2018 Energy Review

National University of Ireland Galway

Prepared by

The NUI Galway Energy Team

October, 2018

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1 Energy Review Summary

This energy review is being carried out to comply with the ISO5001: 2011 Energy Management System (EnMS) standard. The relevant clause is 4.4.3 and its main purpose is to determine NUI Galway's energy performance based on data and other information leading to identification of opportunities for improvement. It is defined as the process of identification and evaluation of energy use leading to the definition of areas of significant energy usage and the identification of opportunities for improving energy performance.

Buildings that are included within the scope of the NUI Galway ISO50001 EnMS are documented and included in a thorough review and updated on the NUI Galway Energy Dashboard. There are 58 buildings included that have a total internal floor area of 155,090 m^2.

Internal audits of each clause of the ISO50001 EnMS have been carried out during 2018 and a number of observations were noted. Those observations coupled with resulting actions taken, compliment the continuous improvement statement as outlined in the NUI Galway Energy Policy.

Section 2, Energy Review ~ Analysis outlines the current (2017) energy sources; including the type, quantity, cost and environmental emissions associated with that energy usage. Additionally, an evaluation of the past and present energy usage is also outlined. Section 3, Energy Review ~ Significant Energy Users, outlines NUI Galway's energy baselines, energy performance indicators, significant energy users, other relevant variables, current energy performance and the estimated future energy usage and consumption. Section 4, Energy Review ~ Opportunities for Improvement, documents recent and ongoing energy management system's related improvements, energy management actions and current legal and other requirements pertaining to its operations as a large Irish Public Body.

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.

NUI Galway operate a formal EnMS which is compliant with the requirements of ISO50001; Energy Management Systems Standard. The Energy Review is carried out once a year. If there is a major change; such as the addition, or decommissioning, of a building(s), to the scope of NUI Galway's ISO50001 Energy Management System, then the energy review document will be updated accordingly. The Energy Review is normally carried out during September, and compiled, reviewed and reported during October, each year.

[1] kWh (e) relates to electricity related usage – the average unit price per kWh(e) used is €0.1218c

[2] kWh (th) relates to gas usage – the average unit price per kWh(gas) used is €0.0688c

2 Energy Review ~ Analysis

2.1 Current Energy Sources

The current energy sources being utilised at NUI Galway to sustain its activities are outlined on table 1. In the main, the campus uses imported electrical and gas related energy to sustain its operations. It also uses a considerable amount of renewable energies such as combined heat and power plant, biomass boiler, solar thermal and solar photovoltaic systems. The campus building's energy consumption during 2017 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	2017			Additional Information – AUP* per kWh of energy used
	Quantity [kWh]		CO2 Emissions [t]	
Net Electricity Imports	18,037,986		8,708.7	AUP 14.19 c per kWh (e)
Gas Imports	13,672,609		2,798.8	AUP 3.97 c per kWh(th)
Biodiesel Litres/% biodiesel	860,783		197.4	AUP 4.6c per kWh (th) - Change from 121,408 Litres to KWh
Wood pellets	1,396,957		368.5	AUP 10.8c per kWh - Change from 132,413 Litres to KWh
Gasoil	391,680		86.2	81.58 Tonnes @€220 per tonne
DERV	75,000		36.2	AUP is 9.14c/kWh
LPG	77,000		20.6	AUP 94.99c/lt -7700 Litres
Solar Thermal	1,306,770		31.7	AUP 58.9c/lt - 130,677/8% Bio
Total	35,818,785		12,248.1	*AUP – Average Unit Price

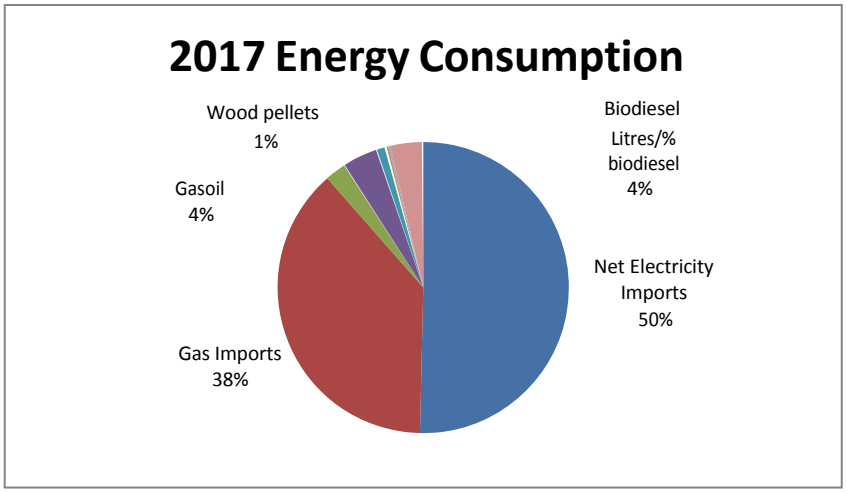

Figure 1: 2017 Breakdown of Energy Consumption (kWh)

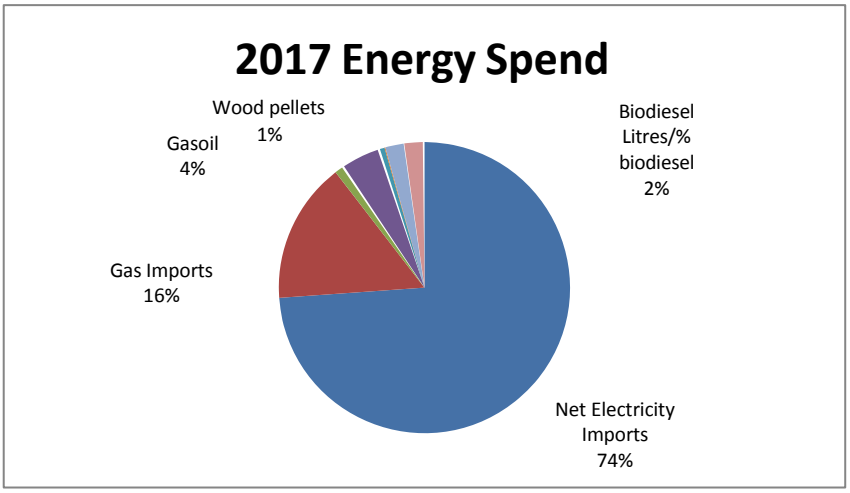

Figure 2: 2017 Breakdown of Energy Spend

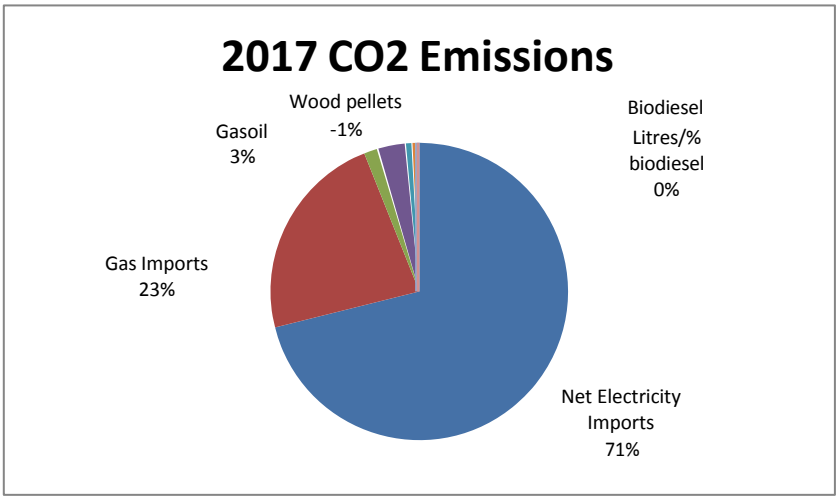

Figure 3: 2017 Breakdown of Energy Related CO_2 Emissions

2.2 Evaluate past & present energy use and 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 database of all public sector organisations' independently assessed energy profile. This is being used as it demonstrates that we are being independent in our assessment criteria. However, this data includes energy used to sustain science and research activities carried out at the SRB Building and that building is not included in NUI Galway's ISO50001 scope. This is discussed in more detail in section 1.5.

Figure 4: NUI Galway's actual energy performance Source SEAI's M&R System

3 Energy Review ~ Significant Energy Users

3.1 Energy baseline

The energy baseline used is the kWh (e) and kWh (th) per m2 of treated floor area. The baseline year is 2006 and NUI Galway's progress since then is plotted on Figure 4. Our energy performance during 2006 was 462.64 kWh per M2 of treated floor area. During 2017 that figure fell to 260.04 kWh per m2. The target for 2017 was 292.19 kWh per m2. The target for 2018 is 282.90, 2019 is 273.60 and for 2020 is 264.30. It is worth noting that during 2011 and 2012, our performance was 256.78 and 248.77 respectively.

NUI Galway's target for 2018 is 282.9 kWh/m2, which is above the 2017 performance level (260.04 kWh per m2). It is expected that our performance will be decrease during 2018, as the new Human Biology Building, is now fully operational. That building is fully treated with exact heating, cooling & humidity controls. It comprises of 8,000 m2.

During 2019 and 2020 the target performance drops to 273.6 kWh/m2 and 264.3 kWh/m2, respectively, but we have already reached our 33%, 2020 target. That said, the team has decided to introduce a 40% target by 2020; which equates to a 3% improvement during 2019 and a further 3% improvement during 2020. This target was announced earlier this

semester and used in an energy awareness campaign called 'Exceeding targets and going beyond 2020'. See also Appendix A.

Additionally, and having spoken to SEAI during a meeting held on campus on 22nd August, it is expected that the 2030 targets will be incorporated into next year's National M&R System, and the target for all public sector organisations will be a 40% improvement in their energy efficiency compared to the baseline year; which in our case is 2006.

3.2 Energy performance indicators

The management team measure its electrical and thermal energy performances using key performance indicators; kWh (e)[3] and kWh (th)[4] 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. Electrical and thermal energy related energy performance indicators (EnPIs) are also used to demonstrate compliance with and achievement of Public Sector 2020 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 2: 2009-17 Energy performance indictors

Year	Energy Performance Indicator (EnPI)	
2017	kWh (e & th) /m2	260.04
2016	kWh (e & th) /m2	275.34
2015	kWh (e & th) /m2	274.66
2014	kWh (e & th) /m2	300.29
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

Additionally, 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 the case where buildings are over or under performing by +/-

[3] kWh (e) relates to electricity related usage – the average unit price per kWh(e) used is €0.1419c

[4] kWh (th) relates to gas usage – the average unit price per kWh(gas) used is €0.0397c

10%, 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 course of 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. NUI 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 also 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.

3.3 Significant Energy Users

The main energy consumers are summarised in Table 3 below. This table is based on the electrical energy using data obtained using the Building Energy Management System (BMS). A table for primary thermal energy users is being developed to include information from the new thermal energy meters.

This table is being used to prioritise opportunities and to support cost accounting exercises. Note that the Science Research Building (SRB) is outside the scope of the ISO50001 Energy Management System at present, even though it is one of the top ten energy users. This building is being managed and operated by Bilfinger.

Additionally, Sankey diagrams are being used to display the energy usage of the significant energy users within buildings. An example of the SRB Sankey Diagram is outlined in Appendix E.

Table 3: Summary of top 10 electrical energy consuming buildings – Oct'17 to Sept'18

Name	*Year*	GIA	*kWh (e)*
Arts Science Building – All Departments	1970, 1973	31,312	4,839,060
Science Research Building	2012	8,212	2,543,815
Human Biology Building	2017	8,000	1,422,039
James Hardiman Library	1980	9,415	1,412,322
Orbsen Building	2003	6,491	1,372,751
Engineering Building	2011	14,145	1,193,122
Arts, Humanities, Social Sciences Research Building (AHSSRB)	2013	5,436	843,520
Áras de Brun	1960	2,426	601,259
Arts Millennium Building (incl. AMBE extension)	2000, 2012	8,054	575,260
Áras Na Mac Léinn / Cultural centre	1995	4,307	591,808

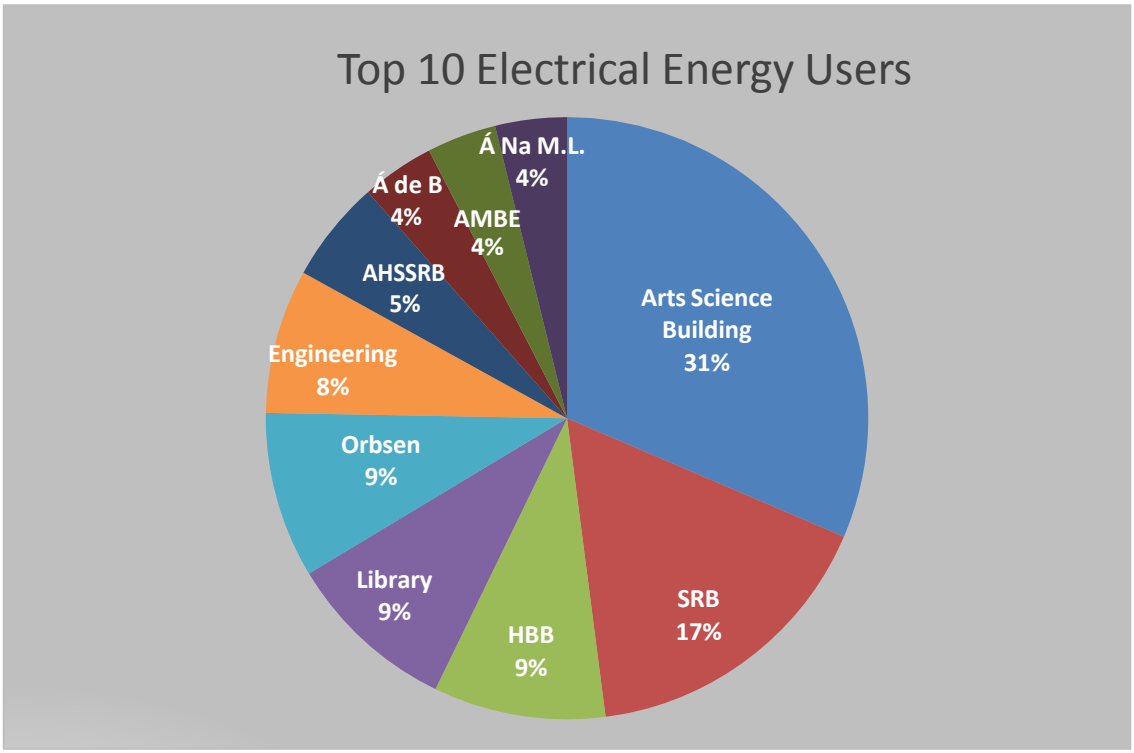

Figure 5: Summary of top 10 electrical energy consuming buildings – Oct'17 to Sept'18

3.4 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 have been carried out on a number of buildings using a base temperature of 15.5 degC. Those buildings are the Science Research, Engineering (Alice Perry Building), Arts Science and the Orbsen Buildings.

Building works on new buildings will have a negative impact on the energy performance of the campus; as construction related energy usage (generally electricity) will be supplied using the campus' main incomers and the overall performance of the campus is measured in kWhs per unit of treated floor area (which will not include buildings being constructed).

This year, and as part of the Green Flag initiative, it was decided to develop a carbon and energy per student related key performance metric. The number of students and the attributable energy and carbon emissions are reported and graphed on following figure and also in Appendix D. The use of carbon performance metrics will be more prevalent in future as this method compliments the move towards a more sustainable campus.

[5] Degree days are essentially 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*"). Source www.degreedays.net

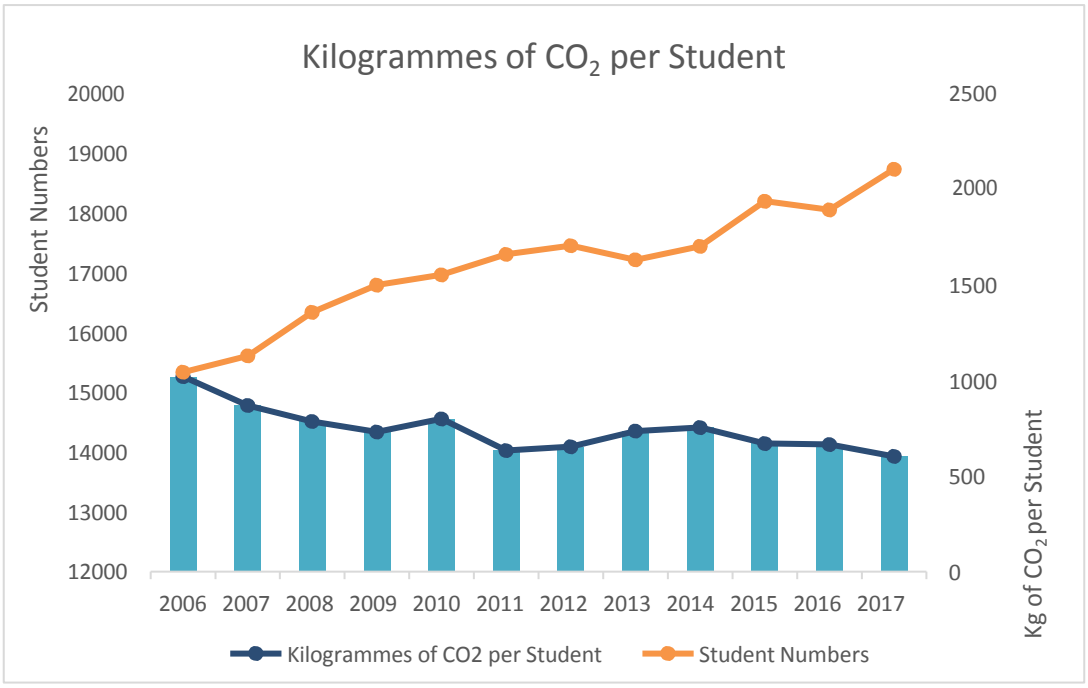

Figure 6: Kilogrammes of CO_2 per Student (2006-2017)

3.5 Current Energy Performance

As discussed previously, the current energy performance of buildings is being monitored daily and being reported on a monthly basis. The energy team reviews the performance of each of the significant energy using buildings, using the monthly cumulative electrical energy usage data and compares that with the cumulative electrical energy usage for the equivalent month from the previous year. Additionally, the annual SEAI M&R Report is being used to review the college's current energy performance. NUI Galway's progress on the M&R systems is being monitored on an ongoing basis. Top management receive a copy of the M&R Annual Report and their comments and any direction given are incorporated into the work undertaken by the Energy Team.

3.6 Estimate future energy usage and consumption

An estimate of the college's future energy usage and consumption was carried out. Historical data was collected over the past 10 years and used to carry out these estimates. The energy usage and consumption will increase again during 2018 mainly due to the growth in student numbers and research intensity. Additionally, the new, 8,000 m.2. fully treated Human Biology Building will be fully operational. The expected energy usage and performance is used to budget for energy usage, consumption and costs over the next period. That increase is factored into the predicted energy use as outlined on the figures included in Table 4 as below. Additionally, the predicted energy consumption is itemised and that factors in energy increases due to factors outlined above and also our energy reduction target; which as stated previously, is 3% per annum up to 2020.

Table 4: Estimate of Future Energy Usage and Consumption

MWh -Usage	2016	2017	2018	2019	2020
Electricity	17,042	19,763	19,170	18,595	18,037
Gas	16,406	17,674	17,144	16,630	16,131
Heating Oils	807	807	783	759	737
Wood Fuels	463	463	449	436	423
Solar Thermal	69	69	67	65	63
Bio Diesels	1,611	1,611	1,563	1,516	1,470
Total	36,398	40,387	39,175	38,000	36,860
EnPI -Consumption					
KWh per Meter Squared (Floor Areas)	177.42	188.72	183.06	177.57	172.24
Total Primary Energy Equivalent (which will change every year)	275.34	260.41	245.48	230.55	215.62

4 Energy Review ~ Opportunities for Improvement

4.1 Recent/Existing Energy Saving Initiatives

Noel O'Connor, Lorraine Rushe, Michael Curran and the energy team at NUI Galway are doing great work in implementing and using their ISO 50001 compliant energy management system, to achieve targets and objectives, and to demonstrate compliance with its legal obligations. Lorraine is the acting Energy Manager and she manages the entire ISO50001 System. The energy team comprises of Noel O'Connor (Assistant Director, Estates Operations), Michael Curran (Head of Building Services, Energy & Utilities), 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 team meet once a month to undertake a review of the EnMS and in particular to review each of the significant energy using building's monthly energy performances. Actions are taken to address any deviations that are found to be +/- 10% from the norm; see also Section 3.2.

Noel O'Connor has continued to lead the ISO50001 Energy Management System and represents top management. Noel has continually demonstrated his commitment to supporting the EnMS and has continually improved its effectiveness by defining, implementing and maintaining the NUI Galway Energy Policy. He has appointed Lorraine Rushe as the Energy Manager and has provided the resources[6] needed to maintain and improve the EnMS and resulting energy performance.

In addition to managing the NUI Galway ISO50001 EnMS, Lorraine has, over the past year, developed the legal and other requirements aspect of the EnMS. She sourced and engaged the services of an external legal registrar and that company (Pegasus) updates and advises NUI Galway on their energy, environmental and health and safety legal obligations. Lorraine and her team have received training in the use of the Pegasus System. The work carried out by Lorraine has ensured that NUI Galway is fully compliant with the

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

Legal and other requirements (4.4.2) and Evaluation of legal requirements and other requirements (4.5.7) clauses of the standard.

Michael Curran has managed the over-haul of the energy management dashboard. That entailed the re-design and re-development of the interfaces and the addition of a number of sheets such as Procedures, Electrical & Thermal Logic Diagrams and Legal Requirements. The 'new' dashboard is a fantastic document and will copper fasten it as one of the key EnMS collection and dissemination communications tools.

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

John Harrington has carried out and completed Internal Audits of the EnMS system during 2018. A number of observations were found and, in each case, Lorraine Rushe was informed using the Internal Audit Report Feedback Forms. John also supported Lorraine in following through, and closing out, actions required arising from those observations.

NUIG's main objective is to reduce electricity and thermal related energy consumption and to improve the overall energy performance of its buildings. The energy performance improvement results during 2017; taken from the Sustainable Energy Authority of Ireland's M&R System proves that NUI Galway's EnMS is being implemented effectively. Some preliminary results follow on figures.

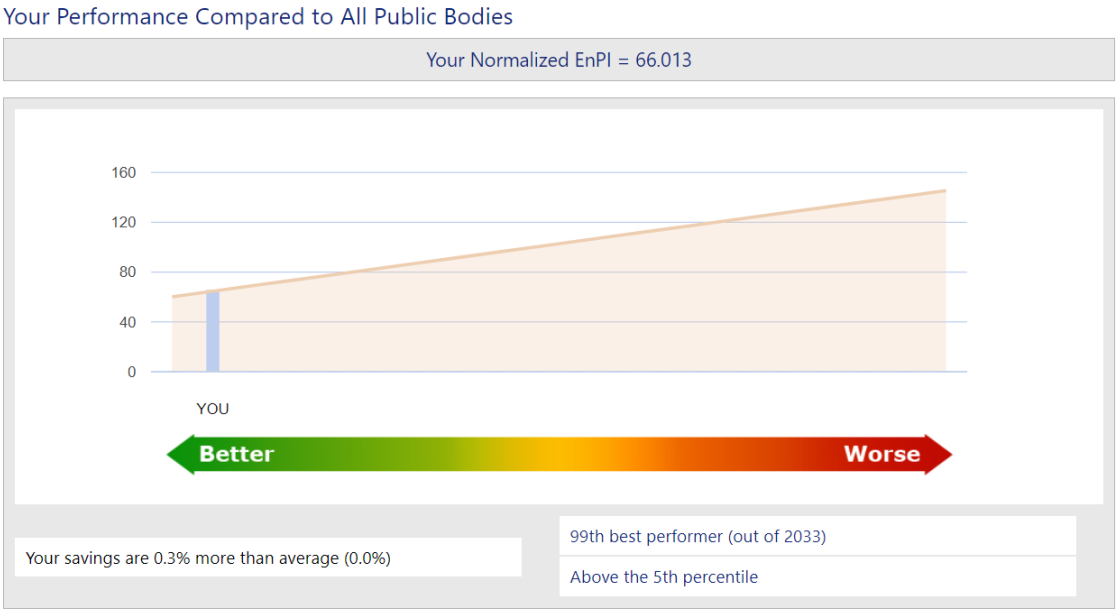

Figure 6: NUI Galway's 2017 energy performance compared to all Public Bodies; Source SEAI's M&R System

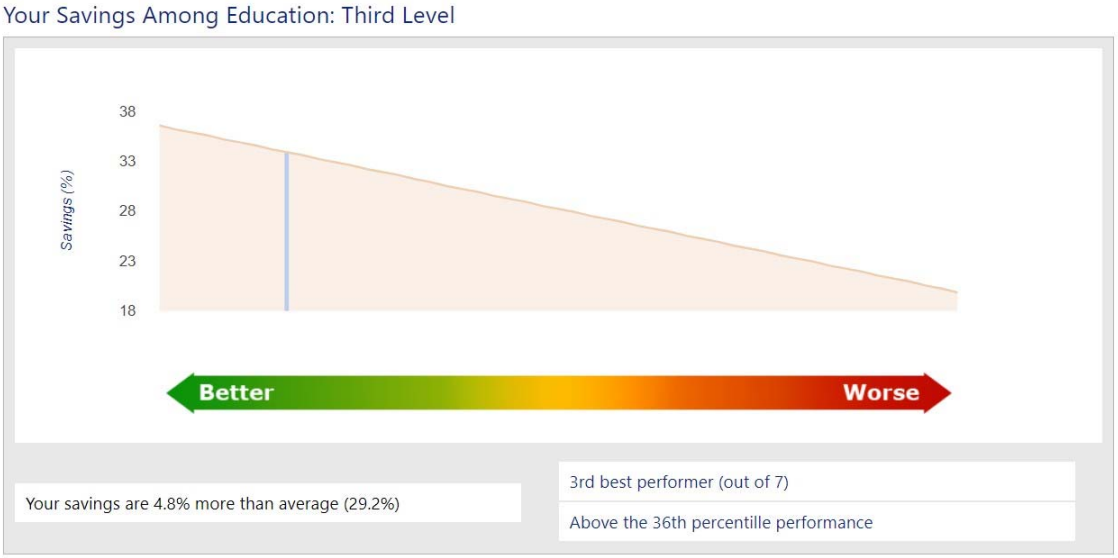

Figure 7: NUI Galway's 2017 energy performance compared to all Third Level Institutes; Source SEAI's M&R System

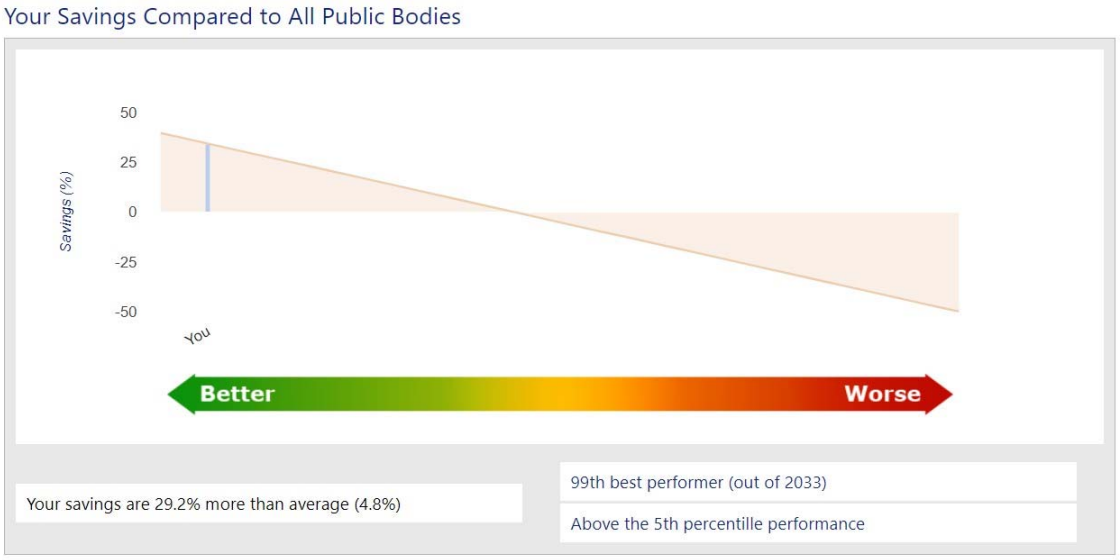

Figure 8: NUI Galway's 2017 energy savings compared to all Public Bodies; Source SEAI's M&R System

Additionally, the Buildings & Estates Team are doing great work on developing energy efficiency projects such as deep energy efficiency upgrades, Boiler-house upgrades, LED lighting replacement projects, implementing set back HVAC opportunities and replacing older generation pumps with modern energy efficient equivalents. A list of completed projects are outlined in the next section, 4.2 ~Energy Management Action Plan.

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

4.2 Energy Management Action Plan

A number of opportunities for further energy savings have been carried out over the past year. The most significant projects include the installation of photovoltaic systems on the roofs of Áras na Gaeilge (13.6 kWp) and Human Biology Building (17 kWp), Boiler-house upgrades; moving from oil to condensing gas/heat pump technology, the installation of a space heating heat pump system to Áras Ní Éimhigh, the continued roll out of energy efficient space heating pumps and the ongoing replacement of florescent light fittings with LED equivalents e.g. the Hardiman Library.

Similarly, an ongoing list of opportunities for improvement and potential projects; for the current period, 2018-19, 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 the highlight action plans relates to the installation of 2 district heating network and biomass energy centres. An application to fund the project (2 district heating networks -1 x North & 1 x South Campus') was submitted to the Department of Communications, Climate Action and Environment under its' Climate Action Fund, in early October, 2018. This is a comprehensive project that will facilitate the migration from fossil fuel to biomass/ renewable energy related heat generation; throughout the NUI Galway Campus. The project will cost in the region of €3.4 mio. Some images are outlined in Appendix B.

The ROO is an active document with 28 opportunities in the seeking funding category, 21 opportunities that have been approved and 13 that have been completed recently. There are also 5 opportunities that have not garnished approval and these are on hold. The ROO is a colour coded document 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; that are set at the annual management review meetings.

Table 5: Summary of the 2018-19 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 (€)	Payback
2018-19	Seeking	6,215,170	2,120,674	7,855,678	€5,063,840	€1,657,226	3.06
	Approved	752,945	566,506	422,813	€472,160	€154,491	3.06
	Completed ~ Approved-Ongoing	99,212	378,007	1,044,257	€383,000	€248,920	1.54
	Total	**7,067,327**	**3,065,188**	**9,322,748**	**€5,919,000**	**€2,060,637**	**2.87**

Table 6, gives an outline of the opportunities for energy efficiency improvements and are categorised as Seeking Funding/Approval, 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; which is presently at Revision 3.

Table 6: Opportunities for Energy Savings and Action Plan (2018-19)

NUI Galway OÉ Gaillimh	National University of Ireland, Galway	ISO 50001	Register of Opportunities 2018/2019												
	NUI GALWAY	Michael Curran / Lorraine Rushe / John Harrington	Noel O'Connor												
Introduction							Estimated Annual Savings								
Building	Opportunity/Objective	Energy	Reason Included	Comment	Business Unit	Project Approval	Fuel Type	KWh (t)	KWh (e)	KgCO2	Capital Cost (€)	Saving (€)	Payback	Comment	
Arts Millennium Building	Upgrade lighting and lighting control to 3no lecture theatres	Elec	Installation of new LED lighting and controls for the 3 no lecture theatres	LED Lighting and controls	Arts Millennium Building	Completed	Electrical		22,105	36,990	€30,000	€9,332	3.2		
AHSSRB	Upgrade existing fixed speed pumps with new energy efficient pumps	Elec	Installation of new energy efficient pumps	Replace 10 No. pumps in plantroom	AHS SRB	Completed	Electrical				€25,000			Grundfos Engineer to review in January	
Block Q	Upgrade existing lighting and storage heating installations	Elec/Therm	Installation of new LED lighting and replace heaters with new energy efficient heaters	Installation of LED Lighting	Block Q	Completed	Electrical	57,158	57,158	29,655	€26,000		3	Replace old fittings and heaters	
Campus Wide	Develop EV Charging Point System	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	Electrical							Link to Green Campus and NUI Galway's Sustainable Campus Strategy. This project also demonstrates that NUIG is committed to reducing carbon emissions by promoting and facilitating Electric Vehicles (EV's)	
Campus Wide	New EV Post Van - Renault Kangoo; located at the HBB Building	Elec	Develop and support a sustainable energy campus	EV Post Van - Quiet, Clean Delivery !	Campus Wide	Completed	Electrical							Linked to Green Campus and NUI Galway's Sustainable Campus Strategy	
Campus Wide	Provision of Campus wide Energy Campaign to the students, staff and contractors	Therm/Elec	Energy awareness campaign and program of events	Provide energy awareness literature, campaigns, switch off days, green week etc.	Campus Wide	Completed - ongoing	Elec/ Thermal			360,099	€50,000	€103,724	0.5	Awareness Campaign - See also Energy Review Document 2018Link to the Green Campus Application	
Campus Wide	Installation of additional metering to remaining buildings not connected to the BMS	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/ Thermal			360,099	€50,000	€103,724	0.5	E-Tender requirement - Ongoing and active monitoring is helping us to reduce energy usage by 3%	
Campus Wide	Maximum Import Capacity (MIC) Project	Elec	Review of existing bills to reduce the Import capacity charges	Review and collate	CAMPUS WIDE	Completed	Elec				€15,000			he summer of 2018. Ongoing monitoring c	
Engineering	Carry out a complete energy efficiency design review of the heating, cooling, ventilation and electrical supply strategies employed at the Engineering Building.	Therm/Elec	Review the existing heating and cooling strategies, review times, air handling units and air balancing.	Specialist engineering review	Engineering	Completed - ongoing	Elec/ Thermal				€25,000	€0	N/A	Review by Energy Specialist - Ongoing- carry this out during the heating season of 2018-19	
Human Biology Building	Installation of Solar PV to the Human Biology Building	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	Electrical		15,500	70,002	€45,000	€2,381	3	ACA /SEAI Grant was awarded to this project that reduced the payback to 3 years	
Library	Upgrade the existing Lighting installation in parts of the Hardimann Library	Elec	Installation of new LED lighting an d 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	Electrical		213,208	102,937	€22,000	€25,969	0.8	Good data available - discussed at September 2018 Monthly Energy Meeting	
Mogola	Installation of LED Lighting to Block A, replace the existing fluorescent	Elec	Installation of new LED Lighting	LED Lighting and controls	Mogola	Completed	Elec	42,054	42,054	22,000	€35,000		5		

Register of Opportunities 2018/2019

NUI Galway OÉ Gaillimh	National University of Ireland, Galway	ISO 50001												
	NUI GALWAY	Michael Curran / Lorraine Rushe / John Harrington	Noel O'Connor											
								Estimated Annual Savings						
Introduction														
Ov	Building	Opportunity/Objective	Energy	Reason Included	Comment	Business Unit	Project Approval	Fuel Type	KWh (t)	KWh (e)	KgCO2	Capital Cost (£)	Saving (£)	Payback	Comment
	Áras na Gaeilge	Boiler Upgrade	Elec	Boiler is inefficient and does require attention	Upgrade the existing thermal heating system to Condensing Gas Boiler & Cascade Conrol technology - Apportioned the capital cost as follows: £23k to space heating upgrade and £5k to DHW upgrade	Áras na Gaeilge	Approved	Elec/ Thermal	241,114	4,140	51,355	£23,000	£17,093	1.3	Reviewed on 30th Oct and this project is almost complete. Pumps have been upgraded, Boilers are in place, Being commissioned.
	Áras na Gaeilge	DHW Upgrade - Included in the boiler house upgrade project, as above	Elec	The capital cost includes boilers, pumps, calorifier & associated controls	See over & above	Áras na Gaeilge	Approved	Elec/ Thermal	-48,223	60,480	13,411	£5,000	£4,049	1.2	Reviewed on 30th Oct. Calorifier has been delivered and will be installed over the next few days.
	Áras de Bruin	Install new LED Lighting to the upper floors	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	Approved	Electrical	0	55,276	26,687	£7,000	£6,733	1.0	Successful project which has complimented the PV Project
	Arts Science Building	Service and carry out works to CHP Unit	Therm/Elec	Annual service to the CHP unit	Manufacturer contract	Arts Science	Approved	Elec/ Thermal	54,320	27,160	24,232	£65,000	£7,045	9.2	Completed by PSE
	AMB	Update the insulation in the boiler house	Therm	Changes to pipework and pumps new insulation to be installed to reduce losses	Internal works to be carried out.	Arts Millennium Building	Approved	Thermal	37,094	0	7,593	£5,000	£2,552	2.0	Existing insulation to be removed and replaced with new insulation and valve jackets.
	Arts Science	Upgrade the remaining Fluorescent lighting in the Arts Science building with new LED lighting	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	Approved	Electrical		26,527	12,807	£10,000	£3,231	3.1	Project Completed
	Biochemistry	Installation of VSD on the existing Fume Cupboard fan	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	Approved	Electrical	0	23,126	11,165	£5,000	£2,817	1.8	1 large motor serving multiple fume cupboards
	Block D & E	Replace existing oil fired boilers with new Gas fired boilers and reduce oil risk - multiple benefits include reducing/eliminating the risk of oil leaks	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	Approved	Thermal	103,864	0	21,261	£10,000	£7,146	1.4	Approximate
	Arts Science Boiler-house	Replace the existing two number existing natural gas burners and controllers	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	Approved	Thermal	74,189		15,186		£5,104		One burner and VSD has been replaced, second tender this summer to replace No 2 Burner and VSD
	Cairnes	Upgrade pump sets in the boilerhouse, replace current fixed speed pumps	Therm/Elec	Replace pumps	In-house project which has been a great success already registered	Cairnes	Approved	Electrical		17,511	11,979	£20,000	£3,022	6.6	Project Completed
	Engineering	Install water savings devices on the Urinals	Water	Existing water usage on 16 urinals is high and needs to be reduced	Existing urinals to be reviewed	Engineering	Approved	Water	0	0	0	£3,720	£22,008	2.9	Tender review with specialist
	Engineering	Service and carry out works to CHP Unit	Therm/Elec	Annual service to the CHP unit	Manufacturer contract	Engineering	Approved	Elec/ Thermal	59,656	29,828	26,613	£45,000	£7,737	5.8	Completed - Schmitt-Enertec CHP by PSE 255 kW; PF
	Library	Complete the upgrade of the heating installation in the Ground and First floor of the library area to match Summer 2016 project	Therm	Replace the existing radiant heaters with new panel radiators and TRVs	Works to be carried out to the existing installation.	Library	Approved	Thermal	55,642		11,390	£30,000	£3,828	7.8	
	Library	Upgrade pump sets in the boiler-house, replace current fixed speed pumps	Therm/Elec	Replace pumps	In-house project, great success already registered	Library	Approved	Electrical		49,622	23,958	£45,000	£6,044	7.4	Project Completed
	Library	Service and carry out works to CHP Unit	Therm/Elec	Annual service to the CHP unit	Manufacturer contract	Library	Approved	Elec/ Thermal	50,532	25,266	22,542	£5,000	£6,554	0.8	Completed by PSE

NUI Galway OÉ Gaillimh	National University of Ireland, Galway	ISO 50001	Register of Opportunities 2018/2019												
	NUI GALWAY	Michael Curran / Lorraine Rushe / John Harrington	Noel O'Connor												
Introduction								Estimated Annual Savings							
Building	Opportunity/Objective	Energy	Reason Included	Comment	Business Unit	Project Approval	Fuel Type	KWh (t)	KWh (e)	KgCO2	Capital Cost (£)	Saving (£)	Payback	Comment	
Cairnes	Upgrade boiler house from Oil to LPG, new boiler and burner	Therm	Removal of oil off site, install new natural gas supply and boiler house	Energy efficient installation, new controls etc.	Cairnes	SEEKING	Thermal	179,379		36,719	£38,000	£12,341	3.1		
Campus Wide	Develop district heating networks for the North & South Campus	Therm	Installation of 2 comprehensive district heating networks linked to 2 energy centres.	Application made to the carbon fund and submitted in October 2018	Campus Wide	SEEKING	Thermal	2,493,600		5,676,970	£3,552,090	£1,117,095	3.2	Link to the Application Document; Calculations sheets and application details.	
Cultural Space	Replace two direct gas fired air handling units feeding student centre	Therm	Existing Direct gas fired units are not efficient and need to be replaced	Installation of new energy efficient Air Handling units	Cultural Space	SEEKING	Thermal				£70,000			Additionality; is is also a Health and Safety related Project	
No. 6 Distillery Road	Deep Retrofit project - Installation of new electric heat pump and associated works, new radiators and controls. Installation of insulation in cavities.	Therm	Existing heating installation not efficient and heating in house is very poor	Installation of Electric Heat Pump and radiators/insulation	No. 6 Distillery Road	SEEKING	Elec/ Thermal	33,755	-9,644	6,910	£30,000	£2,322	12.9	SEAI Better Energy Grant, insulation etc - Need to carry out a BER and establish the EE measures and resulting improvements	
No. 8 Distillery Road	Deep Retrofit project - Installation of new electric heat pump and associated works, new radiators and controls. Installation of insulation in cavities.	Therm	Existing heating installation not efficient and heating in house is very poor	Installation of Electric Heat Pump and radiators/insulation	No. 8 Distillery Road	SEEKING	Elec/ Thermal	33,755	-9,644	6,910	£30,000	£2,322	12.9	SEAI Better Energy Grant, insulation etc - Need to carry out a BER and establish the EE measures and resulting improvements	
No. 12 Distillery Road	Deep Retrofit project - Installation of new electric heat pump and associated works, new radiators and controls. Installation of insulation in cavities.	Therm	Existing heating installation not efficient and heating in house is very poor	Installation of Electric Heat Pump and radiators/insulation	No. 12 Distillery Road	SEEKING	Elec/ Thermal	33,755	-9,644	6,910	£30,000	£2,322	12.9	SEAI Better Energy Grant, insulation etc - Need to carry out a BER and establish the EE measures and resulting improvements	
Engineering	Project to recommission and revisit the utilisation plan for the Biomass Boiler in the Engineering building, Adjust controls and link it to Kingfisher	Therm	Existing installation to be recommissioned and make adjustments for Kingfisher	Contractual agreement with Kingfisher is a barrier	Engineering	SEEKING	Thermal			906,985	£50,000	£152,420	0.3	no confirmation from Kingfisher - Mostly Cost and Environmental Savings	
Engineering	Installation of 100sqm Solar PV to the roof of Engineering	Elec	Installation of 100SQ M of Solar P to the roof Engineering Building	Panels installed to reduce electrical load of the engineering	Engineering	SEEKING	Electrical		11,169	5,392		£1,360			
Gweedore Site	Upgrade the existing Fluorescent lighting to new LED lighting	Elec	Install new energy efficient LED Lighting	LED Modular fittings	Gweedore Site	SEEKING	Electrical	27,868	27,868	14,463	£8,000	£3,716	2.2		
CHP Project 02	Supply and Installation of CHP unit to the Human Biology Building	Therm/Elec	new 140 kw units	Provision for CHP need to find space in SRB	Human Biology Building	SEEKING	Elec/ Thermal	686,040	686,040	356,054	£267,750	£124,026	2.2	E-Tender requirement (140 kW E & 187 kW G?)	
Human Rights	Upgrade the existing oil fired 100kw boiler to new Condensing Gas boiler.	Therm	Installation of new LPG Gas condensing boiler, pumps and controls.	Installation of LPG Gas condensing boiler	Human Rights	SEEKING	Thermal	27,597		5,649	£3,800	£1,899	2.0	Additionality; Replacing oil use on campus - Health, Safety & Environmental risk mitigation	
Kingfisher	Upgrade of 2no existing natural sectional boilers to gas condensing boilers and controls	Therm	Installation of new wall hung gas condensing boilers and controls	New gas condensing cascading boilers and controls	Kingfisher	SEEKING	Thermal	720,000	720,000	148,320	£52,000	£8,657	6.0		
Kingfisher	Upgrade the lighting to the Kingfisher main Hall and support rooms	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	SEEKING	Electrical	62,042	62,042	32,199	£45,000	£8,273	5.4		
Moffett's Restaurant	Replace existing fluorescent lighting with new LED Lighting	Elec	Installation of new LED Lighting	LED Lighting and controls	Moffetts Restaurant	SEEKING	Electrical	14,986	14,986	7,778	£12,000	£2,248	5.3	decorative fittings	
O'Donoghue Theatre	Installation of 20sqm Solar PV to the roof of O'Donoghue Theatre	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	O'Donoghue Theatre	SEEKING	Electrical		2,234	1,078		£272			
Orbsen Building	Refurbishment of 12 no air handling units to the Biomedical section of the Orbsen building	Therm/Elec	Installation of new Energy efficient fans, controllers, filters and heater/cooling	Master air air handling units installed 16 years need to be upgraded	Orbsen Building	SEEKING									

4.3 Legal & Other Requirements

Legal and other requirements are being evaluated on an ongoing basis. Since Q1 of 2017, NUI Galway has subscribed to an external register of energy legislation and staff has undergone training in its use, and the requirements of ISO50001: 2011 Clause 4.4.2. The main pieces of legislation and other requirements that apply to NUI Galway 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.

NEEAP 3, NEEAP 2, NEEAP 1 – National Energy Efficiency Action Plans.

Public Sector Energy Efficiency Strategy – January 2017 – to drive the extra effort needed to realise the energy efficiency potential of the public sector and gain a 33% improvement compared to 2009 levels, by 2020.

Technical Guidance Document Part L – Conservation of Fuel and Energy – Buildings other than Dwellings. The current edition is operative up to 31st December, 2018. The new/future Edition TGD Part L – Conservation of Fuel and Energy (2017) is effective from 1st January 2019.

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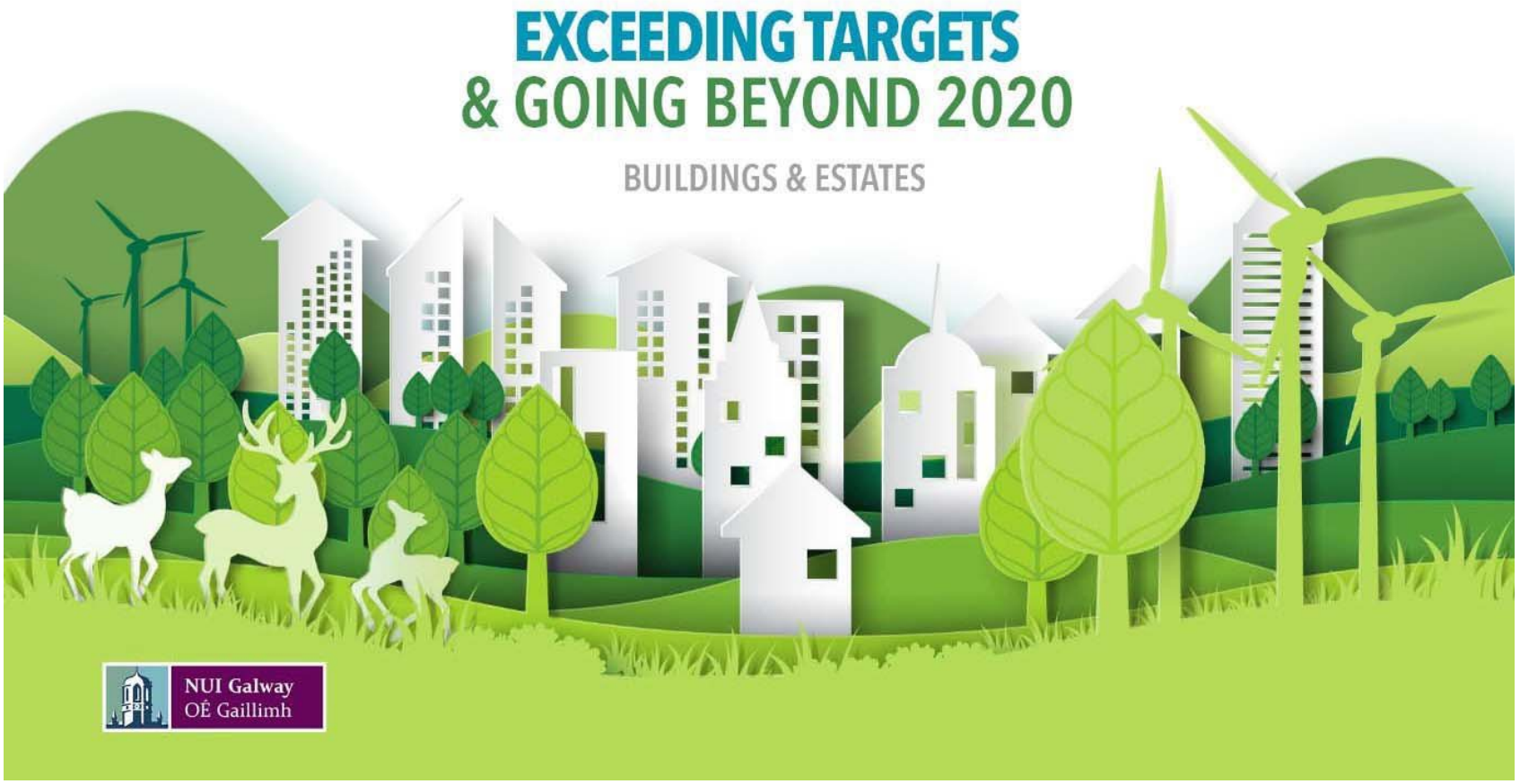
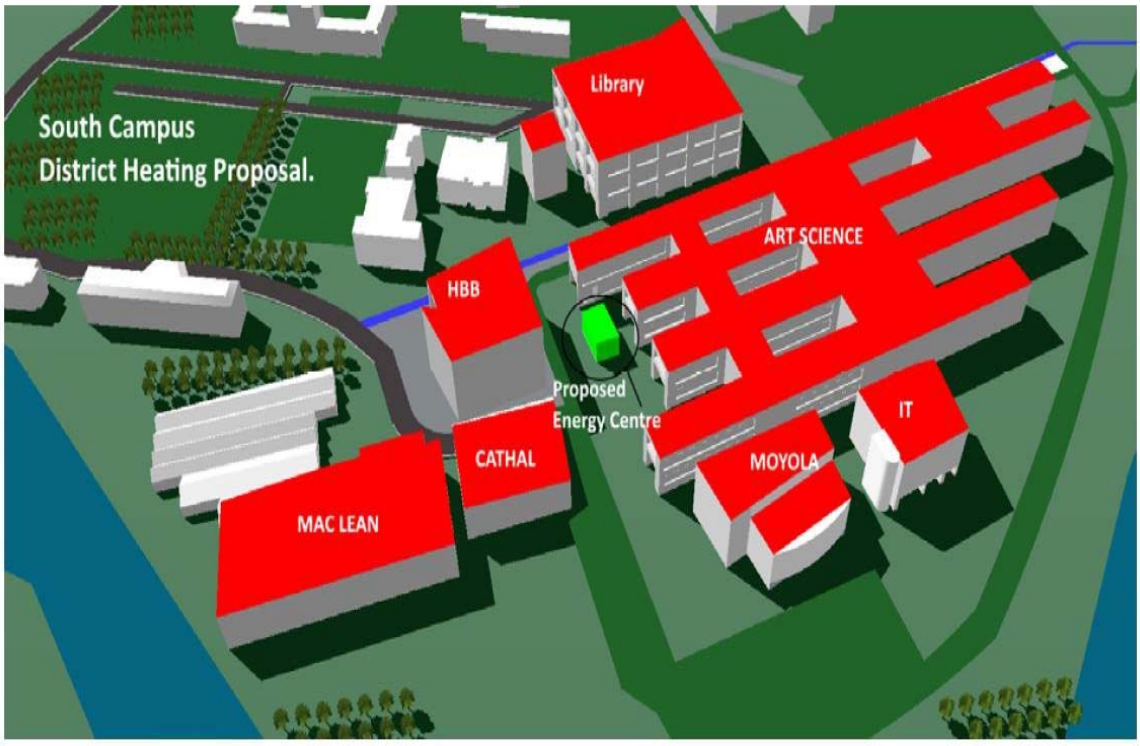
Appendix A: Building & Estate's Energy Awareness Poster.



Appendix B: Images used to display the District Heating Networks/ Biomass Heat Generation Project (for both the North & South Campus)

North Campus Project

South Campus Project



Appendix C: Photographs of the PV installations on the rooftops of Áras na Gaeilge and the Human Biology Building

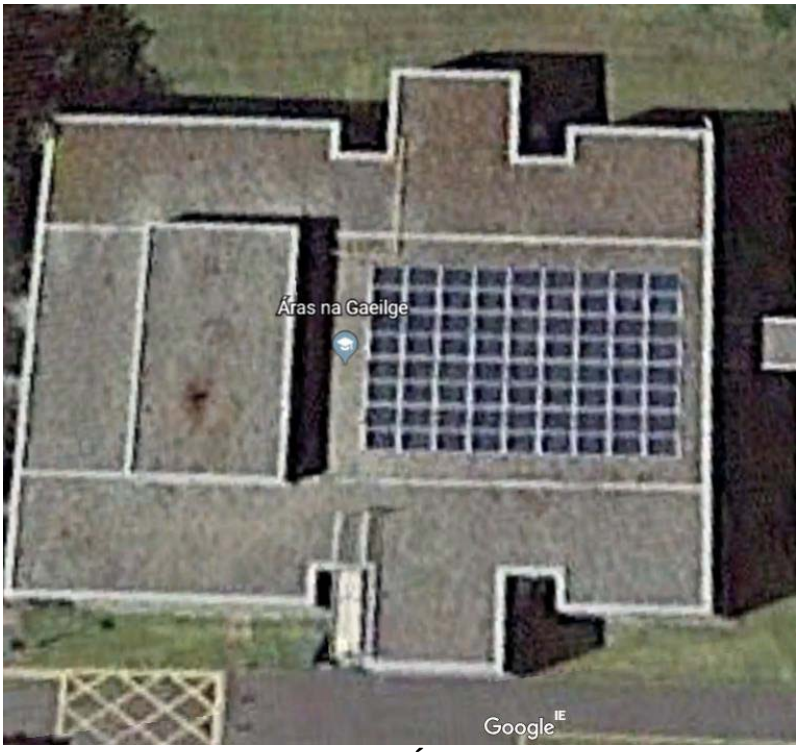


Photo #1; Solar PV installation on the roof of Áras na Gaeilge

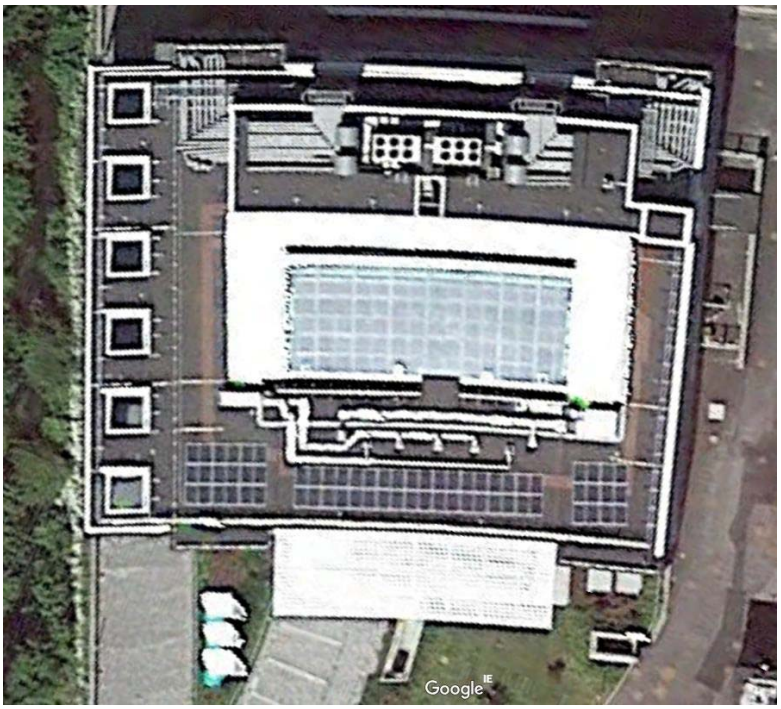
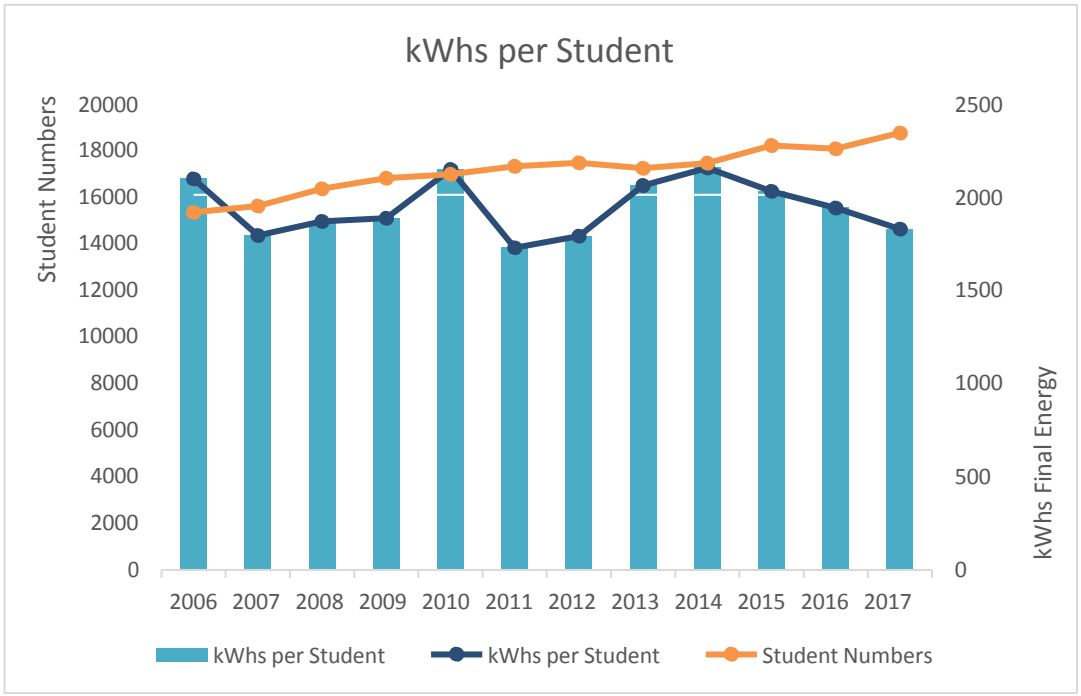


Photo #2; Solar PV installation on the roof of the Human Biology Building

Appendix D: Graph depicting kWh per Student from 2006 to 2017



Appendix E: Sankey Diagram of the energy utilisation at the Science Research Building