University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Towards a Climate Action Plan for UCC

A discussion document

September 2020

UCCGREENCAMPUS

A report produced for the UCC Building and Estates Office by the Cleaner Production Promotion Unit

Document Information

Document reference number	20200930CAP		
Document Title	Towards a Climate Action Plan for UCC – A discussion document		
Funding source	Building and Estates Office, University College Cork		
	Cleaner Production Promotion Unit, School of Engineering / Environmental Research Institute, University College Cork		
Issue date	2020.09.30		
Dissemination level	Internal Discussion document		
Lead Author	Lauren Quinlivan		
Contributing Author	Niall Dunphy		
Other Contributors	Pat Mehigan, Maria Kirrane		
Document checked	Niall Dunphy	Date:	2020.09.30

Glossary of Terms

Climate Action Plan (CAP)	A detailed and strategic framework for reducing greenhouse gas emissions and related climatic impacts as a result of the activities of an organisation.
Greenhouse Gas Emissions (GHG)	Any gaseous compound in the atmosphere capable of absorbing infrared radiation, thereby trapping heat in the atmosphere.
Kyoto Protocol	An international agreement that aimed to reduce the presence of greenhouse gases in the atmosphere.
Paris Agreement	An international agreement that aims to strengthen the global response to climate change by keeping global temperature rise below 2 degrees Celsius above pre-industrial levels.
Carbon Footprint	The amount of greenhouse gases released into the atmosphere as a result of the activities of a particular individual, organisation or community.
Baseline	A minimum or starting point used for comparisons.
Greenhouse Gas Inventory	See "Carbon Footprint".
National Grid	The high-voltage electricity transmission network in Ireland.
Emissions Intensity	The level of greenhouse gas emissions per unit of economic activity.
Carbon Credits	A permit which allows the company that holds it to emit a certain amount of greenhouse gases.
Carbon Offsetting	A carbon reduction measure whereby an organisation's emission of greenhouse gases is reduced by its investment in an equivalent reduction made elsewhere.
Net Emissions	Carbon emissions which include reductions due to carbon offsetting.
Total Emissions	Carbon emissions resulting from all emission categories, including stationary combustion, mobile combustion, purchased grid electricity, staff and student commuting, staff and student travel, club/society travel, water, waste, and procurement.
Emission Factor	A coefficient which allows one to convert activity data into greenhouse gas emissions.

Table of Content

1 Introduction

1.1 Background

University College Cork – National University of Ireland, Cork (UCC) was established in 1845 as one of three Queen's Colleges[1]. Today it is a constituent university of the federal National University of Ireland[2] and regarded as a leading Irish educational and research institution, with one of the highest research incomes in the country. In 2018/19 it recorded approximately 21,894 students and 3,014 staff.

UCC is often referred to as Ireland's "Green University" and today is regarded as one of the most sustainable universities in the world, ranking 9th in the 2018 UI GreenMetric World University Rankings. Sustainability and care for the environment are evident throughout the University curriculum with environmental subjects taught across a range of academic areas, including: Engineering, Chemical Sciences, Biological Sciences, Environmental Science & Management, Geography, Geology, Sociology, Zoology *etc*. In parallel with, and complementary to, this teaching, University College Cork has substantial and diverse research activities in sustainable development and the environment throughout all of its colleges and schools.

In recent years, UCC has concentrated great efforts towards addressing the most pressing challenges faced by society today, namely environmental, social and economic sustainability, and has since gained national and international recognition as a sectoral leader in sustainability. In 2016, UCC launched its Sustainability Strategy with the aim of maintaining and improving UCC's position as one of the leading green universities in the world through the creation of a "living laboratory", whereby the university campus itself becomes a testbed for students, academics and practitioners to investigate solutions to some of the major challenges facing society today. As part of the sustainability strategy, UCC aims to reduce the greenhouse gas emissions associated with its activities through continually monitoring and reducing its carbon footprint, thus minimising the local, regional and global environmental impacts of the university's activities.

1.2 Rational for climate action

In May 2019 Ireland became the second country in the world to declare a climate emergency, recognising that swifter action must be taken in order to tackle the effects of climate change. Intensified human pressure on the Irish environment as a result of strong economic growth during the so-called 'Celtic Tiger' period has been well documented, with the main contributions to the increase in greenhouse gas emissions resulting from the burning of fossil fuels for transport and electricity

[1] Queen's colleges were also established in Belfast (now Queen's University Belfast); and Galway (now National University of Ireland, Galway).

[2] Along with Maynooth University; National University of Ireland, Galway; and University College Dublin – National University of Ireland, Dublin

generation (Lammers *et al.,* 2008)[3]. In 2018 it was estimated that Ireland produced in the region of 60.51 million tonnes of carbon dioxide equivalents (CO_2e). Compared to 2017, increases in greenhouse gas emissions have been noted in the agriculture, transport, residential, manufacturing combustion, industrial processes and commercial and public services sectors, making the achievement of a low-carbon Irish economy an all too distant prospect (Environmental Protection Agency, 2020)[4]. Nonetheless, Ireland is bound under both the Kyoto Protocol and 2015 Paris Agreement to reduce its greenhouse gas emissions in order to limit the global temperature rise to less than 2°C, the threshold beyond which it is believed irreversible changes to the global environment will become likely (Environmental Protection Agency, 2020)[5]. Greater effort is therefore needed from both the government and the public in order to ensure that Ireland stays within its national emission targets and meets the 2030 goal of a 30% reduction in greenhouse gas emissions compared to 2005 levels (Environmental Protection Agency, 2019)[6].

The year 2019 was the second warmest year on record and, as a global community, we are not currently on track to meet either the 1.5 or 2°C targets called for by the Paris Agreement. Though the Covid-19 pandemic has resulted in an estimated 6% reduction in global greenhouse gas emissions for 2020, as well as improvements in air quality, these improvements are temporary (United Nations, 2020)[7]. Immediate action from all countries and sectors of society is needed in order to limit global temperature rise to 2°C and avoid the worst effects of climate change.

Large organisations such as University College Cork (UCC) have a vital role to play in efforts to address climate change, among many other Sustainable Development Goals. As a major stakeholder in the long-term development of the locality, region and nation, UCC holds a unique opportunity to take on an active and leading role in the achievement of environmental, financial and social sustainability, both within and beyond the university walls. In 2019 the Buidling and Estates Office in UCC commenced a project with the Cleaner Production Promotion Unit to work towards developing the university's first Climate Action Plan as a tool to guide the university on the challenging journey ahead. This document represents a key step in developing such a plan.

---

[3] Lammers, A., Moles, R., Walsh, C., Huijbregts, M.A.J. (2008). Ireland's footprint: A time series for 1983-2001. *Land Use Policy*, 25, 53-58.

[4] Environmental Protection Agency. (2020). *Current Situation* [online]. Available at: http://www.epa.ie/ghg/currentsituation/ [accessed 3 January 2020].

[5] Environmental Protection Agency. (2020a). *Addressing climate change* [online]. Available at: https://www.epa.ie/climate/communicatingclimatescience/whatisclimatechange/addresssingclimatechange/ [accessed 3 January 2020].

[6] Environmental Protection Agency. (2019). *Ireland's Greenhouse Gas Emissions Projections 2018-2040* [online]. Available at: https://www.epa.ie/pubs/reports/air/airemissions/ghgprojections2018-2040/Greenhouse_Gas_Projections.pdf [accessed 3 January 2020].

[7] United Nations. (2020). *Goal 13: Take urgent action to combat climate change and its impacts* [online]. Available at: https://www.un.org/sustainabledevelopment/climate-change/ [accessed 12 August 2020].

1.3 Structure of the document

This discussion document outlines commitments made by University College Cork – National University of Ireland, Cork (UCC) with the intent to reduce it's environmental footprint and achieve the minimum net greenhouse gas (GHG) emissions possible. It describes a number of broad framework strategies which will be used as guidance towards reaching that goal, and identifies a variety of potential actions which can be used to fulfil each strategy. The prioritisation and implementation of various actions will follow a detailed analysis of the financial, environmental and social aspects of all actions identified. This discussion document is organised into a number of key sections, each of which contributes valuable information on the experiences of the UCC Climate Action Study to date and how this research will aid in the development of UCC's first Climate Action Plan:

- The methodology used to calculate the 2017/18 UCC carbon footprint is detailed in *Section 2: Understanding Our Greenhouse Gas Emissions*, along with the results of this analysis, comparisons to earlier carbon footprint calculations, and identification of key GHG-producing areas;
- *Section 3: Identification of Reduction Opportunities* covers the methods employed in order to identify potential reduction opportunities based on results of the updated UCC carbon footprint;
- Potential measures for reducing direct greenhouse gas emissions stemming from UCC's activities are investigated in *Section 4: Reducing Emissions Under "Our Control"*;
- *Section 5: Addressing Our "Indirect" Emissions* explores potential opportunities for addressing UCC's indirect emissions, touching on areas like procurement, commuting and waste;
- The experience of designing the discussion document behind the university's first Climate Action Plan, as well as considerations which must be made due to the on-going pandemic, are discussed in *Section 6: Discussion*;
- The document culminates in *Section 7: Conclusions* with recommendations for moving forward with the design of a Climate Action Plan.

It it hoped that this discussion document will equip and enable UCC to embark on process to formally adopt a climate action plan for the university. The adoption of such a plan would establish a long-term vision for the future of the university and its impact on the planet, and would represent an acknowledgement of the university's responsibility to contribute to addressing the growing urgency of the climate crisis.

2 Understanding our greenhouse gas emissions

2.1 Introduction

University College Cork produced its first greenhouse gas inventory[8] for the academic year 2008/09[9], and has aimed to continually refine its calculation of the university's 'carbon footprint' ever since. This original carbon footprint for the university provides a baseline against which emission trends can be explored. However, it should be noted that each iteration of the greenhouse gas inventory include a greater level of detail, and captures more of the university's climate impact.

A key part of the work presented in this report was the determination of an updated greenhouse gas inventory. This measurement was calculated for the 2017/18 academic year, and builds upon work already conducted as part of previous carbon footprints, using the most up-to-date data and including data for categories of emissions not previously available. This updated inventory has been used as a key tool in the identification of greenhouse gas reduction opportunities .

The following section details the methodology used to produce a comprehensive carbon footprint for the university, using data from the 2017/18 academic year.

2.2 Greenhouse Gas Inventory Methodology

University College Cork contributes to climate change and global warming both directly, through university activities, and indirectly, as a result of activities associated with the university. These "direct" and "indirect" emissions are categorised as "Scopes" by the *Greenhouse Gas Protocol Corporate Standard*[10] and are outlined as follows:

- Scope 1 – Core, direct emissions: Direct emissions resulting from activities under UCC's control, from sources owned or controlled by the university, for example, on-site fuel combustion, refrigerant losses and company vehicles;
- Scope 2 – Core, indirect emissions: Indirect emissions resulting as a consequence of the operations of the university, but emitted from sources not owned or controlled by UCC, for example, electricity purchased and used by the university;

[8] More commonly known as a 'carbon footprint'
[9] Prepared by Dunphy *et al.,* Cleaner Production Promotion Unit, School of Engineering and Environmental Research Institute, University College Cork
[10] Ranganathan, J., Corbier, L., Bhatia, P., Schmitz, S., Gage, P., Oren, K., 2004. The Greenhouse Gas Protocol. A Corporate Accounting and Reporting Standard. World Business Council for Sustainable Development and World Resources Institute, Geneva and Washington DC.

- Scope 3 – Non-core indirect emissions: Any other indirect emissions from sources not directly controlled by UCC, for example, employee business travel, procurement, waste, water and student commuting.

Methodologies for determining carbon footprints – such as the Greenhouse Gas Protocol Corporate Standard – general require only the inclusion of Scope 1 and 2 emissions. The inclusion of Scope 3 emissions is not mandatory, though it is encouraged, and the selection of which non-core indirect emissions to include is not established.

During the calculation of UCC's carbon footprint for 2017/18, the standardised approaches and principles detailed in the *GHG Protocol Corporate Standard* were utilised to ensure a true and fair calculation of the university's emissions. Throughout the discussion document greenhouse gas emissions are expressed in terms of Carbon Dioxide Equivalents (CO_2e).

Table 1 below describes the operational boundary for the UCC carbon footprint study, which includes all components that would be expected in the mandatory Scopes 1 and 2. In addition, when selecting Scope 3 emissions, an inclusive approach was adopted in keeping with the objectives of the study. For a more detailed description of the calculation method see Appendix 1 and Appendix 2.

Table 1: Operational Boundary for UCC Carbon Footprint Study 2017/18.

Activity		Activity Subset
Scope 1	Stationary Combustion	Natural gas; liquid fuel
	Mobile Combustion	Motor fuel (UCC-owned vehicles)
	Process Emissions	
	Fugitive Emissions	
Scope 2	Purchased Electricity	
Scope 3	Employee Commuting	Car, bus, rail, motorbike
	Employee Business Travel	Car, bus, rail, motorbike, short-haul flights, long-haul flights, international flights, ferry
	Student Commuting	Car, bus, rail, motorbike
	Student Academic Travel	Car, bus, rail, motorbike, short-haul flights, long-haul flights, international flights, ferry
	Student Club/Society Travel	Car, bus, rail, motorbike, short-haul flights, long-haul flights, international flights, ferry, truck/van
	Waste	Landfill, mixed dry recycling, food, glass, cardboard, WEEE
	Water	Supply, treatment
	Procurement	Various NACE sectors

2.3 UCC's 'Carbon Footprint'

The 2017/18 UCC carbon footprint is currently estimated to be 44,119 tCO_2e (Figure 1). Scope 3 emissions currently account for the largest percentage of the total carbon footprint at *c.* 55%, followed by Scope 2 emissions at *c.* 32% and Scope 1 emissions at *c.*13%. The largest sources of greenhouse gas emissions include purchased grid electricity (32%), procurement (19%), student commuting (15%), stationary combustion (13%), staff business travel (8%), student academic travel (7%) and staff commuting (5%) (Figure 1). An overview of the results from the 2017/18 carbon footprint calculation is presented here, while a more detailed account of the method for calculating the carbon footprint is included in Appendix 2.

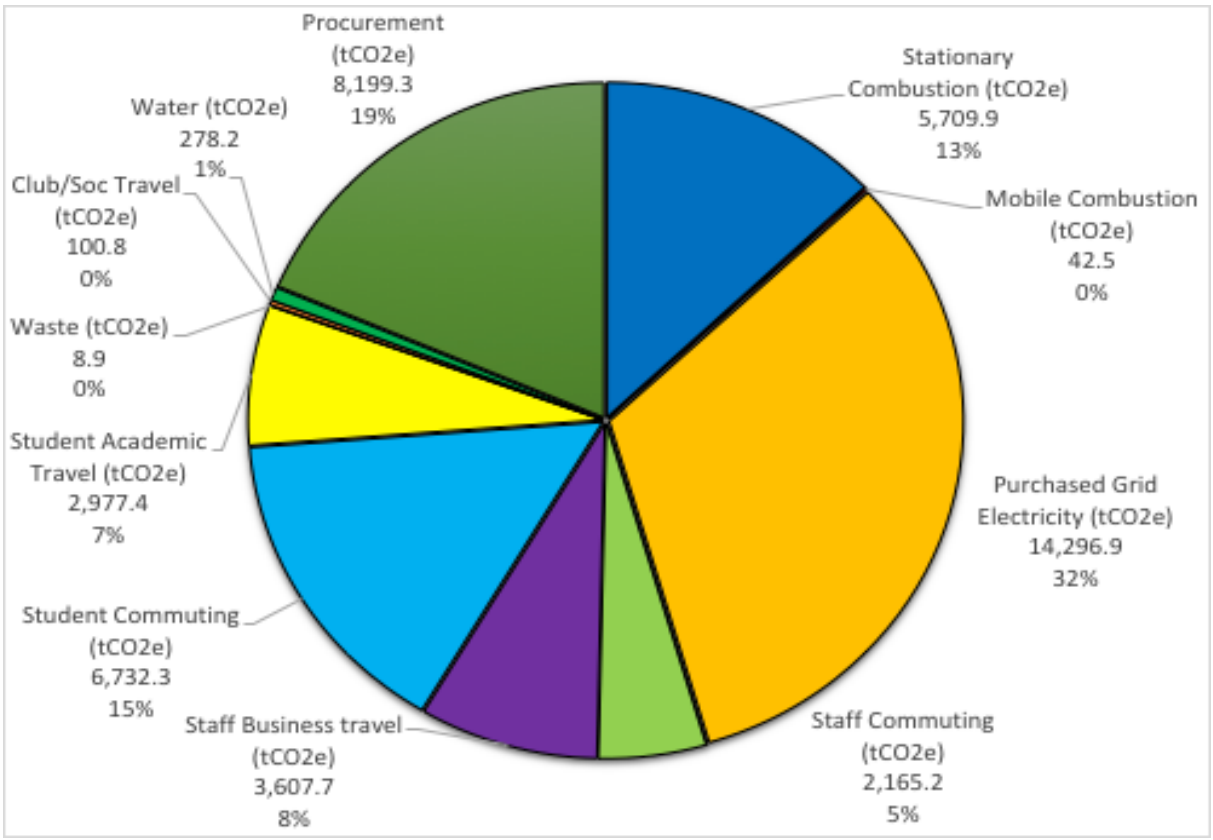

Figure 1: Breakdown of the updated UCC carbon footprint for the 2017/18 academic year.

2.3.1 Trends in Scope 1 and 2 Emissions

Stationary combustion accounted for the vast majority of Scope 1 greenhouse gas emissions at 13% of the total carbon footprint. Mobile combustion associated with UCC-owned vehicles amounted to less than 1% (Figure 1). A breakdown of Scope 1 emissions, and how they compare to 2008/09 baseline Scope 1 emissions, can be seen in Figure 2. Similar to 2008/09, a few particular UCC-clusters such as Main campus, Lee Maltings, the Mardyke and a collection of Other UCC-owned buildings account for the majority of greenhouse gas emissions stemming from stationary combustion within the university. Overall, there has been an increase in Scope 1 emissions from 2008/09 to 2017/18, with decreases in

certain UCC-cluster areas like the Brookfield and North Mall campuses counteracted by increases in most other areas (Figure 2).

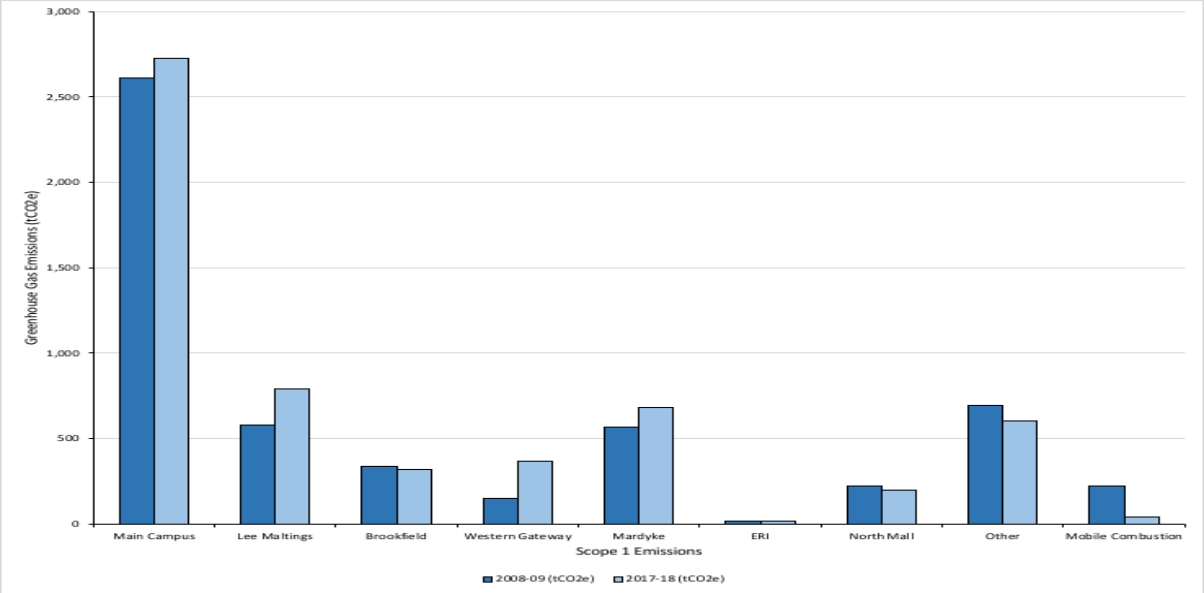

Figure 2: Comparison of Scope 1 emissions from 2008/09 and 2017/18 for various UCC cluster areas[11]

A similar trend can also be seen with regard to Scope 2 emissions as a result of the use of purchased grid electricity, which account for 32% of the total UCC carbon footprint (Figure 1). Again, certain UCC cluster areas like Main Campus, Lee Maltings and a number of other UCC-owned buildings accounted for the greatest production of Scope 2 GHG emissions in 2017/18 (Figure 3). Overall, UCC has seen a decrease in greenhouse gas emissions from Scope 2 activities, in spite of the fact that emissions from purchased grid electricity have increased overall since 2008/09 as UCC requires more purchased electricity to make up for the closure of the CHP plant a number of years ago (Figure 3).

Note: UCC meets all of its electricity demand through renewable energy sourced from "green suppliers", which if accounted for would significantly reduce UCC's Scope 2 emissions, and the overall carbon footprint. However, because this renewable electricity is supplied through the national grid, it is considered more appropriate to use a grid average carbon intensity in calculating the carbon footprint, instead of "taking credit" for this renewable electricity.

[11] The most recent carbon footprint (2017/18) includes buildings which were completed before, and operating during, the 2017/18 academic year, though may not have been in operation at the time the baseline carbon footprint (2008/09) was calculated.

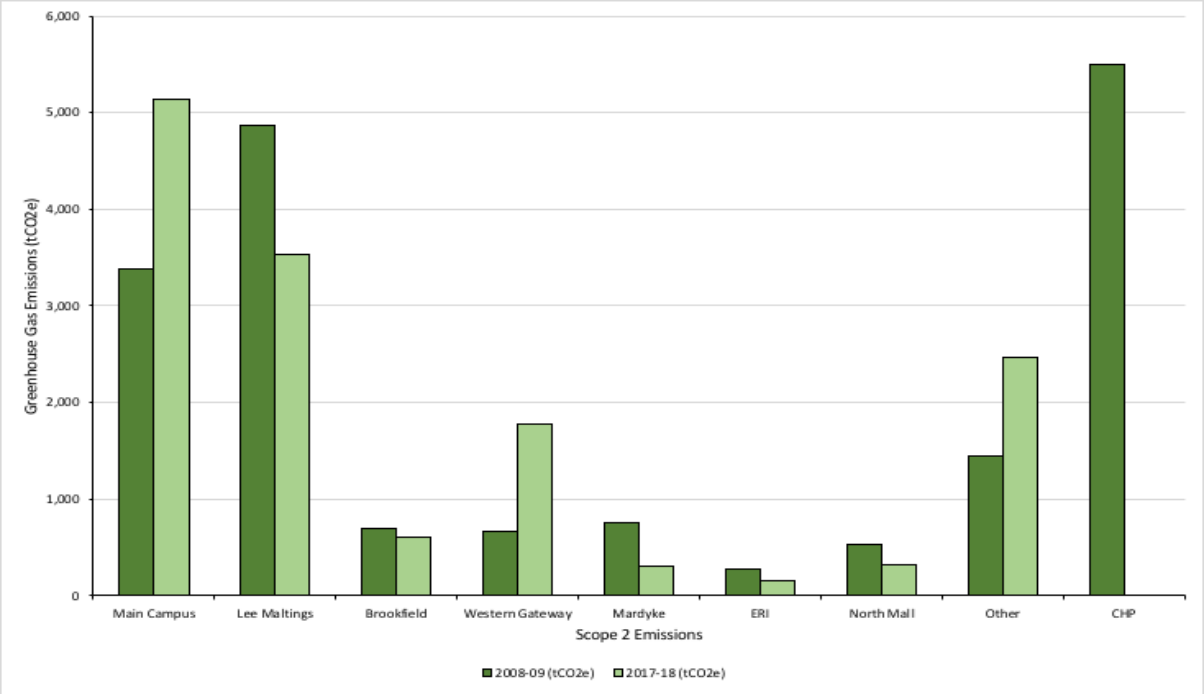

Figure 3: Comparison of Scope 2 emissions from 2008/09 and 2017/18 for various UCC cluster areas.

2.3.2 Trends in Scope 3 Emissions

Procurement accounts for the largest percentage of Scope 3 GHG emissions at 19% of the total UCC carbon footprint, followed by student and staff commuting at a combined 20% and staff and student travel at 15%. Emissions from waste, water and student club/society travel make up small percentages of the total carbon footprint (Figure 1).

There appears to have been a dramatic increase in Scope 3 emissions in 2017/18 compared to the 2008/09 baseline, due to increases in emissions from a number of Scope 3 emission categories as well as the fact that procurement and student club/society emissions were included in the UCC carbon footprint for the first time in 2017/18 (Figure 4). When compared to the 2008/09 baseline, in addition to new consideration of procurement, increases in greenhouse gas emissions can be seen in student and staff travel, student commuting and water (Figure 4).

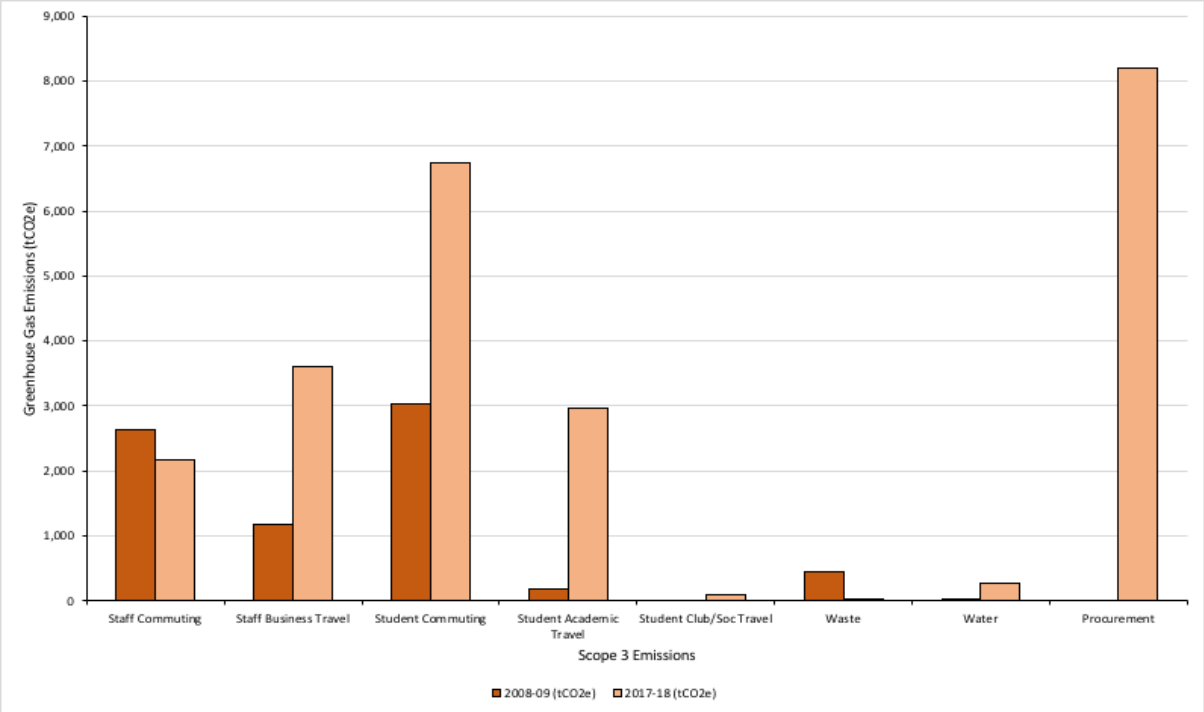

Figure 4: Comparison of Scope 3 emissions from 2008/09 and 2017/18 for various UCC emission categories.

2.4 Commentary

The 2008/09 UCC carbon footprint was estimated at 30,991 tCO_2e, comprising 23,504 tCO_2e for Scope 1 and 2 emissions, and 7,487 tCO_2e for Scope 3 emissions. This would suggest an increase of 13,128 tCO_2e in overall GHG emissions for the 2017/18 carbon footprint, however when the emissions from procurement are excluded (which was not measured to the original inventory), the overall increase is lower at 4,929 tCO_2e (Figure 5).

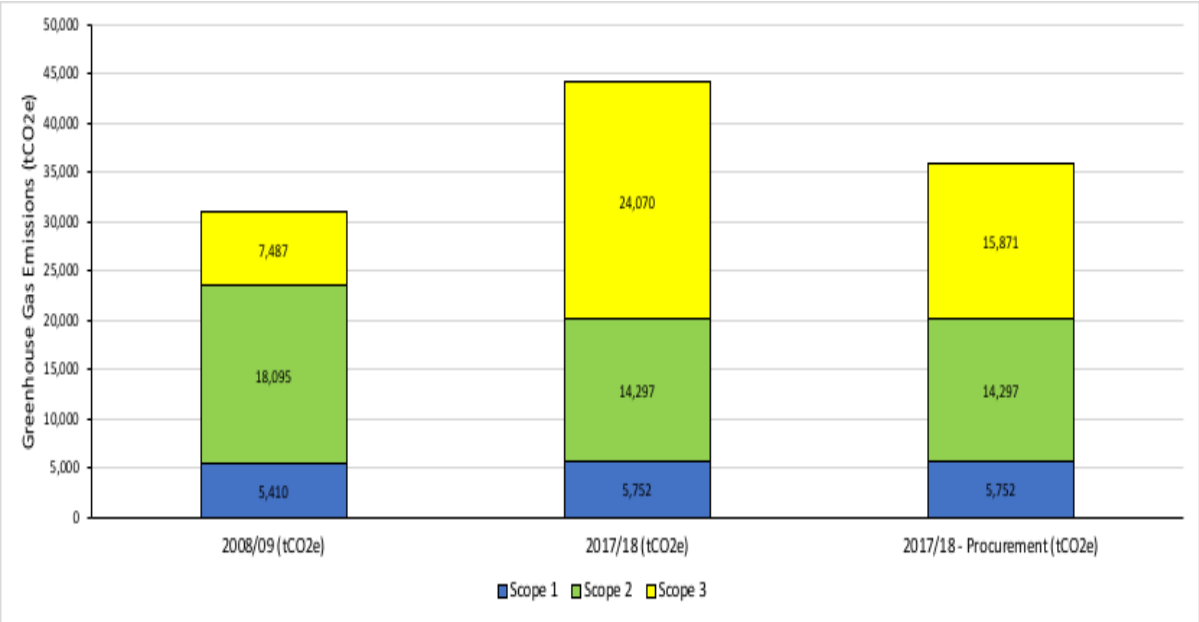

Figure 5: Comparison of the 2008/09 and 2017/18 UCC carbon footprints for Scope 1, 2 and 3 emissions. The 2017/18 carbon footprint excluding emissions from procurement is also shown.

Overall, there has been a reduction of 3,455 tCO_2e in Scope 1 and 2 emissions between 2008/09 and 2017/18.

Scope 1 emissions have increased by *c.* 6% between the two studies. There was an 81% reduction in emissions stemming from mobile combustion of UCC-owned vehicles during that time, therefore the 6% increase can mostly be attributed to an overall 10% increase in the emissions from natural gas consumption on campus.

The 21% decrease in Scope 2 emissions between 2008/09 and 2017/18 can mainly be attributed to the closure of the CHP plant in UCC, as well as a reduction in the carbon intensity of the national grid[12]. Overall, the 2017/18 year saw a 14% increase in emissions from UCC cluster areas, which could be seen as a result of greater electricity consumption on campus due to the closure of the CHP plant. However, particular UCC blocks have succeeded in making reductions to their electricity use and thus emissions, namely Lee Maltings, the Mardyke, ERI and North Mall.

Scope 3 emissions can be broadly broken up into eight categories: staff and student commuting; staff and student (academic/business) travel; student clubs and society's travel; waste; water and procurement. The 2017/18 UCC carbon footprint marked the first time that emissions from student club/society travel and procurement have been included in the GHG inventory, and therefore no comparison can be made to the 2008/09 baseline. The 2017/18 carbon footprint shows an increase in staff (business) and student (academic) travel, as well as water and student commuting, and a decrease in emissions from both staff commuting and waste. These differences may not be so much a reflection of changes in activity levels, rather differences in data quality, collection methods and analysis between the two years of study. This is demonstrated in Figure 6, which shows the disparity between passenger-kilometres travelled by rail between 2008/09 and 2017/18 and the emissions produced in both years, as a result of increase in activity levels and changes to data handling methods[13], but also to greater data availability. This observation may also help explain differences seen in the emissions produced via water and waste between the two different study years, and should be taken into consideration when discussing the university's progress with reducing its carbon footprint compared to the baseline.

[12] Although UCC takes great pride in sourcing all of its electricity from renewable supplies, in calculating the carbon footprint, the university uses the grid average carbon intensity. This is in keeping with best practice in such measurements. While the footprint would be reduced substantially by 'taking credit' for the renewable electricity, as they are supplied via the national grid it is not considered appropriate to do so in this manner.

[13] The 2017/18 carbon footprint saw the inclusion of a higher volume of data, from a greater number of sources, compared to the 2008/09 carbon footprint calculation. As the study timeline allowed, more detailed analyses were conducted with this data than have occurred with previous carbon footprints. Furthermore, emission factors were updated to reflect changes over time. All of these factors may contribute to the differences seen in the two carbon footprints, irrespective of changes in activity levels.

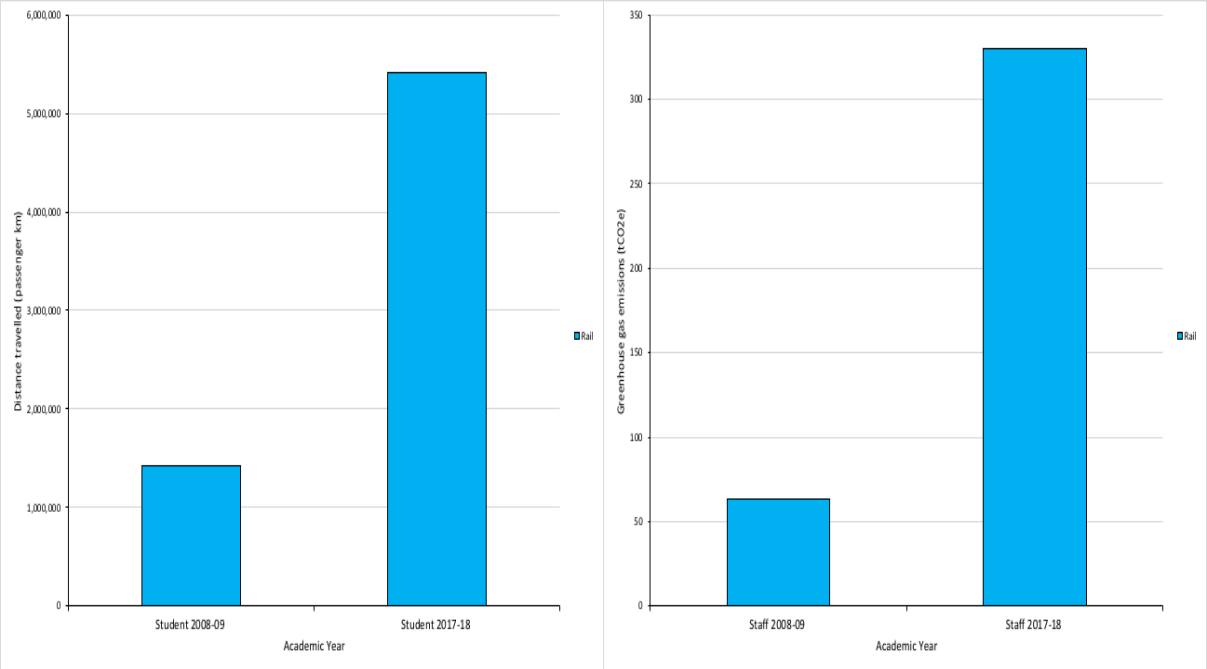

Figure 6: Passenger kilometres travelled by rail increased by c.4 times between 2008/09 and 2017/18, while emissions produced appear to have increased by c.5 times between the two years, due to differences in calculation methods.

3 Identification of reduction opportunities

3.1 Introduction

The 2017/18 UCC carbon footprint provided a detailed picture of the university's greenhouse gas emissions, which the Climate Action Study aimed to use as a tool for identifying opportunities to reduce the university's environmental impact. A number of research methods were employed in order to identify reduction measures which were feasible, provided significant savings of GHGs and garnered support from the UCC community. A participatory approach was employed during the identification of reduction opportunities whereby both staff and students were consulted in order to explore a number of different perspectives.

3.2 Methodology

The identification of reduction opportunities began with an exploration of measures implemented by other universities as part of their Climate Action or similar plans. A number of universities were examined, including the University of New Hampshire (USA), University of Cambridge (UK), University of Newcastle (AU) and Penn State University (USA), among many others. The measures identified by other universities provided a number of unique ideas for which the researchers could gauge support for implementation as part of the UCC Climate Action Plan.

As part of the second phase of research, a "structured dialogue" exercise was used to gather ideas and explore support for a variety of potential climate-action measures (after Revez *et al*. 2020)[14]. The exercise consisted of a number of surveys which were distributed to participants to gauge their response to questions posed. The initial round was used to establish the context, providing basic information and inviting participants to provide their perspectives on a number of matters surrounding sustainability and climate action within UCC. First round questions such as "*Do you consider the UCC campus to be energy efficient?*" tended to be non-specific and encouraged participants to open up a dialogue on a particular topic. Subsequent survey rounds were informed by earlier replies and contained more specific questions aimed to identify measures to reduce the university's climate impact within a number of target areas. Potential measures and the level of support shown from them by survey participants were compiled into a large document for consideration.

Four different structured dialogue exercises were conducted, each with participants from a number of different areas of the university, in order to focus the dialogue on combating a particular area of GHG-production. The groups were as follows: Scope 1 and 2 emissions (staff from the Office of Buildings and Estates); Scope 3 emissions (members of the Green Campus Forum and UCC Environmental Society); staff business/student academic travel (staff and students from the ERI and MaREI); and procurement (staff from the Capital Projects Office, ERI, APC Microbiome, etc.).

3.3 Report on the process

The initial phase of desk-based research proceeded uninterrupted, however the second phase of research, which was originally planned as a series of workshops, was halted suddenly at the start of the Covid-19 pandemic. Due to the closure of the university and the introduction of a number of restrictions around group gatherings, the initial project plan was revised to adopt the structured dialogue method.

Progress using the structured dialogue method was slow due to complications surrounding the identification of suitable participants, as well as long turnaround times between survey rounds. Novel issues such as unreliable internet connections for a number of researchers and participants new to working from home also contributed to lengthening the entire process. Response rates ranged from as low as 36% to as high as 83%, depending on the participant group. For all groups the response rate decreased as the exercise progressed. Despite the slow progress brought on by unpredictable circumstances, the structured dialogue method was useful in providing the researchers with information which could contribute to the identification of carbon footprint reduction opportunities and development of UCC's Climate Action Plan.

[14] Revez, A., Dunphy, N., Harris, C., Mullally, G., Lennon, B., Gaffney, C., 2020. Beyond Forecasting : Using a Modified Delphi Method to Build Upon Participatory Action Research in Developing Principles for a Just and Inclusive Energy Transition. Int. J. Qual. Methods 19, 1–12. https://doi.org/10.1177/1609406920903218

4 Reducing emissions under 'our control'

Scopes 1 and 2 greenhouse gas emissions arising from UCC's consumption of various forms of energy amount to 45% of the university's carbon footprint (Figure 1). UCC has a long track record in energy management, becoming the first third-level institution worldwide to achieve ISO 50001 standard for Energy Management Systems back in 2011. Past and current projects run by UCC involve lighting, metering, heat recovery, ventilation, photovoltaics and wind energy, among others, all with the aim of improving energy efficiency and conservation throughout campus. UCC recognises the importance of addressing the greenhouse gas emissions associated with the university's energy usage, and strives to continually monitor and reduce the university's carbon footprint. Confronting the direct emissions associated with UCC activities provides the most straightforward first step towards lowering the university's greenhouse gas emissions output. The tables which follow in this section and *Section 5* contain potential measures derived from the structured dialogues conducted with the UCC community, as well as examples observed as part of a desk study into measures employed by other universities around the globe. Any financial savings quoted from other university studies are done so in the currency of the original study at the time it was conducted – any potential measures will therefore need to be explored specifically for their application to the UCC campus.

4.1 Energy Consumption

Though UCC does reasonably well at managing energy savings across campus given the nature and age of the building stock, issues with the management of more energy-efficient buildings have been identified. These include an inefficient use of space, such as staff members holding multiple offices and rooms not being used to capacity, as well as a high level of inefficiency associated with laboratory environments due to the individualism of research and lack of responsibility for equipment, among other issues. Better building management could provide a good "value for money" option for improving the energy efficiency of the UCC building stock. The London School of Hygiene and Tropical Medicine (LSHTM)[15] have identified improved energy management practices, including a formalised management system, especially for laboratories, as worth an estimated saving of *c.* £17,000 and 42 tCO_2e annually. Subsequently, a number of measures have been identified for addressing UCC's Scope 1 and 2 greenhouse gas emissions, including updating controls for temperature, ventilation and lighting; encouraging behavioural change surrounding energy consumption through education and training; and optimising space utilisation, among other potential measures (Table 2).

[15] London School of Hygiene and Tropical Medicine (2020). *Energy & Carbon Management Plan (ECMP) 2020* [online]. Available at: https://www.lshtm.ac.uk/files/ecmp-2020-summary.

Table 2: Potential measures associated with energy efficiency and conservation.

Scope 1 and 2 Emissions	
Energy Efficiency and Conservation	
1. *Temperature Controls*	*UCC context:* Temperature remains an issue for most staff at UCC, with differences in temperature preferences among office users, extremes of temperature in older buildings and freezing Monday mornings requiring the use of electric heaters being cited as common grievances. Staff would appreciate more localised control over the office temperature in their buildings through the use of thermostats, but with a limit on the level of control over temperature (*e.g.,* +/- 2 degrees) and the time within which it can be adjusted (*e.g.,* working hours). Banning the use of stand-alone electric heaters is also an option, however this may result in some backlash. *External initiatives:* The University of New Hampshire (UNH)[16] established a building temperature set point policy for all of campus which adjusts the temperature during occupied and unoccupied hours, including during winter and summer, weekends and holidays.
2. *Investment in HVAC/BMS Systems*	*UCC context:* Staff would like to see continued investment in HVAC/BMS systems for aiding temperature control, along with continued close interactions with the staff in B&E regarding current HVAC issues. Smart HVAC/BMS systems, such as those based on some measure of occupancy, like WIFI, are now coming on the market and show great potential for use in bigger buildings in UCC. Designated warmer/colder spaces in larger buildings, to accommodate different temperature preferences, were also suggested during the structured dialogue. As a member of the MUSH (municipalities, universities, schools and hospitals) market, potential exists for UCC to implement many of these carbon-reduction measures using energy savings performance contracts (ESPCs), whereby an energy services company (ESCO) with a focus on driving better performance targets offers to develop and deliver retrofits. The capital cost of these retrofits is repaid through savings over a relatively long-term (10-15 year) contract, and may prove to be an option UCC should explore.

[16] University of New Hampshire. (2014). *WildCap (Climate Action Plan) Update* [online]. Available at: https://reports.aashe.org/media/secure/55/7/679/6093/WildCAP%20Update%20FINAL.pdf.

	External initiatives: Both Pennsylvania State University[17] and UNH recently installed an Aircuity demand-control airflow system comprising sensors in each laboratory which "sniff" for contaminants in the air and adjust the flow of fresh air into the room accordingly. Penn State have observed significant reductions in energy use, with no deterioration in air quality, since its installation, and expects to make back the money invested in energy savings in an estimated two years. UNH also adjust ventilation settings during occupied and unoccupied hours, having recently installed a building automation system (BAS) in areas that previously had HVAC controls that weren't adequately turning back the temperatures and ventilation systems during times when buildings were not fully occupied. The BAS system includes occupancy sensors that allow for reduction of airflows when the space is detected to have less than fully occupied status.
3. *Intelligent Lighting*	*UCC context:* Suggestions have been made by staff for the installation of intelligent and energy-efficient LED lighting systems with occupancy and lighting sensors. *External initiatives:* The London School of Hygiene and Tropical Medicine (LSHTM) estimate that adjusting the settings and fitting variable speed drive and controls to the university's air handling units (AHUs) would result in an estimated saving of *c.* £14,500 and 54 tCO_2e annually. UNH recently installed more efficient lighting fixtures with occupancy and photo sensors which adjust lighting levels based on occupancy and allow for daylight harvesting. The photo sensors allow the lighting to dim and meet minimum levels required for illumination at the surface below the light. Penn State University is looking at installing similar lighting occupancy sensors to conserve electricity. The LSHTM identified an LED lighting retrofit and the installation of passive infrared (PIR) sensors in infrequently occupied areas as potential measures worth exploring as part of their Carbon Management Plan.
4. *More Efficient Use of Fume Cupboards in Laboratories*	*UCC context:* According to survey participants, inefficient fume cupboard use is widespread within laboratories in UCC, using a large portion of energy unnecessarily.

[17] University of Pennsylvania (n.d.). *Climate Action Plan* [online]. Available at: https://www.sustainability.upenn.edu/sites/default/files/pdf/PENN-2009-Climate_Action_Plan.pdf

	External initiatives: The University of British Columbia (UBC)[18] estimated that *c.*10% of their total energy use resulted from the use of fume cupboards. The university aimed to promote behavioural change surrounding fume hood usage in order to conserve energy. Both Penn State and UNH recently upgraded their fume hood controls to include zone presence sensors that adjust fume hood exhaust rates based upon the presence or absence of an operator. For Penn State, this development (if implemented across campus) should result in a saving of approximately $115,000 and 100 tCO_2e annually. UNH have also aimed to reduce the minimum flow settings at all fume hoods that utilize a variable air system tied to fume hood sash position. This allows less airflow when fume hood sashes are fully closed, resulting in less conditioning of the outside air that is required to provide adequate ventilation.
5. *Update to the Fabric of Older Buildings*	*UCC context:* Upgrades to windows and external walls have been identified as potential carbon-saving measures by survey participants. This measure may prove expensive initially, however it could result in great financial and performance payback. *External initiatives:* Heriot-Watt University[19] has declared its intention to replace single-glazed, metal-framed windows on its campus with high performance, double glazing units, estimating an annual saving of 60-80 tCO_2e per building. Penn State University began identifying and replacing defective insulation and repairing aging manholes in 2008, estimating potential savings of *c.* $300,000 in the first year. This is also an aim of the LSHTM.
6. *Green Construction for Future Buildings*	*External initiatives:* Boston University[20] has stated in its CAP discussion document that it aims to certify all new buildings to LEED Gold. Penn State University includes the renovation of existing buildings to higher energy standards (improved to a minimum standard of Energy Star 75) in its CAP. The university has also installed green roofs on five campus buildings with the environmental and cost-effective benefits of capturing rainwater, reducing rooftop temperature during the summer, insulating the

[18] University of British Columbia (n.d.). *Climate Action Plan 2020: Vancouver Campus* [online]. Available at: https://planning.ubc.ca/sites/default/files/2019-11/PLAN_UBC_ClimateActionPlan.pdf.

[19] Heriot-Watt University (n.d.). *Carbon Management Plan 2015/16 – 2019/20* [online]. Available at: https://www.hw.ac.uk/documents/carbon-management-plan.pdf.

[20] Boston University (2017). *Recommendations of the Climate Action Task Force for Boston University's Climate Action Plan* [online]. Available at: https://www.bu.edu/climateactionplan/files/2017/12/ClimateActionPlan_Report_FINAL.pdf.

	buildings during winter, providing a habitat for insect and bird species, and proving a visual relief for residents of neighbouring buildings. The LSHTM aims to update engineering standards to achieve higher energy efficiency standards and lower life-cycle costs of technologies being implemented in new builds and retrofits.
7. *Changes to the IT System*	*UCC context:* Participants would like to see the use of TeamViewer and other remote software that keeps an office computer running while being accessed from home discouraged when not needed. *External initiatives:* UNH no longer configures screen savers on UNH IT-managed workstations. It now uses computer power management systems to shut screens off or go into "sleep mode" when not in use. The university also sends out "Power Down" emails before each weekend and holiday break. The University of Cambridge[21] conducted a study of the campus community in order to better understand plug load as a percentage of overall campus energy usage, with preliminary investigations indicating that plug loads associated with academic scientific research could account for around 60% of the university's carbon emissions. UNH have also proposed a study like this. Numerous CAPs have mentioned raising the temperature in computer server cooling rooms slightly as a potentially promising energy-saving measure.
8. *Metering of Energy Consumption*	*External initiatives:* UNH have installed over 700 meters in its buildings to account for consumption of electricity, as well as natural gas, water, stream and condensate, hot water heat, chilled water and other utilities. Most metres are equipped to be read as frequently as every hour, and are all catalogued at least monthly for historical consumption reporting. The university has also added a public portal for viewing energy metering data on the UNH Energy Office website in order to educate campus on how energy is consumed by buildings.
9. *Shifting Academic Term Dates*	*UCC context:* A suggestion was made by participants to lengthen the winter break in order to extend the academic term further into the summer months, which could result in energy savings. However this measure would also likely result in backlash from students and staff.
10. *Education and Behavioural Change*	*UCC context:* Numerous behaviours have been identified which contribute to the unnecessary production of GHGs within UCC, including leaving lights on and equipment running when not needed; opening

[21] University of Cambridge (2010). *Carbon Management Plan 2010-2020* [online]. Available at: https://www.environment.admin.cam.ac.uk/files/carbon-management-plan.pdf.

	windows rather than turning down the heat; using dishwashers when they are not full; etc.. Small changes to behaviour like removing screen savers, adjusting radiators appropriately and turning off the lights could make a huge difference. These measures, if implemented correctly, could provide energy savings at a minimal cost, though the uncertainty surrounding human behaviour suggests they should be implemented alongside other measures. *External initiatives:* Penn State University hopes to develop and implement educational programmes that focus on occupant behaviour modification to reduce electricity consumption in campus buildings. Penn State is currently working to design training packages for building staff and occupants, materials for use during New Student Orientation, and education and management programmes (such as staff and student Eco-Rep programmes).
11. *Information and Communication Campaigns*	Information and communication campaigns around energy conservation could target a wide number of people, survey participants suggest. *External initiatives:* At the University of Adelaide[22] students in rented accommodation receive Ecoversity building user guides to inform them of how to use the building to maximise energy efficiency.
12. *Compulsory Annual Training for UCC Staff*	*UCC context:* Many survey participants feel that the compulsory aspect of this measure could prove counter-productive and reduce buy-in from the community. On the other hand, this sort of measure may prove necessary in order to engage those who wouldn't normally engage. The benefits of implementing such a measure may outweigh the costs, as relying on volunteerism will not result in change, however force may prove counterproductive. Persuasion is the best option. *External initiatives:* The LSHTM aims to incorporate energy (and sustainability awareness) training into Staff Development Plans. This rolling programme will be similar to others like equality and diversity training for staff.
13. *University-Wide Module on Energy Efficiency Within UCC*	*UCC context:* A university-wide module on "*Understanding Our Climate Impact*" within UCC, similar to the university-wide module on sustainability, could prove useful as a stand-alone module or perhaps as material which can be incorporated into already-established university-

[22] University of Adelaide (n.d.). *Campus Sustainability Plan (2016-2020)* [online]. Available at: https://www.adelaide.edu.au/ecoversity/ua/media/501/campus-sustainability-plan.pdf

	wide modules. Issues may arise with attracting those "already interested" in environmental matters as opposed to those who have never experienced this sort of material before.
14. *Integration of Educational Materials on Energy Efficiency into the UCC Connected Curriculum*	*UCC context:* Integration of materials on energy-efficiency, climate action, and the UN Sustainable Development Goals, into the UCC Connected Curriculum could prove a useful, non-forceful measure for encouraging engagement with climate action through persuasion and education.
15. *Blended Teaching and Learning*	*UCC context:* A mixture of online classes and face-to-face teaching will likely be required in the wake of Covid-19 anyway, however this could also prove useful for reducing energy consumption on the UCC campus.
16. *Optimising Space Utilisation*	*UCC context:* Survey participants would like to see research conducted into space utilisation across campus and contrasted with information on space capacity. This research could potentially inform space and room allocation within the university. Inefficient rooms could then be retired for certain purposes, or entirely, and more energy-efficient rooms used when campus occupancy is low. Changes to the Room Booking System may be required as part of this measure. *External initiatives:* The University of Cambridge aims to increase utilisation of lecture rooms and theatres by 5% year-on-year through conducting regular surveys to promote better utilisation of space across campus.
17. *Repurposing Buildings*	*UCC context:* If marketed correctly, there may be an option to request that staff move their office to more energy-efficient buildings during the summer months so that less efficient buildings could be closed during that period. The "summer offices" would likely comprise classrooms which are set up to allow for staff to work effectively. Also, used in conjunction with a WFH policy, the closure of entire buildings for certain days/months during the year, particularly winter, or a reduction in winter operating hours (e.g. 10am-4pm) could result in energy savings for the university. *External initiatives:* The LSHTM uses their Space Heating Policy to outline heating provision, control and building classification, such as official opening hours of different buildings.

4.2 Energy Supplies

UCC aims to not only reduce its energy consumption as part of the Climate Action Plan, but to also continue to increase the proportion of its energy derived from renewable resources. Though it is expected that the greening of the national grid will naturally help in lowering the university's greenhouse gas emissions over time, UCC aims to be proactive in this challenge by obtaining greater control over where the university's energy is derived. The measures identified aim to reduce the amount of energy lost by the university each year through energy recovery measures, namely exploring and investing in "green energy" and optimising existing energy supplies (Table 3).

Table 3: Potential measures associated with renewable energy and energy recovery.

Scope 1 and 2 Emissions	
Renewable Energy and Energy Recovery	
18. Investment in Green Energy	*UCC context:* The idea of investing in off-campus green energy projects *e.g.* wind farm, in collaboration with another university e.g. CIT/MTU, has been suggested as a means of lowering UCC's greenhouse gas emissions whereby on-campus green energy production is not feasible.
19. Voltage Optimisation	*External initiatives:* De Montfort University[23] estimate that a voltage reduction project would result in a saving of 719 tCO_2e for the university. The University of Ulster[24] also mentions a project to reduce electrical supply voltage which would result in an energy saving of *c.* 81 tCO_2e and cumulative savings of over £200,000 over a number of years. The University of York[25] estimates a saving of 616 tCO_2e following voltage optimisation.
20. HV Transformer Replacements	*External initiatives:* The Edinburgh Campus of Heriot-Watt University is served by a private 11kV distribution network, which includes more than 15 sub-stations housing more than 20 high voltage transformers. Many of the transformers are *c. 45* years old. Transformers of this age are associated with significantly larger load losses than modern equivalents, and replacement provides an opportunity to reduce these electricity

[23] De Montfort University (2011). *Carbon Management Plan* [online]. Available at: https://www.dmu.ac.uk/documents/about-dmu-documents/dmu-estate/environmental/dmu-carbon-management-plan.pdf

[24] University of Ulster (n.d.). *Carbon Management Plan 2010/11 – 2020/21* [online]. Available at: https://www.ulster.ac.uk/__data/assets/pdf_file/0016/107008/Carbon-Management-Plan.pdf

[25] University of York (2011). *Carbon Management Plan 2011-2020* [online]. Available at: https://www.york.ac.uk/media/abouttheuniversity/governanceandmanagement/documents/University%20of%20York%20Carbon%20Mgt%20Plan.pdf

	losses while modernising the electrical infrastructure of the Campus. They estimate an annual saving of 185-250 tCO_2e as a result of this action.
21. Alternative On-Campus Energy Sources	*UCC context:* Survey participants were in support of UCC's investment in the production of on-site renewable energy, who felt that the Initial costs and embodied GHG emissions should not be used as an argument against investing in technology that will pay back in the form of money and energy savings. Investing in larger-scale renewables may be more effective than installing solar panels on the roofs simply because there's a grant to do it. *External initiatives:* UNH is currently exploring the use of solar energy, as well as a wood chip/bioreactor, heating system. Penn State aims to investigate the use of photo-voltaic panels on roofs, micro-wind turbines on campus and the installation of a hydrogen fuelling station on campus. Both Boston University and Penn State mention Renewable Energy Certificates in their CAPs, ranging from the production of renewable energy on-campus to the purchase of certified offsets. Trinity College Dublin[26] have installed a number of solar water heating panels on roods across the university and DCU[27] are aiming to do this in future. De Montfort University estimates that the installation of PV arrays on the roofs of a number of campus buildings will reduce the university's carbon emissions by approximately 90 tCO_2e per year and produce an energy saving of *c.* £33,367 per year at 2018 rates. The University of Ulster installed an 800 KW wind turbine at their Coleraine Campus in 2008 which produces about 1.6 GWh of renewable electricity each year, amounting to 23% of the electricity used on the campus. UBC and the University of Cambridge have biomass boilers. The University of Gloucestershire[28] aims to double the quantity of electricity produced from renewable sources including solar PV, solar thermal, air source and ground source heat pumps.

[26] Trinity College Dublin (2017). *Sustainability Report 2017: From Small Steps to Giant Leaps* [online]. Available at: https://www.tcd.ie/provost/sustainability/assets/reports/TCD%202017%20Sustainability%20Report%20(Final).pdf

[27] Dublin City University (2019). *Sustainability Charter and Climate Action Plan 2019-2022* [online]. Available at: https://www.dcu.ie/sites/default/files/ocoo/docs/dcu_climate_action_plan_2019_v2.7.pdf

[28] University of Gloucestershire (2018). *Carbon Management Plan 2018-2022* [online]. Available at: https://www.glos.ac.uk/docs/download/Sustainability/Carbon-Management-Plan.pdf

5 Addressing our 'indirect' emissions

5.1 Introduction

5.1.1 Context

Scope 3 emissions currently make up the majority of the UCC 2017/18 carbon footprint at 55%, more than both Scope 1 and 2 emissions combined (see Figure 1) on page 9. Despite the fact that Scope 3 emissions often make up a significant portion of an organisation's carbon footprint, reporting on these emissions is not compulsory. This is largely due to difficulty in their calculation as a result of multiple different calculation methods, unreliable data, as well as issues with establishing calculation boundaries. UCC recognises the importance of providing a fair and representative image of the university's carbon footprint, and so has continually strived to refine the university's GHG inventory to include all significant Scope 3 emissions. In this document we aim to address these indirect emissions by identifying measures which will help to lessen the environmental burden produced by sources of GHGs outside of UCC's direct control.

5.1.2 Objectives

The main objective of this section is to identify measures which will address the university's "indirect" Scope 3 greenhouse gas emissions. These measures should:

- Be cost-effective and feasible to implement;
- Provide the university with greater "control" over the amount of indirect emissions produced through university activities;
- Engage the UCC community on the issue to Climate Action and enhance campus life.

5.2 Campus life

UCC aims to promote both the health and wellbeing of its staff and students while also encouraging care for the environment. The university aims to strive for a happy and productive workplace where both parties are supported and encouraged to reach their full potential during their time on campus. One of the ways in which this can be achieved is by advocating for heathier food choices, which will not only contribute to minding the physical health of those on campus, but the mental and emotional health also. A number of sustainable food initiatives have already been developed and trialled within UCC which have been positively received by the university community. Understanding the importance of healthy food choices and its intrinsic link with environmental health, the university aims to promote

the provision of sustainable, low-carbon food choices on campus, with a particular focus on locally-sourced food (Table 4).

Table 4: Potential measures associated with campus life

Scope 3 Emissions	
Campus Life	
22. Low-Carbon Food Options	*UCC context:* Participants would like to see consideration given to the greenhouse gas emissions arising from the food sold on the UCC campus and hope that the university will aim to focus on creating low-carbon food choices for staff and students. Staff and students would like to see low-carbon food menus developed for dining areas across campus. Carbon ratings could be included next to food choices on menus if possible and a "Climate Friendly" meal option incentivised. There could be an overall reduction in the amount of animal products sold on campus, with vegetarian/vegan meals being subsidised by higher cost meat options. Serving sizes could also be reduced to limit food waste. UCC could aim to someday become a meat-free campus, however this measure would likely result in a lot of controversy, so marketing it in a less forceful way may be better at this time *e.g.,* only selling white meat (banning red meat options) or introducing Meatless Mondays to campus every Monday. Local, seasonal food produce should be encouraged on campus.

5.3 Procurement

Procurement represents approximately 19% of UCC's greenhouse gas emissions, based on the calculation methods adopted as part of estimating the university's supply-chain emissions for the first time. It is strongly suspected that this is a significant underestimate, and that further detail is required on UCC's procurement activities, as well as a breakdown of materials from Capital Projects suppliers, in order to obtain a true, representative image of UCC's supply-chain emissions. As a large organisation, it is natural for the university to procure a significant number of goods and services, with far-reaching implications for sustainability. As such, procurement provides an area of great opportunity for the university to reduce its environmental footprint, by committing to "green procurement" with a focus on environmentally, ethically and socially-conscious purchasing practices. A number of potential measures have been identified which will allow the UCC Procurement Office to continue its efforts, in collaboration with the schools and colleges, to reduce unnecessary purchasing, minimise the production of waste, and increase the number of environmentally-friendly products brought to campus. UCC will aim to advance campus sustainability through a reduction in spend on particular carbon-intensive goods and services; promoting "green" purchasing choices; increasing

supplier sustainability requirements (where possible); and conducting more detailed analyses of high-emission goods and services, among other measures (Tables 5 and 6).

5.3.1 Goods and services

Table 5: Potential measures associated with the procurement of goods and services.

Scope 3 Emissions	
Procurement of Goods and Services	
23. Reduction in Cleaning Services	*UCC context:* Changes could be made to UCC's procurement of cleaning services such as cleaning less often, taking out bins less frequently, etc. could reduce GHG emissions estimated to stem from spend on cleaning services.
24. Reduction in Spend on Laboratory Animals	*UCC context:* High GHG emission are estimated to stem from spend on laboratory animals for use in UCC. A reduction in purchases of laboratory animals would reduce UCC's procurement emissions.
25. Better Handling of Laboratory Glassware	*UCC context:* Better care taken of laboratory glassware and plasticware would result in less breakages and need for replacements. A system could potentially be established for sharing laboratory glassware between various labs so that all new ware is not purchased unnecessarily.
26. Procurement Bans	*External initiatives:* DCU is proposing a procurement ban on all single use plastics (catering) from all departments and balloons (including helium and biodegradable) for decorative purposes.
27. Tender Actions	*External initiatives:* DCU hopes to introduce a voluntary clause, in the first instance, in all tender actions/large orders to include a validated carbon footprint of the product/service (across Scopes 1, 2 and 3 emissions) with immediate, mandatory effect where the order is over €500,000 and advised where the order is under €500,000 until it becomes mandatory in 2022.
28. Energy-Smart Purchasing	*External initiatives:* UNH currently offers purchasing training to new employees and those changing to positions that require them to make purchases for the department or the institution. Part of the training includes a discussion and handout on purchasing "Energy Star" equipment. The training materials are supposed to be updated to include additional information on other ways to save energy through buying decisions.
29. EPEAT Purchasing Policy	*External initiatives:* UNH aims to liaise with the UNH IT and Purchasing departments to formally adopt an institution-wide stated preference to purchase computers and/or other electronic products that are EPEAT

	registered or meet similar multi-criteria sustainability standards for electronic products. EPEAT is a comprehensive global environmental rating system that helps purchasers identify greener computers and other electronics and is run by the Green Electronics Council.
30. EcoCat Vehicle Selection Calculator	*External initiatives:* UNH introduced the calculator in 2013 to provide a standard life-cycle cost and emission evaluation of select vehicles for UNH purchase.
31. Increased Research Budget Flexibility	*UCC context:* Survey participants generally agreed that budget constraints and inflexibility of research projects can force Principal Investigators to prioritise lower prices over the sustainability of a product/service. Participants suggest that it may be worth approaching research funders to include sustainability of research projects as a criteria in funding applications and project reporting, as most funders are flexible once a change is cleared in advance and strong justification provided supporting the decision.
32. Sharing Platform	*UCC context:* Survey participants agreed that UCC could potentially develop a platform whereby sharing of certain products and equipment are encouraged between departments e.g. office furniture, laboratory equipment, chemicals, etc. Rewards included in this sort of scheme would encourage uptake.
33. Introduction of "Sustainability Standards"	*UCC context:* All participants agreed that the college could introduce sustainability standards for products and services to nudge procurement decisions. There could be significant opportunity for introducing sustainability standards for companies tendering for multi-year contracts for services like cleaning and catering, perhaps through starting off these measures working with the products/services with the highest impact e.g. energy, transport, food.
34. Increase in Bulk Orders	*UCC context:* Participants agree that bulk orders would reduce emissions from the transport of goods, and could be particularly useful for chemical and gas orders. As commonality exists between a number of UCC departments and their purchases, a wide-scale study could identify purchasing overlaps between departments and allow for bulk ordering.
35. Supplier Requirements for Carbon Footprint Estimation	*UCC context:* Survey participants believe that it may be useful for UCC to request that the suppliers of goods and services to the university provide information on the carbon footprint associated with their good/service. However, thought would need to be given to how to avoid UCC taking on the burden of these calculations, making sure that suppliers can be

	trusted to provide an accurate assessment instead of cheating the system due to a lack of national/international guidelines on how to calculate supply chain emissions. Participants believe that UCC could develop its own protocol for reporting of GHG emissions which suppliers can follow in order to ensure honest reporting to the university.

5.3.2 Capital projects

Table 6: Potential measures associated with capital projects.

Scope 3 Emissions	
Capital Projects	
36. Detailed Construction Procurement	*UCC context:* Contractors could be surveyed for information on how much of the bill presented to UCC represents various materials/cement in order to obtain a better estimate of our emissions stemming from cement alone. These may be significant.
37. Life Cycle Analysis (LCA) of Suspected High-Emissions Goods/Services	*UCC context:* A life cycle analysis could be conducted on some of UCC's highest-emitting procurement categories, for example, construction. This would allow for more detailed reporting than is currently possible with EEIO analysis. *External initiatives:* The University of Gloucestershire proposes in its CAP to conduct life cycle costing for energy and carbon for new equipment and buildings.

5.4 Business travel

Staff business and student academic travel account for roughly 15% of the UCC carbon footprint. The highest emissions stem from the use of air travel by both staff and students, particularly the use of long haul/international flights. As an island nation, it is understandable that UCC's travel emissions will be higher than that of a similar university situated on continental Europe, however it is imperative that the university address its travel emissions regardless, with the goal of minimising the emissions resulting from business and academic travel while continuing to effectively build and maintain relationships with organisations and individuals throughout the globe. Measures identified as part of the Climate Action Plan aim to encourage and incentivise the use of low-carbon modes of transport for business travel, where possible; promote the use of videoconferencing and increase investment in these facilities; employ the use of carbon credits and carbon offsetting programmes where appropriate (Table 7).

5.4.1 Travel action plan

Table 7: Potential measures associated with reducing, refining and replacing business travel.

Scope 3 Emissions	
Reducing, Refining and Replacing Business Travel	
38. Carbon Budget /Carbon Credits Programme	*UCC context:* The introduction of a carbon budget or credits programme to the various UCC departments could prove effective at curbing emissions from staff academic travel[29]. These programmes may be developed at the project or individual researcher level, but either way would ideally give all researchers, regardless of stage, equal opportunity to travel and enhance their careers. Opportunities could also be created for researchers to be able to buy extra carbon credits or swap them with other researchers, though this may prove complicated as it would essentially represent swapping budgets between project accounts. Departments could require proposals from researchers as to why they should be allowed to travel to a particular conference/meeting given the emissions travelling there would produce. *External initiatives:* WWF[30] has an "emissions pot" that is divided up between the departments and which is reduced year on year. Each department submits a request each year with a forecast of the flights they expect to take for the year ahead. Key Travel is used, as well as a spreadsheet, to track emissions. All employees can look at the spreadsheet throughout the year to see how much of the budget has been used and how much is left. All emissions from employees are accounted for, regardless of whether the organisation itself paid for the flights or not.
39. Virtual Attendance at Meetings and Conferences	*UCC context:* Survey participants recognise virtual attendance at meetings and conferences as an essential measure which will need to be encouraged among UCC staff and students. Covid19 has highlighted how lacking many of the resources used for these purposes still are. Microsoft Teams is currently in use by many staff members across campus, though survey participants encourage greater investment in this and similar resources and further exploration of ways in which they can be used to the advantage of staff at the university.

[29] Care would need to be taken to ensure that any such programme acknowledges and takes account of the impacts such an approach would have on different segement of our staff (see also #41 below)

[30] WWF (2011). *WWF-UK Policy Position Statement on Business Travel* [online]. Available at: http://assets.wwf.org.uk/downloads/business_travel_ps_0709.pdf

	External initiatives: The University of Bedfordshire[31] estimates that their project to promote the use of video conferencing in place of staff conference travel will result in annual savings of £60,000 and 38.2 tCO_2e.
40. Land Travel Policy	*UCC context:* Participants have suggested that UCC could charge more to grants or reimburse less to staff for travel choices where significantly less carbon-intensive and efficient travel options exist in order to encourage staff to travel more via public transport, where possible. It may be an option for staff to be reimbursed less on car mileage for example, and the difference used to offset emissions generated. Participants would like to see UCC promote the use of sea and surface travel among researchers, while making air travel less appealing. UCC already has a policy requiring staff to travel to Dublin via public transport, which could potentially be rolled out for other areas across the country also. This measure would have to take into account recent restrictions introduced in response to the Covid19 pandemic, as well as acknowledging the lack of efficient public transport in Ireland. *External initiatives:* The University of Cambridge operates a University Travel Policy requiring staff to use public transport (rather than claim mileage) where there is a direct service.
41. Employee Air Travel Policy	*UCC context:* An air travel policy could ideally aim to reduce the number of flights taken by staff, or seek to mitigate the emissions resulting from flights that must take place. An air travel policy like such could encourage longer individual trips over several short, carbon-intensive trips, or encourage staff to attend conferences with a particular ratio of flight duration : time spent at the conference. Where travel cannot be avoided and a flight must be taken, researchers could be encouraged to take another less carbon-intensive mode of transport as part of their journey (rather than flying direct), within reasonable time constraints. It must be acknowledged that this sort of measure would likely impact researchers differently based on their stage of career and gender, and effort would be required as part of the implementation of such a measure to ensure that no member of staff is discriminated against based on these attributes. *External initiatives:* UNH has established an Employee Air Travel Policy whereby before any faculty or staff member travels for work they should

[31] University of Bedfordshire (2012). *Carbon Management Plan 2012-2020* [online]. Available at: https://www.beds.ac.uk/media/125348/carbon-management-plan-2012-2020.pdf [accessed 22 September 2020].

	a) see if they can participate remotely instead of in person, b) if they must participate in person, see if the conference or event is less than 100 miles from campus and, if so, be required to take public transport or carpool instead of flying, and c) if they must fly they should consider donating money to UNH's Energy Efficiency Fund as a travel "offset" for the emissions emitted by their flight. Penn State.
42. Recording of Travel Routes	*UCC context:* Staff and students who travel abroad for academic study could be required to give travel details to their departments to aid in the calculation of future carbon footprints.
43. Carbon Offsetting	*UCC context:* Carbon offsetting could take place on top of other measures which ideally aim to reduce emissions from commuting and travel. Survey participants believe that any offsetting programme introduced to UCC would need to be auditable, ideally focusing on carbon sequestration. Participants have also identified that there is potential too for UCC to found its own offsetting programme through collaboration with national bodies like Coillte and Bord Na Móna using sequestration technology and work on bog restoration initiatives. Offsetting via tree planting is convenient but temporary where UCC could focus on more permanent carbon storage e.g. bog restoration, investment in disruptive carbon capture material technology. Any offsetting programme introduced would need to be able to demonstrate that it is offsetting higher levels of carbon than is accounted for by UCC. *External initiatives:* Penn State University operates a carbon offset programme wherein carbon emissions generated by university-sponsored air travel are offset by donations from travellers into a fund used to renovate and weatherise local Penn-owned apartment buildings.
44. Policy Changes	*UCC context:* Changes brought in at a policy level to ensure that researchers aren't disadvantaged for not choosing to fly and increase their carbon footprint would require UCC lobbying funding bodies e.g. EPA, to ensure that physical attendance at conferences and meetings is no longer seen as a key deliverable of a project, but virtual attendance is also considered. Funding frameworks would need to be more flexible so that money could be moved between cost categories more easily to get rid of the pressure to travel in order to use up a budget entirely.
45. Meeting Agendas	*UCC context:* All meetings (whether virtual or face-to-face) could have a proposed agenda developed in advance so that meetings are considered

	to have a purpose and time is not wasted. This measure, though simple, could lead many to reconsider how much they need to discuss and whether travel is justified or not.

5.5 Commuting

Commuting accounts for approximately 20% of UCC's greenhouse gas emissions, the vast majority of which can be attributed to emissions from the use of cars by both staff and students for commuting to and from the UCC campus. UCC's Climate Action Plan will adopt a holistic approach to transportation, rather than retaining a focus on primarily reducing single-occupancy vehicles to campus. A variety of programmes and initiatives have been identified in order to increase the number of staff and students choosing sustainable commuting options which are both efficient and safe. These potential measures include promoting the use of local, low-carbon, public transport over private vehicles; prioritising safe cycling and facilities, and encouraging the development of cycling infrastructure in and around the UCC campus; and adopting an official Work-From-Home policy for UCC staff (Tables 8, 9, 10, 11 and 12).

5.5.1 Public Transport

Table 8: Potential measures associated with the use of public transport.

Scope 3 Emissions	
Public Transport	
46. Increased Use of Public Transport	*UCC context:* Participants would like to see greater efforts made by UCC to advertise and encourage the use of Leap Cards among students, perhaps by lowering the price again, and would also encourage the exploration of rebates for staff and students who regularly use public transport. Survey participants realise that UCC is not completely responsible for improving public transport opportunities for the people of Cork, but the university could aim to lead the way in exploring new and exciting measures in the hopes that the city will follow. *External initiatives:* Penn State says in their CAP that they aim to create a partnership with SEPTA (South-eastern Pennsylvania Transportation Authority) to allow students to use university identity cards as SEPTA passes, etc.

5.5.2 Cycling

Table 9: Potential measures associated with cycling.

Scope 3 Emissions	
Cycling	
47. Promotion of Cycling	*UCC context:* Participants would like to see better cycling infrastructure installed on the UCC campus, including facilities such as lockers, shower facilities and bike stands close to offices and big buildings. They would also like to see the introduction of a bike rental scheme which can be rolled out to both staff and students. Cycling could be promoted among UCC members through cycle-safety workshops for incoming students. While participants realise that UCC alone cannot be responsible for the introduction of proper cycling infrastructure within the city (e.g. separated cycle lane from train station to campus, etc.), they rightly point out that the university has huge potential for working with the city council to develop this infrastructure. *External initiatives:* The University of Adelaide conducted cycle-safety workshops for staff and students with the aim of improving confidence among university members who would like to cycle but may lack the confidence in their ability to stay safe on the roads. The University of Cambridge operates a staff "Pool Bike" scheme for short inter-site visits to reduce vehicle movements.

5.5.3 Car-pooling

Table 10: Potential measures associated with car-pooling.

Scope 3 Emissions	
Car-Pooling	
48. Car-Pooling App	*UCC context:* Participants would like to see student carpooling incentivised more, perhaps through the development of a carpooling app. *External initiatives:* UNH and the University of Cambridge have introduced Zipcar, the world's largest car sharing and car club service, in order to promote carpooling to campus. DCU is also planning to work with Sharo to develop and implement a car sharing app across all campuses which they estimate will reduce the number of cars to campus by 5-10%.
49. Changes to Parking Policies	*UCC context:* Participants would like to see parking in UCC charged at the commercial rate for staff and students as they perceive that the free parking currently in place only incentivises driving. It may also be useful

	to guarantee staff parking on certain days in exchange for the use of public transport other days of the week.

5.5.4 Work from home

Table 11: Potential measures associated with working from home.

Scope 3 Emissions	
Working From Home	
50. Working From Home Policy	*UCC context:* Staff generally support the implementation of a Work-From-Home (WFH) policy which would both allow for greater flexibility and a healthier work-life balance and contribute to a reduction in UCC's greenhouse gas emissions stemming from heating and electricity usage, not to mention staff commuting. Staff would like to see a WFH policy set up whereby WFH is required of all office staff for a minimum of one day per week, according to a set schedule, should the staff member's home resources allow for effective WFH. Issues with WIFI and lack of access to UCC systems would need to be considered during the WFH policy design, as this measure may not be possible for all staff due to these issues. *External initiatives:* UNH put in place a new Workplace Flexibility policy for staff whereby staff can meet with their supervisors to discuss the appropriateness of several types of workplace flexibility depending on their position and type of work: compressed work week, flex-time, part-time/reduced time, flex-year, and teleworking/remote work.
51. Hot-Desking	*UCC context:* Used in conjunction with a WFH policy, hot desking could work well if conducted in more energy-efficient buildings.

5.5.5 Greening the park and ride

Table 12: Potential measures associated with greening the Park & Ride.

Scope 3 Emissions	
Greening the Park & Ride	
52. Park & Cycle Scheme	*UCC context:* Survey participants felt that establishing a Park & Cycle scheme may encourage people to cycle more but wouldn't have a huge impact on UCC's overall emissions. If bike stations were set up near the UCC Park & Ride pickup points it could potentially encourage people to cycle into the city rather than drive.

	External initiatives: The University of Cambridge operates a 'Park & Cycle" scheme similar to UCC's "Park & Ride" which encourages drivers not to drive into the city centre to park.
53. *Introduction of Charges for the UCC Park & Ride Scheme*	*UCC context:* Introduction of charges for non-UCC members to use the university's Park & Ride bus could be used to encourage the use of public transport among the wider community, not just UCC members. *External initiatives:* UNH's Wildcat transit system is free to any UNH ID holder and $1.50 for the general public to use. Boston University is aiming to upgrade the GPS system and mobile app for their BU Shuttle so that it provides closer to real-time information that can help potential passengers make the decision to wait, walk or use some other mode of transportation (e.g. cycling).

5.6 Waste

Emissions from waste account for less than 1% of the total UCC carbon footprint. The university currently collects 6 different types of speciality waste: general waste; mixed dry recycling; food; glass; cardboard; and WEEE. UCC's waste management practices are based on reduce, reuse and recycling principles, which the university acknowledges depends on an active partnership with the UCC Procurement Office to minimise the amount of new materials brought to campus. UCC aims to take a holistic approach to waste minimisation and diversion, adopting a life-cycle approach to the consideration of waste for large purchases, and heightening its standards of recycling and reusing existing materials. Potential measures identified as part of this approach, which may be implemented as part of the Climate Action Plan include widespread education on waste minimisation and division through a number of campaigns and workshops; increased use of reuse-and-deposit schemes; and the development of platforms for sharing common materials (e.g. laboratory glassware, furniture, etc.) throughout the university (Table 13).

Table 13: Potential measures associated with waste reduction.

Scope 3 Emissions	
Waste Reduction	
54. Proper Bin Use	*UCC context:* Participants believe efforts made to educate the UCC community on correct bin use would be useful for tackling waste issues at UCC. A greater number of compost bins could be made available on campus, though an overall reduction in the number of bins, particularly in offices would ideally be achieved. A greater push would need to be made

	to educate people on how to use bin categories correctly, while also making the infrastructure available for them. Recycling bins for batteries and mobile phones could also be placed in certain areas, like the library.
55. *Less Availability of Compostable Materials*	*UCC context:* UCC could aim to promote "dining in" with proper cutlery and plates, mugs, etc., and encouraging the use of more sustainable materials like metal, rather than increasing the amount of compostable material available on campus, which carry their own carbon footprint.
56. *Cigarette Litter Campaign*	*UCC context:* A cigarette litter campaign could be run whereby designated clear bins are established as part of a competition each month that encourages students who smoke and would otherwise litter their cigarettes to place them in the bin e.g. who is a better soccer player: Messi or Ronaldo? At the end of the week the bin with the most votes would be identified. This may be a fun way to get people to engage with waste reduction measures.
57. *Trash-2-Treasure Programme/Reuse and Deposit Schemes*	*UCC context:* A Trash-2-Treasure programme could be established in UCC whereby materials are collected from international students at the end of term which could then be passed on to future students – a reuse and deposit scheme of sorts. *External initiatives:* UNH's Trash-2-Treasure is a student-led waste reduction programme that aims to give a second life to the furniture, clothing and household items left behind by students at the end of each academic year. All the materials are placed in storage over the summer and then sold back to students at a discounted rate at the start of the fall semester.
58. *Move to Online/Digital Advertising*	Digital advertising could be promoted in place of paper, as is now being done with the UCC thesis submission. Electronic submission of assignments and FYPs, etc. could be promoted in place of paper, and recycled paper used where paper use is absolutely necessary.
59. *Composting Programme*	*UCC context:* UCC could potentially develop its own composting programme for compostable cups, plates, etc. sold on campus or at UCC balls and events. These could be collected as part of UCC's composting system to ensure that they don't contaminate other bins. *External initiatives:* UNH has its own composting programme whereby food waste from the university can be composted on campus.

60. *Furniture-Sharing App*	*UCC context:* UCC could develop a website or app whereby departments can put up furniture or property not in use and sell or donate it to other departments.
61. *RecycleMania Competition*	*UCC context:* A campaign could be launched encouraging friendly competition with another university to see who has better recycling rates over a given period of time.
62. *Introduction of Edible Cups to Campus*	*External initiatives:* Edible cups have been trialled at Air New Zealand and could potentially be introduced to the UCC campus.
63. *Soft Plastic Recycling*	*UCC context:* Participants were supportive of installing a soft plastic recycling system at UCC or engaging with this type of recycling off campus. *External initiatives:* The University of Newcastle, Australia[32] is currently part of a pilot programme, Bags to Benches, which aims to turn soft plastic into benches.
64. *Workshops Against Waste*	*UCC context:* Similar to the cycling safety workshops mentioned previously, cooking classes and sewing/knitting and "Sustainable Food Shopping in Cork" workshops could be a useful measure to implement in order to teach first year students basic skills which many lack and can lead to the promotion of many types of waste and unsustainable behaviours. *External initiatives:* University of Newcastle, Australia found that "a lack of cooking skills in residents transitioning to living out of home for the first time was a significant barrier to minimise food waste. A professional chef ran two cooking workshops to show students how to plan healthy and budget-friendly meals, manage portion size and store food correctly".
65. *Laboratory Waste*	*UCC context:* Laboratories produce vast quantities of disposable waste each year which will need to be tackled and reduced.
66. *Discouraging Takeaway Packaging*	*UCC context:* Discouraging the use of takeaway packaging through charges for the use of disposables may prove more effective than an outright ban as consideration needs to be given to visitors to the campus. People could be encouraged to bring/use the reusable lunchboxes being introduced to campus in order to take out food. A designated wash facility could be provided for people to wash these lunchboxes.

[32] University of Newcastle Australia (n.d.) *Environmental Sustainability Plan 2019-2025* [online]. Available at: https://www.newcastle.edu.au/__data/assets/pdf_file/0010/536338/UON-ESP-2019-25-Final-2.pdf [accessed 22 September 2020].

5.7 Water

Water usage and treatment account for roughly 1% of all UCC's greenhouse gas emissions. The university recognises the environmental and societal impacts of water use and is fully committed to continually reducing its impact by meeting performance targets. As part of the Climate Action Plan UCC aims to reduce emissions stemming from water usage through water conservation measures, namely identifying leaks in the system which can be rectified; installing water metres to allow for accurate monitoring of the university's water usage; and making appropriate updates to existing water systems aimed at reducing unnecessary water usage (Table 14).

Table 14: Potential measures associated with water conservation.

Scope 3 Emissions	
Water Conservation	
67. Upgrades to Existing Water Systems	*UCC context:* Participants would like to see UCC replace all non-water-saving taps and toilets with water-efficient versions and invest in technology such as low-flow, pre-rinse spray nozzles. Rainwater harvesting and installing greywater recycling systems in newer buildings (and older ones if budgets allow) were suggested as potential measures for water conservation. Installing dual-flush or composting toilets and getting rid of water-based vacuum systems in laboratories would also make a difference. *External initiatives:* Greywater recycling is currently in place at the University of Ulster.
68. Installation of Water Metres	*UCC context:* Meters could be installed to effectively measure UCC's water consumption, as current measurements are not accurate.
69. Leak Detection Survey	*UCC context:* A survey could be conducted across campus to identify leaks and broken pipes in need of fixing.

6 Discussion

Large organisations are often major stakeholders in the promotion of sustainable development and have a hugely influential role to play in the fight against climate change. It is therefore vital that universities like UCC act now and aim to lead by example with regard to climate action. This discussion document outlines the work undertaken at UCC over the past year in order to provide an accurate estimate of the university's climate impact and to use this as a means of identifying GHG reduction opportunities which UCC can implement as part of its first Climate Action Plan.

Since the first UCC carbon footprint was calculated back in 2008/09, UCC has made many advances in the area of sustainability and has become rightly renowned as one of the world's "greenest" universities. The university has seen an overall reduction in Scope 1 and 2 emissions, those which it could be said are "within UCC's control". The increase seen in Scope 3 emissions between 2008/09 and 2017/18 cannot be attributed to one area or issue – it is simply a result of the inclusion of greater amounts and more detailed data, coupled with more complex calculation methods. Irrespective of increases or decreases, the carbon footprint provides a sufficient estimate of the university's greenhouse gas emissions output, showing the key sectors which need to be targeted by reduction measures.

The determination of UCC's carbon footprint for the 2017/18 academic year provided researchers with an opportunity to explore ideas for potential carbon-reduction measures through engagement with UCC staff and students. The structured dialogue exercise was a learning experience for all involved, with participants providing insight on challenges which are unique to life and work at UCC and opinions on potential climate action measures which would gain the support of the university community. These suggested measures are presented in Sections 4 and 5 (Tables 2 – 14), along with examples of similar measures implemented at other universities, identified following a review of Climate Action and similar Plans from universities and organisations across the globe. This desk-based research provided a number of unique ideas which could be presented to participants of the structured dialogue exercises, in order to gauge the level of support for a variety of actions. Furthermore, the review was extremely helpful in identifying measures which could potentially be extremely "cost effective", especially where other universities were able to provide an estimation of the greenhouse gas emissions or financial savings of implementing a particular measure, though this would need to be established specifically based on appropriate implementation within UCC's campus.

Many of the measures outlined in this discussion document – based on research looking at the type of actions implemented at other universities across the globe, as well as the responses provided by participants of the structured dialogue exercise – focus on addressing Scope 1 and 2 emissions, or those considered "within our control". While this is of course an essential task in lowering the university's greenhouse gas emissions output, the influence of Scope 3 emissions, or those generally seen as "outside our control", cannot be ignored. Accounting for *c*. 55% of the total carbon footprint, UCC has already acknowledged as part of its Sustainability Strategy that the university does in fact

have some level of control over these indirect emissions, though the level of influence differs depending on the emissions source in question. Addressing emissions arising from procurement, for example, could be considered within the university's control, as opposed to emissions resulting from student and staff commuting habits. Building on this point, some of the measures desired by panel participants could be categorised as "low-hanging fruit" with regard to the potential reduction opportunities which will have the greatest impact on reducing the UCC carbon footprint. Waste reduction measures, for example, have received significant attention in recent years and UCC has made huge progress in promoting a number of campaigns centred on this issue, yet waste currently only accounts for less than 1% of total greenhouse gas emissions.

While reductions in any source of emissions is a wonderful feat, if UCC is truly committed to making real and significant change to the university's carbon footprint the environmental impact of larger greenhouse gas sources, like capital projects, must be addressed. Construction and construction work alone are currently estimated to account for *c.* 11% of the total UCC carbon footprint, though without a more detailed inventory of construction materials data this number is regarded as a significant underestimate. A greater level of detail on construction materials used as part of these new builds is needed in order to gather an accurate estimate of GHG emissions associated with construction activities using the current methodology. Given the impact this area has on overall greenhouse gas emissions, the recommendation is made to refocus the UCC budget on space optimisation and building repurposing, rather than the construction of new buildings.

Over 35 courses relating to sustainability are currently offered at UCC, yet approximately 70% of panel participants felt that the pillars of sustainability are not equally integrated across all areas of work/study within UCC, and believe that many degree programmes may teach widely on one pillar and barely touch upon another. As an education institution, UCC has wonderful opportunity to encourage the behavioural change necessary to combat climate change through teaching and learning. Both formal and informal education on all aspects of sustainability, through both classroom teachings and engagement with sustainability activities outside the lecture halls will need to be employed in order to induce effective change. The measures included in this discussion document provide an opportunity not only for reducing our GHG emissions, but also for educating both students and staff on the role they play in enhancing all aspects of sustainability, in life both on and off campus. This will only be achieved once proper integration of change-inducing, sustainability-focused materials into the UCC Connected Curriculum has taken place, an activity which is ongoing.

As one of Ireland's leading research universities, with an active research community focused on a number of diverse aspects of sustainability, the measures outlined in the Climate Action Plan will undoubtedly impact upon research activities within UCC. In excess of €20m is secured by the university each year for research on environmental and sustainability topics, producing hundreds of research papers, patents and commercial applications annually. What effect the Covid-19 pandemic will have on this remains to be seen, but what is undeniably certain is the boundless opportunity the development of the UCC Climate Action Plan will offer the university for the identification of new

research topics. Collective effort will be needed from all researchers across the university to ensure that measures implemented as part of the Climate Action Plan only serve to further our efforts in becoming a more sustainable university, and do not negatively impact upon productivity. The Climate Action Plan will hopefully open up new research opportunities investigating many aspects of sustainability and reinforce UCC's reputation as a "living laboratory".

This discussion document would be incomplete unless the phenomenon that is "carbon offsetting" is addressed. This is a measure used by many universities worldwide to account for and reduce their greenhouse gas emissions, however UCC recognises the issues associated with carbon offsetting and ideally strives to avoid producing greenhouse gas emissions rather than offsetting them. Should this measure need to be employed, panel participants have stated the need for an auditable carbon offsetting programme which focuses on long-term carbon storage, which can be used in conjunction with other reduction measures.

Lastly, this study was initiated during a time which is very different to the one we currently live in, with the Covid-19 pandemic gaining momentum just as the second phase of the study, the identification of reduction measures, began. Covid-19 has resulted in dramatic changes to the way we conduct our daily lives and this will need to be acknowledged in the UCC Climate Action Plan and measures continually revised in light of growing knowledge on the coronavirus. It is expected that the Covid-19 pandemic will have an effect on all sectors of UCC's greenhouse gas emissions, namely electricity and natural gas usage, staff business travel, and both staff and student commuting, though it is not currently possible to predict whether the overall effect will be positive or negative for the university's net emissions output. Despite all the challenges which now present themselves, perhaps this time of change offers the chance to encourage dramatic changes in other aspects of life, including the way we treat the environment. The UCC Climate Action Plan could therefore be seen as an opportunity to not only "shake up the system" but to establish positive and lasting change for the future. It is hoped that this discussion document will allow us to take the first step towards this future.

7 Conclusion

While the world now has another challenge to contend with in the form of Covid-19, the threat from climate change remains and still requires immediate attention. This challenge, while daunting is not insurmountable. UCC recognises the influence it has as an organisation, locally, nationally and internationally, and the potential that exists for the university to lead the way in tackling climate change, while also setting an example which others can follow. As a "Living Laboratory", UCC is used to successfully addressing the major societal challenges of today through scholarship – the UCC Climate Action Plan will be the first step towards the start of a journey to address one of the most significant challenges to date.

This discussion document outlines potential measures which the university can implement to encourage improved environmental performance in the near and distant future. This is a direct result of research and discussions stretching over the past 12 months involving students, staff and faculty from all over the university. Here, we present an overview of the baseline climate impact for the 2017/18 academic year, covering all aspects of UCC's greenhouse gas emissions, from stationary combustion to water consumption, procurement to student society travel. Following participatory research with members of the UCC community and desk-based reviews of CAPs from around the world, we present a number of potential measures for reducing the university's climate impact. The following next steps are therefore proposed in order for the university to progress from this initial research stage to the development of a complete Climate Action Plan:

- **Outline which potential measures** suggested as part of this discussion document are most feasible and cost-effective to implement. A **cost-benefit analysis** would ideally be conducted to provide an estimate of the potential carbon savings resulting from the implementation of various measures at UCC.
- **Develop a timeframe** for the implementation of these measures, taking into account changes and flexibility which will be required in response to the ongoing Covid-19 pandemic.
- **Identify any financial constraints** which may impact upon the implementation of suitable measures.
- **Increase reporting of all GHG-producing activities** within the university, in order to **maintain and continually refine the UCC carbon footprint**, allowing for the identification of potential reduction opportunities in future.

While UCC has made significant advances in terms of sustainability over the years, this discussion document comes at a time when the world is quickly gaining a much deeper understanding of the urgency of the climate crisis we face. UCC has huge potential to be a leader with regard to climate action, and it is hoped that this discussion document will highlight this potential and provide the basis for the development of a bold and comprehensive Climate Action Plan.

Appendix 1 – Carbon Footprint: sources of data

Table 15: Data Collection Sources and Data Types for UCC carbon footprint study

GHG Producing Activity	Activity Subset	Data Collection Sources	Units
Stationary Combustion	Natural Gas	B&EO Energy Report 2017-18	MWh/year
	Liquid Fuel	N/A	Quantity of fuel/year
Mobile Combustion	UCC-owned vehicles	Finance Office	Quantity of fuel/year
Process Emissions		N/A	GHG emissions/year
Fugitive Emissions	Refrigerant leakage	N/A	GHG emissions/year
Purchased Electricity	Source fuel mix	B&EO Energy Report 2017-18	MWh/year
Employee Commuting	Car, Bus, Rail, Motorbike	B&EO 2017-18 Commuter Survey	Est. passenger km/year
Student Commuting	Car, Bus, Rail, Motorbike	B&EO 2017-18 Commuter Survey	Est. passenger km/year
Business Travel	Car, Bus, Rail, Motorbike, Plane, Ferry, Van	Finance Office	Est. passenger km/year
Academic Travel	Car, Bus, Rail, Motorbike, Plane, Ferry, Van	Departmental information	Est. passenger km/year
Club/Soc Travel	Car, Bus, Rail, Motorbike, Plane, Ferry, Van	Club/Soc information	Est. passenger km/year
Waste	Landfill, mixed dry recycling, food, glass, cardboard, WEEE	B&EO waste records 2017-18	Tonnes/year
Water	Supply, treatment	B&EO staff	M^3/year
Procurement		Finance Office	Euros (€)

Table 16: Emission Factors (and sources) used in the calculation of UCC's carbon footprint

	Activity	Activity Subset	Emission Factors	Source
Scope 1	Stationary Combustion	Natural Gas	200,648 g CO_2/MWh 18 g CH_4/MWh 0.4 g N_2O/MWh	EPA, 2017[33]
		Liquid Fuel	1,964 g CO_2/Litre 0.3 g CH_4/Litre 0.02 g N_2O/Litre	
	Mobile Combustion	Petrol	2,354 g CO_2/Litre 0.3 g CH_4/Litre 0.03 g N_2O/Litre	
		Diesel	2,683 g CO_2/Litre 0.003 g CH_4/Litre 0.1 g N_2O/Litre	

[33] Environmental Protection Agency (2017). Common Reporting Format tables 2017, electronic dataset. Available at: https://www.epa.ie/pubs/reports/air/airemissions/ghg/nir2017/

Scope 2	Purchased Electricity	Grid Average	436600 g CO_2/MWh 3.5 g CH_4/MWh 8.4 g N_2O/MWh	SEAI, 2017[34]; EPA, 2017
Scope 3	Commuting & Travel	Car (IRE)	144 g CO_2/passenger km	SEAI, 2018[35]; SEAI, 2014[36]; Carbon Tax brackets
		Car (UK)	121 g CO_2/passenger km	SMMT, 2018[37]
		Car (EU)	130 g CO_2/passenger km	European Commission
		Car (USA)	251 g CO_2/passenger km	US EPA
		Car hire (IRE)	114 g CO_2/passenger km	SEAI, 2018; SEAI, 2014; Carbon Tax brackets
		Bus	31 g CO_2/passenger km	Bus Eireann[38], 2017
		Rail (IRE)	61 g CO_2/passenger km	EPA, 2019[39]; Iarnrod Eireann, 2017[40]
		Rail (UK)	44 g CO_2e/passenger km	DEFRA, 2018[41]
		Rail (USA)	12 g CO_2e/passenger km	DEFRA, 2018
		Rail (EU)	12 g CO_2e/passenger km	DEFRA, 2018
		Ferry	113 g CO_2e/passenger km	DEFRA, 2018
		Truck/Van	257 g CO_2e/passenger km	DEFRA, 2018
		Motorbike	115 g CO_2e/passenger km	DEFRA, 2018
		Flight (domestic)	298 g CO_2e/passenger km	DEFRA, 2018
		Flight (short-haul)	162 g CO_2e/passenger km	DEFRA, 2018
		Flight (long-haul)	212 g CO_2e/passenger km	DEFRA, 2018

[34] Sustainable Energy Authority of Ireland. (2017). *Conversion Factors* [online]. Available at: https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/

[35] Sustainable Energy Authority of Ireland. (2018). *Energy In Ireland 2018 Report* [online]. Available at: https://www.seai.ie/publications/Energy-in-Ireland-2018.pdf

[36] Sustainable Energy Authority of Ireland. (2014). *Energy in Transport 2014 Report* [online]. Available at: https://www.seai.ie/publications/Energy-in-Transport-2014-report.pdf

[37] Society of Motor Manufacturers and Traders (SMMT). (2018). *UK average new car CO_2 emissions 1997-2018*, electronic dataset. Available at: https://www.smmt.co.uk/reports/co2-report/#:~:text=Average%20new%20car%20CO2,the%20average%20car%20in%20use.

[38] Bus Eireann. (2017). *Bus Eireann Annual Report 2017* [online]. Available at: https://www.buseireann.ie/pdf/1527845678-Bus-Eireann-Annual-Report-2017.pdf

[39] Environmental Protection Agency. (2019). *Ireland's Final Greenhouse Gas Emissions 1990-2017* [online]. Available at: https://www.epa.ie/pubs/reports/air/airemissions/ghgemissions2017/Report_GHG%201990-2017%20April%202019_Website.pdf

[40] Iarnrod Eireann. (2017). *Iarnrod Eireann Annual Report 2017* [online]. Available at: https://www.irishrail.ie/IrishRail/media/Imported/2017-iarnrod-eireann-annual-report.pdf [accessed 20 November 2019].

[41] Department for Environment, Food & Rural Affairs. (2018). *Conversion Factors 2018 – Full set (for advanced users)*, electronic dataset. Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018

		Flight (international)	183 g CO_2e/passenger km	DEFRA, 2018
	Waste	Landfill	9 g CO_2e/kg	DEFRA, 2018
		Dry mixed recycling	21 g CO2/kg	DEFRA, 2018
		Food	10 g CO_2e/kg	DEFRA, 2018
		Glass	21 g CO_2e/kg	DEFRA, 2018
		Cardboard	21 g CO_2e/kg	DEFRA, 2018
		WEEE	21 g CO_2e/kg	DEFRA, 2018
	Water	Supply	344 g CO_2e/m^3	DEFRA, 2018
		Treatment	708 g CO_2e/m^3	DEFRA, 2018
	Procurement	NACE sectors	Various emission factors (in g CO_2e/€)	CSO[42]; OECD[43]

[42] Central Statistics Office (2015). *Table 9 2015 Symmetric Input-Output Table of domestic product flows at basic prices €m*, electronic dataset. Available at: https://www.cso.ie/en/releasesandpublications/ep/p-sauio/supplyanduseandinput-outputtablesforireland2015/

[43] Organisation for Economic Co-Operation and Development. (2020). *Air Emission Accounts – Ireland*, electronic dataset. Available at: https://stats.oecd.org/Index.aspx?DataSetCode=AIR_GHG

Appendix 2 – Carbon Footprint: method

Method

Table 1 in the discussion document methodology, Section 2, describes the operational boundary for the UCC carbon footprint study, which includes all components that would be expected in the mandatory Scopes 1 and 2. In addition, when selecting Scope 3 emissions, an inclusive approach was adopted in keeping with the objectives of the study, including the addition of new greenhouse gas-producing categories (club/society travel, procurement) to the carbon footprint calculation.

Stationary Combustion

Natural Gas Consumption

Natural gas consumption data was obtained from the B&E 2018 excel file on natural gas and electricity consumption (Table 15). The data covered the period from January-December 2018, rather than the 2017/18 academic year, but the researchers were advised that significant differences were not to be expected between the two periods. The significant energy users (main campus, lee maltings, Brookfield, western gateway, mardyke, ERI and north mall) were identified and all other energy users grouped into one category titled "other". The consumption data was converted to MWh/y for the analyses (Table 15).

Emission factors for CO_2, CH_4 and N_2O were calculated using data from the EPA's Common Reporting Format data file for 2017, a set of excel spreadsheets containing data that accompanies the EPA's annual National Inventory Reports (Table 16). The 2017 data file was the most current data that was available at the time of analysis. Further mathematical calculations on the EPA's data were required in order to produce emission factors in the format g GHG/MWh.

Liquid Fuel

Data on liquid fuel consumption, such as butane used in laboratories, was absent due to lack of records (Table 15).

While it is not considered to be a significant contributor to UCC's carbon footprint (less than 1%), data on this GHG-producing category has been included in previous carbon footprints conducted by UCC. For this reason, emission factors for CO_2, CH_4 and N_2O were calculated for this category through mathematical calculations using data from the EPA's Common Reporting Format data files for 2017, along with data on certain properties of butane gas provided through the SEAI (Table 16).

Mobile Combustion

Data on mobile combustion (UCC-owned vehicles) was obtained from data files provided through the Finance Office in the form of total spend on both petrol and diesel (Table 15). The total spend on both petrol and diesel (in €) were divided by the price per litre, taken to be €1.394/L for petrol and €1.298L

for diesel according to MyLPG.eu (https://www.mylpg.eu/stations/ireland/prices/). These rates were obtained by averaging the prices at the very start and end of 2018. The number of litres of both petrol and diesel used by UCC-owned vehicles during the 2017/18 academic year were therefore obtained (L/year).

Emission factors for CO_2, CH_4 and N_2O were obtained through mathematical calculations involving the EPA's Common Reporting Format data files for 2017 and information on certain properties of petrol/diesel obtained from the SEAI (Table 16).

Process Emissions

No data was obtained on process emissions arising within UCC (Table 15).

No emission factor was calculated as these emissions have not been included in previous carbon footprints (Table 16).

Fugitive Emissions

No data was obtained on fugitive emissions arising within UCC (Table 15).

No emission factor was calculated as these emissions have not been included in previous carbon footprints (Table 16).

Purchased Electricity

Electricity consumption data was obtained from the B&E 2018 excel file on natural gas and electricity consumption (Table 15). The data covered the period from January-December 2018 rather than the 2017/18 academic year, but the researchers were advised that significant differences were not to be expected between the two periods. The significant energy users (main campus, lee maltings, Brookfield, western gateway, mardyke, ERI and north mall) were identified and all other energy users grouped into one category titled "other". The data was converted to MWh/y for analyses.

A CO_2 emission factor for grid electricity for 2017 was obtained from the SEAI website. Emission factors for CH_4 and N_2O were calculated by researchers at the CPPU through mathematical calculations using data from the EPA's Common Reporting Format data files for 2017, based on the various types and percentages of fuels making up the national grid (coal = 18.3%, gas = 51%, oil = 0.8%, peat = 10.3%) (Table 16).

Employee and Student Commuting

Data on staff and student commuting patterns were obtained from the 2017-18 B&E Commuter Survey (Table 15). This survey asks participants to identify the primary mode of transport used to commute to UCC (e.g. car), as well as any secondary modes used throughout their typical commute (e.g. walk). For reasons of complexity and to avoid making too many assumptions, the primary mode of transport used by participants was taken into account in analyses, while other modes of transport

were not considered significant. The survey was used to estimate the number of passenger kilometres travelled by UCC staff and students via each mode of transport for the 2017/18 academic year (passenger km/year).

Various applications were used in order to estimate the distances travelled by UCC staff and students during their daily commute. For primary travel by both car and motorbike, Google Maps was used to obtain distances in km between various points of origin and destinations. For travel by both bus and rail, the website Rome2Rio was used for calculating distances between points of origin and destination (or the closest point to it). When numerous bus or train routes were available, the most straightforward or likely route taken was chosen for estimating distance travelled in kilometres.

Where a staff member or student had indicated in the survey that they had used a particular Park&Ride bus as part of their commute, the distance from the Park&Ride site to UCC was acknowledged as a secondary mode of transport for which an exact distance could be calculated. For this reason, journeys via UCC's Park&Ride service were included in the calculations.

Where it was indicated in the survey that the staff member or student usually carried children to school/creche, but these numbers were not reflected in the number of occupants arriving to UCC, the car occupancy was taken to be that indicated by the number of passengers to UCC specifically.

Where a point of origin in the survey listed more than one area as an option e.g. Douglas/Grange/Donnybrook, the average distance between all areas and UCC was used when calculating commute distance.

The number of passenger kilometres travelled by participants via car, bus, rail and motorbike were estimated using the commuter survey and were then extrapolated to the wider UCC community to obtain an estimate for the university for the 2017/18 year. This extrapolation was done using the full time equivalents (FTEs) for UCC staff (provided by the HR department) and students (calculated using the headcount data provided by the UCC factbook for 2017/18). Staff members were assumed to commute to UCC for 48 weeks of the year. Undergraduate students and taught postgraduates were taken to commute to UCC for 32 weeks of the year. Research postgraduates (29% of postgraduates based on headcount data) were expected to commute to UCC for 48 weeks of the year, the same as staff members. Day/Night students were classified according to the main type (undergraduate/postgraduate) they identified as during the survey. Part-time students were not identified as such (as was done in previous carbon footprint calculations): instead their emissions were calculated based on the number of days they listed as commuting on.

Emission factors (g CO_2e/passenger km) were obtained from various sources including Bus Eireann (bus), DEFRA (motorbike), and through calculations carried out using information from reports produced by Irish Rail and the EPA (car, rail) (Table 16). For these calculations, the average age of a car in Ireland was taken to be 8.7 years, and an appropriate emission factor for all cars driven by UCC staff and students was calculated based on the proportions of cars within each (carbon) tax bracket within the years spanning 2010-2018.

Employee Business Travel

Data on staff business travel was obtained through Club Travel records provided by the Finance Office in the form of an excel file (Table 15). Previous carbon footprints have estimated passenger kilometres travelled using an assumed price per kilometre (€/km) and the spend on various modes of travel e.g. flights, car hire, rail, etc. For this carbon footprint the researchers chose, where possible, to calculate distances travelled based on origins and destinations.

Flights were classified as follows: domestic (flights within Ireland), short haul (flights within Europe), long haul (flights from Europe to outside Europe) and international (between non-European destinations). The records from Club Travel detailed the various flight stages and airports visited by a UCC staff member as part of their journey. To ease calculations, all flights were broken up into individual flight stages, and classified according to the type of flight (short-haul, international, etc.) it was. The distance (in kilometres) travelled during each flight stage was calculated using the Air Miles Calculator website (https://www.airmilescalculator.com/), which calculates the distance in air miles between airports, which can then be translated into kilometres. Emission factors (g CO_2e/passenger km) for all flight types were provided by DEFRA (Table 16).

Travel via ferry was estimated using the Rome2Rio website to obtain distances between various ports. Again, emission factors (g CO_2e/passenger km) for travel by ferry were provided by DEFRA (Table 16).

Rail journeys were classified based on the area (Ireland, UK, Europe, USA) in which they took place, as emission factors (g CO_2e/passenger km) differed across these areas. Distance travelled via rail was estimated using the Rome2Rio website to obtain distances between various origins and destinations. The Club Travel records listed towns/cities as the origin and destination for rail journeys, not specific train stations. Therefore once the likely rail route had been decided upon, the train stations suggested for this route by the Rome2Rio website were assumed to be the origin and destination for this journey, and the specific distance in kilometres was calculated. Emission factors in g CO_2e/passenger km for rail travel within the UK, Europe and USA were provided by DEFRA, while an emission factor for rail travel in Ireland was calculated by researchers at the CPPU using information from reports produced by Irish Rail and the EPA (Table 16).

Travel via hire car was also classified based on whether the car was hired in Europe, Ireland, the UK or North America. No origin or destination was provided for these records in the Club Travel data file, however a price (in €) for the car hire was provided. Assuming a cost of €40 per day for the car hire, divided into the total cost, the number of days a car was hired for could be obtained. This was then multiplied by the assumed distance travelled per day, 170km, to obtain an estimate of passenger kilometres travelled by the UCC staff member. For simplicity, emission factors identified for cars in the USA, UK and EU (Table 3) were used for cars hired outside of Ireland. For cars hired within Ireland, it was assumed that the cars would generally be newer and thus require an updated emission factor to reflect the decreasing carbon intensity of newer cars. Therefore, an appropriate emission factor for fire cars driven by UCC staff was calculated based on the proportions of cars within each (carbon) tax bracket within the years spanning 2015-2018 (Table 16).

Travel via bus/coach calculated in a similar manner to travel via car hire. No origin/destination was provided in the Club Travel records, though a price (in €) for the bus ticket was. Distance travelled was calculated assuming a cost of €0.10 per kilometre travelled. Emission factors were provided by DEFRA and Bus Eireann (Table 16).

Student Academic and Club/Society Travel

Data on student academic and club/society travel was obtained directly through the schools and departments and clubs and societies, respectively, following an email campaign for information on student travel (Table 15). Data was collected for the 2017/18 academic year, however where this was not available, data for the 2018/19 year was accepted once confirmation was given that similar numbers travel each year. For data on student academic travel, data on academic fieldtrips and study abroad years, as well as placement activities, were collected.

Departments and clubs/societies were asked for data on the origin, destination, mode of transport and number of students per journey, however this was rarely available in full and assumptions often had to be made to ease calculations, such as the Irish airport a flight departed from or the number of medical students assigned to particular General Practices throughout the Munster region.

Distances travelled via car, bus and rail were estimated as described above in the *Employee and Student Commuting* section, while distances travelled via plane and ferry followed the same calculation methodology as described in the section on *Employee Business Travel*. Similarly, the emission factors used were the same as those described in the aforementioned sections (Table 3).

Waste

Data on waste generated by UCC for the 2017/18 academic year were obtained through the Waste Activity Reports provided by the Office of Buildings & Estates (Table 15). The pdf reports are provided for all the main areas within UCC (main campus, glucksmann gallery, etc.) and the waste classified into kilograms of landfill, mixed dry recycling, food, glass, cardboard and WEEE. The kilograms of each waste type detailed in the various reports were summed to provide a figure for each waste type for the whole university.

Emission factors for all waste types were obtained from DEFRA (Table 16).

Water

Data on water consumption for the 2017/18 academic year was obtained from a data file provided by Buildings & Estates (Table 15). Cubic metres of water supplied to UCC was calculated by summing all water consumption figures within the designated period of Oct 17-Sept 18. Where a measurement of water consumption was taken which covered a period outside of this academic year the figure was divided by the number of months included in the reading and an average per month allowed for the

water consumption for the correct period to be established. The volume of water emitted from UCC which goes on to be treated at a WWTP was assumed to be equal to the volume supplied to UCC.

Emission factors for both water supply and treatment were obtained from DEFRA (Table 16).

Procurement

Greenhouse gas emissions from procurement or supply-chain activities was estimated for the first time as part of the UCC carbon footprint through the application of environmentally-extended input-output (EEIO) analysis. This EEIO analysis was used to generate emission factors (in g CO_2e/€) which could be applied to UCC consumption data (in €) to obtain an estimate of the mass of greenhouse gases (Kg CO_2e) emitted by UCC through its supply-chain.

EEIO analysis requires two main sources of data, 1. A balanced input-output table of the economy (revealing flows of materials and money between various sectors of the economy), and 2. Data on greenhouse gas emissions from various sectors of the same economy. An excel file revealing a balanced input-output table of the Irish economy was provided by the Central Statistics Office (CSO). Data on the greenhouse gases emitted by each sector of the Irish economy during 2017 was provided by the Organisation for Economic Co-Operation and Development (OECD), also in the form of an excel file. The data from these excel files were amalgamated into one file whereby the greenhouse gas data for each NACE sector were matched to the corresponding monetary data. The EEIO model was used to produce appropriate emission factors (in g CO_2e/€) for each sector of the economy, following the method described by Kitzes (2013)[44] (Table 16). All calculations were carried out using Microsoft Excel.

Consumption data for this analysis took the form of procurement and capital expenditure data obtained from the Finance and Capital Accounting Offices at UCC (Table 15). The spend data was provided in an excel file detailing the amount of money (in €) spend on various goods and services throughout the 2017/18 academic year. Expenditure data on certain categories such as recruitment consultancy and professional fees, as well as other miscellaneous, were amalgamated for privacy reasons, so that one figure was provided to represent the spend in euro on all of these categories.

The UCC expenditure data within the excel file included descriptions of thousands of goods and services, which could all be classified into different categories on the Agresso system e.g. *catering services – food*, *cleaning materials*, *furniture and fittings repair*, etc. Using the United Nations Central Product Classification, Version 2.1 (United Nations, 2015)[45] as an aid to product classification, these categories were all assigned an appropriate emission factor generated through the EEIO analysis.

[44] Kitzes, J. (2013). An Introduction to Environmentally-Extended Input-Output Analysis. *Resources*, 2, 489-503.

[45] United Nations, (2015). *Central Product Classification (CPC) Version 2.1* [online]. Available at: https://unstats.un.org/unsd/classifications/unsdclassifications/cpcv21.pdf [accessed 20 April 2020].

Through multiplying each category of spend data (in €) by the corresponding emission factor (in g CO2e/€) an estimate of UCC's procurement-related greenhouse gas emissions (in Kg) was obtained.

A number of assumptions were made with regard to UCCs expenditure data in order to simplify the classification of the data into the various economic sectors, and thus assign it the appropriate corresponding emission factor. Services like book binding and laboratory analyses were classified in economic sectors describing the provision of these services, for example, while products like books and laboratory chemicals were classified in economic sectors representing the manufacture of various materials.

Due to issues with the availability of recent and up-to-date data, a number of steps involving data manipulation had to be taken to increase the accuracy of results. The input-output tables provided by the CSO are generated at five year intervals, with the 2015 table used in these analyses detailing the most currently available data. The emission factors generated through the EEIO model are therefore generated in 2015 basic prices, while UCC's procurement spend data are in 2018 final demand purchasers' prices. It was therefore necessary to transform the procurement data into 2015 basic prices through deflating the procurement spend data and removing taxes and subsidies.