NUI Galway

Carbon Footprint Report

Baseline 2017, 2018 & 2019

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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 NUI 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 NUI Galway includes global scope 1, 2 and 3 emissions attributable to NUI Galway, as defined in The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard. GHG emissions and the impact of NUI 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 NUI Galway and presents the results of the carbon footprint assessment that has been carried out for NUI Galway for 2017-2019. Gaining an understanding of the sources and quantities of GHG emissions attributable to NUI Galway is an imperative first step in the creation of a climate action plan for NUI Galway and setting a 1.5°C aligned science-based target for NUI 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 NUI Galway to net zero.

NUI Galway
OÉ Gaillimh

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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, 2018 and 2019 GHG emissions under scopes 1, 2 and 3 for NUI Galway. The figures are reported in tonnes of carbon dioxide equivalent (tCO2e). There are also two extra columns for comparison, which show the emissions per full time equivalent (FTE) of staff and students and per meter squared of gross internal floor area (GIA). Scope 1 and 2 emissions have been independently verified by the Sustainable Energy Authority of Ireland (SEAI). Scope 3 emissions have been internally reported, but not independently verified.

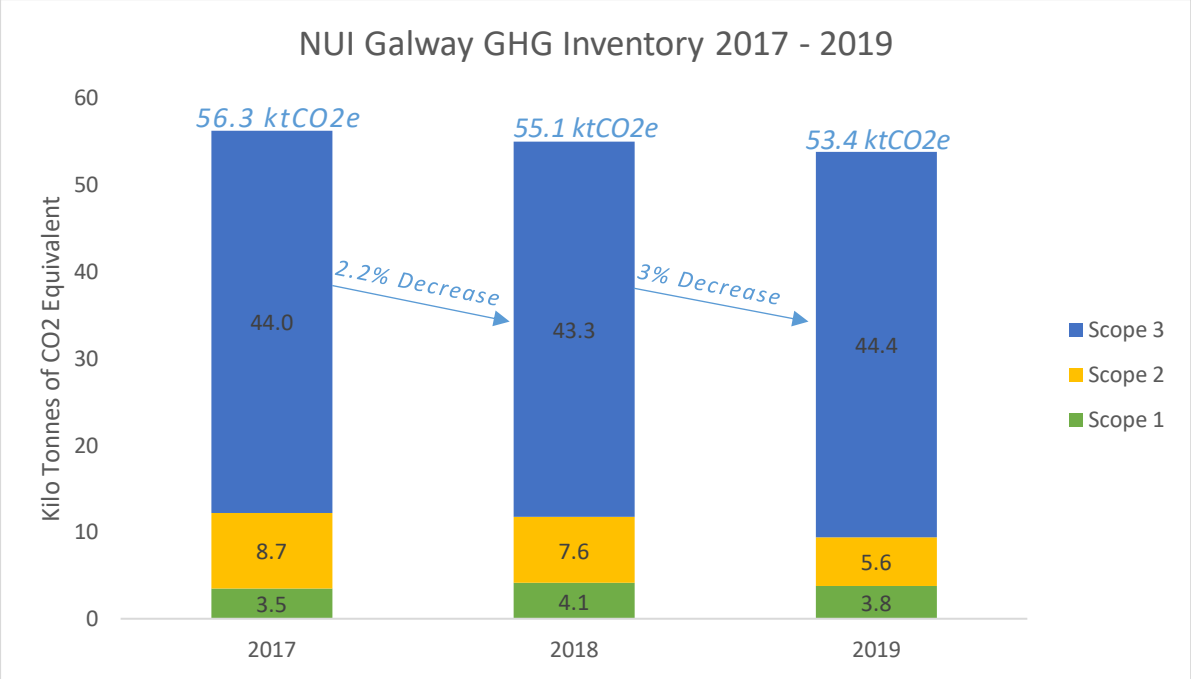

Figure 1 - NUI Galway GHG Inventories 2017, 2018 & 2019

Table 1 - NUI Galway GHG Inventory Summary 2017, 2018, 2019 (tonne of CO2 equivalent)

	Scope 1 (tCO2e)	Scope 2 (tCO2e)	Scope 3 (tCO2e)	Total (tCO2e)	tCO2e/FTE	tCO2/m²
2017	3, 463	8,709	44,075	56,247	2.91	0.362
2018	4,141	7,608	43,310	55,059	2.78	0.355
2019	3,783	5,594	44,020	53,396	2.63	0.347

Table 2 - NUI Galway Full Time Equivalents (FTEs) and campus area (GIA) for 2017, 2018 & 2019

	Staff (FTE)	Students (FTE)	GIA (m^2)
2017	2,126	17,197	155,090
2018	2219	17,552	155,090
2019	2,231	18,094	155,090

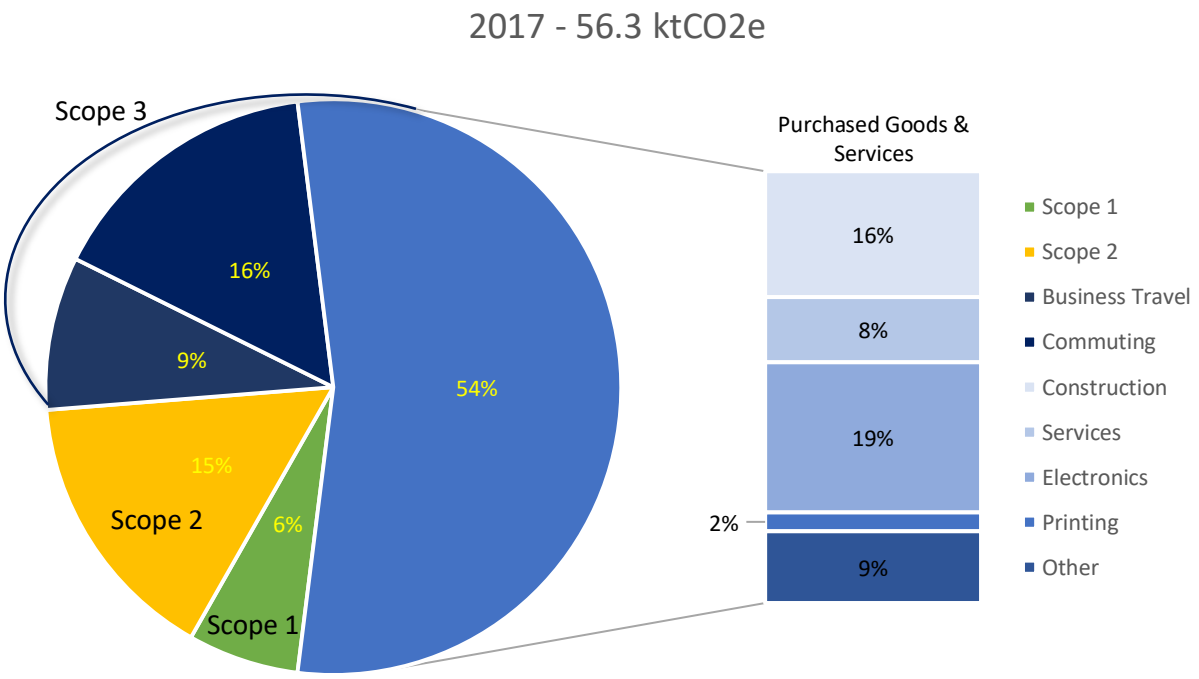

Figure 2 – NUI Galway 2017 GHG Inventory

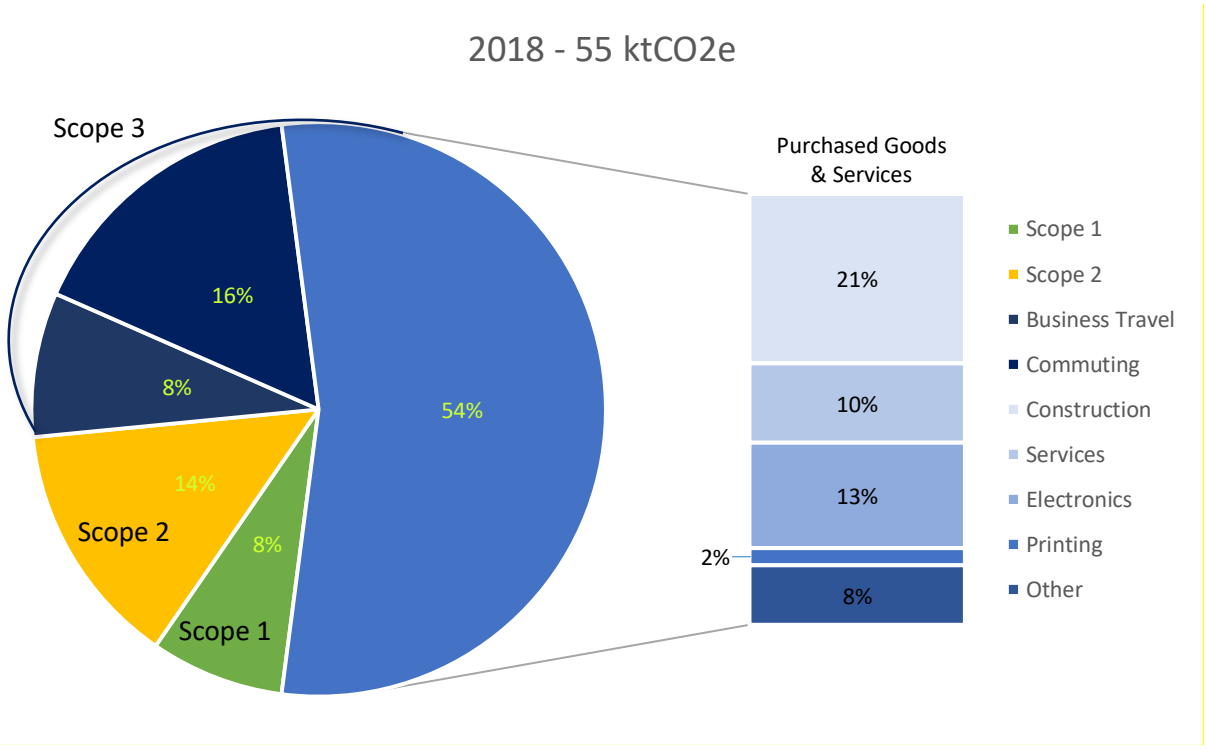

Figure 3 – NUI Galway 2018 GHG Inventory

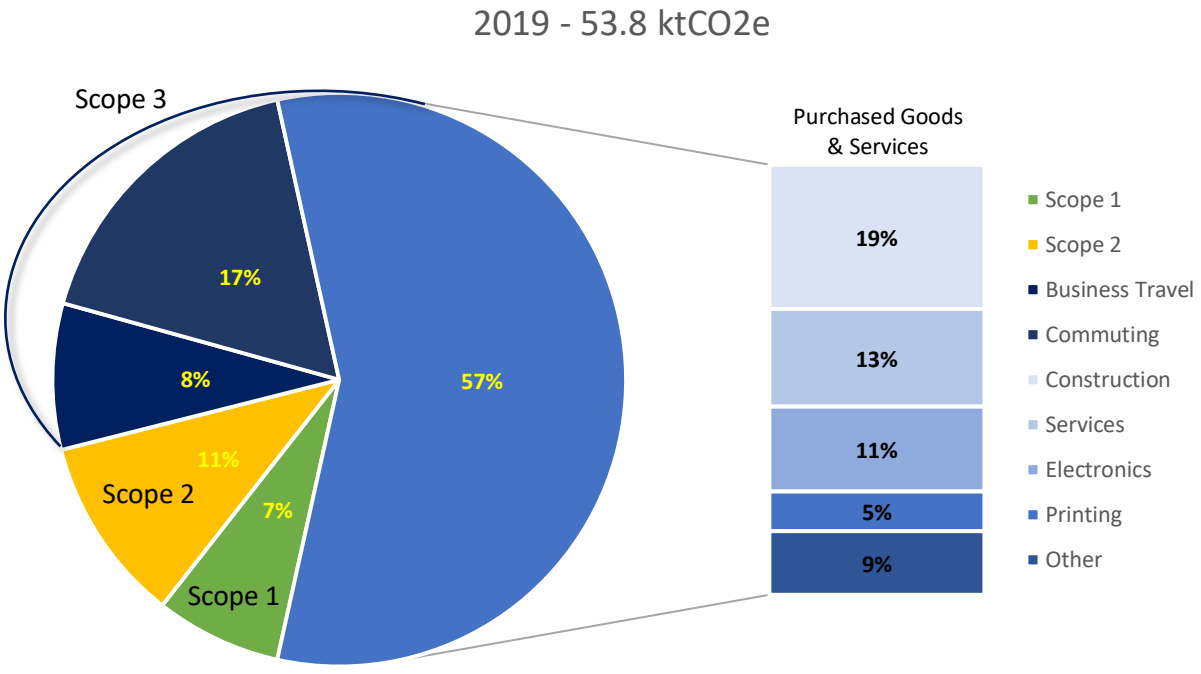

Figure 4 – NUI Galway 2019 GHG Inventory

2 Introduction

The '*NUI Galway Strategic Plan 2020-2025'* and the '*NUI 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, NUI 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 NUI Galway. This baseline will feed into the creation of a climate action plan and a roadmap to net-zero greenhouse emissions for the University; the first step in NUI Galway's journey. With a baseline understanding of the amount of greenhouse gas emissions that are attributable to NUI Galway, 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). But as more organisations push to include the final scope (scope 3 – value 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 UCC (Poland, 2020), and DCU (Morrissey et al., 2020). The Scope 1 and 2 training consisted of four webinars which are available for free online by the Greenhouse Gas Protocol, 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 NUI 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 as used in NUI Galway's Energy Review; that is, NUI Galway Main Campus. Buildings that are included within the scope of the NUI Galway ISO50001 EnMS are documented and included in a thorough review and updated on the NUI 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 NUI 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 5 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.

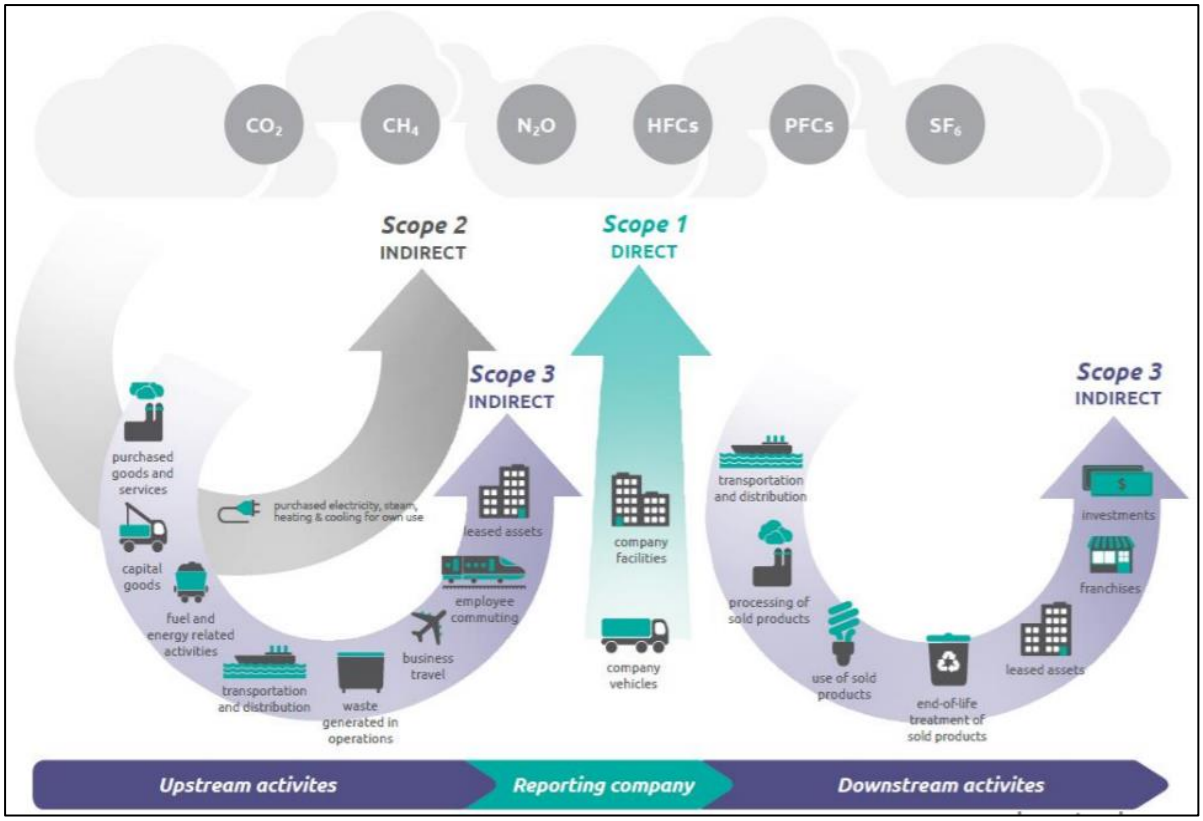

Figure 5 - Scope 1, 2 and 3 Emission broken into upstream activities, on-site activities and downstream activities

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 3 below shows the seven scope 3 categories selected for reporting in this baseline inventory.

Table 3 – Estimated categories which will have a high carbon footprint

#	Category	Data Source	Notes
1	Purchased goods and services	Financial Accounting Office	Cradle-to-gate emission
2	Capital goods	Financial Accounting Office	Capital goods cradle-to-gate emissions
3	Fuel & energy-related activities	Financial Accounting Office	Fuel & Electricity purchased
5	Waste generated in operations	Buildings & Estates	Waste treatment emissions
6	Business travel	Financial Accounting Office	Travel paid for by NUIG
7	Employee commuting	2014/15 Travel Survey	Employee & Student commuting
-	Other	Buildings & Estates	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 NUI 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 NUI 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 NUI Galway ISO50001 formal Energy Management Systems Standard (EnMS) are documented and included in a thorough review and updated on the NUI Galway Energy Manual and Dashboard. There are 58 buildings included that have a total internal floor area of 155,090 m^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. NUI 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.

Table 4 - Scope 1 and 2 Emissions Summary

Scope 1 & 2	**2017**		**2018**		**2019**	
Fuel	**KWh**	**tCO2e**	**KWh**	**tCO2e**	**KWh**	**tCO2e**
Electricity Imports	18,037,986	8,708.7	17,424,502	7,607.5	16,879,260	5,593.8
Electricity Generated on-site	-	-	160,000	0	175,000	0
Gas Imports	13,672,609	2,798.8	15,689,313	3,211.6	15,079,820	3,086.8
LPG	77,000	20.6	698,010	160.1	667,450	153
Gasoil	1,391,680	306	1,371,595	362.0	1,151,541	290.1
Wood pellets	396,957	104	459,082	121.1	415,837	109.7
Solar Thermal	75,000	0	75,000	0	75,000	0
Road Diesel	75,000	36.2	80,250	21.2	55,544	14.7
Biodiesel Litres/ % biodiesel	860,783	197.4	1,325,120	265.0	527,873	128.2
Total	34,587,015	**12,172**	37,282,872	**11,749**	35,027,325	**9,376**

Notes on Energy Review document:

In the NUI 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 NUI 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 associated with solar PV and solar thermal combined, which are reported as negative emissions. In 2019, the equivalent reported value was 89.7 tCO2e. For this report, renewables are considered zero carbon, not carbon negative.

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

Categories 1 and 2 are the highlight of this report. They are also reported under the same heading, as current and capital expenditure have not been separated for emissions reporting. Thus, this section represents all Purchased Goods & Services by the University. This is where the largest portion of the greenhouse gas emissions attributable to NUI Galway lies and these categories were the most time and work intensive to calculate. Figure 6 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 NUIG would then apply to every product purchased from said supplier. The hybrid method is what is followed in this report, which 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 spend-based method is the secondary method used here, which involves estimating emissions for goods and services by multiplying the amount spent on a good/service by an industry average or global average emission factor.

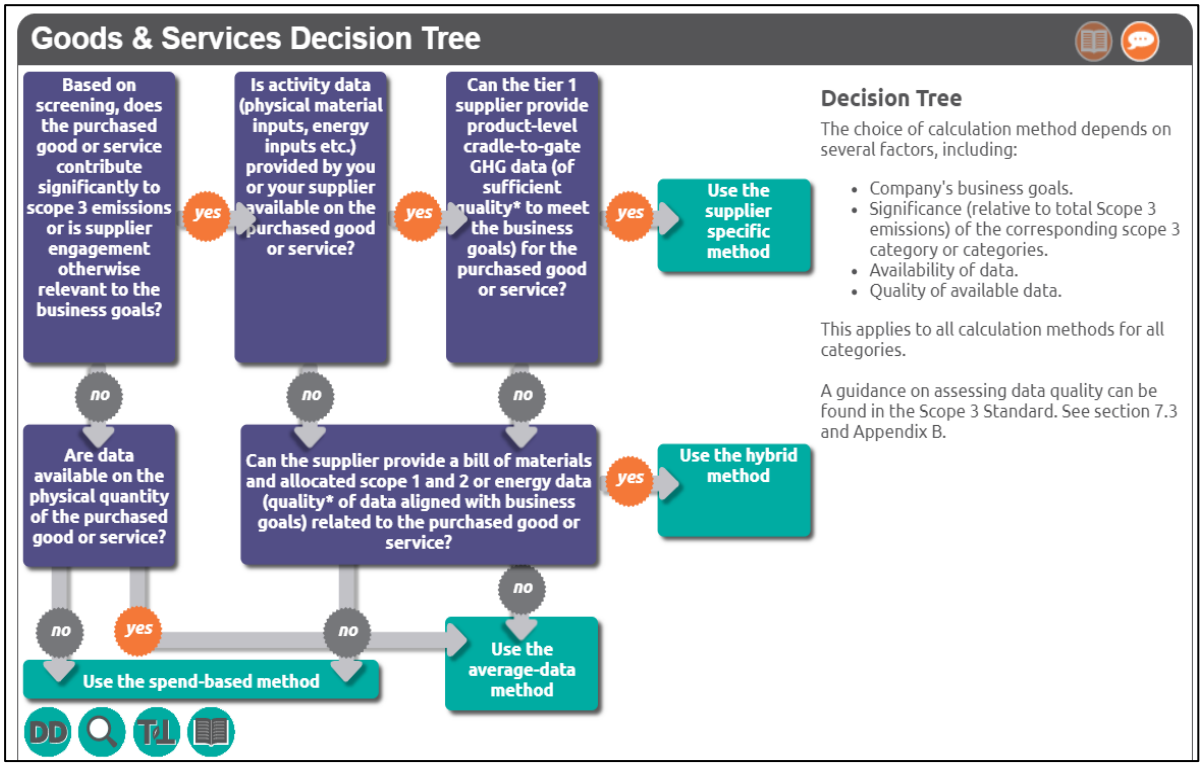

Figure 6 - Decision Tree for Categories 1 & 2 for deciding an emissions calculation method

As mentioned in section 3 of this report, it is important to prioritise scope 3 categories. Creating a first draft of scope 3 emissions, using the online Scope 3 evaluator tool provided by the GHG protocol (Quantis, 2019), highlighted how much emissions are coming from these categories. It was also important to create this estimate baseline, as it builds the base for the hybrid method to be applied. The scope 3 evaluator uses the spend-based method and global average emission factors to calculate emissions. This was achieved using Detailed Product Code Reports from the University's Procurement & Contracts Office. These contain a history of the University's purchases through Agresso, NUI Galway's Financial Management 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.

To create a baseline estimate using the spend-based method, the high-level product code categories were linked to the industry sectors in the Scope 3 evaluator. The product codes were summed and the totals multiplied by the global-average emission factors. Table 5 below shows the global average emission factors associated with each industry sector from the scope 3 evaluator and there is a table in the appendix of this report showing the product code descriptions and linked industry sector. Table 6 presents the summed spend for each product code category and the associated emissions. Spend was converted into US dollars and then multiplied by the emission factor. As can be seen in this table, there are stand out categories, which are highlighted in the table. The main sectors being:

- Construction: Product Code BUILD
- Electrical & Optical equipment: Product Codes COMP + AUDIO
- Community, social & personal services: Product Code SERVE
- Education goods: Product Codes LAB + OFFICE
- Pulp, paper & printing: Product Codes PRINT + STAT + LIBRAY

In order to make the Scope 3 calculation more accurate and specific to NUI Galway, 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 University's Financial Management System operates by product code at the most granular level. There are many 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 Purchased Goods & Services 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.

Table 5 – Scope 3: Goods & Services Emission Factors

Industry Sector - Scope 3 Evaluator	**EEIO Emission Factor (tCO2e/$)**
Chemicals and chemical products	0.00112
Construction	0.00069
Education - standard goods	0.00025
Electrical and optical equipment - standard goods	0.00081
Electricity, gas and water supply	0.00487
Food, beverages and tobacco - service	0.00089
Health and Social Work - standard good/servce	0.00026
Other - standard goods	0.00063
Other Community, Social and Personal Services	0.00063
Post and Telecommunications	0.0003
Pulp, Paper, Paper, Printing and Publishing - standard good/service	0.00064
Retail Trade, Except of Motor Vehicles & Motorcycles; Repair of Household Goods	0.00022
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles	0.00021

Table 6 - Scope 3: Goods & Services Emissions

Product Code	2019 Total Spend	2018 Total Spend	2017 Total Spend	Emissions 2019 (tCO2e)	Emissions 2018 (tCO2e)	Emissions 2017 (tCO2e)
AUDIO	€872,022	€889,034	€549,875	790.7	806.2	498.6
BUILD	€13,240,085	€15,130,155	€11,436,068	10,227.4	11,687.4	8,833.8
CATER	€367,483	€589,774	€537,532	366.1	587.6	535.6
CLEAN	€106,917	€103,155	€118,625	134.1	129.3	148.7
COMP	€6,575,982	€7,136,301	€11,076,934	5,963.1	6,471.2	10,044.5
FOOD	€37,273	€37,063	€33,782	37.1	36.9	33.7
LAB	€7,047,364	€8,133,791	€11,849,419	1,972.4	2,276.4	3,316.4
LIBRAY	€246,437	€313,96	€212,178	176.6	225	152
MEDICL	€667,220	€348,592	€411,134	194.2	101.5	119.7
MISC	€430,131	€941,165	€873,195	303.4	663.8	615.9
OFFICE	€209,985	€250,305	€128,719	58.8	70.1	36.0
POST	€329,069	€427,549	€301,257	110.5	143.6	101.2
PRINT	€3,890,891	€1,059,072	€1,272,768	2,787.7	758.8	911.9
SAFSE	€355,942	€140,096	€134,722	103.6	40.8	39.2
SERVE	€9,729,338	€7,759,396	€6,494,842	6,862	5,472.6	4,580.7
SPORT	€53,668	€16,31	€29,108	13.2	4	7.2
STAT	€207,677	€277,234	€360,200	148.8	198.6	258.1
UTIL	€18,391	€880	€10,396	100.3	4.8	56.7
VEHIC	€56,650	€204,282	€118,685	13.3	48	27.9
Total	**€45,018,734**	**€45,018,498**	**€47,169,230**	**30,363**	**29,726.5**	**30,317.7**

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

In the GHG Protocol Corporate standard, it is recommended to include this category 'category 3 fuel and energy related' in scope 3 to account for any emission associated with scopes 1 and 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*

Emission factors produced by Department for Business, Energy & Industrial Strategy (DBEIS) in the UK 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 7. Currently, this data does not include waste from Commercial Services (i.e. restaurants, cafes and shops on campus) or on campus accommodation. Hazardous waste is also not recorded as of yet in NUI Galway.

Table 7 – Scope 3: Waste emissions

Waste	2017 (kg)	2018 (kg)	2019 (kg)	DBEIS emission factors (kg CO2e/kg waste)	Em 17	Em 18	Em 19
Landfill	208,530	210,715	91,146	458.2	97.4	98.4	42.5
Waste to energy	-	-	125,500	21.3	0.0	0.0	2.7
Mixed Recyclables	222,649	204,503	194,508	21.3	0.0	0.0	0.0
Glass	14,752	16,042	19,200	21.3	4.7	4.3	4.1
Organic	-	-	-	10.2	0.3	0.3	0.4
WEEE	9,520	7,886	21,180	21.3	0.2	0.2	0.5

Moving forward, an emission factor from the Dublin waste-to-energy centre should be used, as well as emission factors for recycling and composting in Ireland, as those used in this report are UK emission factors.

4.5 Scope 3: Category 6 *Business Travel*

The data for this category came from two sources, Club Travel and NUI Galway Accounts. The data received covered flights, car journeys, hotels, buses, trains, ferries and taxis. The most accurate data was for the flights booked through Club Travel, where flights were categorised into short, medium or long haul and into economy or business class. Emission factors from DBEIS (DBEIS, 2021) were utilised 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. This data is summarised in Table 8.

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

Flights – Club Travel	Activity Data 2017	Activity Data 2018	Activity Data 2019	EF - (kgCO2e /unit)	RFF and Class Factor	Emission 2017 (tCO2e)	Emission 2018 (tCO2e)	Emission 2019 (tCO2e)
Short Haul - Economy	545,585 km	574,507 km	540,439 km	0.15102	*2	164.8	173.5	163.2
Short Haul - Business	382 km	-	297 km	0.15102	*2*1.5	0.2	-	0.1
Medium Haul - Economy	3,281,174 km	3,051,571 km	3,742,595 km	0.14063	*2	922.8	858.3	1052.6
Medium Haul - Business	12,976 km	20,790 km	8,001 km	0.14063	*2*1.5	5.5	8.8	3.4
Long Haul - Economy	8,643,466 km	7,866,626 km	7,848,692 km	0.14787	*2	2,556.2	2,326.5	2321.2
Long Haul - Business	439,174 km	308,201 km	563,702 km	0.14787	*2*1.5	194.8	136.7	250.1
Hotel	2131 nights	2087 nights	2508 nights	23.6	-	50.3	49	59.7
Rail	€10,870	€13,777	€17,395	0.2063	-	2.2	2.8	3.6
Car hire	€7,902	€10,622	€13,069	1.4478	-	11.4	15.4	18.9

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 gives 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 information 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 for flights paid directly by NUI Galway staff and students and subsequently claimed back as expenses was only given in euros spent, without the division by class or flight length. To account for this, the data from Club Travel 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 directly by staff and students on flights to get a total number of kilometres, as seen in the Table 9 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 9 - Scope 3: Business Travel Emissions from flights paid directly by NUI Galway staff and students and subsequently claimed back as expenses

Agresso Data	Activity Data (km or €) 2017	Activity Data (km or €) 2018	Activity Data (km or €) 2019	Emission Factors (kg CO2e/km or kgCO2e/€)	Em 2017 (tCO2e)	Em 2018 (tCO2e)	Em 2019 (tCO2e)
Flights	3,355,571	3,125,009	1,583,605	0.173	580.5	540.6	274
Train/ferry	€96,854	€100,859	€52,085	0.2063	20	20.8	10.7
Taxis	€88,324	€89760	€49,279	1.4478	127.9	130	71.3
Bus	€72,019	€83,262	€38,629	0.2063	14.9	17.2	8
Car	1,295,478	1,323,594	836,116	0.16843	218.2	222.9	140.8

4.6 Scope 3: Category 7 *Commuting*

A 2015 commuting survey was used to calculate the commuting behaviour of students and staff. Assumptions for the calculation include the number of days per year that staff and students commute to NUI Galway, these being 143.3 and 150 days, respectively. The survey had high response rates of 27% from 2,293 staff and 8% from 17,153 students. This survey is the only of its kind for NUI Galway since 2015, so the results are being used as a baseline for student and staff commuting methods for 2017, 2018 and 2019. The only variables in the calculations are the number of students and staff FTE each year. The first step is shown in Table 10 below, where an average distance for car usage and bus usage was calculated. The calculation here was the percentage by the mean distance. For example, 94% by 15km for staff car usage between 10 and 20km.

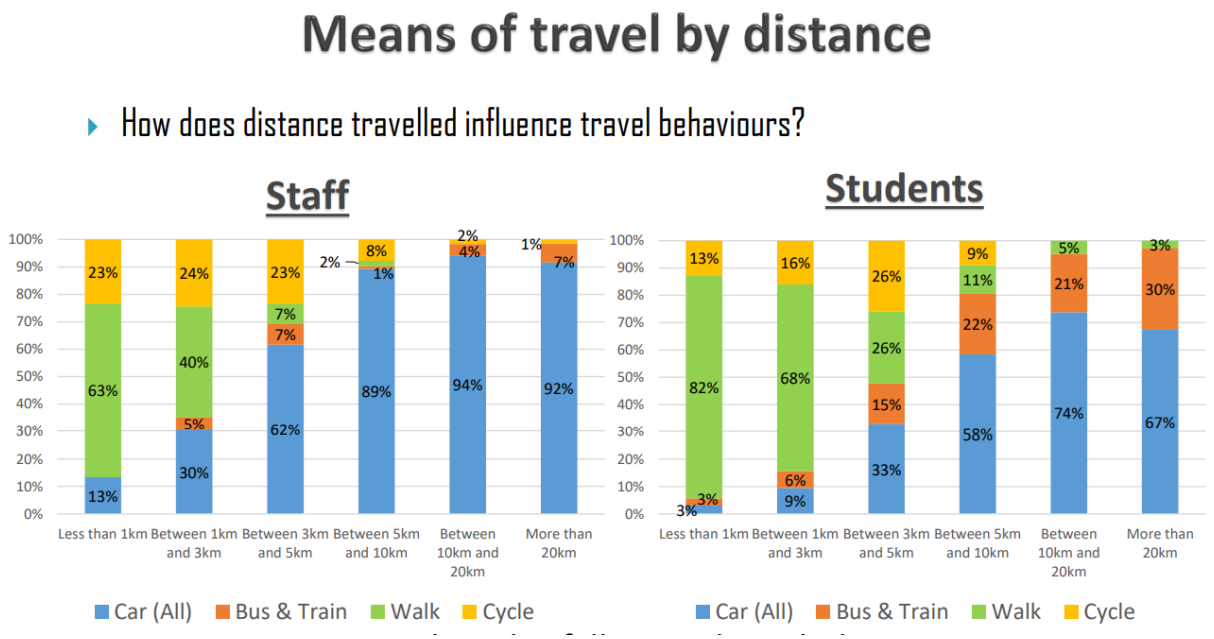

Figure 7 - Results for distance travelled from a 2015 commuting survey for NUI Galway Staff & Students

Table 10 – Calculation of average distance travelled for each transport mode

	Calculation	Average distance (km)
Car Staff	0.13(0.5)+0.3(2)+0.62(4)+0.89(7.5)+0.94(15)+0.92(20)	42.32
Bus/train Staff	0.05(2)+0.07(4)+0.01(7.5)+0.04(15)+0.07(20)	2.455
Car Student	0.03(0.5)+0.09(2)+0.33(4)+0.58(7.5)+0.74(15)+0.67(20)	30.365
Bus/train Student	0.03(0.5)+0.06(2)+0.15(4)+0.22(7.5)+0.21(15)+0.3(20)	11.535

From here, the percent of staff/students who use a certain method can be acquired from Figure 8. This is multiplied by the FTE of staff/students and by the number of commuting days as mentioned above. This gives the total number of kilometres travelled by a transport mode in the year.

$$Average\ distance\ (km) * FTE * \%\ who\ use\ travel\ mode * no.\ days = Total\ distance$$

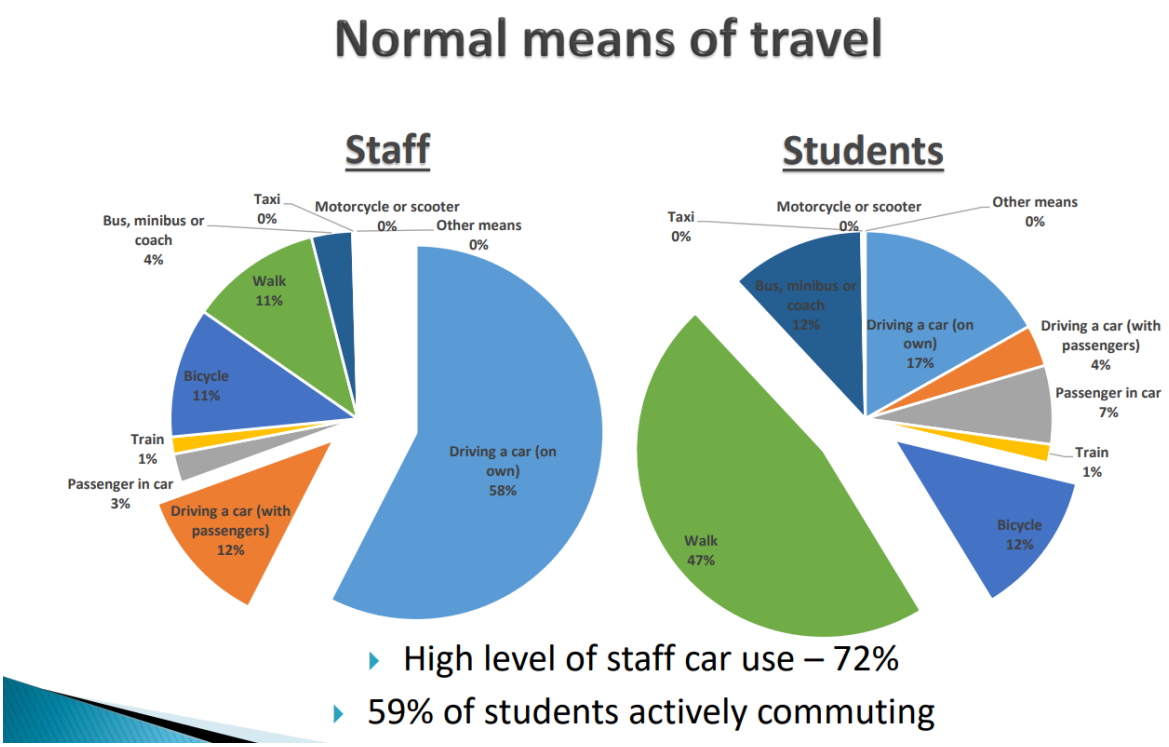

Figure 8 - Results for means of travel from a 2015 commuting survey for NUI Galway Staff & Students

Córas Iompair Éireann (CIE) have emission factors available for Bus Eireann (0.031 kgCO2e/km) and Irish Rail (0.024 - kgCO2e/km) (CIE, 2021). In the data available to NUI Galway, bus and train is collected under the one heading, so an average of Bus Eireann and Irish Rail emission factors was used for the bus, minibus, coach, train section. For car journeys, DBEIS have emission factors for the average diesel car and average petrol car (DBEIS, 2021). There was no separation between fuel types in the data, so an average was taken of these also.

Table 11 - Scope 3: Commuting Emissions

Commuting Survey	2017 (km)	2018 (km)	2019 (km)	Emission Factors (kg CO2e/km)	Emissions 2017 (tCO2e)	Emissions 2018 (tCO2e)	Emissions 2019 (tCO2e)
Car (Staff + Student)	31,342,861	32,141,320	32,207,780	0.275	8,645	8883	9085
Bus/train (Staff + Student)	3,905,447	4,006,185	3,987,046	0.0275	107	110	113

Future recommendations for commuting emissions:

- Carry out another commuting survey for more up-to-date data.
- Separate cars by fuel type including electric and hybrid.
- Give bus and train their own categories and any others deemed relevant.
- Allow for the entry of distance travelled rather than just bracketed groups, to give more accurate distances.

4.7 Scope 3: Other *Water*

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

Table 12 - Scope 3: Water Emissions

Water Consumption Data	Activity Data (m^3) 2017	Activity Data (m^3) 2018	Activity Data (m^3) 2019	DBEIS 2021 Emission Factors (kgCO2e/ m^3)	Emissions 2017 (tCO2e)	Emissions 2018 (tCO2e)	Emissions 2019 (tCO2e)
Supply	77,709	78,950	72,733	0.272	11.6	11.8	10.8
Treatment	77,709	78,950	72,733	0.149	21.1	21.5	19.8

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 Improvements to Carbon Footprint methodology

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 the University and suppliers, allowing the University and its suppliers to work together to reduce their greenhouse gas emissions.

Category 5 Waste

The waste category does not include catering waste and waste from on-campus accommodate, as catering is supplied by contractors in NUI Galway and the accommodation is managed by a third party from NUI Galway. Also, hazardous waste has not been include. All of these waste streams 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 when expenses are being claimed by staff and students, as opposed to just reporting on the amount spent. Incorporating the emission factors above into the Financial Management and Club Travel systems will give automated and more accurate emissions. The more granular the data is the better.

Category 7 Commuting

For the next revision of a commuting survey, a number of changes should be considered. Allow the option for participants in the survey to specify an exact number of kilometres, a fuel type, if applicable, and a car size, if applicable. Include electric and hybrid cars. Separate bus and train into their own categories. Again, the more granular the better.

5.2 Roadmap to Net-Zero

NUI Galway's carbon footprint as of 2019 is around 50,000 tonnes of CO_2 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 CO_2 equivalent. So, if NUI 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 2019 into context, in order to fit the entire 50,000 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, Oughterard or Headford (about 20km). Figure 9 shows a sketch of equivalent area of Irish native woodland trees growing over 10 years that NUI Galway would need to plant annually to offset emissions. This is the area of woodland that would be needed every year!

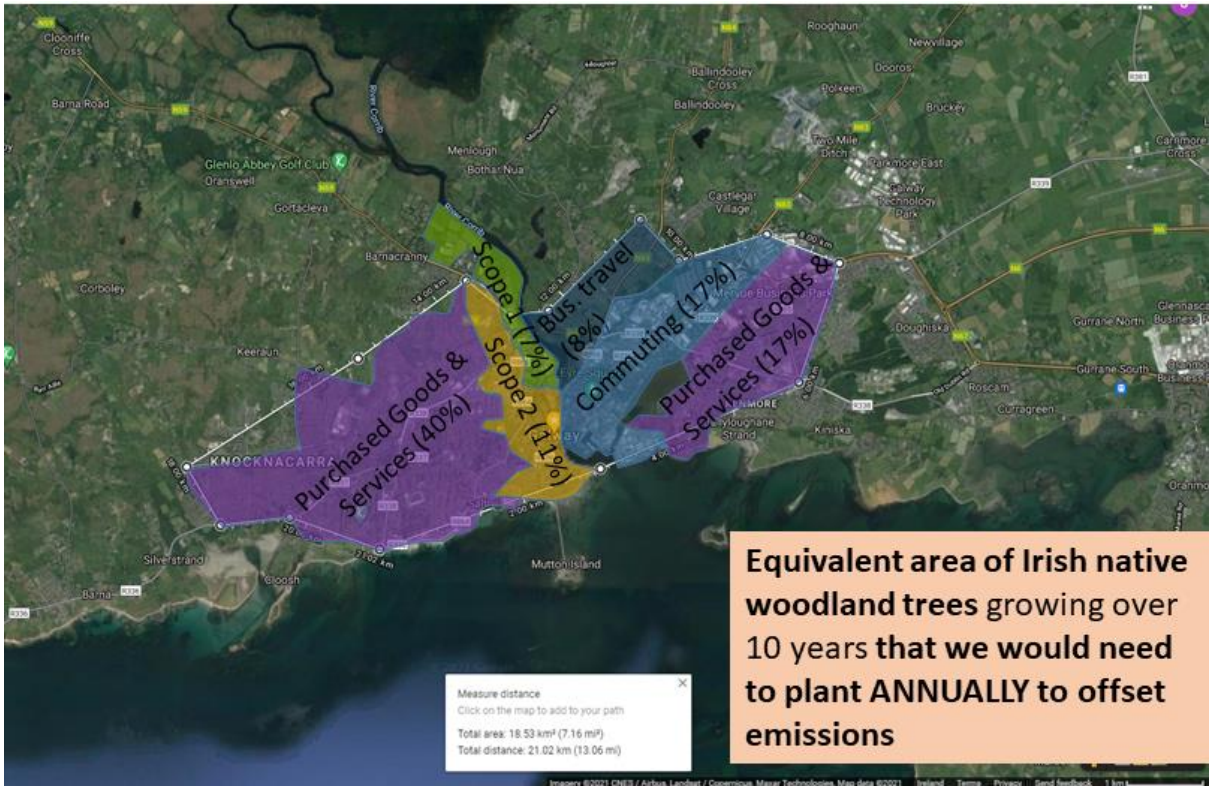

Figure 9 – NUI Galway Carbon Footprint shown in terms of area of native woodland trees, i.e. an offsetting scenario

Offsetting greenhouse gas emissions through carbon credits is not the recommended path for NUI Galway. A roadmap will be outline in a Climate Action Plan, outlining a roadmap to Net-Zero Emissions for the University. 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, NUI 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 University's Sustainability Strategy. Using these targets, combined with the past and present baseline carbon footprints presented in this report, a roadmap can now be constructed.

6 Conclusion

This report presents results and a methodology for creating a scope 1, 2 and 3 baseline carbon footprint for NUI Galway. Scope 1 and 2 have been independently verified by SEAI, while scope 3 is being reported for the first time this year and is not yet independently verified. With the figure of roughly 50,000 tonnes of CO2e as the University's baseline, this baseline can now be used in the creation of a climate action plan and a pathway to net zero. Scope 1 and 2 comprise about a fifth of the GHG emissions attributable to NUI Galway, while the indirect emissions accounted for in Scope 3 are four times this amount. NUI Galway has a commitment to net-zero GHG emissions by 2050, in line with the Irish Governments Climate Action Bill. That is, NUI Galway has committed to reducing its emissions following science-based pathways, with any remaining GHG emissions attributable to NUI 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 NUI Galway includes global scope 1, 2 and 3 emissions attributable to NUI Galway, as defined in The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard. From 2018 to 2019, there was a 3% reduction in GHG emissions attributed to NUI Galway, which equated to 1,663 tonnes of CO2e. If a linear reduction scenario was considered, GHG emissions would need to be reduced, on average, by

approximately 1,800 tonnes of CO2e per annum if NUI Galway is to become a net-zero GHG emissions organisation by 2050. As can be seen in this report, the University's carbon footprint spans a huge range of operations and activities, and a whole-of-University approach is considered best practice for tackling such a substantial change. This involves engaging with internal and external stakeholders. A just transition is one of the major goals of the Irish government, and for a University in Ireland, an effective engagement between the institution, its suppliers, the Department of Further and Higher Education, Research, Innovation and Science (DFHERIS), Higher Education Authority (HEA), local authorities in the region, transport providers and other key stakeholders about GHG emissions reductions is pivotal.

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Appendix

Table 13 - Scope 3: Purchased Goods & Services, Product Codes linked to Scope 3 Evaluator Industry Sectors

Product Code Description - NUI Galway	Product Code	Industry Sector - Scope 3 Evaluator
Audiovisual Equipment, Video Conferencing, Music, Photographic Equipment, Studio/Theatre	AUDIO	Electrical and optical equipment - standard goods
New Buildings Programmes, Building Maintenance, Furniture/Fitout, Facility Management Services, Security	BUILD	Construction
Catering Services, Catering Supplies, Water Coolers, Catering Equipment	CATER	Food, beverages and tobacco - service
Cleaning Services, Cleaning Consumables, Cleaning Equipment	CLEAN	Chemicals and chemical products
Computer Equipment, Computer Peripherals, Computer Consumables, Software, IT Networks, Mobile and Landline Charges, Computer Consultancy	COMP	Electrical and optical equipment - standard goods
This category is for use by Shannon College of Hotel Management only	FOOD	Food, beverages and tobacco - service
Laboratory Equipment, Instruments, Gases, Consumables, Chemicals & Reagents	LAB	Education - standard goods
Library Books, Periodicals, Library Services, Library Equipment	LIBRAY	Pulp, Paper, Paper, Printing and Publishing - standard good/service
Medical Equipment, Surgical Equipment, Medical Services, Research Services, Medical/Surgical Consumables	MEDICL	Health and Social Work - standard good/servce
Awards, Gift Vouchers, Works of Art	MISC	Other - standard goods
Office Equipment, Office Equipment Maintenance, Office Furniture	OFFICE	Education - standard goods
Postal Services, Courier Services, Delivery Charges, One4All Vouchers	POST	Post and Telecommunications
Binding Services, Printing Services, Graphic Design Services, Publishing Services	PRINT	Pulp, Paper, Paper, Printing and Publishing - standard good/service
Health & Safety Services, Health & Safety Equipment, Health & Safety Training, Protecting Clothing, First Aid	SAFSE	Health and Social Work - standard good/servce
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	SERVE	Other Community, Social and Personal Services
Sports Equipment, Sports Consumables, Sports Equipment Maintenance	SPORT	Retail Trade, Except of Motor Vehicles & Motorcycles; Repair of Household Goods
Photocopier Paper, Office Supplies, Small Office Machines and Consumables	STAT	Pulp, Paper, Paper, Printing and Publishing - standard good/service
Electricity	UTIL	Electricity, gas and water supply
Vehicle Purchase, Vehicle Maintenance, Boat Hire	VEHIC	Sales, maintenance and repair of motor vehicles