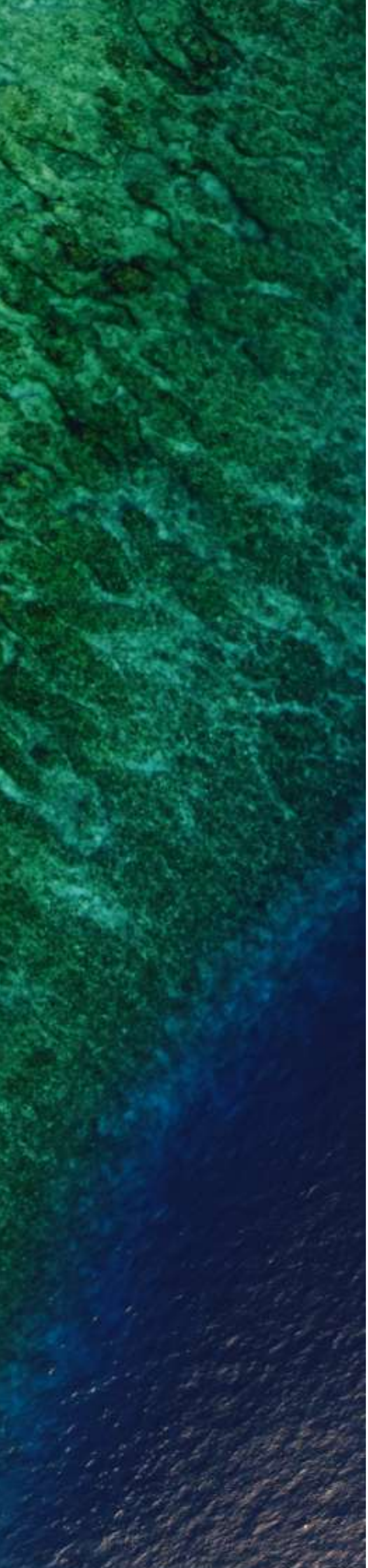

SMALL WORLD CONSULTING

Greenhouse gas footprint of

Lancaster University Students' Union

in 2022-23

A report by Small World Consulting Ltd.

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Introduction

The Climate Emergency

In 2018, the Intergovernmental Panel on Climate Change (IPCC) warned that global heating must be limited to 1.5°C above pre-industrial levels to avoid substantial climate and ecosystem breakdown (IPCC, 2018). To meet this target, global CO_2 emissions must decline by 45% (compared to 2010 levels) by 2030, and reach net zero by 2050, with developed countries making greater and more rapid changes. In 2019, the UK government enshrined in law its commitment to net zero by 2050, requiring 78% reduction in emissions by 2035.

Despite this however, greenhouse gas emissions have continued to rise. The IPCC findings from COP28 confirmed a concerning trend with global warming exceeding 1.1°C above pre-industrial levels due to human activities, primarily from the emission of greenhouse gases. Unsustainable energy practices, changes in land use, and consumption patterns are among the key contributors. This climate emergency is inextricably connected to a wider set of environmental and social challenges facing the world, including depletion of biodiversity, rising pollution, widespread inequality, the triple burden of malnutrition, and disease threats.

The emissions reduction plans outlined in the nationally determined contributions (NDCs) for 2030 predict a probable temperature surpassing 1.5°C in the early 2030s, and at least 2.5°C by the end of the 21st century. Each increment in global warming magnifies these environmental and social impacts worldwide. Therefore, any response by governments, businesses or individuals to the climate emergency needs to keep these far-reaching consequences firmly in mind.

The COP28 summit also marked a pivotal moment, advocating for a global shift away from fossil fuels by 2050 and emphasising the rapid adoption of clean energy while enhancing energy efficiency by 2030. It also stressed the urgency for countries to submit more ambitious NDCs by 2025, integrating enhanced emission reduction targets to address the escalating climate crisis. Many organisations already monitor their scope 1 and 2 emissions (direct emissions, and indirect emissions from electricity generation), but attention is, at last, increasingly turning to emissions across the rest of the value chain (scope 3), which very often dwarf scope 1 and 2 emissions.

Lancaster University Students' Union

Lancaster University Students' Union (LUSU) is dedicated to enriching the student experience by offering various support services such as student clubs and societies, sports opportunities, volunteering, and environmental projects. In addition, LUSU also provides a selection of commercial services including student lettings agency SU Living, LUSU Shop, formerly called Central – an on-campus supermarket, and The Sugarhouse, the union-run student nightclub located in Lancaster City Centre.

Small World Consulting were commissioned by Lancaster University to assess greenhouse gas (GHG) emissions associated with LUSU in July 2022 - June 2023 encompassing operational and supply chain emissions. The purpose of this report is to highlight GHG hotspots to inform future carbon management strategies.

We emphasise that all carbon footprint assessments contain a degree of uncertainty. However, we have confidence that this report identifies in broad terms the most and least significant components of the GHG footprint of LUSU to enable successful carbon management.

Results

Summary

The best estimate for LUSU total GHG footprint in 2022-23 is **2,093.4 tonnes CO_2 equivalent (tCO_2e)**. The footprint can be broken down into different high-level categories, whose emissions are summarised in Figure 1. Figure 2 shows a further summary breakdown by Services, Housing, and General. Key categories are discussed in detail below.

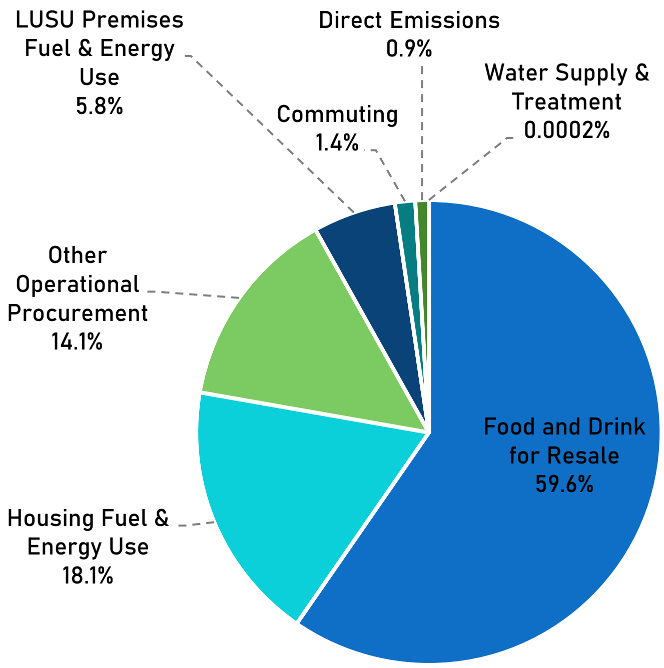

Figure 1: Summary of LUSU's 2022-23 total GHG footprint (2,093.4 tCO_2e).

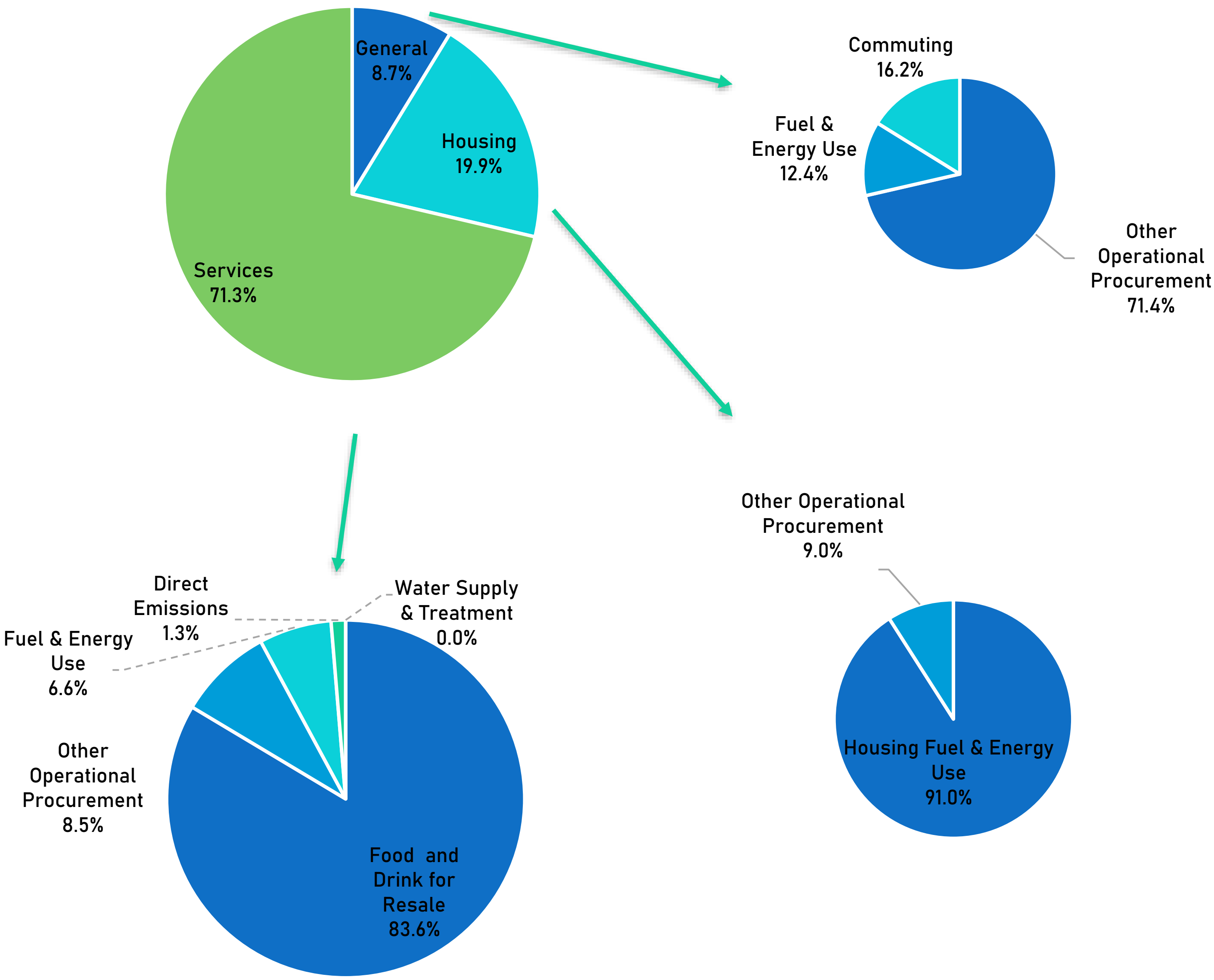

Figure 2: Breakdown summary of LUSU's 2022-23 total GHG footprint (2,093.4 tCO_2e), by Services (1,493.5 tCO_2e), Housing (417.5 tCO_2e), and General (182.5 tCO_2e).

Food and Drink for Resale (59.6% of total footprint)

In 2022-23, the largest share of LUSU's total carbon footprint, totalling **1,248.3 tCO_2e,** was attributed to food and drink purchases by Central and The Sugarhouse. The majority of the footprint was attributed to food purchases by Central (1,203.6 tCO_2e), and the remaining were drink purchases by The Sugarhouse (44.7 tCO_2e) (Figure 3).

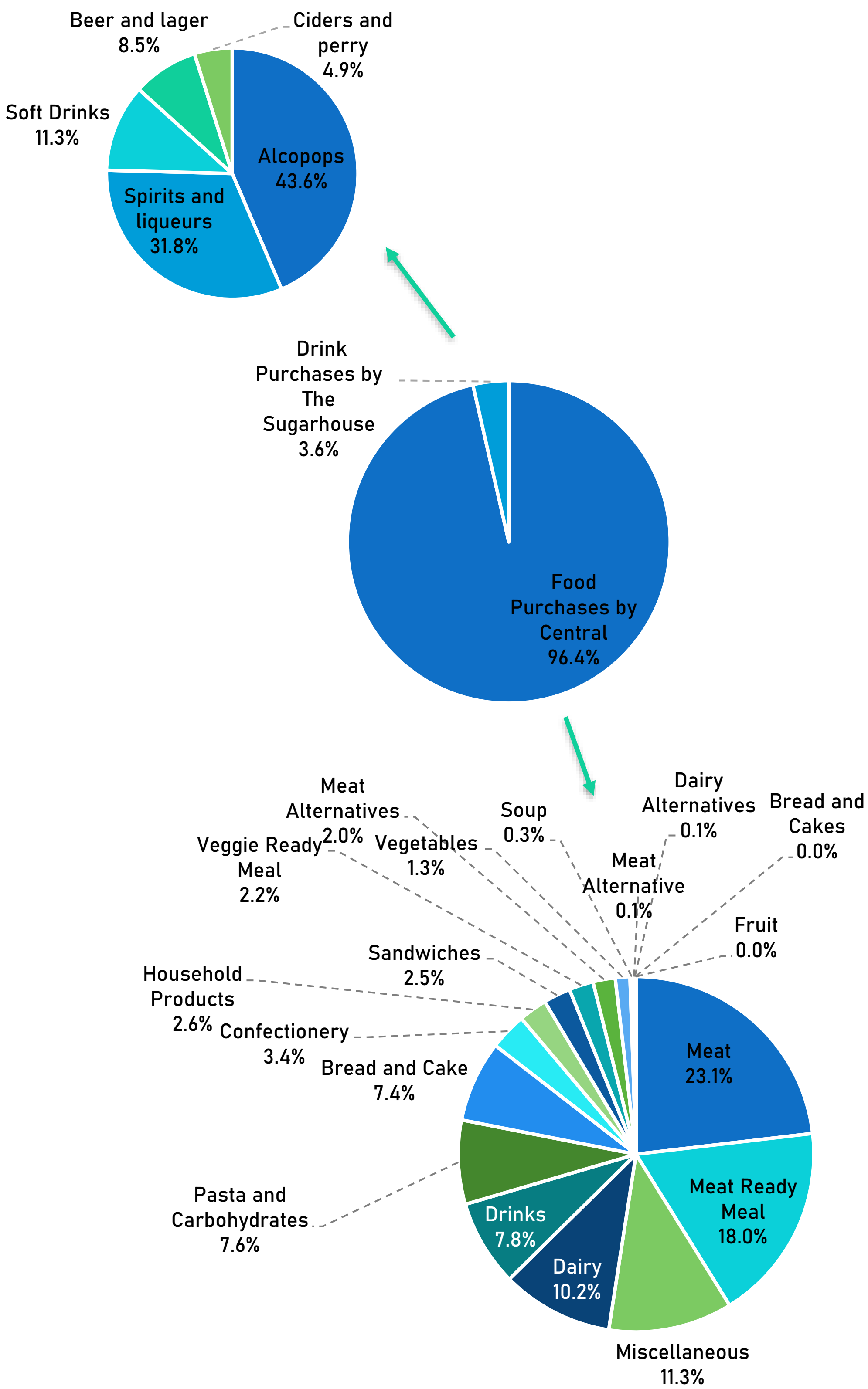

Figure 3: Total Food and Drink Purchases in 2022-23 (1,248.3 tCO_2e), and estimated breakdown of GHG emissions from weekly food and drink procurement Central and The Sugarhouse.

Figure 3 also illustrates a breakdown of GHG emissions from weekly food and drinks purchases by Central. The footprints have been estimated from one week of Co-op and Ginsters orders, representing 57% of Central's goods purchased for resale, and extrapolated out to cover remaining weekly spend. 97.5% of Central's food and drink carbon footprint is therefore associated with Co-op, representing for 1,173.5 tCO_2e, while the remaining emissions stemmed from Ginsters sandwich orders, totalling 30.1 tCO_2e. Based on products mapped, Dairy, meat and ready meals collectively contributed to the largest proportion of the footprint (451.8 tCO_2e), followed by Drinks and long-life products (294.5 tCO_2e), and Meat (201.8 tCO_2e).

The largest proportion of The Sugarhouse drinks footprint is attributed to Alcopops (19.4 tCO_2e), followed by Spirits and liqueurs (14.2 tCO_2e), and Soft drinks (5.0 tCO_2e) (Figure 3).

Housing Fuel and Energy Use (18.1% of total footprint)

Housing Fuel and Energy Use accounted for **379.7 tCO_2e** of LUSU's overall GHG footprint, and this was dominated by gas consumption (286.7 tCO_2e), with the remaining portion of the footprint attributable to electricity consumption (93.0 tCO_2e) (Figure 4).

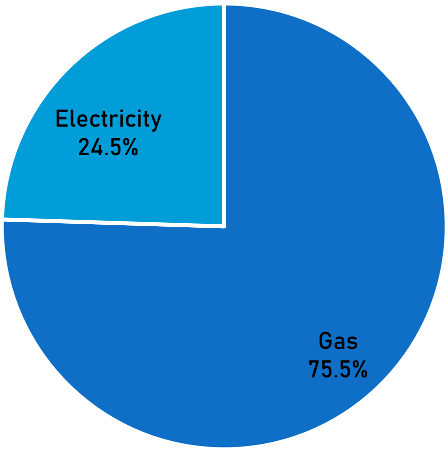

Figure 4: Total GHG emissions from Housing Fuel and Energy Use (379.7 tCO_2e).

Other Operational Procurement (14.1% of total footprint)

Other Operational Procurement contributed **295.7 tCO_2e** to LUSU's total 2022-23 carbon footprint (Figure 5). The emissions associated with General were 130.3 tCO_2e (44.1% of Other Operational Procurement). Almost half of the General footprint was attributed to Events (54.9 tCO_2e), followed by Staff Training (12.0 tCO_2e), and Administration (11.7 tCO_2e). Services were the third largest contributor to Other Purchased Goods and Services footprint, contributing to almost a third of the footprint (127.6 tCO_2e). Figure 5 also shows that the majority of the Services Other Operational Procurement footprint is attributed to The Sugarhouse (95.6 tCO_2e), followed by Central (21.3 tCO_2e), and Services (10.7 tCO_2e). Housing accounted for 12.8% of this footprint (37.7 tCO_2e), primarily from Direct costs (34.2 tCO_2e). Direct Costs include utilities, maintenance, and repair for properties.

Figure 6 shows a further GHG footprint breakdown of Services. Maintenance and Repairs account for the greatest share of Sugarhouse's Other Operational Procurement footprint (18.6 tCO_2e), followed by Rental fees (14.5 tCO_2e), and Cleaning (13.0 tCO_2e). Rental fees contribute almost half of Central's GHG emissions (10.6 tCO_2e), followed by Financial Services (5.0 tCO_2e), and Maintenance and Repairs (2.7 tCO_2e). Services consists of fees related to Marketing, Management, and Financial Services.

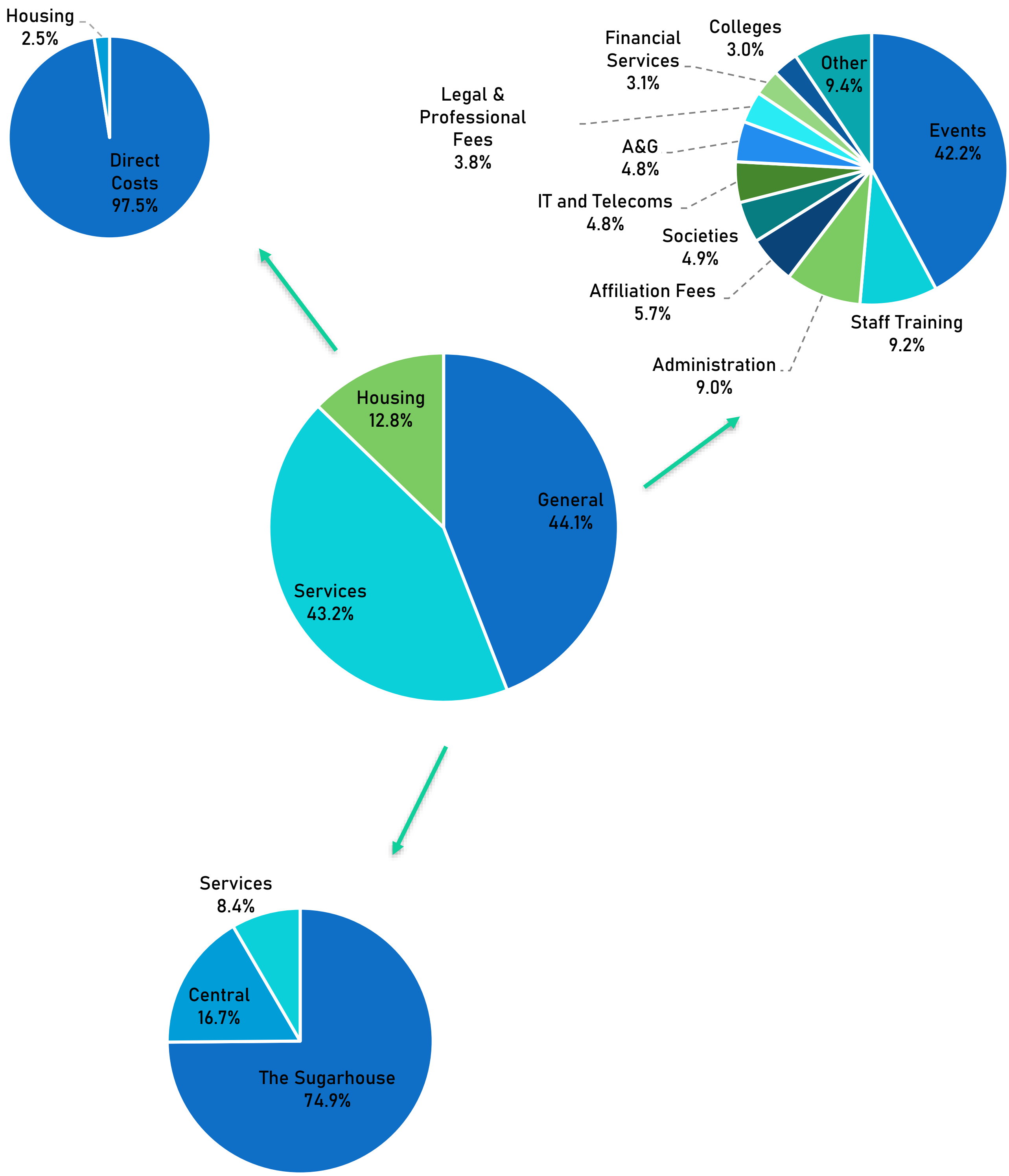

Figure 5: Breakdown of Other Purchased Goods and Services footprint in 2022-23 (295.7 tCO_2e).

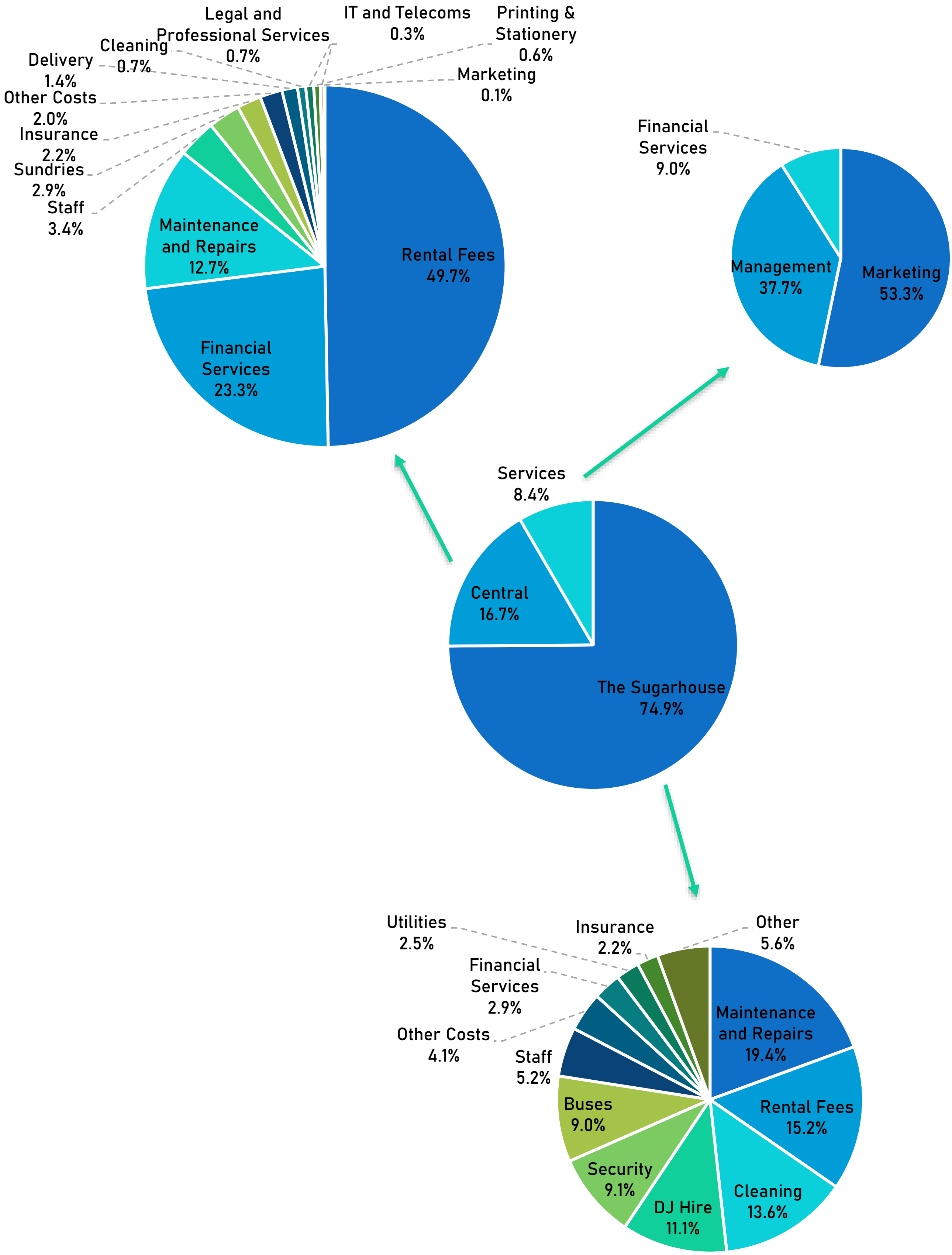

Figure 6: Breakdown of Services' Other Operational Procurement GHG footprint ($127.6\ tCO_2e$).

LUSU Premises Fuel and Energy Use (5.8% of total footprint)

LUSU Premises Fuel and Energy Use accounted for **120.6 tCO_2e** of LUSU's overall GHG footprint, and this was dominated by electricity consumption (83.4 tCO_2e). The largest proportion of the electricity footprint arose from The Sugarhouse (39.3 tCO_2e), followed by Central (34.9 tCO_2e), and LUSU office (9.1 tCO_2e). Gas accounted for over a third of LUSU premises fuel and energy footprint (37.3 tCO_2e). The largest proportion of the gas footprint also arose from The Sugarhouse (23.7 tCO_2e), followed by LUSU office (13.6 tCO_2e) (Figure 7).

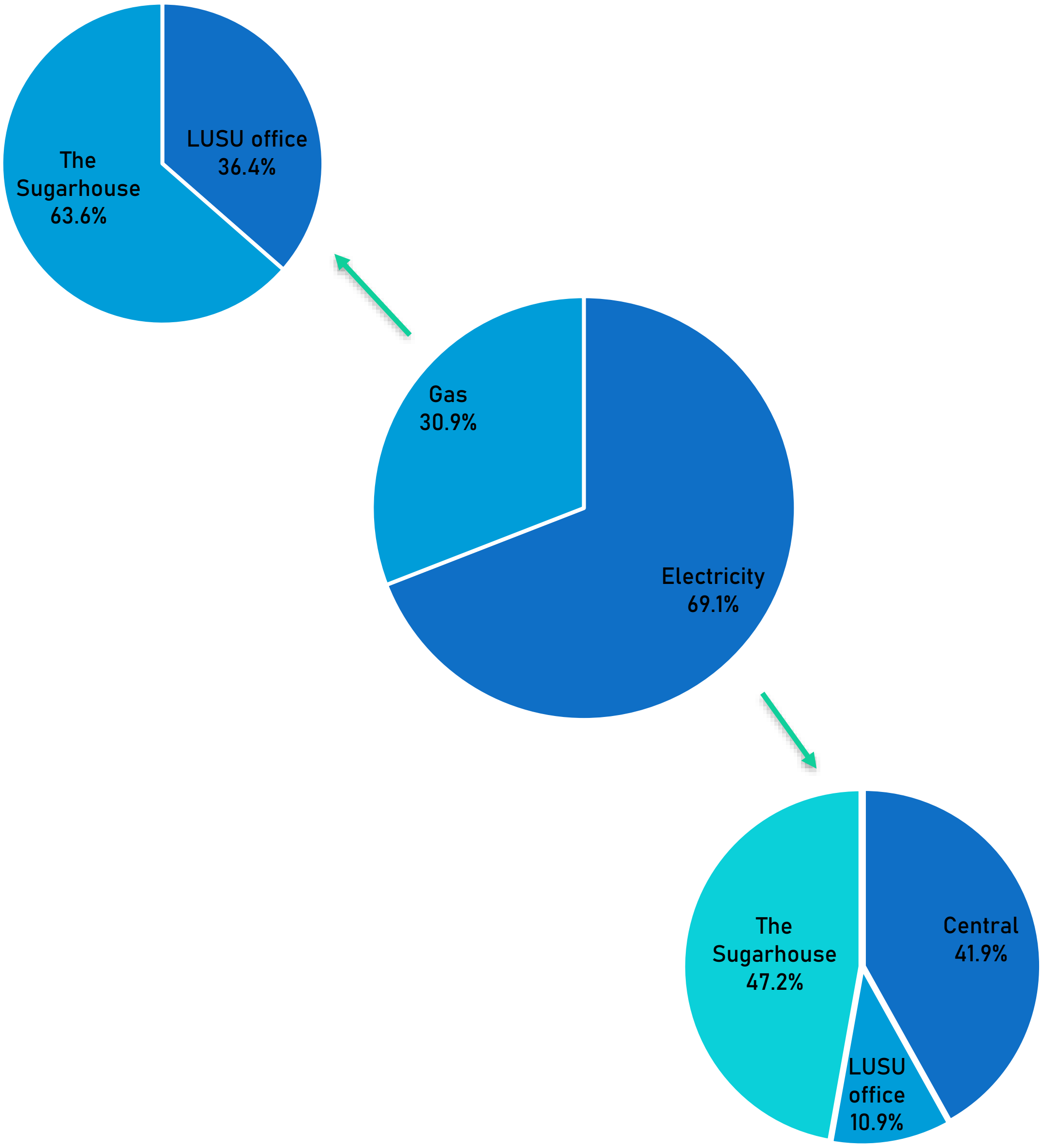

Figure 7: Breakdown of total GHG emissions from LUSU Premises Fuel and Energy Use attributed to LUSU office, Central, and The Sugarhouse (120.6 tCO_2e).

Commuting (1.4% of total footprint)

Staff commuting to and from work in 2022-23 contributed an estimated **29.5 tCO_2e** of the total footprint of LUSU. This was estimated using UK national average commuting patterns as published by the Department for Transport. Granularity could be improved in future by deploying a commuting survey to LUSU staff.

Using national averages, the largest proportion of the commuting footprint was attributed to Car usage (25.8 tCO_2e), followed by Car Share (1.2 tCO_2e), and Train (1.1 tCO_2e) (Figure 8). Emissions per mile by mode of transport is shown in Figure 9: cars emit the greatest emissions per mile (0.50 tCO_2e), followed by taxis/minicabs (0.40 tCO_2e).

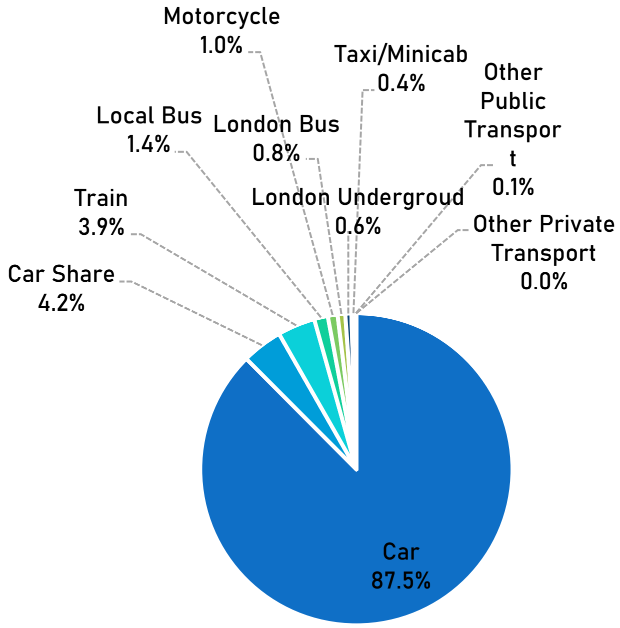

Figure 8: GHG emissions from Staff Commuting at LUSU 22-23 (29.5 tCO_2e), by mode.

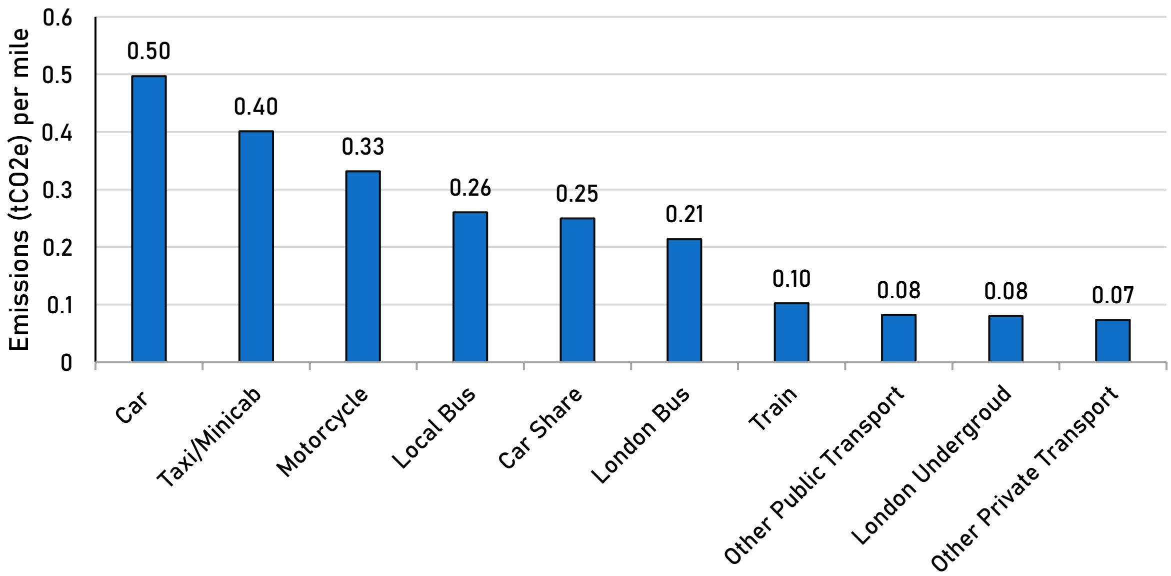

Figure 9: Breakdown of GHG footprint per mile by different travel modes.

Direct Emissions (0.9% of total footprint)

Direct emissions accounted for **19.6 tCO_2e** from LUSU's overall GHG footprint, due to a leak of 5kg of R404A gas from the display chiller in Central. R404A has a global warming potential of 3,922 $kgCO_2e$ per kg, which results in a large global warming impact.

Water Supply and Treatment (0.0002% of total footprint)

The final component of LUSU's 2022-23 footprint, water supply and treatment, accounted for **0.005 tCO_2e.**

Recommendations for future carbon analyses

To improve granularity and efficiency of future carbon analyses of LUSU, recommendations include:

- Ensuring consistent recording of all purchase types across LUSU and increasing granularity of purchase categorisation.
- Establishment of a centralised system to monitor food and beverage purchases effectively and ensuring consistency within the system by recording all food and beverage orders on a weekly basis. This would minimise the need for estimations and reduces the reliance on physical receipts.
- Engaging staff and landlords in monitoring energy consumption through meter readings. Ensuring comprehensive metering data for LUSU housing is gathered. Where feasible, consider the installation of energy management systems.
- Establishing a business travel management system to systematically record and track all LUSU-related business travel activities. Ensure information of modes of transportation, vehicle sizes, and total distances travelled are included.
- Implementing a commuting survey for all staff members of LUSU, including details such as travel distances, modes of transportation, vehicle sizes, and fuel types.

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Appendix: Methodology

Footprinting principles

Whilst the term 'footprint' is used in various ways, we are using it to mean the sum of the direct emissions and the indirect emissions that arise throughout supply chains of activities and products. This assessment considers all seven gases covered in the Greenhouse Gas Protocol, expressed in terms of carbon dioxide equivalent (CO_2e), the sum of the weights of each gas emitted multiplied by their global warming potential (GWP) relative to carbon dioxide over a 100-year period.

The inclusive treatment of supply chain emissions, as presented here, differs from standard production-based assessments but gives a more complete and realistic view of impacts, despite the complexities and uncertainties involved. Footprints of this kind are therefore essential metrics for responsible businesses and consumers.

As an example, the footprint of electricity consumption includes components for the emissions associated with fossil fuel extraction, shipping, refining and transport to power stations, as well as those resulting from the electricity generation process itself. It is worth noting that these factors are not included in standard conversion factors issued by the Department for Business, Energy, and Industrial Strategy (BEIS). To give another example, the footprint of vehicle travel includes, on top of components for direct vehicle emissions, components for the extraction, shipping, refining and distribution of fuel, components for the manufacture and maintenance of cars, and so on.

Greenhouse Gas Protocol guidelines

We have followed the reporting principles of the Greenhouse Gas Protocol published by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI).

The Greenhouse Gas Protocol provides a choice of three scopes for emissions reporting. Scope 1 covers direct emissions from company owned vehicles and facilities. Scope 2 includes net emissions from energy imports and exports, such as electricity. Scope 3 includes other indirect emissions resulting from company activities, as detailed by the boundaries of the study. This report includes all Scope 1 and 2 emissions and an extensive treatment of Scope 3 emissions throughout supply chains of business activities and purchases.

Treatment of high-altitude emissions

High altitude aeroplane emissions are known to have a higher global warming impact than do their low altitude counterparts. Although the science of this is still poorly understood, this study has applied a multiplier of 1.9 to aircraft emissions, to take account of their higher impact. This is the figure currently recommended by BEIS (2022a).

Reporting approach

For the estimation of supply chain emissions from products and services as well as in the production and transport of fuels, this report draws upon and combines two core methodologies: process life cycle analysis (LCA), which has the potential to provide specific but incomplete analysis, and environmentally-extended input-output analysis (EEIO), which, conversely, offers only generalised estimates based on spend data, but is capable of covering all parts of the supply chain.

EEIO combines economic information about the trade between industrial sectors with environmental information about the emissions arising directly from those sectors to produce estimates of the emissions per unit of output from each sector. The central technique is well established and documented (for example Leontief 1986, Miller and Blair 1985). In the UK, the main data sources are the combined supply and use matrix for 105 sectors provided by the Office of National Statistics (ONS, 2022a, and the UK environmental accounts (ONS, 2022b). The specific model used for this project was developed by Small World Consulting with Lancaster University (Berners-Lee et al., 2011). This model augments the basic approach to take account of such factors as the impact of high-altitude emissions that are not factored into the environmental accounts and the use of price indices to compensate for changes in the economy in the time lags that occur in the production of ONS data.

Three main advantages of EEIO over more traditional process-based life cycle approaches to GHG footprinting are worth noting:

- EEIO attributes all the emissions in the economy to final consumption. Although, as with process-based life cycle approaches, there may be inaccuracies in the ways in which it does this, it does not suffer from the systematic underestimation that process-based analyses incur through their inability to trace every pathway in the supply chains.
- EEIO has at its root a transparently impartial process for the calculation of emissions factors per unit of expenditure whereas life cycle approaches entail subjective judgements over the setting of boundaries and the selection of secondary conversion factors.
- Through EEIO, it is possible to make estimates of the footprints resulting from complex activities such as the purchase of intangible services that life cycle approaches struggle to take into account. This report is therefore able to assess the impacts resulting from all business expenditure.

One of the limitations of EEIO in its most basic form is that it relies upon the assumption of homogeneity of the direct emissions and the demands placed on other sectors per unit of output within each sector. As an example, a basic EEIO model does not take account of the carbon efficiencies that may arise from switching expenditure on paper to a renewable source from a virgin source without reducing the actual spend. In order to mitigate this weakness, Small World may apply adjustment multipliers to the EEIO emissions factors. These are established after consultation with the client to understand specific procurement practices within the business which could lead to higher or lower impacts than would be typical for a given expenditure within a sector. The extent of the adjustment is then determined by reference to process-based life cycle analysis and is appropriately documented. Overall, therefore, this report uses a hybrid methodology, drawing upon the strengths of both life cycle analysis and environmental input-output approaches.

Direct emissions associated with fuel consumption and transport are calculated using conversion factors based on those provided by BEIS (2022b) in their guidelines for company reporting on GHG emissions. As the BEIS figures do not take account of supply chain emissions (other than those from fuel production or electricity generation), SWC have developed **hybridized emissions factors**, incorporating the results of the EEIO model to take account of supply chain emissions.

Boundaries of the study

The study covers the core activities of Lancaster University Students' Union's operations, including its supply chains.

The following are specifically included in the scope of the study:

- electricity consumption;
- direct emissions from heating and transport, including all business travel and staff commuting;
- indirect emissions resulting from fuel supply chains, electricity generation and embodied carbon in vehicles for staff travel;
- indirect emissions arising from the supply chains of business activities and purchases both tangible and intangible. These include food and other consumables, laundry, buildings and grounds maintenance, and all professional and financial services.

The following are not included in the scope of the study:

- rates and taxes;
- wages, salaries and pensions;

Data collection

The following data was provided by LUSU staff:

- Purchase ledgers;
- Office floor space and building energy use;
- Housing list;
- Food and drink supplier invoices;
- Staff numbers.

Uncertainties

Footprinting can only ever offer a best estimate rather than an exact measure, and the figures in this report should be viewed in that context. We have operated from the principle that it is more informative to make best estimates of even the most poorly understood components of the footprint, and to discuss the uncertainty openly, than to omit them from the analysis.

Uncertainties over conversion factors

Uncertainty is a feature of all footprint studies, the certainty behind which is frequently over-stated. The areas in which the relationship between consumption and footprints is best understood are gas and electricity consumption. There is relatively good consensus over conversion factors to within around 10% in these areas. The next most certain group of conversion factors are those for travel and transport. In this category, those relating to aviation are the least well understood, due to uncertainties around the impact of high-altitude emissions and the paucity of detailed flight modelling for climate change impact studies.

There is greater uncertainty over supply chain emissions resulting from the purchase of goods and services. The EEIO methodology adopted here removes the problem of systematic underestimation from which traditional life cycle approaches suffer. Nevertheless, as with all footprint studies, the best estimates contained in this report should be viewed as a broad guide.

Uncertainties over data

- Utilities use in LUSU offices was estimated based on area of occupied floor space. Central and Sugarhouse utilities use was calculated using expenditure and average UK non-domestic prices.
  - https://www.gov.uk/government/statistical-data-sets/gas-and-electricity-prices-in-the-non-domestic-sector
- A subset of food and drink supplier invoices from Central and Sugarhouse were provided for one week during term time, and this data was extrapolated to cover all food and drink spend in the year.
- Societies' expenditure has been mapped as industry sector 93: Sports Activities And Amusement And Recreation Activities.
- Housing gas and electricity use were estimated using sub-national postcode-level data.
  - Electricity: https://www.gov.uk/government/collections/sub-national-electricity-consumption-data
  - Gas: https://www.gov.uk/government/collections/sub-national-gas-consumption-data
- Staff commuting estimate is based on average UK commuting patterns.
  - NTS0412b: https://www.gov.uk/government/statistical-data-sets/nts04-purpose-of-trips