University of Galway

# Carbon Footprint Report*

2017 (Baseline), 2018, 2019, 2020, 2021

*Rev 1

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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 2017-2021. 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.

# Table of Contents



**Acknowledgements**

Michael Curran, Alan Lambe, Dean Pearce, Gearóid Ó Broin, Eoghan Clifford, Stephen Canny

**List of Figures**



**List of Tables**

# 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 - 2021 GHG emissions under scopes 1, 2 and 3 for University of Galway. The figures are reported in total kilo-tonnes of carbon dioxide equivalent (KtCO2e), in KtCO2e per full time equivalent (FTE) of staff and students and per meter squared of gross internal floor area (GIA).

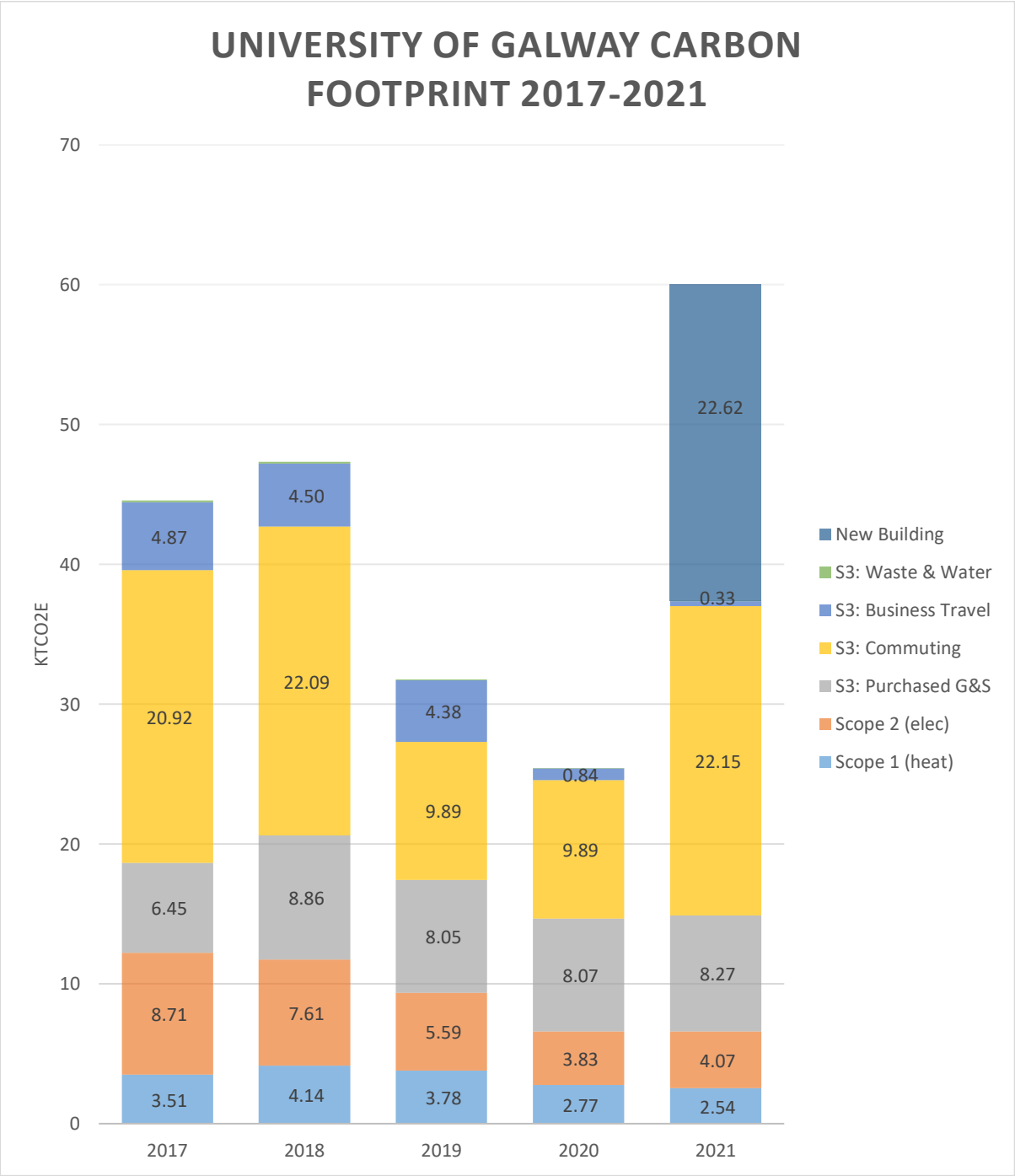


*Figure 1 - University of Galway GHG Inventories 2017-2021, showing 2021 outlier (new building)*

*Table 1 - University of Galway Full Time Equivalent (FTE) figures, campus area and change in emissions year on year*

| Year | Staff (FTE) | Students (FTE) | GIA (m2) | Change in Emissions/2017 |
|---|---|---|---|---|
| 2017 | 2,125.94 | 17,196.50 | 155,090 | - |
| 2018 | 2,218.90 | 17,552 | 155,090 | + 6.2% |
| 2019 | 2,230.99 | 18,094 | 155,090 | - 28.7%* |
| 2020 | 2,387.60 | 17,687 | 155,090 | - 43%* |
| 2021 | 2,488.54 | 18,649.50 | 155,090 | -14.4%** |

**Commuting and business travel emissions dropped due to covid, explaining these large decreases.*

***In 2021 a new student accommodation block was commissioned, explaining some of the increase.*

*Table 2 - University of Galway GHG Inventory Summary 2017-2021 (kilo-tonnes of CO2 equivalent)*

| | *Emissions (KtCO2e)* | | | | |
|---|---|---|---|---|---|
| **Emission Source** | **2017** | **2018** | **2019** | **2020** | **2021** |
| Scope 1 | 3.51 | 4.14 | 3.78 | 2.77 | 2.54 |
| Scope 2 | 8.71 | 7.61 | 5.59 | 3.83 | 4.07 |
| New Building 2021 | | | | | 22.62 |
| S3: Purchased G&S | 6.45 | 8.86 | 8.05 | 8.07 | 8.27 |
| S3: Commuting | 20.92 | 22.09 | 9.89 | 9.89 | 22.15 |
| S3: Business Travel | 4.87 | 4.50 | 4.38 | 0.84 | 0.33 |
| S3: Waste & Water | 0.14 | 0.14 | 0.08 | 0.03 | 0.02 |
| **Total (KtCO2e)** | **44.59** | **47.34** | **31.78** | **25.43** | **60** |
| **Total/FTE (tCO2e/FTE)** | **2.31** | **2.39** | **1.56** | **1.27** | **2.84** |
| **Total/GIA (tCO2e/m2)** | **0.29** | **0.31** | **0.20** | **0.16** | **0.39** |

# 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 decarbonize 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 organizational 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 organizations' boundaries. The method of setting an organizations' 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 organization 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 organization having control over the financial policies of a structure/operation or over the operational policies of a structure/operation. If the organization 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 organization 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 organization 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 organization does not mean new/organic growth. It means to measure the change in emissions if the organization 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 organizations' 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 organization 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 organization. Then the end-of-life emission are associated with what happens to the paper once the organization 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 below 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.

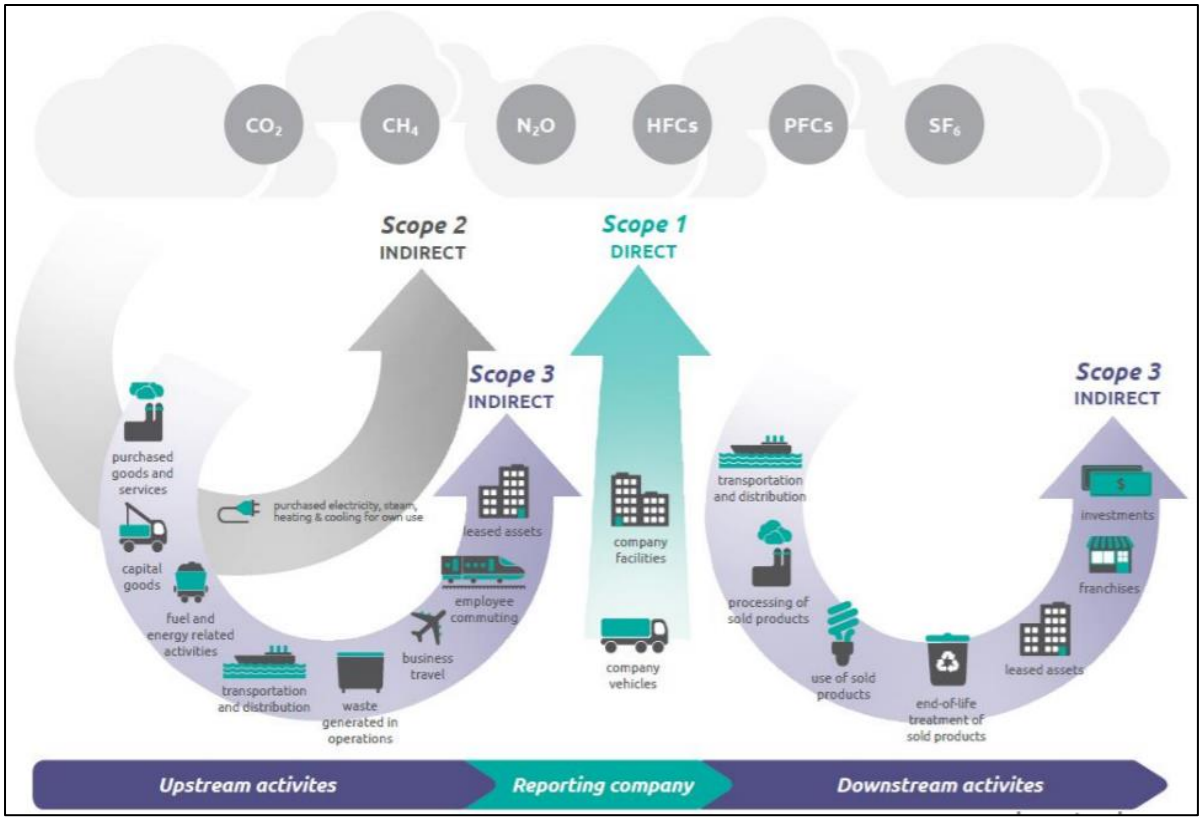


*Figure 2 - Scope 1, 2 and 3 Emission broken into upstream activities, on-site activities and downstream activities*

It is important to prioritize categories based on which activities are expected to have the most GHG emissions, as not all categories will be relevant. In this report, the prioritization 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 3 below shows the seven scope 3 categories selected for reporting in this baseline inventory.

*Table 3 – 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 how activity data was acquired for each scope and what emission factors were used for each section of the inventory.

## 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 155,090 m2. 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. University of Galway operate a formal Energy Management Systems Standard (EnMS) which is compliant with the requirements of ISO50001: 2018. The Energy Review is carried out once a year and also in response to major changes in facilities, equipment, systems or energy using processes. The methods and criteria used to develop each of the Energy Reviews are outlined in the document and the results are documented and retained/maintained as records under our Document Control Procedure.

Notes on Energy Review document: In the University of Galway Energy Review Document in 2017, it is reported that 31.7 tCO2e came from solar thermal energy. This has not been included here as solar thermal is renewable and does not produce emissions. In the University of Galway Energy Review Documents of 2018 and 2019, woodchips are reported as having zero emissions. This is due to them being sourced renewably as biomass. However, for this report, biomass is not considered carbon neutral, so emissions are reported. In 2018 there are 210.9 tCO2e and in 2019 there are 89.7 tCO2e, associated with solar PV and solar

thermal combined, which are reported as negative emissions. For this report, renewables are considered carbon zero not carbon negative.

*Table 4 - Scope 1 and 2 Emissions Summary*

| | | | *(tCO2e)* | | |
|---|---|---|---|---|---|
| **Scope 1 & 2 Fuel** | **2017** | **2018** | **2019** | **2020** | **2021** |
| Electricity Imports | 8,709 | 7,608 | 5,594 | 3,828 | 4,067 |
| Gas Imports | 2,799 | 3,212 | 3,087 | 2,163 | 2,379 |
| LPG | 21 | 160 | 153 | 95 | 119 |
| Gasoil | 86 | 362 | 290 | 88 | 169 |
| Wood pellets | 369 | 121 | 110 | 151 | 62 |
| Road Diesel | 36 | 21 | 15 | 44 | 40 |
| Biodiesel | 197 | 265 | 128 | 0 | 3 |
| **Total** | **12,216** | **11,749** | **9,376** | **6,369** | **6,838** |

## *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. This meant collecting the 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.

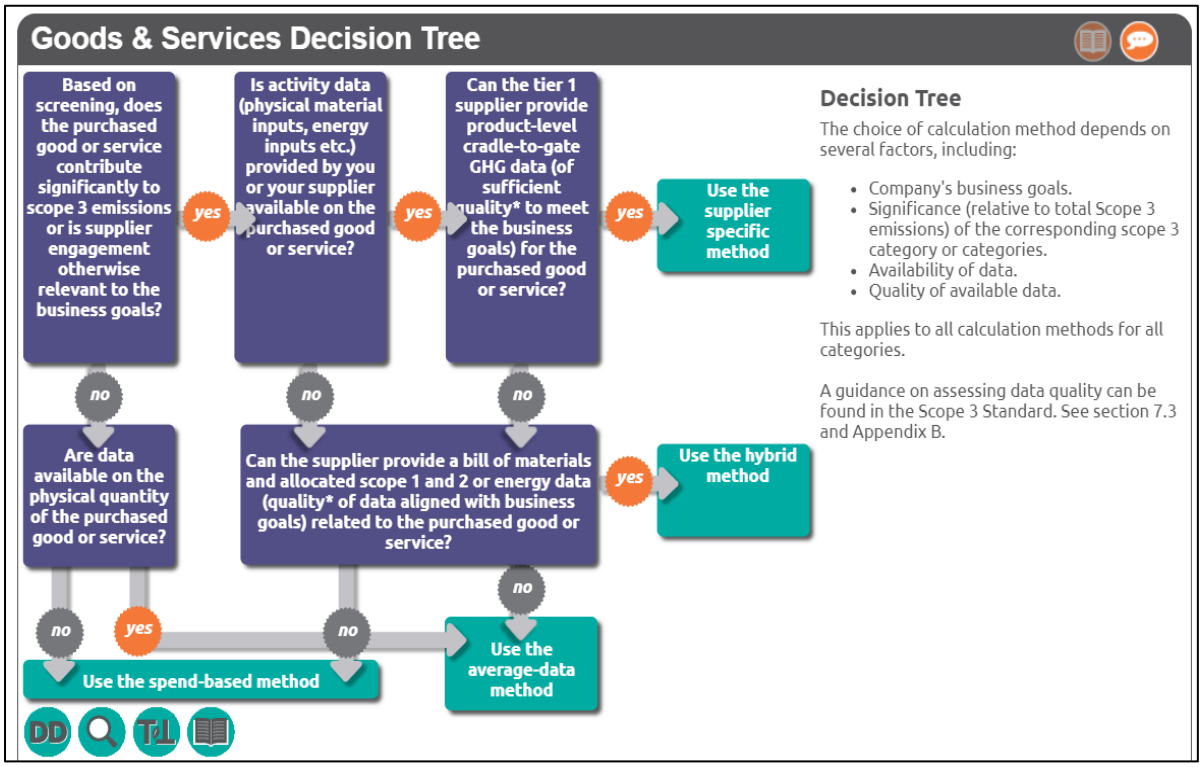


*Figure 3 - Decision Tree for Categories 1 & 2 for deciding an emissions calculation method*

As mentioned in section 3.4 of this report, it is very helpful to prioritize scope 3 categories. Creating a first draft of scope 3 emissions can be quickly achieved using the online Scope 3 evaluator tool provided by the GHG protocol (Quantis, 2019), which will highlight roughly how much emissions are coming from each category using the spend-based method. It's important to note that the GHG Protocol have announced that this tool will be removed from their website at some point in 2023, as it is using a relatively outdated 2009 emission factor database. However, for this project it was still useful for providing a "traffic light" assessment

and showed us that there were five main categories of product codes where most of the emissions were coming from, as can be seen in Table 5.

*Table 5 – 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 |

Following this quick evaluation, a more up-to-date and accurate input-output database was used for the emissions calculations, this being EXIOBASE3 (Bjelle et al., 2019). EXIOBASE3 is one of the most extensive EE-MRIO systems available worldwide. It builds upon the previous versions of EXIOBASE by using rectangular supply-use tables (SUT) in a 163 industry by 200 products classification as the main building blocks. It contains data for range of 12 years (2010-2022) and for 44 countries and 5 rest of world regions. This means that it's more accurate than the Scope 3 Evaluator in 3 dimensions:

1. Specific to the year, rather than using 2009 numbers and adjusting for inflation.
2. Specific to the region, rather than using worldwide average data.
3. Specific to the currency, rather than using US dollars and converting to euros.

The higher degree of granularity in the emission factors meant we could also go more granular with the procurement data. This was achieved by selecting the top product codes in terms of spend for each of the categories shown in Table 5, ensuring these add up to at least 70% 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. This is almost 5 times more granular than the quick assessment, not to mention being specific to the correct year, region and currency. 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. The way these 71 product codes have been matched with EXIOBASE categories can be seen in the Appendix. Table 6 shows the number of product codes taken from each category, the emissions from each category for each year, and the percent of the annual spend that the category accounts for. On the third last row we can see the percent of the annual spend that has been accounted for each year, an average of 72.6%, and how it's adjusted to account for the emissions of all expenditure.

*Table 6 - Scope 3: Purchased Goods and Services Emissions*

| PC Category | Purchased Goods and Services | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|
| BUILD | Emissions from 22 Product Codes (kTCO2e) | 1.5 | 2.0 | 2.7 | 2.4 | 2.6 |
| | Amount of annual spend accounted for (%) | 20% | 19% | 27% | 24% | 23% |
| SERVE | Emissions from 20 Product Codes (kTCO2e) | 0.5 | 0.7 | 0.8 | 0.9 | 1.0 |
| | Amount of annual spend accounted for (%) | 13% | 13% | 17% | 19% | 22% |
| LAB | Emissions from 11 Product Codes (kTCO2e) | 1.6 | 2.1 | 1.4 | 1.4 | 1.0 |
| | Amount of annual spend accounted for (%) | 20% | 21% | 15% | 14% | 11% |
| COMP | Emissions from 13 Product Codes (kTCO2e) | 0.8 | 1.8 | 0.9 | 1.1 | 1.1 |
| | Amount of annual spend accounted for (%) | 15% | 20% | 12% | 15% | 13% |
| PRINT | Emissions from 5 Product Codes (kTCO2e) | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | Amount of annual spend accounted for (%) | 3% | 3% | 2% | 2% | 1% |
| Total calculated (Emissions of 71 PCs) | | 4.5 | 6.7 | 5.9 | 6.0 | 5.8 |
| % of Spend accounted for in 71 PCs | | 70% | 75% | 73% | 75% | 70% |
| Adjusted remainder to account for 100% | | 1.9 | 2.2 | 2.2 | 2.0 | 2.5 |
| **Total PG&S Emissions (ktCO2e)** | | **6.45** | **8.9** | **8.1** | **8.1** | **8.3** |

To make the Scope 3 calculation more accurate and specific to the University, the main suppliers under each of these headings have been identified. A supplier specific emission factor for each product would give a more accurate Scope 3 analysis. As mentioned above, the Universities procurement system operates by product code at the most granular level. There are multiple suppliers available for each product code, meaning even if a supplier-specific product code is acquired, a buyer using the system could potentially order from a different supplier. This is an issue with the methodology currently, but by gathering more and more supplier-specific emission factors and referencing them to the global-average emission factors below, there is potential to create a robust procurement emissions reporting system. An investigation into supplier specific emission factors is being carried out with the goal of using this more accurate methodology in the next greenhouse gas report.

### 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 and in Figure 1 (the full carbon footprint graph) due to their size. 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. Obviously, 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 organization 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 organization. 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*

DBEIS emission factors were used for landfill, recycling, glass, WEEE and waste-to-energy combustion (DBEIS, 2021). These factors and waste data for 2017 – 2029 can be seen in the table below. 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 are UK emission factors.

*Table 7 – Scope 3: Waste emissions*

| | *Emissions (tCO2e)* | | | | |
|---|---|---|---|---|---|
| **Waste** | **2017** | **2018** | **2019** | **2020** | **2021** |
| Landfill | 97.4 | 98.4 | 42.5 | - | - |
| Waste to energy | - | - | 2.7 | 2.4 | 1.5 |
| Mixed Recyclables | - | - | - | 0.0 | - |
| Glass | 4.7 | 4.3 | 4.1 | 2.0 | 0.8 |
| Organic | 0.3 | 0.3 | 0.4 | 0.7 | 0.6 |
| WEEE | 0.2 | 0.2 | 0.5 | 0.2 | 0.0 |
| **Total** | **102.6** | **103.2** | **50.2** | **5.3** | **2.9** |

## 4.5 Scope 3: Category 6 *Business Travel*

The data for this category came from two sources, Club Travel and Procurement. The data received covered flights, car journeys, hotels, buses, trains, ferries and taxis. The most accurate data was for the club travel flights. This was sectioned into short, medium or long haul and into economy or business class. Emission factors from DBEIS (DBEIS, 2021) were acquired for the short, medium or long haul flight per passenger kilometre, a factor of 1.5 is multiplied by the business class flights and all flight emissions are multiplied by a radiative forcing factor (RFF) of 2. Other data from Club Travel included the amount spent on hotels, train journeys and car hire.

The emission factor for Irish rail is 24gCO2e/km as per CIE (CIE, 2021). The 2016 Irish rail report (National Transport Authority, 2016) states "During 2010, the average rail passenger km in Ireland created just 60g of greenhouse gases, vs. 210g for road vehicles". It also states "Iarnród Éireann carries 39.8 million passenger journeys annually, accounting for 18% of the 224 million passenger journeys made annually on Public Service Obligation (PSO) public transport throughout the State. This equates to €174.5m in passenger revenue. Currently c.16m passengers use the DART network and c.21m passengers use the Intercity and Commuter network annually, accounting for over 1500m passenger kilometres." So, €174.5m passenger revenue divided by 1500m passenger kilometres gives €0.1163/km. Taking the 24gCO2e/km for rail and divide by €0.1163/km = 0.2063 kgCO2e/€. From here, using the DBEIS emission factor for an average car for a ratio (168.43 gCO2e/km), the following emission factor is calculated for spend on car travel: 1.4478 kgCO2e/€. Hotel data contained info on the city stayed in and the number of nights spent. The DBEIS inventory contains factors for the emissions associated with a night's stay in a hotel from a list of 54 given countries. For any countries that an emission factor was not provided, an average was calculated (36.5 kgCO2e/night). The flight data from procurement was only given in euros spent, without the division by class or flight length. To account for this, the club travel data was used to calculate an average of the kilometres travelled per euro spent. From four years of data (2016-2020) this resulted in 18.1 km/€ for flights. This was multiplied by the amount spent on flights from procurement to get a total number of kilometres, as seen in the table below. This was then multiplied by an average of the short, medium, long haul emission factors (0.173 kgCO2e/km). Rail and bus were calculated using the rail factor calculated above (0.2063 kgCO2e/€). Taxis used the car factor from above (1.4478 kgCO2e/€) and DBEIS provide emission factors for an average car km (0.16843 kgCO2e/km).

*Table 8 - Scope 3: Business Travel Emissions from Club Travel*

| | *Emissions (tCO2e)* | | | | |
|---|---|---|---|---|---|
| **Business Travel** | **2017** | **2018** | **2019** | **2020** | **2021** |
| Short Haul - Economy | 164.8 | 173.5 | 163.2 | 104.6 | 69.1 |
| Short Haul - Business | 0.2 | - | 0.1 | | |
| Medium Haul - Economy | 922.8 | 858.3 | 1052.6 | 96.7 | 41.6 |

| | | | | | |
|---|---|---|---|---|---|
| Medium Haul - Business | 5.5 | 8.8 | 3.4 | | |
| Long Haul - Economy | 2556.2 | 2326.5 | 2321.2 | 454.6 | 136.5 |
| Long Haul - Business | 194.8 | 136.7 | 250.1 | | |
| Hotel | 50.3 | 49 | 59.7 | 36.6 | 18.2 |
| Rail | 2.2 | 2.8 | 3.6 | 0.8 | 0.4 |
| Car hire | 11.4 | 15.4 | 18.9 | 2.0 | 8.2 |
| **Total** | **3,908.2** | **3,571.0** | **3,872.8** | **695.2** | **274.0** |

*Table 9 - Scope 3: Business Travel Emissions from Procurement*

| | *Emissions (tCO2e)* | | | | |
|---|---|---|---|---|---|
| **Business Travel** | **2017** | **2018** | **2019** | **2020** | **2021** |
| Flights | 580.5 | 540.6 | 274 | 9.0 | 1.4 |
| Train/ferry | 20 | 20.8 | 10.7 | 5.8 | 0.9 |
| Taxis | 127.9 | 130 | 71.3 | 35.0 | 5.7 |
| Bus | 14.9 | 17.2 | 8 | 3.5 | 0.9 |
| Car | 218.2 | 222.9 | 140.8 | 91.1 | 43.4 |
| **Total** | **961.5** | **931.5** | **504.8** | **144.4** | **52.2** |

## 4.6 Scope 3: Category 7 *Commuting*

A commuting survey was carried out as part of a student's master's thesis in 2022, to calculate the emissions associated with the commuting behaviour of students and staff. The survey had a high response rates of 10% or 2,138 responses, a higher proportion which came from staff (34% compared to 7.4% students). The Scope 3 carbon dioxide emissions were calculated for each participant in the survey. The sequence of the calculations was as follows:

a) Calculate how far each participant commute is from their residence to the campus, from data collected.
b) The distance each participant covers each week per mode of transport was calculated.
c) If the participant commuted via car, then the vehicle specifications they provided were used to determine what emissions category it was.

d) The distance covered by each mode of transport per week was multiplied by the average CO2 emissions in Table 10 to give the total emissions per week.

e) Staff members weekly emissions was multiplied by 46.1 to give annual emissions, while students weekly emissions were multiplied by 32 for annual emissions.

f) Finally, the results for staff members and students were extrapolated individually, to give a more accurate account of the entire University of Galway population.

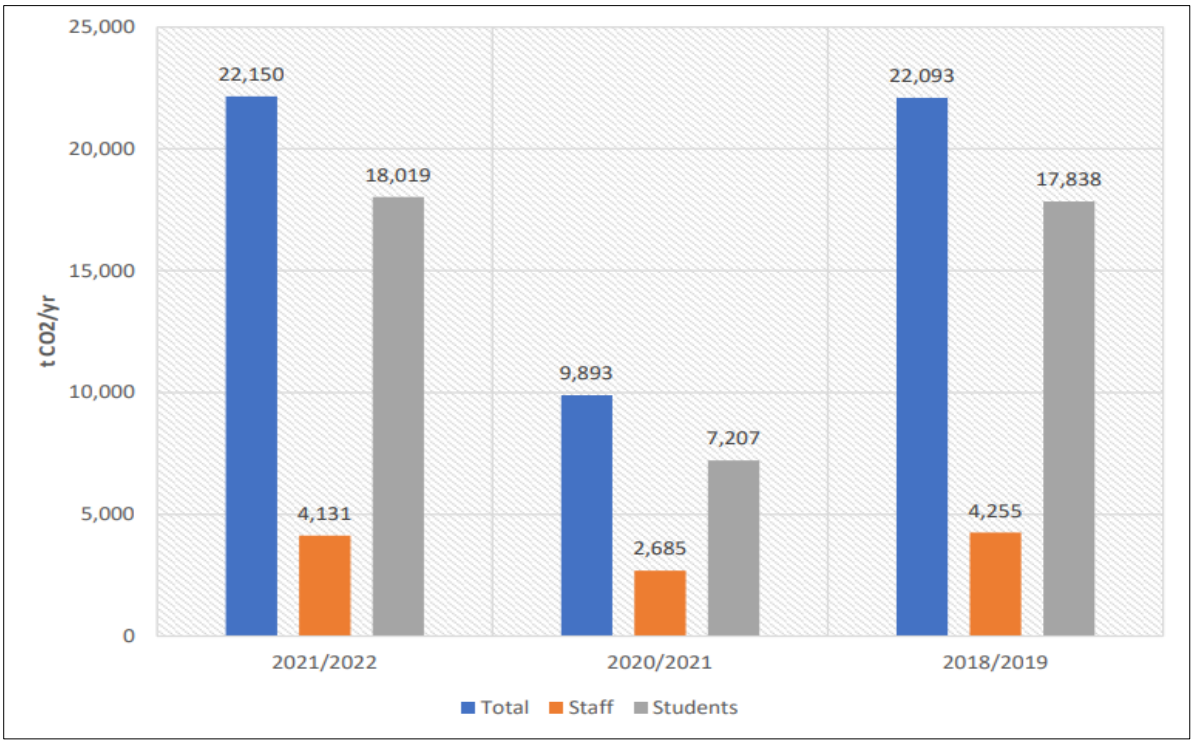


*Figure 4 - Commuting Emissions showing student/staff split for 2018, 2020 and 2021.*

*Table 10 - Ecoinvent CO2 Emission Factors for Transport Modes*

| Transport Mode | Emission Factors (kg C02 eq/km) | Registration Period |
|---|---|---|
| Car RER generic | 0.333 | Any |
| Large diesel EUR03 | 0.415 | 2000-2005 |
| Large diesel EUR04 | 0.3968 | 2006-2010 |
| Large diesel EURO5 | 0.3896 | 2011+ |
| Large petrol EUR03 | 0.4402 | 2000-2005 |
| Lary petrol EUR04 | 0.424 | 2006-2010 |
| Large petrol EURO5 | 0.4108 | 2011+ |
| Medium diesel EURO3 | 0.3312 | 2000—2005 |
| Medium diesel EUR04 | 0.3191 | 2006-2010 |
| Medium diesel EURO5 | 0.3123 | 2011+ |

| | | |
|---|---|---|
| Medium Petrol EUR03 | 0.3707 | 2000-2005 |
| Medium Petrol EUR04 | 0.3542 | 2006—2010 |
| Medium Petrol EURO5 | 0.3414 | 2011+ |
| Small diesel EUR03 | 0.2475 | 2000-2005 |
| Small diesel EUR04 | 0.2418 | 2006-2010 |
| Small diesel EURO5 | 0.2362 | 2011+ |
| Small petrol EUR03 | 0.3012 | 2000-2005 |
| Small petrol EUR04 | 0.2843 | 2006-2010 |
| Small petrol EURO5 | 0.2719 | 2011+ |
| Battery electric (fully electric — EV) | 0.2239 | Any |
| Plug-in hybrid electric (PHEV) | 0.3123 | Any |
| Hybrid electric | 0.3191 | Any |
| Bus GLO | 0.109 | |
| Train GLO | 0.0737 | |
| Tram GLO | 0.0871 | |
| Motor Scooter | 0.124 | |
| Cycling GLO | 0.011 | |
| Walk | 0 | |

It should be noted that the engine abbreviations "Small," "Medium," and "Large" in Table 10 reflect engine sizes of less than 1.4 litres, 1.4 to 2 litres, and larger than 2 litres, respectively.

*Table 11 - Scope 3: Commuting Emissions*

| | *Emissions (tCO2e)* | | | | |
|---|---|---|---|---|---|
| **Commuting** | **2017** | **2018** | **2019** | **2020** | **2021** |
| Total Emissions (tCO2e) | 20,920 | 22,093 | 17,800 | 9,893 | 22,150 |

## 4.7 Scope 3: Other *Water*

Water consumption data was acquired from the Building and Estates Office. The UK conversion factors document has emission factors for water supply and water treatment (DBEIS, 2021), both of which apply to University of Galway.

*Table 12 - Scope 3: Water Emissions*

| | *Emissions (tCO2e)* | | | | |
|---|---|---|---|---|---|
| **Water Consumption** | **2017** | **2018** | **2019** | **2020** | **2021** |

| | | | | | |
|---|---|---|---|---|---|
| Supply | 11.6 | 11.8 | 10.8 | 8.7 | 6.7 |
| Treatment | 21.1 | 21.5 | 19.8 | 15.8 | 12.2 |
| **Total** | **32.7** | **33.3** | **30.6** | **24.5** | **18.8** |

# 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.

## 5.1 Carbon Footprint Improvements

*Categories 1 & 2 Purchased Goods & Services & Capital Goods*

As explained above, an inventory of more accurate emission factors is being put together for purchased goods & services and capital goods. This emission factor inventory should remain up to date and will operate as a link between procurement and suppliers, keeping the conversation flowing about carbon reporting and reducing.

*Category 5 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 the incineration of municipal solid waste.

*Category 6 Business Travel*

In future, it would be useful to require kilometres travelled for ferry, rail, bus, taxis, and flights in Agresso (procurement) as opposed to just reporting on the amount spent. Rail, bus, taxis and flights could also be further separated into vehicle type and fuel type. Incorporating the emission factors above into the procurement and club travel systems will give automated and accurate emissions. The more granular the data is the better.

## 5.2 Roadmap to Net-Zero

University of Galway's carbon footprint as of 2018 is around 47,000 tonnes of CO2 equivalent of greenhouse gas emissions to the atmosphere each year. According to GoCarbonNeutral.ie (GoCarbonNuetral, 2021) the cost of carbon offsetting is €25 per tonne of CO2 equivalent. So, if University of Galway were to fully offset the carbon from 2019, it would cost about €1.25M. To put the amount of GHG emissions associated with the activities of 2018 into context, in

order to fit the entire 47,000 tonnes of carbon into the Alice Perry Engineering building without compressing the gas, it would need to be about 4.7km tall, or about 1,175 storeys high! Or, if the greenhouse gases could be compressed into a similar density to stones, 2,500 trucks would be needed annually to take away the GHG emissions from the University annually, one truck every 4 hours all year round! If the trucks parked bumper to bumper along the road from the University, by the end of the year the line of trucks would make it to Athenry, Inverin, Oughtarard or Headford (about 20km). The rough sketch here shows the carbon footprint in terms of area of Irish native woodland trees growing over 10 years that we would need to plant to offset emissions. This is the area needed every year! Obviously this is an unrealistic solution to the institutions carbon footprint, a more realistic one is called a Climate Action Plan or a Roadmap to Net-Zero Emissions. An example of this can be seen in Edinburgh University (Williamson et al., 2020). A Roadmap to Net-Zero involves developing a baseline of past, present and future emissions using science based reduction targets. As mentioned in the introduction, 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. There is also a commitment to move ambitiously towards carbon neutrality by 2030 in the Universities Sustainability Strategy. Using these targets combined with the past and present baseline carbon footprints presented in this report, a roadmap can now be constructed.

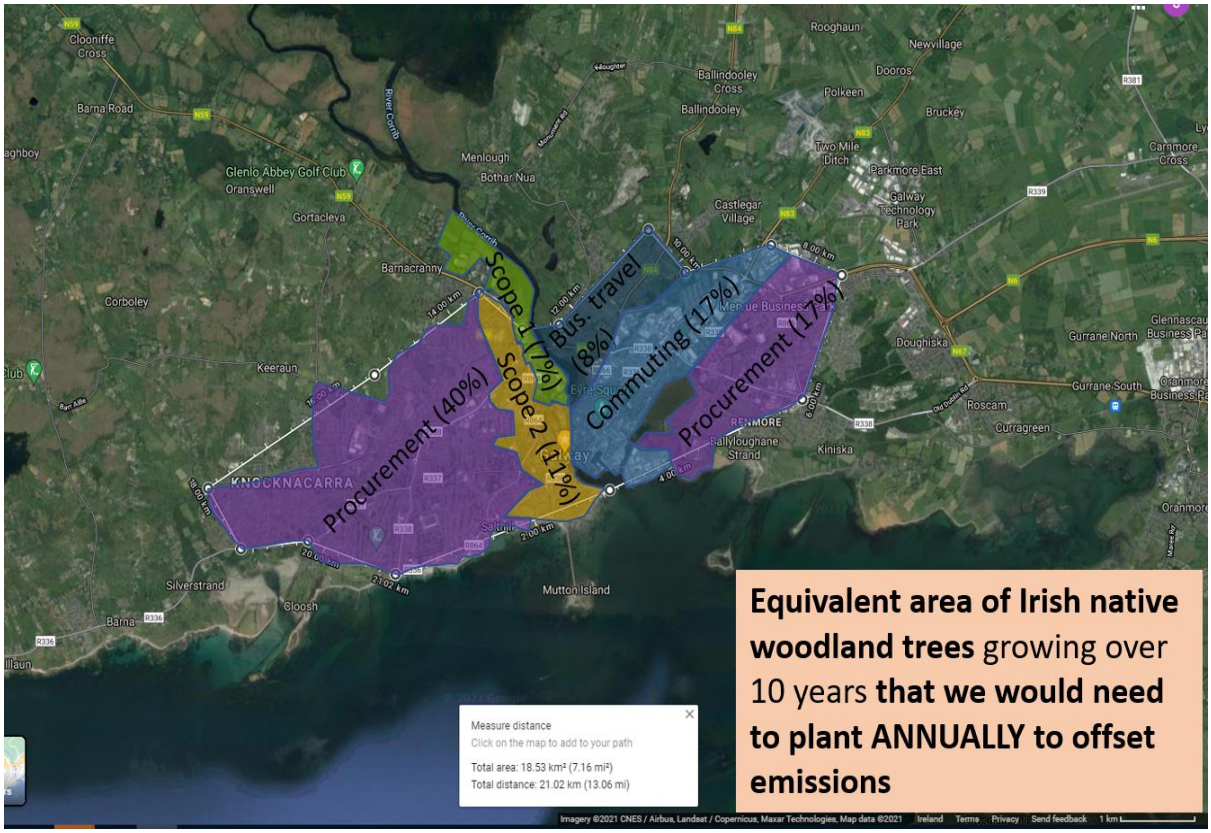


*Figure 5 – University of Galway Carbon Footprint shown in terms of area of native woodland trees, i.e. an offsetting scenario*

# 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 procurement 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 13 - Scope 3: Purchased Goods & Services Product Codes linked to EXIOBASE 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 |
| SERVE145 | Education Recruitment Consultants | Education services | 0.083 |