



## Carbon Footprint Report: 2012 - 2013

10 June 2014



## Executive Summary

This report provides an update on GCU's greenhouse gas emissions and tracks progress towards the 20% carbon reduction target for 2014.

The Carbon Trust produced GCU's first emissions report in 2010 and set 2008-2009 as the baseline year against which improvements would be benchmarked. Since then, material changes to GCU's operations, improvements in data collection and understanding of GCU's environmental impacts, updates to emission factors and changes in carbon reporting methodology warrant a fresh update of GCU's carbon footprint.

This report updates GCU's emissions inventory to reflect these changes and, to move GCU towards full carbon accounting, the 2012-2013 inventory has been widened (in line with current carbon accounting standards). Progress towards the target for 2013-2014 was projected using a number of assumptions applied to the 2012-2013 dataset.

Table 1 details reported emissions for 2008-2009 and 2012-2013, together with projected emissions for 2013-2014 for which comparable datasets were available. Comparable data was available for emissions from: gas from the National Grid; fluorinated gases from refrigeration systems; own transport; electricity from the National Grid and associated losses during transmission and distribution; and, general waste and recycling.

Emission Source	Scope	2008-09	2012-13	2013-14
Gas - Nat. Grid (Tonnes CO <sub>2</sub> e)	1	2,674	2,572	2910
Gas – Refrigerants (Tonnes CO <sub>2</sub> e)	1	152	152	152
Transport – Own (Tonnes CO <sub>2</sub> e)	1	12	11	11
Electricity – Nat. Grid (Tonnes CO <sub>2</sub> e)	2	6,828	5,087	3,495
Electricity - Trans. & Dist. Losses (Tonnes CO <sub>2</sub> e)	3	541	435	301
General Waste & Recycling (Tonnes CO <sub>2</sub> e)	3	107	41	20

Totals & Reduction from Baseline		2008-09	2012-13	2013-14
Scope 1 & 2 – Total (Tonnes CO <sub>2</sub> e)	1+2	9,667	7,822	6,568
Scope 1 & 2 – Reduction from baseline (%)	1+2		19%	32%

Totals & Reduction from Baseline		2008-09	2012-13	2013-14
Scope 1,2 & 3 – Total (Tonnes CO <sub>2</sub> e)	1,2+3	10,315	8,298	6,876
Scope 1,2 & 3 – Reduction from baseline (%)	1,2+3		20%	33%

Table 1 Actual and estimated carbon emissions from comparable datasets for 2008-2009, 2012-2013 and 2013-2014.

Table 1 indicates that GCU will achieve and surpass the 2013-2014 target ahead of schedule, with a 19% reduction in 2012-2013 (7,822 tonnes CO<sub>2</sub>e, vs. 9,667 tonnes CO<sub>2</sub>e in 2008-2009) and a projected reduction of 32% for 2013-2014 (to 6,568 tonnes CO<sub>2</sub>e). These reductions are illustrated in Figure 1.

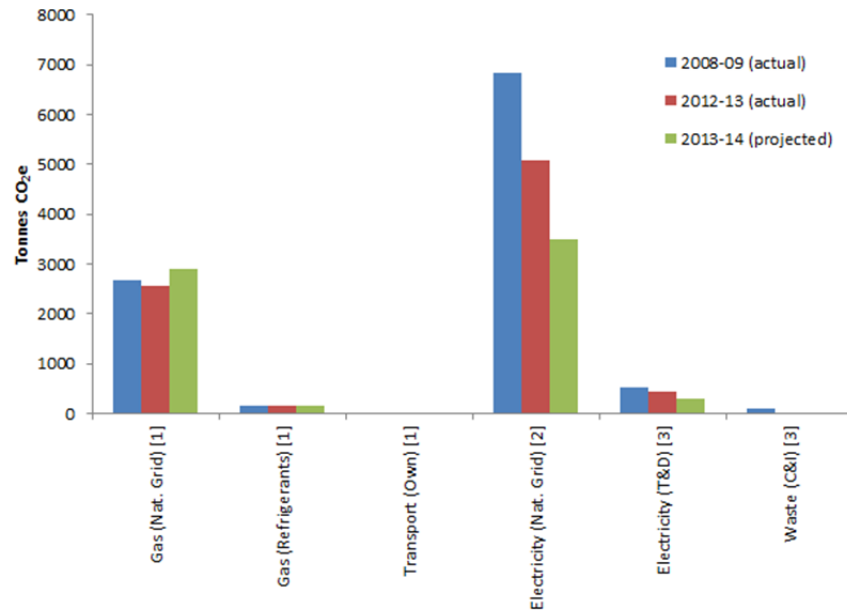


Figure 1 Emissions projections for 2013-2014 using the categories used in the GCU's first carbon footprint.

Whilst these reductions occur across the board, the reduction values are for scope 1 and 2 emissions, which represent aspects of GCU's operations which it can directly influence. The reductions are primarily attributed to less electricity being purchased from the National Grid, which reflects the successful implementation of GCU's Carbon Management Plan and the new Energy Centre coming online).

Moving towards full carbon accounting, total reported emissions for 2012-2013 were 25,803 tonnes CO<sub>2</sub>e, with student commuting, international student travel and electricity and gas purchased from the National Grid representing the largest sources of emissions (as illustrated by Figure 2).

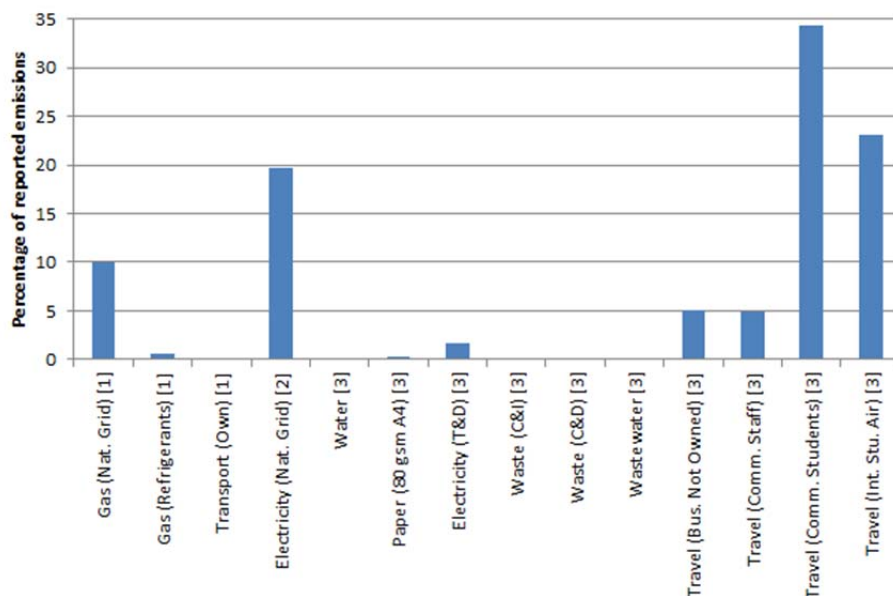


Figure 2 Distribution of GCU's total reported emissions (25,778 tonnes CO<sub>2</sub>e) for 2012-13. The number in square brackets indicates the emission scope.

The broader emissions inventory for 2012-2013 should not be interpreted as an increase in GCU's emissions, but rather reflecting an improvement in GCU's understanding of its carbon emissions and ability to collect associated data.

Whilst GCU is well positioned to achieve and potentially surpass its carbon reduction target for 2013-2014, its broader sustainability aspirations and commitment to supporting the Scottish and UK Governments carbon reduction targets, it is imperative that momentum is sustained. Within this context, this report provides a stepping stone for GCU to:

- Identify additional scope 1 and 2 carbon reduction opportunities and incorporate into a revised Carbon Management Plan.
- Identify opportunities and develop appropriate initiatives for reducing scope 3 emission, e.g. by focusing on promoting more sustainable travel (business and commuting).
- Work with suppliers to further develop GCU's understanding of its indirect emissions (scope 3) and broaden the range of categories in its emissions inventory.
- Use the data from this report to develop a broader environmental report celebrating GCU's environmental achievements.

Combined, the output from the above activities will help GCU sustain momentum for further improvements in its environmental performance over the next five to ten years.

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### Introduction

Carbon footprints use estimates of greenhouse gas emissions as a proxy for measuring environmental impacts arising from an organisation's activities on a comparable basis.

Carbon footprints provide an alternative approach for benchmarking performance and identifying opportunities for improvements. However, data limitations, differences in boundaries used and assumptions used mean that carbon footprints are less useful for comparing different organisations.

In 2010 the Carbon Trust calculated GCU's first carbon footprint (the 2008-2009 carbon footprint) and developed a [Carbon Management Plan](#) (CMP) that identified a number of carbon reduction opportunities for GCU to reduce carbon emissions by 20% by 2014 from a 2008-2009 baseline.

Whilst regular updates have been produced on the progress of the CMP, its narrow focus on primary emissions (arising from activities over which GCU had substantial operational control), material changes to GCU's operations, improvements in data collection and understanding of GCU's environmental impacts, updates to emission factors and changes in carbon reporting methodology warrant a fresh update of GCU's carbon footprint.

This report applies the revised methodology and emission factors to the 2008-2009 data, calculates emission for 2012-2013 and projects likely emissions for the target year of 2013-2014.

Widening the range of reported emissions included in this assessment enables GCU to move towards full carbon reporting.

The report will be used to demonstrate how GCU is aligning its operations to support the Scottish Government's carbon reduction targets, report emissions to the Scottish Funding Council as part of its Outcome Agreements, update GCU's Carbon Management Plan, review GCU's environmental performance, produce a broader Environmental Report and inform the development of a Sustainable Travel Strategy for GCU.

### Data & Methodology

This section outlines the methodology followed, data and boundaries used and assumptions made to calculate GCU's carbon footprint. It also highlights the common notation used throughout the report.

#### Methodology

GCU's carbon footprint was calculated according to the methodology outlined in The Green House Protocol's A Corporate Accounting and Reporting Standard (2004), Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2011) and ISO 14064-1:2012 using Defra's 2013 emission factors (accessed on 17/01/2014).

These Standards categorise emission releasing activities into scopes that reflect direct and indirect emissions and account for the level of control an organisation has those activities. The three scopes are:

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- **Scope 1:** Emissions associated with activities owned or controlled by an organisation that release emissions straight into the atmosphere (e.g. fuel combustion). Scope 1 emissions are classified as direct emissions.
- **Scope 2:** Emissions attributed to the use of purchase of purchased electricity, heat, steam and cooling. These indirect emissions arise as a consequence of an organisation's activities but occur at sources that are not owned or controlled by organisation. Scope 2 emissions are classified as indirect and are the electricity, heat, steam and cooling generators' Scope 1 emissions.
- **Scope 3:** Other emissions that are a consequence of an organisation's actions, but occur at sources not owned or controlled by the organisation and which are not classed as scope 2 emissions. Scope 3 emissions are indirect emissions.

The above Standards detail guidelines for mandatory and voluntary emission reporting, with scopes 1 and 2 being mandatory and scope 3 voluntary. To facilitate the reporting in a systematic manner, scope 3 emissions are further divided into 15 categories in The Greenhouse Gas Protocol's Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2011). This approach means that broader range of activities and emission sources have been included in GCU's carbon footprint for 2012-13 than were used for 2008-09 or are reported to the Scottish Funding Council as part of GCU's Outcome Agreement.

The approach is an iterative process, where efforts focus on refining data for emission categories deemed to be significant (i.e. likely to account for more than 5% of total emissions). In broad terms, the process involved: identifying relevant emission categories; collating outline emission data; determining emission significance; improving data quality for significant emissions and recalculating emissions.

Further details about how this process was applied to GCU's emission inventory, including strategy for collating emission data and improving data quality is provided in Appendix A - Strategy for Managing GCU's Emission Inventory.

This methodology was used to compile GCU's emissions inventory and rebase emissions for 2008-2009, calculate emissions for 2012-2013 and project emissions for 2013-2014.

### Emissions Boundary

GCU's first carbon footprint focused on emissions from operations and activities under its operational control and included emissions from its estate (owned and leased buildings), travel (some business travel and staff commuting), waste and recycling and water consumption and wastewater treatment.

With improvements in GCU ability to collect data and understanding of its environmental impacts, and to help align GCU's carbon footprint to the methodology recommended by the above Standards, the 2012-2013 carbon footprint includes a broader range of emission categories (mainly scope 3). Data from 2012-2013 emissions was used to project emissions for 2013-2014 and gauge progress towards the 20% reduction target for 2014.



GCU's original carbon footprint included emissions from office space in Rose Street (over which GCU had direct operational control), but not Buchanan House (where the electricity, heating and waste services are provided as part of the rental agreement). However, as GCU no longer has offices in Rose Street, emissions from those premises were excluded from the rebased 2008-2009 footprint.

The 2012-13 carbon footprint also includes emissions from waste arising from GCU London, but not those for electricity or gas, which as a result of the rental agreement are outwith GCU's operational control. Emissions from Buchanan House are also excluded from the 2012-13 carbon footprint for the same reason.

### Emissions Inventory

The above Standards detail guidelines for mandatory and voluntary emission reporting, with scopes 1 and 2 being mandatory and scope 3 voluntary.

To facilitate reporting in a systematic manner, scope 3 emissions are further divided into 15 categories in The Greenhouse Gas Protocol's Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2011). The categories used in GCU's emission inventories for 2008-2009 and 2012-2013 are detailed in Table 2.

Emission Category	Scope	Inclusion in GCU inventory	
		2008-2009	2012-2013
Organisation's buildings	1	Yes: majority.	Yes: complete.
Organisation's vehicles	1	Yes: partial data.	Yes: complete.
Purchased electricity	2	Yes.	Yes.
Purchased Goods & Services	3	No: data not available	Yes: limited.
Capital Goods	3	No: data not available	No: data not available
Other fuel & energy related activities	3	Yes.	Yes.
Upstream transportation and distribution	3	No: data not available, but unlikely to be significant.	No: data not available, but unlikely to be significant.
Waste Generated in Operations	3	Yes: complete.	Yes: complete.
Business travel	3	Yes: partial data.	Yes: Comprehensive, although not complete data set.
Employee commuting	3	Yes: partial, limited data, but significant.	Yes: comprehensive. Includes student travel.
Upstream leased assets	3	No: not applicable.	No: not applicable.
Downstream transport and distribution	3	No: not applicable.	No: not applicable.
Processing of sold products	3	No: not applicable.	No: not applicable.
Use of sold products	3	No: not applicable.	No: not applicable.
End-of-life treatment of products	3	No: not applicable.	No: not applicable.
Downstream leased assets	3	No: not applicable.	No: not applicable.
Franchises	3	No: not applicable.	No: not applicable.
Investments	3	No: not applicable.	No: not applicable.

Table 2 Categories in GCU's emissions inventory.

### Independent Verification

This carbon footprint report, the underpinning emissions inventory and associated calculations have been independently verified by Professor J. Baird and Dr C. Russell from GCU's School of Engineering and Built Environment, who are satisfied that this emission report accurately reflects GCU's

emissions for the reporting periods of 2008-2009 and 2012-2013. Their verification statement is available as Appendix B - Verification Statement.

## Results – GCU's Greenhouse Gas Emissions

GCU's carbon emissions for the 2008-09 and 2012-13 reporting periods are detailed below, together with a projection of emissions for the 2013-14 target year, and are followed by a discussion of emissions by individual category in GCU's emissions inventory.

### Reported Emissions for 2012-2013

GCU's total reported emissions for 2012-2013 were 25,803 tonnes CO<sub>2</sub>e, which can be broken down as: 2,735 tonnes CO<sub>2</sub>e in scope 1; 5,087 tonnes CO<sub>2</sub>e in scope 2 and 17,981 tonnes CO<sub>2</sub>e in scope 3 (all reported emissions). Student commuting, international student travel and electricity and gas purchased from the National Grid representing the largest sources of emissions (Figure 3).

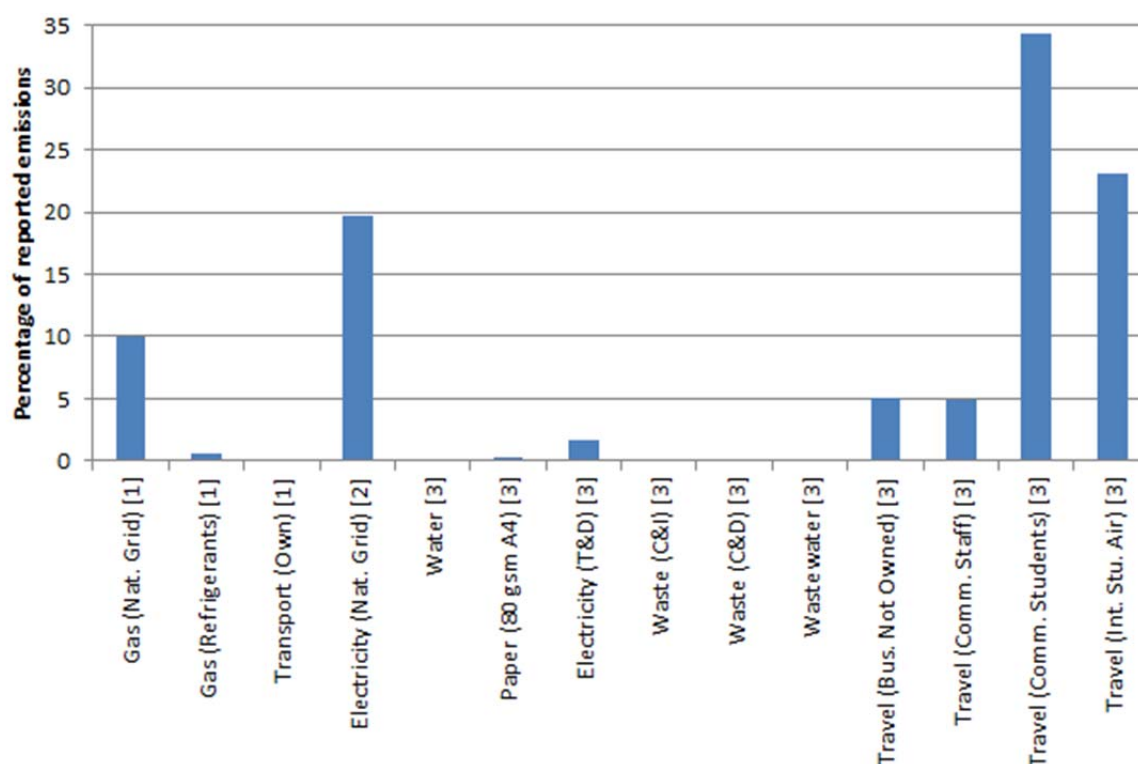


Figure 3 Distribution of GCU's total reported emissions (25,778 tonnes CO<sub>2</sub>e) for 2012-13. The number in square brackets indicates the emission scope.

To enable GCU to align its emissions reporting with current reporting standards and move towards full carbon accounting, the current report is based on a broader emissions inventory than that used in the original carbon footprint. Although data gaps limit the potential for direct comparisons between reported emissions in the two reporting periods, the available data is detailed in Table 3 (and discussed further ahead in the report).

Emission Category	Scope	Emission Activity	Tonnes CO <sub>2</sub> e	
			2008-2009	2012-2013
Organisation's buildings	1	Gas consumption	2,676	2,572
	1	Refrigerant Gases	N/A	152
Organisation's vehicles	1	Business travel (own fleet)	12	11
Purchased electricity	2	Electricity (Nat. Grid) Total	6,828	5,087
Purchased Goods & Services	3	Water	14	18
	3	Paper (80 gsm A4)	N/A	71
Capital Goods	3	Data not available.	N/A	N/A
Other fuel & energy related activities	3	Electricity (transmission & distribution losses)	541	435
Upstream transportation and distribution	3	Data not available.	N/A	N/A
Waste Generated in Operations	3	General Waste & Recycling	107	41
	3	Construction & Demolition Waste	N/A	1.4
	3	Wastewater	28	36
Business travel	3	Travel (business – not owned)	623 [P]	1,298
Employee commuting	3	Travel (commuting – staff)	1,120	1,281
	3	Travel (commuting – students)	N/A	8,884
	3	Travel (international students to Glasgow)	N/A	5,957
Upstream leased assets	3	No: not applicable.	N/A	N/A
Downstream transport and distribution	3	No: not applicable.	N/A	N/A
Processing of sold products	3	No: not applicable.	N/A	N/A
Use of sold products	3	No: not applicable.	N/A	N/A
End-of-life treatment of products	3	No: not applicable.	N/A	N/A
Downstream leased assets	3	No: not applicable.	N/A	N/A
Franchises	3	No: not applicable.	N/A	N/A
Investments	3	No: not applicable.	N/A	N/A

Scope 1 - Total		Direct combustion of fuels or release of certain gases (e.g. refrigerants).	2,688	2,735
Scope 2 - Total		Electricity purchased from the National Grid (exc. Transmission)	6,828	5,087
Scope 3 - Total		Activities outwith GCU's direct control.	2,433	17,981

Table 3 Summary of emissions by category for 2008-2009 and 2012-2013 reporting periods ([P] indicates a partial data).

The inclusion of additional emission categories in the 2012-2013 emission report should not be interpreted as an overall increase in GCU's emissions, but as a reflection of an improvement in GCU's understanding of its environmental impacts and its ability to collect associated data. Whilst this approach makes direct comparisons of total emissions difficult without further adjustments, it does permit more accurate tracking of changes across categories.

### Projection for 2013-2014

To determine progress towards the 2014 target, a number of assumptions were applied to the 2012-2013 data and compared to emissions for 2008-2009 using the categories in the original carbon

footprint report. The results are presented in Figure 4 and Table 4, with associated assumptions discussed below.

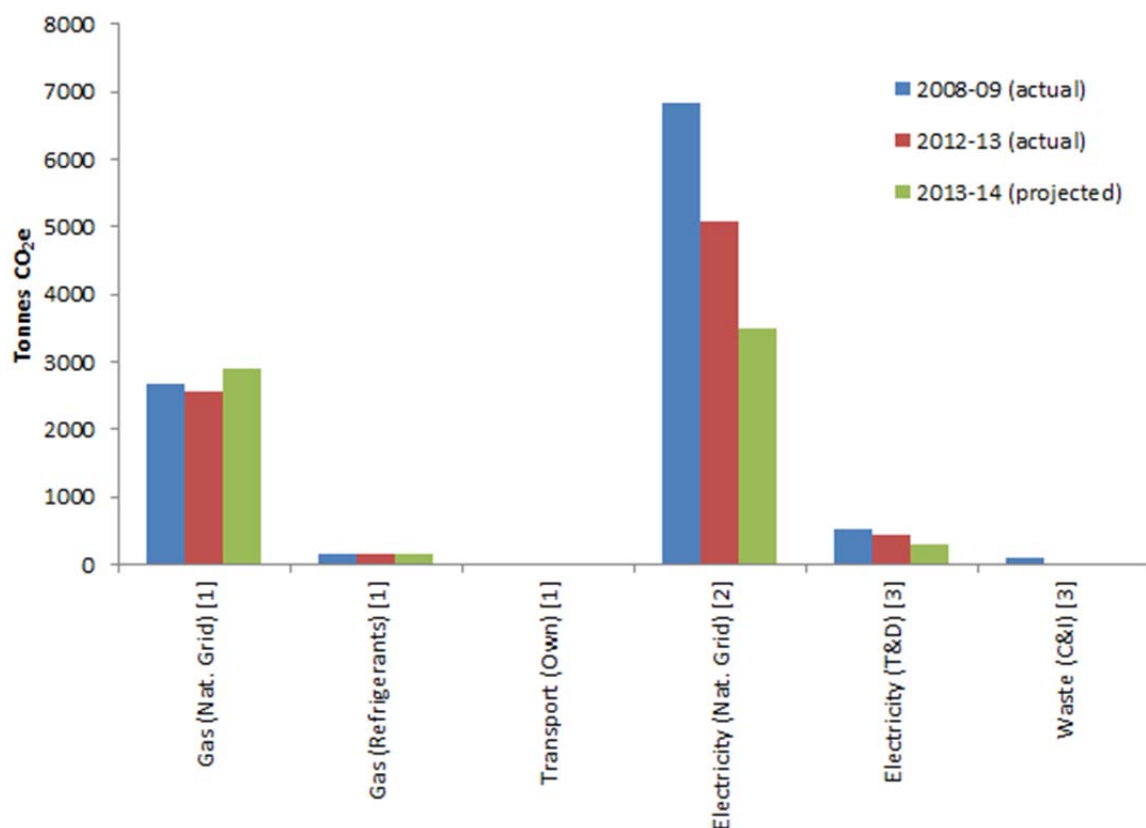


Figure 4 Emissions projections for 2013-14 using the categories used in the GCU's first carbon footprint.

Emission Source	Scope	Tonnes CO <sub>2</sub> e			% change 2008-09 & 2013-14
		2008-09	2012-13	2013-14	
Gas (Nat. Grid)	1	2,674	2,572	2,910	+9%
Gas (Refrigerants)	1	152	152	152	0%
Transport (Own)	1	12	11	11	-8%
Electricity (National Grid)	2	6,828	5,087	3,495	-49%
Electricity - Trans. & Dist. Losses (T&D)	3	541	435	302	-44%
General Waste & Recycling	3	107	41	20	-81%
Total		10,314	8,298	6,890	-33%

Table 4 Estimated emissions for 2013-2014 relative to the rebased emissions for 2008-2009.

The following assumptions were used to estimate emission projections for 2013-2014:

1. GCU installed a new Energy Centre to meet its heat and some of its electricity needs. As a result of it coming online, gas consumption in GCU City Campus will increase by 15% (relative to 2012-13).
2. Business travel other than on University-owned vehicles was excluded because the dataset for 2008-2009 was incomplete.
3. As a result of the new Energy Centre coming online, electricity purchased from the national grid for City Campus will decrease by 33% (relative to 2012-13), as will associated transmission and distribution losses.

4. Emissions from the use of GCU's fleet of vehicles (Business Travel (Own Fleet)) will remain unchanged (from the 2012-2013 levels).
5. Refrigerant losses from various equipment throughout GCU City Campus has remained unchanged from 2008-09 (no data available) to 2013-2014 (data not yet available).
6. GCU's waste contractor converts all non-recyclable waste into a refuse derived fuel, eliminating waste sent to landfill will reduced emissions (in 2012-2013 the proportion was around 20%)

These projections indicate that GCU is on track to achieve its 20% carbon reduction target by reducing emissions by 33% by 2014. The remainder of this section offers a more detailed evaluation of emissions within each category.

### Own Buildings – Scope 1 Emissions

Emissions in this category arise mainly from the combustion of natural gas for space and water heating and losses of refrigerant gases.

Whilst emissions from natural gas are significant (accounting for over 22% and 10% for the 2008-2009 and 2012-2013 emissions, respectively), emissions from refrigerant gases are not (they accounted for around 0.6% of the reported emissions in 2012-2013).

#### Gas from the National Grid

GCU uses gas from the National Grid primarily for space and water heating at GCU's City Campus and Phase 2 at Caledonian Court. Some gas is also be used in GCU's kitchens.

Gas use was determined from monthly meter readings. The quantities of gas used by GCU and resulting emissions are detailed in Table 5 for 2008-2009 and 2012-2013.

Emission Source	Scope	Quantity (kWh)		Emission Factors (kg CO <sub>2</sub> e / kWh)	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		08-09	12-13
Gas (C. Campus)	1	13,063,447	12,232,598	0.18404	2,404	2,251
Gas (C. Court 2)	1	1,474,518	1,741,850		271	321
Total	1				2,676	2,572

**Table 5 GCU's gas consumption (kWh) and related emissions (Tonnes CO<sub>2</sub>e) for 2008-2009 and 2012-2013 academic years. NB. 2008-2009 includes gas consumed in the premises formerly rented in Rose St, as the data was not sufficiently detailed to allow disaggregation (although it is not considered a significant source of emissions).**

Overall there has been a reduction in gas consumption in GCU, with energy efficiency improvements in the City Campus masking an increase in Caledonian Court's Phase 2. The increased in Caledonian Court is attributed to higher demand for heating in 2012-2013<sup>1</sup>.

It is anticipated that emissions in this category will increase in 2013-2014 due to GCU's the gas-fired combined heat and power plant in the new Energy Centre being projected to increase gas consumption in the City Campus by 15%.

<sup>1</sup> 2012-2013 had 2,649 heating degree days (HDD) whilst 2008-2009 had 2,470 HDD. HDD is a measurement designed to reflect the demand for energy needed to heat a building relative to outside air temperature.

### Refrigerant Gases

Refrigeration equipment is used to control temperature in a variety of buildings and equipment throughout GCU and whilst these are subject to a strict maintenance and testing regimes, uncontrolled gas releases occasionally occur.

Table 6 details the refrigerant losses during the 2012-2013 carbon footprint year (no data was available for 2008-2009), as recorded in GCU's maintenance logs for refrigeration equipment.

Emission Source	Scope	Quantity (kg)		Emission Factors (GWP: kg CO <sub>2</sub> e/ kg)	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		08-09	12-13
R134A	1	N/A	0.5	1,300	N/A	0.65
R410A	1	N/A	11.5	1,725	N/A	19.84
R407C	1	N/A	84.5	1,526	N/A	128.95
R442D	1	N/A	1.1	2,230	N/A	2.45
Total						151.89

Table 6 Refrigerant losses (kg) and total associated greenhouse gas emissions (Tonnes CO<sub>2</sub>e).

Whilst GCU actively inspects and leak tests refrigeration equipment on a regular basis (according to statutory guidance), it is not possible to speculate future emissions from losses from refrigerant equipment as these may arise as a result of extended use and age related equipment failure.

### Own Vehicles – Scope 1 Emissions

Emissions in this category arise from GCU fleet of light vehicles, which in the 2012-2013 period included: two cars, two small vans, one medium van and one minibus. The number and range of vehicles in GCU's fleet has remained relatively unchanged during the two reporting periods.

Emissions were calculated using data on distance travelled (km) during the baseline year (2008-2009) and litres fuel used 2012-2013 (the later provided by GCU's Transport Office). The resulting emissions from GCU's fleet, detailed in Table 7 below, are not significant (less than 1% for both carbon footprint periods).

Emission Source	Scope	Quantity		Emission Factors [Note1b]	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		2008-09	2012-13
Own fleet (petrol)	1	56,892 km	241 litres	0.2049 kg CO <sub>2</sub> e/km (08-09) 2.2144 kg CO <sub>2</sub> e/litre (12-13)	11.66	0.53
Own fleet (diesel)	1	N/A	3,934 litres	2.6008 kg CO <sub>2</sub> e/litre		10.23
Total					11.66	10.77

Table 7 Emissions (Tonnes CO<sub>2</sub>e) from GCU's own fleet of light vehicles.

Whilst no data was available for diesel consumption during the baseline year (2008-2009), it is noted that the spreadsheet for the original carbon footprint contained two separate entries for the same size of petrol vehicles (medium petrol vehicle), which raises the possibility of an error in the original calculation. There are no accuracy concerns for the data used for the 2012-2013 calculation. Changes in emissions in this category are not anticipated for 2013-2014.

### Purchased Electricity – Scope 2 Emissions

Until the summer of 2013, when GCU's Energy Centre came online (after the end of the 2012-2013 carbon footprint period), all of the electricity used at GCU was purchased from the National Grid.

Electricity is used primarily for lighting and powering equipment throughout GCU and also providing space and water heating in Phase 1 at Caledonian Court. The use of electricity is a significant source of emissions for GCU, respectively representing nearly 57% and 20% of emissions for the 2008-2009 and 2012-2013 carbon footprint periods.

Table 8 provides details of the quantities of electricity GCU purchased, based on meter reading summaries, for 2008-2009 and 2012-2013.

Emission Source	Scope	Quantity (kWh)		Emission Factors (kg CO <sub>2</sub> e / kWh)	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		08-09	12-13
Electricity (C. Campus)	2	12,963,254	10,513,146	0.49381 [2008-09]	6,401	4,683
Electricity (C. Court 1)	2	354,722	486,415	0.44548 [2012-13]	175	217
Electricity (C. Court 2)	2	509,866	420,619		252	187
Total					6,828	5,087

**Table 8 GCU's electricity consumption (kWh) and related emissions (Tonnes CO<sub>2</sub>e) for 2008-2009 and 2012-2013 academic years.**

The overall trend for electricity consumption and emissions is similar to that for gas: an overall reduction for GCU masking an increase from Phase 1 in Caledonian Court.

Whilst a decrease in electricity in Phase 2 could be attributed to energy efficiency improvements, the increased consumption in Phase 1 could not, and it is possible that it reflects a colder winter (in line with the trend observed for Phase 2, which is heated using gas).

It is anticipated that GCU's new Energy Centre will meet around 30% of the University's electricity needs and as a result a reduction in associated emissions for 2013-2014 is expected.

### Purchased Goods & Services – Scope 3 Emissions

Emissions from purchased goods and services represent emissions up to the point of delivery to GCU. Excluding travel, of the goods and services that GCU purchases data was only available for water and (A4) paper. Improving its understanding of emissions in this category should be an area of focus for future carbon reports.

#### Water

All water used in GCU premises is mains water, but due to operational boundaries and building classification, data is only available for City Campus.

GCU's water consumption, detailed in Table 9, is not a significant source of emissions (representing less than 1% of emissions for both carbon footprint periods).

Emission Source	Scope	Quantity (m <sup>3</sup> )		Emission Factors (kg CO <sub>2</sub> e/m <sup>3</sup> )	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		08-09	12-13
Water	3	42,000	53,055	0.3441	14	18

**Table 9 Water consumption and associated emissions at GCU's City Campus during the 2008-2009 and 2012-2013 carbon footprint years.**

Whilst Caledonian Court is classified as residential and therefore does not have a meter, its administration block isn't and water used there is metered. However, no data for water consumed in Caledonian Court's administration block was available. Data for Buchanan House and GCU London



were excluded because water is included in the rental agreements for these properties and GCU has limited operational control over them.

We recognise that this may introduce some scope for error, but note that the overall impact on GCU's emissions is likely to be negligible, as water is not a significant source of emissions.

### Paper

Purchased paper was the other item in this category whose emissions were readily quantifiable, albeit just for A4 80 gsm white paper (which accounts for 84% of GCU's expenditure on paper products).

Data for paper use was only available for the carbon footprint period of 2012-2013 and details of GCU's A4 paper consumption and associated emissions, which just under 0.3% of reported emissions, are detailed in Table 10.

Emission Source	Scope	Quantity (tonnes)		Emission Factors (kg CO <sub>2</sub> e/ tonne)	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		08-09	12-13
Paper (80 gsm A4) – not recycled	3		74	954.5129		71

**Table 10 Quantity of A4 paper used at GCU and associated emissions for 2012-13.**

It is not possible to predict changes in emissions from paper for 2013-2014. However, switching to paper with a greater recycled content could be a simple mechanism for achieving a modest reduction in GCU's greenhouse gas emissions (GCU uses Antalis 80gsm A4 White Image Business paper, which is FSC certified but does not contain any recycled content).

### Other Fuel & Energy Related Activities – Scope 3 Emissions

Emissions in this category are attributed to transmission and distribution losses for electricity purchased from the National Grid (based on electricity meter readings).

Transport and distribution losses for electricity from the National Grid are not significant in either of the reporting periods, representing 4.5% and just under 2% of total reported emissions in 2008-2009 and 2012-2013 respectively.

Emission Source	Scope	Quantity (kWh)		Emission Factors (kg CO <sub>2</sub> e / kWh)	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		08-09	12-13
Transmission & Distribution	3	13,827,842	11,420,180	0.03910 [2008-09] 0.03809 [2012-13]	541	435

**Table 11 Emissions (Tonnes CO<sub>2</sub>e) attributed to transmission and distribution losses for electricity (kWh) purchased from the National Grid.**

Emissions in this category are proportional to the amount of electricity purchased from the National Grid. For 2013-2014, it is anticipated that there will be a reduction in emissions due to GCU's Energy Centre reducing the amount of electricity purchased from the National Grid.

### Waste Generated in Operations – Scope 3 Emissions

Three activities contributed emissions to this category: general waste and recycling (C&I waste), construction and demolition waste (C&D waste) and wastewater treatment.



### General Waste & Recycling (C&I)

Emissions associated with managing GCU's waste and recycling were calculated from returns submitted by the various contractors involved. Whilst there has been an 62% reduction in emissions between the two reporting periods (2008-2009 and 2012-2013), waste and recycling is not a significant source of emissions for GCU. The breakdown of emissions by waste stream and treatment option is provided Table 12.

Emission Source	Scope	Quantity (Tonnes)		Emission Factors (kg CO <sub>2</sub> e/tonne)	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		08-09	12-13
General – Landfilled	3	383 [A]	38.82 [E]	199	76.07	7.73
General - Refuse derived fuel (RDF)	3	0	11.04 [E]	21	0	0.23
Mixed - Recycling	3	33.2 [E]	323.9 [A]	21	0.70	6.80
Anaerobic Digestion	3	0	49.79 [E]	21	0	1.05
Glass Recycling	3	0	1.63 [E]	21	0	0.03
Paper Recycling	3	0	9.18 [E]	21	0	0.19
Large WEEE Recycling	3	N/A	0.24 [A]	21	0	0.01
Small Mixed WEEE Recycling	3	N/A	18.52 [E]	21	0	0.39
Cal. Court - General – Landfilled	3	150 [E]	125 [E]	199	30	25
Cal. Court - Mixed - Recycling	3	5.8 [E]	2 [E]	21	0.12	0.04
Total	3	580	453		106.89	41.47

**Table 12 Quantity of general waste and recycling produced at GCU, by treatment type, and associated emissions (waste generated in Caledonian Court is listed separately.). Quantities with an [A] are actual, whilst those with an [E] are estimated.**

The reduction in emissions associated with managing GCU's waste is attributed to the introduction of a new waste management service, which maximised recycling by separating food waste for treatment at an anaerobic digestion facility. In June 2013 the performance of the service was further enhanced when GCU's waste contractor announced that residual waste was being converted into a fuel rather than landfilled.

Emissions from general waste and mixed recycling at GCU were calculated using emission factors for Commercial & Industrial wastes, which are the ones that most closely reflect the type of waste produced at GCU.

The above data includes waste arising from GCU London, which GCU can influence how its managed, but not from Buchanan House. A small quantity of waste chemicals (less than a tonne) are produced by GCU's laboratories, but due to the small volumes involved, estimated quantities and resulting low (not significant) emissions do not warrant inclusion in this carbon footprint.

A further reduction in emissions is anticipated for 2013-2014 as the impact of converting general waste into a fuel, rather than landfilling it, becomes apparent.

### Construction & Demolition Wastes (C&D waste)

In preparation for future building works, GCU demolished a building and attached warehouse in 82-90 Dobbies Loan, a piece of land adjacent to City Campus, during the 2012-2013 period. There is no data for 2008-2009 as no similar work was carried during that period.

The demolition contractor provided data on the quantities of materials re-used or removed from the site (summarised in Table 13). Emissions from this source are not significant as they represent less than 1% of total emissions for the reporting period of 2012-2013.

Emission Source	Scope	Quantity (Tonnes)		Emission Factors (kg CO <sub>2</sub> e/tonne)	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		08-09	12-13
Brick + Concrete (R)	3	0	69.36	1	0	0.07
Rough Wood (R)	3	0	19.94	21	0	0.42
Mixed Waste (L)	3	0	21.96	2	0	0.04
Asbestos (L)	3	0	1.68	2	0	0.00
Clean Soil (R)	3	0	420	1.488503	0	0.63
Crusher Run (R)	3	0	240	1	0	0.24
Total	3					1.40

**Table 13 Demolition materials removed from 82-90 Dobbies Loan and associated emissions.**

Emissions from construction and demolition wastes could have accounted for a greater proportion of reported emissions if the contractor had not re-used 80% of the soil and crushed run (materials crushed on site) on site.

It is unlikely that any emissions will be reported for the 2013-2014 period, as no construction work was planned for that period.

## Wastewater Treatment

Volumes of wastewater produced at GCU were determined using Scottish Water's assumption (and basis for billing) that 95% of mains water ends up as wastewater. Quantities of wastewater produced and associated emissions for treating wastewater produced at GCU are detailed in Table 14.

Wastewater treatment is not a significant source of emissions for GCU, accounting for around 0.1% of total reported emissions in both periods.

Emission Source	Scope	Quantity (m <sup>3</sup> )		Emission Factors (kg CO <sub>2</sub> e/m <sup>3</sup> )	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		08-09	12-13
Wastewater	3	39,900	50,402	0.7085	28	36

**Table 14 Wastewater volumes and associated emissions at GCU.**

It is not clear why there has been an increase in consumption (although a desktop evaluation of data by the water supplier does not indicate leakages being a problem). Data was not available for Caledonian Court, which because of its residential status has unmetered water, or Buchanan House and GCU London because GCU has limited operational control over them.

## Business Travel – Scope 3 Emissions

This category in GCU's emissions inventory contains details of activities associated with travel using vehicles not owned by GCU and public transport. Emissions were determined using a wide range of data sources, which included: GCU car hire supplier, GCU's Finance Office summary of mileage payments and returns from GCU's Travel Agents.

Emissions associated with GCU's business travel, detailed in Figure 5 and Table 15, are around the 5% significance threshold for both reporting periods.

## Carbon Footprint Report

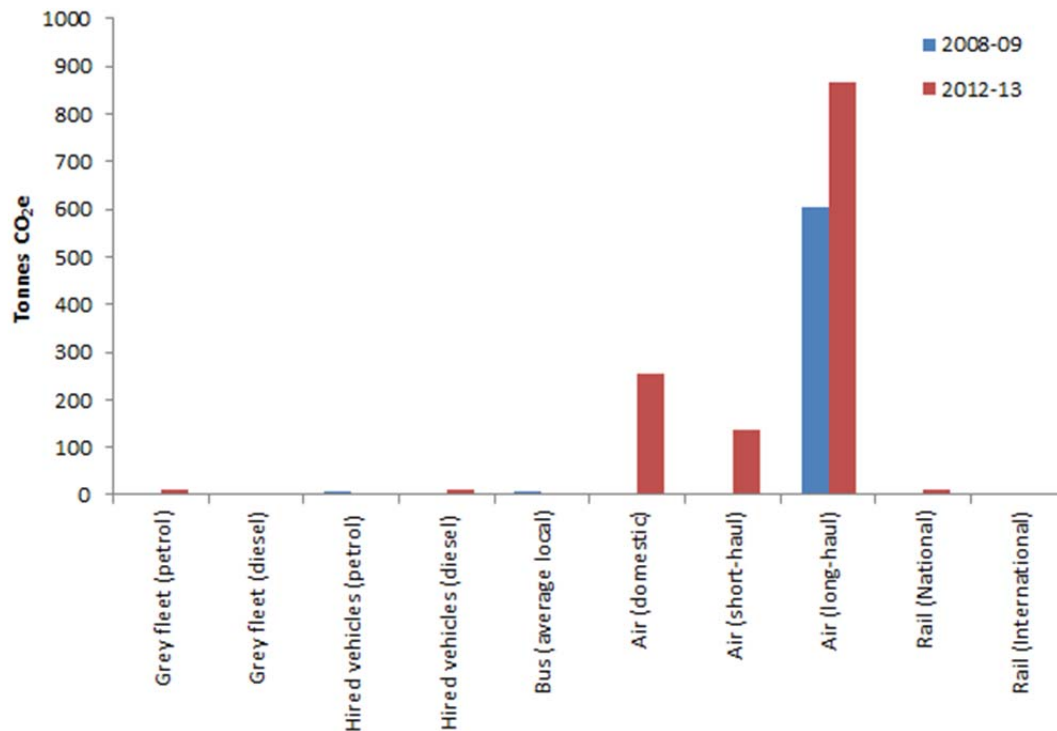


Figure 5 Air travel accounts for a significant proportion of GCU's travel emissions.

Emission Source	Scope	Quantity		Emission Factors	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		08-09	12-13
Grey fleet <sup>2</sup> (petrol)	3	N/A	33,511 miles	0.329755 kg CO <sub>2</sub> e/mile		11.05
Grey fleet (diesel)	3	N/A	19,086 miles	0.281233 kg CO <sub>2</sub> e/mile		5.37
Grey fleet (hybrid)	3	N/A	850 miles	0.184624 kg CO <sub>2</sub> e/mile		0.16
Hired vehicles (petrol)	3	25,157 miles	12,997 miles	0.329755 kg CO <sub>2</sub> e/mile	8.30	4.29
Hired vehicles (diesel)	3	18,765 miles	45,217 miles	0.281233 kg CO <sub>2</sub> e/mile	5.28	12.72
Bus – Local (average)	3	54,815 km	N/A	0.111621 kg CO <sub>2</sub> e/pass. km	6.12	
Air – Domestic (average)	3	N/A	773,876 km	0.326615 kg CO <sub>2</sub> e/pass. km		252.76
Air – Short-haul (average)	3	N/A	705,549 km	0.192457 kg CO <sub>2</sub> e/pass. km		135.79
Air – Long-haul (average)	3	2,665,332 km	3,822,491 km	0.226528 kg CO <sub>2</sub> e/pass.km	603.77	865.90
Rail – National	3	N/A	194,648 km	0.04904 kg CO <sub>2</sub> e/pass.km		9.55
Rail - International	3	N/A	10,351 km	0.01235 kg CO <sub>2</sub> e/pass.km		0.13
Total					633.41	1,309.26

Table 15 Emissions attributed to business travel in not owned vehicled and public transport.

<sup>2</sup> Grey fleet is the term for the use of private vehicles for business travel.

Whilst it may appear that emissions from business travel doubled between 2008-2009 and 2012-2013, it is in fact not the case. The data set for 2008-2009 was incomplete and did not provide an accurate reflection of emissions from GCU business travel. The 2012-2013 dataset provides a much more comprehensive insight into the carbon impact of business travel at GCU.

However, whilst there are some gaps in the data available for the two reporting periods, the dataset for the 2012-2013 reporting period is sufficiently complete that gaps are not considered to be significant.

Whilst data improvements are apparent, it is worthwhile highlight the following gaps:

- Emissions from bus travel were not included in the inventory for the 2012-2013 reporting period because the necessary data was not readily available.
- The 2008-2009 dataset only included data for long-haul flights. Data provided by GCU's travel agents enable the use of a more complete dataset for the 2012-2013 reporting period. However, we're aware of some air travel booked directly by staff and cannot claim that the dataset is complete. Notwithstanding this, it has been assumed that travel booked directly is the exception and does not materially affect the significance of emissions arising from air travel.

More detail about the different methodologies used to calculate emission attributed to GCU's travel emission during the 2012-2013 reporting period is available from Appendix C - Supplementary Methodologies

Due to varied and complex nature of this dataset, no predictions for emissions in this category will be attempted for 2013-2014.

### Employee Commuting – Scope 3 Emissions

This category includes emissions from employee commuting and, for completeness student commuting and international student travel. Emissions for each are discussed individually below.

#### Staff Commuting

Emissions from commuting were derived by extrapolating responses from travel (commuting) surveys carried out in 2009 and October 2012<sup>3</sup>. Emissions from staff commuting, detailed in Figure 6 and Table 16, represented around 9% of the total reported emissions for 2008-2009 and just fewer than 5% for 2012-2013.

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<sup>3</sup> 568 members of staff (nearly a third) completed the 2012 Travel Survey.

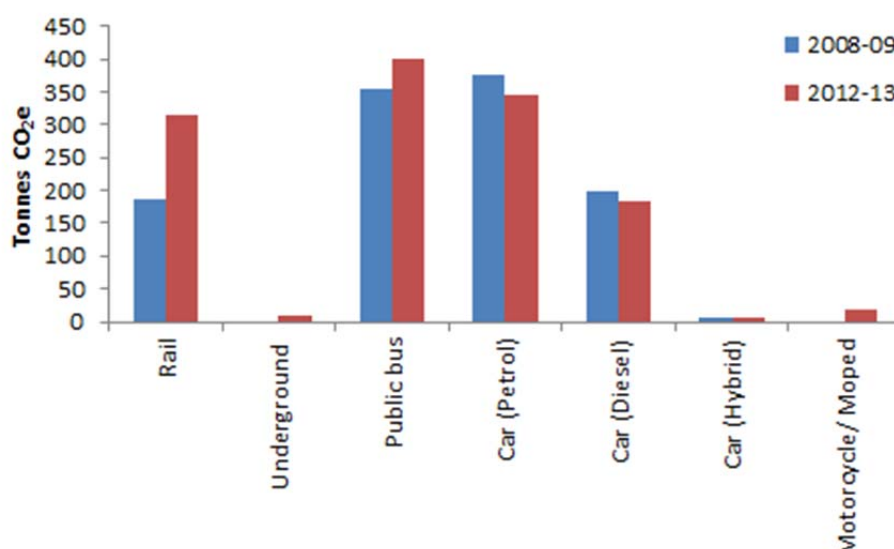


Figure 6 Distribution of reported emissions attributed to staff commuting during the two reporting periods.

Emission Source	Scope	Quantity		Emission Factors	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		08-09	12-13
Rail	3	3,789,370 km	6,423,502 km	0.04904 kg CO <sub>2</sub> e/pass. km	186	315
Underground	3	N/A	166,054 km	0.06006 kg CO <sub>2</sub> e/pass.km	N/A	10
Public bus	3	2,869,727 km	3,259,591 km	0.123218 kg CO <sub>2</sub> e/pass. km	354	402
Car (Petrol)	3	1,896,580 km	1,747,209 km	0.19811 kg CO <sub>2</sub> e/ km	376	346
Car (Diesel)	3	1,080,173 km	995,101 km	0.18322 kg CO <sub>2</sub> e/ km	198	182
Car (Hybrid)	3	48,095 km	44,307 km	0.13103 kg CO <sub>2</sub> e/ km	6	6
Motorcycle/ Moped	3	N/A	101,186 miles	0.191367 kg CO <sub>2</sub> e/ km	N/A	19
Total					1,120	1,280

Table 16 Estimated emissions (Tonnes CO<sub>2</sub>e) from GCU staff commuting.

Emissions from staff commuting during the 2008-2009 reporting period were calculated using data used in the original carbon footprint and derived from a travel survey included in Travel Plan developed by VIPRE with funding from the Energy Saving Trust 2009<sup>4</sup>. For the 2012-2013 reporting period, emissions were calculated using the responses from the 2012 travel survey, which included details of frequency, modes of transport used and distance travelled by staff to commute to GCU. The methodology and assumptions used to estimate these emissions are detailed Appendix C - Supplementary Methodologies

Whilst the two data sets are not directly comparable, it appears that there has been a reduction in emissions arising from commutes made by car. A more detailed evaluation of the travel results in

<sup>4</sup> VIPRE (2009) Travel Plan Report – Glasgow Caledonian University Staff Travel (TP/0809/79)  
Version: 5b (Final)  
Version Date: 10 June 2014  
Author: Paulo Cruz

will reveal whether there have been any changes the modes of transport staff use to commute to GCU.

Emissions are not anticipated to change significantly for 2013-2014, as activity around encouraging GCU staff to adopt more sustainable modes of travel is likely to be limited.

### Student Commuting

Whilst reporting emissions associated with student commuting is voluntary, the decision was taken to include them in the 2012-2013 reporting period to help develop an understanding of GCU's wider carbon footprint and explore opportunities for reducing it. No data was available for student commuting in 2008-2009.

Emissions from commuting were derived by extrapolating responses from the travel (commuting) survey carried out in October 2012<sup>5</sup>. In the 2012-2013 reporting period, emissions from student commuting (detailed in Table 17 and Figure 7) represented around 34% of reported emissions making student commuting a significant source of emissions for this reporting period.

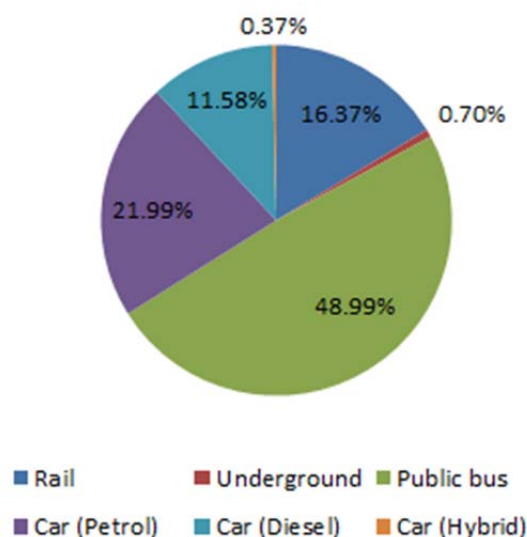


Figure 7 Modal distribution (percentage) of emissions from student commuting to GCU.

Emission Source	Scope	Quantity 2012-2013	Emission Factors	Tonnes CO <sub>2</sub> e
Rail	3	29,522,152 km	0.04904 kg CO <sub>2</sub> e/pass. km	1,488
Underground	3	1,026,464 km	0.06006 kg CO <sub>2</sub> e/pass. km	62
Public bus	3	35,163,375 km	0.123218 kg CO <sub>2</sub> e/pass. km	4,333
Car (Petrol)	3	9,815,659 km	0.19811 kg CO <sub>2</sub> e/ km	1,945
Car (Diesel)	3	5,590,386 km	0.18322 kg CO <sub>2</sub> e/ km	1,024
Car (Hybrid)	3	248,914km	0.13103 kg CO <sub>2</sub> e/ km	33
Total				8,885

Table 17 Estimates emissions (Tonnes CO<sub>2</sub>e) from student commuting to GCU.

<sup>5</sup> 1239 students (nearly 10%) completed the 2012 Travel Survey.

No baseline data (for 2008-2009) was available to estimate emissions from student commuting. For the 2012-2013 reporting period, emissions were estimated following the same approach as that used for staff commuting.

Emissions are not anticipated to change significantly for 2013-2014, as activity around encouraging GCU students to adopt more sustainable modes of travel is likely to be limited.

### International Student Travel

Reporting emission associated with international students travelling to Glasgow is also voluntary, but have been included in the 2012-2013 reporting period for the same reasons as student commuting.

Emissions associated with GCU's international students travelling to Glasgow were estimated by extrapolating data from a survey investigating how international students travel to Glasgow and carried out in March 2014.

Emissions in this category, detailed in Table 17, account for around 23% of reported emissions and represent a significant source of emissions for 2012-2013.

Region	No. Students	Survey (n)	Total km/year	Tonnes CO <sub>2</sub> e
Africa - N	32	1	231,184	52.37
Africa - C	9	1	200,008	45.31
Africa - W	192	17	2,131,386	482.82
Africa - E	7	0	152,510	34.55
Africa - S	28	0	651,168	147.51
Europe	544	32	5,034,370	968.90
Asia - C	27	0	418,786	94.87
Asia - E	185	16	4,302,360	974.61
Asia - SE	97	11	2,465,082	558.41
Asia - S	181	9	2,800,196	634.32
America - N	70	6	1,874,880	424.71
America - S	47	18	1,904,196	431.35
America - C	9	0	300,048	67.97
Middle East	193	11	4,409,656	998.91
Australasia	5	1	177,240	40.15
Totals	1,626	123	27,053,070	5,956.75

Table 18 Estimated emissions (Tonnes CO<sub>2</sub>e) associated with GCU's international student travelling to Glasgow.

The methodology used to estimate these emissions is detailed Appendix C - Supplementary Methodologies. No estimated of emissions from international student travelling were made for 2008-2009 as no baseline data was available.

The above data is not sufficiently detailed to speculate on direction in future years. But as our understanding of how international students travel develops, we will be able to use the data to explore reducing our emissions without detriment to GCU's internationalisation strategy.

### Excluded Categories - Scope 3 Emissions

This section outlines the rationale for excluding a number of emission categories detailed in The Greenhouse Gas Protocol's Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2011) from GCU's emission inventory.

Below is a list of the emissions and associated rationale for excluding from the emission inventory for the 2012-2013 period:

- **Capital goods**: No data available. A strategy needs to be developed for identifying capital goods and for collating associated emission data.
- **Upstream transportation and distribution**: No data available. A strategy needs to be developed for identifying organisations delivering goods to GCU and for collating associated emission data.
- **Upstream leased assets**: Not applicable as GCU has no assets that would fall within this category.
- **Downstream transport and distribution**: Not applicable, as GCU does not require any downstream transportation or distribution.
- **Processing of sold products**: Not applicable, as GCU does not sell any physical products.
- **Use of sold products**: Not applicable (as above).
- **End-of-life treatment of products**: Not applicable (as above).
- **Downstream leased assets**: Not applicable, as GCU does not have any downstream leased assets.
- **Franchises**: Not applicable, as GCU does not have any franchises.
- **Investments**: Not applicable, as GCU does not have any investments.

### Discussion & Next Steps

Since GCU first reported its carbon emissions in 2010, much progress has been made understanding how different aspects of GCU's operations contribute greenhouse emissions, both directly and indirectly, and what opportunities exist for mitigating them.

This understanding has resulted in a concerted effort to implement GCU's Carbon Management Plan and implement the EcoCampus Environmental Management System. Combined these have resulted in a reduction in emissions (as evident from Table 3 and Table 4), which coupled with the completion of a number of developments anticipated for 2013-2014, indicate that GCU is well positioned to meet its 20% target for 2014 and likely to surpass it.

However, whilst this will be a notable achievement, GCU's wider sustainability aspirations and commitment to supporting the Scottish and UK Governments carbon reduction targets, it is imperative that momentum is sustained. Within this context, this report provides a stepping stone for GCU to:

- Identify additional scope 1 and 2 carbon reduction opportunities and incorporate into a revised Carbon Management Plan.



- Identify opportunities and develop appropriate initiatives for reducing scope 3 emission, e.g. by focusing on promoting more sustainable travel (business and commuting).
- Work with suppliers to further develop GCU's understanding of its indirect emissions (scope 3) and broaden the range of categories in its emissions inventory.
- Use the data from this report to develop a broader environmental report celebrating GCU's environmental achievements.

Combined, the output from the above activities will help GCU sustain momentum for further improvements in its environmental performance over the next five to ten years.

## **Appendix A - Strategy for Managing GCU's Emission Inventory**

Overleaf is an outline strategy for managing GCU's emissions inventory which will enable GCU to move towards full carbon accounting by reporting emissions in a consistent and timely manner.

GHG Protocol Emission Category	Scope	Emission Activity	Data Observations & Opportunities	Source	Quantity	Emission Factors		Reported Emissions (Tonnes CO <sub>2</sub> e & %)		Data Owner
Organisation's buildings	1	Gas consumption	Complete, accurate data available from Estates' Utilities Monitoring spreadsheet, which is based on meter readings.	City Campus	12,232,598 kWh	0.18404	kg CO <sub>2</sub> e.kWh	2,251	9.97%	Estates Manager (GCU Facilities Management)
				Caledonian Court (P2)	1,741,850 kWh	0.18404	kg CO <sub>2</sub> e.kWh	321		
	1	Refrigerant Gases	Complete, accurate data available from the refrigeration register and contractor records.	R134A	0.5 kg	1300	kg CO <sub>2</sub> e.kg	0.65	0.59%	Celsius Cooling (refrigeration maintenance contractor)
				R410A	11.5 kg	1725	kg CO <sub>2</sub> e.kg	19.84		
				R407C	84.5 kg	1526	kg CO <sub>2</sub> e.kg	128.95		
				R442D	1.1 kg	2230	kg CO <sub>2</sub> e.kg	2.45		
Organisation's vehicles	1	Business travel (own fleet)	Complete, accurate for data 2012-2013 provided from fuel card records.	Petrol	241 litres	2.2144	kg CO <sub>2</sub> e.km	0.53	0.04%	Transport Team (GCU Facilities Management)
				Diesel	3934 litres	2.6008	kg CO <sub>2</sub> e.km	10.23		
Purchased electricity	2	Electricity (Nat. Grid) Total	Complete, accurate data available from Estates' Utilities Monitoring spreadsheet, which is based on meter readings.	City Campus	10,513,146 kWh	0.44548	kg CO <sub>2</sub> e.kWh	4,683	19.72%	Estates Manager (GCU Facilities Management)
				Caledonian Court (P1)	486,415 kWh	0.44548	kg CO <sub>2</sub> e.kWh	217		
				Caledonian Court (P2)	420,619 kWh	0.44548	kg CO <sub>2</sub> e.kWh	187		
Purchased Goods & Services	3	Water	Complete, accurate data available from Estates' Utilities Monitoring spreadsheet, which is based on meter readings. No water data for Caledonian Court.	City Campus	53,055 m <sup>3</sup>	0.3441	kg CO <sub>2</sub> e.m <sup>3</sup>	18	0.07%	Estates Manager (GCU Facilities Management)
	3	Paper (80 gsm A4)	Due to time constraints, only white A4 80 gsm paper (84% of GCU's expenditure on paper) was used for the 2012-2013 report. Although unlikely to represent a significant proportion of emissions, there is scope to increase the proportion of paper included in future GCU's emissions reports.	GCU	74.25 tonnes (based on: 29,760 reams)	954.51	kg CO <sub>2</sub> e.tonne	70.87	0.27%	Print & Design Services (GCU)
	3	General	Data on expenditure available. Work with suppliers to increase the range of purchased goods and services included in future reports.	N/A	N/A	N/A	N/A	N/A	N/A	Procurement (GCU)
Capital Goods	3	Data not available.	Unclear about what data is available. Work with GCU Procurement and Finance teams to identify capital goods for inclusion in future emission inventories.	N/A	N/A	N/A	N/A	N/A	N/A	Procurement & Finance Teams (GCU)
Other fuel & energy related activities	3	Electricity (transmission & distribution losses)	Complete, accurate data, derived from Estates' Utilities Monitoring spreadsheet, which is based on meter readings.	City Campus & Caledonian Court (P1 & P2).	11,420,180	0.03809	kg CO <sub>2</sub> e.kWh	435	1.69%	Estates Manager (GCU Facilities Management)
Upstream transportation and distribution	3	Data not available.	Data not available, but unlikely to be a significant source of emissions, as emissions from this category are only likely to include deliveries to GCU, which tend to be for consumables and catering supplies. Delivery survey would be required and consultation with suppliers to determine vehicle types, delivery frequencies and distances travelled. Various internal stakeholders likely to be involved (e.g. Security, gatehouse, catering).	N/A	N/A	N/A	N/A	N/A	N/A	Sustainability Officer (GCU Facilities Management)
Waste Generated in Operations	3	General Waste & Recycling	Comprehensive data set with weights provided by GCU's waste contractors. Some values estimated.	C&I Waste – Landfill	38.82 tonnes	199	kg CO <sub>2</sub> e.tonne	7.73	0.16%	Sustainability Officer (GCU Facilities Management)
				C&I Waste – Combustion	11.04 tonnes	21	kg CO <sub>2</sub> e.tonne	0.23		
				C&I Waste – Recycling	323.9 tonnes	21	kg CO <sub>2</sub> e.tonne	6.80		
				Organic: Food & drink waste AD	49.79 tonnes	21	kg CO <sub>2</sub> e.tonne	1.05		
				Glass – Recycling	1.63 tonnes	21	kg CO <sub>2</sub> e.tonne	0.03		

GHG Protocol Emission Category	Scope	Emission Activity	Data Observations & Opportunities	Source	Quantity	Emission Factors		Reported Emissions (Tonnes CO <sub>2</sub> e & %)		Data Owner
				Paper - Recycling	9.18 tonnes	21	kg CO <sub>2</sub> e.tonne	0.19		
				WEEE – large – Recycling	0.24 tonnes	21	kg CO <sub>2</sub> e.tonne	0.01		
				WEEE – small - Recycling	18.52 tonnes	21	kg CO <sub>2</sub> e.tonne	0.39		
				Cal. Court - General – Landfilled	125 tonnes	199	kg CO <sub>2</sub> e.tonne	25.00		
				Cal. Court - Mixed - Recycling	2 tonnes	21	kg CO <sub>2</sub> e.tonne	0.04		
	3	Construction & Demolition Waste	Complete and comprehensive data set with weights provided by the demolition contractor.	Brick + Concrete – Recycling	69.36 tonnes	1	kg CO <sub>2</sub> e.tonne	0.07	0.01%	Estates Project Manager (GCU Facilities Management)
				Rough Wood - Recycling	19.94 tonnes	21	kg CO <sub>2</sub> e.tonne	0.42		
				Mixed Waste – Landfill	21.96 tonnes	2	kg CO <sub>2</sub> e.tonne	0.04		
				Asbestos – Landfill	1.68 tonnes	2	kg CO <sub>2</sub> e.tonne	0.00		
				Clean Soil – Recycling	420 tonnes	1.49	kg CO <sub>2</sub> e.tonne	0.63		
				Crusher Run - Recycling	240 tonnes	1	kg CO <sub>2</sub> e.tonne	0.24		
	3	Wastewater	Complete and accurate data, based on water consumption figures from the Estates' Utilities Monitoring spreadsheet, which is based on meter readings. Assumed 95% of water supplied becomes wastewater.	City Campus	50,402 m <sup>3</sup>	0.7085	kg CO <sub>2</sub> e.m <sup>3</sup>	36	0.14%	Estates Manager (GCU Facilities Management)
Business travel	3	Travel (business – not owned)	Generally a comprehensive set of data. Scope for improvement in internal data collection, especially expense returns submitted through i-expenses.	Grey fleet – Medium petrol car	33,511 miles	0.329755	kg CO <sub>2</sub> e/mile	11.05	5.03%	Finance
				Grey fleet – Medium diesel car	19,086 miles	0.281233	kg CO <sub>2</sub> e/mile	5.37		
				Grey fleet – Medium hybrid car	850 miles	0.184624	kg CO <sub>2</sub> e/mile	0.16		
				Hired – Medium petrol car	12,997 miles	0.329755	kg CO <sub>2</sub> e/mile	4.29		Arnold Clark (car hire supplier)
				Hired – Medium diesel car	45,217 miles	0.281233	kg CO <sub>2</sub> e/mile	12.72		
				Bus – local	N/A	N/A	N/A	N/A		Finance
				Air – Domestic (average)	773,876 km	0.326615	kg CO <sub>2</sub> e/pass.km	252.76		Finance, Procurement & GCU's travel agents
				Air – Short-haul (average)	705,549 km	0.192457	kg CO <sub>2</sub> e/pass.km	135.79		
				Air – Long-haul(average)	3,822,491 km	0.226528	kg CO <sub>2</sub> e/pass.km	865.90		
				Rail – National	194,648 km	0.04904	kg CO <sub>2</sub> e/pass.km	9.55		
				Rail - International	10,351 km	0.01235	kg CO <sub>2</sub> e/pass.km	0.13		
Employee commuting	3	Travel (commuting – staff)	Derived from the 2012 Travel Survey. Comprehensive. Potential to re-use in subsequent reports, provided new travel initiatives are implemented that could disrupt the modal distribution for travel to GCU.	Rail	6,423,502 km	0.04904	kg CO <sub>2</sub> e/pass.km	315	4.96%	Sustainability Officer (GCU Facilities Management)
				Underground	173,011 km	0.06006	kg CO <sub>2</sub> e/pass.km	10		
				Public bus	3,259,591 km	0.123218	kg CO <sub>2</sub> e/pass.km	402		
				Car (Petrol)	1,747,209 km	0.19811	kg CO <sub>2</sub> e/km	346		
				Car (Diesel)	995,101 km	0.18322	kg CO <sub>2</sub> e/km	182		
				Car (Hybrid)	44,307 km	0.13103	kg CO <sub>2</sub> e/km	6		
				Motorcycle/ Moped	101,186 km	0.191367	kg CO <sub>2</sub> e/pass.km	19		
	3	Travel (commuting – students)	Derived from the 2012 Travel Survey. Comprehensive. Potential to re-use in subsequent reports, provided new travel initiatives are implemented that could disrupt the modal distribution for travel to GCU.	Rail	29,522,152 km	0.04904	kg CO <sub>2</sub> e/pass.km	1,448	34.27%	Sustainability Officer (GCU Facilities Management)
				Underground	1,026,464 km	0.06006	kg CO <sub>2</sub> e/pass.km	62		
				Public bus	35,163,375 km	0.123218	kg CO <sub>2</sub> e/pass.km	4,333		
				Car (Petrol)	9,815,659 km	0.19811	kg CO <sub>2</sub> e/km	1,945		
				Car (Diesel)	5,590,386 km	0.18322	kg CO <sub>2</sub> e/km	1,024		
				Car (Hybrid)	248,914 km	0.13103	kg CO <sub>2</sub> e/km	33		
	3	Travel (international students to Glasgow)	Extrapolated responses from the International student travel survey (March 2014) to the international student population at CGU during the 2012-2013 reporting period. Scope for improving how students travel. Subsequent survey is recommended for future reports.	International students' travel to Glasgow (long-haul).	22,018,700 km	0.192457	kg CO <sub>2</sub> e/pass.km	4,988	23.09%	Sustainability Officer (GCU Facilities Management)
				International students' travel to Glasgow (short-haul).	5,034,370	0.226528	kg CO <sub>2</sub> e/pass.km	969		
Upstream leased assets	3	No: not applicable.	GCU has no assets that would fall within this category.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Downstream	3	No: not	GCU does not require any downstream	N/A	N/A	N/A	N/A	N/A	N/A	N/A

GHG Protocol Emission Category	Scope	Emission Activity	Data Observations & Opportunities	Source	Quantity	Emission Factors		Reported Emissions (Tonnes CO2e & %)		Data Owner
transport and distribution		applicable.	transportation or distribution							
Processing of sold products	3	No: not applicable.	GCU does not sell any physical products	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Use of sold products	3	No: not applicable.	GCU does not sell any physical products	N/A	N/A	N/A	N/A	N/A	N/A	N/A
End-of-life treatment of products	3	No: not applicable.	GCU does not sell any physical products	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Downstream leased assets	3	No: not applicable.	GCU does not have any downstream leased assets	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Franchises	3	No: not applicable.	GCU does not have any franchises	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Investments	3	No: not applicable.	GCU does not have any investments	N/A	N/A	N/A	N/A	N/A	N/A	N/A

## **Appendix B - Verification Statement**

**Verification Statement for Glasgow Caledonian University's**  
**2012-2013 Greenhouse Gas Emission Report**

We performed a verification audit to validate the methodologies and data used to report GCU's greenhouse gas (GHG) emission for the reporting periods of 2012-2013. Emissions for 2008-2009 are outwith the scope of this verification audit as they have been verified by the Carbon Trust.


Based on the process and procedures conducted, we are of the opinion that there is no evidence that the assertions made in GCU's 2012-2013 Greenhouse Gas Emission Report:

- are not materially correct and are not a fair representation of GHG data and information, and
- have not been prepared in accordance with the related International Standard on GHG quantification, monitoring and reporting, or to relevant national standards or practices.

Prof. J. Baird



Dr. C. Russell

 - 13/may/2014

Brighter futures begin with GCU



## Appendix C - Supplementary Methodologies

### Business Travel

Emissions from travel are usually based on either litres of fuel used or distance travel. This section details the methodology used to estimate emissions from GCU's business travel for the 2012-2013 reporting period. Emissions for the 2008-2009 reporting period were based on data used in GCU's original carbon footprint.

### Data

Estimates of emissions associated with GCU business travel were derived from data from a variety of internal and external sources of data

- Grey fleet mileage, the term for the use of private vehicles for business travel, was derived from mileage payments for the 2012-2013 reporting period.
- GCU 2012 Travel Survey for the proportion fuels used in vehicles owned by GCU staff.
- Hired vehicles mileage was derived from data provided by GCU's car hire supplier.
- Distance travelled by air was determined from returns provided by GCU's travel agents, which detailed the flight segments in all travel arranged by them.
- Distance travelled by rail was determined from returns provided by GCU's travel agents, which detailed the start and end locations of all rail travel arranged by them.
- Defra's emission factors for the relevant modes of travel (accessed on 17<sup>th</sup> January 2014) used for business travel at GCU, sourced from: <https://www.gov.uk/measuring-and-reporting-environmental-impacts-guidance-for-businesses>.

### Methodology

Emissions from commuting are calculated by multiplying the total travel distance for each category by the appropriate emission factor. Below are details of the outline methodology for the main modes travel used for GCU business.

This section details the methodology used to estimate emissions from GCU's business travel for the 2012-2013 reporting period. Emissions for the 2008-2009 reporting period were based on data used in GCU's original carbon footprint.

**Grey fleet:** Distance travelled in privately owned vehicles was determined by dividing GCU's total mileage payment by the prevailing mileage rate of 45p/mile. The total distance was apportioned to the different fuel types (petrol, diesel and hybrid) noted in the 2012 Travel Survey and the relevant emission factor applied. The emission factors used were for medium sized cars.

**Hired Vehicles:** Emission from travel using hired vehicles were estimated by multiplying total distance travelled by the emission factor for the appropriate fuel type. The emission factors used were for medium sized cars.

**Air travel:** Distance flown was determined from using data on flight segments booked by GCU's travel agents. Distance between segments was calculated and segments were arbitrarily categorised as:



- Domestic if they occurred within the British Isles or were less than 280 miles;
- Short-haul if they were between 280 miles and 995 miles; and
- Long-haul if they were over 995 miles.

The total distances for flights in these categories were multiplied by the appropriate emission factors for domestic, short-haul and long haul flights, which included an adjustment for radiative forcing (the influence of the other climate change effects of aviation, such as water vapour, contrails, NO<sub>x</sub> etc. (DEFRA 2013 Emission Factors)).

Rail travel: Emissions from rail travel were calculated by applying the appropriate emission factor to the total distance travelled. Where GCU's travel agents' returns did not include distance travel, just origin and destination, then the distance was calculated manually (using Google maps). All distances were converted from miles to km before the emission factors for national and international rail travel were applied.

### Assumptions

- Grey fleet: It was assumed that other fuel types potentially used in privately owned vehicles are not a significant source of emissions (as none were identified in the 2012 Travel Survey).
- Hired vehicles: it was assumed that the significant majority of vehicles hired by GCU are supplied by Arnold Clark and that any vehicles hired from other suppliers are not a significant source of emissions.
- Bus travel: As no data was available for the 2012-2013 reporting period, but given the significance of the 2008-2009 emissions, it was assumed that bus travel in 2012-2013 were not significant.
- Air-travel: It was assumed that the significant majority of air-travel was booked through GCU's travel agents and any that wasn't did not represent a significant source of emissions.
- Rail travel: Due to GCU's proximity to Glasgow's main railway stations, it is likely that some local travel is arranged directly without resorting to GCU's travel agents. However, due to rail travel's low carbon intensity, emissions are unlikely to be a significant.
- Rail travel: where distances had to be calculated manually, it was assumed that using the central point for the origin and destination did not significantly impact the estimate of associated emissions.

## Results

Emission Source	Scope	Quantity		Emission Factors	Tonnes CO <sub>2</sub> e	
		2008-09	2012-13		08-09	12-13
Grey fleet <sup>6</sup> (petrol)	3	N/A	33,511 miles	0.329755 kg CO <sub>2</sub> e/mile		11.05
Grey fleet (diesel)	3	N/A	19,086 miles	0.281233 kg CO <sub>2</sub> e/mile		5.37
Grey fleet (hybrid)	3	N/A	850 miles	0.184624 kg CO <sub>2</sub> e/mile		0.16
Hired vehicles (petrol)	3	25,157 miles	12,997 miles	0.329755 kg CO <sub>2</sub> e/mile	8.30	4.29
Hired vehicles (diesel)	3	18,765 miles	45,217 miles	0.281233 kg CO <sub>2</sub> e/mile	5.28	12.72
Bus – Local (average)	3	54,815 km	N/A	0.111621 kg CO <sub>2</sub> e/pass. km	6.12	
Air – Domestic (average)	3	N/A	773,876 km	0.326615 kg CO <sub>2</sub> e/pass. km		252.76
Air – Short-haul (average)	3	N/A	705,549 km	0.192457 kg CO <sub>2</sub> e/pass. km		135.79
Air – Long-haul (average)	3	2,665,332 km	3,822,491 km	0.226528 kg CO <sub>2</sub> e/pass.km	603.77	865.90
Rail – National	3	N/A	194,648 km	0.04904 kg CO <sub>2</sub> e/pass.km		9.55
Rail - International	3	N/A	10,351 km	0.01235 kg CO <sub>2</sub> e/pass.km		0.13
Total					633.41	1,309.26

Table 19 Baseline data and associated (Tonnes CO<sub>2</sub>e) emissions for GCU business travel (not owned).

## Staff & Student Commuting

The data, assumptions and methodology used for estimating greenhouse gas emissions associated student and staff commuting to GCU in Glasgow are presented below.

### Data

Estimates of emissions associated with student and staff commuting are based on commute distance, travel frequency and mode of transport typically used. The following primary and secondary data sets were used to source this information for each of the reporting periods:

- Total distance travelled for each reporting period by mode see (further details below).
- Total number of students and staff at GCU for each reporting period (further details below).
- Defra's emission factors for the relevant modes of travel (accessed on 17<sup>th</sup> January 2014) used by commuters at GCU, sourced from: <https://www.gov.uk/measuring-and-reporting-environmental-impacts-guidance-for-businesses>.
- 2008-2009 data was obtained from the Energy Saving Trust funded Travel Plan produced by VIPRE for GCU, which was used in the original carbon footprint calculations. The data was available as km by mode.
- 2012-2013 data was derived at by extrapolating the results from GCU's 2012 Travel Survey (response rate: 601 staff and 1,396 students) to the total number of students and staff in GCU during the reporting period.

<sup>6</sup> Grey fleet is the term for the use of private vehicles for business travel.

### Methodology

Emissions from commuting are calculated by multiplying the total commuting distance for each mode of travel by the appropriate emission factor.

For the 2008-2009 reporting period as the only available data was in the desired format (total distance travelled for each mode) no further processing was required. However, for the 2012-2013 reporting period, distances travelled by the different modes were derived from the results of the 2012 Travel survey, using the following methodology:

1. GCU students and staff surveyed to determine commuting distance (miles), commuting frequency and mode of transport used.
2. Responses categorised using a matrix with five mile concentric distance bands from GCU and modes of travel. Responses used to calculate the following parameters for each cell in the matrix:
  - Average one-way distance (miles) travelled [ $D_{a1}$ ]
  - Average number of trips per week [ $F_w$ ]
  - Proportion of responses [ $n$ ]
  - Extrapolation of responses to wider GCU population [ $N$ ]  
( $N = n \times \text{GCU staff/student population}$ ).
3. In addition, the following were determined :
  - The proportion of individuals [ $P_x$ ] in the following groups at GCU were determined: academic staff, non-academic staff, undergraduate and post-graduate students (based on data from GCU's Policy & Planning Office).
  - Number of weeks each group commutes to GCU in a year [ $F_y$ ].
4. Total miles travelled [ $D_T$ ] were calculated as:  **$D_T \text{ (miles)} = ([D_{a1}] \times 2) \times [F_w] \times [F_y]$**
5. Total distance travelled for each mode of travel determined.
6. Total distance [ $DT \text{ (miles)}$ ] was converted to [ $DT \text{ (km)}$ ] and the appropriate emission factors applied.

### Results

A summary of emissions associated with student and staff commuting to GCU is presented below. The full dataset used for the 2012-2013 calculations is available as a separate Microsoft Excel spreadsheet. The percentage modal distribution for the two reporting periods is presented in Table 20.

Mode	2008-2009	2012-2013	
	Staff	Staff	Students
Bicycle	2.4%	4.61%	1.83%
Bus	25.9%	24.35%	33.53%
Car – Single Occupant	12.5%	12.55%	12.03%
Car – Shared	8.1%	6.46%	2.32%
Car – As passenger	5.6%	4.43%	2.16%
Motorcycle	0.2%	0.55%	0.00%
Subway	5.1%	4.24%	4.07%
Train	27.9%	34.69%	26.39%
Walk	6.8%	8.12%	17.68%
Other	5.3%	0.00%	0.00%
Total	99.8%	100.00	100.00%

Table 20 Percentage modal distribution for staff and student commuting to GCU City Campus. Original data for 2008-2009 did not add up to 100%.

Estimates of total distance travelled (return, miles) for each mode of transport by distance band (miles), presented in Table 21 and Table 22 below, were converted to km and used to calculate emissions for the 2012-2013 reporting period.

distance band (miles)	distance band class	Bicycle	Bus	Car (31) SOV	Car (32) Shared	Car (33) as passenger	Motorcycle	Subway	Train	Walk
0-1	A	-	-	-	-	-	-	-	-	4,920
1-4	B	61,545	153,809	48,079	45,151	19,038	-	53,277	150,488	-
5-9	C	47,614	266,267	141,801	108,318	97,023	9,272	54,227	359,862	-
10-14	D	18,109	234,554	216,194	80,154	46,358	18,833	-	353,946	-
15-19	E	26,077	297,899	119,272	24,628	58,034	-	-	367,019	-
20-24	F	-	188,445	152,967	110,222	-	34,769	-	273,885	-
25-29	G	-	213,442	86,318	-	-	-	-	416,154	-
30-34	H	-	49,256	80,837	-	-	-	-	616,645	-
35-39	I	-	108,170	76,057	-	-	-	-	425,918	-
40-44	J	-	142,853	46,358	-	-	-	-	115,896	-
45-46	K	-	117,345	54,471	-	-	-	-	150,665	-
50-54	L	-	189,635	28,974	-	-	-	-	143,539	-
55-59	M	-	63,743	-	-	-	-	-	184,146	-
60-64	N	-	-	91,268	-	-	-	-	157,962	-
65-69	O	-	-	-	-	-	-	-	-	-
70-74	P	-	-	-	-	-	-	-	-	-
75-79	Q	-	-	-	-	-	-	-	43,461	-
80-84	R	-	-	-	-	-	-	-	231,792	-
85-89	S	-	-	-	-	-	-	-	-	-
90-94	T	-	-	-	-	-	-	-	-	-
95-99	W	-	-	-	-	-	-	-	-	-
>100	V	-	-	-	-	-	-	-	-	-
TOTALS		153,345	2,025,416	1,142,597	368,473	220,454	62,874	107,504	3,991,379	4,920

Table 21 Total distance travelled (miles) by mode by GCU staff commuting to GCU City Campus.

distance band (miles)	distance band class	Bicycle	Bus	Car (31) SOV	Car (32) Shared	Car (33) as passenger	Motorcycle	Subway	Train	Walk
0-1	A	-	-	-	-	-	-	-	-	85,665
1-4	B	132,987	883,938	128,160	30,095	78,282	-	368,523	576,009	161,505
5-9	C	100,843	2,247,352	878,449	177,913	62,971	-	81,197	1,522,847	-
10-14	D	-	2,222,457	1,017,561	182,386	196,027	-	114,492	2,156,574	-
15-19	E	-	2,765,418	739,239	272,015	205,155	-	-	1,592,831	-
20-24	F	-	2,810,383	493,152	209,902	197,181	-	-	2,753,810	-
25-29	G	-	2,872,230	648,332	-	-	-	73,602	1,464,007	-
30-34	H	-	2,155,152	671,199	-	335,843	-	-	3,488,837	-
35-39	I	-	961,876	443,004	137,390	171,738	-	-	1,051,504	-
40-44	J	-	1,393,596	419,804	-	80,472	-	-	1,494,471	-
45-46	K	-	1,153,234	703,390	44,161	-	-	-	562,283	-
50-54	L	-	1,203,983	282,141	49,068	-	-	-	196,272	-
55-59	M	-	231,601	-	-	-	-	-	53,975	-
60-64	N	-	176,645	294,408	58,882	-	-	-	756,601	-
65-69	O	-	-	-	-	-	-	-	-	-
70-74	P	-	-	-	-	-	-	-	-	-
75-79	Q	-	226,989	-	-	-	-	-	-	-
80-84	R	-	-	-	-	-	-	-	78,509	-
85-89	S	-	-	-	-	-	-	-	-	-
90-94	T	-	264,967	182,533	-	-	-	-	353,290	-
95-99	W	-	279,688	-	-	-	-	-	96,173	-
>100	V	-	-	-	336,688	-	-	-	146,223	-
<b>TOTALS</b>		<b>233,830</b>	<b>21,849,508</b>	<b>6,901,371</b>	<b>1,498,501</b>	<b>1,327,668</b>	<b>-</b>	<b>637,815</b>	<b>18,344,215</b>	<b>247,170</b>

Table 22 Total distance travelled (miles) by mode by GCU students commuting to GCU City Campus.

Emission Source	Staff (Tonnes CO <sub>2</sub> e)		Students (Tonnes CO <sub>2</sub> e) 2012-2013
	2008-2009	2012-2013	
Rail	186	315	1,448
Underground	N/A	10	99
Public bus	354	402	4,333
Car (Petrol)	376	346	1,945
Car (Diesel)	198	182	1,024
Car (Hybrid)	6	6	33
Motorcycle/ Moped	N/A	19	0
<b>Total</b>	<b>1,120</b>	<b>1,280</b>	<b>8,882</b>

Table 23 Emissions (Tonnes CO<sub>2</sub>e) from GCU staff and student commuting.

## International Student Travel

The data, assumptions and methodology used for estimating greenhouse gas emissions associated with GCU's international students travelling to Glasgow are presented below.

### Data

The following data was required to estimate greenhouse gas emissions from GCU's international students travelling to Glasgow.

1. Number of international students by country of origin and academic year, provided by GCU's Policy & Planning Office.
2. Routes taken by international students to travel to Glasgow, determined by surveying international students and consulting the following travel websites: Expedia, SkyScanner, EasyJet and Ryan Air.
3. Emission factors for air travel (Defra, accessed on 17<sup>th</sup> January 2014 from: <https://www.gov.uk/measuring-and-reporting-environmental-impacts-guidance-for-businesses>)

Assumptions: Estimates of international student travel were made using the assumptions listed below

1. Due to the distances involved, emissions from non-air travel are not a significant element of international student travel to Glasgow.
2. Cost was more important than time when making travel arrangements (i.e. route choice).
3. Where student travel data was not available, it was assumed that students would travel from the largest city in their country of origin.
4. It was also assumed that in a 12 month period, students would travel home at least once. It is noted that this might result in an overestimate of emissions.
5. Flights from Europe were assumed to be short-haul, whilst those from the rest of the world were long-haul. Using emission factors for the aggregate journey, rather than individual segments, did not significantly affect overall emissions. It is noted that this might result in an overestimate of emissions.

### Methodology

1. A survey was developed to understand how GCU's international students travelled to Glasgow. The survey sought to capture route choices and flight segments within those routes and number of times students expected to travel home in a 12 month period. Students were surveyed online and face-to-face. The hard-copy version of the survey is attached to this document.
2. For countries where the survey did not capture any responses, typical routes and segments were determined using the following websites: Expedia.co.uk, SkyScanner.net, EasyJet.com and RyanAir.com.
3. Distances between segments were determined using an online flight distance calculator (<http://www.travelmath.com/>). Where more than one route was suggested from a particular country, then median route distance was used.
4. The return route distance was calculated by doubling the route distance
5. Countries were grouped into regions and travel frequency (from survey responses) was extrapolated to countries in the region without any information.
6. Total travel distance was determined as:

$$\text{[total distance travelled (km)]} = \text{[average return distance (km)]} \times \text{[average trip frequency]} \times \text{[number of students from specific country]}$$

7. Emissions for each country were determined by multiplying the total distance by the relevant emission factor for an average passenger. An emission factor of 0.192457 kg CO<sub>2</sub>e/passenger km (short-haul) was used for journeys within Europe, whilst 0.226528 kg CO<sub>2</sub>e/passenger km (long-haul) was used for journeys from the rest of the world. Results were divided by 1000 to convert emissions from kg to Tonnes CO<sub>2</sub>e. The full calculation is detailed below:

$$\text{[Tonnes CO}_2\text{e]} = \text{([total distance travelled (km)]} \times \text{[emission factor])}/1000$$

## Results

A summary of estimated emissions, from GCU's international students travelling to Glasgow are presented by region in the table below. The full data set is available as an a separate excel spreadsheet.

Region	No. Students	Survey (n)	Total km/year	Tonnes CO <sub>2</sub> e
Africa - N	32	1	231,184	52.37
Africa - C	9	1	200,008	45.31
Africa - W	192	17	2,131,386	482.82
Africa - E	7	0	152,510	34.55
Africa - S	28	0	651,168	147.51
Europe	544	32	5,034,370	968.90
Asia - C	27	0	418,786	94.87
Asia - E	185	16	4,302,360	974.61
Asia - SE	97	11	2,465,082	558.41
Asia - S	181	9	2,800,196	634.32
America - N	70	6	1,874,880	424.71
America - S	47	18	1,904,196	431.35
America - C	9	0	300,048	67.97
Middle East	193	11	4,409,656	998.91
Australasia	5	1	177,240	40.15
Totals	1,626	123	27,053,070	5,956.75

Table 24 Data and estimates of emissions associated with international student travelling to Glasgow.

General comment: Whilst this approach provides a good first step in understanding emissions arising from GCU's international students travelling to Glasgow, improvements in the accuracy of the journey data could significantly improve the accuracy of this estimate.



Glasgow Caledonian University  
Cowcaddens Road  
Glasgow, G4 0BA  
Scotland, United Kingdom

[www.gcu.ac.uk/sustainability](http://www.gcu.ac.uk/sustainability)

Brighter futures begin with GCU



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