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University College Birmingham

250209

Carbon Benchmarking Report

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Introduction

1.0 Introduction

University College Birmingham (UCB) have appointed CPW to carry out the carbon emissions footprint calculations for their estate for the 2023-24 Academic year. Carbon footprinting is a method used to measure the amount of greenhouse gases (GHGs), that are emitted directly or indirectly as a result of various human activities, products, or services. This method is a valuable analysis for raising awareness about climate change and guiding efforts to mitigate its effects by reducing GHG emissions.

The report includes a comprehensive breakdown of the emissions by source and includes a comparison to the previous year. The calculation accounts for all GHG emissions and is reported as Carbon Dioxide equivalent (CO_2e) emissions, in line with the Greenhouse Gas Protocol and UK Government reporting standards.

As in the previous year, Scope 1 and 2 emissions are reported herein. The activities are in line with UCB's pledge to the West Midlands Combined Authority 's (WMCA) carbon reduction by 2041 target. Additionally, this year some Scope 3 emissions are also included where data has been made available. Any challenges to data collection have been listed in the relevant sections, to enable improvements to be identified for future years.

1. **Identifying emissions sources:** This includes direct emissions from activities like burning fossil fuels for energy and transportation, as well as indirect emissions associated with the production and transportation of goods and services consumed.

2. **Quantifying emissions:** Once sources are identified, emissions are quantified using carbon emission factors. These provide standardized values for the number of emissions produced per unit of activity (e.g., per km driven, per kilowatt-hour of electricity used).

3. **Calculating total footprint:** Emissions from all identified sources are summed up to calculate the total carbon footprint. This can be done for individuals, organizations, events, products, or services.

4. **Reporting and analysis:** The results are reported in metric tons of CO_2e and broken down by emission source / activity. Analysis of the footprint can identify areas of high emissions and thus opportunities for reduction.

5. **Reducing emissions:** Armed with information about carbon footprint UCB can implement robust strategies to reduce emissions. This might include increasing energy efficiency, transitioning to renewable energy sources, changing consumption patterns, or investing in carbon offset projects.

Introduction

1.1 Reporting Methodology

To enable the development of the 2023-24 carbon emissions report, CPW have worked closely with the UCB Sustainability & Estates teams in a vast data gathering exercise. This has included collating metering data, bills information, expense receipts, and waste data amongst others.

This report follows the GHG reporting methodology of scope 1 & 2 emissions. Scope 3 emissions data has been included where it is available. UCB are also a part of the West Midlands Combined Authorities Business pledge to be net zero by 2041, the initiative assist businesses in the West Midlands on setting pragmatic aims and methods on their path to net zero by 2041.

Both commissions express the need to manage, monitor, and report scope 1,2&3 emissions to give a clear understanding of UCB's energy consumption and overall carbon footprint. Once it is understood where UCB's emissions are coming from, then action plans can be instigated to reduce these emissions as far as possible.

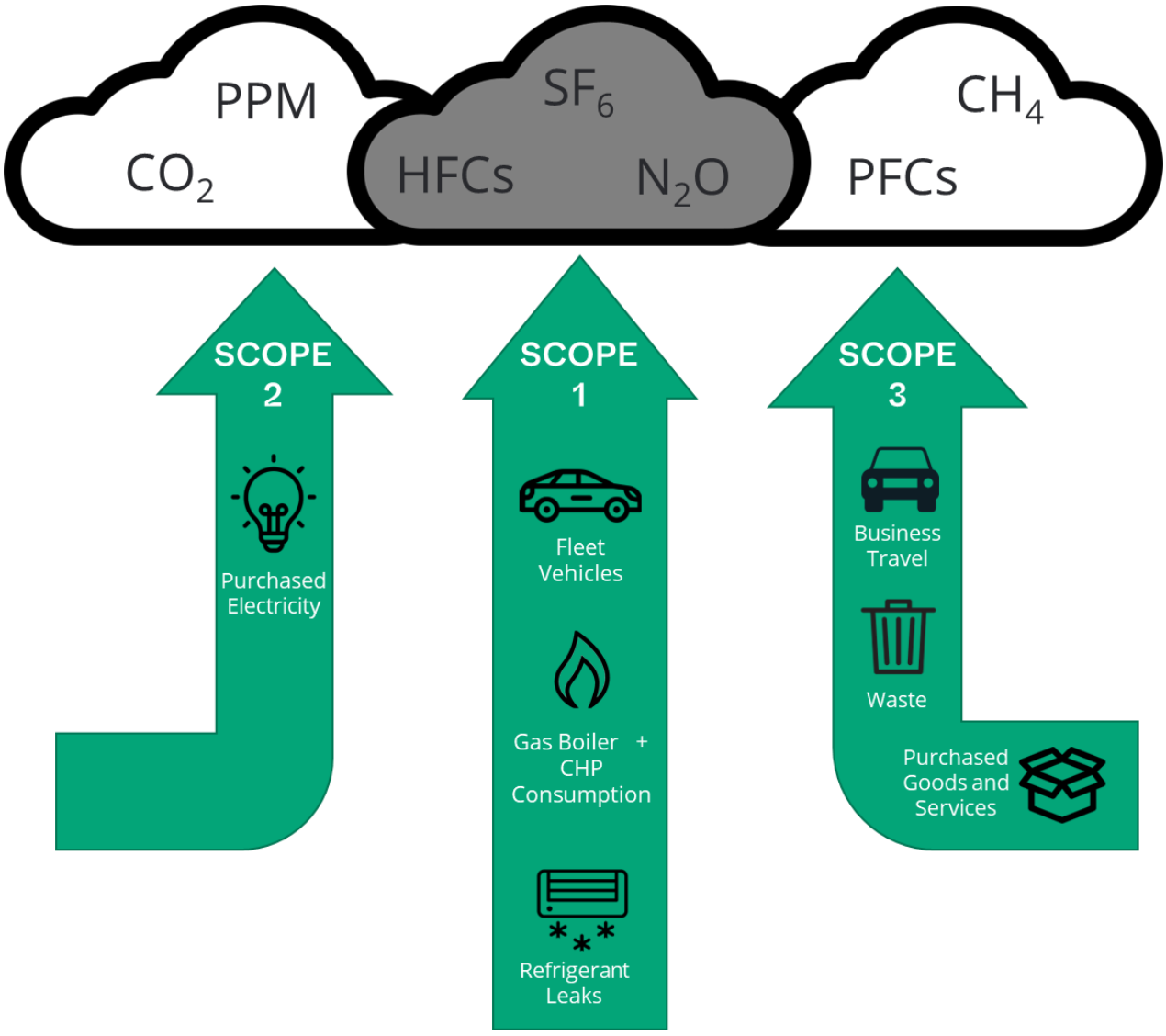


Figure 1 - Scope 1, 2, and 3 emissions

Introduction

Scope 1 carbon emissions refer to direct GHG emissions that occur from sources that are owned or controlled by UCB. Scope 1 emissions typically include emissions from burning fossil fuels, such as in boilers, vehicles, and other equipment. It will also include emissions from leaks of refrigerant from heat pumps and cooling systems.

The UCB Scope 1 emissions included are:

- Gas usage in boilers and a Combined Heat and Power unit (CHP)
- Fuel from university owned vehicles
- Refrigerant leaks from air conditioning systems and heat pumps

Scope 2 carbon emissions refer to indirect GHG emissions that occur as a result of the consumption of purchased or acquired electricity, steam, heat, or cooling. These emissions are associated with the generation of electricity or heat off-site, typically by a utility company or another third party.

Scope 2 emissions are considered indirect because they are generated from sources that are not owned or controlled by UCB but are associated with its activities.

The UCB Scope 2 emissions included are:

- Electricity usage for each building

Scope 3 carbon emissions represent indirect GHG emissions that occur as a result of an organization's activities, but which are not directly owned or controlled by the organization itself. Scope 3 emissions are typically the most challenging to measure because they encompass a wide range of sources and often involve multiple stakeholders.

The UCB Scope 3 emissions included are:

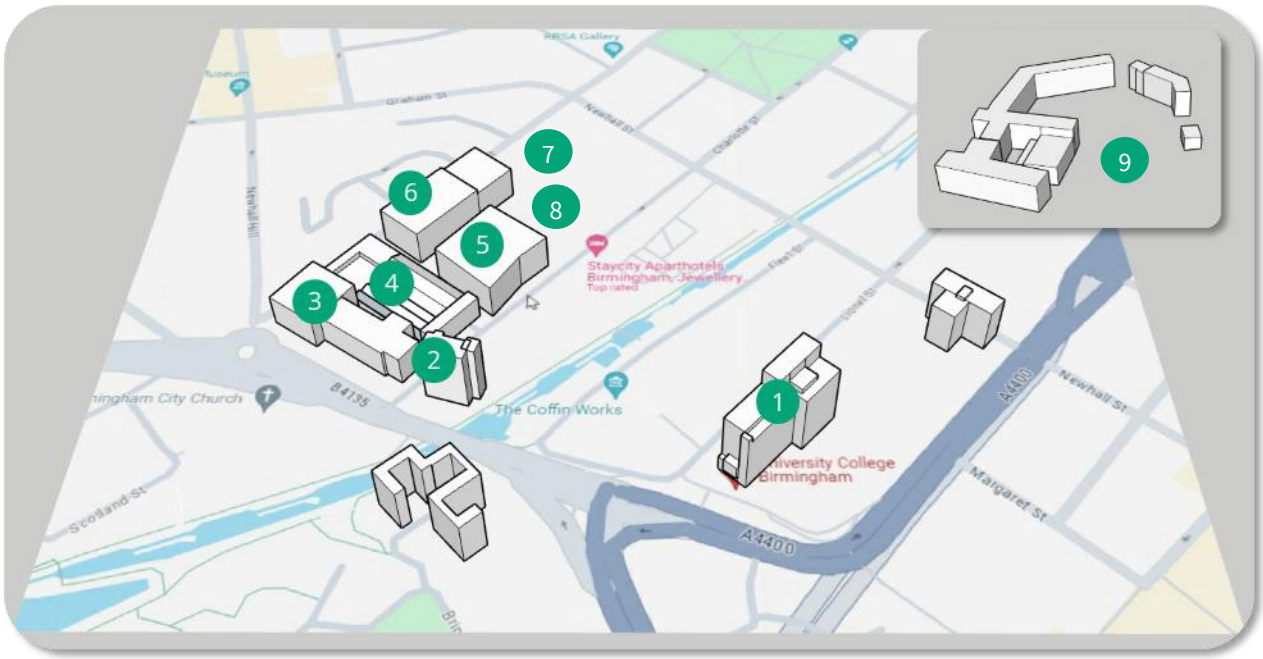
- Waste disposal
- Water supply and wastage
- Business travel – including grey fleet, taxies, and train travel
- Hotel stays

Introduction

1.2 Estate

The UCB Campus comprises seven buildings across central Birmingham locations. The buildings on campus include a wide variety of functions including educational spaces, lecture theatres, offices, IT suites, culinary training rooms as well as Aviation training areas. This leads to a substantial range of energy demands with a large requirement for maintenance and management which also have a high equivalent cost in CO_2.

Within this report where possible, the footprint has been split out to show the carbon emissions from each individual building, as well as the estate as a whole.



1. Summer Row	4. James Cond	7. Crosby Court
2. The Link	5. McIntyre House	8. Broughton Works
3. Camden House	6. Moss House	9. The Maltings (Off site)

Figure 2 - UCB building locations

There are three changes to buildings included in this year's report. The refurbishment of James Cond completed and opened to students, whilst Richmond house and Cambrian Halls have been excluded.

Introduction

1.3 Previous Footprints

UCB has previously performed three carbon footprinting exercises. Two were completed in line with the Higher Education Funding Council for England (HEFCE), for the years 2005-2006, and 2008-2009, and set a benchmark for future studies.

The third report was completed by CPW for 2022-2023 and marked the rejuvenation of carbon reporting for UCB. By comparing this year's figures against last, a clearer understanding of where UCB's emissions are resulting from will be made.

Last year's exercise highlighted areas where data collection could be improved upon. As a result, the data collection was significantly improved for this year's reporting, which has allowed more accurate figures to be recorded. It also allows more data to be collated, giving a clearer picture of UCB's footprint as a whole.

1.3.1 Carbon Emission Factors

Carbon emissions conversion factors are numerical values used to quantify the amount of GHGs emitted per unit of activity, fuel consumption, or product/process output. They are usually reported in CO_2 equivalences and are crucial for estimating and reporting GHGs across various sectors.

The most common types of carbon emissions conversion factors include:

1) Fuel Combustion Emission Factors
2) Activity-Based Emission Factors
3) Process Emission Factors
4) Lifecycle Emission Factors
5) Grid Emission Factors
6) Land Use Emission Factors

The Department for Energy Security and Net Zero (DESNZ), releases annual GHG conversion factors for company reporting of greenhouse gas emissions[1]. These cover a wide variety of fuels, activities, and processes. Many of these figures change annually, either due to better calculation methods or, more likely, through system changes, e.g. the amount of coal, gas, or zero carbon energy that was used to generate grid electricity in the year.

Due to the fact the majority of data provided for UCB is given on a total annual basis, the figures for 2023 have been used in this report. This also allows better alignment with the university's Higher Education Statistics Agency (HESA) reporting. With the exception of gas, these figures are the same as the previous year's report, allowing easy comparison between the two years.

Fuel Type	2022-23 report figures ($kgCO_{2e}$ per fuel unit)	2023-24 report figures ($kgCO_{2e}$ per fuel unit)
Gas (kWh)	0.20	0.18
Electricity (kWh)	0.21	0.21
Water (m^3)	0.177	0.177
Diesel (miles)	0.27	0.27
Petrol (miles)	0.25	0.25

[1] Greenhouse gas reporting: conversion factors 2023, DESNZ, Available at: Greenhouse gas reporting: conversion factors 2023 - GOV.UK

Scope 1 & 2

2.0 Scope 1 & 2 Emissions

UCB's Scope 1&2 emissions Carbon footprint for the 2023-24 year was 3,117 tCO_2e. The largest source of emissions was grid electricity, closely followed by gas use (Figure 3). Electricity usage was 5% more than gas usage in terms of kWh, and currently has a higher carbon emissions factor, explaining this difference.

Whilst energy use increased compared to last year, grey fleet and refrigerant emissions reduced due to greater precision in how these emissions have been calculated. This combined with the lower emissions factor used for gas, means the 2023-24 carbon footprint is 1% lower than the previous year.

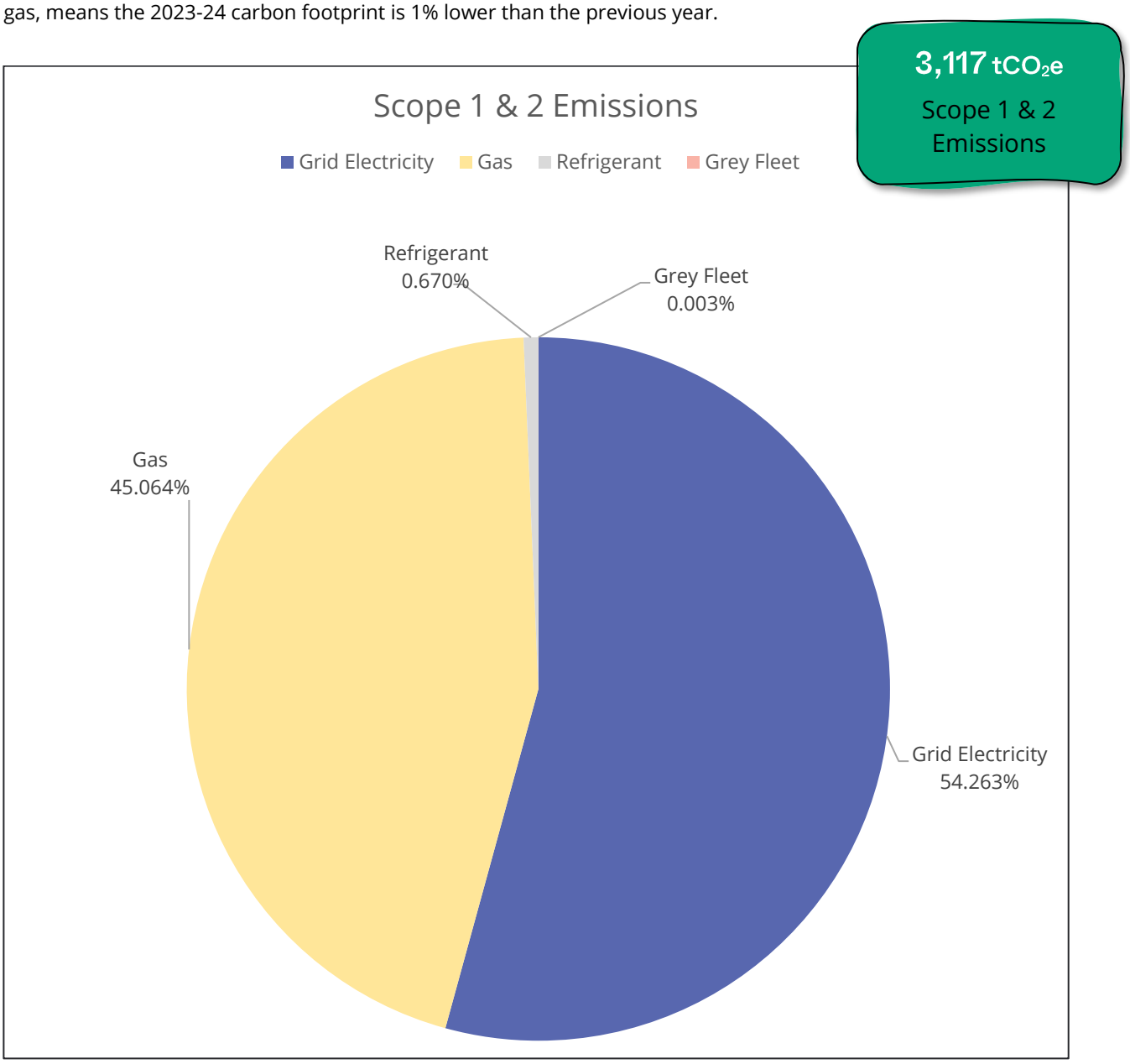


Figure 3 - Scope 1&2 CO2e Emissions 2023-24 year

Scope 1 & 2

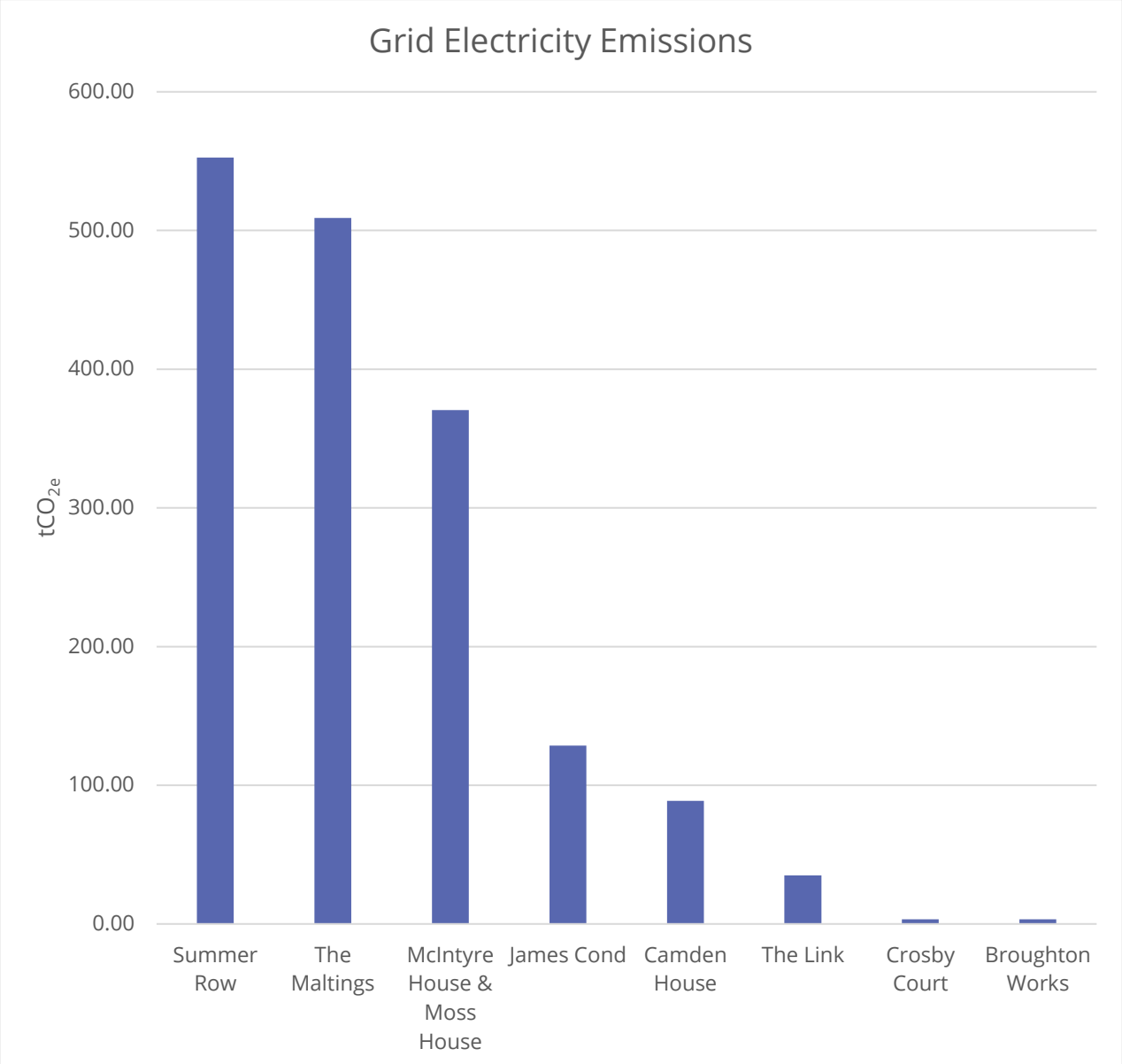
2.1 Grid Electricity

The collection of the electrical consumption has been taken from twelve months utility bills dated 1st August 2023 to 31st July 2024. The only exception to this was the James Cond building for which metered data was not available. For this building, electricity consumption was based on the predicted demands taken from the as-built EPC.

After UCB held talks with their energy provided, data collection was improved this year, with clearer and more accurate information being provided. However, there are still some areas which could be improved upon.

The billing data for McIntyre House and Moss House is provided as a single combined figure for example. UCB are addressing the BMS and metering strategies to alleviate this in future reporting of the carbon footprint. Camden House and Summer Row both have more than one meter, therefore the total energy used has been combined to complete the total demand for each building.

Figure 4 details the CO_2e emissions from grid electricity across each building on the UCB estate. As would be expected, the largest emissions come from the buildings which are the oldest and/or largest on the estate, and have no PV , and therefore have the largest electricity demands.



Scope 1 & 2

Figure 4 - Grid electricity emissions by building 2023-24

Grid electricity consumption, and by relation emissions, increased by 3% overall in the 2023/24 year. Much of this increase can be attributed to the James Cond building coming online, however The Maltings saw an 8% increase in electricity consumption (Figure 7). Crosby Court and Broughton works increased by 99% and 75% respectively, although this is likely due to better collation of data. Richmond House and Cambrian Halls were excluded this year, however these had little impact on the overall emissions. Camden House saw a 47% decrease in electricity demand, although again, this is likely due to better collation of data, rather than significant changes in the building use.
Large decreases were seen at Summer Row and The Link. Summer Row saw a drop of almost 220MWh (45.5tCO_2e, 8%), whilst the Link dropped almost 27MWh (5.6tCO_2e, 14%) compared to the previous year. The methodology of energy collection remained the same for these buildings, so it is expected that these decreases are down to changes in user behavior and building operation.

Scope 1 & 2

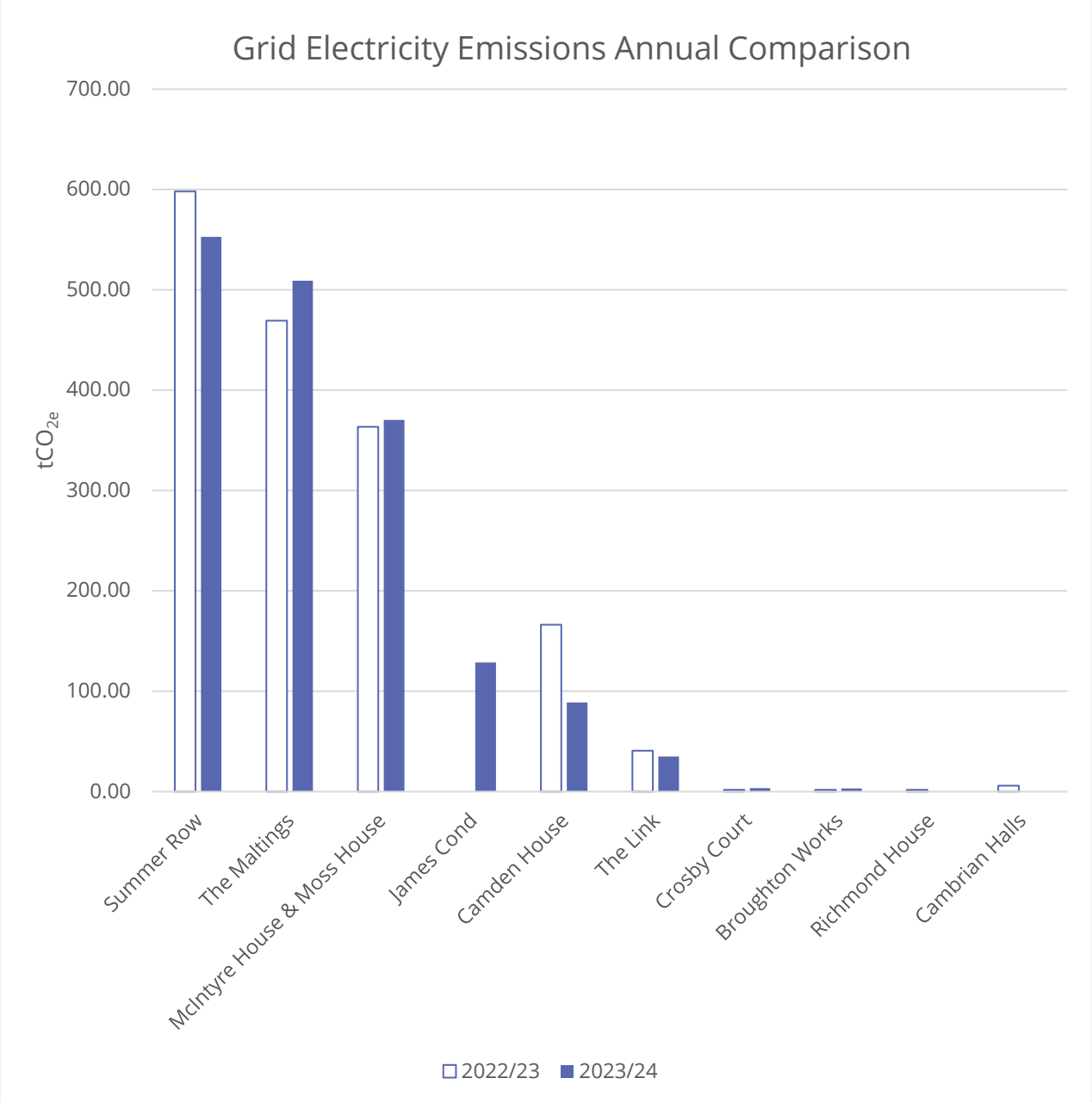


Figure 5 - Comparison of annual emissions from grid electricity 2022/23 and 2023/24

Scope 1 & 2

2.2 Gas

Gas data was taken from 1st August 2023 to 21st July 2024. McIntyre and Moss house are reported separately, and there is no change in the number of buildings reported from last year. After UCB held talks with their energy provided, data collection was improved this year, with clearer and more accurate information being provided.

Summer Row has the greatest emissions due to having the greatest demand for gas of any building (Figure 6). This is not only due to its size requiring a large amount of heating in winter, but also due to the kitchens within the College of Food. McIntyre House hosts a CHP unit which, whilst reducing the electricity demand within the building, will increase the gas demand as compared to if it were heated using a gas fuelled system.

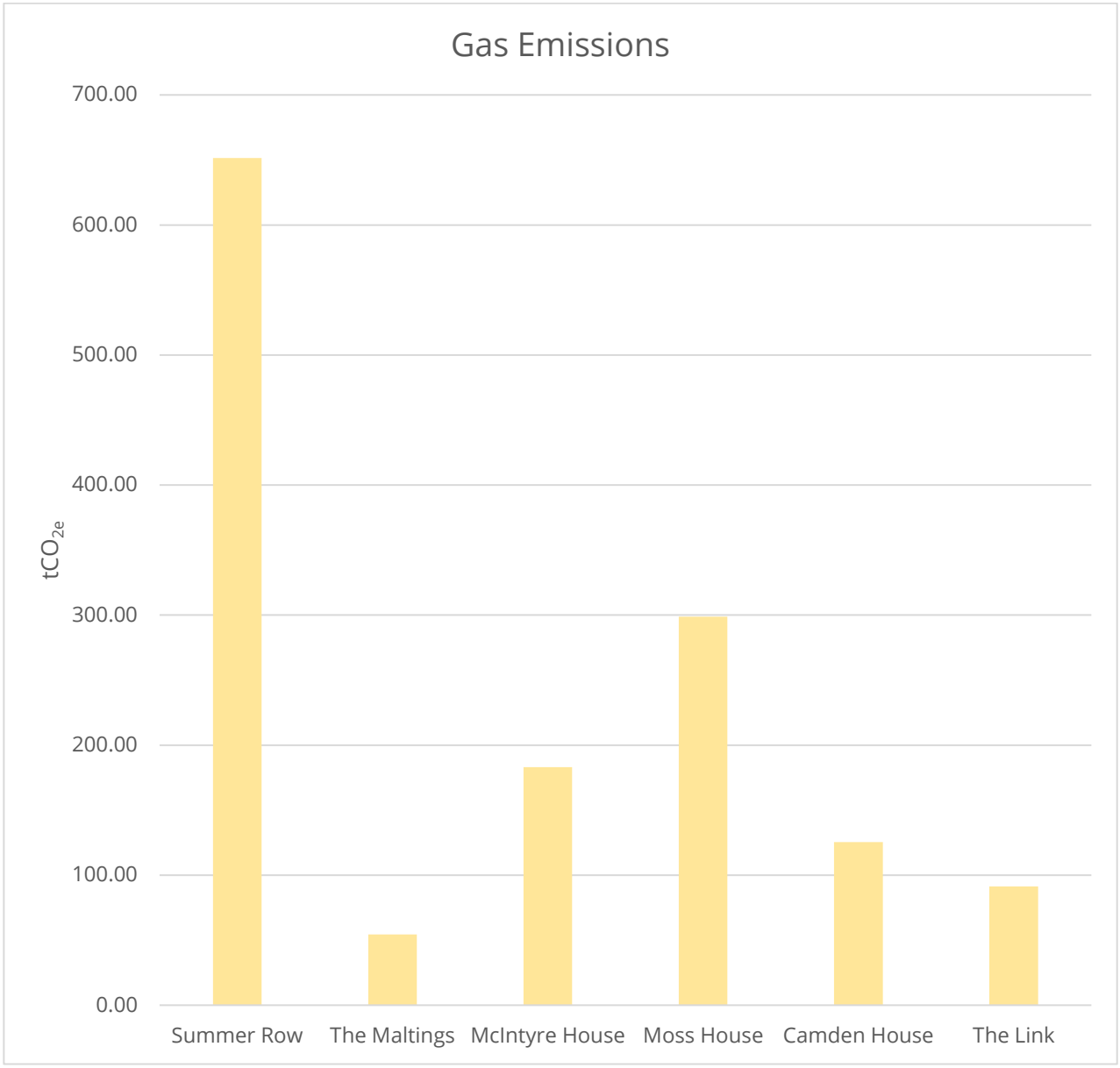


Figure 6 - Gas emissions by building 2023-24

Scope 1 & 2

Overall, there was a 10% increase in gas consumption in the 2023/24 year, however a 2% drop in CO_2e emissions. The overall fall in emissions is due to the lower emissions factor for Gas, therefore it is important to look at consumption for comparison.

In terms of percentages, the largest increase was seen at The Maltings, where consumption increased by 80% (135MWh). The winter period was largely warmer than average, and as such this increase may be due improved reporting from the supplier. In terms of energy use, this increase was not as much as elsewhere on the site. Both Moss House (360MWh, 28%) and Summer Row (377MWh, 12%) had large increases in Gas demand. The remaining buildings dropped consumption by 3-12%.

The improved reporting means a more accurate comparison should be available in the coming years. If UCB wanted to analyse change in use in more detail, getting monthly data on gas usage would be useful. From here, analysis can be made on when the gas is being used most, and more accurate tallies against weather data and events on site can be made.

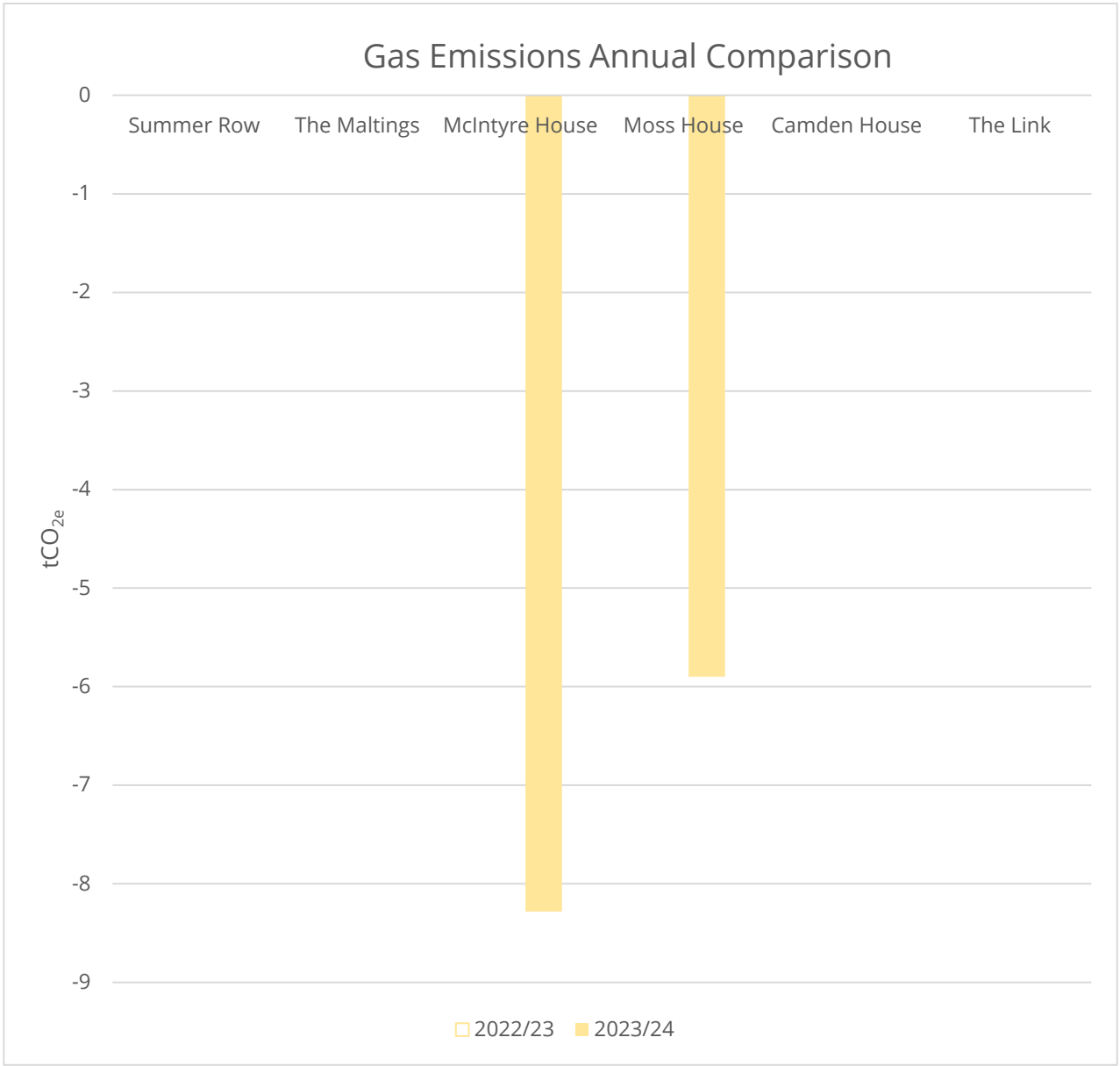


Figure 7 - Comparison of annual emissions from Gas 2022/23 and 2023/24

2.3 Refrigerant

Measurement of refrigerant leakage has been improved this year, with typical leakage rates taken from the Government's Environmental Reporting Guidelines Screening Method[2]. Where units have been inspected, and shown no signs of leakage, these units have been assumed to have zero refrigerant leak. Where units were not inspected, the refrigerant type has been assumed to be the same as the surveyed units in the same building.

All units were inspected in Camden House and shown to have no signs of leakage. This building therefore has no emissions attributed to refrigerants.

Moss House has the largest quantity of emissions (Figure 8). This is due to there being 20 uninspected units using the R410A refrigerant. This F-Gas has a high global warming potential (CO_2 equivalence) and is being phased out of use. Newer units, such as those in Summer Row, use R32 refrigerant, which has a much lower GWP. Units using R410A are no longer sold in the UK as of 2025, therefore, as the units in Moss house, and elsewhere on site, reach their end of life, they will be replaced by units with lower emissions.

James Cond has two heat Pumps with large quantities of refrigerant. Despite these being lower GWP R32 type, the large quantities and 6% leakage rate prescribed by the Reporting Guidelines, means the quantity of emissions is high compared to other buildings. In reality, because these are new units, it is likely that there has been no leakage, and therefore no emissions at all.

Indeed, due to the usage of these typical leakage rates for uninspected units, but the lack of leakage seen in any of the surveyed units, it is likely that these emissions have been overestimated. However, refrigerant emissions as a whole are still insignificant compared to emissions from electricity and gas.

[2] Environmental Reporting Guidelines, HM Government, March 2029 - Environmental Reporting Guidelines

Scope 1 & 2

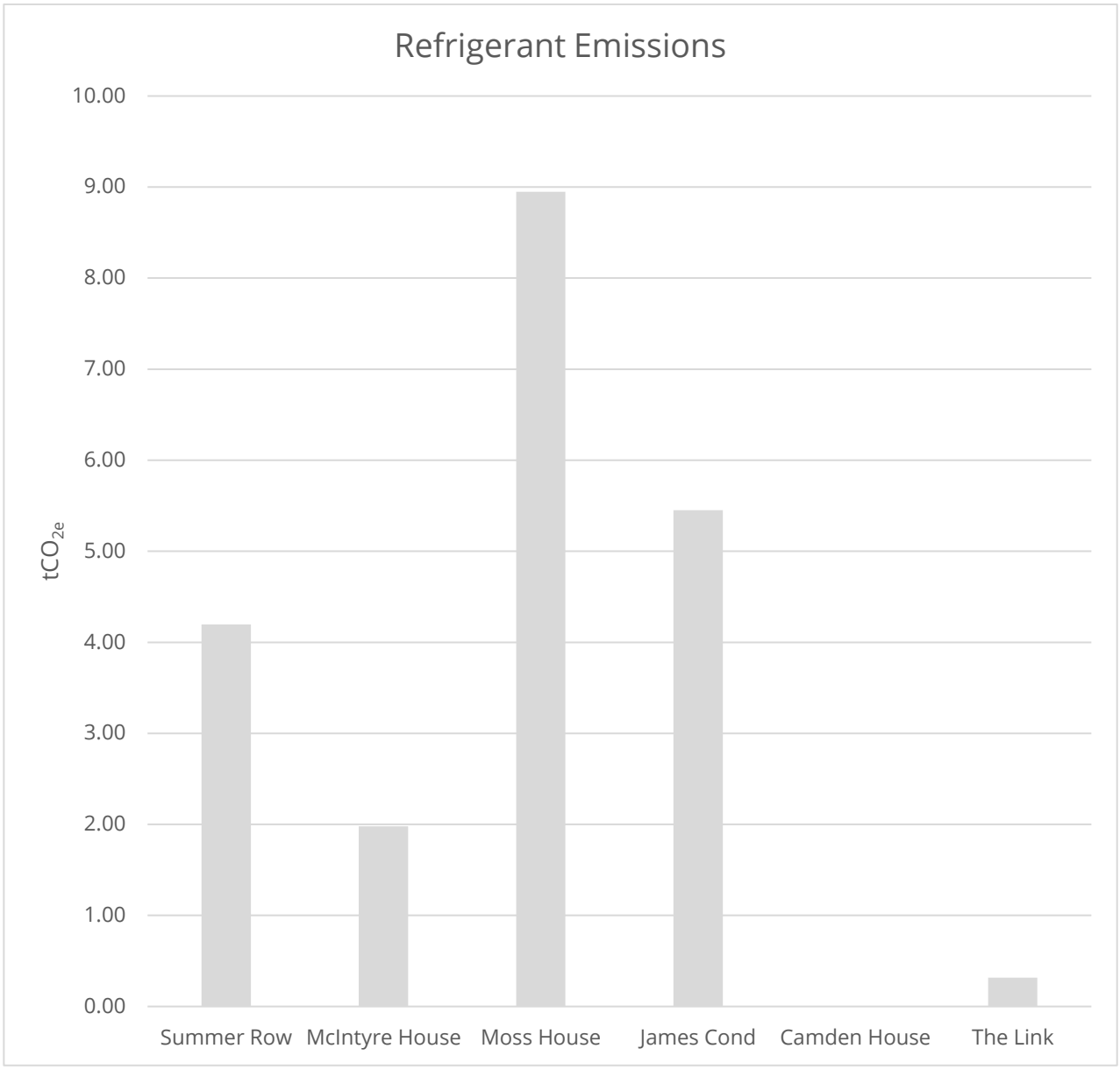


Figure 8 - Refrigerant emissions by building 2023-24

Despite the James Cond building coming online this year, UCB's refrigerant emissions dropped by 62 tCO_2e (75%) compared to the previous year (Figure 9). This is entirely due to the improvement in reporting methodology.

As has been mentioned, this figure is likely to be an overestimation, but without specific confirmation that units are not leaking, estimated leakage rates must be used.

Scope 1 & 2

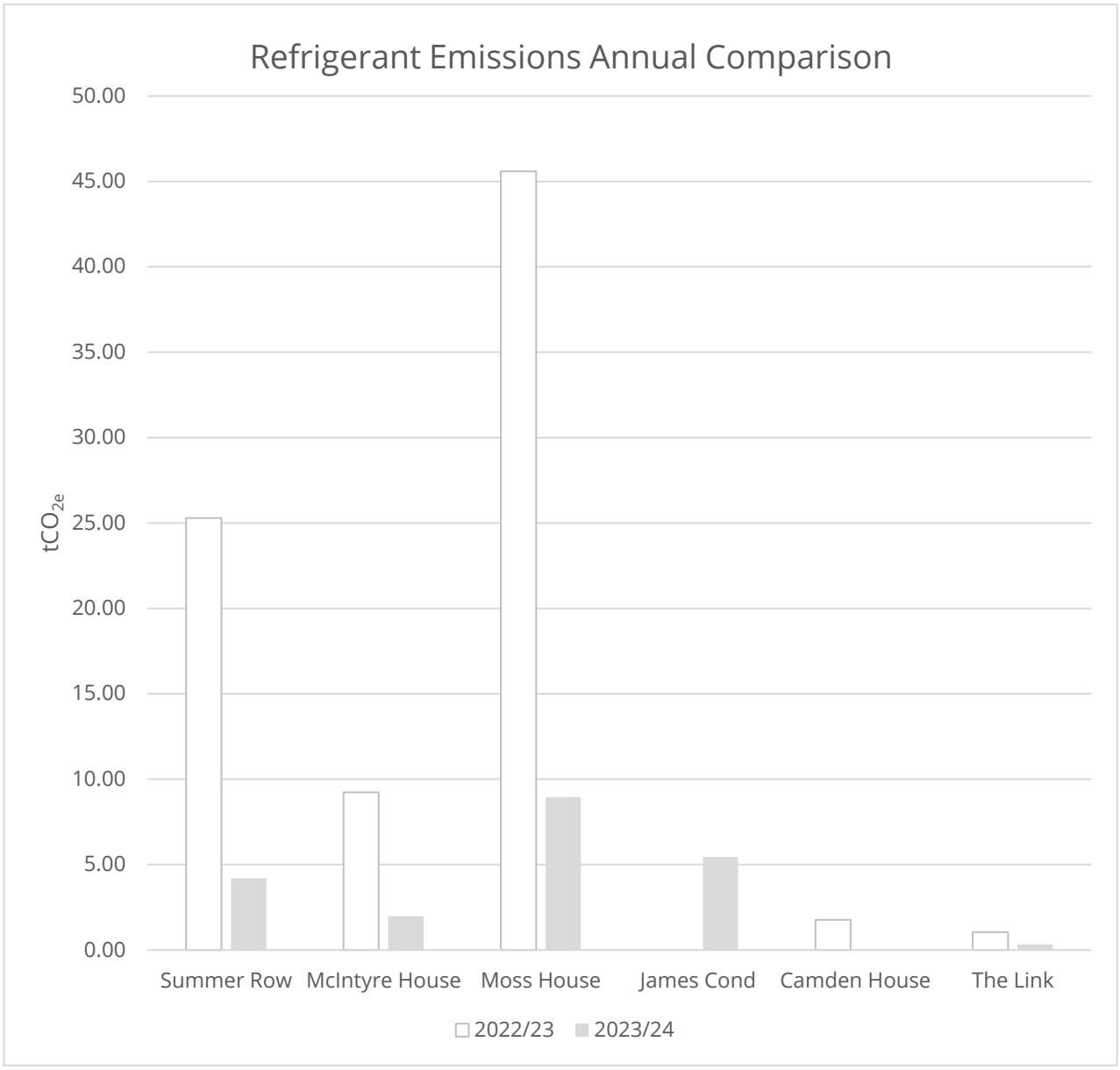


Figure 9 - Comparison of annual emissions from Refrigerants 2022/23 and 2023/24

2.4 Vehicles

Emissions from University owned vehicles has been estimated based on expenses data from 1st August 2023, to the 31st July 2024. Mileage was calculated based on a 45p/mile allowance, and emissions factors based on average $kgCO_2e$ per mile for diesel vans.

The analysis shows that University owned vehicles were used less this year, travelling 570 fewer miles (Figure 10). This translates to an emissions reduction of 60%. It is unclear if the vehicles were used less, or if expenses were claimed differently.

The University are currently updating the way they collect this data in order to establish more accurate data for future years. This should provide more insight on how these vehicles are used.

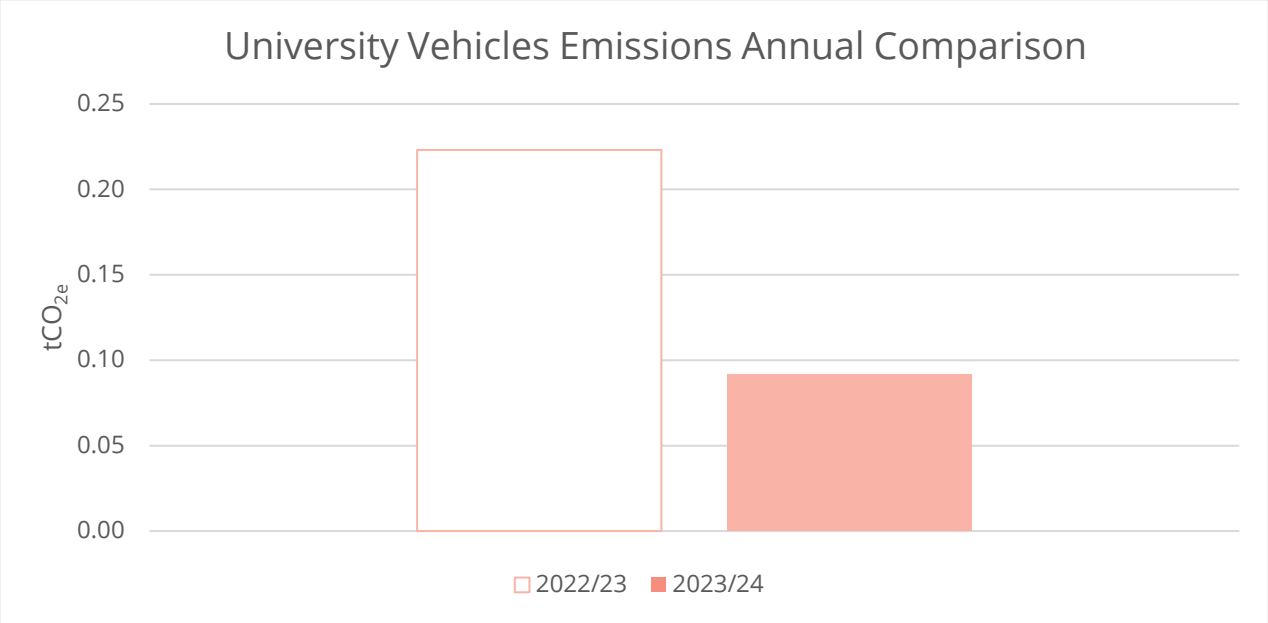


Figure 10 - Comparison of annual emissions from university owned vehicles 2022/23 and 2023/24

2.5 On-Site Generation

UCB currently has two methods of generating electricity on site. There are three buildings on the UCB campus which have Photovoltaic (PV) arrays installed on the roof, whilst McIntyre house is home to a Combined Heat and Power unit (CHP).

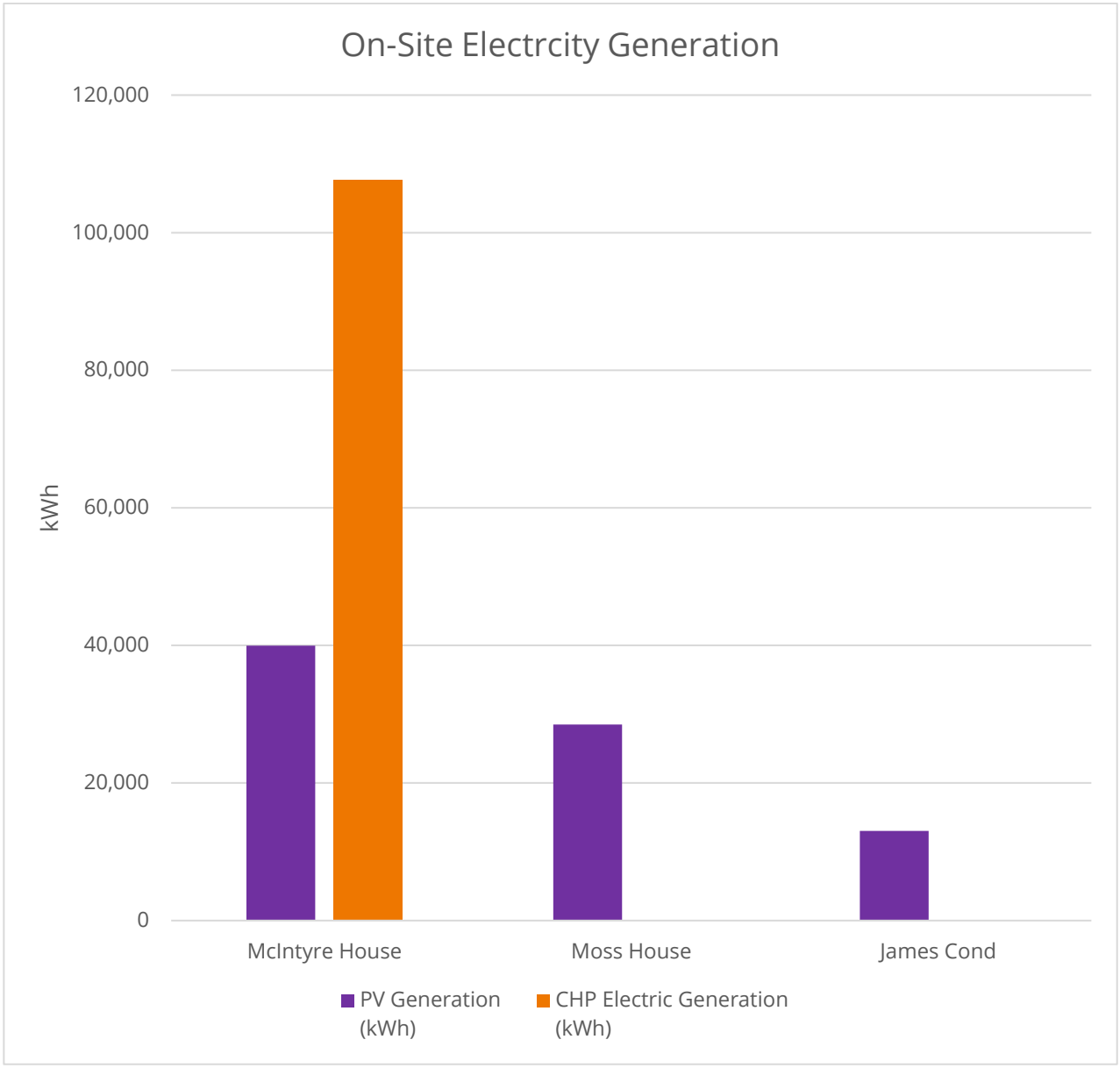


Figure 11 - Energy generated by PV and CHP installations on UCB campus

2.5.1 PV

There are PV arrays located on the roofs of Moss House and McIntyre House. UCB are addressing the BMS and metering strategies for these buildings so more accurate metering data can be utilised in future. For this year, as with last year's reporting, carbon saving calculations have been based on modelled generation data.

A new array on the James Cond building came online in 2024. Metering data was collected from 5th January – 31st July 2024.

The total amount of electricity generated by the PV systems was 81.5MWh, meeting 1% of UCBs total electricity demand (Figure 11). The arrays saved just under 17tCO_2e or 0.5% of UCB's CO_2 emissions (Figure 12).

2.5.2 CHP

The CHP unit is housed in McIntyre House. Data relating to fuel use, heat generation, and energy generation was provided from 1st August 2023 to 31st July 2024.

The CHP generates heat and electricity by burning gas on site. Whilst this reduces demand on the electricity grid, the CHP is not as efficient at generating heat as a traditional gas boiler, therefore it increases the amount of gas that would be used in the building. Whist the national electricity grid had higher emissions than the gas grid, this meant CHP units led to an overall reduction in CO_2 emissions. However, as grid emissions now near parity, this is no longer the case.

The CHP unit generated 107MWh of electricity which equates to 1.3% of UCB's overall electrical demand (Figure 11). However, emissions from the extra gas consumed (as compared to a standard gas boiler), offset those saved by not using electricity from the grid. As such emissions from the CHP were greater than savings, although by a negligible amount of 0.2 tCO_2e, 0.01% of total building (Figure 12).

As the electricity grid has rapidly decarbonised over recent years, CHP units are becoming less useful as a carbon reduction tool. Indeed, as the electricity grid reaches its Net Zero target, CHP units will become worse for a building's carbon footprint than a traditional gas boiler. Eventually, it will be prudent to turn the CHP off and replace it with a lower carbon source of electricity.

However, due to the significant cost difference between gas and electricity prices, CHP units still offer a significant reduction in the energy bills of the buildings in which they are installed. Thus, it is not recommended the CHP is switched off until there is a greater disparity between the emissions of the gas and electricity grids, or it reaches its end of life.

Scope 1 & 2

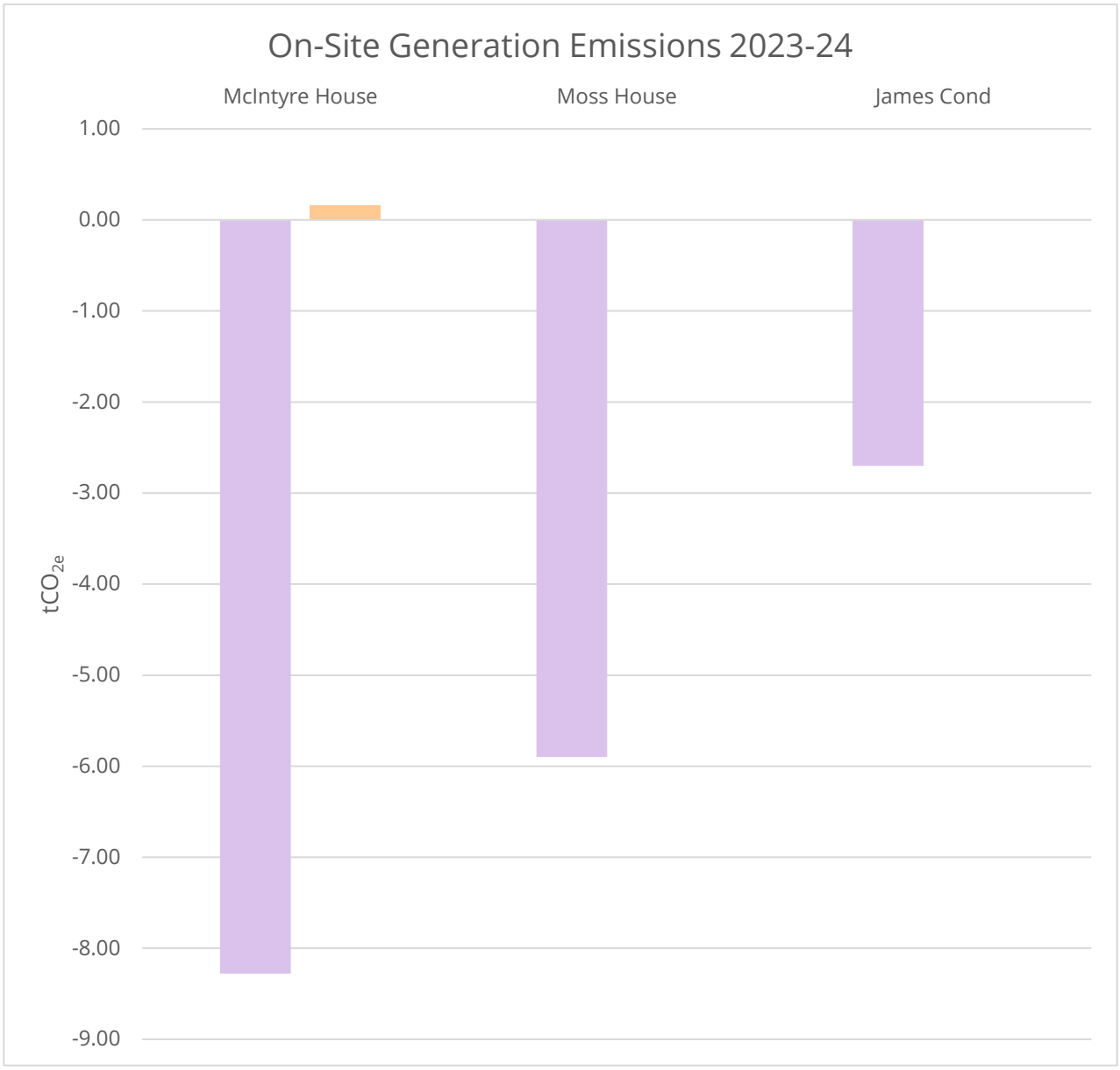


Figure 12 - Annual emissions from PV and CHP 2023/24

Scope 3

3.0 Scope 3 Emissions

UCB's measured scope 3 emissions were 25 tCO_2e. Travel for business, and water related emissions were the highest sectors here. These include road, and public transport, and both water use and waste water. Waste was another large proportion although these figures have less accuracy, as explained in section 27 below.

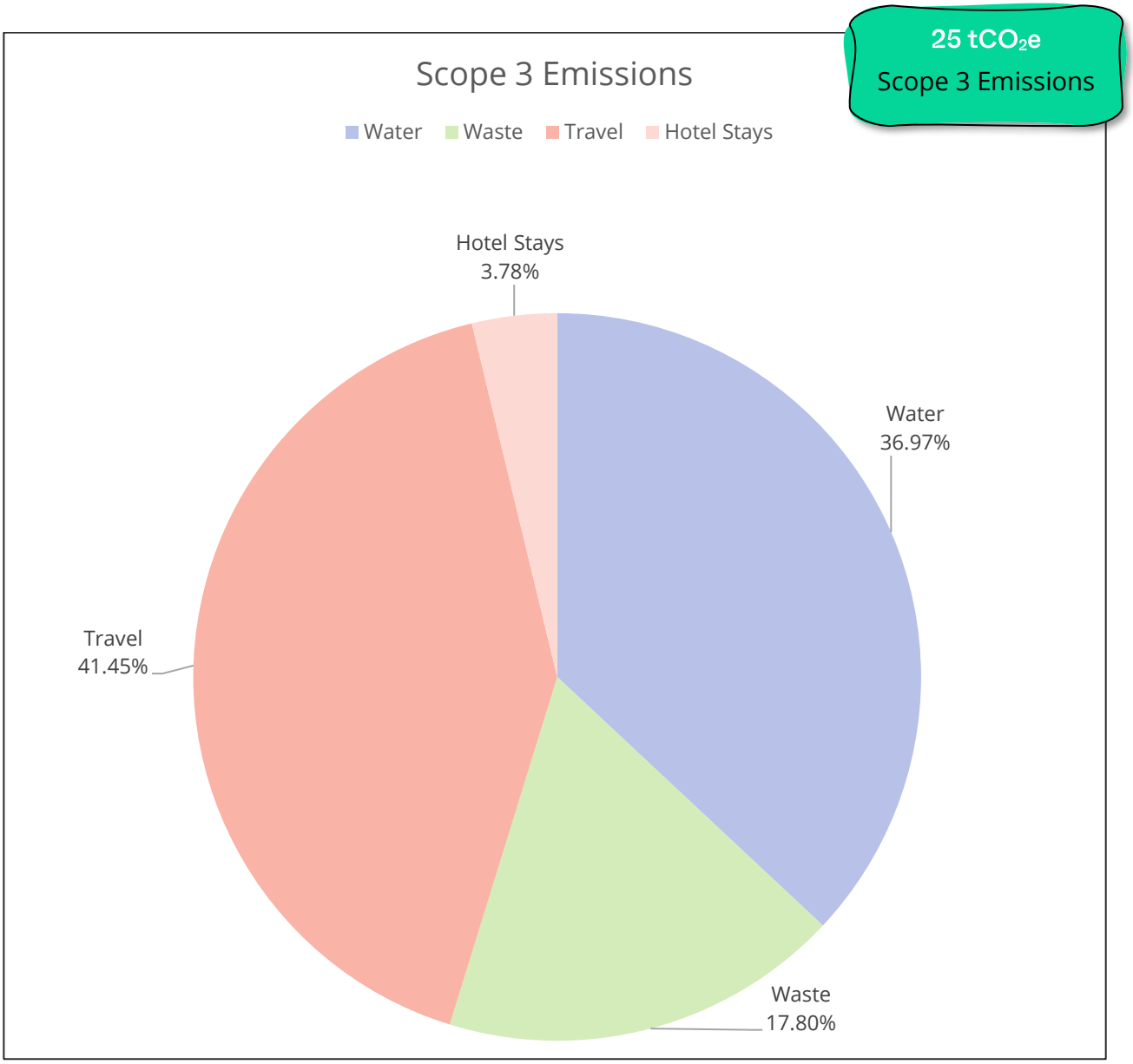


Figure 13 - Scope 3 Emissions 2023-24 year

Due to there being limited Scope 3 data available for the previous year, comparisons have not been established herein. The significant improvements in data collection in these areas this year, and proposed improvements for the upcoming year, mean comparisons can begin to be made in next year's report.

Scope 3

3.1 Business Travel

Emissions related to business travel include any travel undertaken by staff, which takes them away from their normal place of work. It does not include commuting or student travel to the UCB campus.

This emissions were calculated based on expenses data taken from 1st August 2023 to 31st July 2024. Where expenses were marked clearly as Taxi, Train, or Hotel these were separated out. The University is currently updating the way they collect this data in order to establish more accurate data for future years.

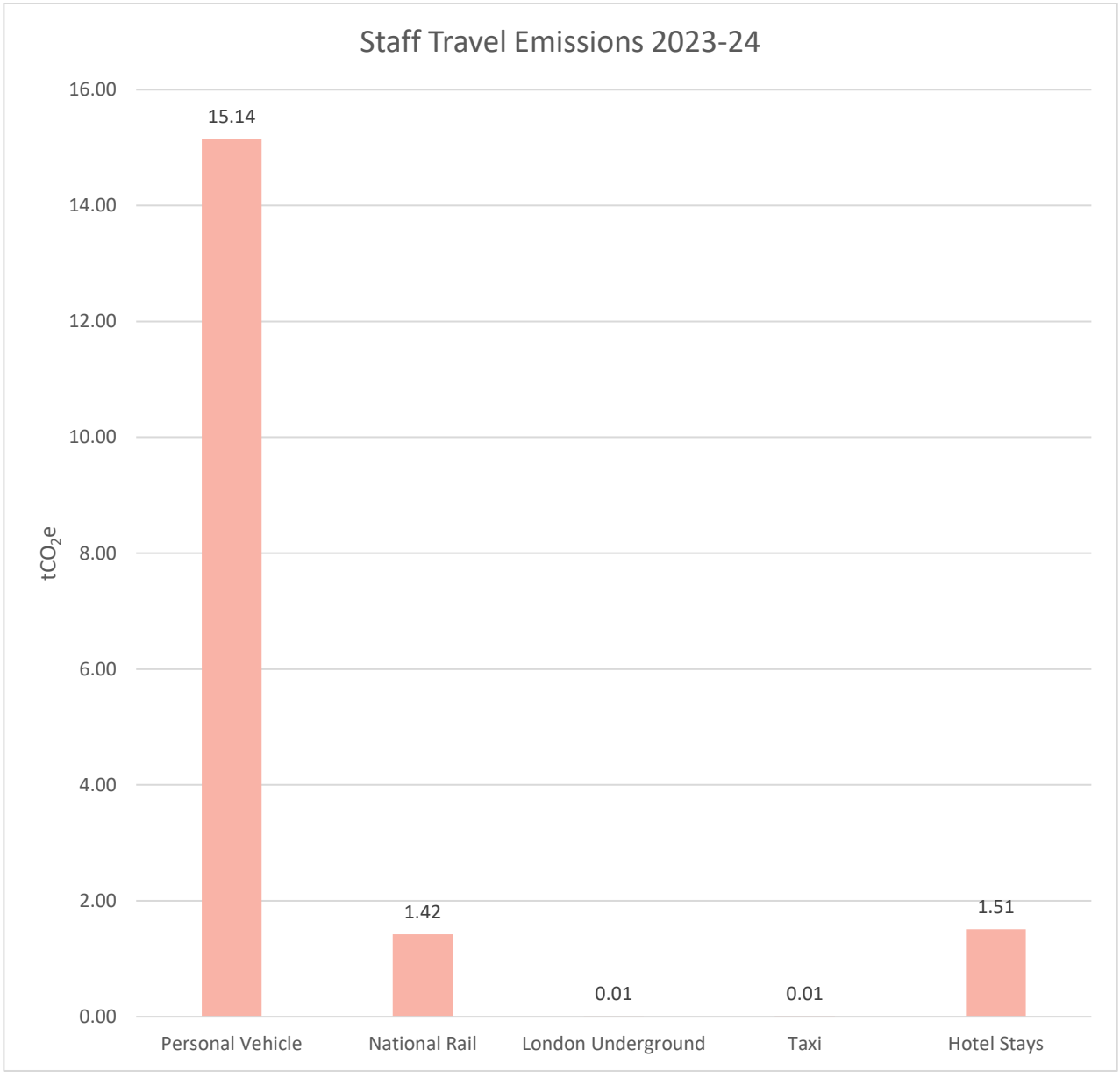


Figure 14 - Annual emissions from travel 2023/24

3.1.1 Hotel Stays

Emissions from hotel stays are provided from the DESNZ GHG reporting on a per night basis. The average cost per room in each location was applied to expenses claim to estimate the number of nights stayed. Where emissions for a particular country were not available, the closest match in terms of climate, location, and socio-economic status was chosen.

Not all hotel stays will have been captured. Those booked internally rather than being claimed back by expenses, will have been excluded, but UCB are aiming to improve this for next year's report.

There were 85 nights of hotel stays accounted for during the reporting period, 70% of which were in the UK. Figure 14 shows that hotel stays were the second highest carbon emitter after car travel.

3.1.2 Transport

Where noted on expenses data, travel by transport was separated into National Rail, London Underground, and Taxi. All other expenses have been listed under Personal Vehicles. In order to calculate emissions, all personal vehicles have been assumed as average sized cars. Typical cost per mile ratios for each transport type were established, and mileage estimated based on expenses paid.

The majority of travel (69%) was by staff travelling in their own vehicle, whilst around a third was by Train (Figure 15). However, due to the lower CO_2 emissions related to train travel, over 90% of emissions associated with transport were down to staff's personal vehicle use (Figure 16).

Scope 3

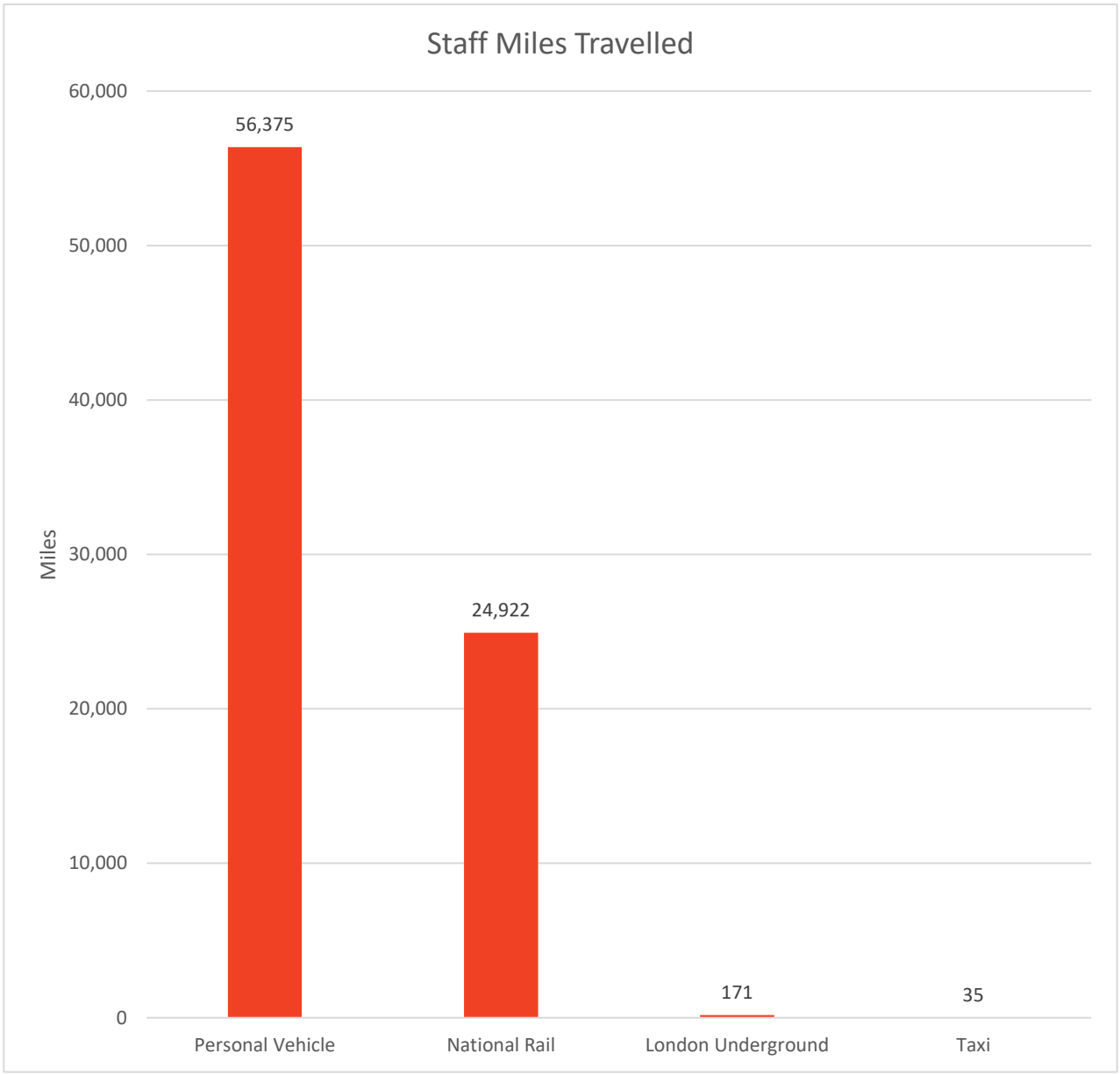


Figure 15 - Miles travelled by UCB staff 2023/24 by transport type

Scope 3

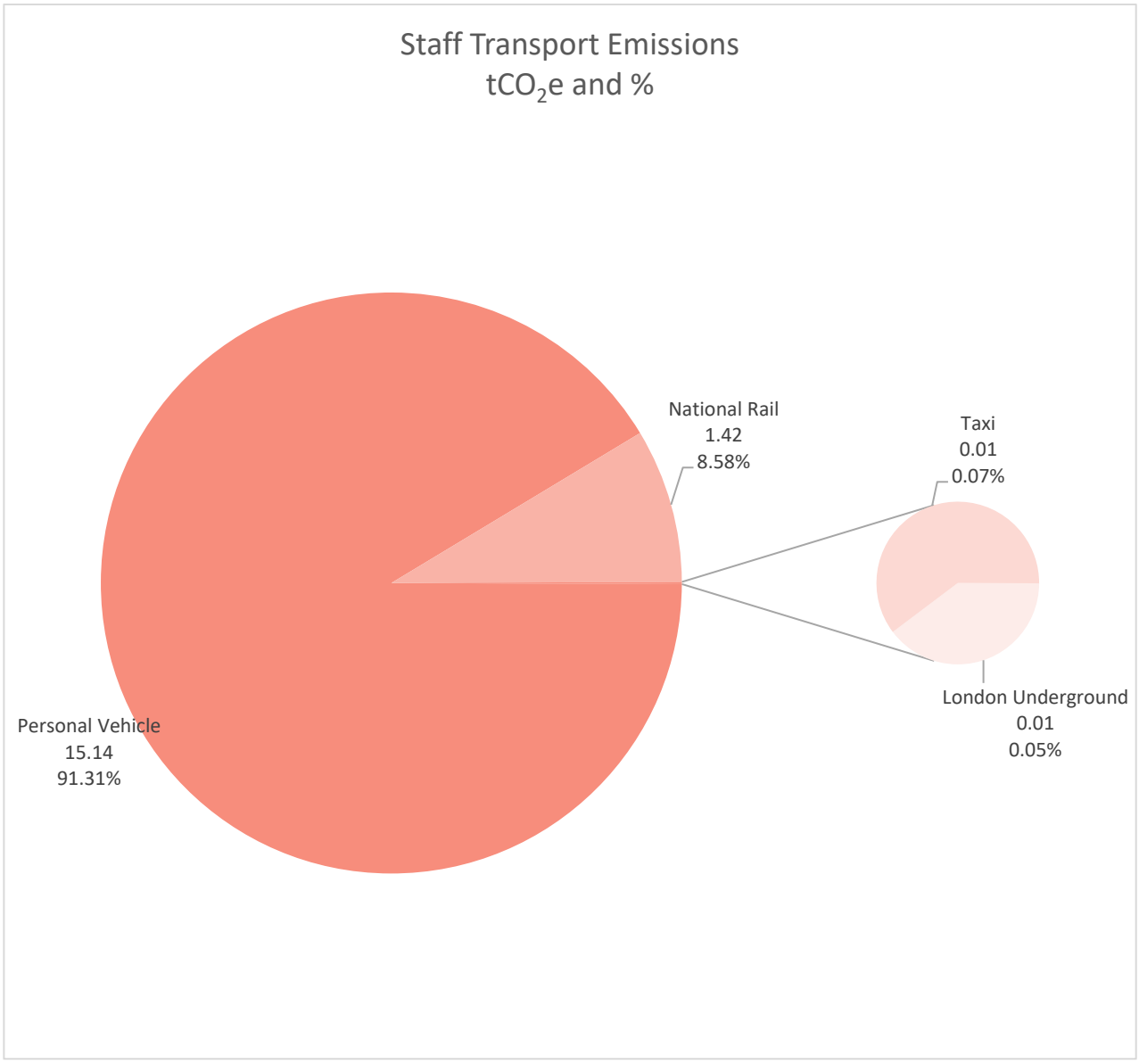


Figure 16 - Emissions due to staff business travel 23/24 by transport type

3.2 Waste

All waste from the University is diverted from landfill, either being recycled, sent for anaerobic digestion, or combustion at an energy from waste plant. Due to changes in waste contractors at the University, waste figures for the 23/24 year estimated based on sample data from October-December 2024.

There is a single bin store covering both McIntyre House and Moss House therefore this waste cannot be separated. There was also no waste reported for Broughton works.

The majority of waste (46%) was reported from Summer Row which is to be expected due to the size and nature of the building (Figure 17). The College of Food being located here leads to the large amount of food waste going to Anaerobic Digestion.

The waste quantities from The Maltings seem quite low, compared to their size and use type. This may be a sign that the extrapolation of data has caused this to be underestimated.

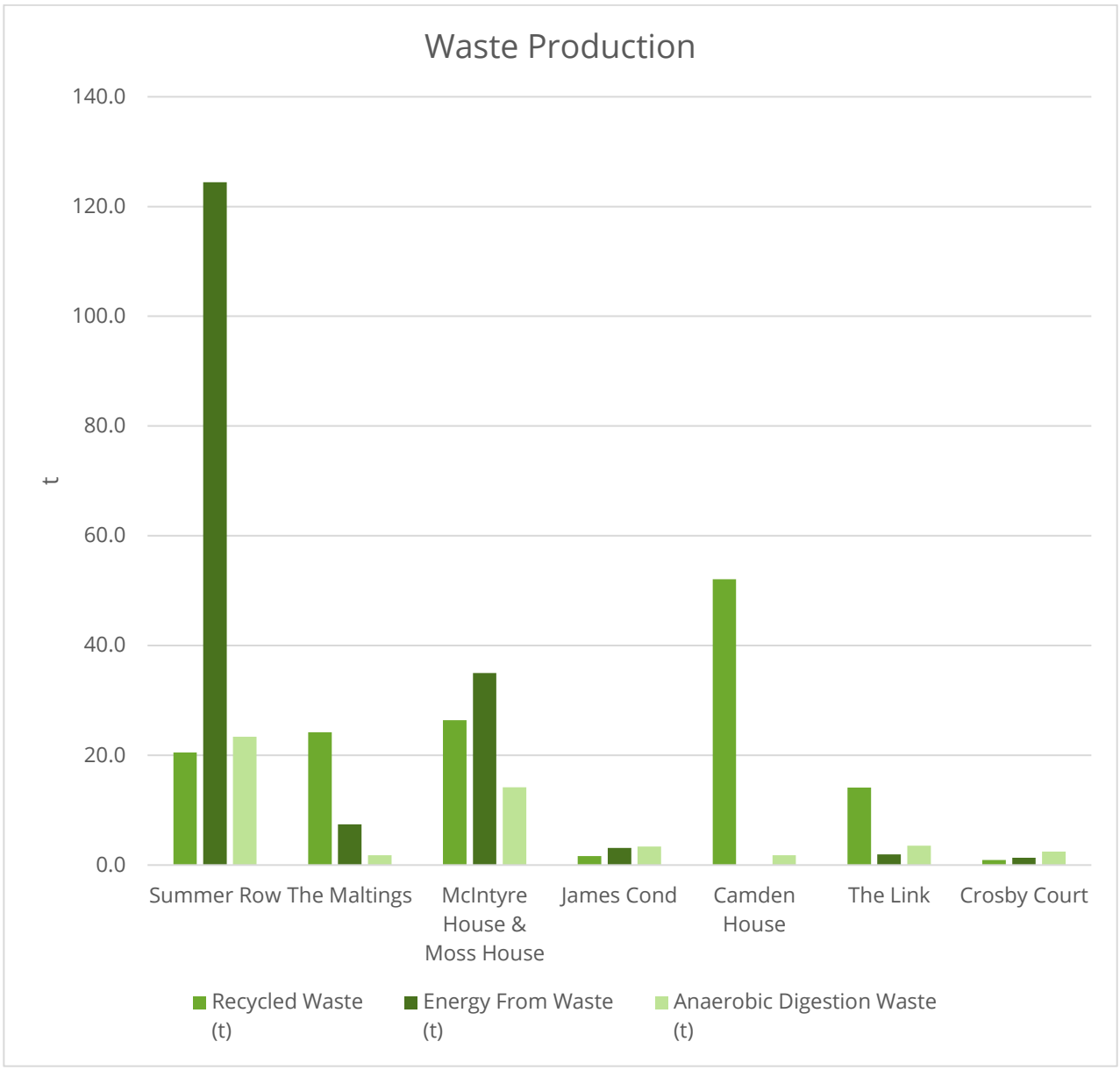


Figure 17 - Tons of Waste produced 2023/24 by building and waste stream

Scope 3

The significant amount of waste generated at Summer Row, and the fact the majority of this is sent to an energy from waste facility, means this building has the greatest waste-related CO_2 emissions (Figure 18).

More comment will be made about how emissions from waste can be reduced in next year's report, once more accurate data has been collated.

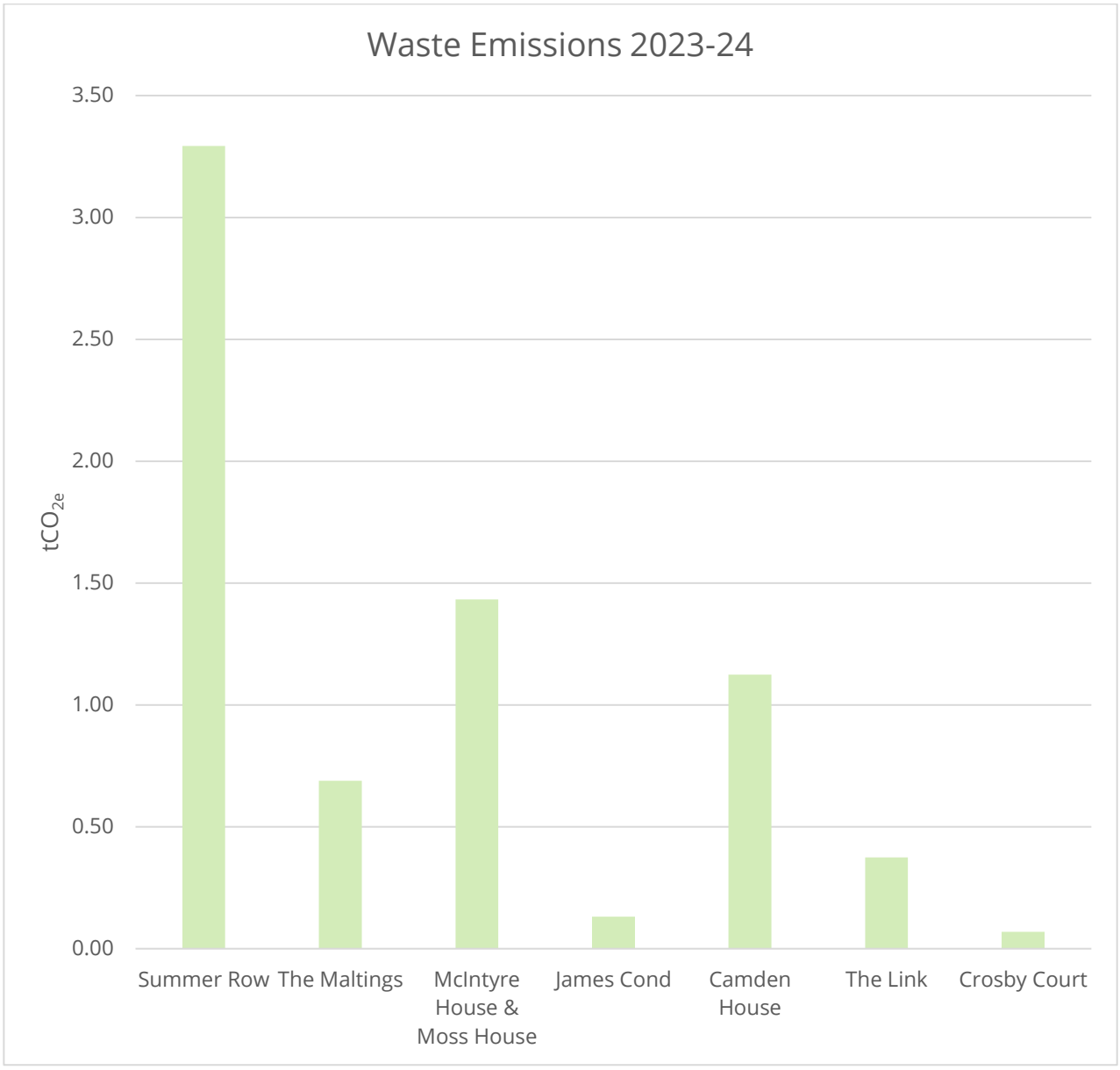


Figure 18 - Emissions from waste by building 2023/24

3.3 Water

Water use data was provided by the supplier for 1st August 2023 to 31st July 2024. Data was provided for all buildings except Summer Row. The waste water figures provided matched the consumption figures, indicating these were estimates. This will lead to emissions being overestimated, as waste water is typically lower than consumption. UCB are currently reviewing their data collection methods for water use.

As would be expected, the residential buildings at The Maltings had the highest water consumption (Figure 19), and therefore emissions (Figure 20), accounting for 77% of usage across the UCB estate. The water use is higher here due to the added use from showers and kitchens.

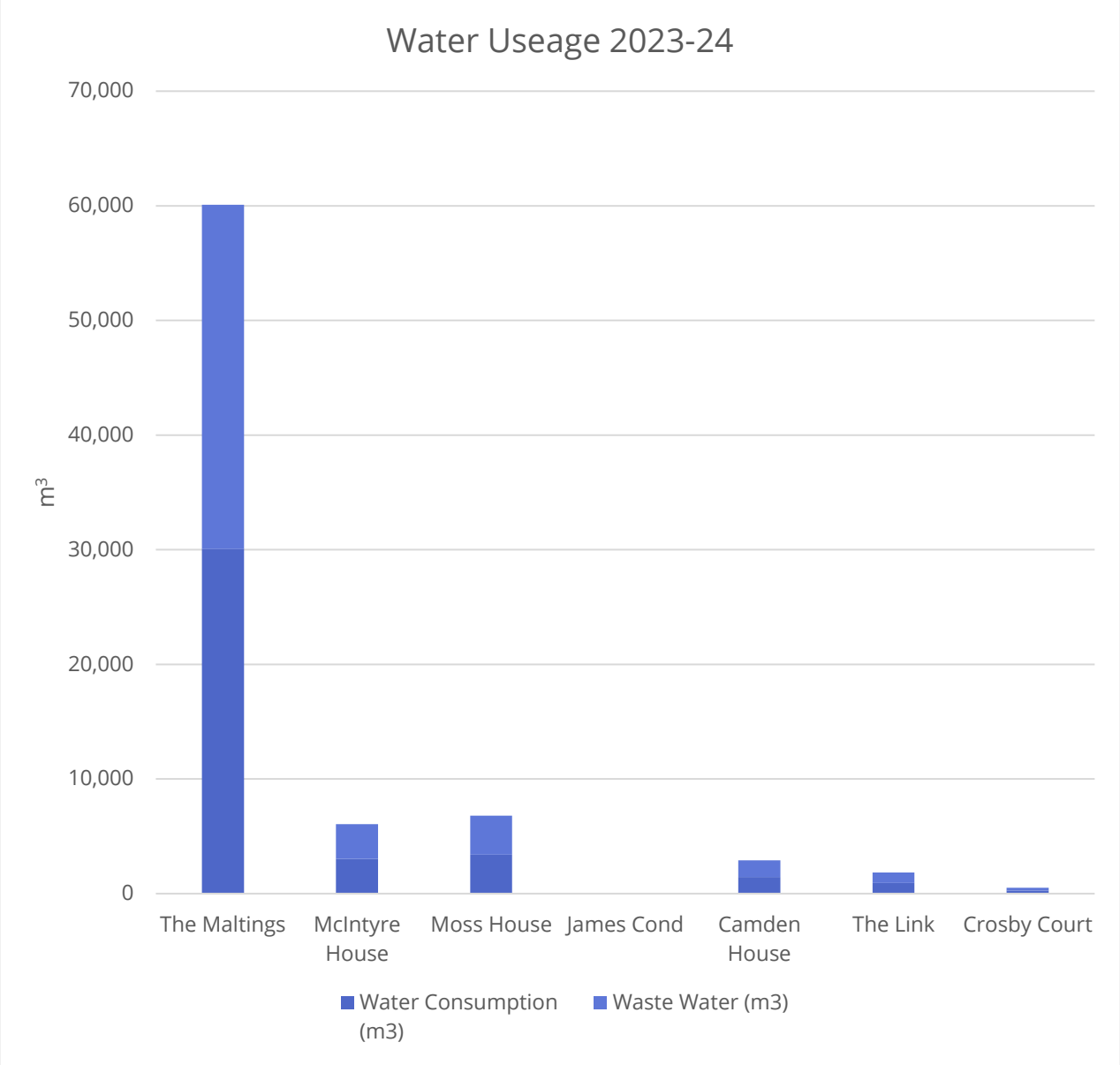


Figure 19 - Water consumption and wastewater for 2023/24 by building

Scope 3

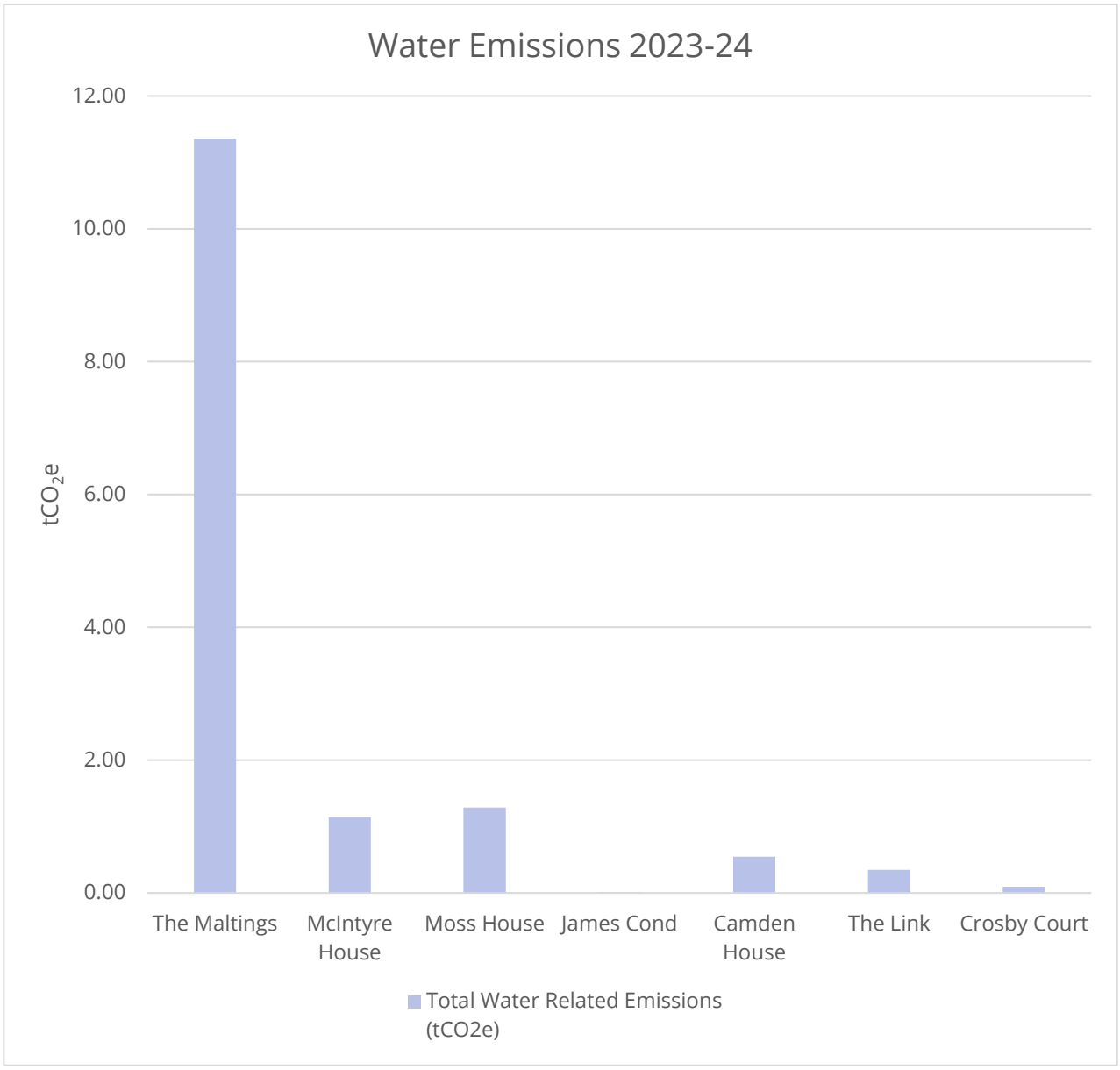


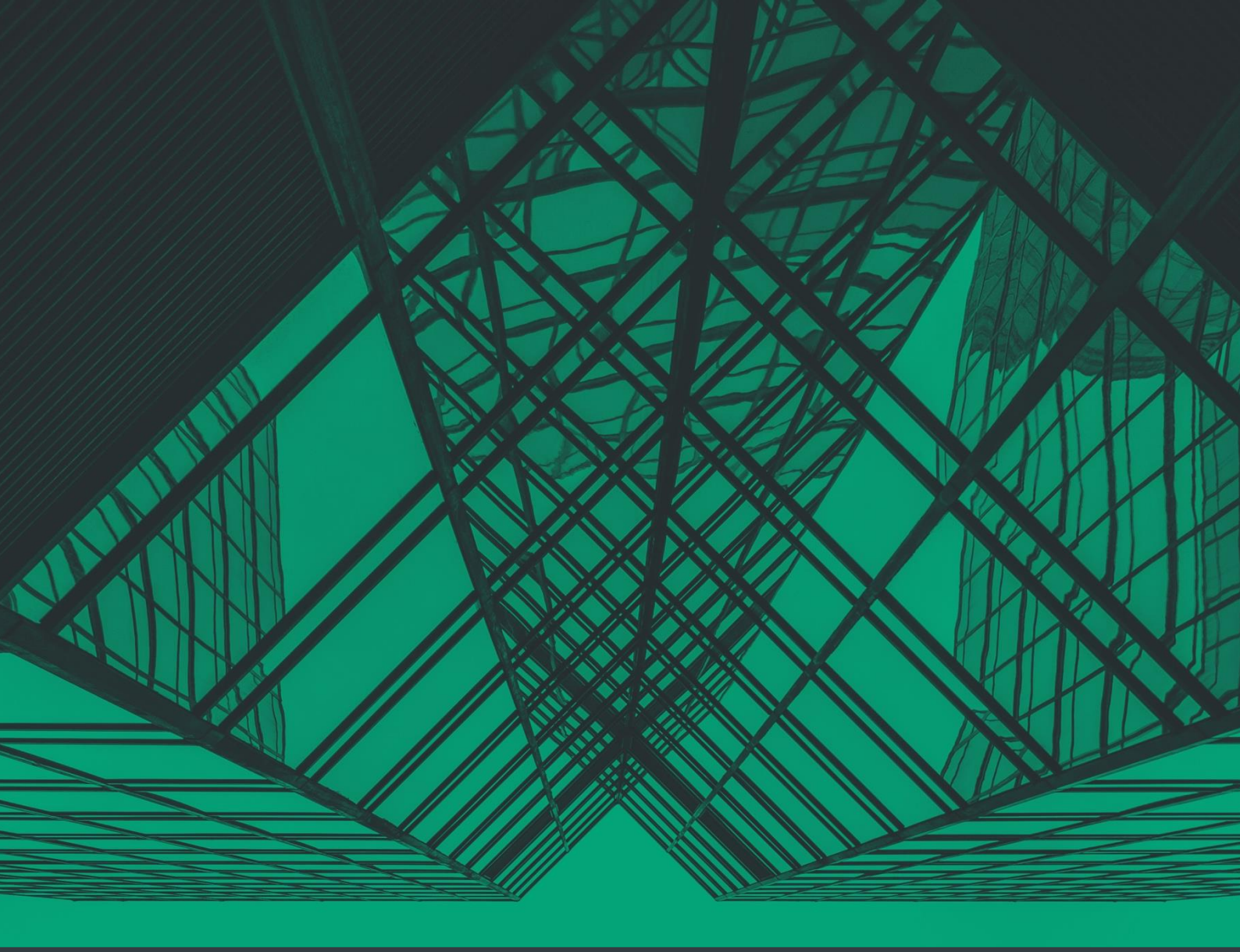
Figure 20 - CO2 emissions related to water use 2023/24

Appendices

4.0 Appendix

Total Emissions in $kgCO_2e$ for all buildings

Emissions Source	Scope	Summer Row	The Maltings	McIntyre House & Moss House	James Cond	Camden House	The Link	Crosby Court	Broughton Works
Grid Electricity Emissions	2	552,664	509,054	370,473	128,558	88,777	35,090	3,368	3,247
Grid Gas Emissions	1	651,436	54,513	481,857	0	125,445	91,275	0	0
Refrigerant Emissions	1	4,197	0	10,926	5,453	0	315	0	0
Recycled Waste Emissions	3	436	515	561	35	1,108	35	19	0
Anaerobic Digestion Waste Emissions	3	208	16	126	30	16	31	16	0
Energy from Waste Emissions	3	2,648	158	745	67	0	42	28	42
Total		**1,211,590**	**564,256**	**864,689**	**134,142**	**215,347**	**126,788**	**3,431**	**3,289**
Scope 1 & 2		1,208,297	563,567	863,256	134,010	214,223	126,680	3,368	3,247
Scope 3 Total		3,293	689	1,433	132	1,124	108	63	42



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