University of Galway

Carbon Footprint Report*

2017 - 2023

*Rev 2

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Abstract

A net-zero greenhouse gas (GHG) emissions organisation reduces its emissions following science-based pathways, with any remaining GHG emissions attributable to University of Galway being fully neutralised by like-for-like removals of emissions from the earth's atmosphere, without purchasing carbon credits, in line with global efforts to limit warming to 1.5^{o}C. The boundary of a net zero target for University of Galway includes global scope 1, 2 and 3 emissions attributable to University of Galway, as defined in The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard. GHG emissions and the impact of University of Galway on climate can be measured in terms of equivalent CO_2 emission. This report outlines the methodology used to quantify the GHG emissions attributable to University of Galway and presents the results of the carbon footprint assessment that has been carried out for University of Galway for 2017-2023. Gaining an understanding of the sources and quantities of GHG emissions attributable to University of Galway is an imperative first step in the creation of a climate action plan for University of Galway and setting a 1.5°C aligned science-based target for University of Galway and its value chain, so that the University can put in place a carbon management plan and roadmap to reduce GHG emissions attributable to University of Galway to net zero.

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1 Executive Summary

For this Greenhouse Gas (GHG) Inventory, the Greenhouse Gas Protocol Corporate Standard methodology was used (GHG Protocol, 2020). The graph and tables below summarise the 2017 - 2023 GHG emissions under scopes 1, 2 and 3 for University of Galway. The figures are reported in total kilo-tonnes of carbon dioxide equivalent ($KtCO_2e$), in KtCO2e per full time equivalent (FTE) of staff and students and per meter squared of gross internal floor area (GIA).

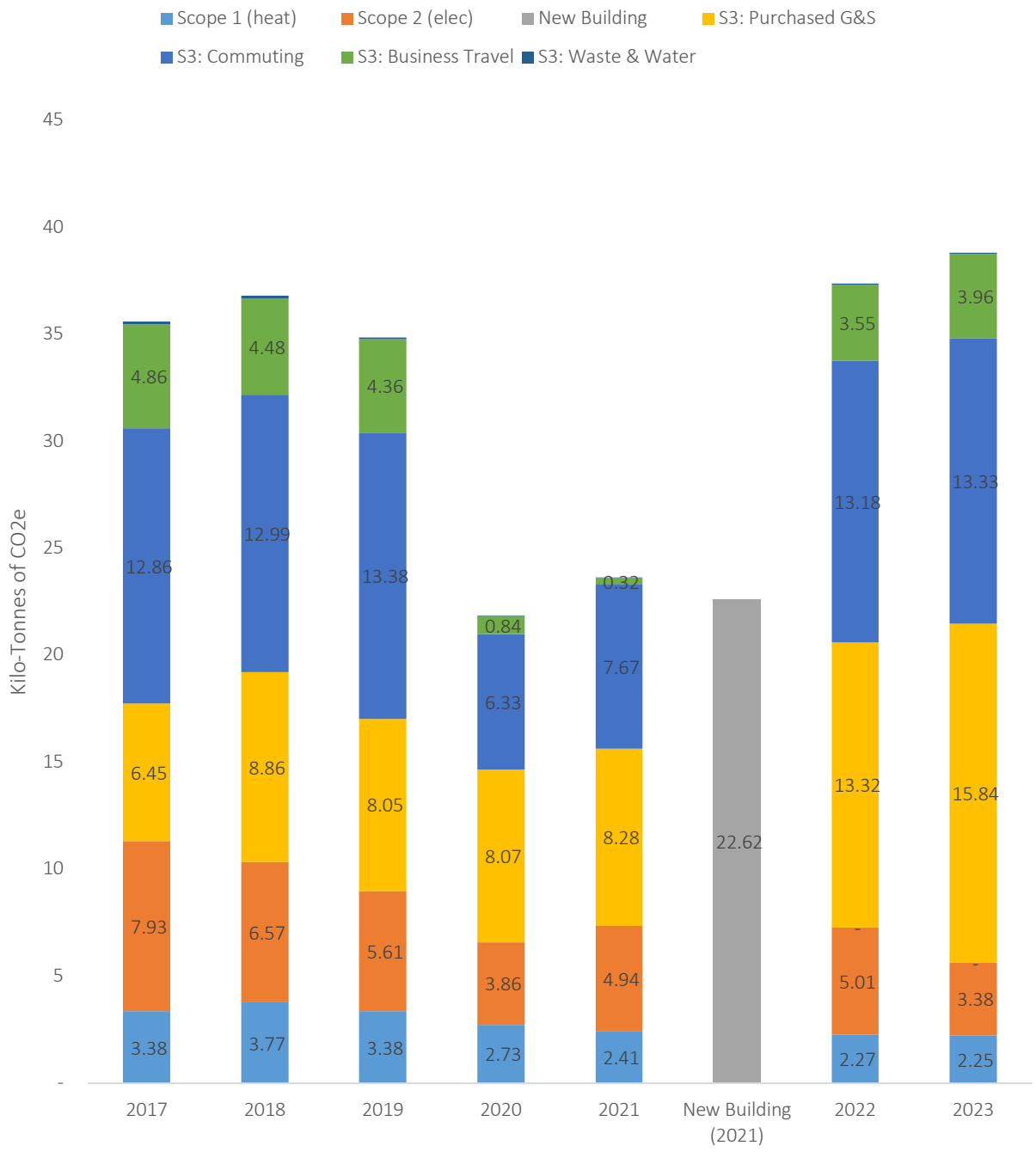

Figure 1 - University of Galway Carbon Footprint 2017-2023, showing 2021 outlier (new building)

Table 1 summarise the 2017 - 2023 GHG emissions under scopes 1, 2 and 3 for University of Galway. It shows the annual total emissions for scope 1, scope 2 and major categories of scope 3, and the outlier of the new building procured in 2021. The table also presents the total annual emissions in three different metrics, the first being standard kilo-tonnes of carbon dioxide equivalent (ktCO2e), the next is the emissions per full time equivalent (FTE) of staff and students (ktCO2e/FTE) and the third is the emissions per total gross internal floor area (ktCO2e/m^2). The FTE of students and staff is shown for each year and the total gross internal floor area (GIA) is 213,720 m^2 for all years. Figure 1 presents the results from this table in a bar chart and the Appendix contains Table 5, which shows a more detailed breakdown of the emissions, showing the fuels reported on in scopes 1 and 2, and a detailed breakdown for the results of scope 3 emissions.

Table 1 - University of Galway GHG Inventory Summary 2017-2023 (kilo-tonnes of CO2 equivalent)

	Emissions (KtCO2e)						
Emission Source	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Scope 1	3.4	3.8	3.4	2.7	2.4	2.3	2.2
Scope 2	7.9	6.6	5.6	3.9	4.9	5.0	3.4
New Building 2021					22.6		
S3: Purchased G&S	6.5	8.9	8.1	8.1	8.3	13.3	15.8
S3: Commuting	12.9	13.2	13.7	14.0	14.4	14.3	13.3
S3: Business Travel	5	4	4	1	0.3	4	4
S3: Waste & Water	0.1	0.1	0.1	0.03	0.02	0.04	0.04
Total (KtCO2e)	35.6	37.1	35.1	29.6	53.0	38.4	38.8
Total/FTE (tCO2e/FTE)	1.9	1.9	1.8	1.4	2.5	1.9	1.9
Total/GIA (tCO2e/m2)	0.17	0.17	0.16	0.14	0.25	0.18	0.18
FTE Total	18,816	19,319	19,853	20,432	20,910	20,328	20,530
FTE Students	16,690	17,100	17,532	18,044	18,421	17,690	18,053
FTE Staff	2,126	2,219	2,321	2,388	2,489	2,639	2,477

2 Introduction

The '*University of Galway Strategic Plan 2020-2025'* and the '*University of Galway Sustainability Strategy 2021-2025'* commits *to "providing leadership to inform the transition to a sustainable future through our teaching, research actions and impacts*; and *to developing a roadmap to move ambitiously towards carbon neutrality by 2030"*. In line with the *'Climate Action and Low Carbon Development (Amendment) Bill 2021'* in Ireland, University of Galway commits to pursue and achieve no later than 2050, the transition to being a university with net-zero greenhouse gas emissions that is climate resilient, biodiversity-rich and environmentally sustainable. This document presents the findings from the creation of a carbon footprint baseline for University of Galway. This baseline will feed into the creation of a climate action plan and a roadmap to net-zero for the University, the first step in University of Galway's journey. With a baseline understanding of how much carbon the institution produces, the roadmap will set out how the University will decarbonise over the coming years.

As Ireland moves towards a pathway to net zero emissions, it is becoming clear that effective reporting on carbon producing activities is a step of major importance. The Greenhouse Gas Protocol Corporate Standard (WRI, 2020a) is the most commonly used carbon reporting method, which is why it is the method chosen for this GHG report. It has also been decided to report a full scope 1, scope 2 and scope 3 carbon footprint, as recommended in the GHG Protocol. Carbon footprint is a term that is commonly known, but less commonly fully understood. Many organisations who estimate their carbon footprint focus on measuring emissions from their own operations and electricity consumption, which is scope 1 and scope 2. Basically, an organisation's gas/oil bill (scope 1) and electricity bill (scope 2). These two scopes are relatively easy to report on, which is why these are the scopes that many organisations begin with. But as more organisations push to include the final scope (scope 3 – supply chain), it's becoming clear that more often than not, this scope makes up a larger portion of an organisation's carbon footprint than scope 1 and 2 combined. Scope 3 is a much more difficult scope to report on, which is part of the reason why organisations opt for only reporting on scope 1 and 2. One of the goals of this report is to present a methodology for reporting scope 3 emissions for an Irish University's GHG inventory, to encourage other institutions to adopt a method and begin scope 3 reporting.

3 Literature Review

3.1 Intro – GHG Protocol Corporate Standard

The methodology followed in this report was acquired from The Greenhouse Gas Protocol Corporate Standard Training Webinar (WRI, 2020a), Scope 2 Guidance Training Webinar (WRI, 2020b) and Scope 3 Training (WRI & WBCSD, 2011). This methodology is the most commonly used, as can be seen in other Irish University GHG reports such as University College Cork (Poland, 2020), and Dublin City University (Morrissey et al., 2020). The Scope 1 and 2 training consisted of four webinars which are available for free online as well as four exercise documents that are also freely available. The Scope 3 training consisted of eleven modules of learning, each of which involved a series of short videos and supplementary reading and exercises.

3.2 Organisational & Operational Boundaries

The main steps in the GHG Protocol Corporate Standard process are setting organisational boundaries, determining operational boundaries within each scope, defining a base year, defining a significance threshold for recalculation, and carrying out the calculations using various methods and tools. This section of the report will go through all of these steps bar the last, which is shown in the methodology section. The first step in the GHG Protocol is to define the organisations' boundaries. The method of setting an organisations' boundaries is determined by choosing a consolidation approach. The possible consolidation approaches are as follows:

1. Equity Share
2. Control
    a. Financial Control
    b. Operational Control

The equity share approach refers to using the percentage of ownership that an organisation has on a structure/operation as the percentage of emissions to account for from that structure/operation. The control approach can be done in one of two ways. Either the organisation having control over the financial policies of a structure/operation or over the operational policies of a structure/operation. If the organisation has control, then it must account for all of the emissions from this structure/operation. The financial control approach

has been chosen for University of Galway as financial data is easily accessible. For future reference, The GHG Protocol recommends using the equity share approach and one of the control approaches for a more thorough analysis. The Operational Boundary of this report is the same of University of Galway's Energy Review, i.e. University of Galway Main Campus. Buildings that are included within the scope of the University of Galway ISO50001 EnMS are documented and included in a thorough review and updated on the University of Galway Energy Manual and Dashboard. There are 58 buildings included that have a total internal floor area of 155,090 m^2.

3.3 Base Year & Recalculation Policy

2017 was chosen as the base year for University of Galway. The protocol recommends using the furthest back year which still has all the data needed to complete a comprehensive assessment. So, if an organisation intends to complete a full scope 1, scope 2, and scope 3 assessment, there must be data for a complete assessment of these three scopes in the chosen base year and all years following. 2017 was chosen as it aligned with another assessment that the University was going through, a submission for a STARS ranking. For the STARS application, much of the data was required over a three-year period, meaning 2017-2019 was used. This set the base for the GHG reporting data. A recalculation policy must also be defined. This policy is determined by deciding on a significance threshold. The significance threshold is a percentage of change in emissions which is deemed significant for a recalculation of the base year emissions. The percentage is up to the organisation to decide but generally a figure between two and five percent is used, for this report 5% will be set as standard. The reason for this policy is to ensure the base year remains accurate. The change in emissions can occur due to a few reasons:

- Structural changes
- Calculation method changes
- Discovery of errors in method

It is important to note that structural changes in the organisation does not mean new/organic growth. It means to measure the change in emissions if the organisation obtains a new structure which existed and emitted greenhouse gases during the base year. Hence if the new

structure obtained emitted enough during the base year to change the total carbon footprint by over 5% then the base year must be recalculated with this structures' emissions included.

3.4 Scopes

Scope 1 accounts for all direct emissions of greenhouse gases within the organisations' boundaries. These can come from four sources:

- Stationary combustion of fuel to generate electricity, heat, or steam.
- Mobile combustion of fuel for the transportation of materials, waste, or employees.
- Physical or chemical processing such as waste processing, cement production etc.
- Fugitive emissions from unintentional leakages such as refrigeration/HVAC units

Scope 2 accounts for indirect emissions from the purchase of electricity. These can be calculated on a location-based and/or a market-based approach. The location-based approach is determined using the grid average emission factor and the consumption data from the grid. The market-based approach is derived from contractual information depending on what suppliers the organisation is associated with and accounting for any guarantees of origin or power purchase agreements that can offer a zero-emission electricity supply.

Scope 3 emissions, also known as value-chain emissions, are emissions associated with in-direct emissions not including Scope 2. The reason it is called value-chain is because Scope 3 report on emissions from cradle-to-grave. Cradle-to-grave encapsulates cradle-to-gate and end-of-life emissions into one. In order to categorise these emissions, the GHG Protocol starts by splitting the value chain into upstream (cradle-to-gate) and downstream (end-of-life). Using paper as an example of this, if a company buys an A4 pack of paper, the cradle-to-gate emissions are those associated with the sourcing of the materials, the processing of the wood into paper and the transport of the paper to the organisation. Then the end-of-life emission are associated with what happens to the paper once the organisation seeks to dispose of it, such as the emissions associated with transporting the paper to the recycling plant and the emissions from the recycling process. Figure 2 shows a graphic taken from the GHG Protocol Corporate Standard which shows Scope 1, Scope 2, and Scope 3 emissions as well as Scope 3 broken into the eight upstream categories and the seven downstream categories.

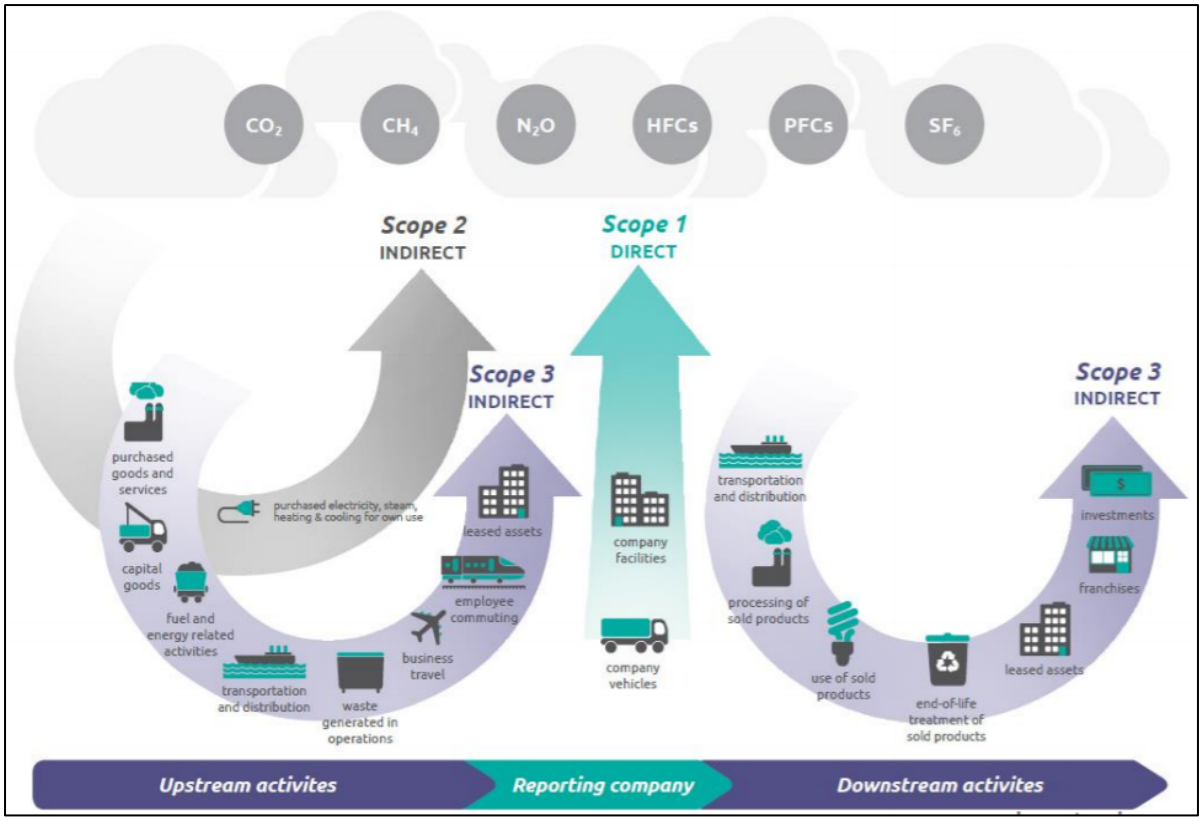

Figure 2 - Scope 1, 2 and 3 Emission broken into upstream activities, on-site activities and downstream activities

It is important to prioritise categories based on which activities are expected to have the most GHG emissions, as not all categories will be relevant. In this report, the prioritisation of categories was done using The GHG Protocol Scope 3 evaluator tool. This tool can give a rough estimation of Scope 3 emissions based on financial data (Quantis, 2019), which can be plugged straight into this online calculator to give results based on an archive of global average emission factors. Table 2 below shows the seven scope 3 categories selected for reporting in this baseline inventory.

Table 2 – Scope 3 categories expected to have a significant carbon footprint.

#	Category	Data Source	Notes
1	Purchased goods and services	Finance Office	Goods/services cradle-to-gate emission
2	Capital goods	Finance Office	Capital goods cradle-to-gate emissions
3	Fuel and energy-related activities	Finance Office	Fuel & Electricity purchased
5	Waste generated in operations	Estates Office	Waste treatment emissions
6	Business travel	Finance Office	Travel paid for by University
7	Employee commuting	Survey	Employee & Student commuting
-	Other	Buildings Office	Water Consumption Emissions

4 Methodology

The methodology section goes into detail on what activity data, calculation methods and emission factors were used for each subcategory of emissions.

4.1 Scope 1 & 2

The Energy Team at University of Galway have been carrying out annual energy reviews since 2006 to comply with the requirements of the ISO5001: 2018 Energy Management System (EnMS) standard, clause is 6.3. The main purpose of this energy review is to analyse University of Galway's energy usage and consumption based on measurement and other data i.e. the identification of current types of energy use, the evaluation of past and present energy usage and the analysis and identification of the Significant Energy Users (SEUs). Buildings that are included within the scope of the University of Galway ISO50001 formal Energy Management Systems Standard (EnMS) are documented and included in a thorough review and updated on the University of Galway Energy Manual and Dashboard. There are 58 buildings included that have a total internal floor area of 213,720m^2. The management team measure electrical and thermal energy performance using key performance indicators; kWh (e)1 and kWh (th)2 per metre squared of treated floor area per annum. These are termed Energy Performance Indicators (EnPIs) and are being used to set targets for enhanced energy performance improvement plans. In the University of Galway Energy Review Documents of 2018 and 2019, woodchips are reported as having zero emissions due to being sourced renewably as biomass. However, for this carbon footprint report, biomass is not considered carbon neutral, so emissions are reported as a scope 1 fuel. All other scope 1 and 2 emissions are taken directly from the SEAI's Public Sector Monitoring & Reporting (M&R) framework (SEAI, 2023b).

4.2 Scope 3: Categories 1 & 2 *Purchased Goods & Services & Capital Goods*

Categories 1 and 2 are reported under the same heading as current and capital expenditure have not been separated for emissions reporting, meaning this section represents all procurement by the University. Figure 3 below is taken from the GHG Protocol training, and it shows a thought process or "decision tree" for deciding how to calculate these sections. As can be seen there are four options, the supplier-specific method, hybrid method, average-data-method and the spend-based method. The supplier-specific method is best practice as it is most accurate. It involves acquiring product-level cradle-to-gate GHG inventory data from

suppliers, which the University would then apply to every product purchased from said supplier. The hybrid method involves getting as much supplier-specific data as is available and then using one of the other two methods to fill in the gaps. The average-data-method makes use of any available activity data that isn't spend data, such as weight, volume etc. The spend-based method involves estimating emissions for goods and services by multiplying the amount spent on a good/service by an industry average emission factor.

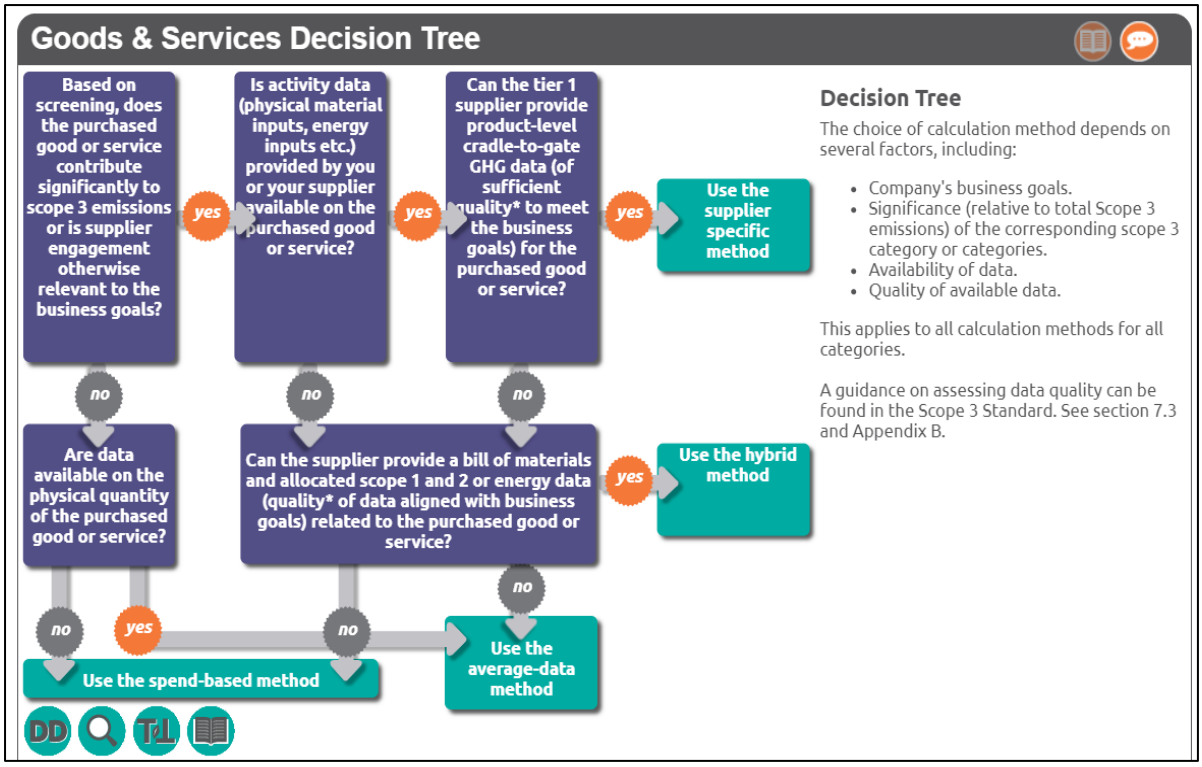

Figure 3 - Decision Tree for Categories 1 & 2 for deciding an emissions calculation method

In this Carbon Footprint Report, the spend-based approach was utilised as it's the easiest way to calculate a full baseline of supply chain emissions, even though it sacrifices some accuracy (El Geneidy et al., 2021). Data extracted from EXIOBASE3, was used for the emissions calculations (Ignite Procurement and Backsæther, 2022; Stadler et al., 2021). EXIOBASE3 is one of the most extensive Environmentally Extended Multi-Region Input-Output (EE-MRIO) systems available worldwide, using rectangular supply-use tables (SUT) in a 163 industry by 200 product classifications as the main building blocks. It contains data for 12 years (2010-2022) and for 44 countries and 5 rest-of-world regions. The 200 product categories are listed according to the statistical classification of economic activities in the European Community (eurostat, 2023). For the purpose of carbon accounting, a sustainability consultancy created its own version of EXIOBASE where outliers are adjusted, and blank values filled with

estimates based on the other available data (Ignite Procurement and Backsæther, 2022). A full description of the extraction methodology along with the full set of emission factors can be found on GitHub (Ignite Procurement and Backsæther, 2022).

The main task in this section of the calculator is to match categories of spend from the company's annual expenditure report with the industry sectors in EXIOBASE. The spend-based approach involves estimating emissions for goods and services by multiplying the amount spent on a good/service by an industry average emission factor. These values have been extracted for a range of years and regions for the purpose of carbon accounting by a sustainability consultancy, Ignite Procurement, which has created its own version of EXIOBASE. This version adjusts outliers and fills blank values with estimates based on other available data. The full set of emission factors and the extraction methodology can be found on GitHub (Ignite Procurement and Backsæther, 2022). Figure 4 shows the purchased goods and services (PG&S) calculator as in the Carbon Footprint Calculator Excel spreadsheet.

Purchased Goods and Services/Capital goods					
Year *2010-2022*	Region *49 regions*	Category *200 Industry Sectors*	EXIOBASE3 V3.8.2 Emission Factors *(EEIO - kgCO2e/€)*	Activity Data *(Annual Spend in €)*	Emissions *(tCO2e)*
2022	Ireland	Paddy rice	0.12	€ 10,000	1
		Wheat	1.44	€ 25,000	36
		Cereal grains nec	1.10		-

Figure 4 - Purchased Goods and Services Carbon Footprint Calculator

To make the Scope 3 calculation more accurate the GHG Protocol recommends using the hybrid method, in which activity-based or supplier-specific emission factors are collected over time and compared against the spend-based emission factors, replacing them if more appropriate. The ideal situation would be to calculate emissions using a supplier specific emission factor for each product or service. However, achieving this requires huge effort, time and expertise, hence the selection of the spend-based method as the first step. Using the spend-based method, a supply chain baseline and emission factor database can be created. Following this, there is more work associated with PG&S emissions outside the scope of the calculator, involving a supply chain analysis and supplier engagement. The EXIOBASE emission factors offer a quick route to a baseline of supply chain emissions, from which an analysis and engagement plan can be created.

The data source for this scope was university's historical expenditure data, which came in the form of detailed product code reports from the university's Procurement Office. These contain a history of the university's procurement through Agresso, the procurement system. In these spreadsheets, product codes are used to identify the category of supply, service or works that is being purchased. A product code is typically an abbreviation of the category of product or service, followed by a number, e.g. PRINT101, STAT101, etc. The words before these numbers represent the high-level category, such as PRINT being "Binding Services, Printing Services, Graphic Design Services, and Publishing Services". Then the numbers define more specific products within these categories, PRINT104 being "Pre-printed Stationery (Letterhead, Business Cards)" for example. As mentioned in section 3.4 of this report, it is very helpful to prioritise scope 3 categories. This was achieved by selecting the top product codes in terms of spend for each of the categories shown in Table 3, ensuring these add up to at least 80% of the spend for that year. This amounted to a total of 71 product codes which were each matched up with 23 different EXIOBASE categories. A full list of these 71 product codes and their associated emission factors can be seen in the Appendix, Table 6.

Table 3 – Major emitting product code categories and their descriptions.

Product Code	Description
BUILD	New Buildings Programmes, Building Maintenance, Furniture/Fitout, Facility Management Services, Security
SERVE	Advertising, Professional Services, Memberships, Training Courses, Photography, Patent Fees, Florists, Document Management, Laundry, Consultancy Services, HR Services, Insurance, Communications, Public Relations, Venue/Meeting Rooms, Website Design and Services
LAB	Laboratory Equipment, Instruments, Gases, Consumables, Chemicals & Reagents
COMP	Computer Equipment, Computer Peripherals, Computer Consumables, Software, IT Networks, Mobile and Landline Charges, Computer Consultancy
PRINT	Binding Services, Printing Services, Graphic Design Services, Publishing Services

Once these 71 product codes were matched with an EXIOBASE category, the spend was multiplied by the emission factor to get the emissions, which then had to be adjusted to ensure 100% of the annual expenditure was accounted for.

4.2.1 Construction of New Student Accommodation Block 2021

There was an outlier in the procurement data in 2021, this being an abnormally large amount of expenditure on construction due to the commissioning of a new block of student apartments. Even though these emissions fall under purchased goods and services, they've been separated in this report as can be seen in Figure 1. Using the spend-based method and emission factors from EXIOBASE, the **total emissions** associated with the construction of this building are **22.62 ktCO2e**.

This outlier has also shown an opportunity for a case study into comparing the spend-based method of calculating emissions to a building Life Cycle Assessment (LCA). Life Cycle Assessment captures a much more accurate and specific picture of a product/service's impact as this requires going through every material item that will go into the building and finding an emission factor specific to that item. We can see the benefit of the spend-based method here, as all we have to do is multiply the cost of the building by the emission factor for construction work in Ireland in 2021. However, by investigating the LCA of the building, we will gain an understanding of how accurate the spend-based method really is.

4.3 Scope 3: Category 3 *Fuel and Energy Related*

In the GHG Protocol Corporate standard, it is recommended to include this category in scope 3 to account for any emission associated with scopes 1 & 2 but have not been reported there. Usually, the main source of these emissions is from transmission & distribution losses on imported electricity. The amount of electricity purchased by an organisation differs slightly from the amount of electricity produced by an electricity supplier, as there is a small percentage of the energy lost as it travels between the supplier and the organisation. It is recommended to account for this loss in this category. However, in Ireland, the Sustainable Energy Authority or Ireland (SEAI) provide what they call the "Electricity supply efficiency". This differs from electricity generation efficiency as it includes:

- Losses from transmission and distribution of electricity on the network
- Consumption of electricity in power plants which are considered as losses

As it includes these losses, scope 3 emissions associated with transmission and distribution losses of purchased electricity are accounted for in scope 2.

Other fuel and energy related emissions that should be calculated are the well-to-tank emissions for all other fuels purchased and used on campus. This accounts for the mining, processing and transportation of fossil fuels in scope 1. This is not a step that has been pursued in this report but could be in the future.

4.4 Scope 3: Category 5 *Waste*

The UK Government's GHG conversion factors resource was used for waste streams as no emission factors specific Irish waste streams are currently available (DBEIS, 2021). The Calculator shows 25 different waste streams separated into industry/domestic waste and construction waste, showing emission factors for landfill, combustion and composting, as shown in Figure 5. Moving forward, an emission factor from the Dublin waste-to-energy centre would be ideal, as well as emission factors for recycling and composting in Ireland, as these emission factors are UK based.

Waste	**Activity Data *(tonnes)***			*DBEIS Emission Factors			Emissions *(tCO2e)*			Emissions total *(tCO2e)*
	Combustion	Composting	Landfill	Combustion	Composting	Landfill	Combustion	Composting	Landfill	
Industry & Domestic										
Domestic Municipal waste				21.3		497.0	0.0	0.0	0.0	0.0
Commercial and industrial waste				21.3		520.3	0.0	0.0	0.0	0.0
Plastic				21.3		8.9	0.0	0.0	0.0	0.0
Paper				21.3	8.9	1164.4	0.0	0.0	0.0	0.0
Metal				21.3		8.9	0.0	0.0	0.0	0.0
WEEE Electrical Items				21.3		8.9	0.0	0.0	0.0	0.0
Organic: food and drink waste				21.3	8.9	700.2	0.0	0.0	0.0	0.0
Organic: garden waste				21.3	8.9	646.6	0.0	0.0	0.0	0.0
Organic: mixed food and garden waste				21.3	8.9	656.0	0.0	0.0	0.0	0.0
Books				21.1	8.3	1164.1	0.0	0.0	0.0	0.0
Glass				21.3		8.9	0.0	0.0	0.0	0.0
Clothing				21.3		496.7	0.0	0.0	0.0	0.0
Construction										
Aggregates						1.2	0.0	0.0	0.0	0.0
Average construction				21.3			0.0	0.0	0.0	0.0
Asbestos						5.9	0.0	0.0	0.0	0.0
Asphalt						1.2	0.0	0.0	0.0	0.0
Bricks						1.2	0.0	0.0	0.0	0.0
Concrete						1.2	0.0	0.0	0.0	0.0
Insulation						1.2	0.0	0.0	0.0	0.0
Metals						1.3	0.0	0.0	0.0	0.0
Soils						19.5	0.0	0.0	0.0	0.0
Mineral oil				21.3			0.0	0.0	0.0	0.0
Plasterboard						72.0	0.0	0.0	0.0	0.0
Tyres							0.0	0.0	0.0	0.0
Wood				21.3	8.9	925.2	0.0	0.0	0.0	0.0
Total:										0.0

Figure 5 - Waste Carbon Footprint Calculator

The same resource was used to identify emission factors water supply and treatment, as again there were no Ireland specific emission factors available (DBEIS, 2021). It would be more ideal if these emission factors were calculated for the Ireland's water treatment industry.

4.5 Scope 3: Category 7 *Commuting*

Emission factors for commuting and business travel involved using Life Cycle Assessment (LCA) data to determine emissions per passenger-kilometre for various transport modes, as per the literature (Noussan et al., 2022). This includes direct (tailpipe) and indirect (fuel supply

chain) emissions. Various data sources were used in a research paper to compile average carbon intensities, also considering emissions from services and infrastructure when applicable (Noussan et al., 2022). Table 4 shows the database of emission factors adopted from this study and used in this carbon footprint report.

Table 4 – Life-Cycle Emission Factors for Transport Modes (Noussan et al., 2022)

Transport Mode	Category	Registration Period	*Emission Factors *(kg C02 eq/km)*
Private Car	Average	Average	0.262
Petrol Car	Average	Average	0.235
	Small (<1.4 litre)	2000-2005	0.213
		2006-2010	0.224
		2011+	0.2139
	Medium (1.4-2 litre)	2000-2005	0.2917
		2006-2010	0.2787
		2011+	0.2686
	Large (>2 litre)	2000-2005	0.3463
		2006-2010	0.3336
		2011+	0.3232
Diesel Car	Average	Average	0.187
	Small (<1.4 litre)	2000-2005	0.195
		2006-2010	0.190
		2011+	0.186
	Medium (1.4-2 litre)	2000-2005	0.261
		2006-2010	0.251
		2011+	0.246
	Large (>2 litre)	2000-2005	0.327
		2006-2010	0.312
		2011+	0.307
Electric Car	Hybrid electric (not plug-in)	Any	0.15
	Plug-in hybrid electric (PHEV)	Any	0.138
	Battery (BEV) Irish electricity grid	Any	0.12
Public Transport	Bus		0.048
	Train		0.033
	Tram		0.007
Bikes/Walking	Motor Scooter		0.085
	Cycling		0.021
	Walking		0

In order to calculate organisational commuting emissions, the best approach is to use a survey to collect the relevant information from employees. A list of sample questions for the survey is shown below:

1. How may days per week do you commute to work?
2. How many weeks per year do you commute to work?
3. In kilometres, how far is your (one-way) commute to work? (Hint: Google maps may be useful to estimate distance).
4. What is your usual mode of transport for your commute?
5. If it's by car, please select petrol or diesel.
6. If it's by car, please select a registration period for your car (2000-2005 or 2006-2010 or 2011+).
7. If it's by car, please select an engine size for your car, or in unknown, select generic (small or medium or large).

The answers to these questions can then be manually sorted or MS Power BI can be used in combination with MS Forms to run the reports automatically. The general formula is to get the annual commute distance by multiplying the days per week by the weeks per year by the daily distance (double the one-way distance). This annual commute distance can then be multiplied by the appropriate emission factor from Table 4 depending on the travel mode indicated. The commuting survey is a crucial tool in understanding the travel patterns of staff and students, collecting data on the modes of transport used, distance travelled, and frequency of trips. This helps in accurately estimating the emissions associated with commuting. The survey had a high response rate of 10% or 2,138 responses, a higher proportion which came from staff (34% compared to 7.4% students). Results from this survey can be seen on the University of Galway website (Curran, 2022).

To calculate commuting emissions, the commuting survey provides an overview of the various travel modes used by the campus community at specific points in time (January 2022 and March 2024). This snapshot method captures travel behaviour but is limited as it may vary depending on a variety of factors, such as the time of year that the information is captured. Therefore, these snapshots are combined with other metrics to estimate how commuting emissions may have fluctuated over the years. The approach involves calculating a weekly emissions figure per Full-Time Equivalent (FTE) of student/staff based on these snapshots. This is done by calculating the total emissions per week of commuting for all students/staff that answered the survey and then dividing by the number of student/staffs that answered. This results in weekly commuting emissions per campus user, as shown below.

- 23.6 kgCO2e/FTE – Students 2022
- 23.4 kgCO2e/FTE – Students 2024

- 33.5 kgCO2e/FTE – Staff 2022
- 27 kgCO2e/FTE – Staff 2024

These weekly figures are then multiplied by the associated FTE for each week and summed to produce annual total according to the calendar year. The reason for this process is because the FTE figures are for academic years, whereas the rest of the carbon footprint is reported according to the calendar year. Figure 6 shows results from the January 2022 survey, showing total emissions by staff and student, notes on remote working and the assumptions made.

Annual CO_2 eq emissions due to commuting

Annual Extrapolation (18,000 students + 2,500 staff)

Student commuting 2022 travel survey	Student commuting (remote working)*	Staff commuting 2022 travel survey	Staff commuting (remote working)*
13,106 tonnes CO_2 eq	8,639 tonnes CO_2 eq	4,722 tonnes CO_2 eq	2,861 tonnes CO_2eq

*The survey asked how often respondees would prefer to come to campus in an ideal scenario. It is acknowledged this may be more feasible for staff than students

**Comparison based on 2019 NUI Galway greenhouse gas emission report (https://sustainability.nuigalway.ie/media/sustainability/files/NUI-Galway-GHG-Report-(2017-2019).pdf)

- 48 working weeks were assumed per year for staff
- 24 working weeks were assumed per year for students

NOTE: Data presented is overall life cycle related emissions. Fuel consumption would account for 30% - 40% of the above total. Fuel consumption may be a more realistic figure of greenhouse gas savings

HIGHLIGHTS

- Total commuting emissions estimated at 17,800 tonnes CO_2 eq/annum
- Commuting comprises 33% of NUI Galway emissions**
- Remote working for staff could "save" 40% staff commuting emissions
- This equates to 3.5% of all NUI Galway emissions**
- Ensuring students can find/afford accommodation close to camps would have a very significant impact on emissions

Figure 6 - January 2022 Commuting Survey Results, showing extrapolation of emissions to the universities whole population (Curran, 2022)

To incorporate the effects of COVID-19 on commuting, the survey collected data indicating that during the 2020 academic year, the average commuting was 1.76 days per week (35% of 5 days), and during the 2021 academic year, it was 4.54 days per week (91% of 5 days). These rates are applied at the monthly level, using 35% from March 2020-Aug 2021 and 94% from September 2021 to December 2021, before returning to normal rates in January 2022. This adjusted commuting emissions, accordingly, reflecting the reduced commuting frequency during the pandemic. This method allows for a comprehensive calculation of commuting emissions, accounting for variations in travel behaviour over time and the impact of external factors such as COVID-19. Microsoft Power BI can be a useful application for organisations with a large number of employees, as it turns results from MS forms (commuting survey) straight into useable reports.

4.6 Scope 3: Category 6 *Business Travel*

For all transport modes other than flights, the emission factors shown in Table 4 were used to calculate business travel emissions. For flights, the UK Government's GHG conversion factors (DBEIS, 2021) were used again, as they are account for short, medium and long haul flights in kgCO2e per passenger kilometre. A class factor of 1.5 is multiplied by the business class flights and the calculator automatically multiplies all flight emissions by the radiative forcing factor (RFF) of 2. Figure 7 shows the layout of the Business Travel Calculator.

Business Travel		**Activity Data** ***(passenger.km) or (€) or (room.nights)***	*Emission Factors *(kgCO2e/unit)*	Emissions *(tCO2e)*
*Short-haul flight	Average passenger		0.154	0.0
(under 3 hours)	Economy class		0.151	0.0
Unit: passenger.km	Business class		0.227	0.0
	Average passenger		0.193	0.0
*Long-haul flight	Economy class		0.148	0.0
(over 3 hours)	Premium economy class		0.237	0.0
Unit: passenger.km	Business class		0.429	0.0
	First class		0.591	0.0
	Foot passenger		0.019	0.0
*Ferry	Car passenger		0.130	0.0
Unit: passenger.km	Average (all passenger)		0.113	0.0
	Ferry (by spend)		0.206	0.0
	Intra-city bus (within)		0.024	0.0
	Inter-city bus (between)		0.031	0.0
**Public Trasnport	Irish Rail		0.024	0.0
Unit: passenger.km	Dart/Luas		0.014	0.0
	Bus (by spend)		0.206	0.0
	Train (by spend)		0.206	0.0
**Car	Car generic (by distance)		0.262	0.0
	Car generic (by spend)		1.448	0.0
*Hotel	Hotel (auto filled from table to the right)	-	#DIV/0!	0.0

Figure 7 - Business Travel Carbon Footprint Calculator

5 Next Steps

This section will advise best practice moving forward for more accurate and efficient carbon reporting and give a brief overview of the next stage, the roadmap to net-zero emissions. It is important to note that emission factors should be updated annually at least.

Commuting has been identified as a the most significant emission category for the University of Galway, accounting for 36% of the total carbon footprint on average over the seven years. These emissions account for the movement of roughly 17,650 students and 2,400 staff to and from campus over the course of the academic year. While staff make up just 12% of the numbers, they account for about 19% of commuting emissions, meaning the average staff member emits 1.3 tCO2e/year, while the average student emits 0.47 tCO2e/year. The second and third most emitting categories were purchased goods and services and Scope 2, accounting for 31% and 17% of the total footprint, respectively. Business travel accounted for 10% and Scope 1 was 9%, with waste & water accounting for just 0.2% collectively.

There is an outlier in the data, seen under “New building 2021”. The 22.62 ktCO2e accounted for here were calculated through the spend-based method using the EXIOBASE3 emission factor for construction work in Ireland in 2021. This expense represents capital expenditure by the University and shows how significant construction can be as an emission source. The rest of this section will advise best practice moving forward for more accurate and efficient carbon reporting, noting that it is important to update emission factors regularly.

5.1 Scope 3: Purchased Goods & Services & Capital Goods

A supply chain emission factor inventory should be compiled for purchased goods & services and capital goods as part of this research, utilising spend-based factors from EXIOABSE3 as the backbone of the inventory. These spend-based factors are useful for the purpose of getting an initial understanding of the supply chains emissions, but moving forward these will have to be replaced by activity-based or supplier-specific factors to ensure accuracy in reporting. The supply chain should be sectioned out by sectors of spend and plans to replace emission factors and to actually reduce emissions should be theorised. The procurement office and sustainability office will have to work together to increase the accuracy of this inventory over time, by searching for the most appropriate activity-based or supplier-based

emission factors. Also, catering and food data has not yet been included in the purchased goods and services inventory. This should be pursued in future reports.

The emission factor inventory should operate as a link between the University and its suppliers in terms of discussing supply chain decarbonisation. Engagement is a crucial step in understanding the unique impact of each individual supply chain and for opening a space for communication and collaboration between the University and its suppliers. The need for a just-transition emphasizes the need for a fair and equitable shift to a sustainable economy. This can't be done without supply chains also shifting, but without engaging with suppliers there is a danger of transition in an un-just manor. Greenwashing is a significant issue when it comes to green public procurement, and supplier engagement can assist in overcoming this barrier, ensuring the University gains an in-depth understanding of how it's procurement activities and policies are impacting the environment.

5.2 Scope 3: Commuting

Commuting surveys should be taken regularly and the next survey should include a section on working from home. The DEFRA database of emission factors includes a factor for working from home, which attempts to estimate the average household energy usage for a homeworker in the UK. These factors could be used to draw up comparisons between the total emissions associated with commuting and working on campus versus not commuting and working from home. Otherwise, the commuting emission factors should remain up to date to reflect increasing national bio-fuel blend (for car journeys), the decarbonising electricity grid (for electric vehicles) and any significant changes in public transport (e.g. zero-emission buses in Galway city).

5.3 Scope 3: Business Travel

In future, it would be useful to require kilometres travelled for business travel expenses (ferry, rail, bus, taxis, and flights) as opposed to just recording the amount spent. Rail, bus, taxis and flights could also be further separated into vehicle type and fuel type. Incorporating emission factors into the procurement and club travel systems will give automated emission reports, similar to purchased goods and services.

5.4 Scope 3: Waste

The waste category does not include catering waste, as catering is supplied by contractors in the University. This waste should be included in future. It would also be preferable to acquire an Irish emission factor for waste treatment to replace the DEFRA factors being used. All municipal-solid waste from the University is sent to the Dublin waste-to-energy plant, which has recently published emissions information (ENCYCLIS, 2024). This could be assimilated into future CF reports.

6 Conclusion

This report presents results and a methodology for creating a scope 1, 2 & 3 baseline carbon footprint for an Irish University. This baseline can now be used in the creation of a climate action plan and a pathway to net zero. One of the main findings here is that commuting, and procurement behaviour is key to understanding and controlling a universities carbon footprint. It is important to highlight this so that communication can begin between procurers and suppliers on carbon reporting and reducing. A just transition is one of the major goals of the Irish government, and for a University in Ireland, it appears effective communication between the institution and its suppliers about carbon reductions is pivotal.

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Appendix

Table 5 – Detailed Carbon Emissions Summary for the University of Galway, 2017-2023.

	Emissions (tCO2e)						
Emission Sources	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Scope 1 and 2							
Electricity Imports	7,930	6,574	5,608	3,857	4,941	5,014	3,383
Gas Imports	2,525	2,897	2,785	2,409	2,190	2,065	2,060
LPG	155	150	143	119	96	116	105
Gasoil	355	349	306	163	85	45	41
Wood pellets	-	-	-	-	-	-	-
Road Diesel	342	375	143	41	44	41	41
Biodiesel	-	-	-	-	-	-	-
Commuting							
Students	9,443	9,675	9,920	10,210	10,423	10,009	10,118
Staff	3,417	3,566	3,731	3,838	4,000	4,241	3,213
Purchased Goods and Services							
New Building 2021					22,616		
BUILD	1,458	1,951	2,743	2,449	2,619	3,095	5,730
LAB	1,582	2,118	1,377	1,405	1,026	2,447	3,078
COMP	847	1,782	856	1,127	1,069	1,627	1,377
SERVE	517	681	785	934	976	1,207	1,482
PRINT	129	137	127	119	77	143	134
Other	1,917	2,191	2,165	2,035	2,509	4,801	4,044
Business Travel							
Short Haul - Economy	165	174	163	105	69	258	349
Short Haul - Business	0	-	0			2	2
Medium Haul - Economy	923	858	1,053	97	42	573	689
Medium Haul - Business	6	9	3			6	9
Long Haul - Economy	2,556	2,327	2,321	455	137	1,826	2,097
Long Haul - Premium						51	43
Long Haul - Business	195	137	250			190	218
Hotel	50	49	60	37	18	378	152
Flights (other)	581	541	274	9	1	28	86
Train/ferry (spend)	20	21	11	6	1	7	12
Taxis (spend)	128	130	71	35	6	126	165
Bus (spend)	15	17	8	3	1	7	11
Car (kilometers)	218	223	141	91	43	97	126
Waste							
Landfill	97	98	43	-	-		
Waste to energy	-	-	3	2	1	8	8
Mixed Recyclables	-	-	-	0	-	5	5
Glass	5	4	4	2	1	1	1
Organic	0	0	0	1	1	2	2
WEEE	0	0	1	0	0	0	0
Water							
Water Supply	12	12	11	9	7	11	12
Water Treatment	21	22	20	16	12	12	14

Table 6 - Seventy-one University of Galway product codes aligned to 23 EXIOBASE3 industry categories.

Product Code	Product Code Description	EXIOBASE Category	Emission Factor kgCO2e/€ (IRE 2021)
BUILD101	New Building – Cap. Project	Construction Work	0.312
BUILD103	Refurbishment – Cap. Project	Construction Work	0.312
BUILD113	General Building Repairs & Maint.	Construction Work	0.312
BUILD115	Ground maintenance – services	Products of forestry, logging, and related services	0.222
BUILD116	Estates Waste + Refuse disposal	Collected and purified water, distribution services of water	0.231
BUILD119	Electrical Repairs	Electrical machinery and apparatus n.e.c.	0.213
BUILD120	Plumbing Materials	Rubber and plastic products	0.241
BUILD121	Plumbing Repairs	Other services	0.204
BUILD124	Rental of Buildings	Real estate services	0.133
BUILD129	CAP (BUILD Fees - Architects)	Construction Work	0.312
BUILD134	CAP (Bld fees - other prof.fees)	Other business services	0.083
BUILD137	CAPITAL gen.blding materials/maint	Construction Work	0.312
BUILD143	CAPITAL Electrical repairs	Electrical machinery and apparatus n.e.c.	0.213
BUILD145	CAPITAL Plumbing repairs	Construction Work	0.312
BUILD167	Fire Maintenance & Repair	Other business services	0.083
BUILD172	Integrated Facilities Management	Computer and related services	0.160
BUILD173	Minor Works	Construction Work	0.312
BUILD174	Ground Maintenance Works/Civil Works	Products of forestry, logging, and related services	0.222
BUILD180	Cleaning Services Contract	Other services	0.204
BUILD181	Cleaning Consumables	Chemicals and fertilizer minerals, salt, and other mining and quarrying products n.e.c.	0.611
BUILD195	Security Services Contract Work	Other services	0.204
BUILD196	Campus Parking and Transport Services	Other land transportation services	0.157
COMP201	Windows Desktop Purchase	Office machinery and computers	0.346
COMP202	Windows Laptop Purchase	Office machinery and computers	0.346
COMP203	Apple PC/Laptop	Office machinery and computers	0.346
COMP208	Computer Cabling/Accessories	Radio, television and communication equipment and apparatus	0.131
COMP209	Software Purchase - Recurrent	Computer and related services	0.160
COMP210	Software Maintenance - Recurrent	Computer and related services	0.160
COMP212	IT Equipment Capital Purchase >€10,000	Electrical machinery and apparatus n.e.c.	0.213
COMP216	Software Consultants - Capital >€10,000	Computer and related services	0.160
COMP224	IT Hardware Maintenance	Computer and related services	0.160
COMP226	IT Network Maintenance	Computer and related services	0.160
COMP229	HEAnet - External Network Services	Computer and related services	0.160
AUDIO107	AUDIOVISUAL - Equipment Purchase < €10,000	Radio, television and communication equipment and apparatus	0.131
COMP232	COMPUTER EQUIPMENT MISCELLANEOUS	Radio, television and communication equipment and apparatus	0.131

LAB2009	LAB Experimental Kits/Apparatus	Medical, precision and optical instruments, watches and clocks	0.163
LAB2034	Diagnostic services	Research and development services	0.083
LAB2012	Capital Equipment > €10,000	Machinery and equipment n.e.c.	0.270
LAB2015	Capital Equipment - Maintenance	Machinery and equipment n.e.c.	0.270
LAB2016	Laboratory, Small Appartus	Medical, precision and optical instruments, watches and clocks	0.163
LAB2018	LAB - Test Equipment < €10,000	Medical, precision and optical instruments, watches and clocks	0.163
LAB2019	Lab Instruments < €10,000	Medical, precision and optical instruments, watches and clocks	0.163
LAB2020	Laboratory Chemicals and Reagents	Chemicals nec	0.324
LAB2024	Plastic consumables	Rubber and plastic products	0.241
LAB2032	Consumables Other/General	Rubber and plastic products	0.241
LAB2035	Engineering/Scientific Services	Research and development services	0.083
PRINT102	External or outsourced printing	Printed matter and recorded media	0.140
PRINT103	External Graphic Design and Artwork	Printed matter and recorded media	0.140
PRINT104	Pre-printed Stationery (Letterhead, Business Cards)	Printed matter and recorded media	0.140
PRINT105	Marketing Print (Brochures, Prospectus, etc)	Printed matter and recorded media	0.140
PRINT106	Publication Services	Research and development services	0.083
SERVE07	Insurance renewals	Insurance and pension funding services, except compulsory social security services	0.083
SERVE101	Advertising - General	Other business services	0.083
SERVE103	Conferences & meetings	Education services	0.083
SERVE104	Data information services	Computer and related services	0.160
SERVE106	General Consultancy	Other business services	0.083
SERVE107	Legal Services	Public administration and defence services; compulsory social security services	0.086
SERVE109	Promotions and Publicitiy	Other business services	0.083
SERVE111	Membership Subs to Professi Bodies	Membership organisation services n.e.c.	0.219
SERVE114	Services - Campus Companies	Membership organisation services n.e.c.	0.219
SERVE116	Patent Agent Fees and Charges	Research and development services	0.083
SERVE112	Training Courses - External	Education services	0.083
MISC103	Other Educational Establishments	Education services	0.083
SERVE120	Consultancy - Business Strategy and Operations	Other business services	0.083
SERVE123	Consultancy - Research Services & Surveys	Research and development services	0.083
SERVE131	Insurance Underwriting Services	Insurance and pension funding services, except compulsory social security services	0.083
SERVE133	Consultancy and Advisory Services	Research and development services	0.083
SERVE134	Communications/Media Services	Other services	0.204
SERVE140	HSE Personnel Billings	Health and social work services	0.083
SERVE144	Invigilation and Other Exam Expenses	Education services	0.083