2023 Energy Review

OLLSCOIL NA GAILLIMHE
UNIVERSITY OF GALWAY

Prepared by
University of Galway's Energy Team
September 2023

Table of Contents

Executive Summary

This Energy Review is being carried out to comply with the requirements of the ISO5001: 2018 Energy Management System (EnMS) standard, clause is 6.3. The main purpose of this energy review is to analyse University of Galway's energy usage and consumption based on measurement and other data i.e. the identification of current types of energy use, the evaluation of past and present energy usage and the analysis and identification of the Significant Energy Users (SEUs). For each SEU, the relevant variables and current energy performance is determined and the person(s) doing work under our control, who have an influence, or effect, on each of the SEUs, have been identified. Additionally, opportunities for improving the energy performance of the University of Galway's SEUs are outlined and prioritised. Furthermore, the estimated future energy usage and consumption is documented.

Buildings that are included within the scope of the University of Galway's ISO50001 EnMS have been reviewed and are listed in our Energy Manual and Dashboard. There are fifty-eight buildings included that have a total internal floor area of 155,090 m^2. The overall treated unit floor areas of the University is 213,720 m.2.

Internal audits of the ISO50001 EnMS have been carried out during 2022-23 and there were no non-conformances found. The main observations are in relation to the energy crisis (security of supply & escalating costs), associated with the war in Ukraine and other global uncertainties such as climate change, It is a testament to the hard work and dedication of the University of Galway's Buildings & Estates Team, that the colleges energy performance has continued to improve (see also Figure 4).

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, or EnPIs, and are being used to set targets for enhanced energy performance improvement plans. These metrics are used to monitor the performance of each of the SEU buildings, on a weekly/ monthly basis and are actively discussed during our monthly energy review meetings.

University of Galway operate a formal EnMS which is compliant with the requirements of ISO50001: 2018; Energy Management Systems Standard. The Energy Review is carried out once a year and in response to major changes in facilities, equipment, systems, or energy using processes. It is normally carried out during August/September/October, and compiled, reviewed, and reported during October/November, each year and to align with the surveillance audit which is planned to take place on 10th & 11th October this year.

The methods and criteria used to develop each of our Energy Reviews are outlined and the results are documented and retained/ maintained as records under our Document Control Procedure.

[1] kWh (e) relates to electricity related usage – the average unit price per kWh(e) used is €0.152c
[2] kWh (th) relates to gas usage – the average unit price per kWh(gas) used is €0.062c

1. Analyse Energy Use & Consumption

1.1 Current Types of Energy

The types of energy being used at University of Galway are outlined on table 1, with further details outlined on Appendix F. In the main, the campus uses imported electrical and gas to sustain its operations. It also uses a considerable number of renewable energies such as combined heat and power plant, biomass boiler, solar thermal and solar photovoltaic systems. Over the past few years, the college has continued to roll out the installation of solar photovoltaic electrical energy generation systems and these are proving very worthwhile. The campus building's energy consumption during 2022 is set out in Table 1 and summarised in Figures 1, 2 and 3.

Table 1: Annual Energy Consumption, Energy Costs & CO2 Emissions (t)

Fuel	2022		
	Quantity [kWh]	Spend (Est.)	CO2 * Emissions [kg.]
Electricity Imports	15,289,806	€2,324,051	5,051,752
Electricity Generated on-site from PV	221,153	-€33,615	-73,069
Gas Imports	10,590,522	€656,612	2,148,817
LPG	504,972	€27,016	115,790
Gasoil - Kerosene & Heating	170,738	€13,318	43,009
Wood pellets	264,000	€22,275	0
Solar Thermal	144,500	-€7,500	-36,400
Road Diesel	155,453	€16,089	41,024
Transport Biofuels	11,993	€1,241	0
Total	**27,353,137**	**€3,019,487**	**7,290,923**

**Referenced SEAI website on 2nd October – see also Appendix F*

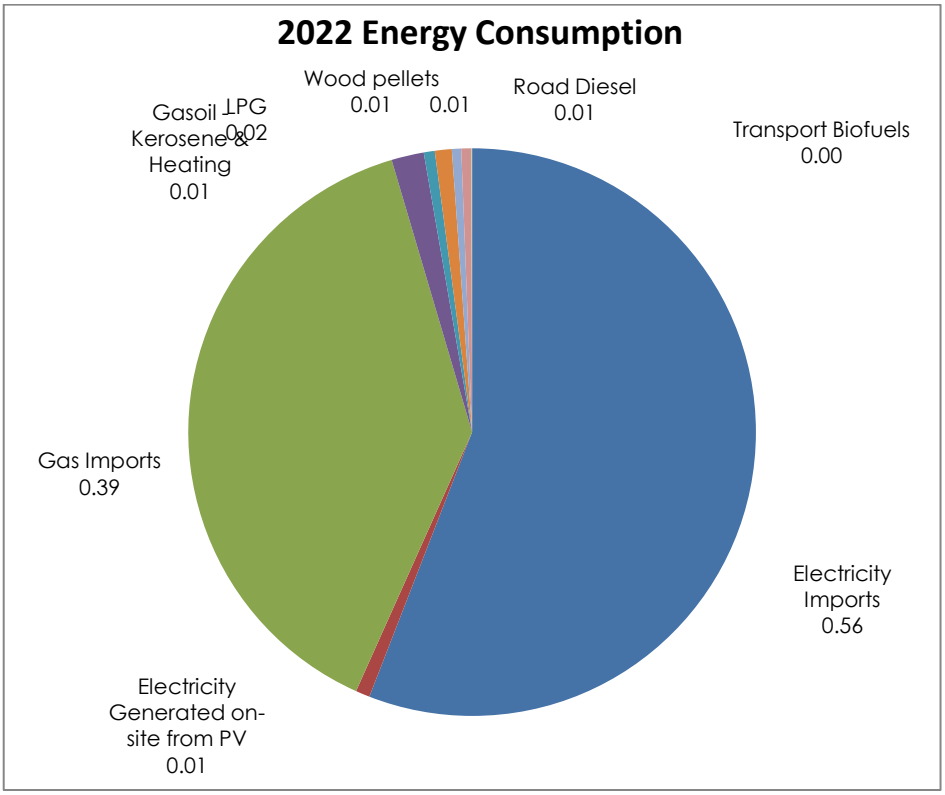


Figure 1: 2022 Breakdown of Energy Consumption (kWh)

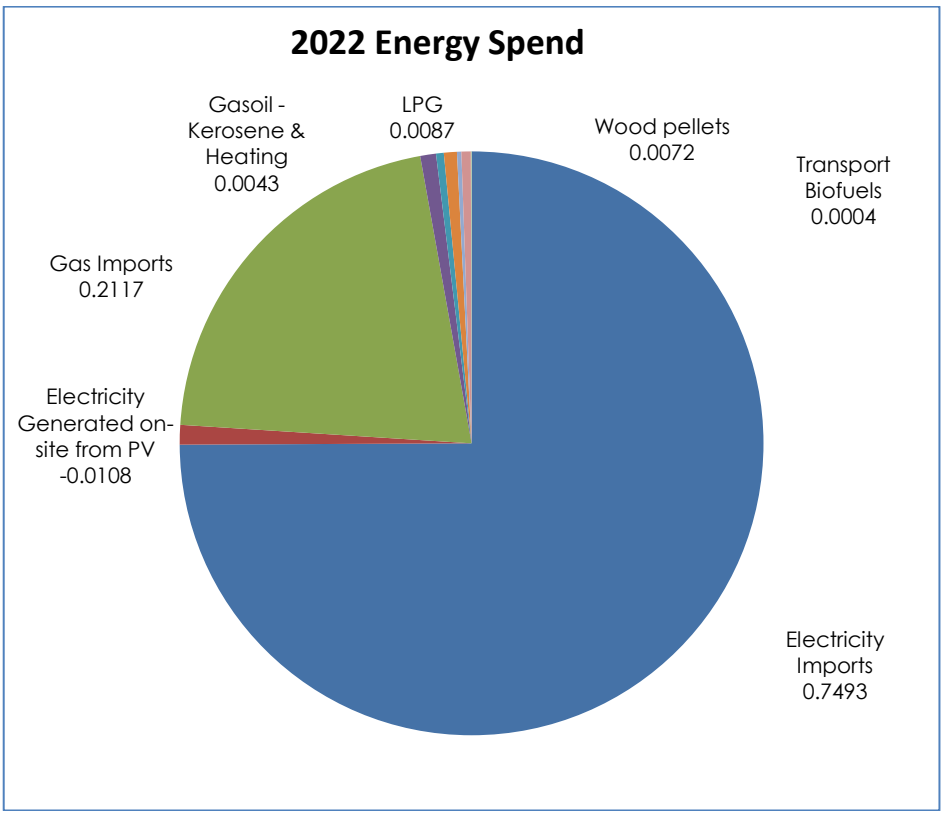


Figure 2: 2022 Breakdown of Energy Spend

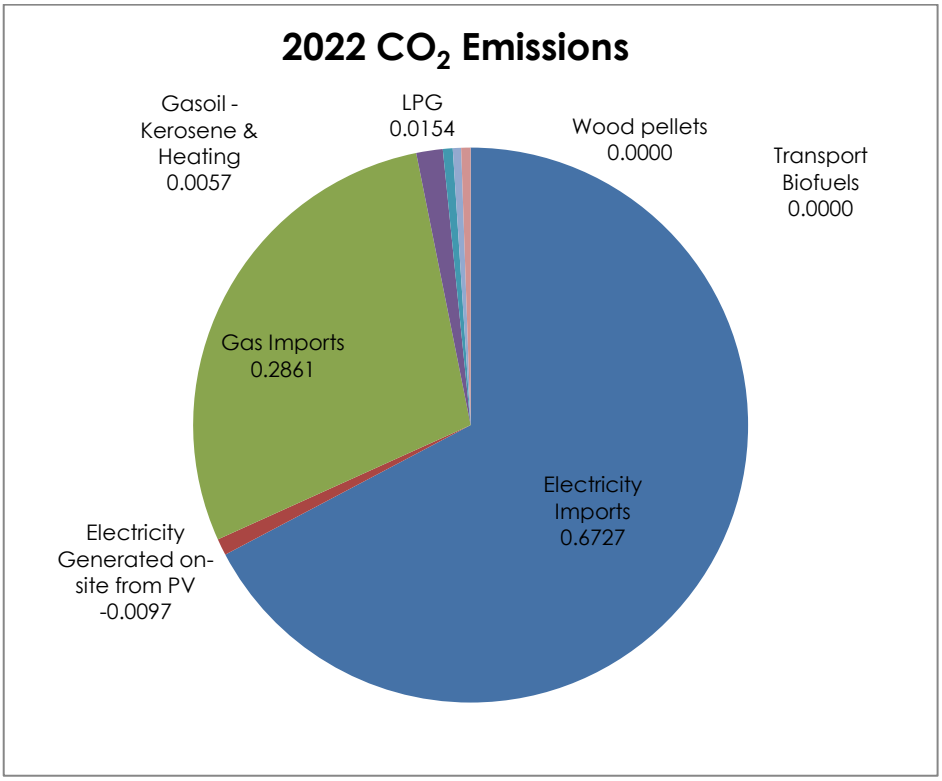


Figure 3: 2022 Breakdown of Energy Related CO_2 Emissions

1.2 Evaluation of past & present energy use & consumption

An evaluation of the past and present energy use and consumption was carried out using the SEAI's M&R System. This is the national profile database of all public sector organisations. It is 'independently assessed' using a stringent quality assurance system and uses electricity and natural gas data, accessed from the national Meter Point Registration Operators. The M&R System is heavily referenced as it demonstrates that we are being independent in our assessment criteria. That said, this data includes energy used to sustain science and research activities carried out at the SRB Building and that building is not included yet, in the scope of our ISO50001 EnMS. An annual highlight of our energy performance from 2006 to 2022, inclusive, is outlined on Figure 4, below.

Figure 4: University of Galway's actual energy performance Source SEAI's M&R System – accessed on 27th September 2023

Additionally, the energy performance of each of our buildings is being monitored daily and reported monthly. The Energy Team reviews the performance of each of our significant energy using buildings; using monthly cumulative electrical energy usage data and compares that to the cumulative electrical energy usage for the equivalent month, from the previous year. This is carried out to react to any untoward changes in a timely fashion. The methodology was adjusted to factor pandemic related guidelines, but these have since returned to reflect 'normal' campus operations. A proactive approach allows us to micro-manage each of our building's energy performance so that monthly and annual objectives and targets are continuously met.

Additionally, the annual SEAI M&R Report is being used to review our past and present energy performance (as per figure 4). Our energy performance has steadily improved, and the downward trend has resulted in a 49.6% overall improvement in our energy performance, since our baseline year, which is 2006. The energy performance indicator used is kWh/TUFA (Treated Unit Floor Area), but it is noted that the M&R has changed to reflect carbon emissions related performance; to encourage more active carbon efficiency measures.

A copy of the annual SEAI M&R Report is sent to our President, by SEAI, every year.

2. Identification and analysis of our Significant Energy Users

2.1 Significant Energy Users

The main energy consumers are summarised in Table 2 below. This table is based on the electrical energy using data obtained using the Building Energy Management System (BMS). It is used to prioritise opportunities and support cost

accounting exercises. The Arts Science Building includes the Main Concourse, Chemistry/ Bio-Chemistry and Physics. As outlined previously, The Science Research Building (SRB) is outside the scope of the ISO50001 Energy Management System and is being managed by Neylons' FM.

This table shows that the overall electrical energy usage is reducing. HBB – Human Biology Building, is a full treated medical building with 'live' research laboratories. The building has reached it full operating capacity during 2020. During 2022, the electrical energy usage reduced by 136,865 kWh and this is probably due to the comprehensive corrective actions taken by the facilities team, Technical Building Office and Energy Team. This result is very pleasing.

A table for primary thermal energy users is being developed to include information from the new thermal energy meters. Additionally, we have conducted a degree day regression analysis recently and the results are outlined in Section 2.2.2.

Table 2: Summary of top ten electrical energy consuming buildings

Name	Year	GIA[3]	2021 kWh (e)	2022 kWh (e)	Diff.
Arts Science Building – Main Meter	1970, 1973	31,312	1,613,083	1,556,974	-56,109
Alice Perry - Engineering Building	2011	14,145	1,216,014	1,151,987	-64,027
James Hardiman Library	1980	9,415	977,365	1,282,920	305,555
Science Research Building	2012	8,212	2,406,549	2,376,038	-30,511
Arts Millennium Building (incl. AMBE extension)	2000, 2012	8,054	335,368	345,619	10,251
Human Biology Building	2017	8,000	1,961,688	1,824,823	-136,865
Orbsen Building	2003	6,491	975,442	938,395	-37,047
Arts, Humanities, Social Sciences Research Building (AHSSRB)	2013	5,436	683,043	717,021	33,978
Áras Na Mac Léinn / Cultural centre	1995	4,307	669,487	758,989	89,502
Áras de Brun, Anatomy & Terrapin	1960	2,426	467,726	387,463	-80,263
Overall		34,464	***Reduction***		

[3] GIA – Gross Internal Floor Area

2.2 Relevant Variables

2.2.1 Baseline

The energy baseline used is the kWh (e) and kWh (th) per m2 of treated floor area. The baseline year is 2006 and University of Galway's progress since then is plotted on Figure 4. Our energy performance during 2006 was 462.64 kWh per m.2 of treated floor area. During 2020 that figure fell to 180 kWh per m.2, which is a 54.2% improvement. However, as we returned to a more normal operating environment during 2021 and 2022, that figure rose to 190.50 kWh & 198.02 kWh per m.2, respectively. This demonstrates a significant improvement of 49.6% lower than the baseline. The target set for 2030 under the Climate Action Plan 2023 is 50% improvement which equates to 196.47 kWh per m.2. However, as expected our targeted performance will continue to be a challenge e.g. the Science Research and Human Biology Buildings, both have exact heating, cooling & humidity control to some areas, which is required 24 hours a day 365 days per year, and that is dragging down the overall energy performance of our University.

As expected, the Climate Action Plan targets a 51% improvement in carbon[4] emissions performance compared to the baseline year; for all public sector organisations. In preparation for the transition to Carbon and Green House Gas Emissions – GHGs, we are monitoring our CO_2 emissions every year, since 2006. We have placed more emphasis on this aspect since 2014 and are delighted to report that our primary emissions are on the wane, since then. See also Appendix D - Yearly CO_2 emissions.

Finally, there is a requirement to monitor travel related carbon emissions associated with our operations and a database is being compiled to capture and populate all travel related carbon emissions. This is an onerous task and will take some time to develop and mature. It is expected that during next year's M&R return cycle our college will have enough data to accurately report travel related carbon emissions.

2.2.2 Other Relevant Variables

There are a number of other relevant variables such as number of students and staff (and researchers), number of conferences, number of projects completed (including new or renovated buildings) and degree days[5]. Degree days and regression analysis exercises are being undertaken. The calculated regression or R value during 2021 is 0.906 (Strong Positive Relationship between gas usage and outside ambient temperatures). During 2020, it was 0.754, which demonstrates a positive correlation between gas usage and outside ambient temperature. During 2019 the R-Value was 0.626. Additionally, an analysis of Annual Thermal Energy Versus Degree Days was conducted and this shows that thermal energy usage is on the wane and degree days are reducing (which reflects the trend identified by meteorological experts). A strong positive correlation between annual thermal usage and degree days was noted at 0.998975 during the period from 2020-2022.

[4] Carbon dioxide is abbreviated to carbon and is denoted by CO_2

[5] Degree days are a simplified representation of outside air-temperature data. "*Heating degree days*", or "*HDD*", are a measure of how much (in degrees), and for how long (in days), outside air temperature is lower than a specific "*base temperature*" (or "*balance point*"), which in our case is 15.5 deg C. Source www.degreedays.net

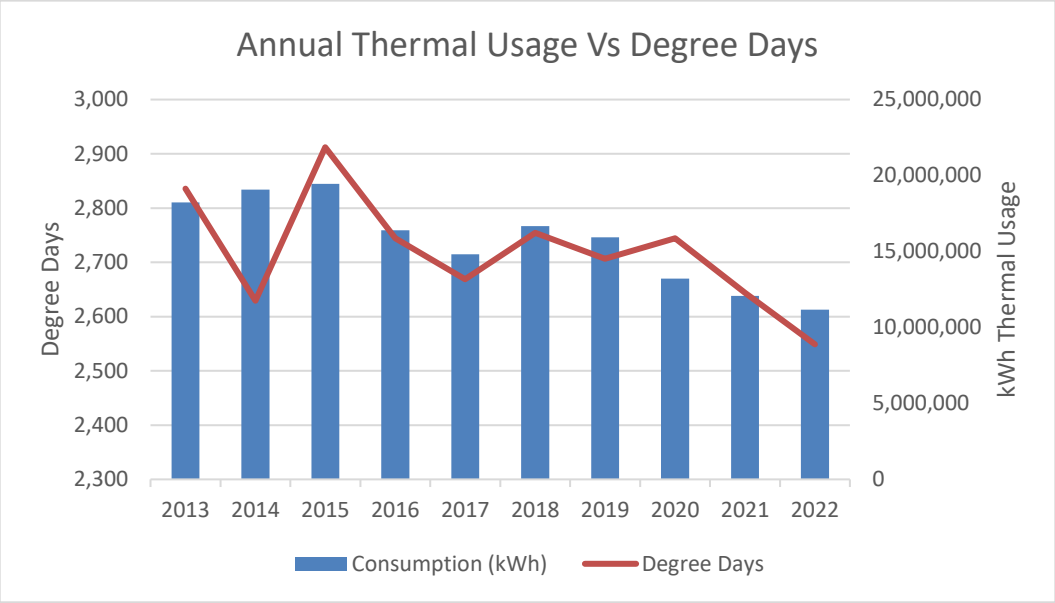


Figure 5: Degree Day Analysis

As part of the Green Flag initiative, we began reporting a carbon and energy per student related key performance metric, and this proved to be a very successful tool in engaging with students. We will continue this initiative during 2023/24 as this has enabled our students to become more conscious of their impact on energy and carbon usage at our university. During 2020, the weight of carbon dioxide emitted per student dropped from 465 kg to 348 kg which will be a factor of the pandemic national guidelines and associated remote learning. However, during 2021, the weight increased to just 373 kg per associated with each student and this metric is particularly pleasing. Figure 6 plots the kg of CO_2 per student during the period from 2006 to present. The use of carbon performance metrics will be more prevalent in future as this method compliments the move towards a more sustainable campus.

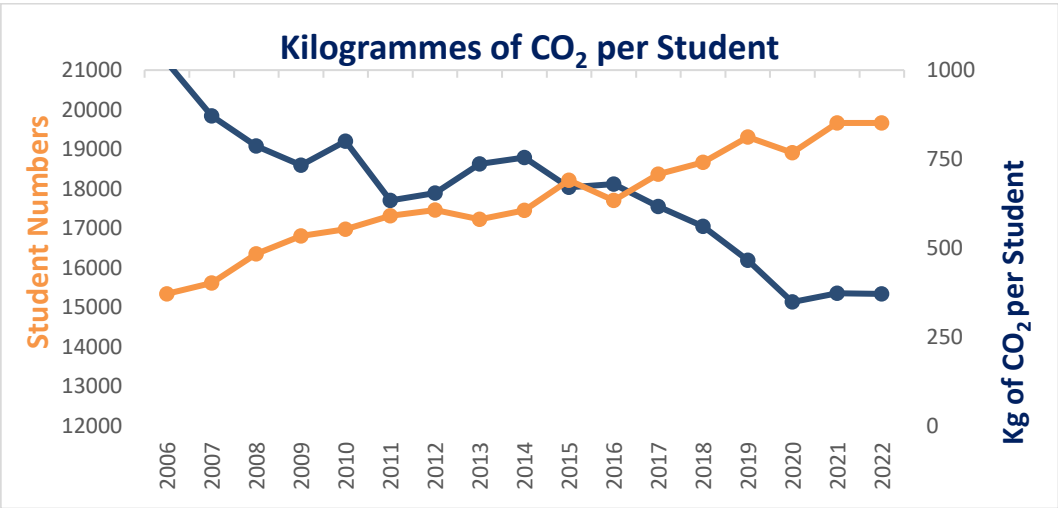


Figure 6: Kilogrammes of CO_2 per Student (2006-2022)

2.2.3 Legal & Other Requirements

Legal and other requirements are being evaluated on an ongoing basis. Since Q1 of 2017, University of Galway has subscribed to an external register of energy legislation and staff has undergone training in its use, and the requirements of ISO50001: 2018 Clause 9.1.2.

The main pieces of legislation and other requirements that apply to the university on an ongoing basis are: -

- S.I. 426 of 2014 – European Union (Energy Efficiency) Regulations – that place responsibilities on public sector organisations to take an exemplar role in relation to energy efficiency and energy management.
- S.I. 292 & 183 of 2019, S.I. 243 of 2012, S.I. 872 of 2005 – European Union (Energy Performance of Buildings) Regulations 2005, 2012 & 2019
- Climate Action Plan – 2023 and previous Plans and National Energy Efficiency Action Plans 1, 2, 3 & 4
- Building Regulations 2021: Technical Guidance Document L – Buildings other than Dwellings Published on 7th December 2020 and updated on 12th August 2021.

Finally, the Buildings and Estates team operate a comprehensive 'Statement of fundamentals' that is integrated into the college's purchasing procedure. This document obliges all interested parties to undertake life cycle assessments so that all new and refurbished plant, equipment, and projects undertaken include energy efficiency measures during the design, procurement, installation, and commissioning phases.

2.3 Current energy performance

The management team measure its electrical and thermal energy performances using key performance indicators; kWh (e) and kWh (th) per metre squared of treated floor area per annum. These are termed Energy Performance Indicators, or EnPIs, and are being used to set targets for enhanced energy performance improvement plans. Table 3, as below, gives an outline of the kWh usage of both electricity and thermal energy per m.2. of treated floor area per annum. This table demonstrates that our annual energy performance has improved over the past 4-years but went up slightly during 2022, as the college returned to more 'normal' operations. Electrical and thermal energy related energy performance indicators (EnPIs) are also used to demonstrate compliance with and achievement of Public Sector 2030 targets, the use of EnPIs may be developed further to include performance monitoring of each of its significant energy users such as the chiller, IT equipment, catering, lighting, boilers, and CHP plant.

Table 3: 2006-22 Energy performance indictors

Year	Energy Performance Indicator (EnPI)	
2022	kWh (e & th) /m2	198.00
2021	kWh (e & th) /m2	189.98[6]
2020	kWh (e & th) /m2	180.25
2019	kWh (e & th) /m2	237.06
2018	kWh (e & th) /m2	249.42
2017	kWh (e & th) /m2	259.85
2016	kWh (e & th) /m2	274.81
2015	kWh (e & th) /m2	274.20
2014	kWh (e & th) /m2	299.76
2013	kWh (e & th) /m2	283.71
2012	kWh (e & th) /m2	248.77
2011	kWh (e & th) /m2	256.77
2010	kWh (e & th) /m2	336.32
2009	kWh (e & th) /m2	334.55
2008	kWh (e & th) /m2	356.04
2007	kWh (e & th) /m2	371.86
2006	kWh (e & th) /m2	462.64

EnPIs (kWh (e)/m2 of treated floor area are being used to monitor the energy performance of each building and those are reported and discussed during monthly energy review meetings. In 'normal years', prior to and following the effects of pandemic related remote learning/ working measures, buildings that were under performing by 10%, or overperforming by 20%, were highlighted for special attention, but that has passed. During 2022, performance has improved by 16.5% compared to the years prior to the Pandemic, and this is to be lauded.

The reasons why the performance has improved or worsened are noted and follow-on actions are agreed. Those are then documented and followed up on during the next few days and reviewed again during the next scheduled energy review meeting. In this manner, the EnPI data is being used as a springboard for enhanced energy efficiency. University of Galway are using EnPIs as an essential tool for developing an effective EnMS and are also using those as a method to demonstrate that it is achieving its targets for improvement.

Finally, we also use Display Energy Certificates (DECs) to report each publicly used building, to report the operational performance, in kilograms of CO_2 per m.2 of treated floor area. The DECs are a performance rating and demonstrate that we are compliant with the requirements of the European Union (Energy Efficiency) Regulations and the Irish Statutory Instrument; S.I. 426 of 2014. Copies of the ten most recent DECs are outlined on Appendix B.

[6] During 2020 & 2021 there was a significant drop largely due to the pandemic and not reflective of a 'normal' year.

2.4 The identification of person(s) that affect our SEUs.

The persons that affect the energy performance of our SEUs are identified and outlined on Table 3: Periodic & Operational Tasks/Roles in our Energy Manual. These include the details of each role and the person or title of the person who has overall responsibility for carrying out the duties and associated tasks. Michael Curran, who is Head of Building Services, Energy & Utilities has overarching responsibility for the operational control of our SEUs. Michael has a team of electrical and mechanic personnel and several preferred contractors, and he manages these personnel so that each of our SEU buildings are controlled and operated to strict performance specifications. Additionally, there are a few buildings that are managed by external companies. Michael has overarching responsibility for the performance of these buildings.

3. Determining & Prioritising Opportunities for Improvement

3.1 Recent/Existing Energy Saving Initiatives

University of Galway's Energy Team is doing great work in developing and using their ISO 50001: 2018 compliant energy management system, to achieve targets and objectives, and to demonstrate compliance with its legal obligations. The Energy Team comprises of Lorraine Rushe (University of Galway's Energy Manager), Michael Curran (Head of Building Services, Energy & Utilities), Seán Farrell (Electrical Engineer), Anthony Nevin (Mechanical Supervisor), Kenneth O'Toole (Electrical Supervisor), Karl Byrne (Building Management Systems' Consultant) and John Harrington (Energy Management Systems' Consultant). Occasionally, other interested parties are invited to attend and to present to the EnMS Team. In general, the Energy Team meet once a month to undertake a review of the EnMS and to review each of the significant energy using building's monthly energy performance data. Actions are taken to address any deviations that are found to be + 10%, and -20%, from the norm; see also Section 8.1.

Michael has continued to lead the ISO50001 Energy Management System and represents top management. He has continually demonstrated his commitment to supporting the EnMS and is focused on delivering an effective system; by defining, implementing, and maintaining the University of Galway's Energy Policy. Lorraine Rushe is the Energy Manager, and she is pivotal in the management of the system elements and in providing the resources[7] needed to maintain and improve the EnMS and resulting energy performance, on a continual basis.

Lorraine has also continued to develop the legal and other requirements aspect using the external legal registrar, known as Pegasus. That registrar updates and advises University of Galway on their Energy, Environmental, Health and Safety related legal obligations. Lorraine and the core Energy Team has received training in the use of the Pegasus System. The work carried out by Lorraine has ensured that University of Galway is fully compliant with the Legal and other requirements outlined in Section 9.1.2 of the standard.

[7] Resources include human resources, specialised skills, technology, and financial resources.

Michael Curran has led the way in terms of implementing energy efficiency projects throughout the year. He has developed the deep retrofit of the Áras de Brun building and has been actively interacting with the HEA Pathfinder Programme to support this national pilot initiative. Other projects include the continued installation of LED lighting and upgrading oil and gas boilers to heat pump equivalents. Furthermore, the Energy Team has continued to decarbonise the University of Galway's campus and generated 221 MWh during 2023.

Karl Byrne has responsibility for developing and managing the Monthly Building Performance Metering and Reporting System. He presents the results to the energy team once a month and follows up on any metering related action(s) and updates the reports and corrective actions accordingly.

John Harrington has supported the team throughout and has carried out the 2022 Internal Audit Programme of the EnMS system. Additionally, he planned and documented the internal audit schedule for 2023-4 which is outlined on our EnMS Dashboard. John will continue to report any observations and/or non-conformances using the Internal Audit Report Feedback Forms. Lorraine and John will be responsible for following through, and closing out, actions required arising from those observations/ non-conformances, as applicable.

University of Galway's main objective is to reduce electricity and thermal related energy consumption and to improve the overall energy performance of its buildings. During 2022, our university's energy performance improved by 23% (198 kWh/m2), when compared to the 5-year average of 2015-2019 (259.07 kWh/m.2). Overall, we have demonstrated energy savings of 49.6% lower than the baseline year (2006) and this is documented on the Sustainable Energy Authority of Ireland's M&R System. It provides independent proof that University of Galway's Energy Performance is continuously improving.

We have factored in risks associated with security of energy supplies and escalating energy costs caused by recent uncertainties in the international markets and mitigation factors are being managed on a monthly basis. Furthermore, a top management committee has been formed, chaired by the Bursar, which is tasked with guiding the university through this current energy crisis.

The Energy Team are developing further energy efficiency projects and will use the results from the Áras de Brun deep retrofit project to roll out similar projects, on similar buildings, into the future. The Energy Team and indeed all of the Building & Estates Department continues to identify potential boiler-house upgrade projects, LED lighting replacement projects, Set-back HVAC opportunities and pumps/ motors that could be replaced with modern energy efficient equivalents. The boiler house upgrades include fuel switching and the college's annual reduction in Gasoil usage is plotted on Figure 7. Additionally, it has installed a hydrogenated vegetable oil – HVO boiler system in Carna which is being used to improve the college's knowledge (on new technologies/techniques) and carbon performance. It also is continuing to 'roll out' renewable energy projects such as the installation of large scale geothermal (GeoFit), photovoltaic, and solar hot water systems and biomass boiler and power plant upgrades and the combination of results will lead to the decarbonisation of the University of Galway campus by 2030.

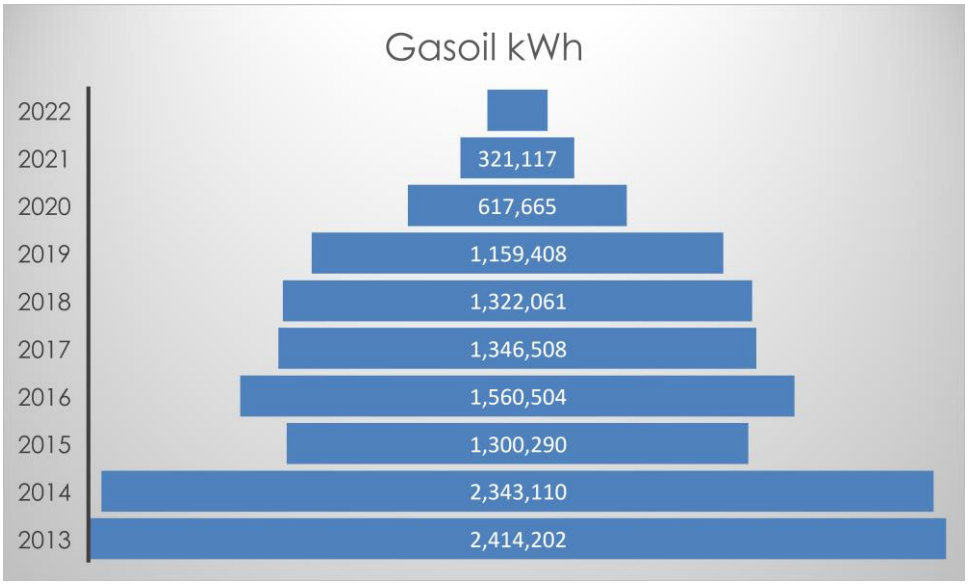


Figure 7: Annual decrease in Gasoil usage

A list of completed projects are outlined in the next section, 3.2 ~Energy Management Action Plan.

By taking an energy management system's approach to reducing energy costs and usage, University of Galway continually improve its energy performance and, in so doing, reduces its environmental burden.

3.2 Energy Management Action Plan

A number of opportunities for further energy savings have been carried out over the past year and a further €1.228 Million has been spent and/or approved. The most significant projects include HVAC upgrades, the continued roll out of energy efficient space heating pumps and the ongoing replacement of florescent light fittings with LED equivalents. Additionally, the Buildings and Estates team continue to roll out photovoltaic electricity generation projects.

Similarly, an ongoing list of opportunities for improvement and potential projects; for the current period, 2023-24, are outlined in the Register of Opportunities (ROO). The values quoted for energy savings are reasonable estimates and calculations, and any assumptions made, are carried out on the right-hand side of the ROO sheet.

One of the highlight action plans relates to the University of Galway 2030 Zero Carbon Action Plan. The University is formulating a fully costed action plan to transition to a zero-carbon campus in the next decade. It includes the installation of a district heating network with geothermal borehole technology employed (GeoFIT) to provide a primary heat pump related thermal energy source and this is estimated to cost in the region of €3.4 million to design, tender, install and commission. Other key actions relate to upgrading numerous fume cupboards; and retrofitting energy efficient motors, sensors, and hoods/doors/screens, carrying out behavioural change campaigns to improve the energy efficiency of ICT

equipment and reviewing the building fabrics with the view to improving U-values and the thermal mass of buildings. The latter action will lead to the reduction of unwanted draughts and ambient noise.

The Register of Opportunities - ROO is an active document with twenty-six opportunities in the 'Seeking Funding Category,' sixteen opportunities have been recently approved, seventy-two have been completed. There are also five opportunities that were reviewed again during Q3, 2023 and these did not gain approval. These are on hold and are categorised as 'Not Approved'. The ROO is colour coded for ease of use. Table 5 below contains a summary of the potential projects and their expected savings. This table forms the basis for achieving energy efficient targets. Targets are reviewed during Annual Management Review Meetings.

Table 5: Summary of the 2023-4 energy efficient projects; either seeking approval, approved, or completed, and their respective kWh (t), kWh (e), Kilogrammes of CO2 and Cost Savings and the average payback periods.

Status	kWh (t)	kWh (e)	KgCO2	Capital Cost (€)	Saving(€)	Pay-back
Seeking	6,169,093	5,517,308	2,819,801	€16,028,400	€1,396,675	11.48
Approved	1,477,180	576,811	1,400,607	€645,000	€990,841	0.65
Completed during 2023	801,533	266,570	574,358	€582,887	€130,340	4.47
Ongoing annual savings	2,488,125	2,067,829	1,707,445	€3,032,145	€744,307	4.07
Total	**10,935,931**	**8,428,518**	**6,502,211**	**€20,288,432**	**€3,262,163[8]**	**6.22**

Table 6, gives an outline of the opportunities for energy efficiency improvements and are categorised as Seeking Funding, Approved, Completed ~ Approved/Ongoing or Not Approved. These are colour coded in light brown, light green, dark green and red, respectively. The following tables should be read in conjunction with the Master ROO as per the Dashboard 2023 Rev. 1.

We are also using the Gap to Target tool to populate projects that will enable a reduction in our carbon emissions by 51% by 2030. A copy of the glidepath graph is outlined on Appendix B.

[8] Per annum

Table 6: Opportunities for Energy Savings and Action Plan (2023-24)

Overview		Michael Curran, Lorraine Rushe, Seán Farrell, Anthony Neville, Kenneth O'Toole & John Harrington		
Energy	**Reason Included**	**Comments - Potential Risks**	**Business Unit**	**Project Approval**
Therm	Strategic review of the buildings to look at costs associated with Fabric upgrades to buildings	Building Engineer and Energy team. The costs associated with fabric upgrades are prohibitive. Additionally, fabric will have to be exactly specified and lessons learnt from the Grenfell Towers Tragic Fire, incorporated into the design process.	Buildings and Estates	APPROVED - Ongoing
Therm/Elec	Behavioural opportunities. ARUPs has been appointed as the Consultants to Chair this.	Westside Decarbonisation Zone, Partners GCC, HSE, NUI G, Dunnes Stores & 2000 Homeowners. Seeking European and SEAI funding. Budget of €200 million available.	Buildings and Estates	APPROVED - Ongoing
Therm/Elec	Ongoing projects - Pumps refitted, AHUs replaced - upgraded, Fluorescent light fittings being replaced with LED equivalents	This is an on-going - Kenneth (Electrical) and Anthony (Mechanical)	Buildings and Estates	APPROVED - Ongoing
Therm/Elec	Karl has continued to update the BMS systems to keep pace with technology that maximises the effectiveness of energy using equipment with data/controls interfaces	This is on-going - Karl (BMS & Controls Expert)	Buildings and Estates	APPROVED - Ongoing
Transport	The college is continuing to promote the use of electric vehicles both on campus and beyond.	During 2023 it has installed No. 5 new EV Charging Points and has added No. 3 light goods vehicles to its campus fleet.	Buildings and Estates	APPROVED - Ongoing

Therm	Existing installation to be recommissioned and make adjustments for Kingfisher	Contractual agreement with Kingfisher is a barrier. GEOFIT Project will be supplying geothermal to the swimming pool - Live	Engineering	See Over - Tendered and ongoing
Ele	Reduce water usage and pumping power demand	PIR solenoid fitted on urinals in engineering building again this is to reduce water consumption and in line will reduce energy costs (note this project is on a trial basis also)	Engineering	Ongoing
Ele	Reduce water usage and pumping power demand	These new flush systems are designed to reduce water volume but increase power on flush, this will reduce water consumption thus reducing power consumption on main pumps (note this project is on a trial basis in terms of issues with toilets and blockages)	College Bar	Ongoing
Therm/Elec	AHU set back control implementation	New PIR/CO2 controls fitted in AHU units In Arts millennium , IT and science block units, this new control system is fully incorporated into the BMS for all Lecture halls and will control the units to facilitate the occupancy level also will sit back the units when no occupancy present	Arts millennium , IT and science block units	Ongoing
Therm/Elec	New high efficiency heat exchanger will gain 20% plus on efficiency also will increase heat delivery and customer comfort in physics block.	Heat Exchanger Upgrade with 20% efficiency gain.	Arts Science (Physics)	Ongoing
Thermal	Health & Safety Issue in the main.	Completed during the End of Oct 2023- Noel Rogers project. Facility to ensure regulatory compliance.	Buildings and Estates	Completed by 1st Nov

Therm/Elec	New hot water up grade , solar panels to pre heat direct fired 65kw high efficiency Cosmo units	This removes the need for water storage and allows the natural gain from the solar panels, old units were noncondensing and would have had an efficiency of 55 to 60%, new Cosmo is fully modulating with the demand of hot water and runs at 97% in efficiency	Cairnes	Ongoing
Therm	Existing Direct gas fired units are not efficient and need to be replaced - Also put in new roof, 110PV	Installation of new energy efficient Air Handling units. There is a risk associated with not replacing these units, as they continue to drag down our energy performance in Áras Mac Léinn. On their way - completed Oct 2022.	Cultural Space	APPROVED - Ongoing
Therm/Elec	The energy performance of the HBB is poor. The energy rating for the period from July 2020 to June 2021 is an E2. The building has an actual Electrical kWh/m.2./yr result of 457.37 and Non-electrical kWh/m.2./yr result of 199.3. The typical energy usage for a building of this category should be 295.36 kWh (e) per m.2./yr and 246.93 kWh (ther) per m.2./yr.	There is an opportunity to carry out 3 actions to address or reduce energy usage. I.) carry out a review of the heating and cooling strategies with the Design and Build Teams. 2.) carry out training for the users of the HVAC Systems at HBB 3.) Review the dehumidifiers and consider replacing both. These appear to be inefficient, dumping hot water to drain.	Buildings and Estates	APPROVED - Ongoing
Elec	University of Galway must look at the behavioural requirements of all its staff in the use of IT equipment and also the cost of running of all equipment during the weekends and evenings. Green Procurement of all new equipment	Strategic alliance with ISS on the computer equipment. There may be risk that ISS may decide not to proceed with any energy efficiency improvements to its ISS. We will manage this risk accordingly. Fall as part of the emergency crisis. University of Galway has given global funding for hi-efficiency desktops and laptops.	Buildings and Estates /ISS	APPROVED - Ongoing

Therm/Elec	DHW Systems upgrade project	New high efficiency Jole clarifier (1000 ltr) to replace out old high loss copper cylinder, the new clarifier will reduce heat loss to 1 degree in 12 hours also in this project the BMS control system will control three port valves to maintain hot water on demand along with removing the need for greater storage	Orbsen	Ongoing
Therm/Elec	New high efficiency Jole clarifier (500) to replace out old high loss copper cylinder,	The new clarifier will reduce heat loss to 1 degree in 12 hours also in this project new BMS control panel and low loss header will be integrated to allow a fully zoned and controlled system with an excellent high efficiency boiler (Viessmann) this will allow reduced outputs s	Shannon	Ongoing
Therm/Elec	Managing the COVID Risk - Students are back, the heating season has begun.	This is an on-going project - Regular meetings	Buildings and Estates	COMPLETED
Elec	Develop and support a sustainable energy campus	Orbsen Bld - 2*2 Charging Points, Cairns Bld - 2*2 Charging Points, Aras na Cathal 1*2 Charging Point, Quad (Upgrade of existing Charging Point System, Park & Ride 1*1	Campus Wide	Completed
Elec	Develop and support a sustainable energy campus	EV Post Van - Quiet, Clean Delivery !	Campus Wide	Completed
Therm/Elec	Energy awareness campaign and program of events	Provide energy awareness literature, campaigns, switch off days, green week etc.	Campus Wide	Completed ~ ongoing

Therm/Elec	Recording of energy usage and performance data and information. This provides the information, which is reviewed daily, weekly and during our monthly energy review meetings.	Provides Up To Date records of systems etc.	Campus Wide	Completed ~ ongoing
Elec	Existing lighting is fluorescent lighting and should be replaced with LED Lighting	This project is in relation to LED upgrade (x20 fittings) to offices and Replacement of external lamps with LED Equivalents	Miscellaneous	Completed
Elec	Review of existing bills to reduce the Import capacity charges	Review and collate	CAMPUS WIDE	Completed
Elec	Installation of 50SQ M of Solar P to the roof Engineering Building	Panels installed to reduce electrical load of the engineering	Engineering	Completed
Water	Existing water usage on 16 urinals is high and needs to be reduced	Existing urinals to be reviewed	Engineering	COMPLETED
Therm/Elec	Annual service to the CHP unit	Manufacturer contract	Engineering	COMPLETED
Therm/Elec	Review the existing heating and cooling strategies, review times, air handling units and air balancing.	Specialist engineering review	Engineering	Completed ~ ongoing
Therm /Elec	University of Galway have been selected by HEA and SEAI to carry out a pilot project for the Decarbonisation study for the upgrade of services in the Aras De Brun building	Installation of new electric heat pump, PV and battery storage, new heating system, new pumps and LED lighting	Buildings and Estates	Completed

Elec	Existing lighting is fluorescent lighting and should be replaced with LED Lighting	Existing lighting can be changed out with new LED panels and also install new Emergency Lighting	Áras de Brun	Completed
Elec	Boiler is inefficient and does require attention	Upgrade the existing thermal heating system to Condensing Gas Boiler & Cascade Control technology - Apportioned the capital cost as follows: €23k to space heating upgrade and €5k to DHW upgrade	Áras na Gaeilge	Completed
Elec	The capital cost includes boilers, pumps, calorifier & associated controls	See over & above	Áras na Gaeilge	Completed
Elec	Installation on flat roof	Assist reduction in electrical loading	Áras na Gaeilge	Completed
Therm	Installation of and steel panel radiators	Heat Pump, Radiators & Controls	Áras Ní Éimhigh	Completed
Therm	Removal of oil off site, install new natural gas supply and boiler house. See DEC Spreadsheet.	Energy efficient installation, new controls etc. Risks associated with health and safety, conservation measures, additional cost justification etc.	Anatomy	Completed
Therm/Elec	The existing control panel has had modification carried out and is installed a number of years, replace the panel and update controllers	Existing control panel needs to be changed out and new modern controls to be installed. Recommendation from controls specialist.	Arts Millennium Building	Completed
Elec	Installation of new LED Lighting and control sensors	LED Lighting and controls	Arts Millennium Building	Completed
Therm	Changes to pipework and pumps new insulation to be installed to reduce losses	Internal works to be carried out.	Arts Millennium Building	Completed

Elec	Installation of new LED lighting and controls for the 3 no lecture theatres	LED Lighting and controls	Arts Millennium Building	Completed
Elec	Installation of new energy efficient pumps	Replace 10 No. pumps in plantroom	AHS SRB	Completed
Therm/Elec	Annual service to the CHP unit	Manufacturer contract	Arts Science	COMPLETED
Therm	The existing burners and controllers are causing problems and installed a number of years, invertors overheating	Install new control panel for optimisation of the boilers, install new high efficiency burners and controls package to the two 1MW boilers.	Boiler-House	Completed
Therm/Elec	Main pumps for high pressure high temperature replaced out with 14kw inverters to allow modulation from 20 to 100 %, project	includes a full display and monitoring system incorporated into the BMS.	Arts Science	COMPLETED
Therm/Elec	Arts Millenium BEMS - Building Energy Management System	Karl (BMS & Controls Expert) - has continued to update the BMS systems to keep pace with technology that maximises the effectiveness of energy using equipment with data/controls interfaces	Buildings and Estates	COMPLETED
Elec	Installation of 250 SQ M of Solar Photovoltaic (PV) to the roof Arts Science Building	Panels installed to reduce electrical load of the arts science building	Arts Science	Completed
Elec	A number of areas require the upgrade of fluorescent lighting with new LED	Works to be carried out by Engineering Services in house, survey to be carried out.	Arts Science	Completed

Elec	Installation of 150 SQ M of Solar Photovoltaic (PV) to the roof Arts Science Building	Panels installed to reduce electrical load of the Arts Science building. Risk is greatly reduced as we have pedigree in this 'space', and it aligns with our overall climate change - carbon neutral campus strategy.	Arts Science	COMPLETED
Elec	Installation of new LED Lighting and control sensors	LED Lighting and controls	Chemistry	Completed
Elec	4*18 watt tubular fluorescent fittings to be replaced	Need an inventory of existing fittings	Arts Science	Completed
Elec	Installation of LED panels, recessed lights and control sensors	LED Lighting and controls. The risk associated with this project is largely down to funding. However existing fitting are grossly inefficient, and payback will be short i.e. < 3.1 years.	Tower 1 & 2	Completed
Elec	The existing fan is a fixed speed fan and needs to be controlled better	Adjoining extract fan fitted with VSD and reduced energy costs	Biochemistry	Completed
Therm	Existing 4 No. oil fired boilers to be replaced and install new wall hung gas condensing boilers and controls	Disconnection and removal of the existing oil tank install new Natural gas network points.	Block D and E	Completed
Elec/Therm	Installation of new LED lighting and replace heaters with new energy efficient heaters	Installation of LED Lighting	Block Q	Completed
Elec	The existing lighting is high bay light fittings and switch control.	Install new LED lighting to serve the BOI Theatre. An additional risk will be the H&S aspects associated with working at heights. This will also adversely affect maintenance and associated costs.	BOI Theatre	COMPLETED

Therm	Removal of oil off site, install new natural gas supply and boiler house	Energy efficient installation, new controls etc.	Cairnes	Completed
Therm/Elec	Replace pumps	In-house project which has been a great success already registered	Cairnes	COMPLETED
Therm	Existing ACV water heater and oil fired sectional boiler	Install new LPG Gas to the site and replace burners only	Carna	Completed
Therm	Existing oil fired boiler/burner unit is a fossil fuel based system. The HVO is carbon neutral.	Install new Hydrogenated Vegetable Oil supply to the boiler house at Carna	Carna	COMPLETED
Therm/Elec	Replacement of old low efficiency units to high efficiency ACV units,	Replacement units remove the need for water storage and gains 38% on efficiency also units have been mechanically fitted to support both hot water on demand and heating. Unit efficiency is 98.7 maintained and fully controlled by the BMS controls	Dangon Sports Center	COMPLETED
Therm/Elec	Replace pumps	In-house project, great success already registered	Sports Pavilion	Completed
Therm	Existing heating installation not efficient and heating in house is very poor	Installation of Electric Heat Pump and radiators/insulation	No. 9 Distillery Road	Completed
Therm	Existing heating installation not efficient and heating in house is very poor	Installation of Electric Heat Pump and radiators/insulation	No. 14 University Road	Completed
Elec	Installation of new LED Lighting and control sensors	LED Lighting and controls	Distillery Road	Completed

Elec	Install new energy efficient LED Lighting	LED Modular fittings	Gweedore Site	Completed
Elec	Installation to the roof of the new Human Biology Building for creating electrical energy.	High electrical loading to the building.	Human Biology Building	Completed
Therm	Installation of new LPG Gas condensing boiler, pumps and controls.	Installation of LPG Gas condensing boiler	Human Rights	Completed
Elec	It appears that the chilled water load is over specified for the current coolth load.	Seán - Michael to give a briefing on a potential replacement strategy. Carry out a before and after analysis and write a project brief. The contractor has been appointed and is commencing the replacement and installation Week	Buildings and Estates /ISS	Completed
Elec	Installation of new LED Lighting and control sensors	LED Lighting and controls	IT Building	Completed
Elec	Installation of new LED Lighting and control sensors	LED Lighting and controls	IT Buildings	Completed
Elec	Installation of new LED Lighting and control sensors	LED Lighting and controls	IT Buildings	Completed
Elec	Installation of new LED lighting to replace the existing high level light fittings.	Installation of new LED lighting to the Main Hall and support areas	Kingfisher	Completed
Therm/Elec	Library BEMS - Building Energy Management System	Karl (BMS & Controls Expert) - has continued to update the BMS systems to keep pace with technology that maximises the effectiveness of	Buildings and Estates	COMPLETED

		energy using equipment with data/controls interfaces		
Therm	Replace the existing radiant heaters with new panel radiators and TRVs	Works to be carried out to the existing installation.	Library	Completed
Therm/Elec	Replace pumps	In-house project, great success already registered	Library	Completed
Therm/Elec	Annual service to the CHP unit	Manufacturer contract	Library	COMPLETED
Elec	Installation of new LED lighting and controls to the library on Ground, first and second floor levels	Existing 4x18 fluorescent light fittings (with choke start ballasts factor of 1.2) replaced with new LED	Hardiman Library	Completed
Therm	Replace 5no pumps	In-house project	Nursing	Completed
Elec	Installation of new LED Lighting and control sensors	LED Lighting and controls	Microbiology	Completed
Elec	Installation of new LED Lighting	LED Lighting and controls	Moffatts Restaurant	Completed
Therm/Elec	Replace pumps	In-house project, great success already registered	Moyola	Completed
Elec	Installation of new LED Lighting	LED Lighting and controls	Moyola	Completed

Therm/Elec	Replacement of old units for two high efficiency 115 kw fully modulating boilers controlled by 0-10v in order to ramp up and down on demand new units.	Replacement units will gain 25% on efficiency compared to old units. 0-10 modulation controlled by the BMS System controls	MRI Annex	COMPLETED
Elec	Installation of 20 SQ M of Solar Photovoltaic Panels to the roof O'Donoghue Theatre	Panels installed to reduce electrical load of the O'Donoghue. Risk is greatly reduced as we have pedigree in this 'space', and it aligns with our overall climate change - carbon neutral campus strategy.	O'Donoghue Theatre	COMPLETED
Therm/Elec	Replace pumps	In-house project, great success already registered	Orbsen	Completed
Therm/Elec	Annual service to the CHP unit	Manufacturer contract	Orbsen	COMPLETED
Elec	Existing lighting are 250 Son-T lamps and running extensive hours, replacement costs and running costs are expensive	Recommendation from the external contractor to replace these with LED lamps.	Park & Ride Carpark	Completed
Therm/Elec	Existing Air Handling units installed around 1997, Masterair systems, controls not working and not efficient	Recommendations to replace air handling units with new packaged energy efficient units	Shannon	Completed
Elec	Existing lighting is fluorescent lighting and should be replaced with LED Lighting	Existing lighting can be changed out with new LED panels and also install new Emergency Lighting	Shannon	Completed
Therm/Elec	Replace the existing oil fired sectional boilers, capacity 650kw, 550kw and 150kw boilers, new controls etc.	Installation of new natural gas supply from local network, remove existing 5000litre oil tanks, installation of new gas condensing modular boilers	The Quad	Completed

4. Estimate of University of Galway's future energy consumption

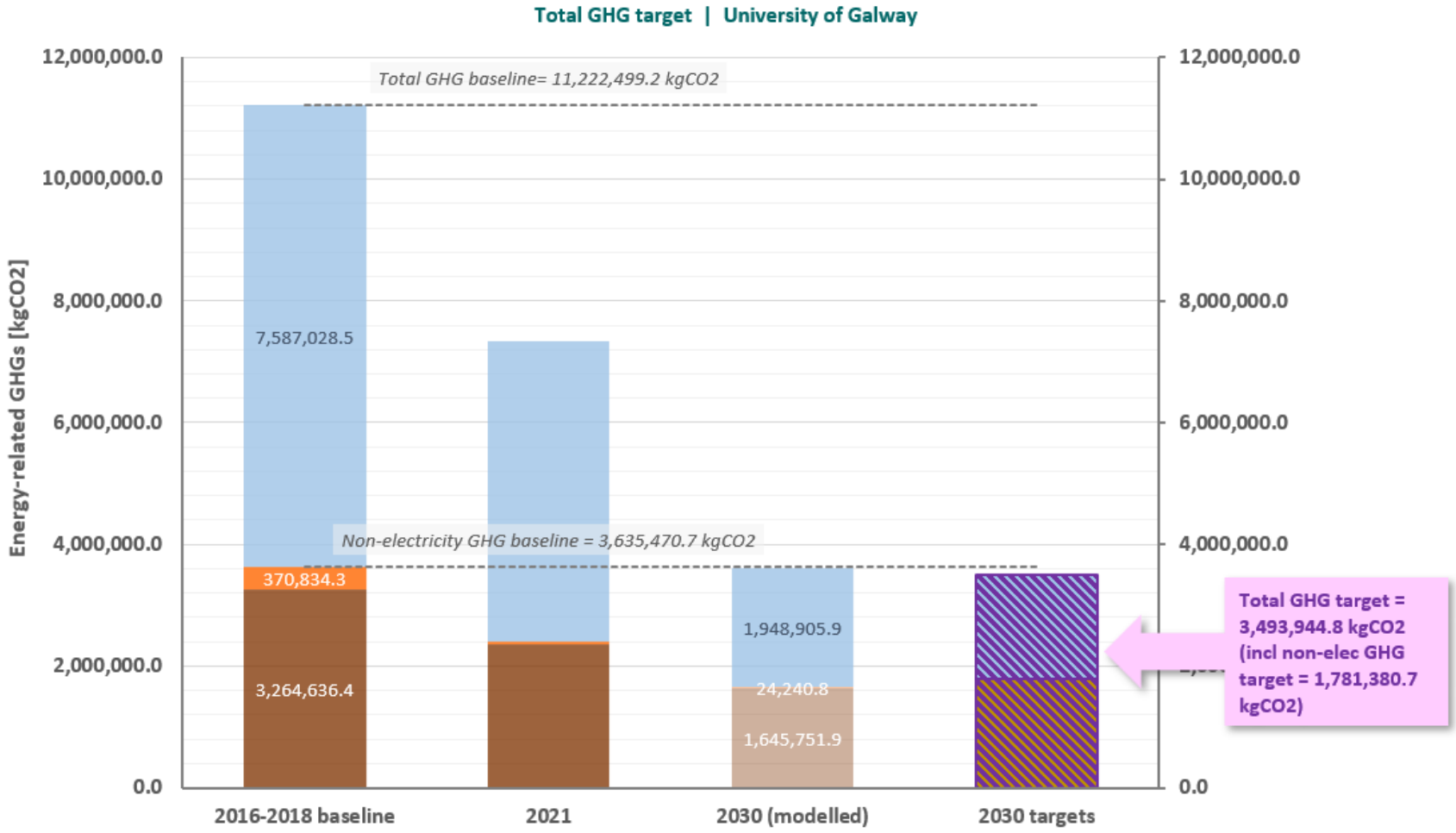
An estimate of University of Galway's future energy usage and consumption has been carried out. 10 years, historical data, was used to carry out these estimates. As predicted the energy usage and consumption has decreased during 2022 due to the increased use of on-site renewable energy capacity and the effectiveness of the EnMS- Energy Management System. The expected energy usage and performance is used to carry out a budget for energy costs during 2023 and beyond. That increase is factored into the predicted energy use as outlined on the figures included in Table 7, as below. Additionally, the predicted energy consumption is itemised and potential factors that will increase energy usage (more students, research intensity, ventilation rate and occupancy strategies) are accommodated. We are predicting that energy usage during 2023 will be slightly lower than 2022. We also increased the level of PV electricity production to reflect our year-to-date PV related energy production data. From 2023 on we are targeting a reduction in energy use and consumption by 3% per annum and are planning an increase in solar thermal by 5% per annum and an increase in PV electrical generation by15% per annum.

Table 7: estimate of future energy usage, generation, and consumption.

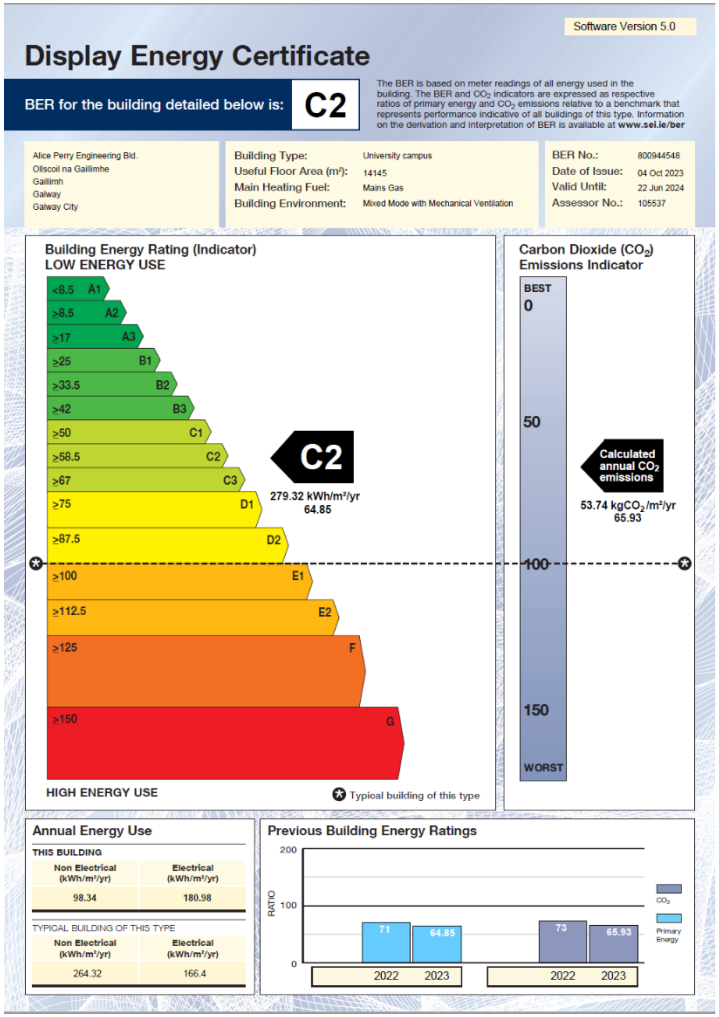
Estimate of Future Energy Usage and Consumption			
MWh -Usage	2023	2024	2025
Electricity	14,831	14,386	13,955
Electricity Generated on-site from PV	254	292	336
Gas	10,273	9,965	9,666
LPG	490	475	461
Gasoil	166	161	156
Wood Fuels	256	248	241
Solar Thermal	152	159	167
Road Diesel	151	146	142
Transport	11.54	11.20	10.86
Total	26,585	25,845	25,135
EnPI -Consumption			
Total - KWh/M2	192.06	186.30	180.71
Conversion factors to calculate the Total Primary Energy Equivalent will change every year			

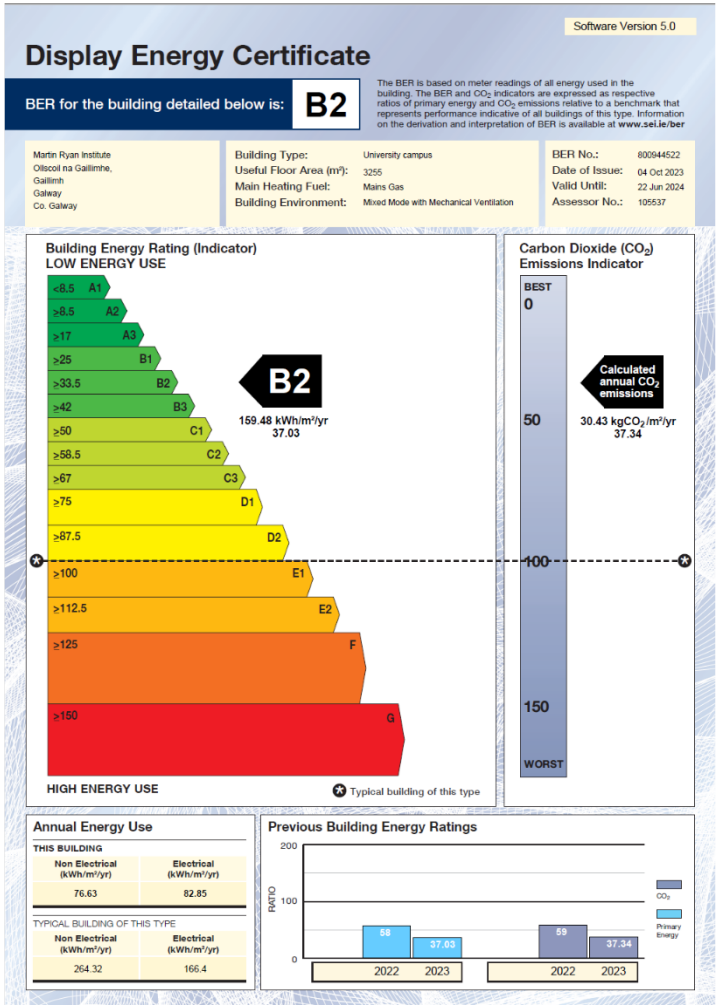
Appendix A: Photo of our President signing the 2030 Carbon Pledge

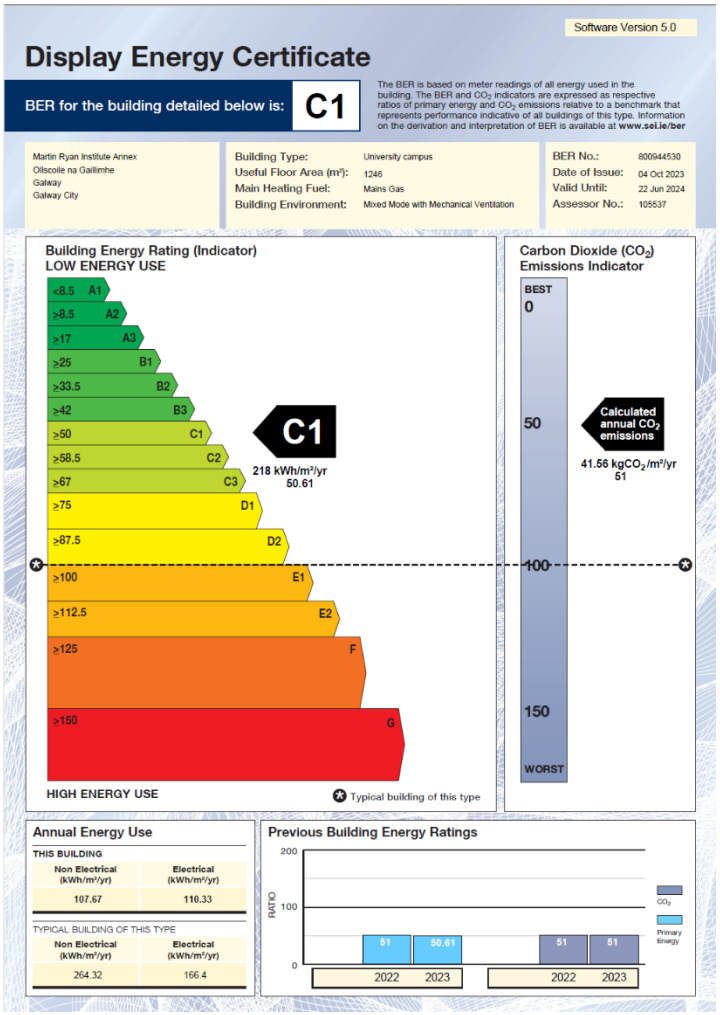
Appendix B: University of Galway's Gap to Target to 2030

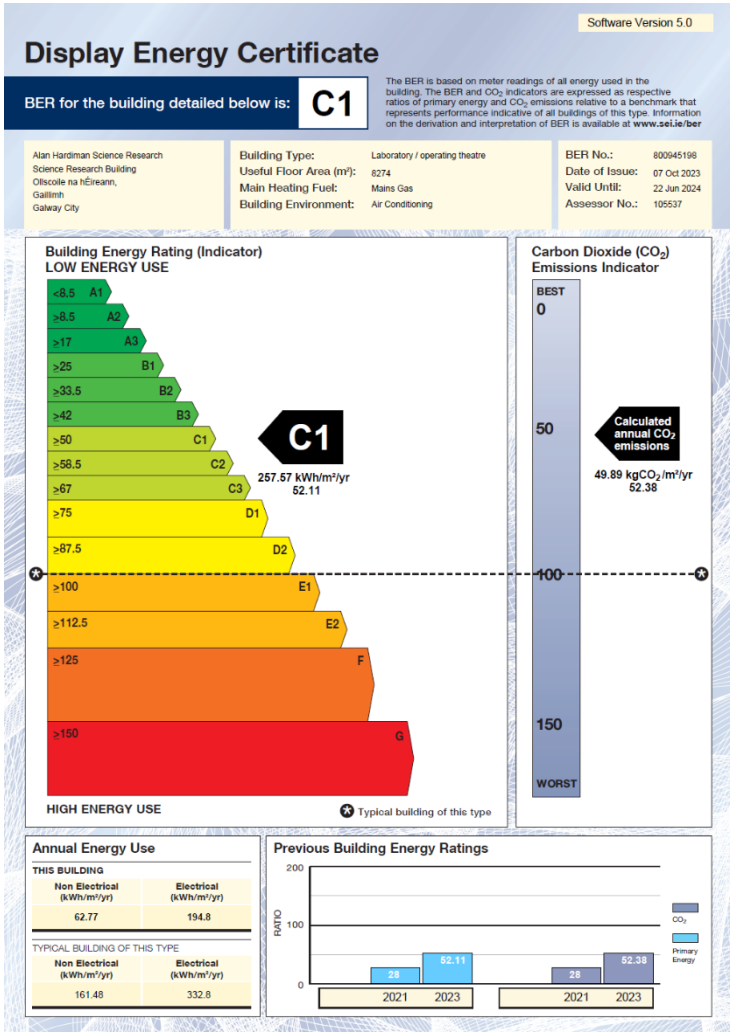


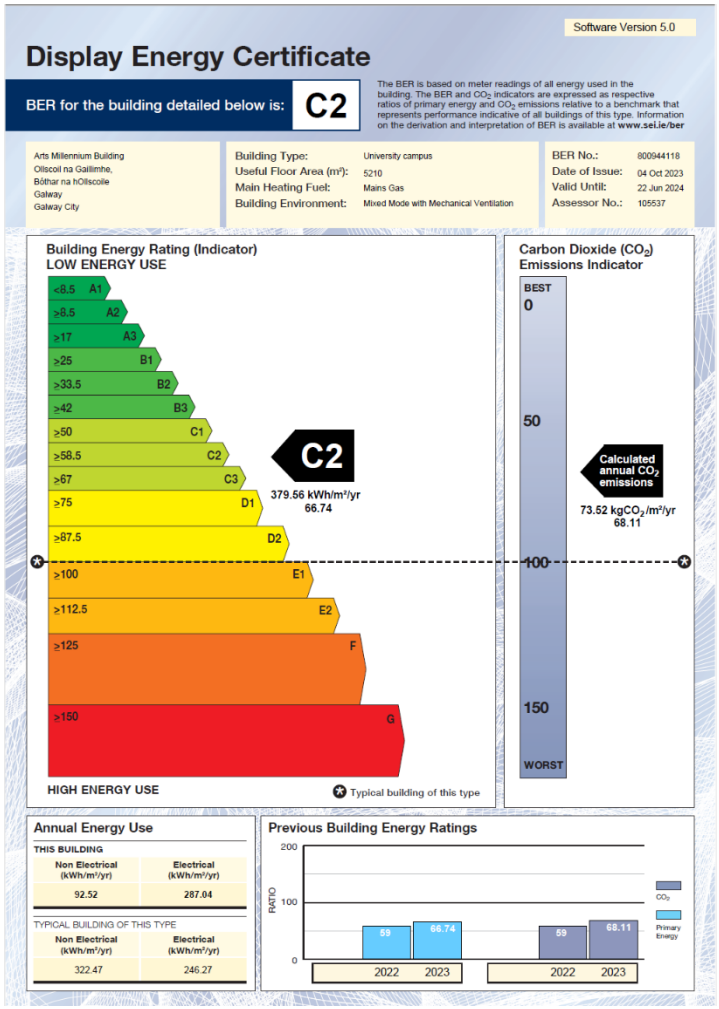
Appendix C: Display Energy Certificates






Software Version 5.0
Display Energy Certificate
BER for the building detailed below is: C1
The BER is based on meter readings of all energy used in the building. The BER and CO2 indicators are expressed as respective ratios of primary energy and CO2 emissions relative to a benchmark that represents performance indicative of all buildings of this type. Information on the derivation and interpretation of BER is available at www.sei.ie/ber
Martin Ryan Institute Annex
Ollscoile na Gaillimhe
Galway
Galway City
Building Type: University campus
Useful Floor Area (m²): 1246
Main Heating Fuel: Mains Gas
Building Environment: Mixed Mode with Mechanical Ventilation
BER No.: 800944530
Date of Issue: 04 Oct 2023
Valid Until: 22 Jun 2024
Assessor No.: 105537
Building Energy Rating (Indicator)
LOW ENERGY USE
<8.5 A1
≥8.5 A2
≥17 A3
≥25 B1
≥33.5 B2
≥42 B3
≥50 C1
≥58.5 C2
≥67 C3
≥75 D1
≥87.5 D2
≥100 E1
≥112.5 E2
≥125 F
≥150 G
C1
218 kWh/m²/yr
50.61
HIGH ENERGY USE
Typical building of this type
Carbon Dioxide (CO2) Emissions Indicator
BEST
0
50
100
150
WORST
Calculated annual CO2 emissions
41.56 kgCO2/m²/yr
51
Annual Energy Use
THIS BUILDING
Non Electrical (kWh/m²/yr) 107.67
Electrical (kWh/m²/yr) 110.33
TYPICAL BUILDING OF THIS TYPE
Non Electrical (kWh/m²/yr) 264.32
Electrical (kWh/m²/yr) 166.4
Previous Building Energy Ratings
RATIO
200
100
0
51
50.61
51
51
2022
2023
2022
2023
CO2
Primary Energy


Software Version 5.0
Display Energy Certificate
BER for the building detailed below is: C1
The BER is based on meter readings of all energy used in the building. The BER and CO2 indicators are expressed as respective ratios of primary energy and CO2 emissions relative to a benchmark that represents performance indicative of all buildings of this type. Information on the derivation and interpretation of BER is available at www.sei.ie/ber
Alan Hardiman Science Research
Science Research Building
Ollscoile na hÉireann,
Gaillimh
Galway City
Building Type: Laboratory / operating theatre
Useful Floor Area (m²): 8274
Main Heating Fuel: Mains Gas
Building Environment: Air Conditioning
BER No.: 800945198
Date of Issue: 07 Oct 2023
Valid Until: 22 Jun 2024
Assessor No.: 105537
Building Energy Rating (Indicator)
LOW ENERGY USE
<8.5 A1
≥8.5 A2
≥17 A3
≥25 B1
≥33.5 B2
≥42 B3
≥50 C1
≥58.5 C2
≥67 C3
≥75 D1
≥87.5 D2
≥100 E1
≥112.5 E2
≥125 F
≥150 G
C1
257.57 kWh/m²/yr
52.11
HIGH ENERGY USE
Typical building of this type
Carbon Dioxide (CO2) Emissions Indicator
BEST
0
50
100
150
WORST
Calculated annual CO2 emissions
49.89 kgCO2/m²/yr
52.38
Annual Energy Use
THIS BUILDING
Non Electrical (kWh/m²/yr) 62.77
Electrical (kWh/m²/yr) 194.8
TYPICAL BUILDING OF THIS TYPE
Non Electrical (kWh/m²/yr) 161.48
Electrical (kWh/m²/yr) 332.8
Previous Building Energy Ratings
RATIO
200
100
0
28
52.11
28
52.38
2021
2023
2021
2023
CO2
Primary Energy



Software Version 5.0

Display Energy Certificate

BER for the building detailed below is: **C2**

The BER is based on meter readings of all energy used in the building. The BER and CO_2 indicators are expressed as respective ratios of primary energy and CO_2 emissions relative to a benchmark that represents performance indicative of all buildings of this type. Information on the derivation and interpretation of BER is available at **www.sei.ie/ber**

Arts Millennium Building
Ollscoil na Gaillimhe,
Bóthar na hOllscoile
Galway
Galway City

Building Type:	University campus
Useful Floor Area (m^2):	5210
Main Heating Fuel:	Mains Gas
Building Environment:	Mixed Mode with Mechanical Ventilation

BER No.:	800944118
Date of Issue:	04 Oct 2023
Valid Until:	22 Jun 2024
Assessor No.:	105537

Building Energy Rating (Indicator)
LOW ENERGY USE

Carbon Dioxide (CO_2) Emissions Indicator

Annual Energy Use

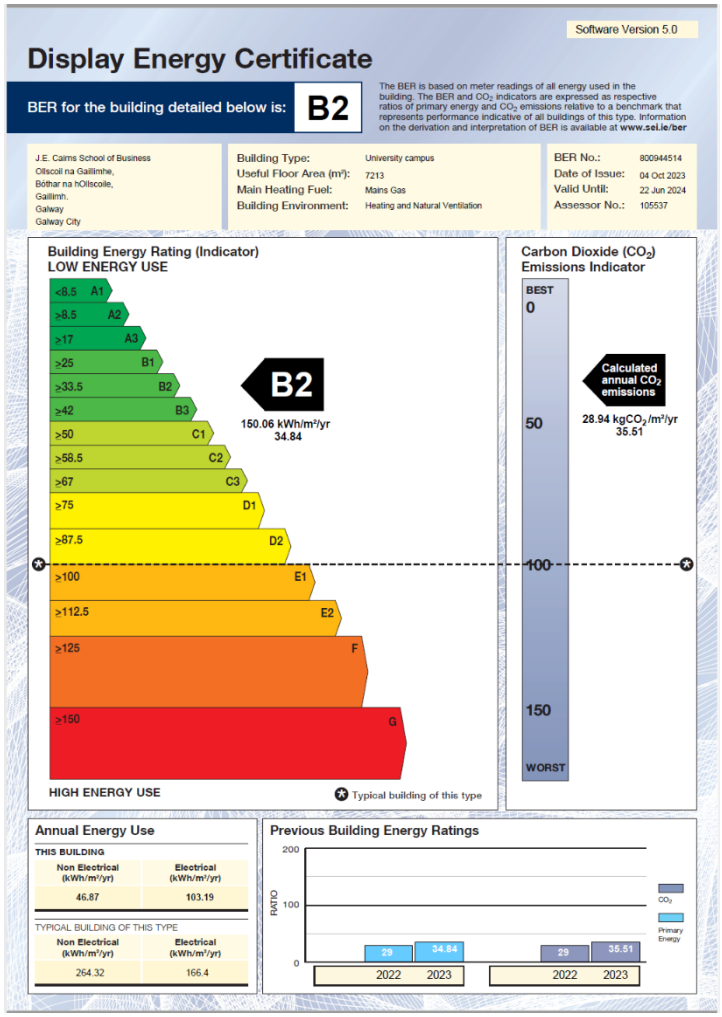
THIS BUILDING

Non Electrical (kWh/m²/yr)	Electrical (kWh/m²/yr)
92.52	287.04

TYPICAL BUILDING OF THIS TYPE

Non Electrical (kWh/m²/yr)	Electrical (kWh/m²/yr)
322.47	246.27

Previous Building Energy Ratings



Software Version 5.0

Display Energy Certificate

BER for the building detailed below is: **B2**

The BER is based on meter readings of all energy used in the building. The BER and CO_2 indicators are expressed as respective ratios of primary energy and CO_2 emissions relative to a benchmark that represents performance indicative of all buildings of this type. Information on the derivation and interpretation of BER is available at **www.sei.ie/ber**

J.E. Cairns School of Business
Ollscoil na Gaillimhe,
Bóthar na hOllscoile,
Gaillimh,
Galway
Galway City

Building Type:	University campus
Useful Floor Area (m^2):	7213
Main Heating Fuel:	Mains Gas
Building Environment:	Heating and Natural Ventilation

BER No.:	800944514
Date of Issue:	04 Oct 2023
Valid Until:	22 Jun 2024
Assessor No.:	105537

Building Energy Rating (Indicator)
LOW ENERGY USE

Carbon Dioxide (CO_2) Emissions Indicator

Annual Energy Use

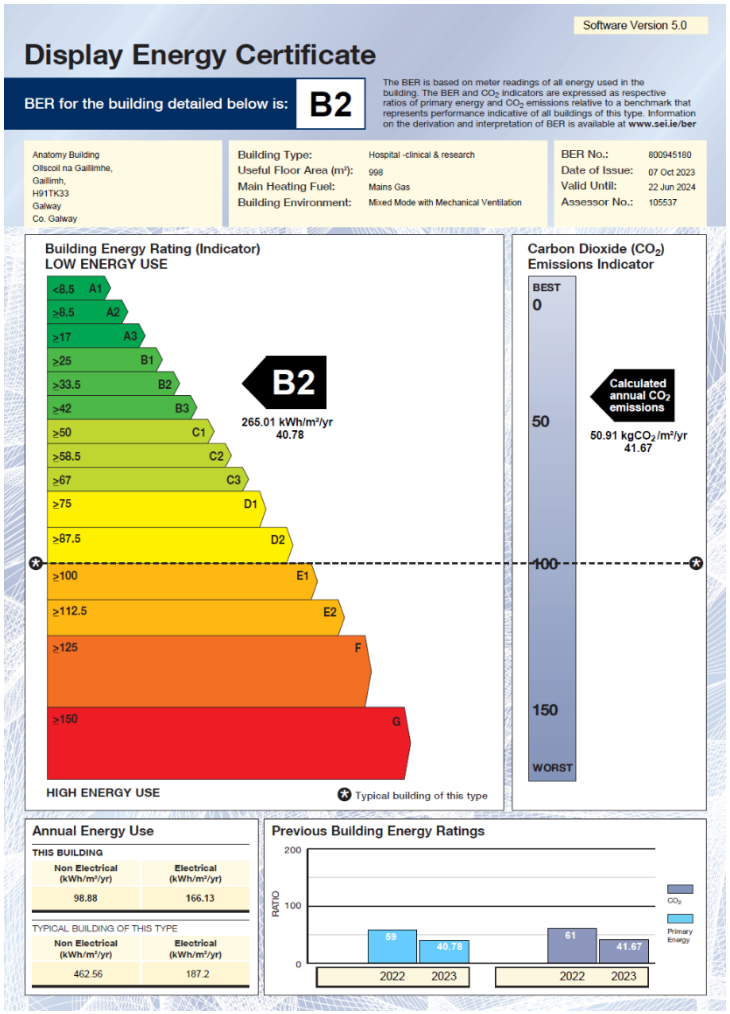
THIS BUILDING

Non Electrical (kWh/m²/yr)	Electrical (kWh/m²/yr)
46.87	103.19

TYPICAL BUILDING OF THIS TYPE

Non Electrical (kWh/m²/yr)	Electrical (kWh/m²/yr)
264.32	166.4

Previous Building Energy Ratings



Software Version 5.0

Display Energy Certificate

BER for the building detailed below is: **B2**

The BER is based on meter readings of all energy used in the building. The BER and CO_2 indicators are expressed as respective ratios of primary energy and CO_2 emissions relative to a benchmark that represents performance indicative of all buildings of this type. Information on the derivation and interpretation of BER is available at **www.sei.ie/ber**

Anatomy Building
Ollscoil na Gaillimhe,
Gaillimh,
H91TK33
Galway
Co. Galway

Building Type:	Hospital -clinical & research
Useful Floor Area (m^2):	998
Main Heating Fuel:	Mains Gas
Building Environment:	Mixed Mode with Mechanical Ventilation

BER No.:	800945180
Date of Issue:	07 Oct 2023
Valid Until:	22 Jun 2024
Assessor No.:	105537

Building Energy Rating (Indicator)
LOW ENERGY USE

Carbon Dioxide (CO_2) Emissions Indicator

Annual Energy Use

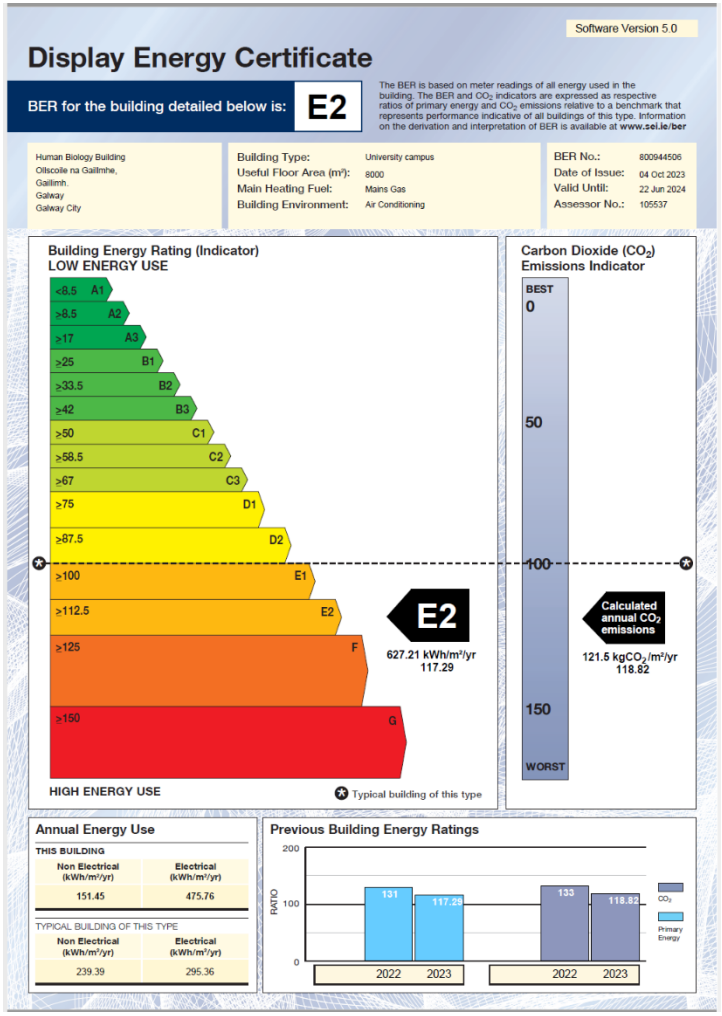
THIS BUILDING

Non Electrical (kWh/m²/yr)	Electrical (kWh/m²/yr)
98.88	166.13

TYPICAL BUILDING OF THIS TYPE

Non Electrical (kWh/m²/yr)	Electrical (kWh/m²/yr)
462.56	187.2

Previous Building Energy Ratings



Software Version 5.0

Display Energy Certificate

BER for the building detailed below is: **E2**

The BER is based on meter readings of all energy used in the building. The BER and CO_2 indicators are expressed as respective ratios of primary energy and CO_2 emissions relative to a benchmark that represents performance indicative of all buildings of this type. Information on the derivation and interpretation of BER is available at **www.sei.ie/ber**

Human Biology Building
Ollscoile na Gaillimhe,
Gaillimh,
Galway
Galway City

Building Type:	University campus
Useful Floor Area (m^2):	8000
Main Heating Fuel:	Mains Gas
Building Environment:	Air Conditioning

BER No.:	800944506
Date of Issue:	04 Oct 2023
Valid Until:	22 Jun 2024
Assessor No.:	105537

Building Energy Rating (Indicator)
LOW ENERGY USE

Carbon Dioxide (CO_2) Emissions Indicator

Annual Energy Use

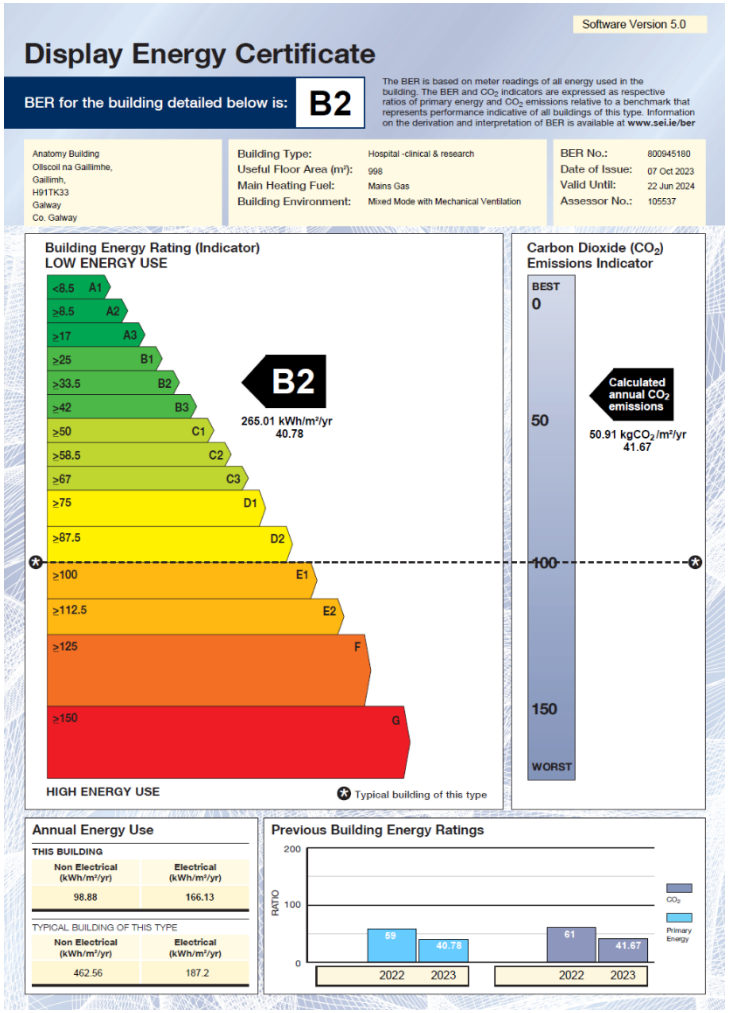
THIS BUILDING

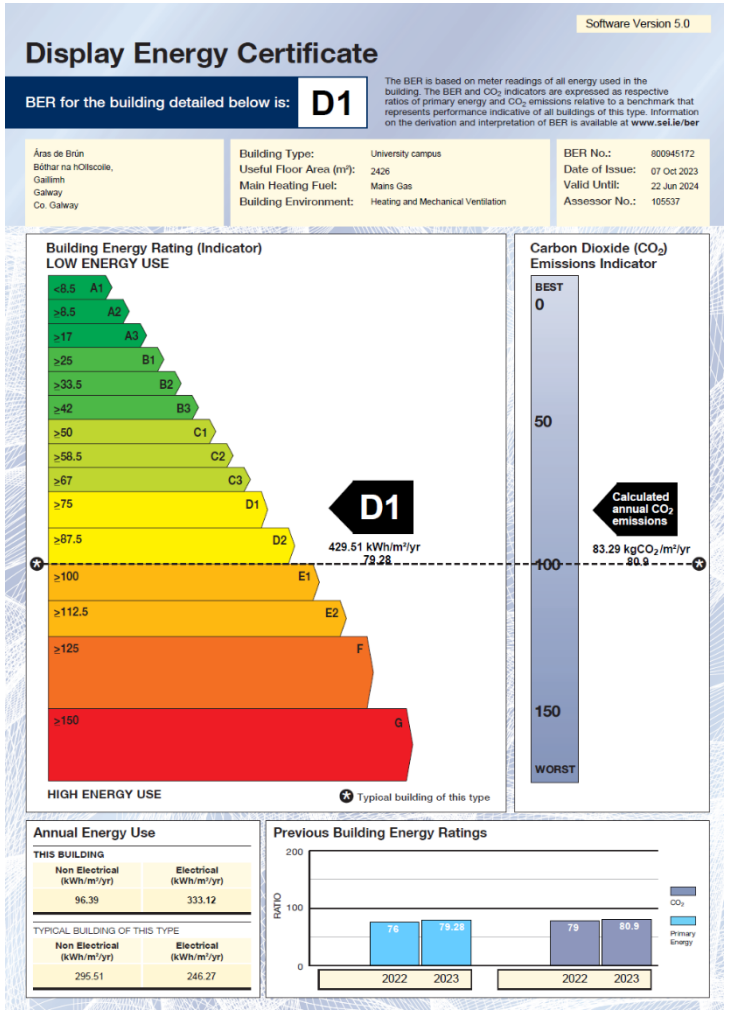
Non Electrical (kWh/m²/yr)	Electrical (kWh/m²/yr)
151.45	475.76

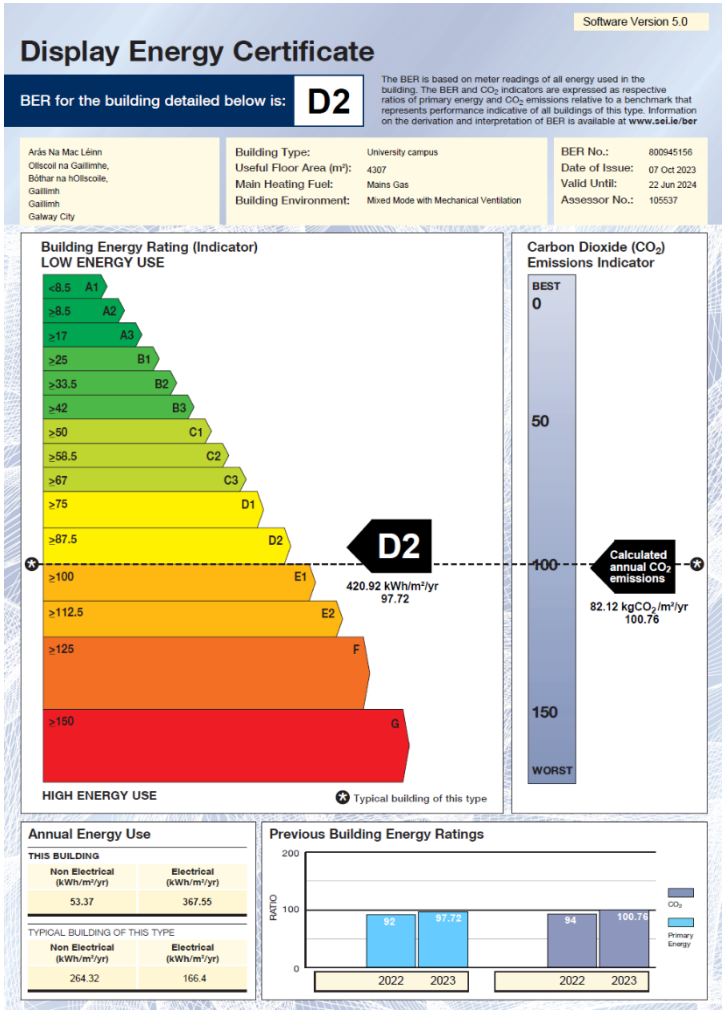
TYPICAL BUILDING OF THIS TYPE

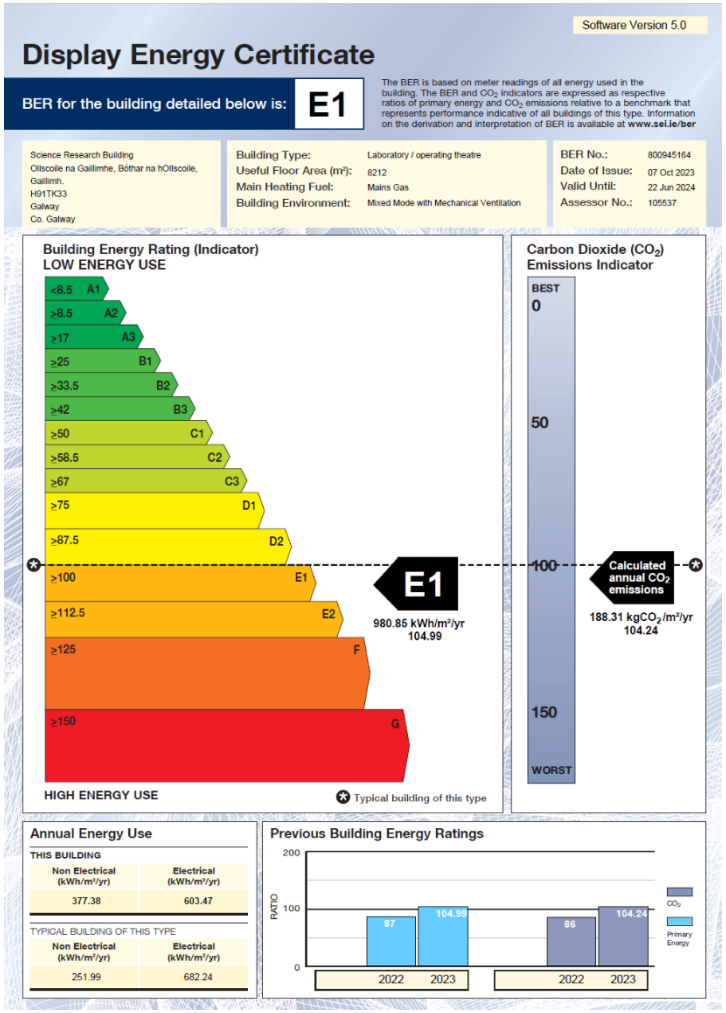
Non Electrical (kWh/m²/yr)	Electrical (kWh/m²/yr)
239.39	295.36

Previous Building Energy Ratings

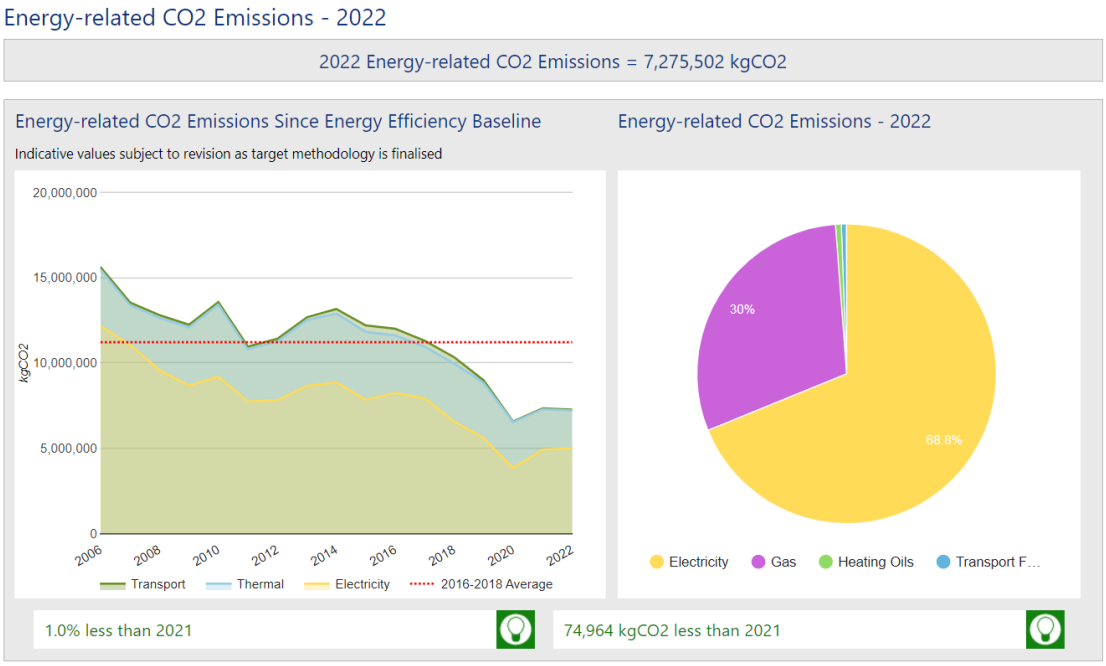

Software Version 5.0
Display Energy Certificate
BER for the building detailed below is: B2
The BER is based on meter readings of all energy used in the building. The BER and CO2 indicators are expressed as respective ratios of primary energy and CO2 emissions relative to a benchmark that represents performance indicative of all buildings of this type. Information on the derivation and interpretation of BER is available at www.sei.ie/ber
Anatomy Building
Ollscoil na Gaillimhe,
Gaillimh,
H91TK33
Galway
Co. Galway
Building Type: Hospital -clinical & research
Useful Floor Area (m²): 998
Main Heating Fuel: Mains Gas
Building Environment: Mixed Mode with Mechanical Ventilation
BER No.: 800945180
Date of Issue: 07 Oct 2023
Valid Until: 22 Jun 2024
Assessor No.: 105537
Building Energy Rating (Indicator)
LOW ENERGY USE
<8.5 A1
≥8.5 A2
≥17 A3
≥25 B1
≥33.5 B2
≥42 B3
≥50 C1
≥58.5 C2
≥67 C3
≥75 D1
≥87.5 D2
≥100 E1
≥112.5 E2
≥125 F
≥150 G
B2
265.01 kWh/m²/yr
40.78
HIGH ENERGY USE
Typical building of this type
Carbon Dioxide (CO2) Emissions Indicator
BEST
0
50
100
150
WORST
Calculated annual CO2 emissions
50.91 kgCO2/m²/yr
41.67
Annual Energy Use
THIS BUILDING
Non Electrical (kWh/m²/yr)
Electrical (kWh/m²/yr)
98.88
166.13
TYPICAL BUILDING OF THIS TYPE
Non Electrical (kWh/m²/yr)
Electrical (kWh/m²/yr)
462.56
187.2
Previous Building Energy Ratings
RATIO
200
100
0
59
40.78
61
41.67
2022
2023
2022
2023
CO2
Primary Energy


Software Version 5.0
Display Energy Certificate
BER for the building detailed below is: D1
The BER is based on meter readings of all energy used in the building. The BER and CO2 indicators are expressed as respective ratios of primary energy and CO2 emissions relative to a benchmark that represents performance indicative of all buildings of this type. Information on the derivation and interpretation of BER is available at www.sei.ie/ber
Áras de Brún
Bóthar na hOllscoile,
Gaillimh
Galway
Co. Galway
Building Type: University campus
Useful Floor Area (m²): 2426
Main Heating Fuel: Mains Gas
Building Environment: Heating and Mechanical Ventilation
BER No.: 800945172
Date of Issue: 07 Oct 2023
Valid Until: 22 Jun 2024
Assessor No.: 105537
Building Energy Rating (Indicator)
LOW ENERGY USE
<8.5 A1
≥8.5 A2
≥17 A3
≥25 B1
≥33.5 B2
≥42 B3
≥50 C1
≥58.5 C2
≥67 C3
≥75 D1
≥87.5 D2
≥100 E1
≥112.5 E2
≥125 F
≥150 G
D1
429.51 kWh/m²/yr
79.28
HIGH ENERGY USE
Typical building of this type
Carbon Dioxide (CO2) Emissions Indicator
BEST
0
50
100
150
WORST
Calculated annual CO2 emissions
83.29 kgCO2/m²/yr
80.9
Annual Energy Use
THIS BUILDING
Non Electrical (kWh/m²/yr)
Electrical (kWh/m²/yr)
96.39
333.12
TYPICAL BUILDING OF THIS TYPE
Non Electrical (kWh/m²/yr)
Electrical (kWh/m²/yr)
295.51
246.27
Previous Building Energy Ratings
RATIO
200
100
0
76
79.28
79
80.9
2022
2023
2022
2023
CO2
Primary Energy

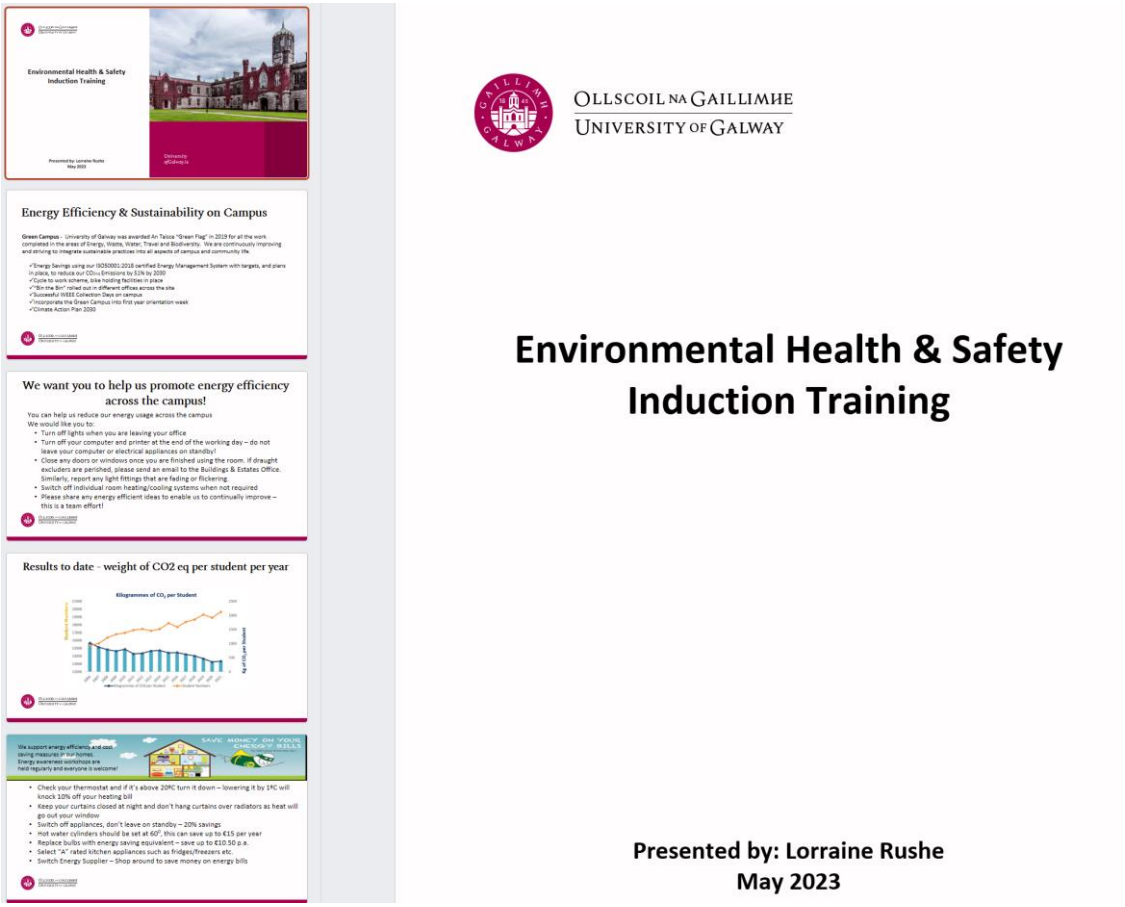

Software Version 5.0
Display Energy Certificate
BER for the building detailed below is: D2
The BER is based on meter readings of all energy used in the building. The BER and CO2 indicators are expressed as respective ratios of primary energy and CO2 emissions relative to a benchmark that represents performance indicative of all buildings of this type. Information on the derivation and interpretation of BER is available at www.sei.ie/ber
Arás Na Mac Léinn
Ollscoil na Gaillimhe,
Bóthar na hOllscoile,
Gaillimh
Gaillimh
Galway City
Building Type: University campus
Useful Floor Area (m²): 4307
Main Heating Fuel: Mains Gas
Building Environment: Mixed Mode with Mechanical Ventilation
BER No.: 800945156
Date of Issue: 07 Oct 2023
Valid Until: 22 Jun 2024
Assessor No.: 105537
Building Energy Rating (Indicator)
LOW ENERGY USE
<8.5 A1
≥8.5 A2
≥17 A3
≥25 B1
≥33.5 B2
≥42 B3
≥50 C1
≥58.5 C2
≥67 C3
≥75 D1
≥87.5 D2
≥100 E1
≥112.5 E2
≥125 F
≥150 G
D2
420.92 kWh/m²/yr
97.72
HIGH ENERGY USE
Typical building of this type
Carbon Dioxide (CO2) Emissions Indicator
BEST
0
50
100
150
WORST
Calculated annual CO2 emissions
82.12 kgCO2/m²/yr
100.76
Annual Energy Use
THIS BUILDING
Non Electrical (kWh/m²/yr) 53.37
Electrical (kWh/m²/yr) 367.55
TYPICAL BUILDING OF THIS TYPE
Non Electrical (kWh/m²/yr) 264.32
Electrical (kWh/m²/yr) 166.4
Previous Building Energy Ratings
RATIO
200
100
0
92
97.72
94
100.76
2022
2023
2022
2023
CO2
Primary Energy


Software Version 5.0
Display Energy Certificate
BER for the building detailed below is: E1
The BER is based on meter readings of all energy used in the building. The BER and CO2 indicators are expressed as respective ratios of primary energy and CO2 emissions relative to a benchmark that represents performance indicative of all buildings of this type. Information on the derivation and interpretation of BER is available at www.sei.ie/ber
Science Research Building
Ollscoile na Gaillimhe, Bóthar na hOllscoile,
Gaillimh,
H91TK33
Galway
Co. Galway
Building Type: Laboratory / operating theatre
Useful Floor Area (m²): 8212
Main Heating Fuel: Mains Gas
Building Environment: Mixed Mode with Mechanical Ventilation
BER No.: 800945164
Date of Issue: 07 Oct 2023
Valid Until: 22 Jun 2024
Assessor No.: 105537
Building Energy Rating (Indicator)
LOW ENERGY USE
<8.5 A1
≥8.5 A2
≥17 A3
≥25 B1
≥33.5 B2
≥42 B3
≥50 C1
≥58.5 C2
≥67 C3
≥75 D1
≥87.5 D2
≥100 E1
≥112.5 E2
≥125 F
≥150 G
E1
980.85 kWh/m²/yr
104.99
HIGH ENERGY USE
Typical building of this type
Carbon Dioxide (CO2) Emissions Indicator
BEST
0
50
100
150
WORST
Calculated annual CO2 emissions
188.31 kgCO2/m²/yr
104.24
Annual Energy Use
THIS BUILDING
Non Electrical (kWh/m²/yr) 377.38
Electrical (kWh/m²/yr) 603.47
TYPICAL BUILDING OF THIS TYPE
Non Electrical (kWh/m²/yr) 251.99
Electrical (kWh/m²/yr) 682.24
Previous Building Energy Ratings
RATIO
200
100
0
87
104.99
86
104.24
2022
2023
2022
2023
CO2
Primary Energy

Appendix D: Yearly CO_2 emissions continue to fall.



Appendix E: Energy/Environmental Induction Training



Ollscoil na Gaillimhe
University of Galway

Appendix F Supplementary Energy usage information - 2022

Fuel	2022			Additional Information
	Quantity [kWh]	Spend (Est.)	CO2 Emissions (kg.)	
Electricity Imports	15,289,806	€2,324,051	5,051,752	AUP 15.2c per kWh € - Set to double during 2023
Electricity Generated on-site from PV	221,153	-€33,615	-73,069	Credit by AUP of 15.2c per kWh. 313,500 kWh during 2021
Gas Imports	10,590,522	€656,612	2,148,817	AUP 6.2 c per kWh(th) - Set to double during 2023
LPG	504,972	€27,016	115,790	AUP 5.35c per kWh (th) @ a rate of 7.1 kWh per Litre - Set to double during 2023
Gasoil - Kerosene & Heating	170,738	€13,318	43,009	AUP 7.8c per kWh @ a rate of 10.1 kWh per Litre - Set to double during 2023
Wood pellets	264,000	€22,275	0	55 Tonnes @ €405 per tonne - Doubled during 2023
Solar Thermal	144,500	-€7,500	-36,400	Negative cost @ say 10c /kWh
Road Diesel	155,453	€16,089	41,024	AUP 10.35 kWh/Lt 15,170 Lt @
Transport Biofuels	11,993	€1,241	0	AUP 10.35 kWh/Lt 1,156 Lt
Total	**27,353,137**	**€3,019,487**	**7,290,923**	
Total Primary Energy Requirement	58,086,455			From M&R
Total Primary Energy Requirement - CO2 emissions			7,275,502	From M&R

Appendix G: SEAI Conversion Factors 2022

Energy conversion and emission factors 2022

Unless otherwise stated, all values are based on net calorific value (NCV).

Comments

- The tables below provide the latest conversion and emission factors for common fuel and energy types.
- Some factors change over time as fuel properties, biofuel contents or electricity generation mix change.
- The 'timeseries' worksheets provide historical annual factors and some additional explanation of the factors.

Colour coding for conversion and emission factors:

Value is typically constant from year to year.
Value typically changes on an annual basis.

Liquid	Energy content			Emission factor				Density	Specific vol.	PE factor	Note
	toe/t	MJ/kg	MJ/l	gCO2/kWh	gCO2/MJ	kgCO2/kg	kgCO2/l	kg/m^3	l/t	-	
Petroleum											
Crude oil	1.023	42.81	40.13	264.0	73.33	3.140	2.943	937	1,067	-	
Gasoline / petrol (100% petroleu	1.065	44.59	33.03	251.9	69.96	3.119	2.311	741	1,350	1.1	
Kerosene	1.056	44.20	35.36	257.0	71.39	3.155	2.524	800	1,250	1.1	
Jet Kerosene	1.053	44.10	35.28	257.0	71.39	3.148	2.519	800	1,250	1.1	
Diesel / gasoil (100% petroleum)	1.034	43.31	36.61	263.9	73.30	3.174	2.683	845	1,183	1.1	
Residual fuel oil / fuel oil	0.985	41.24	38.83	273.6	76.01	3.134	2.951	942	1,062	1.1	
LPG	1.126	47.16	24.62	229.3	63.69	3.003	1.568	522	1,915	1.1	Assumes a mixture of 70% propane & 3
Biofuel / bioliquid											
Bioethanol	0.633	26.49	21.20	0.0	0.00	0.000	0.000	800	1,250	1.1	
Biodiesel ME	0.890	37.27	32.79	0.0	0.00	0.000	0.000	880	1,136	1.1	Methyl ester
Biodiesel HVO	1.051	44.00	37.23	0.0	0.00	0.000	0.000	846	1,182	1.1	Hydrotreated vegetable oil
Biodiesel CHVO	1.027	43.00	36.38	0.0	0.00	0.000	0.000	846	1,182	1.1	Co-processed hydrotreated vegetable
Biopropane	1.099	46.00	24.00	0.0	0.00	0.000	0.000	522	1,917	1.1	
Blended petroleum & biofuel											
Road diesel (avg. biofuel conten	1.025	42.90	36.36	248.4	69.00	2.960	2.509	848	1,180	1.1	Average diesel-biofuel blend sold in 2
Road petrol (avg. biofuel content	1.042	43.63	32.44	243.7	67.69	2.953	2.196	744	1,345	1.1	Average petrol-biofuel blend sold in 2

Solid	Energy content		Emission factor				PE factor	Note
	toe/t	MJ/kg	gCO2/kWh	gCO2/MJ	kgCO2/kg		-	
Fossil fuel								
Petroleum coke	0.740	31.00	338.7	94.08	2.916		1.1	Value for 2022
Bituminous coal	0.665	27.84	340.6	94.60	2.634		1.1	
Anthracite	0.665	27.84	353.9	98.30	2.737		1.1	
Lignite	0.473	19.82	363.6	101.00	2.001		1.1	
Milled peat	0.154	6.43	430.5	119.58	0.769		1.1	Value for 2022
Sod peat	0.313	13.10	374.4	104.00	1.363		1.1	
Peat briquettes	0.443	18.55	355.9	98.86	1.834		1.1	
Biomass								
Wood pellets & briquettes	0.413	17.28	0.0	0.00	0.000		1.1	
Wood logs & chips	0.313	13.11	0.0	0.00	0.000		1.1	Assumes 25% moisture content

Gas	Energy content	Emission factor				PE factor	Note
	MJ/m^3	gCO2/kWh	gCO2/MJ	kgCO2/m^3		-	
Natural gas (GCV)	39.28	183.6	51.00	2.003		1.1	Gross calorific value for 2022
Natural gas (NCV)	35.55	202.9	56.36	2.003		1.1	Net calorific value for 2022

Electricity	Emission factor		PE factor	Note
	gCO2/kWh	gCO2/MJ	-	
Electricity consumption	330.4	91.77	1.884	- CO2 per unit of electricity **consumed** - Total CO2 from electricity generation consumption of electricity - Use this factor to calculate CO2 for el consumption **including** generation, tran distribution losses, and own-use of el power plants (scope 2 and 3 under the - 2022 value is provisional.
Electricity generation	296.0	82.21		- CO2 per unit of electricity **generated** - Total CO2 from electricity generation electricity production (incl. net imports - Use this factor to calculate CO2 for el generation **only** (scope 2 under the GH - 2022 value is provisional.

Accessed on the WWW on 2nd Oct 2023