbon footprint. Past data For the GSB from 2010 through to 2013 was made available, allowing comparisons to be made over a number of years in the student report that would aid identification of mitigation measures (Green Campus Rangers, 2012).

For the Satellite Residences, the data set provided by Student Housing comprised both monetary value and energy consumption in kilowatt hours (kWh) in an Excel spreadsheet. In the previous report, only monetary value was given, and therefore assumptions were required to estimate free electricity in flats. A **high** confidence level is assigned to these results. The granularity of the data allowed for analysis by residence and month (Green Campus Rangers, 2012).

There is a **medium** confidence level in the data supplied for Hiddingh as there was missing 3 months (March, April and May 2012). As such, an estimate was utilised for these months (Green Campus Rangers, 2012).

Scope 3: Indirect Emissions

Staff and student commuting

For the student and staff commuting, initially the team sought existing survey data from the Centre for Transport, but this was not available. Properties and Services, responsible for transport services at UCT, were approached for data; however due to lack of cooperation from data holders resulting in delays, many assumptions had to be made to arrive at the results for this component. (Blue Team, 2012).

At a late stage in the project, lacking any useable data the students conducted a paper-based survey on campus to determine the distribution of modes of transport for commuting daily to and from campus. Due to lack of time, there were a low number of respondents to the survey. Averaging methods were then used to account for the entire staff and student body for each area. These results are therefore assigned a **low** confidence level (Blue Team, 2012).

For the Jammie shuttle, the fuel report provided by the service provider was used to calculate the emissions. A full set of 12 months fuel consumption broken down by month was provided and these results have a **high** level of confidence.

Food supply

The residence food supply figures were estimated from a sample menu for one week was provided by Fedics. The footprints for different foods (raw ingredients) were derived from a study by Audsley et al. (2009) for WWF-UK and FCRN (Gravenor, 2013).

The campus food system's carbon footprint was estimated using two methods: the first involved meal sales data from a major campus food service provider at UCT, while the second method used the responses from the campus food survey. Using the survey software available to UCT students and staff on Vula, a survey was constructed for UCT's campus food customers, the students and staff, for the purpose of quantifying the amount of food purchased on campus as a whole. The survey was made available online via a public link for two and a half months at the end of 2012, and was advertised via posters that were placed in food venues on UCT campuses. The survey had 296 respondents (Gravenor 2013). Given the assumptions and extrapolations required to arrive at this result, the confidence level for this result is **low;** however a conservative estimate of 6000 tons CO_2-eq per annum, well below the top of the numerical range has been included in the calculations.

Official flights
Detailed data was available however because travel distances were not calculated and estimates are used with many assumptions, a **low** confidence level has been assigned here.

Paper products
Data was received for office paper consumed from both Nashua campus print and copy service provider, and the ICTS Department who control certain printers. Since this data is captured automatically it is likely to be accurate. However, departments purchase paper directly and other use of paper is difficult to track, therefore this result is likely to be an underestimation of paper use and therefore confidence is **low.**

Data for paper products was received for 2012 as total amount of rolls and sheets of various products purchased by service providers SuperCare and Metro. Supercare provided monthly data on all paper products purchased, while Metro provided only the total amount of toilet rolls for the year. The confidence level is **medium** as it is expected that additional paper products are in use that need to be identified.

Water supply
The municipality meters the water that is supplied to the university and the various residences. Main campus has only one or two meters for the entire area and this data was provided by the Finance Department, Properties and Services. The Student Housing Department provided the data for off-campus, satellite residences from the utility accounts. The confidence level of these results is h**igh**. The split between domestic water use and irrigation would be an important metric to develop in future to aid identification of conservation measures.

Solid waste
Solid waste data comprised a breakdown of waste collected and recycled in each month of 2012, and for the years 2009 to present. A monthly breakdown in two categories is given, 'Recycled' (Dry) waste and Non-recycled (Wet) waste; totals and percentages of each category were given for each month. Waste statistics are based on an estimate of volume/weight per 'wheelie' bin collected by Wasteman; therefore the confidence level of these results is **medium**.

Data on **e-Waste** was provided by Charl Souma, ICTS and Brett Roden, P&S since there are presently two e-waste collection systems at UCT. Data was received as totals of e-Waste collected in Kilograms per year from 2010 to 2013. Unfortunately, the methodology could not be resolved or an emission factor found, and the quantity recycled or disposed of could not be established; therefore e-Waste volumes are not included in these results. For future data reporting, it should be noted that most conversions of this waste to emissions require details of size of machines, or number of machines.

Data on **Hazardous waste** for the last 3 years was provided by Brett Roden, Environmental Risk Officer, P&S, consisting of totals collected per year in kilograms and litres, from 2010 to 2012. This data collection system is required for compliance purposes, and therefore likely to be accurate. The amount of waste represents two components; Total Mass of Healthcare Risk Waste removed from UCT; and the Total Volume of Chemical Waste removed from UCT. Emission factors could not be found for this type of waste and therefore hazardous waste is not included in this carbon footprint.

LPG

There is a **medium** level of confidence in the quality of the data supplied for LPG. Results show a significant reduction in emissions of over 50%; however reasons for this are not understood. They could be due to the different methodological approach or to poor data capture.

Acetylene usage was included in the 2007 report, however it was advised in 2013 that UCT no longer utilised Acetylene, and therefore it has not been included in this carbon footprint.

5 BENCHMARKING AGAINST OTHER UNIVERSITIES

The emissions produced by UCT have been compared with that of other universities from a selection of geographic and climatic regions in Table 3 below, using a per capita intensity benchmark. Results show that UCT has relatively low emissions at 2.70 tons of CO2eq per capita, with the Mean being 6.54 tons CO_2-eq per capita. UCT's per-capita emissions for 2007 amounted to about 4.0 tons CO2-eq emissions per capita. Both students and staff were included in the calculation. Compared with Rhodes University in Grahamstown, South Africa with an intensity of 3.84 tons CO_2-eq per capita, UCT is producing lower emissions. Monash University, which is based in Melbourne Australia but has campuses around the world, has the lowest per capita emissions of the samples selected at 2.47 tons of CO2eq per capita. Further analysis of these results is needed, considering factors such as climate and heating and cooling technologies.

Table 3: Comparison with other Universities - Emissions per capita

University	Reporting year	Population (students & staff)	Total tCO2eq	Intensity tCO2e per capita
Washington University in St. Louis	2009	16 930.00	409 500.00	24.19
Cornell University	2012	28 306.00	218 000.00	7.70
University of Maryland	2010	42 109.00	277 353.00	6.59
University of California, Berkeley	2011	38 224.00	183 592.00	4.80
University of Queensland	2011	52 096.00	188 607.00	3.62
Rhodes University	2008	7 362.00	28 260.52	3.84
University of Hongkong	2011	32 654.00	98 550.00	3.02
University of Cape Town	**2012**	**30 579.00**	**82 704.00**	**2.70**
Monash University	2012	79 558.00	196 140.00	2.47
Mean		36 424.22	186 967.39	6.55

Figure 2 below compares the same set of universities in terms of total emissions per scope 1,2 and 3. In this comparison, UCT performs well due to the lowest total emissions. Rhodes is not included since the carbon footprinting study undertaken in 2008 did not use the GHG Protocol.

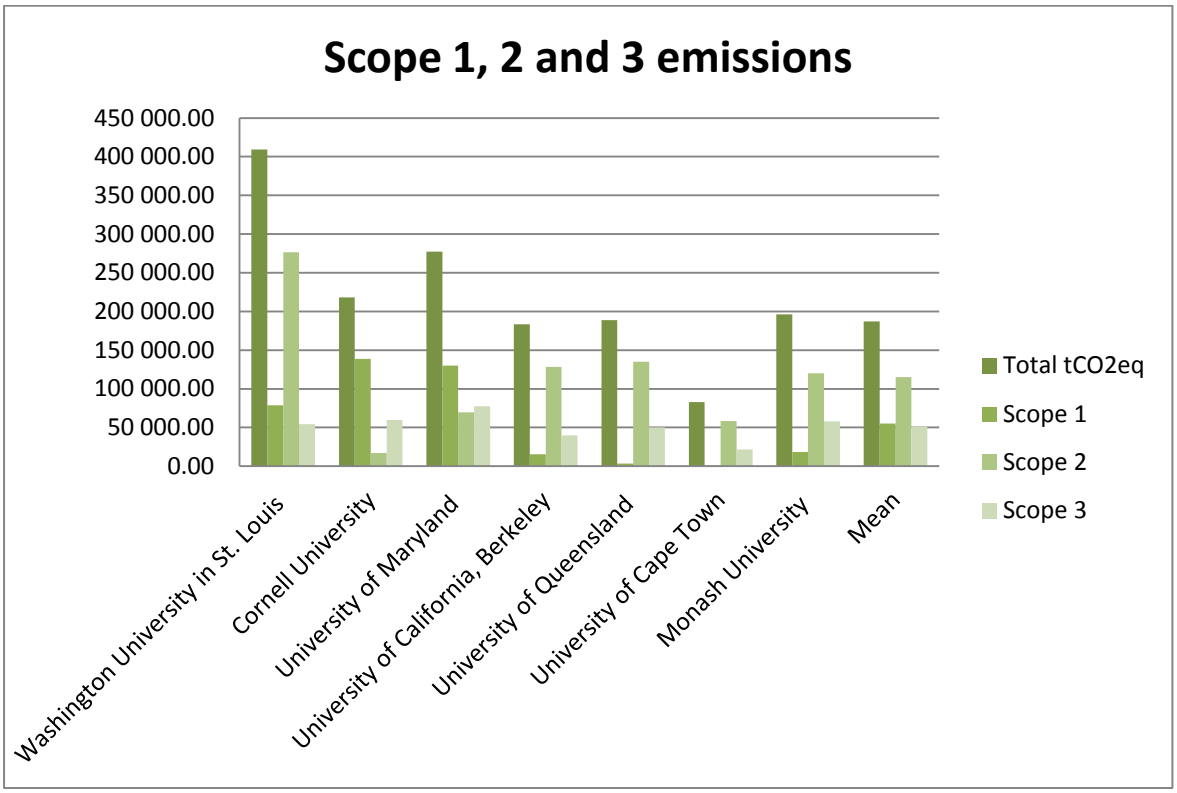

Figure 2: Comparison of total emissions per Scope of selected universities

6 CONCLUSIONS AND RECOMMENDATIONS

Since the first carbon footprint was completed in 2009, a number of positive developments have occurred: access to data has improved moderately; data holders have demonstrated greater understanding of the process and been more cooperative on the whole; and there are improvements in the monitoring of electricity consumption, via the use of digital web-based meters. With measurement and monitoring of the carbon footprint now being more easily achieved, efforts could be focused on ensuring that reporting occurs regularly every year, and on the reduction and mitigation of GHG emissions. Through this practice, UCT would show leadership amongst Higher Education institutions in the South African and African context. The move to the GHG Protocol for these calculations is a positive step and will result in the ability to more easily compare emissions with other universities both locally and internationally.

The reduction in electricity consumption on some campuses, particularly Main campus and Medical campus is very encouraging and certainly making a contribution to meeting UCTs sustainability goals. Even though the change in emission factors contributes approximately 11% of the apparent reduction, the significant increase in population and the increase in floor area since 2007, mean that the overall result is positive. In addition to the continued retrofitting of electrical equipment with more efficient technologies across the campuses, a shift towards renewable energy sources, generated both on- and off-site should become a more active agenda.

Results of transport emissions reflect little change since the baseline study; however given the 17.3% increase in population since 2007, this result reflects a substantial reduction in emissions. The focus of campus greening should be to continue promoting a shift away from private car use to public transport and non-motorised transport. The upward trend in official flights is alarming and efforts should be made to understand this trend and to mitigate it by, for example, promoting greater use of video conferencing through the increased provision of infrastructure.

With the inclusion of Food Supply in this study, the UCT carbon footprint is more complete; however the methodology for capturing food supply emissions needs further development. The measurement and reporting of this aspect of the UCT Carbon Footprint as a master's thesis, highlights potential educational benefits of incorporating the management of the carbon footprint into research and curriculum at UCT, and addresses Principle 3 of the ISCN-GULF Charter.

In future, consideration should be given to the inclusion of additional scope 3 indirect emissions, for example waste water, hazardous waste, refrigeration, and construction waste. The results have highlighted the significance of the Scope 3 emissions for this institution and it is recommended that further efforts to improve data collection and methodologies for these emission sources should be addressed.

Finally, addressing the purpose of the exercise, to manage and mitigated emissions, the findings of the Carbon Footprint need to be communicated to the UCT community. Going beyond communication, forums for participation in finding solutions towards reduction and mitigation of the GHG emissions might result in innovation and strengthening commitment to these goals. Governance issues within the UCT leadership, around carbon management and more broadly around sustainability, need to be more clearly defined, including target setting, so that responsibility for the measurement, monitoring and reporting are firmly embedded and do not rely on ad hoc initiatives in future.

Reflections on the process

The intention of involving the students in the process of carbon measurement was to prioritise the educational benefits associated with the process of managing and reporting the university's carbon footprint. There was positive feedback associated with the course, and there were some successful outcomes. This study took a shorter period of time (Feb to August 2013) to complete than the previous Carbon Footprint report.

Some concerns about the process need to be highlighted. Initially it appeared that the division of the task amongst the five student groups of the Information Systems course was an effective way of managing the task; however the time taken to integrate the findings into the total footprint and to re-check the calculations was lengthy, from June to August. Some major errors were found that undermined confidence and necessitated redoing the calculations. Work of this nature is best undertaken with some continuity rather than being intermittent, as errors are more likely to occur. The work had to be fitted into the schedules and workload of the staff of the ERC, competing with their other commitments.

In hindsight the carbon footprinting process is not as complex as it first appeared and if well planned would be far less onerous in future. What is required is to clarify the data inputs, formats and metrics, identify staff responsible for submitting data; the timeframes for submission; and the establishment of a central database to house this data. At present it is intended to repeat the exercise as part of the INF3011F course next year as the education value is undoubted. The ERC has agreed to lead and manage the project. Next year there will be a greater focus on ensuring efficiency and accuracy as these were the major pitfalls of the approach this year. In addition, it is recognised

that more support needs to be provided to the students at the outset of the project to ensure adequate understanding of the methodology.

Specific recommendations for more effective data collection

The goal of data collection is to allow for effective analysis so that measurable targets may be set and recommendations may be made to decision-makers and the UCT community for the reduction and mitigation of greenhouse gas emissions. While some of the data received for the student reports allowed for effective analysis, there is a much room for improvement:

1) The data collection process for the student project was scattered across all sorts of communication channels which resulted in errors being made. This would be rectified by the creation of a central database for storing the relevant data.

2) Data needs to be made available to a range of stakeholders and is held by many stakeholders across the institution. It is recommended that for future carbon footprinting processes, the data be stored in a central database to improve accessibility.

3) The format of the data was inconsistent, which could be avoided by simply providing data holders with a template. It is recommended that a more standardised data submission process be developed and adopted, to structure the manner in which the data holders maintain their data and how and when it is submitted for annual reporting.

4) Installation of more digital meters, for both electricity and water, preferably down to a building level, would enable trends to be observed more clearly and immediately, enhancing awareness of resource use and environmental impacts, leading to behaviour change.

5) A Green Information System, combining the agencies of data holders, researchers, teachers, students and other stakeholders in a co-ordinated technological system needs to be prioritised if UCT aims to produce a robust carbon footprint report on an annual basis.

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INF3011 Student Project Reports: available on http://www.greening.uct.ac.za/about/policies/

Blue Team – Student and Staff Commuting
Green Campus Rangers – Electricity on Satellite Campuses and LPG
Green Inc. – Electricity on Main Campus and Water
Green Initiative – UCT Vehicle Fleet and Air Travel
Waste Busters – Solid Waste

APPENDIX 1: INFORMATION SOURCES

CATEGORY/SECTOR	CONTACT	DESIGNATION
Building List & Areas	Nigel Haupt	Properties and Services (P&S): Physical Planning Unit
Population data	Hugh Amoore	Registrar's office
Electricity: Main campus; Medical campus	André Theys	Properties and Services: Engineering Services Manager
Electricity: Hiddingh Campus	Fahmza Jaffar	Finance Manager: Properties and Services
Electricity: Residences	Linda Tsipa	Student Housing
Electricity: GSB	Rayner Canning; Charlene Paris	GSB Finance Dept
LPG	Di de Villiers	Finance Department: Vendor Management
Water: All except GSB	Fahmza Jaffar	Finance Manager: Properties and Services
Water: GSB	Rayner Canning; Charlene Paris	GSB Finance Dept
Solid Waste & Paper	Duke Metcalf	Properties and Services: Custodial and Estates Manager
Paper (Campus copy Centres)	Therese Wiborg	Nashua
E-Waste & Hazardous Waste	Brett Roden	P&S: Environmental Risk Officer
E-Waste	Charl Souma	ICTS
Transport: Jammie Shuttle	Roland September; Bruce Jansen	P&S: Traffic manager
Transport: Fuel; UCT Vehicle Fleet	Carol Paulse; Sabie Mqhane	Finance Dept Procurement & Purchasing Dept manager
Air travel	Johan Nel	Millway Travel
	Nina Riddell	Tourvest
	Dominique Frick	STA travel
Toilet paper & paper towels	Adele Moller	Supercare
	Clive Damonse	Metro