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CAMPUS, CURRICULUM AND COMMUNITY

230522

University College Birmingham

Carbon Benchmarking Report: Campus

GREENHOUSE GAS PROTOCOL

West Midlands Combined Authority

// Research Led Design

Sustainability at our core.

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A	N.Bees	V.Sadler	10/04/2024		First Draft
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Date:	10/04/2024
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1.0 Introduction

NET ZERO TARGET JOURNEY

University College Birmingham have appointed CPW to carry out the carbon emissions footprint calculations for the estate and deliver a comprehensive breakdown of the energy demand by source. This will effectively set standards for UCB's carbon reporting in future years. These activities are in line with UCB's pledge to the West Midlands Combined Authority 's (WMCA) carbon reduction by 2041 target.

Carbon foot printing is a method used to measure the amount of greenhouse gases (GHGs), particularly carbon dioxide (CO_2), that are emitted directly or indirectly by human activities. This method is a valuable analysis for raising awareness about climate change and guiding efforts to mitigate its effects by reducing greenhouse gas emissions.

Foot printing estimates the total emissions which are associated with various activities, products, services, or at organizational level over a specific period. Emissions are expressed in equivalent units of carbon dioxide (CO_2e). This helps identify opportunities to reduce emissions. The emissions are organised into 3 scopes of classification which are described overleaf. Generally, total CO_2 for large buildings or estates are measured in tons (tCO_2e) due to the high quantities. This report considers only scopes 1 and 2 currently, as data for other carbon consumption is not currently available.

At UCB (University College Birmingham) there is a target to be Operationally Net Zero Carbon by 2041 and CPW have been commissioned to assist with carbon foot printing analysis of the estate. University College Birmingham have adopted the robust approach using the Greenhouse Gas Protocol.

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.

1.1 Reporting Methodology

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To enable the development of the 2022-23 Carbon Emissions Report there has been interrogation of the University College Birmingham's energy data and conversions to carbon in line with the published GHG protocol 2023. This report follows the GHG reporting methodology of scope 1 & 2 emissions currently, Scope 3 emissions data is not currently 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 us a clear understanding of our energy consumption and over all carbon footprints.

Scope 2 carbon emissions refer to indirect greenhouse gas (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.

Scope 1 carbon emissions refer to direct greenhouse gas (GHG) emissions that occur from sources that are owned or controlled by UCB. Scope 1 emissions typically include the following sources:
Fuel: This includes emissions from burning fossil fuels on-site, such as in boilers, vehicles and other equipment. Examples include emissions from company-owned vehicles, heating systems, and onsite power generation.

Scope 3 carbon emissions represent indirect greenhouse gas (GHG) emissions that occur as a result of an organization's activities, but which are not directly owned or controlled by the organization itself. These emissions occur throughout the value chain, including both upstream and downstream activities. Scope 3 emissions are typically the most extensive and challenging to measure because they encompass a wide range of sources and often involve multiple stakeholders. Business travel and employee commuting are included in scope 3.

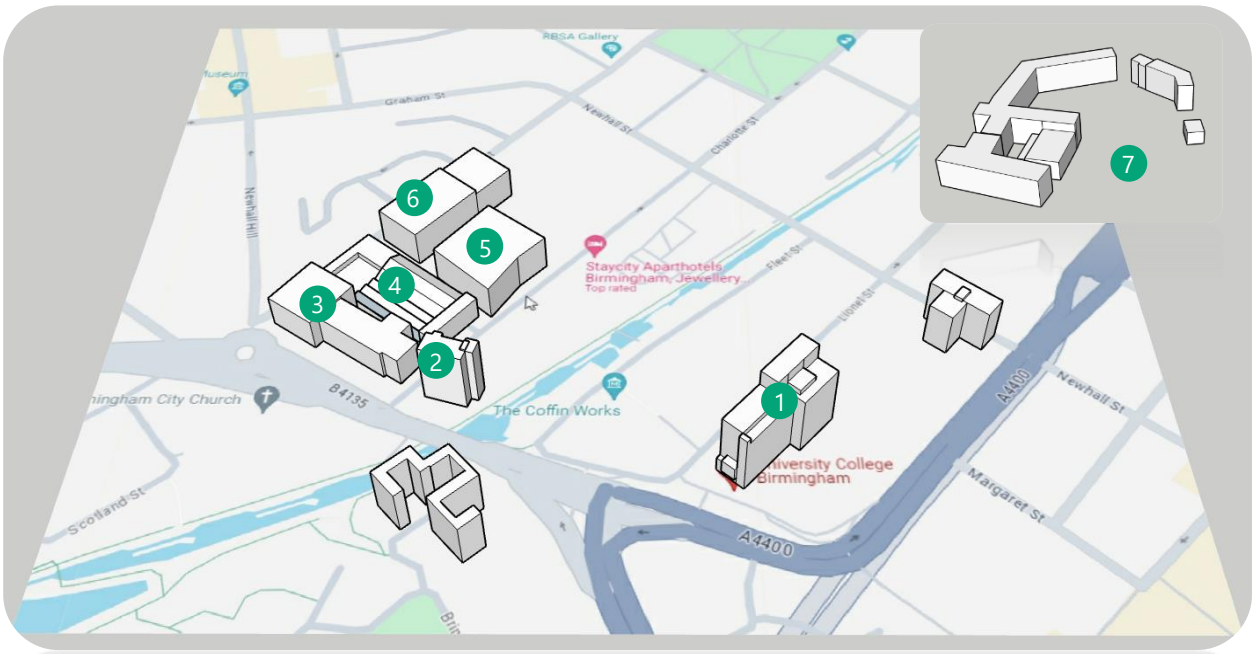
1.2 Estate

UCB - Carbon Benchmarking

The UCB Campus comprises of seven buildings across central Birmingham locations. Each are located around the Birmingham and Fazeley Canal and have access to public transport, although currently the staff predominately use personally owned cars as their method of commuting.
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. In this report the focus is on scope 1 & 2 Carbon emissions only. There is currently insufficient data to include the scope 3 emissions at this time.

CPW have worked closely with the UCB Sustainability manager & Estates teams in a vast data gathering exercise. This has included interrogating the UCB's metering data for analysis, which identified the energy used between August 2022 to August 2023.

In this report the James Cond building is excluded from the 2022-23 Carbon footprint as construction on this building completed late 2023.
James Cond will be included in future footprint reporting as data is not currently available due to the building's recent refurbishment.
The metering strategy across the site requires attention to allow UCB to understand the actual performance of each building across the estate.



1. Summer Row
2. The Link
3. Camden House
4. James Cond
5. McIntyre House
6. Moss House
7. The Maltings (Off site)

UCB - Carbon Benchmarking

1.3 Our Approach

The necessary requirement for this carbon emissions report detailing the University's total carbon footprint is to continue the net zero journey with a good foundation to further build /develop UCB's Decarbonisation plan. A detailed decarbonisation plan will spear head the required changes to the university's approach. Decarbonisation plans require input from previous studies and investigations of building systems - heating, lighting, power and their sources are interrogated along with building fabrics in finer detail to understand the impact and what is really needed to achieve the net zero goals.

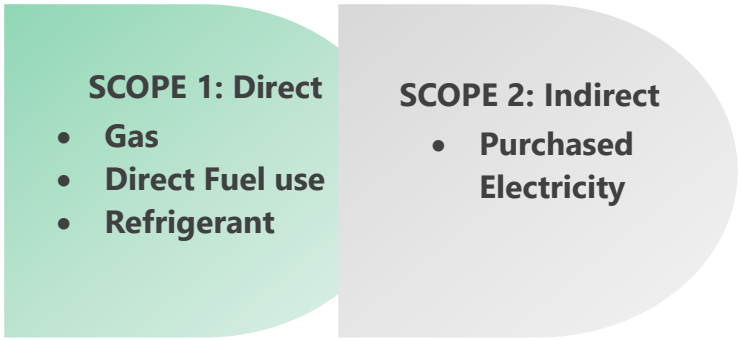
UCB is currently creating a carbon reduction plan in line with the West Midlands Combined Authority's (WMCA) Carbon Pledge for a net zero target by 2041. The creation of this plan involves setting ambitious goals and implementing strategies to significantly decrease carbon emissions.

Targeted approaches are required to focus on the carbon reduction of the estate with high energy usage buildings being the first. For instance, Summer Row consumes more than 50% of the total energy across the UCB estate, this initially is due to poor performing external fabrics (Windows, Wall insulation, Roof insulation etc.) and in turn large heat losses, so the first action should be to improve the external fabric and assist in the reduction the energy demand. Mechanical and electrical services improvement should follow from this.

By implementing such improvements throughout University College Birmingham's Campus, the Net Zero targets become more achievable. These interventions and the need to understand our energy consumption profile highlight the importance of the energy management strategy and the carbon reduction plan.

Implementing a comprehensive carbon reduction plan requires coordinated efforts from across the university's teams, including administration, sustainability team, facilities management, academic departments, student groups, employee groups (with Unions), partners and the board of governors. It's essential to prioritize actions that deliver the greatest emissions reductions while promoting sustainable development and equity within the campus. This footprint report is the first step in in the latest standard for University College Birmingham's net zero journey.

Gas, Electricity, refrigerant demands, and fuel for mileage are used to determine the 2022-23 carbon footprint baseline, these scope 1 and 2 emissions are the four data sets available which are the Universities metered data provided by their nominated energy supplier. These reported factors are shown below.



2.1 Carbon Analysis- Historic Baseline

UCB - Carbon Benchmarking

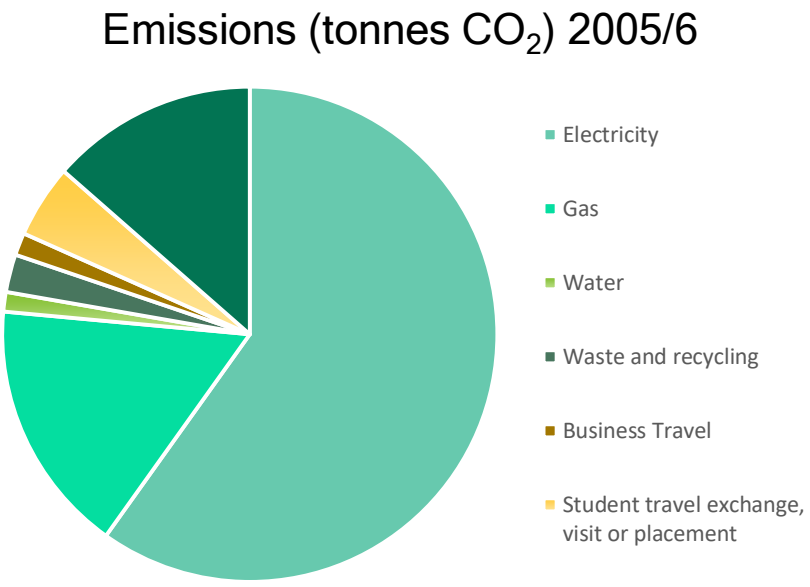
University College Birmingham has previously performed a carbon emissions baseline exercise in line with The Higher Education Funding Council for England (HEFCE).

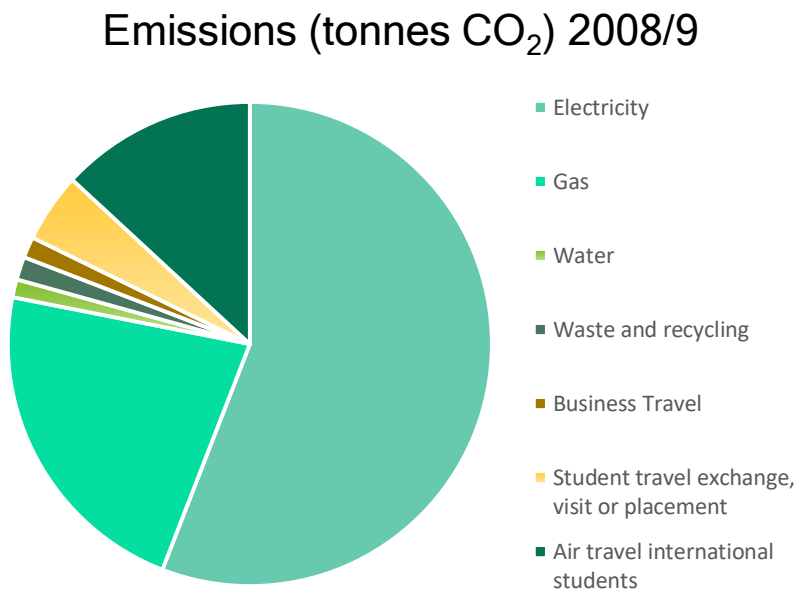
This study was performed across 2005-2006 and again in 2008-2009. This carbon footprint analysis comprised of Gas, Water and Electricity. It also included the quantification of waste streams and an estimation of travel to appreciate the carbon footprint at that time.

These combined scopes of energy provided an estimated total carbon footprint as follows:

- 2005/6 = 5796(tCO_2e)
- 2008/9 = 5983(tCO_2e).

As shown on the pie chart diagrams for 2005/6 & 2008/9 the carbon emissions were dominated by electrical consumption in both cases. Gas consumption can be seen to be less than half of the electrical consumption in terms of equivalent CO_2 due to the historic conversion factors used to calculate the previous footprint.





Carbon Analysis- Historic Baseline

UCB - Carbon Benchmarking

Carbon emissions conversion factors are numerical values used to quantify the amount of greenhouse gases (GHGs) emitted per unit of activity, fuel consumption, or product/process output. These factors are crucial for estimating and reporting greenhouse gas emissions 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**

Carbon emissions conversion factors are essential tools for organisations, governments, and researchers seeking to quantify, monitor, and reduce greenhouse gas emissions. They enable consistent and comparable reporting of emissions across sectors and activities, supporting efforts to mitigate climate change and transition to a low-carbon economy.

The 2005/6 and 2008/9 reports used conversion factors released at the time of the report which differ to today's, this is due to: Advancements have been made in the understanding of climate science where methodologies in GHG calculations have been refined to better understand the impact and therefore reducing the overall conversion factor. The change of emissions sources also plays a large part such as the transition from coal to natural gas or renewable energy sources which has led to changes in the carbon intensity of electricity generation. Data collection and analysis has improved over years to give a 'real world' view of emissions.

The conversion factors used in the 2005/6 & 2008/9 reports vs the 2023 GHG Conversion factors.
in this report were as follows:

GHG Emission Conversion Factors by Date (kg/CO_2e/kWh)		
	2005-09 Reports	2023 GHG Factors
Gas	0.2	0.2
Electricity	0.49	0.21
Water	0.969	0.177
Diesel	2.669	0.27
Petrol	2.33	0.25
Refrigerant	-	R410a-1924/HF32 677

UCB - Carbon Benchmarking

2.2 Carbon Analysis – Total Carbon Emissions

From the data gathering exercises undertaken by University College Birmingham & CPW, we have broken down each building across the estate to establish the areas consuming the most carbon.

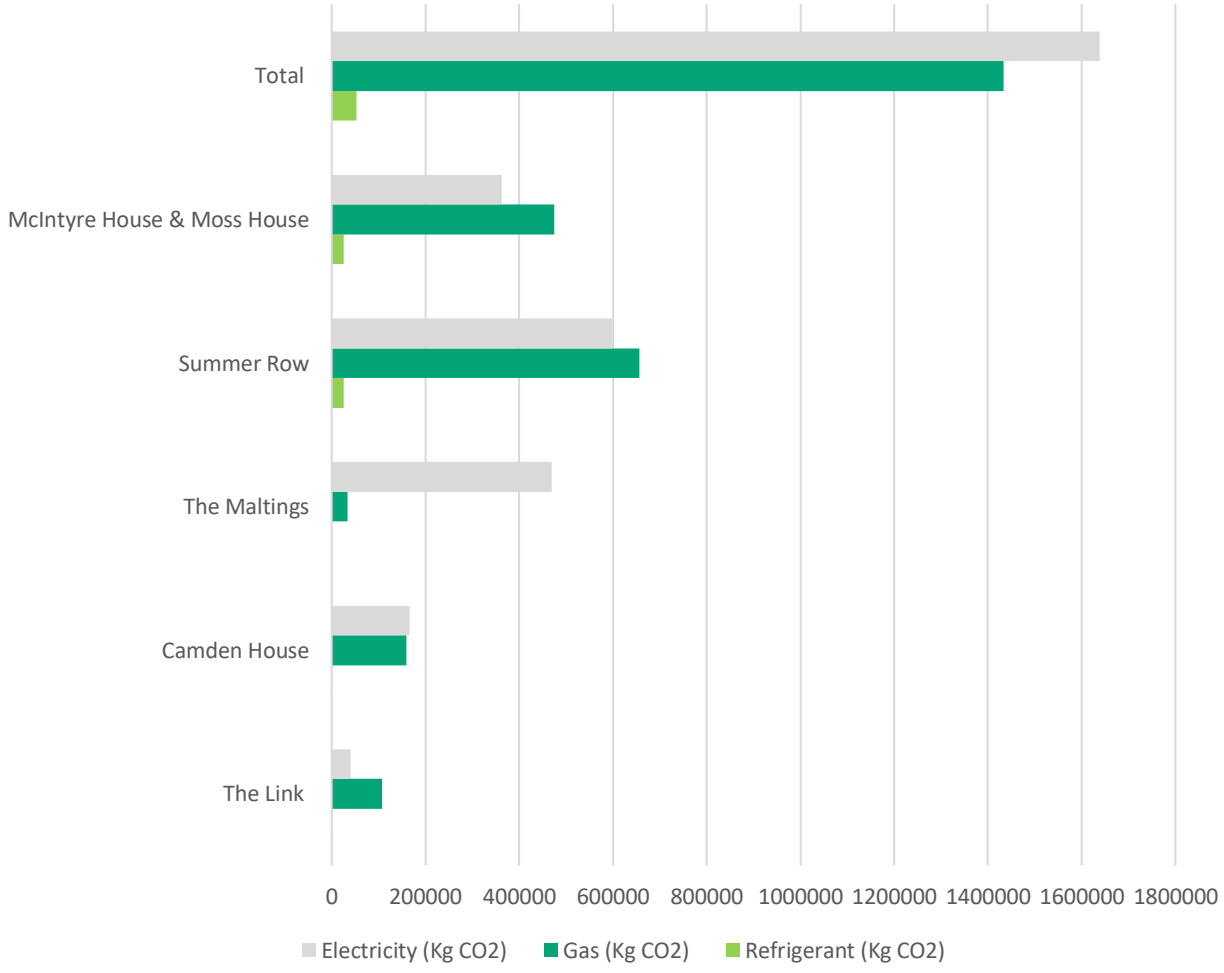
As can be seen from the below graph, Electricity is currently the highest of the fuel types in regard to CO_2 creating an equivalent of 1,649 (tCO_2e) across 2022/23.

This is predominantly because of the large heating loads of The Maltings which is heated electrically along with ethe generally high electrical demand of the larger buildings across the estate which are Summer Row and a combined Moss & McIntyre House.

Summer Row building has the highest carbon emissions with 1,280 (tCO_2e) across 2022/23.

The remaining buildings when combined have a total carbon emission of 1,877 (tCO_2e) which highlights how high and significant the carbon emissions from Summer Row building are.

Total Footprint
3,171 tCO_2e



2.3 Emissions Breakdown – Electricity

UCB - Carbon Benchmarking

The collection of the electrical meter readings has been taken from twelve months utility bills dated august- 2023 to July-2024.

This energy consumption data has been converted using the 2023 Green House Gas carbon conversion factors into tCO_2e, the factor for electricity in kWh being 0.21.

Some of the datasets provided for the buildings were in multiple portions and of different time periods so rationality of these and further investigation to understand the metering strategy was required, assumptions were made in some cases for meter allocation to buildings where duplicates of building names were apparent.

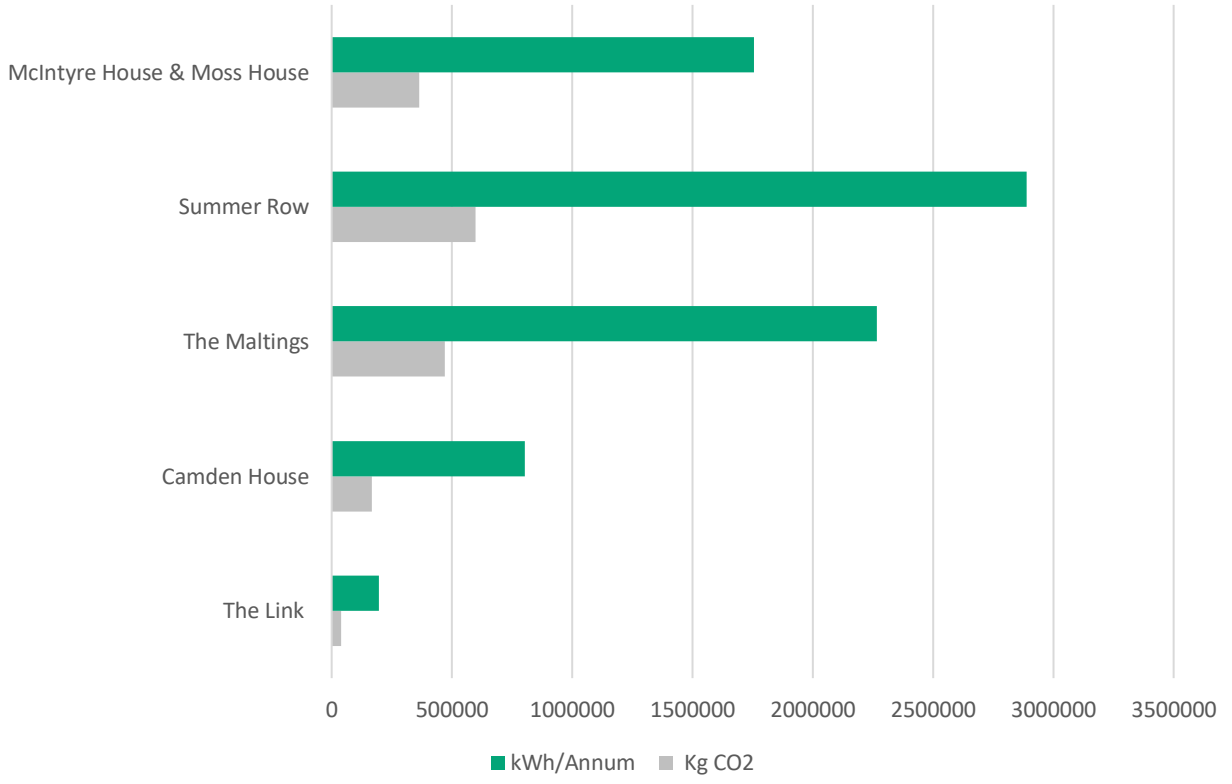
This process was based on similarity and building sizes led by support from the UCB Estates team.

University College Birmingham are addressing the metering strategy to alleviate this in future reporting of the carbon footprint.

Buildings such as Camden House has multiple meters allocated, therefore the total energy used has been combined to complete the total building demand. The graph below details the consumption of electricity across each building on the UCB estate, Summer Row which is the highest electrical energy user at 2,888,783 kWh in year 2022/23 which is an equivalent 598 tCO_2e followed by The Maltings then the combined Moss & McIntyre House.

Moss House and McIntyre house have been shown as combined energy demands (Electricity only) this is due to the metering data being difficult to interpret as the locations shown across the billing data are inconsistent, with no immediate solution.

Electricity
1,638 tCO_2e



Electric CO_2e conversion factor = 0.21 / kWh

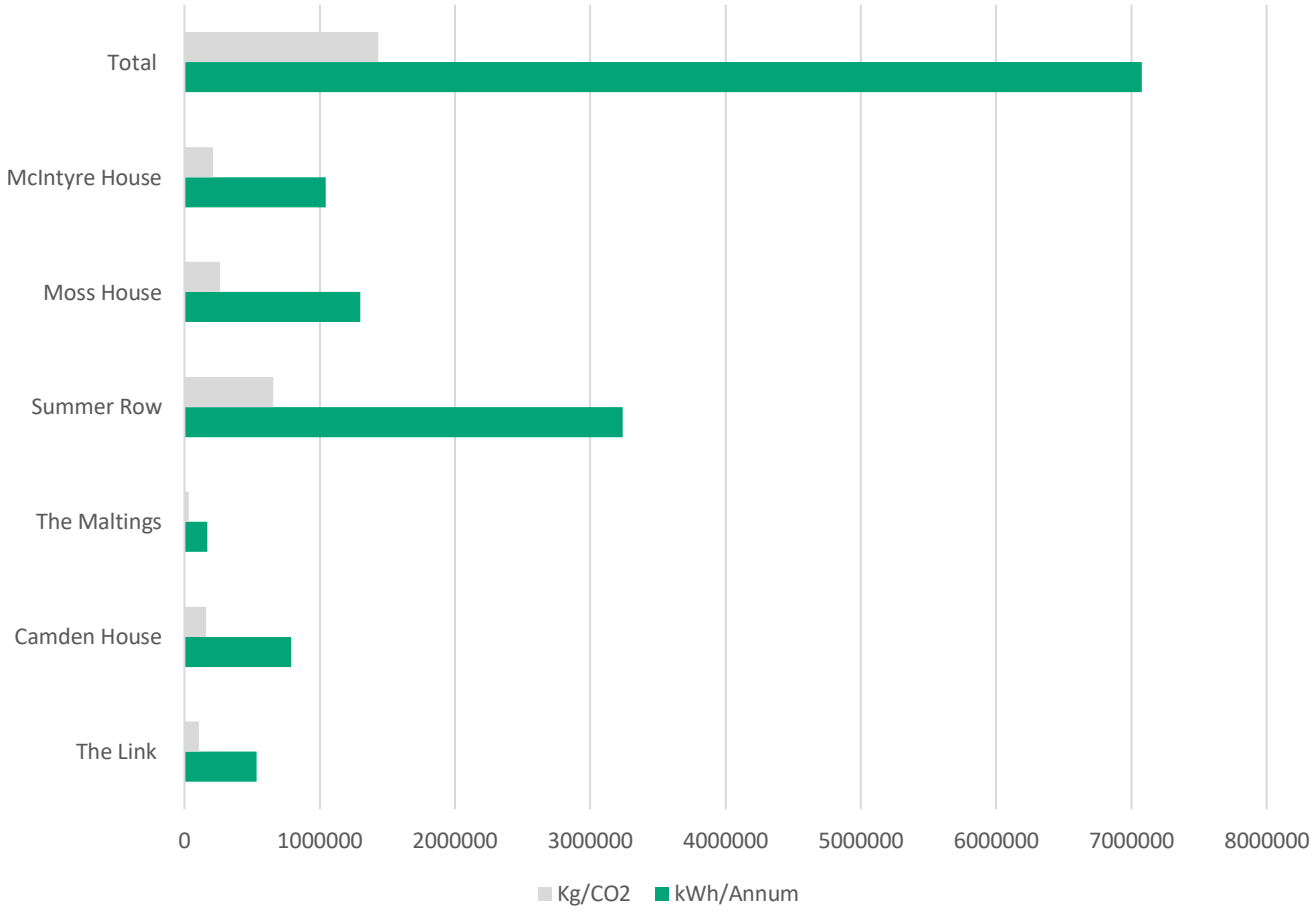
2.4 Emissions Breakdown – Gas

UCB - Carbon Benchmarking

The Gas utility readings were used for this Carbon footprint exercise to calculate the equivalent CO_2 consumption. 2023 GHG Conversion factors have been used to calculate the equivalent CO_2e in kilograms and tons (0.20).
These utility readings are presented across seven meters around the campus which does not give the granular 'split' required to understand the individual Gas consumption of the individual building. This Gas consumption is predominantly for the heating and hot water supply to the buildings.

To understand the gas demand per building, sub meters are required for the individual Gas supplies. University College Birmingham are addressing the metering to alleviate this in future reporting of the carbon foot printing exercise.
The table pictured below shows the consumption of Gas across each meter of the UCB estate, Summer Row again is the highest energy user at 3,241,733 kWh in year 2022/23 which is an equivalent 675 tCO_2e followed by Moss house.

Gas
1,434 tCO_2e



2.5 Emissions Breakdown – Refrigerant

UCB - Carbon Benchmarking

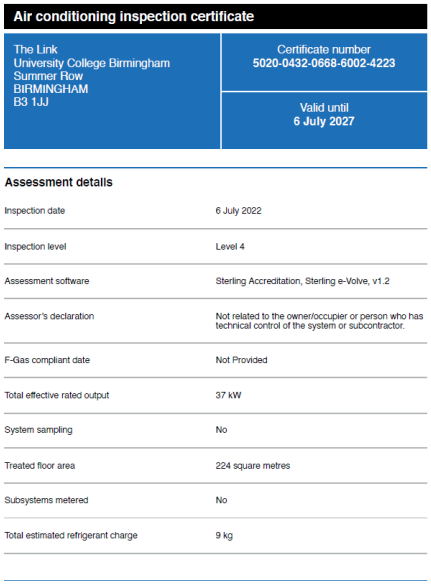
The total estimated refrigerant charge has been taken from the TM44 certificates provided by University College Birmingham, example shown on the right.

We have then estimated the expected 'top up' amounts of each system refrigerant across the campus, this has been estimated at ten percent per system over the twelve-month period as there is no record currently stating any 'top up values' for refrigerant.

The systems across the UCB campus use different refrigerant types – R410A, HFC-32, HFC-23 & R407C, all having differing Greenhouse gas conversion factors, these factors were consulted to determine the equivalent CO_2 for each fuel type across 2022/23 allowing the total CO_2e equivalent used to be calculated.

The cumulative total footprint of CO_2 equivalent of refrigerant equates to 82.9 tCO_2e.

The majority of these emissions are emanating from Moss House Building with a total of 45.6 tCO_2e alone, Summer Row building following this with a total 25.3 tCO_2e.



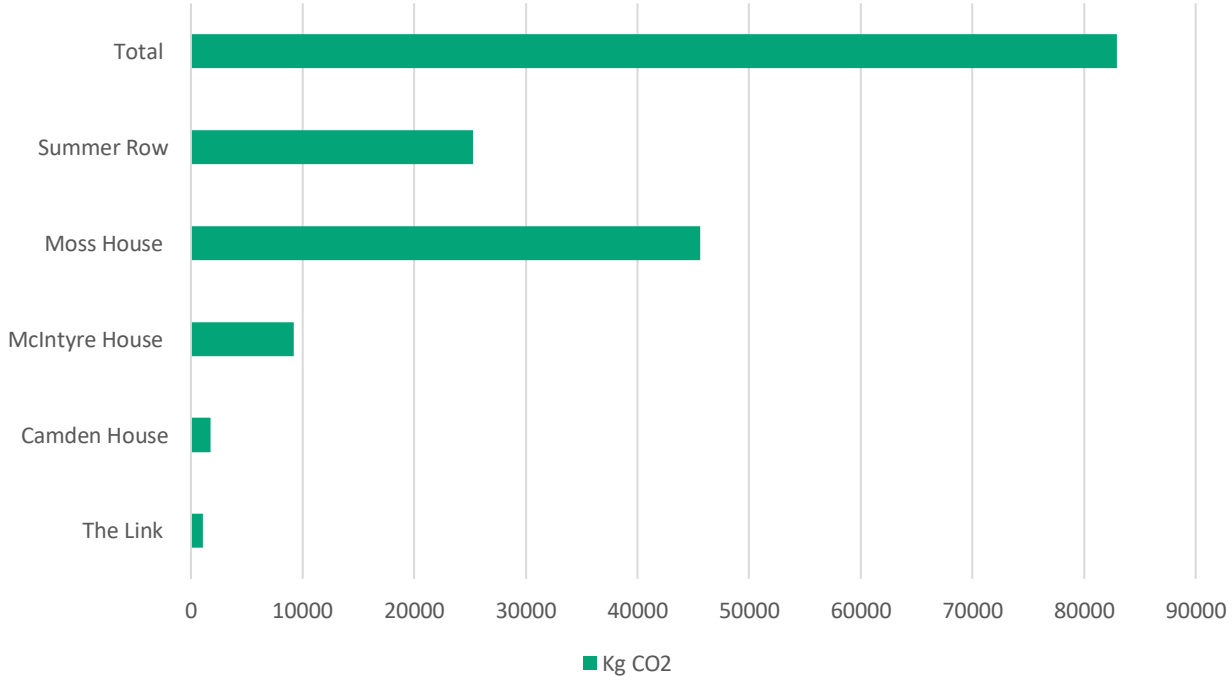
Air conditioning inspection certificate

The Link University College Birmingham Summer Row BIRMINGHAM B3 1JJ	Certificate number **5020-0432-0668-6002-4223** Valid until **6 July 2027**

Assessment details

Inspection date	6 July 2022
Inspection level	Level 4
Assessment software	Sterling Accreditation, Sterling e-Volve, v1.2
Assessor's declaration	Not related to the owner/occupier or person who has technical control of the system or subcontractor.
F-Gas compliant date	Not Provided
Total effective rated output	37 kW
System sampling	No
Treated floor area	224 square metres
Subsystems metered	No
Total estimated refrigerant charge	9 kg

Refrigerant
82.9 tCO_2e



2.6 Emissions Breakdown – Fuel for travel

UCB - Carbon Benchmarking

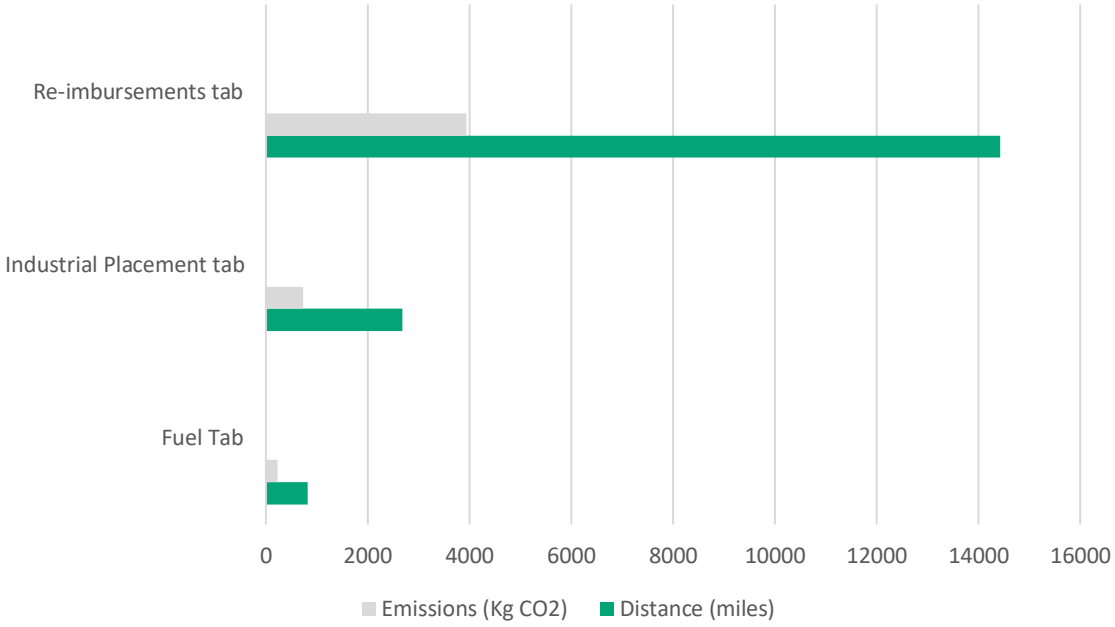
The current method of collating the fuel usage is via expenses claimed information. Previously there was not always accurate fuel types denoted as the logged data stated the mode of transport not the fuel type, in those instances it has been assumed that all fuel is of the *Heavy diesel* type when considering the conversion of the fuel to CO_2e.

The total cost of the heavy diesel fuel expenses collected was a total of £7,180. Using the 0.27 GHG conversion equates to 4,898.4 kg CO_2e.

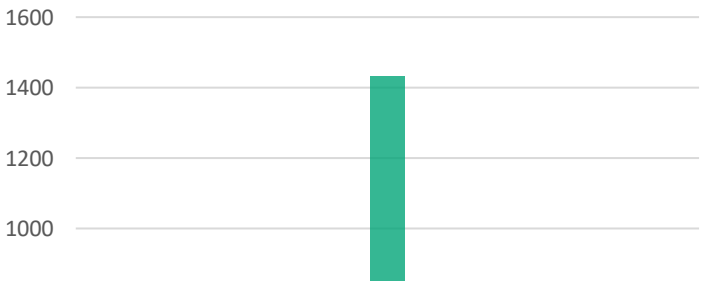
Vehicles are the smallest contribution to the overall carbon footprint at UCB, future collection methods are required to be updated to assist the reporting methodology and give a further understanding of the potential areas that require attention regarding the operational energy use.

Data shown in the below graph depicts the information collected and the factors used to convert the fuel used into the equivalent carbon.

Fuel for travel.
4.9 tCO_2e



2.7 Emissions Breakdown

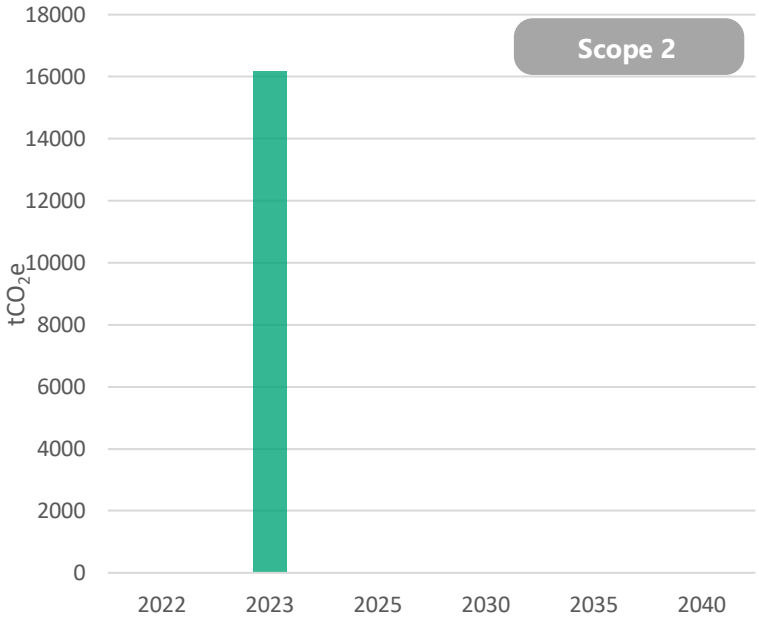


UCB - Carbon Benchmarking

Scope 1 emissions are detailed within 3 categories contributing to the total of 1521 tons of CO_2e (tCO_2e). below are the percentages of the energy which make up the total carbon footprint:

- Gas // 45%
- Travel // <1%
- Refrigerant // 3%

Scope 1



Scope 2 emissions are shown above as a singular value as University College Birmingham have reported Electricity only as their scope 2 emissions due to insufficient data in other areas.

- Purchased Electricity // 52% (of total CO_2 emissions across all scopes)

2.8 Emissions Breakdown by Building

Below we have detailed in the form charts to distinguish the emissions break down per source per building. In some cases, such as Richmond house and Cambrian Halls there is insufficient data available to compare carbon emissions of sources, electricity

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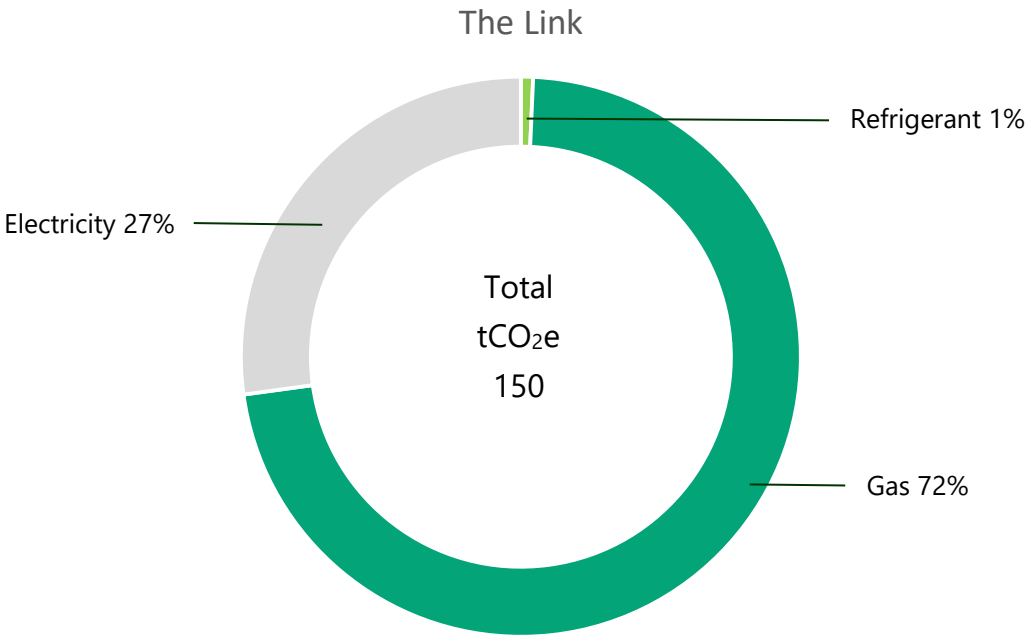
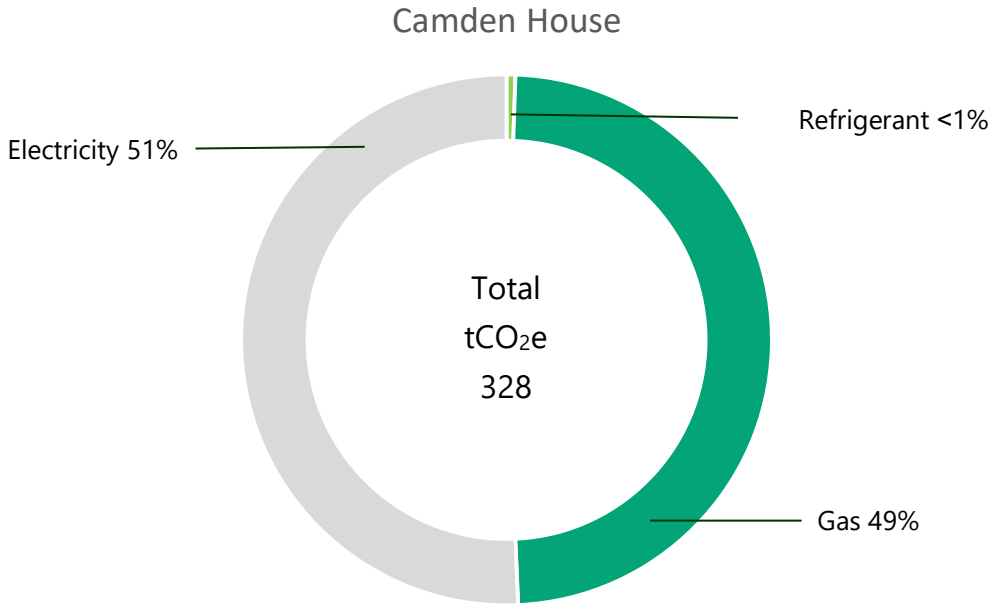
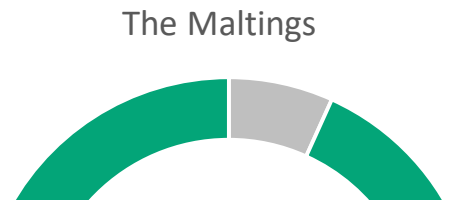
consumption data is the only available energy source information for these two sites. these buildings are no longer part of the UCB campus. (Richmond House tCo_2e = 1.8/ Cambrian Halls tCO_2e = 6)

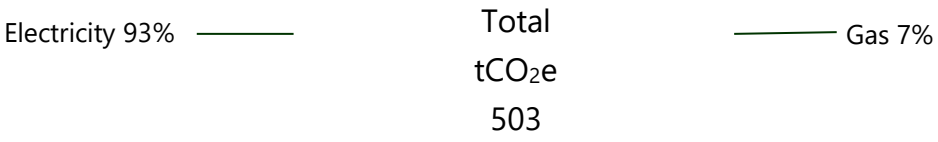


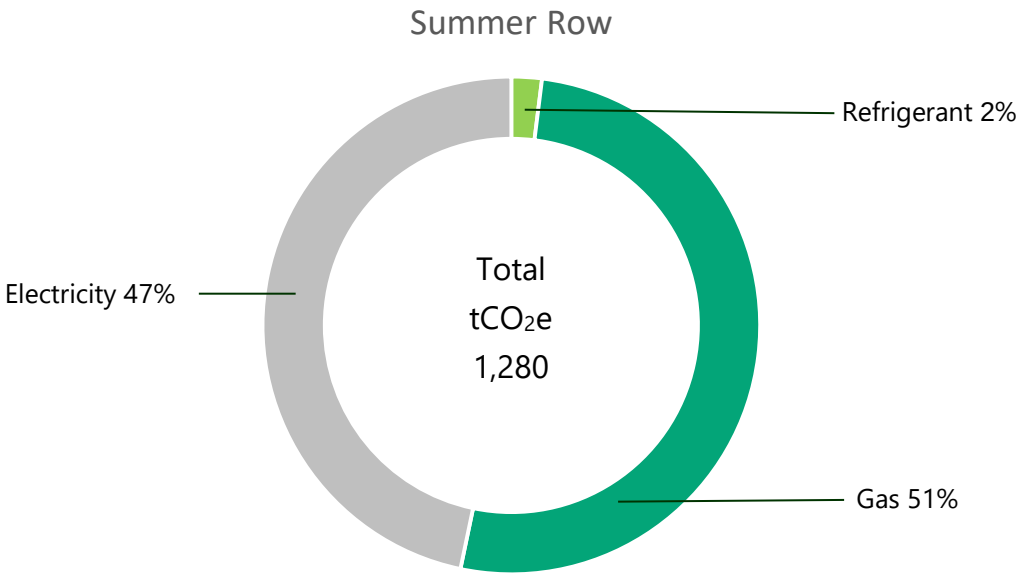


Emissions Breakdown by Building



UCB - Carbon Benchmarking

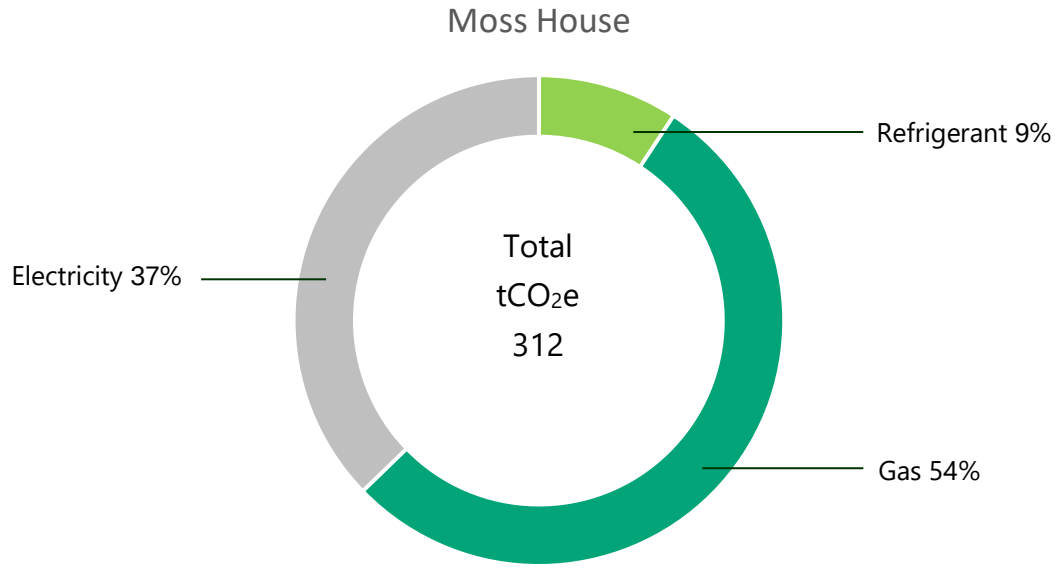


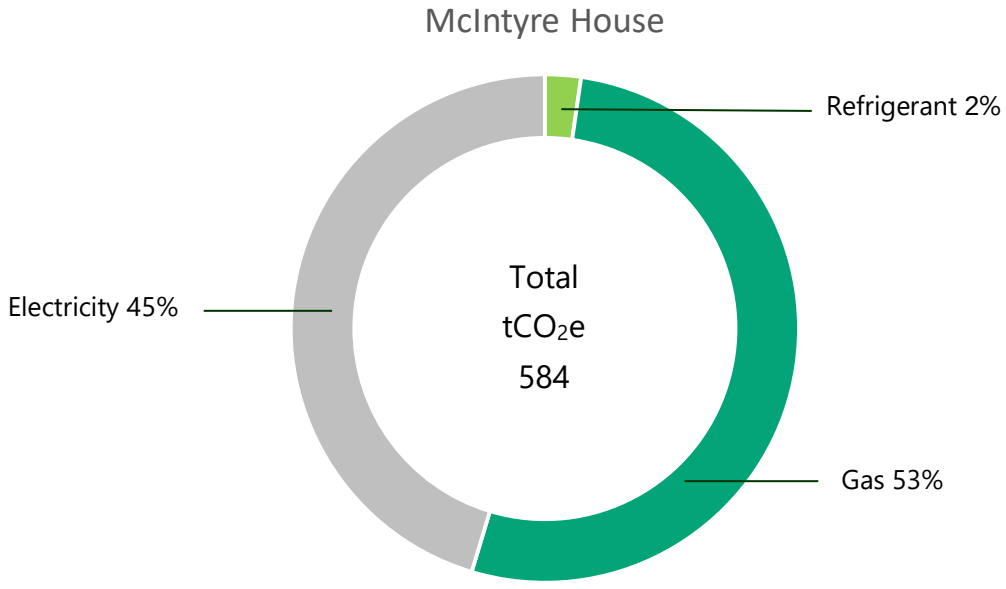


Emissions Breakdown by Building

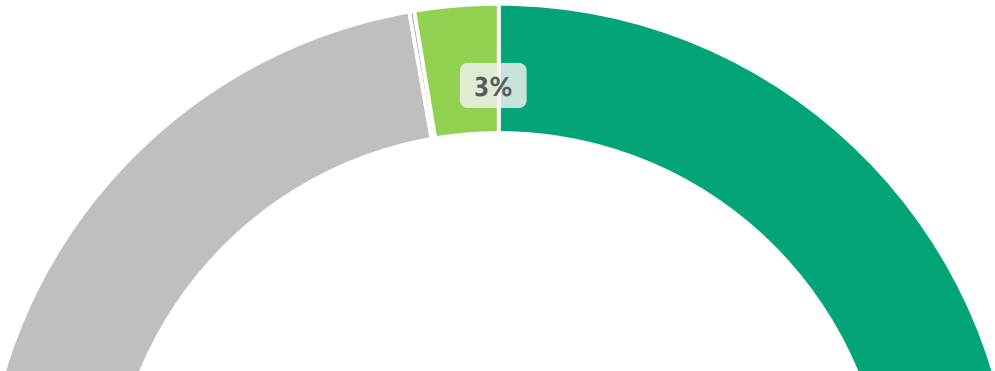
Please note that the electricity data is currently shared across Moss House and McIntyre House due to the assumed shared electrical supply currently, resolution of the meter allocation to each building will allow us to determine the actual energy intensity (electrically) of each building.

UCB - Carbon Benchmarking





2.9 Actual Total Carbon Footprint



UCB - Carbon Benchmarking

52%

Total Emissions Overview of Calculated Footprint 3,161 tCO_2e

45%

Gas	1,434	tCO_2e
Electricity	1,639	tCO_2e
Vehicles	5	tCO_2e
Refrigerant	83	tCO_2e

#Fuel for travel - <1%

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2.10 Carbon Footprint Offsetting

Carbon offsetting is aimed at compensating for carbon dioxide emissions produced by the individual, organisation, or activity by investing in projects that reduce or remove an equivalent amount of CO_2.

These systems can include renewable generation of energy, re-forestation efforts & energy efficiency initiatives to name a few. The idea is aimed to balance out your carbon footprint of particular activities or operation by mitigating the equivalent carbon via supporting these systems.

For example, if you are using high amounts of energy for marketing campaigns this creates a CO2 Equivalent (e), this can be offset by purchasing innovative solutions.

Carbon offsetting however is not to be used as a 'substitute' but in conjunction with the implementation of the decarbonisation plan which outlines energy efficiency, renewable energy generation and other sustainable aspirations of UCB.

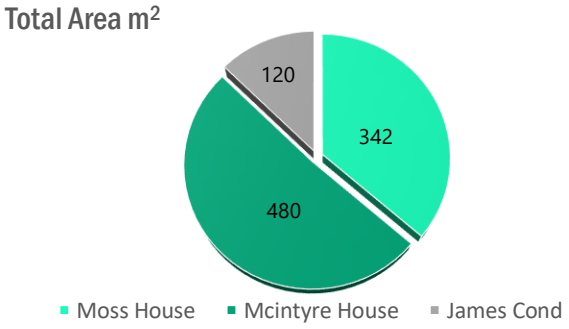
At University College Birmingham there is limited information for the renewable systems on site, Metering again being the biggest issue in the data collection of the yearly generation of energy. Solar PV systems do not currently have access to view the energy generation from these renewable systems. Below we have shown a simplified calculation to assess the expected renewable generation across the campus.

Solar Photo Voltaic systems

Assumptions have been made for the Solar PV system(s) generation across the UCB Campus as this information is currently not available. James Cond information is available so actual system size is advised, the assumptions of the system sizes are as shown in the below pie chart, McIntyre house having the largest PV system size on campus.

Using the areas shown in the adjacent chart, we have calculated each system size based on the following: UK average solar panel yield using estimated annual radiation with an efficiency of 16% of not only the solar voltaic panels themselves but also the inverters, these will be lower than today's standards at circa 21%. Systems that have been installed circa 5-10 years will be based on an average output of 100 w/m2. The panels are assumed to have a 45-degree inclination from the sun and with a Birmingham weather file giving a circa conversion factor (x833- for this estimation only). This information allows a high-level appreciation of the system generation over a 12-month period. The James Cond PV system size and expected kWh/Annum were taken from the optimised design provided by the design team of the construction project.

Solar PV Offsetting
Total
18.6 tCO_2e



Moss House	McIntyre House	James Cond	Total Generation across systems
28,488.6	39,984	20,000	88,472.6 kWh/A

3.1 Route to Net Zero – Next Steps

The route to net zero as detailed within this report is a steep and evolving critical path. regarding the current building stock, it is an urgent requirement to fully understand the existing buildings performance to enable focus on the wider masterplan requirements and the impacts of improvement options.

There are several key risks listed below, that if not implemented will hinder the overall decarbonisation process, these are associated with the recommendations within this report. These have been identified below and should be observed during the next stage of development.

- Undertake a more detailed review of the electrical capacity including point of connection to serve any new plant.
- Collect energy metering data and carry out further site surveys to record any site restrictions.
- Investigate the building fabric to confirm thermal performances.
- Undertake commissioning of all building service-related equipment to confirm efficiencies.
- Carry out air permeability testing to the buildings.
- Review any logistical challenges to undertake the improvements in a 'live building' setting.
- Appoint a cost consultant to advise of any financial restrictions.
- Carry out acoustic surveys to measure the noise levels.
- Continue to input into the decarbonisation plan of the UCB estate.

UCB is currently creating a carbon reduction plan in line with the West Midlands Combined Authority's (WMCA) Carbon Pledge for a net zero target by 2041. The creation of this plan involves setting ambitious goals and implementing strategies to significantly decrease carbon emissions.

Targeted approaches are required to focus on the carbon reduction of the campus with high energy using buildings being the first. For instance, Summer Row consumes more than 41% of the total energy across the UCB estate, this initially is due to poor performing external fabrics (Windows, Wall insulation, Roof insulation etc.) and in turn large heat losses, so the first action should be to improve the external fabric and assist in the reduction the energy demand. Mechanical and electrical services improvement should follow from this.

By implementing such improvements throughout University College Birmingham's Campus, the Net Zero targets become more achievable. These interventions and the need to understand our energy consumption profile highlight the importance of the energy management strategy and the carbon reduction plan.

This footprint report is the first step in in the latest standard for University College Birmingham's net zero journey.

UCB - Carbon Benchmarking

Route to Net Zero – Next Steps

Please see the table providing the challenges faced compiling this report along with the necessary steps to improve the process in future years in line with the GHG protocol and the West Midlands Combined Authority.
Listed below is a brief description of the potential improvement measure along with the next step to action the implementation of this improvement.

Comments
The collation and monitoring of detailed data in future years will give a more accurate understanding of where the greatest emission sources are, these requirements once implemented will create a more robust result along with the collection of Scope 3 emissions data which UCB will aim to produce in the following years.

Challenges	Brief Description	Action	Benefits	Feasible for site
Metering Strategy	The data required for this report in most cases is not readily available, this is predominantly as the metering installed on site again in most cases is not connected to a network and collecting/storing the metering information.	A robust data collection method and metering strategy.	Not only does this give an exact measure of the energy consumption to utilise in procurement and tracking methods of energy providers but also a continual snapshot of the energy demand in which we aim to continually reduce.	Yes
Building Stock Information	Elevations and/or existing models of the building stock are not available for all buildings such as, THE LINK, SUMMER ROW.	Model each building using a preferred software, REVIT, IES, SKP, BIM.	Adopting this will give you instant access to building automation experiences and monitoring platforms that can control you building remotely and showcase the energy consumption data.	Yes
Data collection & Storage	The data storage methodology would benefit from consolidation. There are many methods and portals which can be difficult to interpret. Metering addresses also caused difficulty in identifying the allocation to each building.	Contact should be made with the network providers to survey and establish the correct details for name and location of the meters along with a central location for information to be stored or accessed.	Easy access and confidence in completeness of the energy data. This will aid in the decarbonisation journey.	Yes

UCB - Carbon Benchmarking

Direction	UCB requires a robust strategy to be adopted to enable the net zero 2041 targets to be hit. A clear direction is required to enable focused approaches.	Adopt a robust Heat Decarbonisation Plan initially then on to the further reduction or offset detailed in a Carbon Reduction Plan.	This will set out in detail the path and steps required to achieve carbon neutrality for UCB.	Yes
Renewable system integration	Additional renewable sources should be investigated to assist with the UCB carbon reduction targets in the way of carbon offsetting.	Study to be undertaken for Solar PV where possible. Valuation of existing systems also to be carried out (Brief overview below).	Studies are to be undertaken as soon as possible to understand the benefits of renewing or installing energy generation where possible.	Yes
Solar Thermal	Solar thermal energy can be used to contribute towards space heating and hot water requirements. The two most common forms of collector are panel and evacuated tube.	Further studies are required to understand if the solar thermal system(s) are viable for UCB campus.	Low maintenance Little/no ongoing costs	n/a
Air Source Heat Pump (ASHP)	Electric or gas driven air source heat pumps extract thermal energy from the surrounding air and transfer it to the working fluid (air or water).	Feasibility studies are required for each building as all are varying in construction.	Better potential performance than closed systems.	Yes
Bio-Renewable Energy Sources *(Automated feed – wood-fuel boiler plant)*	Modern wood-fuel boilers are highly efficient, clean, and almost carbon neutral (the tree growing process effectively absorbs the CO_2 that is emitted during combustion) Automated systems require mechanical fuel handling and a large storage silo.	Feasibility study to be undertaken	Stable long-term running costs Potential good CO_2 saving	n/a

Route to Net Zero – Next Steps

UCB - Carbon Benchmarking

Solar PV Feasibility

Solar Photo Voltaic systems have been identified as the simplest method in energy generation and a 'quick win' for UCB through a desktop study and physical review of the roof areas available. We have proposed high level solar PV opportunities where possible along with the associated generation and carbon equivalent.

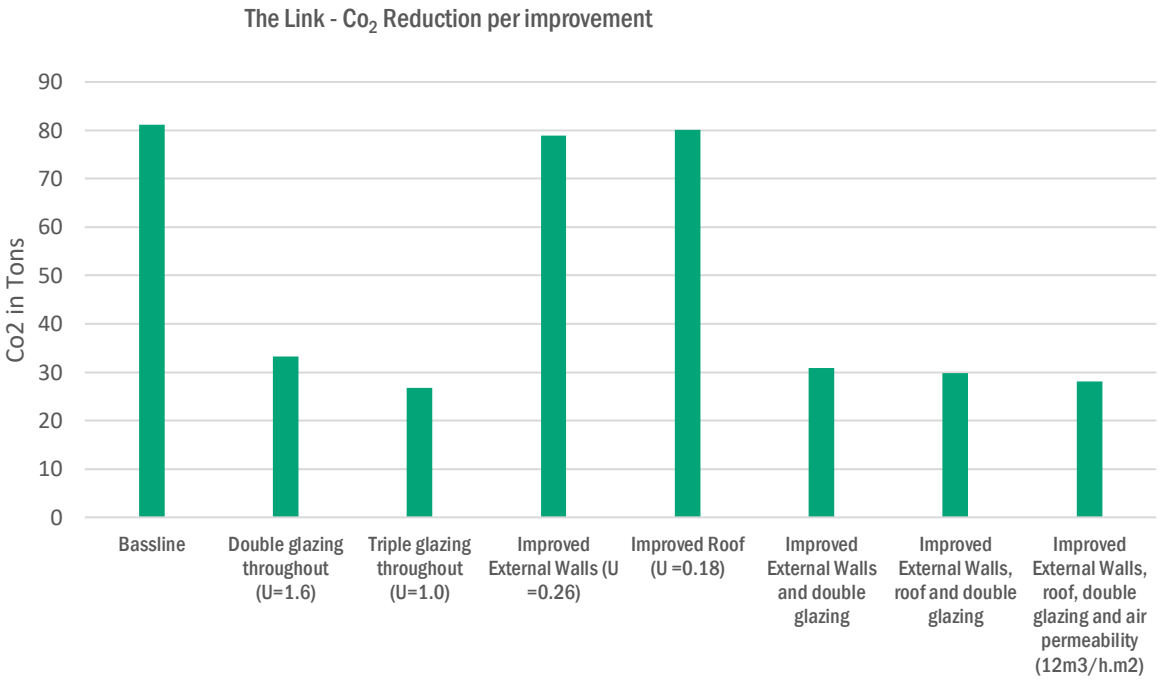
With the additional Renewables systems considered there is a potential further offsetting of 60 tons of CO_2e. These areas have been taken from Google Earth and an in-depth study of the potential space available will need to be undertaken. To be included in this assessment will also be the existing PV systems and if the replacement of newer panels with increased efficiencies will provide any valuable benefit.

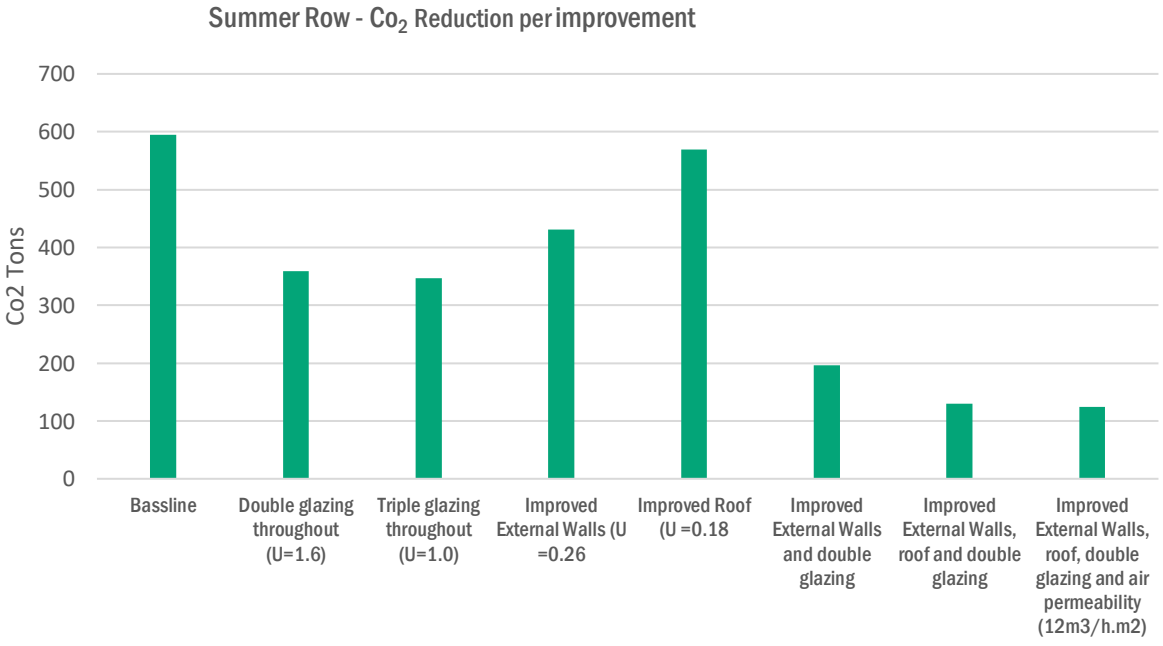
Building Name	Estimated Total roof area (m2)	Estimated total (kWh/A)	Equivalent tCO_2e
Summer Row	530	92,713	19
The Link	352	61,575	13
Moss House	333	58,252	12
Camden House	426	74,520	16
Total	1,641	287,060	60

UCB - Carbon Benchmarking

4.0 Summary of Capital Cost and Energy/CO_2 Saving Data

The below information has been taken from the existing UCB Heat Decarbonisation Plan for Summer Row and The Link buildings, this shows the improvement options proposed and how this affects the overall CO2 consumption of the two buildings. Below these charts are the iterations proposed for The Link & Summer Row and have been converted into an average improvement percentage to the buildings reviewed within this report and used to calculate a very high-level equivalent in energy savings.





UCB - Carbon Benchmarking

The table below summarises the approximate capital cost and estimated energy/CO_2 saving associated with improvement options detailed within the summer row & the link heat decarbonisation feasibility studies, these improvement options have been used as a metric to show the potential reduction of energy across the UCB building stock. At this time the comparison is based on existing gas usage with a view to move to ASHP, this is expected to be supplied via the electrical infrastructure.

Fabric improvement measures have been considered in the first instance as per the UCB-HDP, followed by services interventions and upgrades.

Please note - The Maltings heat demand is supported by the electrical systems on site therefore the gas demand is considerably lower than other buildings on campus.

We have used the link and summer row buildings as and average baseline for improvement cost, this is due to summer row's requirements are extensive and improvements may be disproportionate, The Link requires similar improvements in comparison to the age of the existing buildings. the following will be used in this benchmark as further feasibility studies are required to understand improvement options throughout.

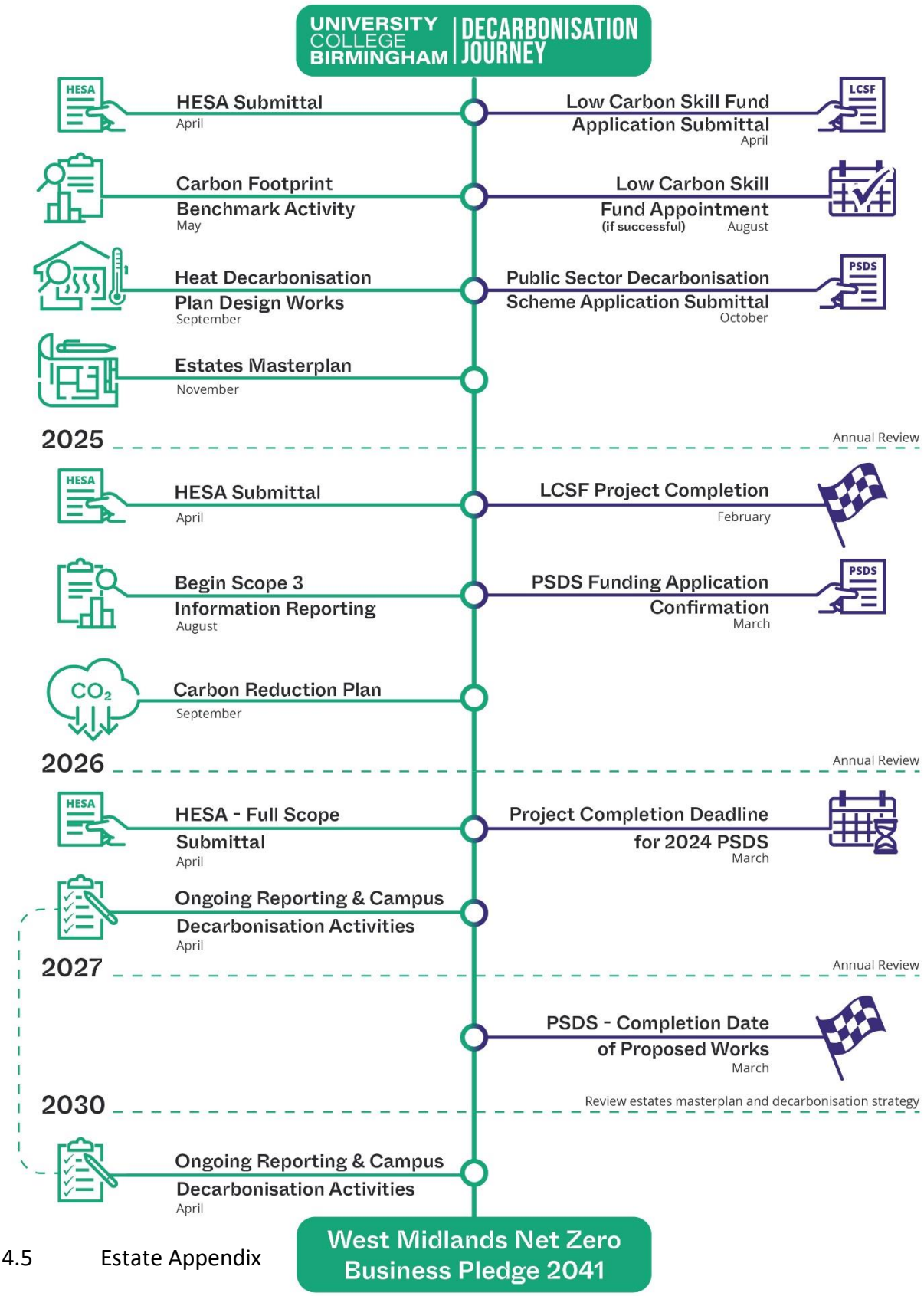
1. Cost reduction to utilities – £0.22 per KWH has been used as per the previous HDP report to standardise energy demand metric.
2. The reduced energy demand is expected to be added to the electricity consumption if moving to Air Source Heat Pump for the proposed building heat source.
3. The Link and Summer row have existing feasibility reports in which we have established an overall percentage improvement, to allow a high level understanding of the potential impacts of energy saving measures across the remaining buildings. EPC's have been used to base the current level of required works and improvement percentages prorated as shown in the below table.

Building name	Current heating energy demand (kWh)per annum	Current gas utility cost (£)	Building EPC	Estimated percentage improvement	Potential energy saved (kWh/a)	Equivalent Cost saving	Equivalent tCO2e saving
The Link	533,041	£117,269	E	65%	346,477	£41,044	34
Camden House East	509,274	£112,040	D	49%	259,730	£54,900	45
Camden House West Parade	280,573	£61,726	D	49%	143,092	£30,246	25
Moss House	1,299,131	£285,809	B	23%	298,800	£220,073	181
The Maltings	167,820	£36,920	C	37%	62,093	£23,260	19
Summer Row	3,241,733	£713,181	F	79%	2,560,969	£149,768	123
McIntyre House	1,044,285	£229,743	B	23%	240,186	£176,902	145
Total	7,075,857	£1,556,688	n/a	n/a	3,911,347	£696,192	572

#Please note the costs and percentages are post improvements of potential methods as shown in the above tables Summary of Capital Cost and Energy/CO_2 Saving Data

4.1 Road Map

UCB - Carbon Benchmarking



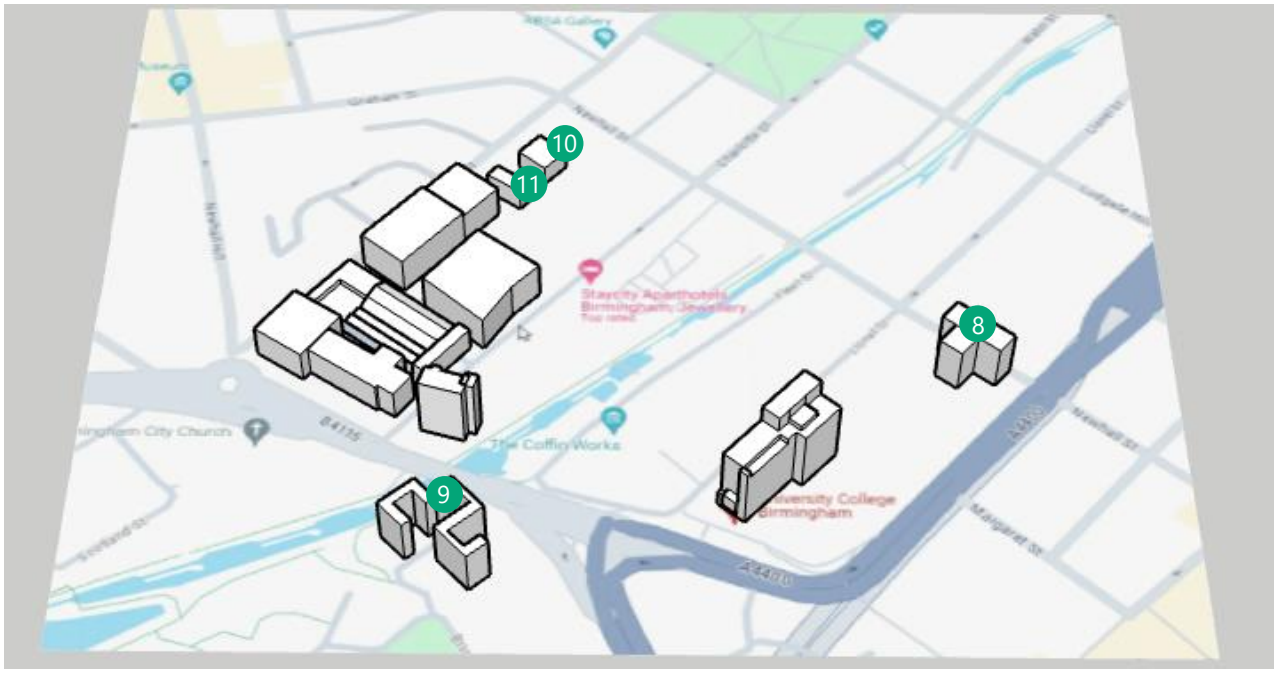
4.5 Estate Appendix

UCB - Carbon Benchmarking

Shown in below site map are the four additional buildings which form the total UCB estate, these buildings are Richmond House, Cambrian Hall, Crosby Court and Broughton works. Richmond house has now been sold and will be removed from the UCB building stock inventory with no requirement for further reporting.

This appendix details the additional carbon footprint of the four buildings along with the revised overall carbon footprint using the data provided across.

The additional buildings are of mixed use with varying energy intensities, Cambrian Halls for instance are a group of connected buildings for student accommodation use, these residential properties are heated via localised electric panel heaters and point of use water heaters therefore no requirement for gas usage across the site. Richmond house comprises of teaching and office spaces similar to Crosby court and Broughton Works therefore energy use is similar although varying in intensity.



8. Richmond house

9. Cambrian Halls

10. Crosby Court

11. Broughton works

Emissions Breakdown

UCB - Carbon Benchmarking

Using the methodology as the Campus report, metering data is used to quantify the energy intensity of each building and its source, (gas, electricity etc) this allows the calculation of the estate wide carbon footprint to be carried out. In this appendix no refrigerant or gas has been documented to have been consumed by these buildings therefore there will be no change to these demonstrated values in the campus report.

Detailed in this appendix are the output's from further desktop studies and reviews of data between August 2022 to August 2023 to create the overall University college Birmingham estate carbon footprint.

Electricity data

The electricity metering data has been collated from each of the four buildings over the 12-month period to allow the assessment of the energy consumption with the associated carbon equivalent.

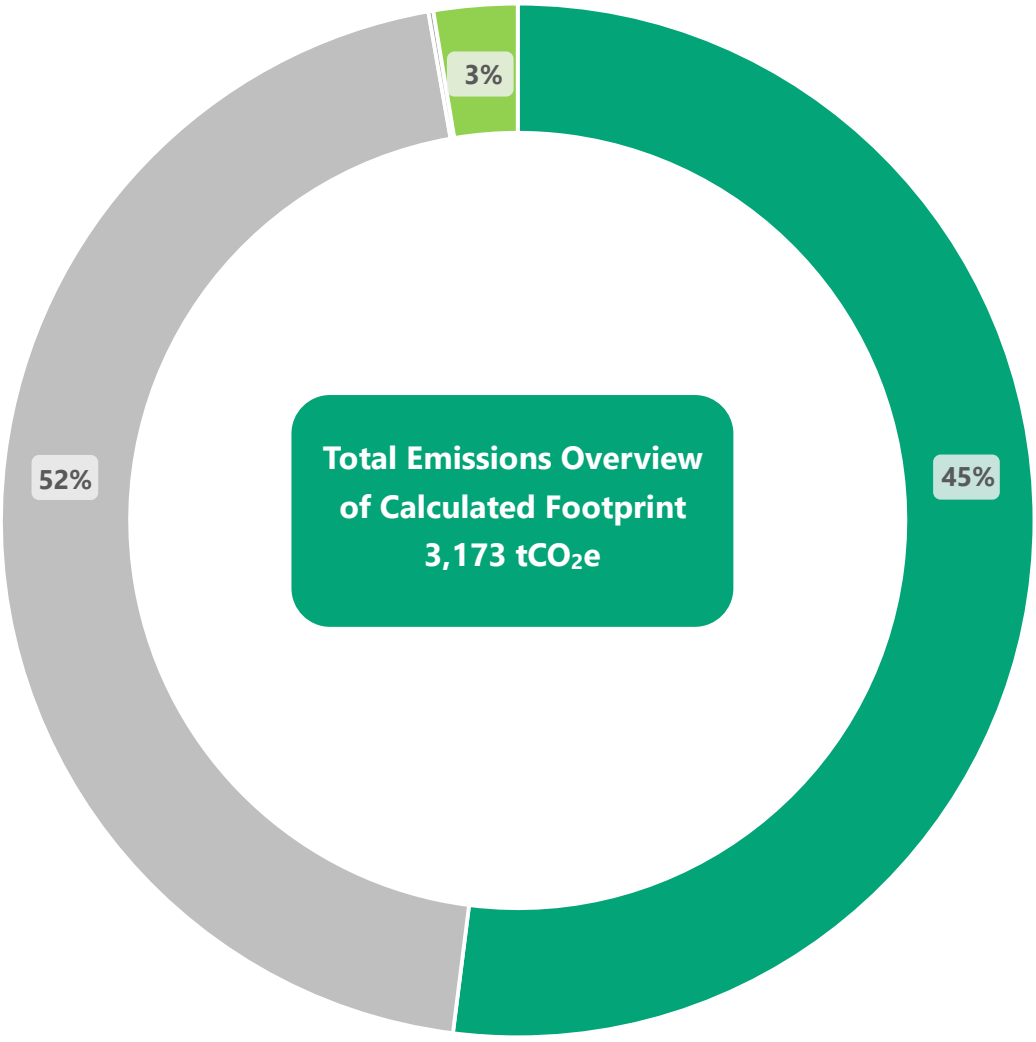
As shown in the below table Cambrian hall's is the most energy intense due to its high electrical demands such as the heating & hot water. Collectively, the four buildings consume 63739 kWh per annum of electricity which is an equivalent of over 11 tCO_2e.

Building name	Total Electricity used (kWh)	Associated tCO_2e
Broughton works	9918	2
Richmond House	8761	3.1
Crosby Court	16086	0.2
Cambrian Halls	28974	5.9

UCB - Carbon Benchmarking

Estate Analysis - carbon footprint

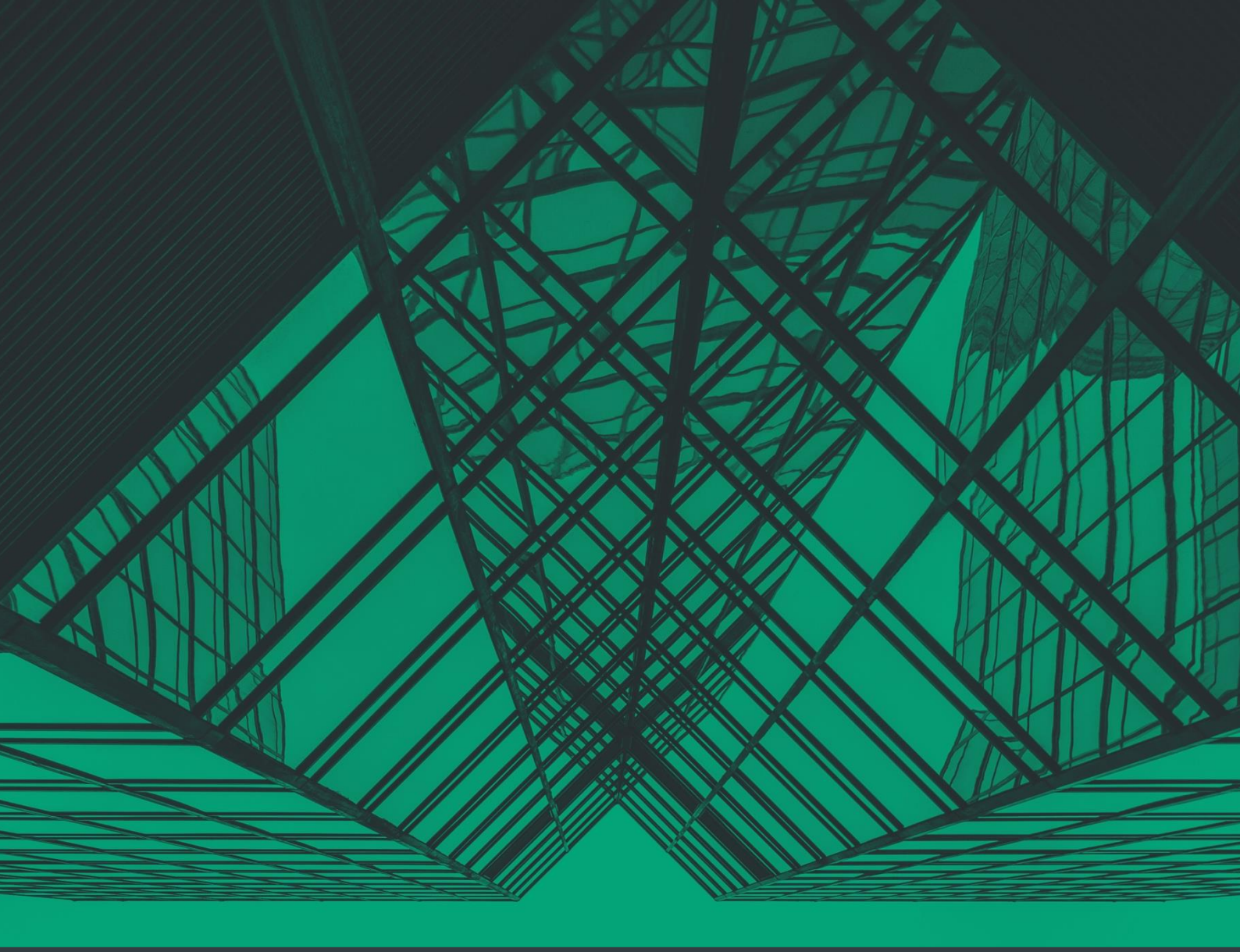
Below details the revised carbon footprint of the UCB estate inclusive of Richmond House, Cambrian Hall, Crosby Court and Broughton Works. The additional 11 tons of CO_2 consumed due to the operational electrical energy use across the buildings is shown below, the cumulative carbon footprint for electricity has increased with revised total of 1,650 tCO_2e and the overall carbon footprint of 3,173 tCO_2e.



Gas	1,434	tCO_2e
Electricity	1,650	tCO_2e
Vehicles	5	tCO_2e
Refrigerant	83	tCO_2e

Carbon offsetting

Richmond House, Cambrian Hall, Crosby Court and Broughton works have not been considered for solar PV opportunities within his appendix . Richmond house and Broughton works have smaller roof areas not allowing viable scale roof mounted PV opportunities at this time , Richmond house has been removed from the UCB building stock And Cambrian halls has planned works with future potential opportunities to be explored in the future.



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