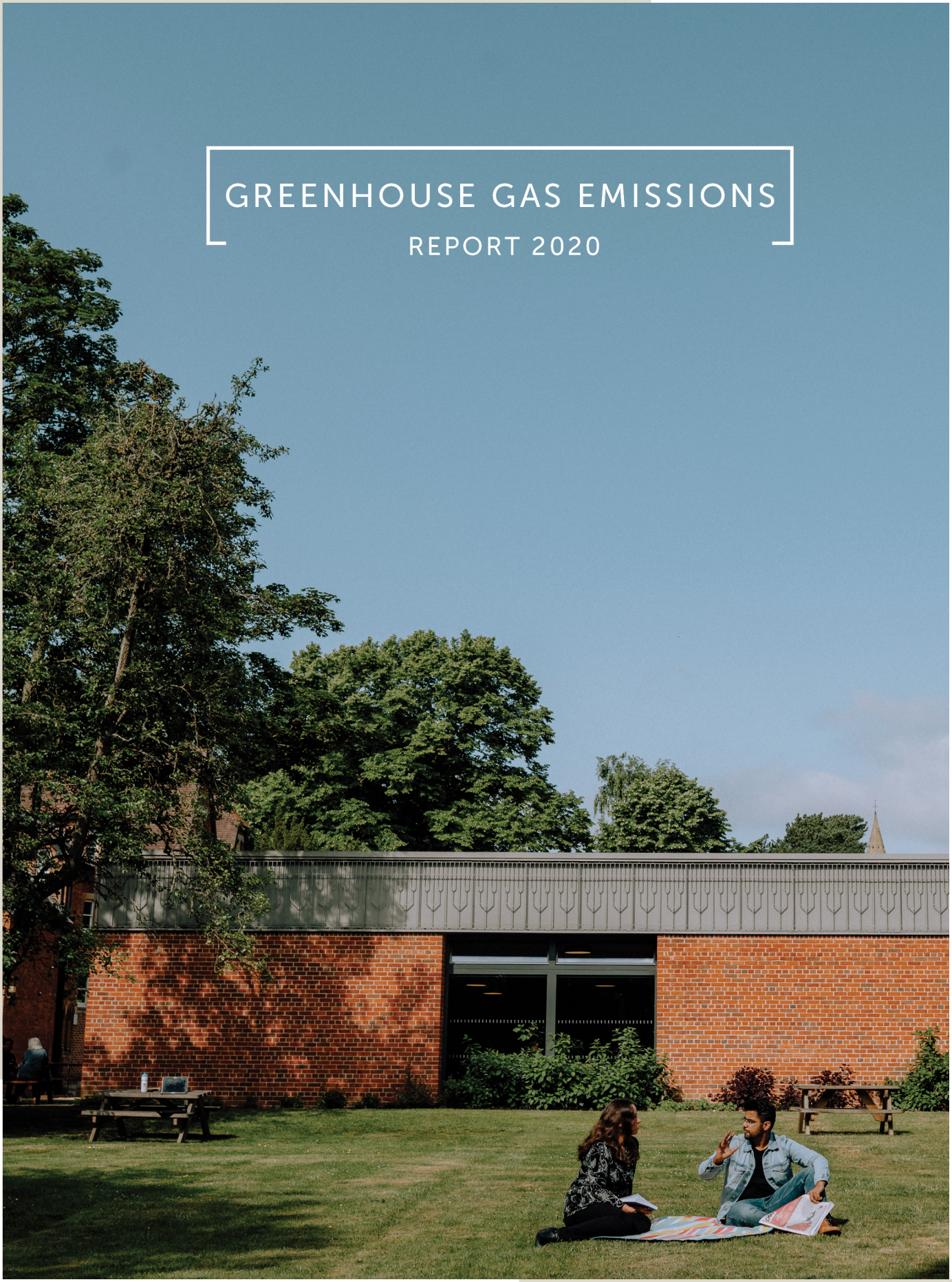
GREENHOUSE GAS EMISSIONS

REPORT 2020



Kellogg College
University of Oxford

Table of Contents

Introduction

1.1 Context

Human induced climate change is the defining challenge of our time. Businesses and institutions contribute in many direct and indirect ways to climate change; however, greenhouse gas emissions pose the most direct and manageable aspect. Thus, reporting and accurately quantifying greenhouse gas emissions is a crucial step in reducing Kellogg College's contribution to climate change. In accordance with the University of Oxford's forthcoming environmental sustainability strategy and Kellogg College's own policy commitments to sustainability, this report analyses Kellogg College's carbon footprint over the period 2017 to 2020.

In addition, this report will operate as a guide and baseline for future policies, aimed at reducing the absolute emissions of the College and its members.

1.2 Reporting Framework

1.2.1 General Overview

The report follows the UK government Greenhouse Gas (GHG) emissions reporting framework developed by the Department of Business, Energy, and Industrial Strategy (https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting). The framework consists of three scopes:

• Scope 1: Direct energy emissions from activities owned or controlled by Kellogg College.

• Scope 2: Indirect energy emissions from combustion or utilization of energy consumed by Kellogg College.

• Scope 3: Indirect energy emissions resulting from Kellogg College activities that occur at sources that Kellogg College does not own or control and are not classed as scope 2 emissions, such as business travel.

1.2.2 Scope analysis as applied to Kellogg College

• Scope 1: Natural gas usage to heat buildings

• Scope 2: Electricity used in buildings

• Scope 3: Water usage in buildings, staff commuting to work, and international student travel (Full-time and Part-time)[1]

[1] Although students come to Oxford for tuition purposes, some reside in Kellogg accommodation and the use of college facilities is attributed to the college rather than the department. However, recommendations to reduce these emissions are given later.

For each of those scopes, the data is presented in units that conform to the UK's framework guidelines. Further graphical analysis of specific buildings and activities is provided to where significant trends are observed trends.

1.3 Limitations

• Water usage data was obtained from Kellogg College's facilities meter readings instead of supplier's bills as those were issued using an estimation. Access to office buildings (60-62 Banbury Road) and 8 Bradmore Road metre readings were not available.

• Electricity emissions were calculated using suppliers' bills based on a combination of estimates and actual consumption.

• Although gas, water, and electricity had meters installed before 2015, the readings were not taken consistently and efficiently. Considering this, only data from 2015 onwards have been used for analysis.

• 8 Bradmore Road was transferred to Kellogg College in 2018, therefore data before this date were not available for direct comparison.

• 62 Banbury Road (including the Hub) had its natural gas meters reset in 2017.

Scope 1: Direct Emissions

2.1 Results

Scope 1 emissions were calculated using gas bills based on actual consumption. Gazprom, the gas supplier, provides regular readings in cubic meters, which were converted to kWh by multiplying the correction factor of 1.02264 and the calorific value of 39.2, and later dividing it by 3.6 which is the conversion factor to joules. Then kWh were converted to tCO2e by multiplying 0.184×10^{-3} using the government's conversion factors.
Table 1 presents scope 1 data.

Table 1-Scope 1 Emissions

Scope 1		2016	2017	2018	2019	2020
Natural Gas	tCO_2e	146.7	140.4	214.1	142.8	154.2
	MWh	797.3	762.9	1,163.8	775.9	838.1

2.2 Analysis

Fig 1 shows changes in emissions due to the natural gas consumption.

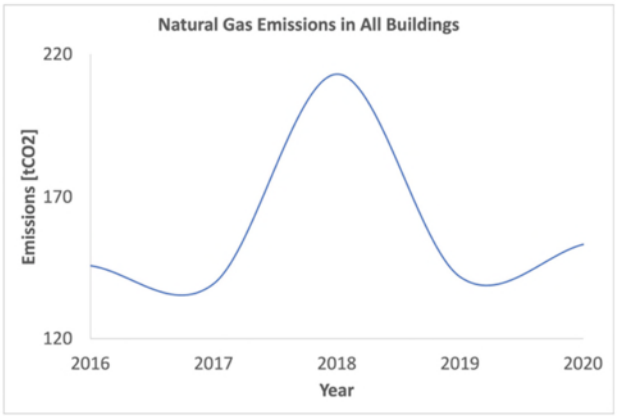
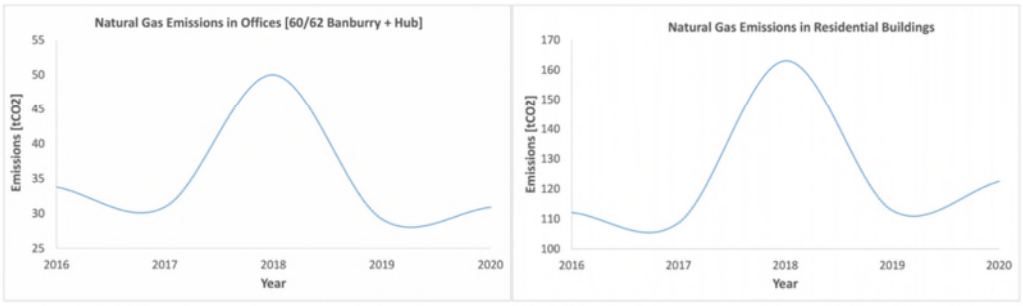


Figure 1: Scope 1 CO_2 Emissions



(a) Natural gas Emissions in Office Buildings **(b)** Natural gas Emissions in Residential Buildings

Figure 2: Changes in natural gas emissions by building type

The trends in both residential and office buildings represent a standard distribution curve with a maximum value in 2018. To understand the trends, it is critical to analyse the underlying principles that govern the utilization of gas.

Heating is automated with a thermostat set to maintain a standard temperature. Given that the average temperature in 2018 was lower than in 2017, greater quantities of gas were used for heating, leading to the increase seen in **Fig 2a**. However, the main reason behind the rise in 2018 was related to the building of the Hub and, especially, the acquisition of 8 Bradmore Road, increasing the number of buildings to be considered.

The rise of consumption from 2019 to 2020 is counter-intuitive given that the college was closed during a significant part of the year due to Covid-19 lockdown regulation. The reason is likely associated with the heating system operating automatically even if staff were working from home. Moreover, the heating system helps to preserve the books and other items conserved in the library.

The growth in emissions between 2019 and 2020 was steeper in residential buildings and this could be attributed to the longer time spent by students in their accommodation as remote and online learning came into place, leading to higher heating demands and/or use of showers by students.

2.3 Recommendations

• Consider manual heating in 62 Banbury Road.

• Educate and encourage students to reduce their gas consumption. Publicising per student usage between buildings, providing shower timers, and providing information on the college's sustainability goals within the building can help students change behaviour.

Scope 2: Kellogg Owned Indirect Emissions

3.1 Results

The scope 2 emissions considered are those associated with electricity consumption. Scottish Power and Scottish and Southern Electric (SSEN) are the two suppliers of electricity, of which Scottish Power provides services in 7, 9-10 and 11 Bradmore Road and 60-62 Banbury Road, and SSEN is responsible for services to 8 and 12 Bradmore Road and 38 Norham Road. These emissions were calculated using suppliers' bills based on a combination of estimates and actual consumption. As the bills were reported in kWh, the results were multiplied by a conversion factor of 0.23314 as suggested in the UK emissions reporting framework.

Table 2- Scope 2 Emissions

Scope 2		2016	2017	2018	2019	2020
Electricity	tCO_2e	98	98.8	96.9	92.3	74.9
	MWh	420.3	423.9	415.5	395.9	321.5

3.2 Analysis

3.2.1 Electricity

Fig 3 shows changes in emissions due to electricity consumption.

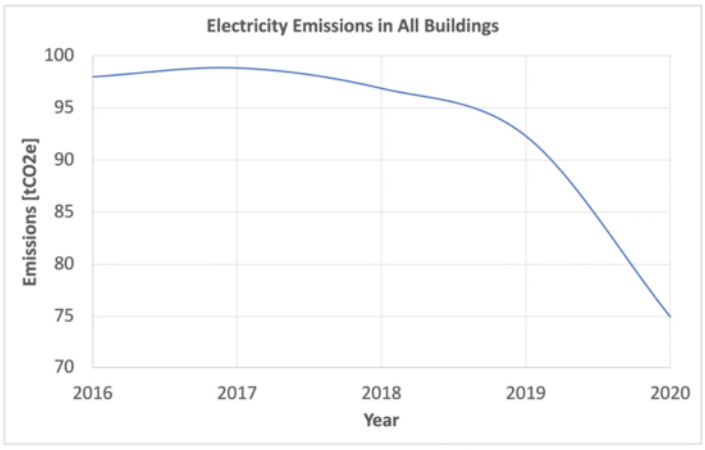
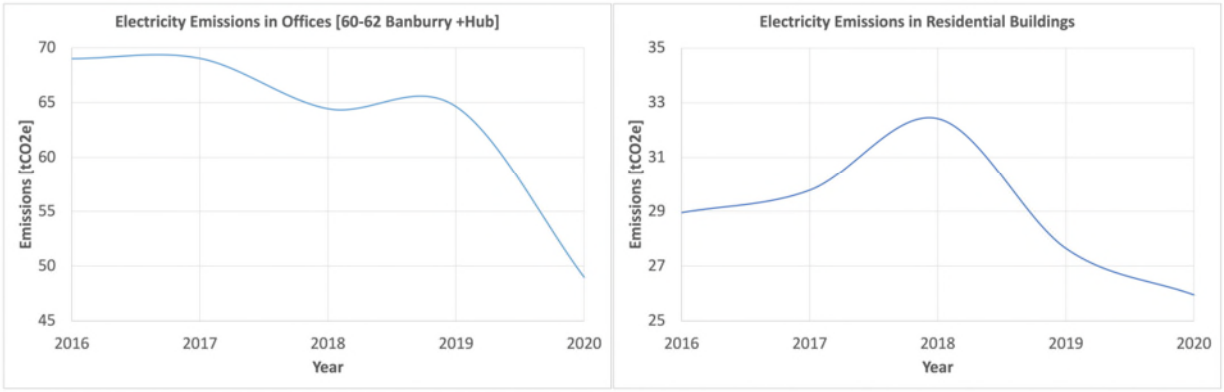


Figure 3: Electricity Emissions in All Buildings



(a) Electricity Emissions in Office Buildings **(b)** Electricity Emissions in Residential Buildings

Figure 4: Changes in electricity emissions by building type

The overall trend of electricity consumption shows a decrease throughout the 5-year time span. In office buildings there was a steady decline between 2016 and 2019 which indicates that staff become better aware and efficient in their utilization of electricity. Furthermore, the steep decline between 2019 and 2020 was attributed to staff working from home due to the pandemic restrictions. Kellogg College's main kitchen, which operates exclusively using induction cooking, was also closed for the majority of 2020, further strengthening the decrease observed.

In respect of residential buildings, electricity consumption increased from 2016 to 2018 due to the addition of 8 Bradmore Road. The consumption then decreased from 2018 to 2020, confirming the positive impact of multiple actions focused on saving electricity, such as replacing high consumption lights for LED, installing light sensors, and improving insulation in most buildings, amongst other measures.

3.3 Recommendations

• Retrofit old inefficient electric appliances with new appliances that conform to UK energy label standards, ensuring that only A+ and above appliances are purchased.

• Complete the replacement of all high consumption lights for LED.

Scope 3 Emissions: Non-Kellogg Owned Indirect Emissions

4.1 Results

Scope 3 emissions include all water usage, staff commuting to work, and student travel to and from Kellogg College during a natural year. Water readings were obtained in m_3 from meter readings in residential buildings. The reading records were transformed in kgCO2e using the conversion factors of 0.344 m^3 /$kgCO_2e$ (water supply) and 0.708 m^3 /$kgCO_2e$ (water treatment) according to the UK emissions reporting framework.

In regard to staff commuting, these emissions were calculated using available data from the 32 active members of staff at Kellogg College at the time of the survey in 2019. The data was obtained via a personal survey which detailed the mode of transport and distance from home to office.

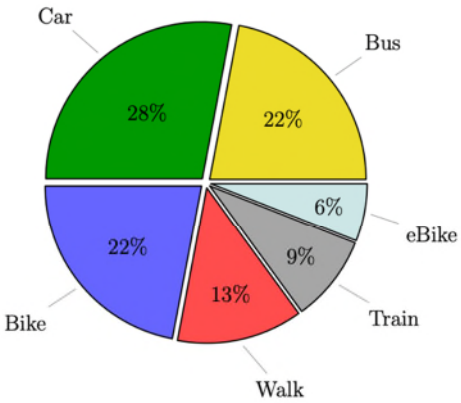


Figure 5: Kellogg College Staff Mode of Transport

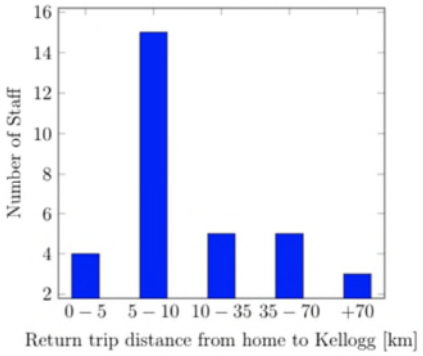


Figure 6: Histogram representing distance each staff member travels to and from work

The estimated number of return trips was accounted for by calculating the number of days an average individual worked when the weekends and holidays (or college closure) were deducted. The conversion factors for bus, car, and train transport were obtained from the UK Greenhouse Gas emissions conversion factor database as 0.1, 0.17, and 0.037 $kgCO_2e$/km respectively. The trips made by walking and bike (including eBike) are considered zero carbon.

Kellogg College is the largest college in number of students and it hosts a big community of part-time students. A breakdown of numbers by mode of study is given in **Table 3** below.

Table 3- Breakdown of Kellogg College students by attendance

Year	Full-Time Students	Part-Time Students
2018	385	1,168
2019	375	1,191
2020	262	980

Due to the complexity of international travel and the different mode of transports available to students, several assumptions were made:

• Flight distance has been considered as the distance between the capital of each outbound country to London.

• Full-time student travel has been calculated estimating a single return trip to Oxford from their previous permanent residence. Other trips, due to academical or personal reasons, were not considered.

• Part-time student travel frequency has been estimated in relation to the number of modules
or residences taking place in Oxford each term. Their current residence has been used as a reference to measure the distance.

• Distance and mode of transport for students from North Ireland, England, Wales, and Scotland have been calculated at 150 kms by car per trip.

• Distance and method of travel for students from Belgium, France, Luxembourg and Netherlands have been estimated at 500 kms by car per trip.

• Travelling by plane has been considered as the mode of transport for students from all the remaining countries.

While the assumptions made above were needed, it is worth being critical of them to understand the full capacity of the results.

Students residing in England may live less than 150 kms away of Oxford and may use other method of travel instead of their car. Those coming from the four EU countries mentioned above, may travel to Oxford by train or plane. International students may have layovers which extend the distance travelled, while others may come from countries different from their stated permanent residence, for example coming to Oxford from a temporary stay at other country. Additionally, not all students reside in the capital of the country and therefore the distance used as a reference could be underestimated. It is important to note that in many countries the capitals are closer to London than other cities or territories. For example, students residing in California are 4,000kms further away from London than if they were residing in Washington DC.

In order to calculate the level of attendance per term for part-time students, the number of modules/residences in each course was divided by the number of terms these students have to complete their programmes.

The results for scope 3 emissions are reported in tCO_2e and the conversion factor for plane and car emissions are 0.18 and 0.17$kgCO_2e$/km. Moreover, due to the difference in the number of trips made by part-time and full-time students, the reporting is divided to reflect this.

Table 4- Scope 3 emissions

Scope 3		2016	2017	2018	2019	2020
Water	**m^3**	3,888	2,922	3,612	2,911	2,094
	tCO_2e	0.95	0.71	0.88	0.71	0.51
All Students Travel	**tCO_2e**	NA	NA	3,941	3,810	1,417
Full-Time Students	**tCO_2e**	NA	NA	538	474	377
Part-Time Students	**tCO_2e**	NA	NA	3,403	3,336	1,040
Staff Commuting	**tCO_2e**	NA	NA	NA	15.5	6.9

4.2 Analysis

4.2.1 Water Consumption

The emissions related to water consumption are seen in **Fig 7**.

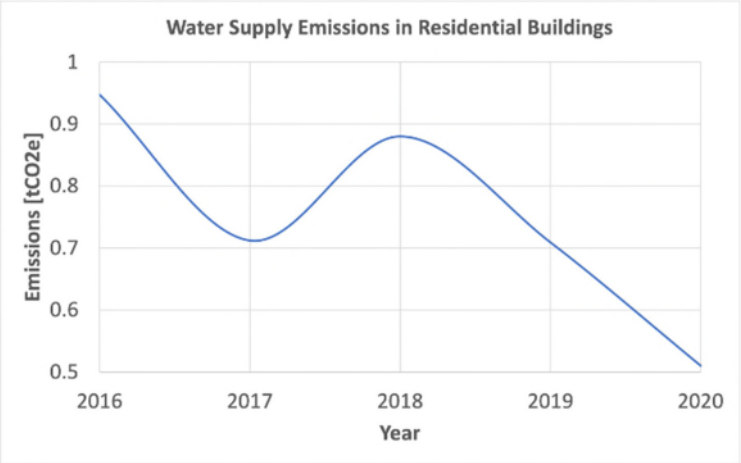


Figure 7: Water Emissions in Residential Buildings

The carbon emissions linked to water consumption show a decrease throughout the 5-year time span, except in 2018. However, unlike trends in electricity and gas consumption, this increase cannot be attributed to the transfer of 8 Bradmore Road to Kellogg College because water values are not available for this building.

4.2.2 Staff Commuting

It is apparent from **Table 4** above that travel emissions more than halved between the two years compared. The clear factor relating to these changes was the number of return trips made to Kellogg College.
In 2019, the average number of return trips was 223, which came down to 100 in 2020 due to significant periods of college closure.

Values of greenhouse gas conversion factors were made on the basis of an average petrol car in the UK. To improve the accuracy of the results estimated, using the correct model of each car would be necessary.

4.2.3 Emissions Per Student

Due to the diverse number and mode of study of students present at Kellogg, estimating emissions per student provides a better picture to identify general trends in scope 3 emissions. This category has been split by part-time and full-time students.

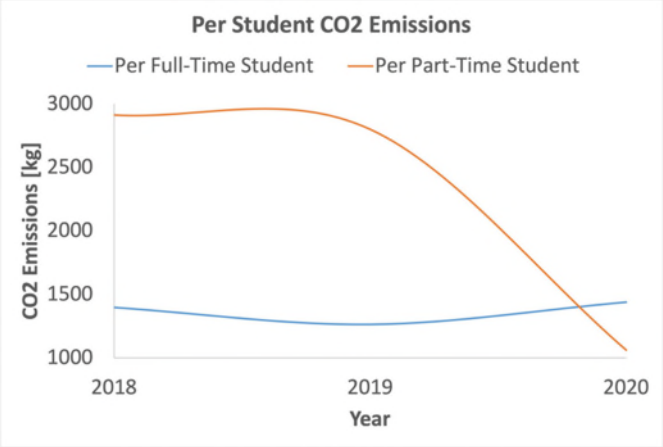


Figure 8: Per Student CO_2 Emissions

Several conclusions can be drawn from **Fig 8** above. In 2018 and 2019, part-time students' impact was double the emissions of full-time students. The levels of emissions of full-time students have been constant throughout the entire period estimated. There is, however, a clear drop in 2020 for part time students' emissions because Trinity Term and Michaelmas Term modules and residences were conducted online.

4.2.4 Deep Dive into Part-Time Emissions

Taking into account that part-time programmes are responsible for the main contribution to scope 3 emissions, this section aims to divulge which courses generate the largest carbon footprint. Data from Hilary and Trinity Terms in 2019 have been considered for this analysis. Courses with fewer than 10 students in Kellogg College were disregarded as such a small amount could not produce representative results. The top 10 programmes with the highest amount of carbon emissions and associated number of students are presented in **Table 5** below.

Table 5- Programmes with the highest total carbon emissions

Rank	Programme	Carbon Emissions (tCO_2e)	Number of Students
1	MSc Software Engineering	451	222
2	MSc Software and Systems Security	273	176
3	MSc Evidence-Based Health Care	270	87
4	MSc Sustainable Urban Development	260	51
5	EMBA	239	31
6	MSc Major Programme Management	105	27
7	MSc Surgical Science and Practice	97	23
8	MSt Creative Writing	94	39
9	MSc Nanotechnology for Medicine and Health Care	67	24
10	MSc in Evidence-Based Health Care (MS)	65	15

The top 10 programmes contributed to 67% of all scope 3 emissions, the other 180+ programmes only contributing to 33% as shown in **Fig 9** below. The main reason for this high contribution is their organization of one-week modules or residences spread out through the year, requiring students to travel multiple times to Oxford.

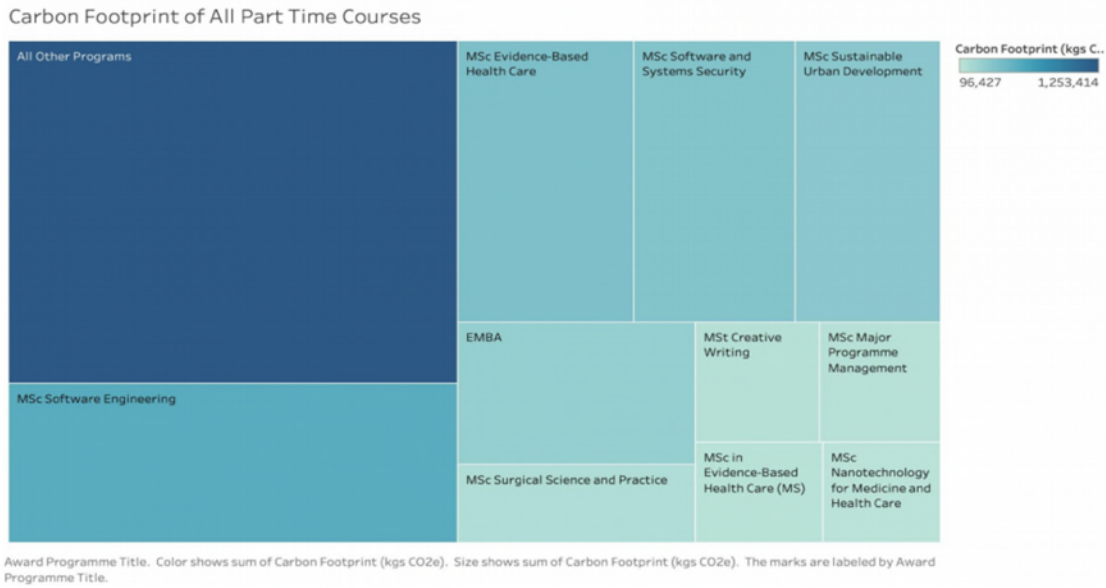


Figure 9: Part-Time Programmes Carbon Emissions

A similar analysis was performed on emissions per part-time student as shown in **Fig 10.** The analysis indicates that some courses contributing to the highest total emissions are present as well in the list of highest-level emissions per student: EMBA, MSc in Sustainable Urban Development, MSc in Evidence-Based Health Care (MS), MSc in Surgical Science and Practice and MSc in Major Programme Management.

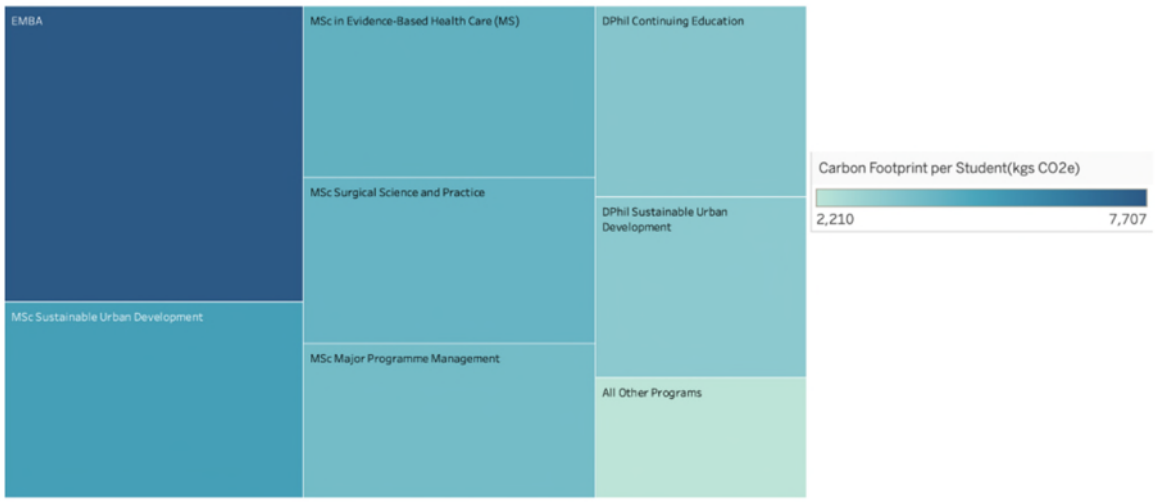


Figure 10: Per Student Part-Time Programmes Carbon Emissions

Table 6- Programmes with the highest per student carbon emissions

Rank	Programme	Carbon Emissions ($kgCO_2e$) per Student
1	EMBA	7,707
2	MSc Sustainable Urban Development	5,091
3	MSc in Evidence-Based Health Care (MS)	4,353
4	MSc Surgical Science and Practice	4,234
5	MSc Major Programme Management	3,906
6	DPhil Continuing Education	3,505
7	DPhil Sustainable Urban Development	3,330

The average carbon footprint per person in the UK, per year, is **12,700 kgs CO2e.** The data employed above to design these lists excluded modules or residences which took place during Michaelmas Term 2019, which would add up to a 33% more tons/kgs of CO2e to the sum of total and per student emissions.

4.3 Recommendations

• Ensure that modules for part time students are flexible and can be easily combined to maximise the efficiency of trips to Oxford, for example offering the option to take two modules within a month.

• Depending on success and availability of online learning, offer the opportunity to part-time and full-time students to attend modules online, unless their attendance in person is essential.

• Motivate staff to switch to a sustainable mode of transport, that is, encourage the use of public transport or promote free parking for electric cars.

• Considering the positive results during the pandemic, Kellogg College could allow staff to work from home to reduce emissions from travel.

• Following the approval of a new University sustainability strategy which will monitor international travel, Kellogg College will only estimate students' national travel in the future.

Total Emissions: 2018-2020

Total emissions are divided by scope and year in **Fig 11.** Scope 3 emissions represent approximately 93% of all emissions. 2018 was chosen as the starting baseline because data from students and staff emissions were not available before.

Figure 11: 2018-2020 Total Emissions divided by Scope

The graph above shows a slight improvement between 2018 and 2019; but the major fall in emissions between 2019 and 2020 was mainly due to Covid-19 and the subsequent reduction of scope 3 emissions was due to part-time students travelling to Oxford in only one term in 2020.

Conclusion

This report detailed Kellogg College Greenhouse Gas (GHG) emissions following the UK Greenhouse Gas emissions standards and procedures, including the reporting of data in scopes 1, 2, and 3.

Decreasing the frequency of student travel to Oxford would result in a considerable reduction to the amount of college carbon emissions. However, student travel's responsibility cannot lie solely on Kellogg College and these emissions could be the responsibility of the departments in charge of the tuition or the students as individuals.
The results show the impact of Covid-19 with a small "reduction" on scope 2 emissions and a significant 63% reduction on scope 3 emissions, due to limitations on student travel.
A notable amount of scope 2 emissions has been transferred from college to a series of individuals (staff homes).

This report represents a baseline for future work on improving the energy efficiency and carbon footprint at Kellogg College.

Produced and designed by
Abdul Sattar AlKahala (MSc Energy Systems)
Rodrigo Hernandez (Kellogg College, Academic Office)

Kellogg College

University of Oxford

WWW.KELLOGG.OX.AC.UK