

CLIMATE CHANGE AND ATU:

The Carbon Footprint of ATU Sligo Campus



AUTHORS:

ANITA CONEFREY* (ANITA.CONEFREY@RESEARCH.ATU.IE),
LEO CREEDON & JAMES HANRAHAN



Ollscoil
Teicneolaíochta
an Atlantaigh

Atlantic
Technological
University



2025



Storyatu.ie
Sustainable Tourism and Visitor
Experience Lab



MISHE
Mathematical Modelling
and Intelligent Systems
for Health and Environment

Acknowledgements

The authors wish to express our sincere gratitude to Dr Orla Flynn, *the President of Atlantic Technological University (ATU)*, for recognising and promoting our efforts in completing this project for the ATU Sligo campus and for encouraging other ATU campuses to adopt a similar approach, fostering a unified measurement and reporting mechanism.

We would also like to extend our sincere appreciation to our colleagues at ATU Sligo campus: Úna Parsons, Previous *Head of College and Head of the Faculty of Engineering and Design*; Professor Frances Lucy, *Head of the Department of Environmental Science and ATU's EU GREEN Alliance Coordinator*; Dr John Bartlett, *Head of Research*; and Dr Tomás O'Flaherty, Previous *Head of the Department of Marketing, Tourism and Sport*. Their continuous enthusiasm, collaboration, and unwavering encouragement were instrumental in the successful completion of this research project. Their persistent advocacy and efforts in facilitating connections with key stakeholders enabled us to gather the essential data required to complete this study.

We are deeply grateful to Noel McLoughlin (*Facilities Manager*), Lisa Flynn (*Trainee Chartered Accountant, Finance Department*) and Brian McCann (*Department of Civil Engineering and Construction*) at the ATU Sligo campus for their invaluable assistance during the data collection process, which was essential to the success of this research.

We sincerely thank the ATU Sligo *Green Campus Committee* for their valuable collaboration and constructive feedback, which significantly contributed to refining and enhancing the quality of this research.

We would like to express our appreciation to our colleagues in the *EU GREENS University Alliance Network* for their encouraging words and support throughout this extensive project.

Finally, we extend our gratitude to the industry professionals whose insights played a pivotal role in shaping the methodology and approach of this research.

This study was conducted independently, without financial support from public, commercial, or not-for-profit funding agencies.

Table of Contents

Foreward.....	i
Executive Summary	1
Introduction	5
Methodology	7
Method and System Boundaries	7
Implications, Limitations and Data Gaps	10
Sample University Campus	13
Results	14
Recommendations	17
Road Map to Net-Zero	17
Conclusion	20
References	21
Appendix	24

Foreword



As climate change intensifies, universities must not only educate the next generation of leaders but also lead by example in sustainability. At Atlantic Technological University (ATU), we are committed to empowering our students by providing them with the knowledge and skills to tackle these global challenges. But education alone is not enough—we must actively model sustainable practices within our own institution.

This pilot research study report presents a legacy project originating from the former Institute of Technology Sligo (IT Sligo), conducted prior to the amalgamation of the nine constituent campuses into ATU. The report emphasises the importance of quantifying greenhouse gas emissions both at the individual campus level and across ATU as a whole. This approach is critical for establishing evidence-based sustainability and climate action targets. Furthermore, it enables the development of a comprehensive emissions profile for ATU, thereby facilitating alignment with the sustainability and climate action objectives set forth in the ATU Strategic Action Plan 2024–2028.

By fostering a unified measurement and reporting mechanism for emissions across ATU, we aim to reduce our environmental impact as a whole while providing a transparent toolkit for local businesses to follow suit. Our goal is to inspire collective action by sharing our data and best practices, thereby supporting the broader community in its own sustainability efforts.

This commitment reflects our dedication to not just teaching sustainability but living it—empowering our institute and the surrounding community to create a more resilient and sustainable future for all.

Dr Orla Flynn
President of Atlantic Technological University



Universities must lead in climate action through both education and practice. At the Atlantic Technological University (ATU), as part of the EU GREEN University Alliance, we are committed to measuring, monitoring, and reporting our emissions as a practical example of environmental responsibility.

In my work as an ecologist, I understand the urgency of reducing human impact on ecosystems. By sharing our emissions data, we provide a blueprint for local businesses and the community to follow, helping to create a collaborative effort for a more sustainable, low-carbon future.

Through research, education, and action, we can drive the change needed to protect our planet.

Professor Frances Lucy

Atlantic Technological University Lead for the EU GREEN European University Alliance

EPA Advisory Committee member



Climate action is no longer a choice—it is a necessity. In this context, it is paramount that universities not only contribute to the conversation but lead it through research, innovation and bold decision-making, where students must be at the centre of that effort.

Universities are more than institutions of learning—they are the foundation for future leadership. The students we nurture today will shape, govern and protect the world of tomorrow. That is why it is so crucial that ATU prioritises embedding sustainability into institutional practices in line with Sustainable Development Goals (SDGs) and actively creates opportunities for students to lead them. By giving students the responsibility and support to take ownership of projects, we are not only responding to today's challenges but preparing future leaders to meet tomorrow's.

ATU Sligo campus's efforts to measure, monitor and reduce its carbon footprint are a clear example of this leadership in action and a commitment to environmental responsibility. How we respond to the developing world reflects our values, our priorities and our shared vision of what the world should look like. Measuring our carbon emissions is not just about data; it's about accountability, awareness and collective responsibility.

Let this report stand as both a record of progress and a call to further action. Together, we will ensure that student leadership, community collaboration and academic excellence continue to drive sustainable and lasting change.

Emil Kindl

President of the Students Union, ATU Sligo Campus



Climate change is an urgent, global challenge that directly affects communities worldwide. Through my research, I emphasise the critical need for a unified mechanism to measure and report emissions at all levels—guided by the principle that “*we cannot manage what we do not measure*”. Accurate, transparent data is essential for tracking progress, identifying gaps, and enabling effective climate action.

Reliable emissions data form the foundation of meaningful climate governance. Without it, we cannot evaluate the impact of interventions, pinpoint emission hotspots or develop policies that support long-term sustainability. This research addresses a vital gap in climate accountability and offers a replicable model for institutions and regions working to align with international climate goals, including the Paris Agreement and the United Nations Sustainable Development Goals (SDGs).

It also highlights the crucial role that universities play in driving climate leadership. Institutions like Atlantic Technological University (ATU) are uniquely positioned at the intersection of education, innovation and community engagement. They have both the opportunity and the responsibility to lead by example in building a more sustainable society.

At ATU Sligo Campus, this research supports the transition to a low-carbon economy by embedding sustainability into institutional practices and academic learning. It equips students, staff and communities with the knowledge and tools to measure emissions, understand their impacts and implement practical, science-based solutions. In doing so, it fosters climate literacy, critical thinking, and civic responsibility—skills essential for the next generation of leaders, entrepreneurs and changemakers.

Ultimately, investing in climate-focused research and education strengthens our collective ability to address the climate crisis—not only through technological innovation, but through systemic transformation, community resilience and global cooperation.

Anita Conefrey

Doctoral Researcher

Department of Marketing, Tourism and Sport, Atlantic Technological University

Principal Investigator for the Sustainable Tourism and Visitor Experience Lab at the Atlantic Technological University (STORYATU)

Executive Summary

Climate change represents one of the most pressing crises affecting people, the planet, and global prosperity. A report by Times Higher Education (2021, 2023) underscores that while sustainability is a significant concern for university leaders, very few prioritise environmental sustainability within their top three institutional goals. Alarmingly, nearly half of the universities worldwide that claim to be committed to climate action have yet to set clear target dates or science-based pathways to achieve Net-Zero emissions (Bothwell, 2021a). Interestingly, the world's top research universities, often at the forefront of innovation, do not necessarily have the most ambitious or comprehensive plans for achieving Net-Zero. While universities in Australia and New Zealand are leading the way with their Net-Zero commitments, institutions in Europe and North America are lagging in their progress (Times Higher Education, 2024). In contrast, universities in South America are more likely to address all three emission scopes (direct, indirect, and supply chain emissions) in their climate action plans.

In response to the climate crisis, the European Union (EU) introduced the *Corporate Sustainability Reporting Directive (CSRD)* in 2022, requiring large organisations to disclose their environmental and social impacts by 2024 (EC, 2023). Under this framework, true sustainability involves active decarbonisation. Universities are central to advancing the EU's political agenda (EC, 2024), contributing to various recovery and resilience initiatives. The European Commission (2022) launched the *European Strategy for Universities*, aiming to strengthen the role of universities in addressing societal challenges and supporting the EU's long-term objectives. Several key goals are outlined in the strategy (*Table 1*).

Table 1. Key goals and objectives of the European Strategy for Universities initiative

Aim	Objective
Strengthening the role of universities	Driving innovation, research, and addressing global challenges like climate change and digitalisation
Enhancing autonomy and governance	Modernising university governance to boost autonomy and responsiveness to societal needs, encouraging cross-border and sectoral collaboration
Boosting collaboration across the EU and beyond	Stronger cooperation within the EU and internationally, fostering a European Education Area and improving mobility for students, staff, and researchers
Promoting inclusiveness and diversity	Improve access to higher education for all, reduce inequalities, and ensure inclusive environments that support diverse student populations
Fostering digital and green transitions	Preparing the workforce with the necessary skills and leading by example by reducing their environmental impact through sustainable practices
Improving funding and investments	Increase investment in universities, including EU funding, to support education, research, and innovation
Creating a stronger European University Area	Strengthening European Universities Initiatives, to support the creation of transnational university alliances
Supporting innovation and knowledge transfer	Foster innovation, especially in digitalisation, AI, and green technology by strengthening ties with industry to enhance knowledge transfer and commercialisation

Source: adapted and modified (EC, 2022).

Therefore, it is incumbent upon Atlantic Technological University (ATU) to take proactive measures to comply with the *Corporate Sustainability Reporting Directive* (CSRD) and align with the *European Strategy for Universities* by systematically measuring, monitoring, and publicly reporting its carbon footprint. These actions are central to the university's broader sustainability agenda, as outlined in the ATU Strategic Action Plan 2024–2028. Such efforts will contribute to the European Union's climate objectives while also demonstrating institutional leadership, enhancing reputation, ensuring regulatory compliance, facilitating access to funding, and advancing progress toward a Net-Zero future.

This pilot study, conducted at the ATU Sligo campus, establishes a foundational methodology adapted from best practices employed by leading Irish institutions—University College Cork (UCC), Dublin City University (DCU), and the University of Galway (UG). The study represents a legacy project originating from the former Institute of Technology Sligo (IT Sligo), undertaken prior to the amalgamation of the nine constituent campuses into ATU, a process completed involuntarily and without financial compensation.

This report underscores the importance of quantifying greenhouse gas (GHG) emissions both at the individual campus level and across ATU as a whole. Specifically, it presents a comprehensive emissions inventory for the ATU Sligo campus for the calendar year 2022. The inventory encompasses Scope 1 (direct emissions from owned or controlled sources), Scope 2 (indirect emissions from the generation of purchased electricity), and Scope 3 (all other indirect emissions, including those from staff and student commuting, waste management, and procurement activities) (UCC, 2022; Goggins & Adams, 2021, 2023; Fahy, 2022).

For Scopes 1 and 2, nationally verified emission factors from the Sustainable Energy Authority of Ireland (SEAI) were utilised. Estimating Scope 3 emissions proved more complex due to the diversity of sources. These were assessed using a combination of internal research (STORY@ATU) and external data, including figures from Club Travel, DEFRA 2022 emission factors, the GHG Protocol Scope 3 Evaluator, and EXIOBASE. While this multi-source approach improves data robustness, it also introduces methodological complexity, which is further examined in the methodology section.

The findings underscore the critical importance of extending this pilot study across all ATU campuses. A unified, evidence-based approach to carbon accounting is essential for establishing institution-wide, science-based, 1.5°C-aligned emissions reduction targets. This will enable ATU to fulfil its obligations as a higher education leader in sustainability and to fully align with the goals of the ATU Strategic Action Plan 2024–2028. Moreover, implementation of this framework university-wide will ensure compliance with relevant standards, including the GHG Protocol, the CSRD, and the European Strategy for Universities, while also strengthening institutional credibility, attracting funding, and contributing meaningfully to national and EU climate objectives.

The results presented focus specifically on the ATU Sligo campus and are expressed in tonnes of carbon dioxide equivalent (tCO₂e). Table 2 summarises the estimated emissions for the campus in 2022. Scope 3 emissions from purchased goods and services were calculated using the EXIOBASE tool (EEA, 2019). However, financial limitations restricted access to detailed emission factors across all categories, potentially leading to underestimation. *Appendices 1–5* include two figures developed to support carbon footprint measurement and offer a comparative analysis of toolkits used to assess Scope 3 emissions from purchased goods and services.

Initially, the GHG Protocol Scope 3 Evaluator was employed; however, it was decommissioned in 2023 due to technological obsolescence (GHG Protocol, 2024a). Subsequently, EXIOBASE was adopted as a more accurate and current tool. A comparative analysis of both methodologies illustrates the variability in emission factors and underscores the necessity of selecting reliable tools for precise carbon accounting.

Table 2. Summary of 2022 emissions for ATU Sligo campus (based on Full-Time Equivalent (FTE) person)

	Total emissions (tCO ₂ e)	Emissions per person (FTE)/year (tCO ₂ e)	Emissions per student (FTE)/year (tCO ₂ e)	Total emissions per 4-year degree (FTE)/year (tCO ₂ e)
Scope 1, 2 and 3				
ATU Sligo campus 2022 (EXIOBASE emission factors for purchased goods and services)	14,655	1.23	1.31	5.2

ATU Sligo campus emissions are on a per-full-time equivalent (FTE) person basis (*Table 3*), with separate calculations for university staff, students, and students enrolled in four-year degree programs (*Table 4*). The research excludes apprentice students due to data limitations.

Table 3. Full-Time Equivalent (FTE) person numbers at the ATU Sligo campus

	Persons (FTE)	Staff (FTE)	Students (FTE)
2022	11,938	715	11,223

Table 4 below benchmarks the carbon footprint of the ATU Sligo campus with the findings of other Irish universities. This comparison focuses solely on Scope 1 and Scope 2 emissions, as these emissions are directly comparable and controllable. This benchmark is crucial for understanding the ATU Sligo campus’ position relative to peers and identifying areas for improvement in its sustainability efforts. By benchmarking against other institutions, valuable insights can be gained to inform future carbon reduction strategies and align with best practices in the sector.

Figure 1 below presents the carbon footprint for the ATU Sligo campus for the calendar year 2022, detailing emission Scopes and their respective percentage contributions. This figure is essential for understanding the key drivers of ATU Sligo campus's environmental impact and for identifying areas where targeted actions can be taken to reduce emissions.

Table 4. Benchmarking ATU Sligo campus emissions against other Irish universities

Category	ATU Sligo campus 2022 (tCO ₂ e) (FTE) (EXIOBASE)	UG 2021 (tCO ₂ e) (FTE) (EXIOBASE)	UG 2019 (tCO ₂ e) (FTE) (GHG Protocol)	DCU 2021 (tCO ₂ e) (FTE) (GHG Protocol)	UCC 2018 (tCO ₂ e) (FTE) [1]
Campus area (acres)	68	-	-	156	-
Campus area (hectares)	27	-	-	-	-
Campus area (m ²)	273,000	-	-	631,255	311,592
Building area (m ²)	49,842	155,090	-	-	-
No. buildings	12 (excluding rented off campus)	58	-	62	-
Total full-time (FTE) staff	715	2,231	2,489	1,883	2,697
Total full-time (FTE) students	11,223	18,094	18,650	13,956	18,464
Total Scope 1 and 2 emissions	2,630 [2][3]	6,839	9,376	10,111	23,050
Total emissions per person (FTE)	0.22	0.32	0.46	0.64	1.09
Total emissions per student (FTE)	0.23	0.367	0.518	0.72	1.248
Total emissions per 4-year degree (FTE)	0.94	1.47	2.07	2.88	4.99
Total Scope 1, 2 and 3 emissions	14,655 [2][4][5][6][8][10][11][13]	60,227 [7][13]	53,396 [7][9][12]	47,630 [2][12]	31,486 [2]
Total emissions per person (FTE)	1.23 [14]	2.8	2.6	3	1.5
Total emissions per student (FTE)	1.31 [14]	3.23	2.95	3.413	1.71
Total emissions per 4-year degree (FTE)	5.2 [14]	12.8	11.8	13.65	6.8

[1] Using STARS Inventory

[2] Data limitations

[3] Electricity generated on-site (Solar PV) is excluded as renewable energy has previously been considered zero carbon by other universities (e.g. University of Galway)

[4] WEEE emissions are high due to a one-time spike from a recent electronics upgrade and disposal of accumulated waste

[5] No organic waste data available

[6] Emissions in Scope 3 are higher than other universities possibly due to recent construction activities and an upgrade of electronic equipment

[7] Assumes mixed recycling is zero carbon

[8] Emissions from ATU Sligo campus water are assumed to be higher than other universities due to a water leak, with a new valve and meter recently installed

[9] Emissions are based on 2015 commute data

[10] International flights emissions are based on Club Travel figure

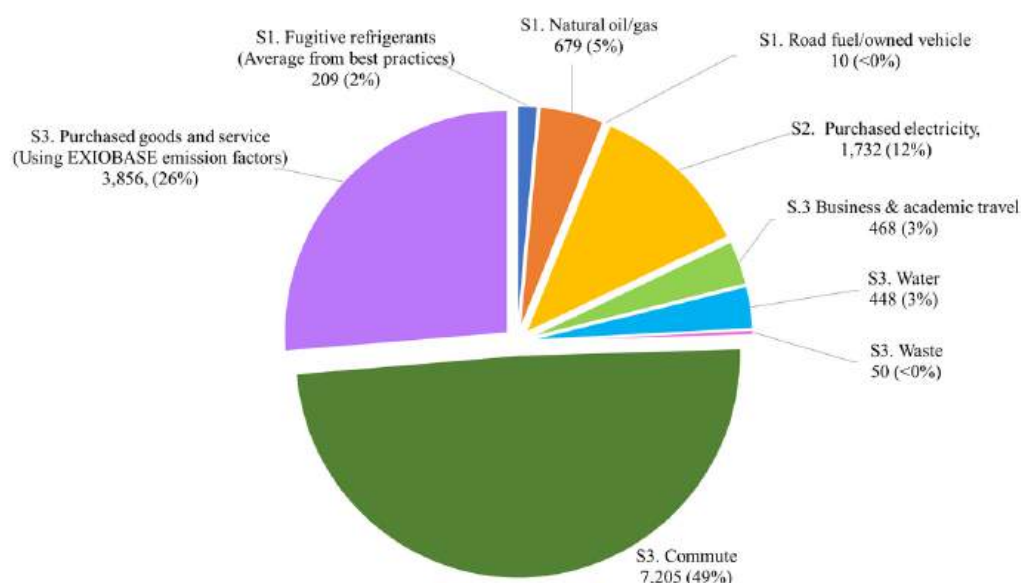
[11] Accommodation and food and beverage emissions are based on STORY@ATU emission factors

[12] Using GHG Protocol emission factors for purchased goods and services

[13] Using EXIOBASE emission factors for purchased goods and services

[14] ATU Sligo campus emissions per persons are assumed to be higher than other universities due to the smaller population size

Figure 1. ATU Sligo campus estimated carbon footprint for 2022 – total emissions 14,655 tCO₂e (FTE) (using the EXIOBASE emission factors for purchased goods and services)



This carbon footprint report for the ATU Sligo campus aims to support ongoing emissions monitoring and reporting while embedding sustainability within the university's policies, mission, and strategic plans. This integration will raise awareness of climate action across the campus and ensure that future graduates are equipped with the skills needed to contribute to the broader Net-Zero agenda.

Introduction

Policymakers and scientists agree that limiting the global temperature increase to 1.5°C is crucial for managing climate change risks (IPCC, 2018). In response, the European Union introduced the *Corporate Sustainability Reporting Directive* in 2022, requiring organisations across Member States to disclose their environmental and social impacts by 2024, with SMES following by 2028 (EC, 2023). The directive also mandates the adoption of science-based sustainability targets and concrete emission reduction plans. These measures are designed to help investors, civil society, consumers, and other stakeholders assess corporate sustainability performance, thereby strengthening the *Green Deal* and supporting the European Union's broader climate goals.

The term "*carbon footprint*" refers to the total amount of greenhouse gas emissions (both direct and indirect) associated with an activity, product life cycle, or organisation (Fahy, 2022). Emissions are typically categorised into three scopes: Scope 1, Scope 2, and Scope 3, which help differentiate direct and indirect sources, improving transparency and reporting utility (WRI & WBCSD, 2004; Fahy, 2022; WRI, 2024). Scope 1 emissions cover direct emissions from sources owned or controlled by the organisation, such as combustion in boilers, furnaces, and vehicles. Scope 2 emissions involve emissions from purchased or produced electricity. Scope 3 emissions include all other emissions within the organisation's value chain, such as those from purchased materials, fuel transportation, and the use of sold products and services.

Historically, organisations were expected to report emissions from Scopes 1 and 2, as Scope 3 emissions are more challenging to quantify due to unclear guidance on which activities to include or exclude. However, neglecting Scope 3 can result in an incomplete understanding of an organisation's total emissions or lead to double-counting (Fahy, 2022). Therefore, organisations must recognise and report Scope 3 emissions to provide a more accurate and transparent assessment of their environmental impact, as these often constitute a larger portion of the carbon footprint than Scopes 1 and 2 combined.

Higher Education Institutions (HEIS) play a pivotal role in promoting sustainability and driving societal change by influencing attitudes and behaviours through education, innovation, and research, areas where solutions to global challenges like climate change can be developed (Barkathunnisha et al., 2019; Zizka & Varga, 2021; Fahy, 2022; Serafini et al., 2022; UNDP, 2024). HEIS are also responsible for producing skilled graduates capable of addressing sustainability issues and contributing to the achievement of the United Nations Sustainable Development Goals (UNSDGS) (Arrobas et al., 2020; Chen et al., 2022; Conefrey & Hanrahan, 2022; Conefrey et al., 2023; Žalėnienė & Pereira, 2023; Conefrey et al., 2024). It is critical that HEIS actively support the 2030 Agenda for Sustainable Development and integrate the UNSDGS into their operations, as these goals cannot be achieved without the involvement of higher education (Serafini et al., 2022; Leal Filho et al., 2023a). Several frameworks and initiatives have been developed to guide and monitor the integration of the UNSDGS within HEIs (*Table 5*).

Table 5. Framework for Integrating the UNSDGs within HEIs

Objective	Strategies
Governance & resources	<ul style="list-style-type: none"> ● Assess and incorporate UNSDGs into policies and strategic plans ● Allocate resources and establish performance indicators for continuous improvement ● Provide human, physical, and IT resources for effective implementation
Learning & teaching	<ul style="list-style-type: none"> ● Educate the community on UNSDGs ● Integrate UNSDGs into curricula, projects, and theses ● Foster awareness through practical application
Research & outreach	<ul style="list-style-type: none"> ● Align research with UNSDGs ● Develop partnerships with external organisations ● Share findings with civil society and support outreach projects aligned with the UNSDGs

Source: Adapted and modified (Boluk et al., 2019; Ferrer-Estévez & Chalmeta, 2021; Serafini et al., 2022; Leal Filho et al., 2023a, 2023b).

These frameworks guide HEIS in fostering a culture of sustainability, ensuring that their educational, research, and outreach activities contribute to the global sustainability agenda.

Research has shown that HEIS have yet to fully define their contributions to the sustainability and Net-Zero agendas, as their organisational structures, curricula, and research programs often fail to reflect the interdisciplinary nature of sustainability and the climate crisis (Leal Filho, 2023a, 2023b). HEIS must therefore take a leadership role in sustainability, starting with the measurement, monitoring, and reporting of their environmental impacts, as organisations cannot manage what they do not measure (Kiehle et al., 2023; Conefrey et al., 2023; Conefrey et al., 2024; Times Higher Education, 2021, 2023; Paredes-Canencio et al., 2024). Measuring the carbon footprint of university operations is a critical first step in developing a sustainability and climate action plan aimed at achieving Net-Zero emissions by 2050 (Conefrey et al., 2023). By showcasing their commitment to Net-Zero, HEIS can inspire other organisations and governments to take meaningful action against climate change (Kiehle et al., 2023). Importantly, HEIS possess the capacity to make significant sustainability progress independently of national laws or regulations, through the adoption of new technologies and practices supported by their research. Therefore, HEIS are vital to advancing the global Net-Zero agenda.

In accordance with the *Climate Action and Low Carbon Development (Amendment) Bill 2021* in Ireland, ATU is obligated to achieve Net-Zero emissions by 2050 (Goggins & Adams, 2021, 2023). To facilitate this transition, the university must measure, monitor, and report its carbon footprint to set science-based targets for effective emissions management (Bothwell, 2021b; Conefrey & Hanrahan, 2022; Conefrey et al., 2024). This report presents the findings of ATU Sligo campus's first baseline carbon footprint assessment, using the *Greenhouse Gas Protocol Corporate Standard* to define the Scopes, and methodologies from other Irish universities such as the EXIOBASE(UCC, DCU, UG). This baseline will allow ATU to develop an evidence-based climate action plan and a roadmap to Net-Zero, outlining steps for decarbonisation in the coming years. By doing so, ATU can lead the transition to a sustainable future through its teaching, research, and broader impact, ensuring alignment with the *EU Corporate Sustainability Reporting Directive (CSRD)* and the *European Strategy for Universities*.

Methodology

This section outlines the methodology employed to quantify the greenhouse gas (GHG) emissions associated with the ATU Sligo campus, the chosen university campus for this study. The methodology provides a clear framework for understanding the system boundaries, emission sources, and the data collection process used to compile the emissions inventory.

Method and System Boundaries

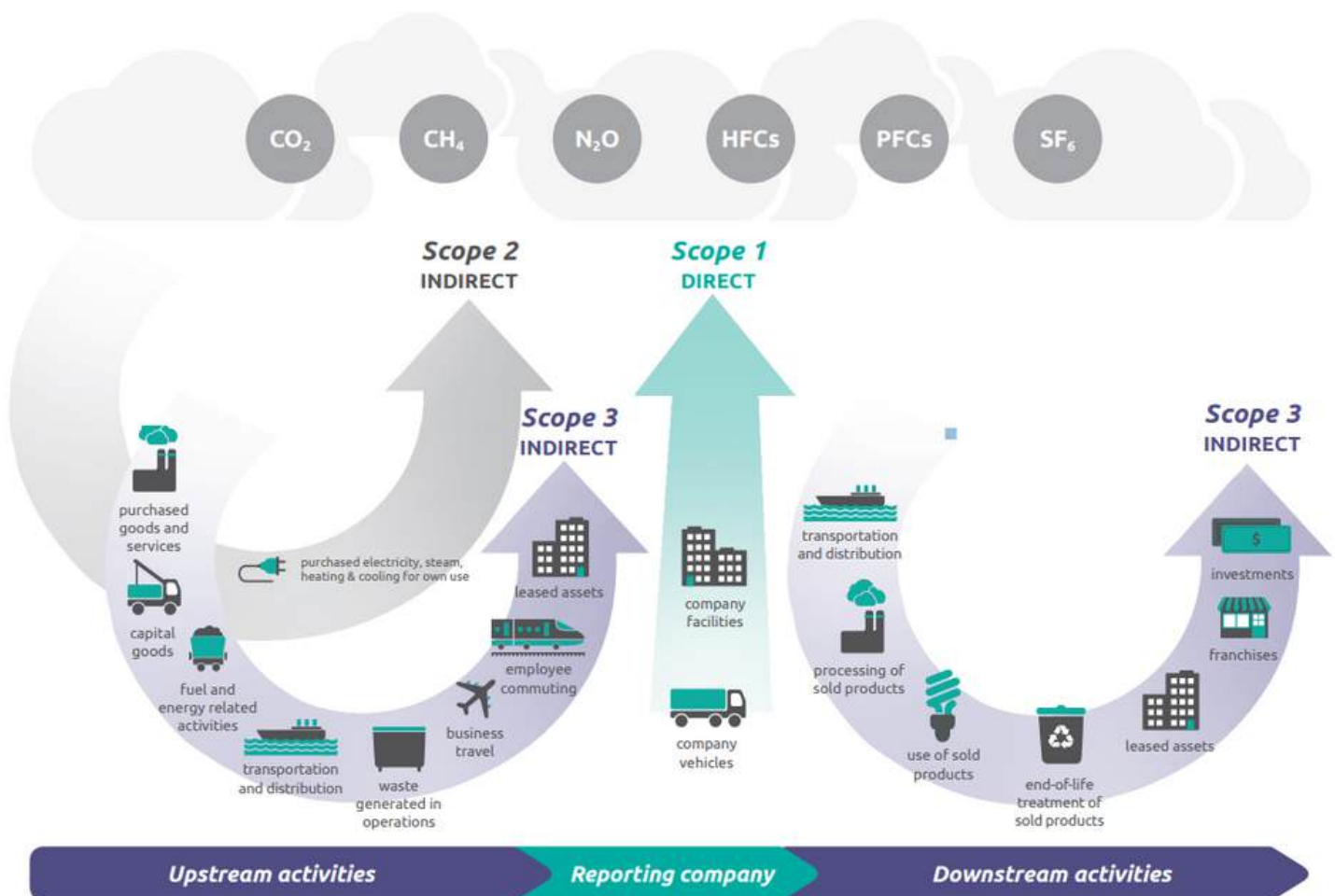
The study adopts the Greenhouse Gas (GHG) Protocol framework to classify emissions into three distinct Scopes (Figure 3):

Scope 1: Direct emissions from owned or controlled sources.

Scope 2: Indirect emissions from the generation of purchased electricity consumed.

Scope 3: Other indirect emissions, such as those from the transportation of students and staff, waste disposal, and supply chain activities (which combine both cradle-to-gate and end-of-life emissions).

Figure 3. Overview of GHG Protocol scopes and emissions across the value chain



Source: (GHG Protocol, 2024b).

Scope 3 emissions are the most complex to quantify and report (WBCSD & WRI, 2004; UCC, 2018; Goggins & Adams, 2021, 2023; Fahy, 2022). To categorise these emissions, the *GHG Protocol* divides the value chain into upstream (cradle-to-gate) and downstream (end-of-life) emissions (*Figure 3*). For example, when an organisation purchases an A4 pack of paper, cradle-to-grave emissions include those from sourcing raw materials, manufacturing, and transportation to the organisation. End-of-life emissions, on the other hand, are associated with the disposal or recycling of paper, including transport to recycling facilities and emissions from the recycling process. This distinction is essential for understanding an organisation's full environmental impact, as Scope 3 emissions often make up the largest share of its carbon footprint but are the hardest to track due to external supply chains and disposal processes.

Each scope is clearly defined within the context of ATU Sligo campus' operations, and the study identifies the sources of emissions under each scope (*Table 6*). This approach has been successfully implemented by other Irish universities that have successfully calculated Scopes 1, 2, and 3 emissions from business operations (Goggins & Adams, 2021, 2023; Fahy, 2022). The emissions are measured in tonnes of carbon dioxide equivalent (tCO₂e) (WRI & WBCSD, 2004). Accounting for the six most significant greenhouse gases: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF₆).

Table 6 outlines the specific system boundaries of this study to quantify and report the GHG emissions associated with the ATU Sligo campus. It gives a summary of emission sources by scope, including the nature of these sources, the tools used to apply emission factors, the activity data required, and the limitations encountered in measuring emissions for each scope.

Factors were selected based on their relevance to the Irish context, particularly for energy use and transportation. Emissions associated with Scope 1 and Scope 2 utilised nationally verified emission factors from the Sustainable Energy Authority of Ireland (SEAI). This is a sound choice as SEAI provides country-specific data that is more accurate for emissions associated with energy production and consumption in Ireland. Scope 3 emissions are calculated using emission factors from unpublished internal research conducted by STORY@ATU, alongside data from external sources such as Club Travel and internationally verified emission factors, including the UK DEFRA emission factors 2022, the GHG Protocol Scope 3 Evaluator tool, and EXIOBASE. This approach is appropriate as it incorporates multiple reputable sources, but it also raises several concerns, which are outlined in the '*implications, limitations and data gaps*' section of this report.

Data was collected through a combination of institutional records, surveys, and direct observation. Where primary data was unavailable, secondary data sources, such as national statistics or benchmarks from similar institutions, were used to estimate emissions.

Table 6. Summary of identified emissions, quantification tools used to identify emission factors, activity data needed for each emission source and limitations of the data provided

Source	Nature of source	Tools used (emission factors)	Activity data & unit used	Data limitations	Data source
Scope 1					
Natural gas & oil	Stationary combustion	SEAI (CO ₂)	Consumed (litres)	-	ATU Sligo campus Finance & Estates
Road fuel (owned vehicles)	Mobile combustion (road fuel)	SEAI (CO ₂)	€ spent	-Does not differentiate between diesel/petrol fuel -Does not report the volume of fuel purchased in litres by fuel type	
Fugitive refrigerants	Leakage of refrigerants	DEFRA (CO ₂ e)	Amount of refrigerant leaked (kg)	No data is available, an average from DCU is utilised	-
Scope 2					
Purchased electricity	Stationary combustion	SEAI (CO ₂)	Consumed (kWh)	-	ATU Sligo campus Finance & Estates
Produced electricity		IPCC (CO ₂ e)			
Scope 3					
Staff & students commute/ remote working	Mobile combustion (road fuel, excluding electric vehicles)	DEFRA (CO ₂ e)	Average distance (km) & transport mode	-Does not capture the exact km travelled each week via public transport If using a personal vehicle: -Does not differentiate between diesel/petrol fuel -Does not report the volume of fuel purchased in litres by fuel type	ATU Sligo campus Smarter Travel Survey
	Indirect stationary combustion	SEAI (CO ₂)	Total number of staff & students working remotely & total number of remote working days/hours	Data not credible	
Business & academic travel	Mobile combustion (aeroplane fuel)	DEFRA (CO ₂ e)	Total emissions from international flights in 2022 (tCO ₂)	No detailed data was provided to cross-examine the figure provided	Club Travel
			Domestic flights: Distance (km) & € spent	-	ATU Sligo campus Finance & Estates
	Mobile combustion (road fuel)	Distance (km) & € spent	Distance (km) is not accurate for public transport		
	Accommodation indirect emission	STORY@ATU (CO ₂ e)	Number of nights & € spent	Average for international and national accommodation	
	Mobile combustion (ferry fuel)		Distance (km) & € spent	Data does not differentiate between domestic island/international ferries	
	Food & beverage	DEFRA (CO ₂ e)	€ spent	Data does not differentiate between meat eaters and vegans	
Waste	Production & process emissions	DEFRA (CO ₂ e)	Landfill mixed waste, mixed dry recycling & timber (tonnes)		Third-party
			Glass (tonnes)		
			WEEE (€ spent)		
			Organic	No data is available	
Water	Indirect supply & treatment emissions	DEFRA (CO ₂ e)	Water supplied in m ³	-	ATU Sligo campus Finance & Estates
Purchased goods & services	Cradle-to-gate/ End-of-life emissions	EXIOBASE (CO ₂ e)	€ spent in each sector purchase category	No data is available for categories: - Food, beverages & tobacco services - Health & social services	

Source adapted and modified: (Fahy, 2022)

According to Goggins & Adams (2021, 2023), Valls-Val & Bovea (2021) and Fahy (2022), emissions can be calculated for each source using the following formula:

$$\text{Total Carbon Footprint} = \sum_{s=1}^n E_s = \sum_{s=1}^n AD_s \times EF_s$$

$\sum_{s=1}^n$ The summation notation indicates that the calculation should be carried out for each value of 's' from 1 to 'n'. The variable 's' acts as an index that allows for the repetition of the calculation across a set of sources contributing to the total carbon footprint, with 'n' representing the total number of these sources contributing to the carbon footprint.

E_s Represents the *Emissions* associated with sources "s". It is the total emissions for that particular

AD_s Represents the *Activity Data* for sources "s" and is expressed in units (e.g. kWh of electricity). Activity data refers to quantifiable measures related to the activity causing emissions.

EF_s Represents the *Emission Factor* for sources "s". The emission factor is a coefficient that quantifies the amount of emissions emitted per unit of activity. It is usually based on data or averages for the specific activity.

Emission factors are challenging to determine, as they depend on a variety of variables and require accurate data for precise calculation. Therefore, for the sake of transparency and replicability, *Appendix 6* and *Appendix 7* provide a detailed outline of the emission factors used in this study.

Implications, limitations and data gaps

Several limitations were encountered during this research project, primarily due to time constraints, the absence of financial resources, and data gaps in certain areas. As a result, the accuracy of emissions estimates for some source segments may have been affected. However, efforts to address these gaps are ongoing, in collaboration with the Finance and Estates Office and through data collected via the ATU Sligo campus Smarter Travel Survey.

Emissions were calculated on a per Full-Time Equivalent (FTE) basis for both staff and students to allow for the standardisation of emissions across different institutional groups, thereby facilitating more meaningful comparative analysis. However, several limitations in the availability and quality of personnel data were identified (see Table 7). Notably, apprentices were excluded from the emissions calculations due to these data constraints. While this exclusion is understandable, it may result in the underestimation of the university's total carbon footprint. Apprentices are likely to contribute to indirect emissions, particularly through commuting and energy consumption related to digital learning environments. As such, their omission may obscure the full extent of institutional emissions and hinder comprehensive sustainability assessments.

Table 7. Person data limitations

Persons	Data limitations	Future actions required
Full-time students	Demographics, lifestyle and behaviours overlooked	Obtain a detailed breakdown of full-time students: course year, international/exchange students, and postgraduate students
Part-time staff/students	No data available on part-time staff; no data on part-time students' use of university facilities; no data on workdays/hours	Collect data on the number of part-time staff, and determine the number of days/hours part-time students spend on campus and using university facilities
E-Learning staff/students	No data available on workdays/hours	Collect data on the number of workdays and hours spent by e-learning staff/students
Apprentices	No data available	Collect data on the number of apprentices, including their weekly hours and the blocks they attend (e.g., 10-week or 11-week blocks), and the number of days/hours spent on campus using university facilities

For Scope 1, data limitations exist regarding mobile combustion emissions from road fuel used in the operation of university-owned vehicles, as well as fugitive refrigerant emissions from air conditioning and refrigeration systems (Table 8).

Table 8. Scope 1 data limitations

Source	Data limitations	Solution	Future actions required
Road fuel (university-owned vehicles)	Data does not differentiate between diesel and petrol; no data is available on the volume of fuel in litres	-Assumption made to divide the expenditure evenly between petrol and diesel -To estimate the volume of fuel purchased in 2022, the cost per litre (€/L) was determined -An average cost for petrol and diesel was obtained from AA Ireland fuel prices for 2022	-Collect data on the annual expenditure in euros and differentiate the spending between petrol and diesel -Collect data on electricity expenditure for electric vehicle charging stations on campus -Determine the volume of fuel purchased in litres by fuel type
Fugitive refrigerants	No data available	Secondary data was utilised, drawing on benchmarks from similar institutions	Request data on refrigerant usage from third-party suppliers, expressed in kilograms (kg)

The only Scope 2 emission source is purchased electricity. ATU Sligo campus Solar PV energy is excluded, as Irish universities previously considered it to be zero carbon. However, the IPCC's Fifth Assessment Report notes renewable energy has life-cycle emissions (0.041 kgCO₂e/kWh) (Bruckner et al., 2014). Future assessments should include Solar PV emissions.

Table 9. Scope 2 data limitations

Source	Limitations	Solution	Future actions required
Solar PV energy	Considered zero-carbon	Measure emissions (12 tCO₂e in 2022) and acknowledge them in the report, but exclude them from the overall measurement to maintain comparability with other universities	Include solar energy emissions in future assessments to provide a more comprehensive carbon footprint

Source adapted and modified: (Bruckner et al, 2014)

The measurement of Scope 3 emissions is widely regarded as the most complex, primarily due to significant limitations in the availability and quality of data (*see Table 10*).

Table 10. Scope 3 data limitations

Source	Data limitations	Solution	Future actions required
Staff & student commute	No data is available regarding the volume of fuel combusted	A weighted average of litres used to estimate emissions	-Update the Smarter Travel Survey to capture more accurate commuting / remote working data (i.e. volume of fuel used per week/per day for commute) -Collect data on ATU Sligo campus international/exchange students (incoming & outgoing)
Staff & students remote working	Does not capture credible data	Excluded from measurement due to lack of data	Collect data on staff and students working remotely (e.g., workdays/hours)
Business travel	- Emissions figures provided by Club Travel cannot be cross-verified - Insufficient data on accommodation type and location - Transport data is not accurately reported by distance (km) - Food and beverage data does not differentiate by dietary preference	-Used Club Travel's emissions figure with limitations clearly highlighted -Applied average emission factors for accommodation types based on internal research done by STORY@ATU, that utilised national and international figures -€ spent was used for transport emissions estimation. -Assumed an average emissions factor for a meat eater	-Up-date travel claim forms to collect more detailed data on: -Number of flights, flight class (business/economy), departure/arrival airports, connecting flights -Number of nights, expenditure (€), accommodation type, and location -Distance travelled (km) by mode of transport/location -Specify dietary preferences (e.g., meat eater, vegan, vegetarian)
Waste	-Assumption: Open-loop emission factors for recycled products -Glass waste reported in litres (l) - WEEE waste reported by € spent - No data available for organic waste, controlled by third-party vendors	-Converted glass waste from litres to tonnes of waste -Used the Environmental Protection Agency (2004) € per tonne figure, as there is no updated figure, to convert the € spent to tonnes of waste -Excluded organic waste from the assessment due to lack of data	-Update waste disposal forms to measure all waste in tonnes -Revise third-party contracts to require waste data reporting in tonnes of waste, particularly for organic waste from canteens and the student union shop
Purchased goods & services	- No data available for food, beverage, and tobacco services or health and social services (controlled by third-party vendors) - No data on student housing/accommodation	Excluded from assessment, with data limitations clearly noted	Update third-party contracts to disclose data on total expenditure for goods and services

Purchased goods and services typically represent the largest share of Scope 3 emissions, as demonstrated in previous carbon footprint reports from other Irish universities, and are among the most time-consuming to calculate (Goggins & Adams, 2021, 2023; Fahy, 2022). According to Goggins & Adams (2021, 2023), a rough estimate of Scope 3 emissions can be derived by leveraging financial data in conjunction with global average emission factors, where the amount spent on a good or service is multiplied by the industry or global average emission factor. A critical aspect of this process involves categorising activities that are most likely to contribute substantially to emissions. This categorisation was facilitated using *Detailed Product Code Reports* from the University's Finance and Estates Office, which document the University's purchases of goods and services through Agresso, ATU Sligo's Financial Management System (*see Appendix 7*).

To support this estimation, tools such as the *GHG Protocol Scope 3 Evaluator* and the *EXIOBASE* toolkit are commonly employed. However, these methods are not without limitations. Specifically, the *GHG Protocol Scope 3 Evaluator* was discontinued prior to the time of this study, rendering it no longer a viable source for global emission factors (GHG Protocol, 2024a). Although *EXIOBASE* remains accessible, it requires a financial payment to access its datasets, with annual subscription packages starting from €2,630 to €7,564 (SimaPro, 2024). As this study lacked the necessary funding, the researchers were unable to utilise it. Consequently, the emission factors used in this study were derived from prior studies that employed these frameworks, which may introduce discrepancies or limitations in the accuracy of the data (*Appendix 6*). While these tools offer useful estimations, they are subject to inherent methodological constraints and challenges.

Data limitations across all scopes are acknowledged and taken into account when interpreting the findings of this study.

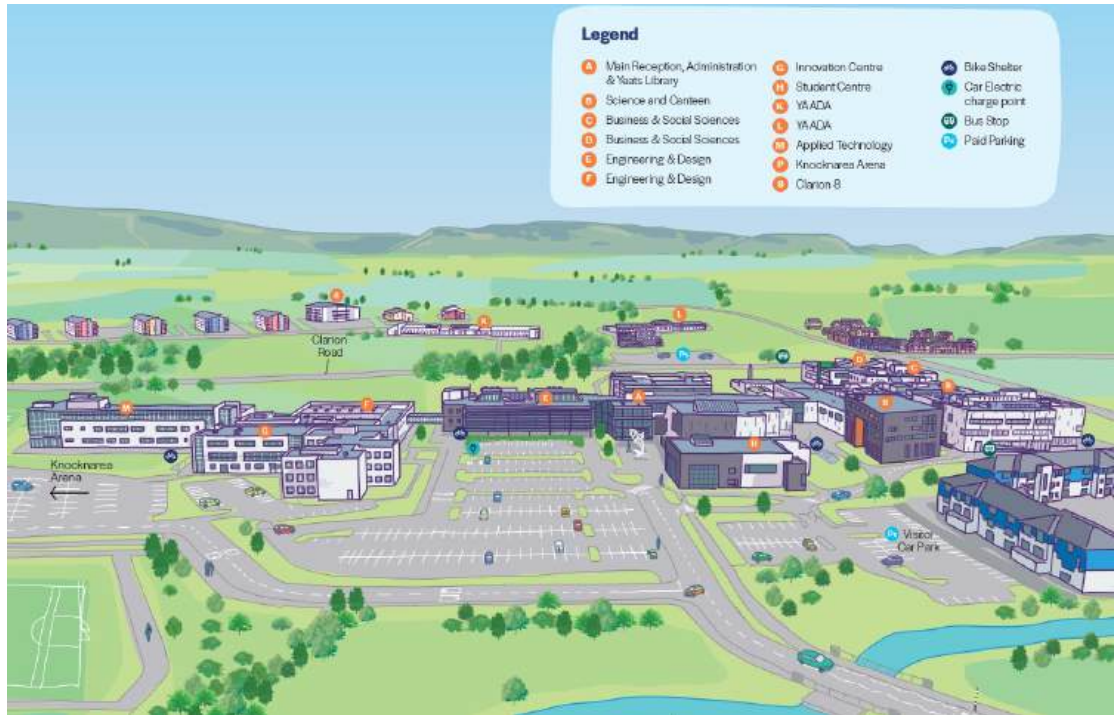
Sample University Campus

The Atlantic Technological University (ATU) is one of the largest multi-campus universities in Ireland and offers students a diverse range of experiences, from bustling cities to wild Atlantic coastal regions: ATU Sligo campus, ATU St Angela's, ATU Galway City, ATU Connemara, ATU Mountbellew, ATU Mayo, ATU Donegal Killybegs and ATU Donegal Letterkenny (ATU, 2024a). This research focuses exclusively on the ATU Sligo campus due to limitations in time and financial resources, which necessitate a more concentrated investigation into a single campus within the broader Atlantic Technological University network.

ATU Sligo campus is located on the northwest coast of Ireland. The campus offers a diverse range of third-level programmes, including 80 full-time and 150 part-time online courses, across three academic schools: Business and Social Sciences, Engineering and Design, and Science (UniScholars, 2024). In addition, the ATU Sligo campus provides a variety of taught postgraduate courses and research-based opportunities. In 2022, the university had a population of over 11,223 students and employed 715 full-time staff members.

Figure 4 illustrates the ATU Sligo campus, which consists of 12 buildings with a total floor area of 49,842 m² (excluding the buildings rented off-campus).

Figure 4. Image of ATU Sligo main campus area



Source: (ATU, 2024b).

It is important to note that this analysis excludes St. Angela's campus. The temporal boundary selected for this report covers the calendar year 2022 (1st January – 31st December).

Results

In carbon footprint reports, it is essential that all quantified emissions are reported to ensure transparency. In accordance with the Greenhouse Gas Protocol standard, a base year was selected (1st January 2022 – 31st December 2022) to enable meaningful comparisons of emissions over time and to track progress in decarbonisation on an annual basis (WBCSD & WRI, 2004; Fahy, 2022). A summary of the emissions quantified for the ATU Sligo campus in 2022 is presented in *Tables 11 and 12*.

The figures for ATU Sligo campus, Scope 1 fugitive refrigerant emissions, are based on national averages derived from previous reports by DCU. These averages were utilised to address existing data gaps. This methodology will be reassessed as the ATU Sligo campus Estates and Finance teams collaborate to enhance data collection processes and resolve current limitations.

Scope 2 emissions from the life cycle of solar PV-produced energy are measured and reported; however, to ensure comparability with other universities, these emissions have not been included in the overall emissions figure.

Regarding Scope 3 emissions from waste and water, the findings suggest that, in comparison with other universities, the ATU Sligo campus exhibits a significantly larger carbon footprint. Due to the fact that ATU Sligo campus waste emissions are underestimated due to the exclusion of emissions from organic waste, owing to the unavailability of data, this limitation should be acknowledged when interpreting the findings. The higher emissions are likely attributable to specific factors, including a water leak, the construction of new building blocks, and the upgrade of the university's electrical appliances and equipment. It is important to note that these are temporary events, and their long-term impact on Scope 3 emissions may be minimal once the necessary repairs, construction, and upgrades are completed.

An analysis of primary data on water usage indicates that the installation of a new water valve and meter has led to a significant reduction in water consumption. Similarly, although the construction of new building blocks and the upgrading of electrical equipment were energy-intensive and likely resulted in short-term increases in emissions, these activities do not necessarily reflect the university's ongoing carbon footprint. The emissions associated with these projects are expected to be temporary and may be offset by improved energy efficiency in the long term. Future assessments will likely provide a clearer picture of the university's baseline emissions once these temporary factors have been addressed.

Table 11. Summary and benchmark of Irish university emissions (tCO₂e/FTE)

Emission source	ATU Sligo Campus 2022 (FTE) (tCO ₂ e)	UG 2021 (FTE) (tCO ₂ e)	UG 2019 (FTE) (tCO ₂ e)	DCU 2021 (FTE) (tCO ₂ e)	UCC 2018 (FTE) (tCO ₂ e) [1]
Scope 1 emissions					
Total Scope 1 emissions	898	2,772	3,783	4,427	7,669
Scope 2 emissions					
Total Scope 2 emissions	1,732 [3]	4,067	5,594	5,684	15,381
Scope 3 emissions					
Total Scope 3 emissions	12,025 [6]	53,388 [6]	44,019 [5]	37,519 [5]	8,437 [1]
Total emissions (Scopes 1, 2 and 3)	14,655 [2][4][6]	60,227 [6]	53,396 [5]	47,630 [5]	31,486 [2]
<i>Total emissions per person</i>	<i>1.23</i>	<i>2.8</i>	<i>2.6</i>	<i>3</i>	<i>1.5</i>
<i>Total emissions per student</i>	<i>1.31</i>	<i>3.23</i>	<i>2.95</i>	<i>3.413</i>	<i>1.71</i>
<i>Total emissions per 4-year degree</i>	<i>5.2</i>	<i>12.9</i>	<i>11.8</i>	<i>13.65</i>	<i>6.8</i>

[1] Using STARS Inventory

[2] Data limitations

[3] Electricity generated on-site (Solar PV) is excluded as renewable energy has previously been considered zero carbon

[4] WEEE emissions are assumed to be higher due to a one-time spike from a recent electronics upgrade and accumulated waste

[5] Using GHG protocol emission factors for purchased goods and services

[6] Using EXIOBASE emission factors for purchased goods and services

Table 12. Summary and benchmarking of Irish university emissions inventory and sources (tCO₂e/FTE)

Emission source	ATU Sligo campus 2022 (FTE) (tCO ₂ e) EXIOBASE	UG 2021 (FTE) (tCO ₂ e) EXIOBASE	UG 2019 (FTE) (tCO ₂ e) GHG protocol	DCU 2021 (FTE) (tCO ₂ e) GHG protocol	UCC 2018 (FTE) (tCO ₂ e) GHG protocol [1]
Scope 1 emissions					
Total Scope 1 emissions	898	2,772	3,783	4,427	7,669
Liquid fuel consumption	0	0	0	0	7,611
Natural gas	0	0	0	4,140	0
Oil	597	0	0	0	0
LPG	82	119	153	0	0
Gas imports	0	2,379	3,087	0	0
Gasoil	0	169	290	0	0
Wood pellets	0	62	110	0	0
Fugitive refrigerants	209 [2]	0	0	277	0
Road fuel/owned vehicle	10	40	15	10	57
Biodiesel	0	3	128	0	0
Scope 2 emissions					
Total Scope 2 emissions	1,732 [3]	4,067	5,594	5,684	15,381
Electricity imports	1,732	4,067	5,594	5,684	11,740
Electricity generated on-site (Solar PV)	12 [3]	0	0	0	0
Electricity and steam produced on-site	0	0	0	0	3,641
Scope 3 emissions					
Total Scope 3 emissions	12,025 [13]	53,062 [13]	44,019 [12]	37,519 [12]	8,437 [1]
Waste	50 [6]	2.9	50	27	43
<i>Landfill mixed</i>	35.2	0	42.5	0	25.3
<i>Mixed recycling</i>	0.34	0 [7]	0 [7]	0	17.8
<i>Waste to energy</i>	0	1.5	2.7	0	0
<i>Glass</i>	0.05	0.8	4.1	0	0
<i>Timber</i>	0.17	0	0	0	0
<i>Organic</i>	0 [5]	0.6	0.4	0	0
<i>WEEE</i>	13.8 [4]	0	0.5	0	0
Water	448 [8]	18.8	30.6	42	3
Staff and students commute	7,205	22,150	9,198 [9]	14,192	6,713
Business and academic travel	468	326	4,378	822 [2]	1,677 [2]
<i>Fights</i>	378	248.6	4,064.6	822	1,441.2
<i>International flights</i>	378 [10]	0	0	0	0
<i>Domestic flights</i>	0.13	0	0	0	0
<i>Ferry</i>	0.07	0	0	0	0
<i>Public transport</i>	2.3	2.2	22.3	0	94.4
<i>Taxis</i>	0.13	5.7	71.3	0	0
<i>Personal vehicle</i>	38	43.4	140.8	0	141.4
<i>Car hire</i>	0 [14]	8.2	18.9	0	0
<i>Accommodation</i>	22 [11]	18.2	59.7	0	0
<i>Food and beverage</i>	26 [11]	0	0	0	0
Purchased goods and services	3,856 [6][13]	60,227 [13]	30,363 [12]	22,436 [12]	0
<i>New building</i>	2,102 [13]	22,620 [13]	0	0	0

[1] Using STARS Inventory

[2] Data limitations

[3] Electricity generated on-site (Solar PV) is excluded as renewable energy has previously been considered zero carbon

[4] WEEE emissions are assumed to be higher due to a one-time spike from a recent electronics upgrade and accumulated waste

[5] No organic waste data available

[6] Emissions are assumed to be higher than other universities due to recent construction activities and an upgrade of electronic equipment

[7] Assumes mixed recycling is zero carbon

[8] Emissions from ATU Sligo campus water are assumed to be higher than other universities due to a water leak, with a new valve and meter recently installed

[9] Emissions are based on 2015 commute data

[10] International flights emissions are based on Club Travel emission figure

[11] Accommodation and food and beverage emissions are based on STORY@ATU emission factors

[12] Using GHG protocol emission factors for purchased goods and services

[13] Using EXIOBASE emission factors for purchased goods and services

[14] ATU Sligo campus does not offer funding for car hire

Recommendations

ATU Sligo campus's carbon footprint for the year 2022 is estimated to be 14,655 tCO₂e. Since emissions are not visible to the human eye, it is challenging to engage society in the importance of decarbonisation. *Figure 5* provides a visual representation of the emissions produced by the ATU Sligo campus in 2022.

Figure 5. Visualisation of ATU Sligo campus emissions (14,655 tCO₂e) depicted against Benbulbin Mountain



Source: AI-generated

This AI-generated image visualises a cloud over Benbulbin Mountain, representing 4,543,939 m³ in volume and approximately 14,655 tCO₂e under standard atmospheric conditions.

Road Map to Net-Zero

Universities are key drivers of climate action through research, education, societal influence, and infrastructure. By raising awareness and sharing knowledge, they prepare future leaders and offer climate solutions (UNEP, 2024; Filho et al., 2023b). A Net-Zero roadmap showcases leadership and promotes sustainability. For ATU to align with global climate goals and lead in this space, key steps include:

1. **Sustainability budget allocation plan:** Establish a dedicated sustainability fund to support key initiatives, personnel and sustainability projects.
2. **Replicate:** ATU Sligo campus study should be replicated across all ATU campuses for 2022, compiled into a unified report and conducted annually for ongoing analysis.
3. **Form a sustainability team:** Form a diverse team with senior leadership to drive impact, assigning clear roles, responsibilities, and SMART goals.
4. **Recruit a sustainability officer:** Appoint a staff member to manage sustainability initiatives, oversee budget and grants, and ensure progress towards climate goals.
5. **Recruit a sustainability data analyst:** Employ a dedicated individual to oversee emissions assessments, refine data collection, and track Net-Zero progress.
6. **Develop an action plan:** the vision, key initiatives, funding, emissions targets, and strategies for reducing energy use, promoting sustainable transport, enhancing resource efficiency, and embedding sustainability in curriculum and research.
7. **Refine data collection and reporting mechanisms:** Improve data collection to enhance emissions accuracy, with regular audits and training to ensure consistency, and track sustainability goals.
8. **Investment:** Purchase a licence for the EXIOBASE software to increase the accuracy of measuring Scope 3 emissions and invest in energy-efficient infrastructure, sustainable transport solutions, and waste reduction programs.
9. **Certification:** Seek recognised sustainability certifications to validate ATU's commitment to environmental responsibility and use certification as a tool to benchmark progress and drive continuous improvement.
10. **Collaborate:** Forge partnerships with other universities, research institutions, businesses, and local communities to exchange knowledge and accelerate sustainability initiatives.

These key steps are detailed in *Tables 13* and *14*, which present a comprehensive Net-Zero roadmap for ATU, outlining specific actions and strategies to achieve sustainability and align with global climate change mitigation efforts.

Table 13. ATU's roadmap to Net-Zero to foster a sustainability culture

Road map		Recommendations
Recruit Sustainability Data Analyst	☐	Recruit a member of the research community to oversee annual emission assessments
	☐	Generate reports and dashboards to present these findings to sustainability team, management, stakeholders, or regulatory bodies
	☐	Monitor and track progress to ensure prioritising impact areas, achieving reduction targets and climate action goals
	☐	Benchmark performance against industry standards and regulations to track progress and identify areas for improvement
	☐	Advise on emission reduction strategies and support implementation
	☐	Research new technologies, methods, and regulations for carbon footprint assessment and reduction
	☐	Aim for recognised sustainability certifications, such as STARS (Sustainability Tracking, Assessment & Rating System) and LEED (Leadership in Energy and Environmental Design)
	☐	Refine data collection processes across departments and expand emissions inventory
	☐	Use the latest, location-specific, and activity-specific emission factors to ensure accurate carbon footprint calculations
Form a Sustainability Team	☐	Form an internal sustainability team on each campus
	☐	Liaise with sustainability teams across all ATU campuses
	☐	Recruit members from both students and staff, ensuring diverse departmental representation, including Heads of Schools, to maintain a cascading effect
	☐	Assign leadership roles and responsibilities
	☐	Clearly define the purpose of the team and set SMART (specific, measurable, achievable, relevant and time-bound goals)
	☐	Develop sustainability and climate action policies and plans aimed at reducing the campus' environmental impact
	☐	Form partnerships with other universities, research institutions, industry leaders and local communities to exchange knowledge and share best practices
	☐	Hold monthly meetings
Recruit Sustainability Officer	☐	Recruit a member of the staff to lead the campus sustainability agenda, providing guidance and ensuring the team stays on track
	☐	Allocate a sustainability budget, ensuring effective fund allocation
	☐	Search for new partnership possibilities to progress sustainability goals
	☐	Manage the process of obtaining and maintaining environmental certifications
Recruit Energy/Resource Efficiency Specialist	☐	Establish evidence-based decarbonisation targets in compliance with national regulations
	☐	Advise on emission reduction strategies and support implementation
	☐	Advocate for sustainable sourcing practices
	☐	Develop and invest in reduction and adaption strategies
	☐	Evaluate the financial impact of sustainability initiatives to ensure cost-effectiveness and ROI through savings or operational efficiencies
	☐	Establish a carbon budget in collaboration with the sustainability officer
	☐	Liaise and support sustainability data analyst to achieve recognised sustainability certifications
Sustainability Communications & Marketing Leader	☐	Establish a communications strategy to promote sustainability actions across campus
	☐	Create marketing campaigns and events to promote sustainable practices both at work and home
	☐	Promote sustainability achievements and initiatives internally and to external audiences, such as media, government agencies, and industry groups

Source adopted and modified: (Lopez Lalinde & Maierhofer, 2021; Leal Filho et al., 2021; Times Higher Education, 2021, 2023; Leal Filho et al., 2023a, 2023b).

This initial roadmap outlines a strategic plan for the ATU Sligo campus to foster a sustainability culture within its community, guiding the university towards Net-Zero with clear responsibilities. Furthermore, it enables the community to establish an evidence-based sustainability and climate action plan (*Table 14*).

Table 14. ATU Sligo campus' roadmap to Net-Zero to create a sustainability and climate action plan

Road map	Recommendations
Develop a Sustainability and Climate Action Plan	<p><i>Outline ATU's sustainability and climate action vision, mission and goals, including initiatives, required resources, and timelines:</i></p> <ul style="list-style-type: none"> ☐ Allocate funding for climate action projects and seek external grants to support large-scale efforts ☐ Aim for recognised sustainability certifications, such as Times Higher Education (THE) Impact rankings, STARS, LEED, and Green Labs. <p>Conduct an emissions inventory to identify major sources, categorise emissions into Scopes, and present baseline carbon footprint findings to promote transparency:</p> <ul style="list-style-type: none"> ☐ Set science-based reduction targets to guide future efforts <p><i>Campus engagement and education:</i></p> <ul style="list-style-type: none"> ☐ Enhance campus engagement by expanding sustainability literacy in curriculums and aligning with UNSDGs. ☐ Invest in research and innovation for sustainability solutions, using a Living Lab to test them ☐ Upskill staff on sustainability practices and run awareness campaigns. <p><i>Develop and invest in reduction strategies:</i></p> <ul style="list-style-type: none"> ☐ Explore energy efficiency retrofitting opportunities ☐ Explore on-campus renewable energy and new technology options to enhance energy conservation ☐ Incorporate sustainable building practices ☐ Promote green transportation: encourage students and staff to use bicycles, public transportation, and electric vehicles ☐ Increase electric vehicle charging points, provide bike-sharing programs and implement carpooling programs or campus shuttles to reduce single-occupancy vehicle use ☐ Increase water efficiency: Install low-flow fixtures and invest in rain harvesting systems ☐ Explore local carbon offset projects as a complementary emission reduction strategy, not the primary solution ☐ Establish a carbon budget for business and academic travel: Reduce flights, promote ferry use, encourage public transport over personal vehicles, and support sustainably verified accommodation ☐ Require third-party suppliers to disclose data ☐ Food systems: Source food from local, sustainable suppliers, promote plant-based options, and implement food waste reduction systems like donation programs, composting, and portion control <p><i>Develop and invest in adaptation strategies:</i></p> <ul style="list-style-type: none"> ☐ Enhance ATU Sligo campus resilience to climate impacts like extreme weather, flooding, and rising temperatures ☐ Increase native Irish tree coverage for shade and wind protection, implement flood barriers in vulnerable areas, and protect and boost biodiversity <p><i>Monitor and report progress:</i></p> <ul style="list-style-type: none"> ☐ Establish a regular reporting system to track emissions reduction ☐ Use dashboards to measure key metrics and create a sustainability section on ATU's website to highlight the action plan and commitment to environmental responsibility. ☐ Regularly review and adjust the plan as needed <p><i>Collaboration:</i></p> <ul style="list-style-type: none"> ☐ Form partnerships with other universities, research institutions, industry leaders and local communities to exchange knowledge and share best practices

Source adopted and modified: (Lopez Lalinde & Maierhofer, 2021; Leal Filho et al., 2021; Times Higher Education, 2021, 2023; Leal Filho et al., 2023a, 2023b).

Overall, a sustainability and climate action plan is crucial for providing a structured approach to addressing climate change. This plan guides the ATU Sligo campus toward long-term environmental stewardship, supporting efforts to mitigate climate change, ensure resilience, and contribute to broader global sustainability goals.

Conclusion

ATU must demonstrate a strong commitment to achieving Net-Zero emissions by 2050, in alignment with the Irish Government's Climate Action and Low Carbon Development (Amendment) Act 2021 and global efforts to limit warming to 1.5°C. This report outlines a robust methodology for establishing the first baseline carbon footprint for the ATU Sligo campus, covering Scope 1 (direct), Scope 2 (indirect energy), and Scope 3 (other indirect) emissions. With a baseline estimate ranging from approximately 14,655 to 24,041 tCO₂e, this data provides a critical foundation for establishing a clear, evidence-based pathway toward Net-Zero emissions.

Scope 3 emissions account for approximately 82-91% of the campus' total carbon footprint, which is consistent with the typical proportion of Scope 3 emissions observed in many organisations. However, it is important to note that this scope is particularly large for the ATU Sligo campus in the current studied year (2022) due to specific factors, including a water leak, construction projects and electronic upgrades. These activities have contributed to elevated emissions from waste and other indirect sources. Given that these are temporary and non-recurring events, it is expected that emissions from these areas will decrease in future assessments, leading to a more stable baseline.

While the methodology employed reflects national and international best practices, certain limitations and data gaps may result in underreporting or partial representation of total campus emissions. Therefore, enhancing data collection systems and fostering a stronger culture of sustainability across the ATU Sligo community will be essential to improving future inventories and ensuring the accuracy of long-term carbon management strategies.

The findings of this pilot study underscore the need to expand this methodology to all ATU campuses. A unified, evidence-based approach to emissions accounting is essential for setting institution-wide, science-based, 1.5°C-aligned emissions reduction targets. This will position ATU as a leader in sustainability within higher education, ensure compliance with EU climate regulations, and support the successful implementation of the ATU Strategic Action Plan 2024–2028.

References

- Arrobas, F., Ferreira, J., Brito-Henriques, E., and Fernandes, A. (2020). Measuring tourism and environmental sciences students' attitudes towards sustainable tourism. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 27. <https://doi.org/10.1016/j.jhlste.2020.100273>
- ATU. (2024a). *Campus locations*. <https://www.atu.ie/about/campus-locations>
- ATU. (2024b). *ATU Sligo campus maps*. <https://www.itsligo.ie/atu-sligo-campus-maps/>
- Barkathunnisha, A. B., Diane, L., Price, A., and Wilson, E. (2019). Towards a spirituality-based platform in tourism higher education. *Current Issues in Tourism*, 22(17), 2140–2156. <https://doi.org/10.1080/13683500.2018.1424810>
- Boluk, K. A., Cavaliere, C. T., and Higgins-Desbiolles, F. (2019). A critical framework for interrogating the United Nations Sustainable Development Goals 2030 agenda in tourism. *Journal of Sustainable Tourism*, 27(7), 847–864. <https://doi.org/10.1080/09669582.2019.1619748>
- Bothwell, E. (2021a). Hundreds of global universities 'yet to set a net zero target'. *Times Higher Education*. <https://www.timeshighereducation.com/news/hundreds-global-universities-yet-to-set-net-zero-target#:~:text=While%20more%20than%20550%20universities%20across%20the%20world,the%20Greenhouse%20Gas%20Protocol%20%28GHGP%29%2C%20a%20global%20standard.>
- Bothwell, E. (2021b). Eight ways universities can reduce greenhouse gas emissions. *Times Higher Education*. <https://www.timeshighereducation.com/campus/eight-ways-universities-can-reduce-greenhouse-gas-emissions>
- Bruckner, T., Bashmakov, I.A., Mulugetta, Y., Chum, H., de la Vega Navarro, A., Edmonds, J., Faaij, A., Fungtammasan, B., Garg, A., Hertwich, E., Honnery, D., Infield, D., Kainuma, M., Khennas, S., Kim, S., Nimir, H.B., Riahi, K., Strachan, N., Wisner, R., and Zhang, X. (2014). *Energy Systems*. In: Climate Change: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Farahani, E., Kadner, S., Seyboth, K., Adler, A., Baum, I., Brunner, S., Eickemeier, P., Kriemann, B., J. Savolainen, J., Schlömer, S., von Stechow, C., Zwickel, T. and Minx, J.C. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Chen, C., An, Q., Zheng, L., and Guan, C. (2022). Sustainability literacy: Assessment of knowingness, attitude and behaviour regarding sustainable development among students in China. *Sustainability*, 14(9). <https://doi.org/10.3390/su14094886>
- Conefrey, A., and Hanrahan, J. (2022). *Climate change and tourism: The carbon footprint of Irish tourism*. <https://doi.org/10.13140/RG.2.2.13191.27048>
- Conefrey, A., Hanrahan, J., McTiernan, C., Carty, J., Byrne, D. (2023). The Net-Zero Challenge for Tourism & Hospitality Educators. https://www.researchgate.net/publication/370498292_The_Net-Zero_Challenge_for_Tourism_Hospitality_Educators
- Conefrey, A., Hanrahan, J., McTiernan, C., Carty, J., Byrne, D., and Melly, D. (2024). Tracking tourism enterprises decarbonisation actions to reach Net-Zero before 2050: a case study approach. *Journal of Policy Research in Tourism, Leisure and Events*. <https://doi.org/10.1080/19407963.2024.2401516>

- European Commission (EC). (2022). *Communication from the Commission: On a European strategy for universities*. <https://education.ec.europa.eu/sites/default/files/2022-01/communication-european-strategy-for-universities-graphic-version.pdf>
- European Commission (EC). (2023). *Corporate sustainability reporting*. https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en
- European Commission (EC). (2024). *Europe's choice: Political guidelines for the next European Commission 2024-2029*. https://commission.europa.eu/document/download/e6cd4328-673c-4e7a-8683-f63ffb2cf648_en?filename=Political%20Guidelines%202024-2029_EN.pdf
- European Environment Agency (EEA). (2019). *EXIOBASE*. <https://www.eea.europa.eu/data-and-maps/data/external/exiobase>
- Fahy, S. (2022). *DCU Campuses carbon footprint 2020 & 2021 summary report*. https://www.dcu.ie/sites/default/files/sustainability_dcu_editor/2023-10/DCU%20CO2FP_2020_2021_report-acc.pdf
- Ferrer-Estévez, M. and Chalmeta, R. (2021). Integrating Sustainable Development Goals in educational institutions. *The International Journal of Management Education*, 19(2). <https://doi.org/10.1016/j.ijme.2021.100494>.
- Goggins, J. and Adams, T. (2021). NUI Galway carbon footprint report: Baselines 2017, 2018 & 2019. <https://www.universityofgalway.ie/sustainability/sustainabilityreports/carbonfootprint/>
- Goggins, J. and Adams, T. (2023). University of Galway carbon footprint report* 2017 - 2023. [https://www.universityofgalway.ie/media/sustainability/University-of-Galway-Carbon-Footprint-Report-2017-2023-\(R2\).pdf](https://www.universityofgalway.ie/media/sustainability/University-of-Galway-Carbon-Footprint-Report-2017-2023-(R2).pdf)
- Greenhouse Gas Protocol. (GHG Protocol). (2024a). *The GHG Protocol Scope 3 Evaluator was decommissioned on August 30, 2023*. <https://quantis-suite.com/Scope-3-Evaluator/>
- Greenhouse Gas Protocol. (2024b). *Diagram of scopes and emissions across the value chain*. https://ghgprotocol.org/sites/default/files/ghgp/standards_supporting/Diagram%20of%20scopes%20and%20emissions%20across%20the%20value%20chain.pdf
- Intergovernmental Panel on Climate Change (IPCC). (2018). *Summary for Policymakers*. https://www.ipcc.ch/site/assets/uploads/sites/2/2022/06/SPM_version_report_LR.pdf
- Kiehle, J., Kopsakangas-Savolainen, M., Hilli, M. and Pongrácz, E. (2023). Carbon footprint at institutions of higher education: The case of the University of Oulu. *Journal of Environmental Management*, 329. <https://doi.org/10.1016/j.jenvman.2022.117056>
- Leal Filho, W., Sima, M., Sharifi, A., Luetz, J.M., Salvia, A.L., Mifsud, M., Olooto, F.M., Djekic, I., Anholon, R., Rampasso, I., Donkor, F.K., Dinis, M.A.P., Klavins, M., Finnveden, G., Chari, M.M., Molthan-Hill, P., Mifsud, A., Sen., S.K. & Lokupitiya, E. (2021). Handling climate change education at universities: an overview. *Environmental Science Europe*, 33(109). <https://doi.org/10.1186/s12302-021-00552-5>
- Leal Filho, W., Simaens, A., Paço, A., Hernandez-Díaz, P. M., Vasconcelos, C. R. P., Fritzen, B. and Mac-Lean, C. (2023a). Integrating the Sustainable Development Goals into the strategy of higher education institutions. *International Journal of Sustainable Development & World Ecology*. <https://doi.org/10.1080/13504509.2023.2167884>

- Leal Filho, W. L., Weissenberger, S., Luetz, J.M., Sierra, J., Rampasso, I.S., Sharifi, A., Anholon, R., Eustachio, J.H.P.P. & Kovalea, M. (2023b). Towards a greater engagement of universities in addressing climate change challenges. *Scientific Reports*, 13(1). <https://doi.org/10.1038/s41598-023-45866-x>
- Lopez Lalinde, L. & Maierhofer, C. (2021). Creating a Culture of Shared Responsibility for Climate Action in Guatemala Through Education. In: F.M. (eds.), *Education and Climate Change*. International Explorations in Outdoor and Environmental Education. Springer, Cham. https://doi.org/10.1007/978-3-030-57927-2_3
- Paredes-Canencio, K.N., Lasso, A., Castrillon, R. (2024). Carbon footprint of higher education institutions. *Environment, Development and Sustainability*. <https://doi.org/10.1007/s10668-024-04596-4>
- Serafini, P. G., Moura, J. M., Almeida, M. R. and Rezende, J. F. D. (2022). Sustainable Development Goals in Higher Education Institutions: A systematic literature review. *Journal of Cleaner Production*, 370, 133473. <https://doi.org/10.1016/j.jclepro.2022.133473>
- SimaPro (2024). EXIOBASE database. <https://simapro.com/products/exiobase-database/>
- Times Higher Education. (2021). *The race to Net Zero: How global universities are performing*. https://www.timeshighereducation.com/sites/default/files/the_race-to-net-zero-report.pdf
- Times Higher Education. (2023). *Charting a shared path to net zero universities*. <https://www.timeshighereducation.com/campus/charting-shared-path-net-zero-universities>
- Times Higher Education. (2024). *Top universities for climate action 2024*. <https://www.timeshighereducation.com/student/best-universities/top-universities-climate-action>
- UniScholars. (2024). *Atlantic Technological University, Sligo*. <https://unischolars.com/universities/ireland/atlantic-technological-university-sligo>
- University College Cork (UCC). (2022). *Emissions Inventory and Disclosure*. STARS. [UCC STARS GHG Inventory 2017-18.xlsx](https://www.ucc.ie/en/stars/ghg-inventory-2017-18.xlsx)
- United Nations Development Programme (UNDP). (2024). *Why universities play a crucial role in climate adaptation*. <https://climatepromise.undp.org/news-and-stories/why-universities-play-crucial-role-climate-adaptation>
- Valls-Val, K. and Bovea, M. D. (2022). Carbon footprint assessment tool for universities: CO2UNV. *Sustainable Production and Consumption*, 29, 791-804. <https://doi.org/10.1016/j.spc.2021.11.020>
- World Resources Institute (WRI). (2024). *Sustainability Dashboard Methodology*. <https://www.wri.org/sustainability-wri/dashboard/methodology>
- World Resources Institute and World Business Council for Sustainable Development (WRI & WBCSD). (2004). *The Greenhouse Gas Protocol: a Corporate Accounting and Reporting Standard, Revised Edition*. <https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf>
- Zizka, L., and Varga, P. (2021). Teaching sustainability in Higher Education institutions: Assessing hospitality students' sustainability literacy. *Journal of Hospitality & Tourism Education*, 33(4), 242–257. <https://doi.org/10.1080/10963758.2020.1726771>

Appendix

Appendix 1. Comparison of emissions using the GHG Protocol and EXIOBASE emission factors for purchased goods and services

	Total emissions (tCO ₂ e)	Total emissions per person (FTE) (tCO ₂ e)	Total emissions per student per year (FTE) (tCO ₂ e)	Total emissions per 4-year degree (FTE) (tCO ₂ e)
Scope 1, 2 and 3				
ATU Sligo 2022 (GHG Protocol Scope 3 evaluator emission factors for purchased goods & services)	24,041	2	2.14	9
ATU Sligo 2022 (EXIOBASE emission factors for purchased goods and services)	14,655	1.23	1.31	5.2

Appendix 2. Benchmark of emissions using the GHG Protocol and EXIOBASE emission factors for purchased goods and services

Category	ATU Sligo 2022 (FTE) (tCO ₂ e) GHG Protocol	ATU Sligo 2022 (FTE) (tCO ₂ e) EXIOBASE	UG 2021 (FTE) (tCO ₂ e) EXIOBASE	UG 2019 (FTE) (tCO ₂ e) GHG Protocol	DCU 2021 (FTE) (tCO ₂ e) GHG Protocol	UCC 2018 (FTE) (tCO ₂ e) [1]
Campus area (Acres)	68		-		156	-
Campus area (Hectares)	27		-		-	-
Campus area (m2)	273,000		-		631,255	311,592
Building area (m2)	49,842		155,090		-	-
No. buildings	12 (excluding rented off-campus)		58		62	-
Total staff	715		2,231	2,489	1,883	2,697
Total students	11,938		18,094	18,650	13,956	18,464
Total Scope 1 and 2 emissions	2,630 [2][3]		6,839	9,376	10,111	23,050
Emissions per person (FTE)/year	0.60		0.32	0.46	0.64	1.09
Emissions per student (FTE)/year	0.72		0.37	0.52	0.72	1.25
Emissions per student per 4-year degree (FTE)	2.88		1.47	2.07	2.90	4.99
Total Scope 1, 2 and 3 emissions	24,041 [2][4][5][6][8][10][11][12]	14,655 [2][4][5][6][8][10][11][13]	60,227 [7][13]	53,396 [7][9][12]	47,630 [2][12]	31,486 [2]
Emissions per person (FTE)/year	2	1.23	2.8	2.6	3	1.5
Emissions per student (FTE)/year	2.14	1.31	3.2	3	3.4	1.7
Emissions per student per 4-year degree (FTE)	9	5.2	12.9	11.8	14	7

[1] Using STARS Inventory

[2] Data limitations

[3] Electricity generated on-site (Solar PV) is excluded as renewable energy has previously been considered zero carbon

[4] WEEE emissions are high due to a one-time spike from a recent electronics upgrade and accumulated waste

[5] No organic waste data available

[6] Emissions in scope 3 are assumed to be higher than other universities due to recent construction activities and an upgrade of electronic equipment

[7] Assumes mixed recycling is zero carbon

[8] Emissions from ATU Sligo's water are assumed to be higher than other universities due to a water leak, with a new valve and meter recently installed

[9] Emissions are based on 2015 commute data

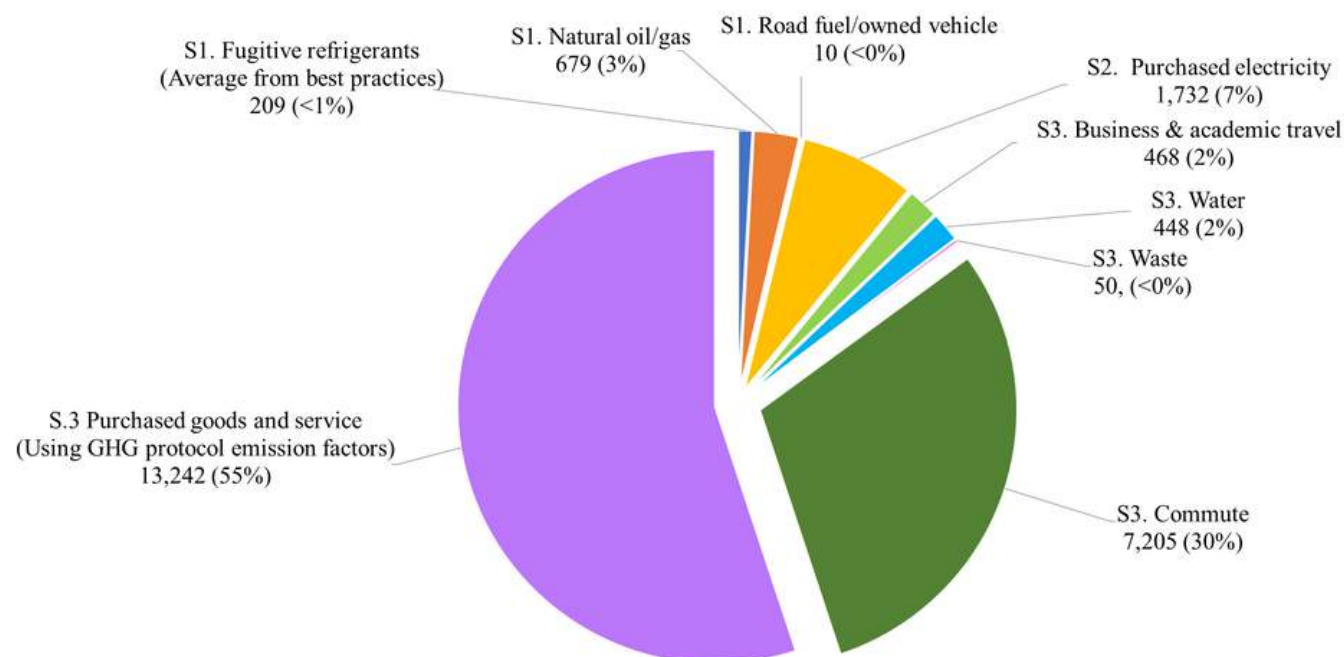
[10] International flights emissions are based on Club Travel emission figure

[11] Accommodation and food and beverage emissions are based on STORY@ATU emission factors

[12] Using GHG Protocol emission factors for purchased goods and services

[13] Using EXIOBASE emission factors for purchased goods and services

Appendix 3. ATU Sligo's estimated carbon footprint for 2022 – total emissions 24,041 tCO₂e (FT) (using the GHG Protocol Scope 3 Evaluator emission factors for purchased goods and services)



Appendix 4. Summary and comparison of Irish university emissions (tCO₂e) using the GHG Protocol and EXIOBASE emission factors for purchased goods and services

Emission source	ATU Sligo campus 2022 (FT) (tCO ₂ e)	UG 2021 (FTE) (tCO ₂ e)	UG 2019 (FTE) (tCO ₂ e)	DCU 2021 (FTE) (tCO ₂ e)	UCC 2018 (FTE) (tCO ₂ e) [1]
Scope 1 emissions					
Total Scope 1 emissions	898	2,772	3,783	4,427	7,669
Scope 2 emissions					
Total Scope 2 emissions	1,732 [3]	4,067	5,594	5,684	15,381
Scope 3 emissions					
Total Scope 3 emissions	21,412 [12]	12,025 [13]	53,388 [13]	44,019 [12]	37,519 [12]
Total emissions (Scopes 1, 2 and 3)	24,041 [2][4][12]	14,655 [2][4][13]	60,227 [13]	53,396 [12]	47,630 [12]
<i>Emissions per person/year</i>	2	1.23	2.8	2.6	3
<i>Emissions per student/year</i>	2.14	1.31	3.23	2.95	3.413
<i>Emissions per student per 4-year degree</i>	9	5.2	12.9	11.8	13.65

[1] Using STARS Inventory

[2] Data limitations

[3] Electricity generated on-site (Solar PV) is excluded as renewable energy has previously been considered zero carbon

[4] WEEE emissions are assumed to be higher due to a one-time spike from a recent electronics upgrade and accumulated waste

[5] No organic waste data available

[6] Emissions are assumed to be higher than other universities due to recent construction activities and an upgrade of electronic equipment

[7] Assumes mixed recycling is zero carbon

[8] Emissions from ATU Sligo's water are assumed to be higher than other universities due to a water leak, with a new valve and meter recently installed

[9] Emissions are based on 2015 commute data

[10] International flights emissions are based on Club Travel emission figure

[11] Accommodation and food and beverage emissions are based on STORY@ATU emission factors

[12] Using GHG protocol emission factors for purchased goods and services

[13] Using EXIOBASE emission factors for purchased goods and services

[14] New building is included in purchased goods and services

[15] ATU Sligo does not offer funding for car hire

Appendix 5. Summary and benchmark of Irish university emissions (tCO₂e) using the GHG Protocol and EXIOBASE emission factors for purchased goods and services

Emission source	ATU Sligo campus 2022 (FT) (tCO ₂ e)	UG 2021 (FTE) (tCO ₂ e)	UG 2019 (FTE) (tCO ₂ e)	DCU 2021 (FTE) (tCO ₂ e)	UCC 2018 (FTE) (tCO ₂ e) [1]	
Scope 1 emissions						
Total Scope 1 emissions	898	2,772	3,783	4,427	7,669	
Liquid fuel consumption	0	0	0	0	7,611	
Natural gas	0	0	0	4,140	0	
Oil	597	0	0	0	0	
LPG	82	119	153	0	0	
Gas imports	0	2,379	3,087	0	0	
Gasoil	0	169	290	0	0	
Wood pellets	0	62	110	0	0	
Fugitive refrigerants	209 [2]	0	0	277	0	
Road fuel/ owned vehicle	10	40	15	10	57	
Biodiesel	0	3	128	0	0	
Scope 2 emissions						
Total Scope 2 emissions	1,732 [3]	4,067	5,594	5,684	15,381	
Electricity imports	1,732	4,067	5,594	5,684	11,740	
Electricity generated on-site (Solar PV)	12 [3]	0	0	0	0	
Electricity and steam produced on-site	0	0	0	0	3,641	
Scope 3 emissions						
Total Scope 3 emissions	21,412 [12]	12,025 [13]	53,392 [13]	43,974 [12]	37,519 [12]	8,437 [1]
Waste	50 [6]	2.9	50	27	43	
Landfill mixed	35	0	42.5	0	25.3	
Mixed recycling	0.34	0 [7]	0 [7]	0	17.8	
Waste to energy	0	1.5	2.7	0	0	
Glass	0.051	0.8	4.1	0	0	
Timber	0.17	0	0	0	0	
Organic	0 [5]	0.6	0.4	0	0	
WEEE	13.8 [4]	0	0.5	0	0	
Water	448 [8]	18.8	30.6	42	3	
Staff and students commute		22,150	9,198 [9]	14,192	6,713	
Business and academic travel	468	326	4,378	822 [2]	1,677 [2]	
Fights	378	248.6	4,064.6	822	1,441.2	
International flights	378 [10]	0	0	0	0	
Domestic flights	0.13	0	0	0	0	
Ferry	0.07	0	0	0	0	
Public transport	2.3	2.2	22.3	0	94.4	
Taxis	0.13	5.7	71.3	0	0	
Personal vehicle	38	43.4	140.8	0	141.4	
Car hire	0 [15]	8.2	18.9	0	0	
Accommodation	22 [11]	18.2	59.7	0	0	
Food and beverage	26.3 [11]	0	0	0	0	
Purchased goods and services [12][14]	13,242 [6][12]	0	30,363 [12]	22,436 [12]	0	
Purchased goods and services [13][14]	3,856 [6][13]	30,890 [13]	0	0	0	

[1] Using STARS Inventory

[2] Data limitations

[3] Electricity generated on-site (Solar PV) is excluded as renewable energy has previously been considered zero carbon

[4] WEEE emissions are assumed to be higher due to a one-time spike from a recent electronics upgrade and accumulated waste

[5] No organic waste data available

[6] Emissions are assumed to be higher than other universities due to recent construction activities and an upgrade of electronic equipment

[7] Assumes mixed recycling is zero carbon

[8] Emissions from ATU Sligo's water are assumed to be higher than other universities due to a water leak, with a new valve and meter recently installed

[9] Emissions are based on 2015 commute data

[10] International flights emissions are based on Club Travel emission figure

[11] Accommodation and food and beverage emissions are based on STORY@ATU emission factors

[12] Using GHG protocol emission factors for purchased goods and services

[13] Using EXIOBASE emission factors for purchased goods and services

[14] New building is included in purchased goods and services

[15] ATU Sligo does not offer funding for car hire

Appendix 6. Emission factors used for Scope 1, Scope 2 and Scope 3 (excluding purchased goods and services)

Emission inventory	Emission factors used for 2022	Sources
Scope 1		
Oil	2.9430 (kg CO ₂ /l)	SEAI (CO ₂)
LPG	1.5680 (kg CO ₂ /l)	
Road fuel	Petrol: 2.34 kgCO ₂ /l Diesel: 2.70 kgCO ₂ /l	
Fugitive refrigerants	Average per person (2021): 17 kgCO ₂ e [1]	DCU average (best practice)
Scope 2		
Purchase electricity	0.33 (kgCO ₂ /kWh)	SEAI (CO ₂)
Produced electricity (Solar PV)	0.041 (kg CO ₂ e/kWh)	IPCC (CO ₂ e)
Scope 3		
Waste		DEFRA (CO ₂ e)
Landfill mixed waste	Commercial and industrial waste: 467.008 kg CO ₂ e/t	
Mixed recycling waste	Open-loop average plastics: 21.280 kgCO ₂ e/t [2]	
Glass	Open-loop: 21.280 kgCO ₂ e/t [2]	
Timber	Closed-loop: 21.280 kgCO ₂ e/t [3]	
Organic	Composting: 8.911 kgCO ₂ e/t	
WEEE	WEEE Open-loop mixed: 21.280 kgCO ₂ e/t [2]	
Water	Supply & treatment: 0.421 kgCO ₂ e/m ³	
Staff & students commute		
Car alone	Average car (fuel unknown): 0.17067 kgCO ₂ e/km	DEFRA (CO ₂ e)
Car with 1 passenger	Average car (fuel unknown): 0.085 kgCO ₂ e/km	
Car with passenger(s)	Average car (fuel unknown): 0.049 kgCO ₂ e/km	
Van alone	Average van (fuel unknown): 0.23099 kgCO ₂ e/km	
Van with 1 passenger	Average van (fuel unknown): 0.115 kgCO ₂ e/km	
Van with passenger(s)	Average van (fuel unknown): 0.066 kgCO ₂ e/km	
Motorbikes/scooter	Average: 0.11355 kgCO ₂ e/km	
Train	National rail: 0.03549 kgCO ₂ e/passenger-km	
Bus	Average: 0.0965 kgCO ₂ e/passenger-km	
Business & academic travel		
International flights	Unknown [4]	Club Travel
Domestic flights	Domestic flights (with Radiative Forcing): 0.24587 kgCO ₂ e/passenger-km	DEFRA (CO ₂ e)
Public transport	National rail: 0.03549 kgCO ₂ e/passenger-km	
	International rail: 0.00446 kgCO ₂ e/passenger-km	
	Average bus: 0.0965 kgCO ₂ e/passenger-km	
	Coach: 0.02733 kgCO ₂ e/passenger-km	
Taxis	Average: 0.14876 kgCO ₂ e/passenger-km	
Car alone	Average car (fuel unknown): 0.17067 kgCO ₂ e/km	
Car with 1 passenger	Average car (fuel unknown): 0.085 kgCO ₂ e/km	
Car with passenger(s)	Average car (fuel unknown): 0.049 kgCO ₂ e/km	
Car hire	N/A [5]	
Ferry	Average for foot and vehicle passengers: 0.140 kgCO ₂ e/nm [6]	STORY@ATU (Conefrey & Hanrahan, 2022)
Accommodation	Average for all accommodation types: 22 kgCO ₂ e/per night [6]	
Food & beverage	Average for a medium meat eater [7]	Carbon footprint calculator (DEFRA (CO ₂ e))

[1] ATU Sligo does not have data on fugitive refrigerants, therefore the average per person from national best practices is used

[2] Open-loop emission factor is used under the assumption that material will be processed into new products

[3] Closed-loop emission factor is used under the assumption that material will be processed into new products

[4] Club Travel failed to disclose the emission factors used for international flights, and no alternative data was provided

[5] ATU Sligo does not offer funding for car hire

[6] STORY@ATU utilised international and national averages

[7] Carbon footprint calculator was used to estimate the emissions from the euro spent on food and beverage

Appendix 7. Comparing the emission factors used for purchased goods and services

Agresso categories	GHG Protocol emission factor (kgCO ₂ e)	EXIOBASE emission factor (kgCO ₂ e)
Chemicals and chemical products (Cleaning Services, Cleaning Consumables, Cleaning Equipment/chemical products)	1.12	0.41
Construction (New Buildings Programmes, Building Maintenance, Facility Management Services, Security)	0.69	0.20
Education - standard goods (Laboratory Equipment, Instruments, Gases, Consumables, Chemicals & Reagents, Office Equipment, Office Equipment Maintenance, Furniture/fit out)	0.25	0.22
Food, beverages and tobacco - service (Catering Services, Catering Supplies, Water Coolers, Catering Equipment)	0.89	-
Health and Social Work - standard goods/services (Medical Equipment, Surgical Equipment, Medical Services, Research Services, Medical/Surgical Consumables, Health & Safety Services, Health & Safety Equipment, Health & Safety Training, Protective Clothing, First Aid)	0.26	-
Other Community, Social and Personal Services (Advertising, Professional Services, Memberships, Training Courses, Photography, Patent Fees, Florists, Landscaping, Document Management, Laundry, Consultancy Services, HR Services, Insurance, Communications, Public Relations, Venue/Meeting Rooms, Website Design and Services)	0.63	0.14
Other - standard goods (Awards, Gift Vouchers, Works of Art, One4All Vouchers, Florists)	0.63	-
Post and Telecommunication (Mobile and Landline Charges, Postal Services, Courier Services, Delivery Charges)	0.30	-
Pulp, Paper, Paper, Printing and Publishing - standard good/service (Photocopier Paper, Office Supplies, Small Office Machines and Consumables, Printing Services, Graphic Design Services, Library Books, Periodicals, Library Services, Library Equipment)	0.64	0.11
Retail Trade, Except of Motor Vehicles & Motorcycles; Repair of Household Goods (Sports Equipment, Sports Consumables, Sports Equipment Maintenance)	0.22	-
Sales, maintenance and repair of motor vehicles (Vehicle Purchase, Vehicle Maintenance, Boat Hire)	0.21	-

Source adapted and modified: (Goggins & Adams, 2021, 2023)