Ollscoil na Gaillimhe
University of Galway

Energy Management Policy and Design Statement of Fundamentals

15th April 2024

Revision History

Rev	Date	Purpose/Status	Document Ref.	Comments
G	15/04/2024	Superseded Rev F	BSE 011 STATEMENT OF FUNDAMENTALS	ENERGY MANAGEMENT POLICY, Update on policy and procedures.

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1.0 Introduction

1.1 Climate Action Plan

The Government's Climate Action Plan 2021 and the Climate Action and Low Carbon Development (Amendment) Bill 2021 is aligned with the European Green Deal, which sets out European Commission policy initiatives with the overarching aim of making the European Union (EU) climate neutral by 2050. Energy policy and directives such as the Energy Performance of Buildings Directive and the Energy Efficiency Directive are being updated under the European Green Deal and will be reflected in the Irish Government's annual updating of the Climate Action Plan.

The Government's Climate Action Plan sets out the energy efficiency and energy related Green House Gas (GHG) emissions reduction targets which Public Sector Bodies in Ireland are legally obliged to meet and mandates the University of Galway as a Public Body to develop a Climate Action Roadmap setting out how it will deliver these targets.

This guide has been produced by the University of Galway in response to this obligation. It outlines the work undertaken by the University of Galway to date and our approach to continuing to reduce energy emissions from our buildings and their operation by reducing energy usage and shifting the University of Galway Energy sources from fossil fuels towards renewable and carbon zero energy sources.

This document will be updated annually due to the changing legislative requirements and the urgency around Climate Action in Ireland and Europe. Guidance from central government will be updated to reflect the new targets.

The document focusses on the Energy reduction measures but should be read in conjunction with the Buildings Services Engineering design guidelines and the University of Galway Carbon Roadmaps. By reducing energy consumption this will help the university meet its Scope 1 and 2 emissions requirements.

1.2 Aims

To align the requirements of Government of Ireland Climate Action Mandate and University of Galway sustainability strategy emission reduction and energy efficiency targets for public bodies as follows:

Decarbonisation Targets and Scope

1. Reduce energy related GHG emissions by 51% by 2030 (against a baseline of 2016-2018 average emissions)
2. Increase the improvement in energy efficiency in the Public Sector from the 33% target in 2020 to 50% by 2030 (against a 2009 baseline)
3. A net zero energy related emissions target for 2050 at the latest.

These targets relate to:

- Scope 1 Emissions:

  Direct energy related emissions from fuel (Oil, Gas, Coal etc.) used by owned buildings, vehicles, and equipment (including energy used for heating, catering, and the delivery of research and teaching).

• Scope 2 Emissions:

Indirect energy related emissions from electricity used by owned buildings, vehicles, and equipment.

Energy related emissions from fuel (Oil, Gas, Coal etc.) and electricity used by leased and controlled buildings, vehicles, and equipment also.

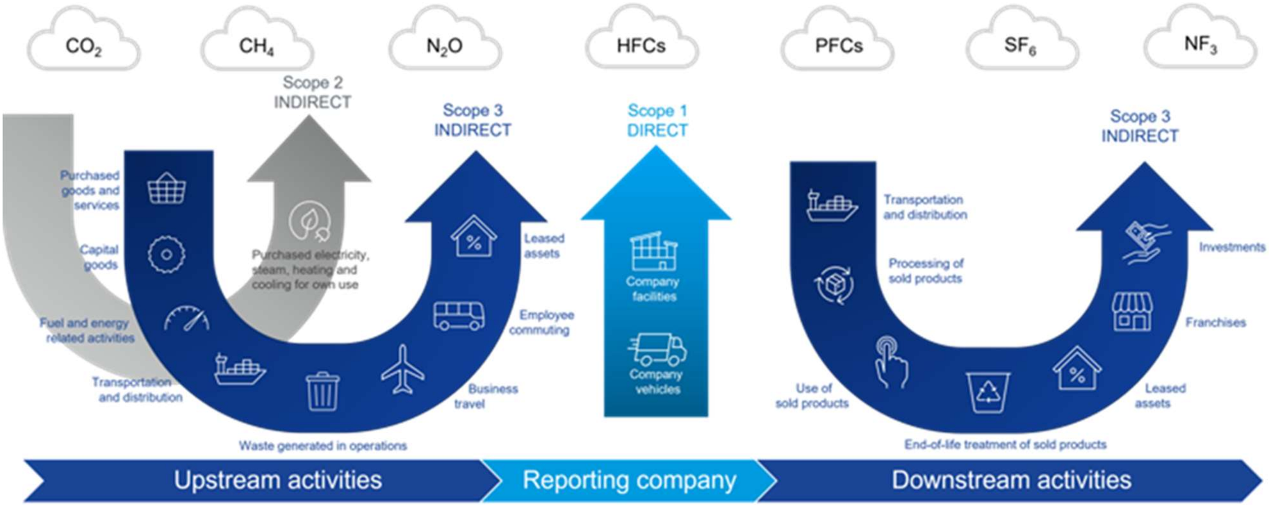

Figure 1: Diagram of Scope 1,2 and 3 of Climate Action Plan Public Sector Targets

1.3 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

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.

- SI393/2021 Energy Performance of buildings, which requires installation of Building Automation and Control by 2025, for buildings with HVAC rated output over 290kW; requires installation of electric vehicle charging points in carparks for new or refurbished buildings with more than 10 car parking spaces.

- 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 – 2024 and previous National Energy Efficiency Action Plans – i.e. 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.

- SI381/2021 Clean Vehicles Directive, which sets targets for the procurement of clean light and heavy-duty vehicles, with the first target falling in 2025 and the second in 2030. The definition of clean vehicle changes to zero emission vehicles in 2025.

- SI4/2017 Energy Performance of Buildings, which requires all new public sector buildings built since 2018 to be "nearly zero emissions".

- SI646/2016, which requires that public bodies procure only energy using products and vehicles that are on the Triple E register.

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.

1.4 Achieving the Carbon Emissions Reduction Targets & Overview of Energy Usage

The University of Galway Energy Team has been pivotal in managing energy and carbon related Green House Gas (GHG) emissions for the past 15 years. We continue to adhere to national legislation and other requirements and are fully compliant with the Sustainable Energy Authority of Ireland's Monitoring and Reporting obligations. We are very proud of our continued certification to ISO50001: 2018 Energy Management System and we use this standard to enable us to continuously improve our energy & carbon performance.

Our staff, students & researcher have continued to improve the overall energy performance of our campus. Energy usage at each of our significant energy using buildings is monitored using our bespoke building energy management system software. We also demonstrate our continued improvement using the centralised and independent reporting platform (M&R), which is managed by the Sustainable Energy Authority of Ireland.

Our baseline year is 2006. Since then, our 'treated' floor area has increased by 56% and student numbers have increased by almost 30%. Our energy performance is TUFA- Treated Unit Floor Area or kWh (electricity and thermal related energy) per m.2. That said, we have managed our energy & carbon usage and have pushed for and consistently achieved a position well below the glidepath- targets.

Our target for the period from 2010 to 2020 was to achieve a reduction in energy usage and consumption by 30% and we managed a 51.7% reduction.

The energy team is committed to meeting and exceeding the energy targets set by the Government on reduction of energy usage by 51% by 2030.

1.5 Scope

Our policy ensures that the university shall:

- Use Energy in a prudent and responsible manner
- Procure Fuels at the most economic cost
- Reduce the Consumption of Fossil Fuels for thermal and vehicular transport, this excludes generators although alternative forms of fuel are being investigated.
- Utilise Energy from Sustainable sources where practical
- Monitor and Report Energy Performance
- Promote Energy Awareness amongst both Students and Staff
- Identify and implement Energy Efficiency measures throughout all our campuses.
- Target a reduction in Energy Consumption and Pollution Emissions in line with Ireland’s National Energy Efficiency Action Plan
- Promote Sustainable Energy Management practices, and
- Incorporate Energy Efficient and Sustainable Designs and Management for both new Build and Refurbishment Building Projects

The overall design philosophy for a building and the chosen methods for servicing the facility will have a significant influence on it’s final energy performance. In terms of minimising the energy use the strategy shall be to utilise passive systems where feasible, thus reducing energy demand to the absolute minimum. The remaining energy demand shall be met by incorporating high efficiency systems complimented with fully automated and intelligent control systems.

1.6 Energy Efficient Project Management

Energy Efficient Project Management is the key to ensuring University of Galway builds and retrofits its facilities to the highest possible clean and sustainability standards. The key requirements shall be as follows:

- Early intervention (at conceptual design stage) to ensure energy demand management is a key objective of the completed project,
- Early communication with the relevant personnel in the Energy Teams within the Buildings & Estates Office to ensure controls and systems efficiency is a key enabler of the project,
- They shall be issued to all designers and contractors associated with the project upon their appointment shall meet with the Energy team and assess utilities for the project.
- Preliminary Conceptual Design Philosophy Document to be submitted to Energy Team for consideration and approval as early as possible in the project process,
- Early adoption of an energy efficient design methodology and the inclusion of a predicted and forecasted energy increase or decrease in the final detailed design, (a BER and DEC rating to be included for a major capital build).
- Ensure the procurement of the project complies with Green Public Procurement Guidelines (GPP)
- Sub metering of energy systems and integration with the Building Management Systems to be included for all projects, or as dictated by the Energy Team. The consultants shall meet with the BMS Contractor on site and review the existing network installed on campus.
- Regular reviews of the design during the construction works to be undertaken with feedback given by the Energy team.
- Ensure the Controls and Facilities Teams within Estates are fully involved with the commissioning of the building and its services systems,
- Demonstration of the systems to all Facilities, Energy Teams on final completion of the project.
- Optimisation of building physics such as orientation and thermal performance
- Plant efficiencies and minimisation of losses and auxiliary loads
- Optimisation of solar gains when required whilst minimising solar gain overheating during summer months
- Holistic occupancy control and profiling of M&E systems
- Optimising the benefit of mixed mode system design including natural ventilation where feasible.
- The consultants engineers shall ensure the system designs are not complicated and can be flexible in operation, systems shall be design so during low occupancy these areas can be turn off to maximise energy savings.

1.7 Part L compliance

It provides guidance in relation to Part L of the Second Schedule to the Building Regulations as inserted by Building Regulations (Part L Amendment) Regulations(S.I. No. 538 of 2017) and the European Union (Energy Performance of Buildings) Regulations 2021 (S.I. No. 393 of 2021). The guidance in this document applies to buildings other than dwellings.

The Part L Regulations and the European Union (Energy Performance of Buildings) Regulations (and this document) partly transpose the EU Energy Performance of Buildings Directive Recast (EPBD Recast) 2010/31/EU of 19 May 2010 and amending Directive 2018/844 of 30 May 2018, Articles 2, 3, 4, 6 (part of), 7, 8 (part of) and 9(3(b)).

The 2017 amendment to Part L (Conservation of Fuel and Energy) of the Building Regulations and the Technical Guidance Document L, for Buildings other than Dwellings, provide for the implementation of requirements of Articles 2,3 4, 6 (part of), 7, 8, 9(3,b) of the EU Energy Performance of Buildings Directive – EPBD (recast) (2010/31/EU of 19 May 2010).

They provide guidance in relation to Part L of the Second Schedule to the Regulations as inserted by Building Regulations (Part L Amendment) Regulations (S.I. No. 538 of 2017).

Part L of the Building Regulations 2017 applies to buildings other than dwellings and was published on 22 December 2017.

This sets out to the approach to be taken for Public sector projects with reference to the Building Regulations 2017 Technical Guidance Document L – Conservation of Fuel and Energy for Buildings other than Dwellings.

This design brief will be developed based on adherence to the following guides and standards.

NZEB Standards

BREEAM Standards

Building Regulations Part L – Non Domestic Buildings

CIBSE Technical Design Documents

BIM – Building Information Modelling.

To ensure the longevity of this brief, specific mention of individual standards, which are continuously being updated, has generally been avoided.

Where standards are noted, it is the responsibility of Design Teams to ensure compliance with the prevailing version of that standard.

The design, installation, commissioning and handover of the project, including materials, products and workmanship shall comply with the relevant prevailing standards in the following order of preference: national standards transposing European standards, European Technical Assessments, common technical specifications, international standards, other technical reference systems established by European standardisation bodies or - when any of those do not exist - national standards, national technical approvals or national technical specifications relating to the design, calculation and execution of the works and use of the supplies and each reference shall be accompanied by the words ‘or equivalent’.

1.8 Energy Efficient Design (EED) (New buildings)

The EED Project Summary Report is a EED document which must be completed and updated at specific stages of the project. The EED project summary report should capture the following:

- Part L Compliance Declaration and provisional BER
- Project Design Considerations
- General Design: Orientation, fabric, air tightness etc.
- Active Design Elements: HVAC, lighting, controls, metering etc.
- Renewable Energy Design: solar, biofuels etc.
- Building Orientation Study: orientation, glazing ratio, sun cast study,
- overheating study etc.
- Energy Data and Energy Balance Study
- Register of Opportunities including opportunities incorporated
- HVAC & Domestic HW System Selection Matrix
- Summary of Outcomes: Avoided energy / CO_2, building performance,
- lessons learned etc.
- Targets and outputs for the next stage of the project

1.9 Energy Balance Study (EBS) (Existing buildings)

The Energy Balance Study (EBS) is an analysis of an asset's energy types, energy consumption, energy consumption profiles, energy costs and Significant Energy Users (SEUs).

The EBS should represent 12 months of energy data and should have sufficient detail to illustrate the energy consumption profiles on a daily, weekly or monthly basis depending on the information available. The EBS should also identify the asset's energy users (heating, cooling, lighting etc.) and their respective energy consumption, with larger energy users categorised as Significant Energy Users.

Where actual energy data is unavailable building modelling or the development of a BER can be used to generate the EBS. Note that the EBS must include all energy associated with the project including process related energy not just building fabric elements.

1.10 External Conditions

External conditions shall align with CIBSE Guide A – Environmental Design. Where plant and equipment is required to operate continuously or for the purpose of AHU frost coil sizing or pipework frost protection the design winter temperature should be takenas -10°C.

Where heat rejection plant and equipment is expected to operate continuously serving critical infrastructure or building operation, it should be capable of operating when the external temperature is 32°C and 50% saturated providing full design capacity.

1.11 Internal Comfort Conditions

Internal comfort conditions shall align with CIBSE Guide A – Environmental Design. The following internal conditions shall be considered for each internal space:

- Fresh air rates
- Air change rate
- Thermal comfort
- Sumer design temperature
- Winter design temperature
- Humidity level
- Filtration
- Internal noise level

1.12 Thermal Comfort

Thermal comfort is to be assessed for winter and summer based on CIBSE TM52: The Limits of Thermal Comfort: Overheating in European Buildings. Unless otherwise agreed, environment types are as follows:

- New building and major refurbishments: Type II
- Existing buildings: Type III

1.13 Noise Criterion

Several alternative guides to acceptable ambient noise have been published in recent years. These have been referred to in CIBSE Guide A. The designers are encouraged to review these guides as part of the design process:

- BB93 – for teaching environment
- BCO Guide to Specification – for office environment
- DOH Technical Design Manual – for laboratories

Plantrooms shall be designed to meet CIBSE Guide A: Environmental Design – recommended comfort criteria for factories/light work environment.

The consultant shall take into consideration when proposing the installation of external air to water heat pump that in periods of de-frost but also generally running fan noise may exceed acceptable levels, therefore it is essential that the units are in areas that maybe sensitive noise. Link with the architect or designers to ensure suitable acoustic boundaries are in place.

2.0 Key Energy Efficient Design and Equipment Concepts

The following design concepts shall be incorporated by Project Managers within the Buildings & Estates Office.

- Air tightness shall comply with the latest NZEB Interim specification.

- All electricity, gas and water utilities shall be sub-metered and connected to the Building and Energy Management Systems.

- Both the Conceptual and Detailed Design Stages of a project shall include for separate meetings with the Energy Teams to ensure all relevant utility standards are being met.

- Temperature set points to be selected to minimise energy usage whilst maintaining optimum environmental comfort within the building. It is accepted that occupants will accept higher temperatures in the summer period and mechanical cooling should only be adopted if a passive solution has proven not to be feasible. Where environmental control is provided a dead band of 5 deg. C shall be adopted but this should be reviewed for every individual project.

- Lighting levels to be set in accordance with similar principles to internal temperatures.

- Mechanical ventilation systems shall only be considered when strategies to provide natural ventilation have been fully explored. Where forced mechanical ventilation is deemed necessary the plant shall be sized to provide the minimum outdoor airflow rates as recommended by CIBSE. The effectiveness of the ventilation systems should be considered in the appraisal of systems at the various design stages.

- Use of high efficiency, variable speed motors to be specified for all fans and pumps where continuous running over long periods is envisaged. Motors should be Class Eff1 with the efficiency stated.

- Realistic and diversified assessment of likely internal gains from equipment, people and lighting to be included for heat loss calculations.

- Lighting systems shall consider LED as the first option. Ensure minimum 5 year warranty.

- All Toilet, Corridors, Plant-rooms, Circulation Areas and Stairwells shall include for PIR Controlled Lighting.

- External Lighting shall be photocell controlled. Specify lighting for maximum durability, energy efficiency and lifespan.

- Large scale lighting retrofits should include for PIR / Daylighting controls with simplied local management systems.

- All thermal insulants selected for use with the fabric and services systems should be manufactured from products having zero ozone depletion potential.

- All building products should be selected to compliment the sustainable building strategy.

- Design to minimize life cycle costs, including the use of materials that will maximize durability and longevity.

- Design to minimize embodied carbon on all mechanical and electrical products for the project shall be considered.

- All WC's should have dual flush capacity.

- Consideration shall be given to utilising rainwater recovery where economically viable (yielding payback of less than five years).

- Lighting and HVAC controls to be designed to serve zoned areas as applicable to the use of the building.

- Upon completion of all refurbishment projects the PM shall include for the completion of a revised Display Energy Certificate to be included as part of the overall project cost.

- All equipment must comply and adhere to the Triple E Register.

2.1 Near Zero Energy Buildings (NEZB)

All buildings shall be designed to meet the requirements of NZEB. The European Energy Performance of Buildings Directive (EPBD) requires all new buildings to be Nearly Zero Energy Buildings (NZEB) by 31st December 2020.

DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings (recast)

NZEB "nearly zero-energy buildings" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby;"

University of Galway will therefore implement the standards and requirements set out in the Part L of the Building Regulations was updated to define the requirements in legislation and compliance with NZEB. The Non-Domestic Energy Assessment Procedure (NEAP) is Ireland's official methodology for calculating a Building Energy Rating (BER) for non-domestic buildings

2.2 PASSIVE ENERGY MEASURES

The use of passive energy measures to achieve a comfortable internal environment shall be employed where possible. The positioning of the building (allowing for site restrictions) should be developed to take account of the need to minimise energy consumption with particular emphasis on maximising the use of natural ventilation, daylighting, useful solar gain and minimising heat losses and unwanted solar gains.

The consultant engineers shall assume the energy targets below are industry standard although it is expected that the designs will exceed all the above targets to achieve the highest rating.

The designers must target an energy rating of A2 and equate to a carbon emission of <50kg CO_2/m^2.

Low energy targets for a new, minimally M&E serviced, naturally ventilated building are as follows;

- an electrical demand of less than 80kwhrs/m2/year and
- a thermal demand of less than 100 kwhrs/m2/year.

These targets are taken from good exemplars on University of Galway campus and from SEAI 2030 energy goals.

- Low energy targets for a more heavily M&E serviced, mechanically ventilated building, such as a science building will be as follows;
- electrical demand of less than 200kwhrs/m2/year and
- a thermal demand of less than 150 kwhrs/m2/year for both the building and equipment/contents.

These targets are taken from good exemplars on University of Galway campus and from SEAI 2030 energy goals.

The Design team must include relevant and beneficial sustainable/ renewable energy technologies in its preliminary and detailed designs, which must be analysed and have a full Cost Benefit Analysis (BBA) carried out. These cost-benefits shall then be compared with traditional fossil fuel solutions. This should include, but is not limited to, the analysis of available useful natural energy sources including biomasss, wind, solar, hydro, geothermal, pump head hydro and tidal energy.

In presenting CBA case studies to University of Galway, the merits of sustainable energy solutions Vs traditional solutions shall include the capital costs of the equipment, cost of installation, the cost of maintenance ongoing, availability of any grants, and the present and likely future cost of fuel and Carbon emissions (ETS & Carbon Taxes) from both fossil fuel and sustainable/renewable technologies.

The ongoing running cost of the building shall also be analysed by inputting the existing contracted tariffs for LV/MV power, gas and water tariffs. For future years, energy costs, an inflation index based on CSO/ CPI stats should be used. This will inform University of Galway of the future running costs of both options.

The consultant shall be aware of the phasing out of all fossil fuel technology under the government climate action plans, therefore in preparing the reports the reference of fossil fuels is only given for comparison against previous projects on campus.

The University of Galway are signed up to climate action plan and the electrification of the thermal heating and cooling systems.

3.0 Design Review Agenda Checklist

In review of design strategies and proposals for projects please note the following guidelines below. These notes are for guidance only to help identify the issues to be considered as appropriate for the building or refurbishment project at the University of Galway:

3.1 Heating System Strategy

The Building Service Engineer shall refer to the Heating and Cooling policy for information relating to thermal comfort in the campus buildings, designs should reflect the information provided. Reference to Statement of Fundamentals for Building Service Engineering should be referenced for materials and installation techniques.

Space heating should be achieved in accordance with the space heating strategy for the building.

- Design for Maximum Energy Efficiency – system boundarys.
- Potential and Opportunities for Waste Heat Recovery, CHP and Ground Source Heat Pumps/ Air to Water Heat Pumps, Solar PV and Wind Turbines.
- Energy Efficient Controls and data collection.
- Bi Valent heating systems.
- Use systems with low water return temperatures such as under floor heating to maximise system efficiency.
- The size and location of heat emitters in any given space should take account of the heat loss and ventilation requirements of that space.

3.2 Domestic Hot Water Services

- Design for Maximum Energy Efficiency
- Storage or Non-Storage Principles
- Potential for Solar Water Heating
- High Efficiency heat pumps for hot water
- Direct hot water systems, ie under sink water heaters etc.
- Reduced pipework runs and control systems for water systems.
- Hot water control for legionnaires disease.
- Energy Efficient Controls

3.3 Ventilation Systems

- Minimum Requirements Analysis
- Design for Maximum Energy Efficiency and Maximum Natural Ventilation Potential
- Opportunities for Mixed Mode Operation
- Heat Recovery
- Air Tightness
- Selection of Air Handling units and associated heating/cooling modes.
- Energy Efficient Controls

3.4 Cooling Systems

- Minimum Requirements Analysis
- Dynamic Simulation to maximize low energy cooling
- Opportunities to reduce loads to be considered in detail at conceptual design
- Realistic Design Loads
- Energy Efficient Control
- Sub metering of all Chillers

3.5 Lighting Installations

- Opportunities to maximize Daylight
- Lighting Efficacy
- Lighting Controls
- Presence Detection
- LED Technology

3.6 Water Systems

- Opportunities for Low Water Consumption
- Flushing Control
- Sub Metering
- Thermostatic Mixing Valves
- Low Flow Showers and Taps

3.7 Building/Energy Management System, Controls and Metering

- Sub Metering (pulsed and compatible)
- Design Philosophy and Strategy
- Controls Strategy (An allowance for updating BMS Graphics must be included in refurbishment budget)
- Data monitoring and display of results.

3.8 Building Information Modelling and CFD Design.

CFD, Thermal modelling and daylight modelling shall be completed by suitably qualified contractors with regard to the following;

- models will test latest architectural design and with full room utilisation/equipment load and full room data sheet information available.
- where solar gain is likely to result in unacceptable internal heat gain, heavy duty white solar blinds and /or external solar film shading is preferable to mechanical or AC cooling.
- weather files for modelling and BER/DEC iSBEM models will be chosen by agreement with University of Galway/design team.
- all latent and sensible heat data entry & occupancy assumptions built into the model will be agreed with University of Galway / design team & documented.
- Max/min room temperatures in sedentary areas such as offices, libraries and theatres shall be 18-22C in winter and 20-25C in summer.
- Max/min room temperatures in PC suites and data centers shall be

  20-25C in winter and 20-27C in summer.

3.9 VENTILATION/HVAC/COOLING

- Natural ventilation is the preferred method in low density and narrow and medium plan spaces (up to 7meters wide).
- For more heavily services/large equipment loads Mixed mode ventilation (natural ventilation assisted with mechanical ventilation) is the next preferred method for medium plan spaces (7-10meters wide).
- Full Mechanical ventilation and/or cooling may be the only practical solution in deep plan spaces (of >10 meters width) or lecture theatres; these systems will only be acceptable where natural ventilation or mixed mode is proven ineffective.
- Air Conditioning shall only be installed for specific rigid regulatory or process related requirements or where mechanical extract proves insufficient.

- Smaller internal works spaces with high occupancy and high latent heat gains or solar gain which are modelled to result in temperatures which exceed 28°C for greater than 1% of the working year, CIBSE guidelines, are also eligible for mechanical cooling.

- Any HVAC/mechanical ventilation installed shall be tested and commissioned fully with duct leak testing being carried out. VSD controls shall be used to reduce fan energy consumption and duct overpressure while being able to achieve the required air exchange and air comfort in the spaces required.

- Passive cooling through exposed building mass/ structure should also be examined and modelled.

- The embodied energy contained in concrete, steelwork and insulation materials shall be assessed in the design process, and used in calculating the carbon load of the construction phase.

- Air tightness standard- Buildings shall be leak tested to ensure the building is well insulated and sealed.

- Air leakage from the building shall be tested and must be less than 3.0 m3/hr/ m2 @ 50Pa and a test cert shall be supplied prior to handover to NUIG.

- Air changes shall be set so as to provide the required air volume change without exceeding duct pressure limits and without unnecessarily consuming power. (using efficient motors and fans).

- Procurement of all materials and equipment shall take account of the energy rating of such, and the award criteria must reward more energy efficient equipment.

- Non essential fumehoods and extract fans shall be BMS/timer controlled where possible so they do not run 24-7. For essential fans and extracts that need to run 24-7, highly efficient fans (n=>93%) rather than standard fans must be fitted. (the consultant shall refer to the LEV (Local echaust ventilation guidelines for reference on flow rates etc)

3.10 CHILLERS / SPLIT DX AIR CON SYSTEMS

New buildings and refurbishments of buildings must include for the legally required legitimate costs of collecting, removing, and legal disposal of these gases and installation of new refrigerants with lower global warming potential (GWP). All new builds must only use approved refrigerant gases, HCFC and CFC free. All these gases and blends must comply with Montreal protocol and F Gases legislation.

The European Union's F-Gas Regulation is a testament to its commitment to environmental protection. This regulation seeks to curtail the use of fluorinated greenhouse gases, commonly known as Hydrofluorocarbons (HFCs) by 95% by 2030 compared to 2015, going down to zero by 2050.

Starting in 2027, plug-in and other self-contained systems under capacity 50kW will be prohibited from using F-gases with a Global Warm Potential (GWP) of 150 or more. Additionally, single-split systems containing less than 3 kilograms of F-gases with a GWP of 750 or more will be banned in 2025.

Further restrictions will be implemented, Air-to-Water Split systems will be limited from 2027 and Air-to-Air Split Systems from 2029 to using F-gases with a GWP below 150. All split systems with a capacity of 12 kW or more are limited to using F-gases with a GWP below 750 from 2029.

CIBSE TM65 Embodied Carbon in building services a methodology specifically includes refrigerants as a significant contributor to the embodied carbon in building services systems. The refrigerant charge (the mass of refrigerant in the system) is related to the heating or cooling load and the method of distributing the heat around the building.

Therefore University of Galway will task the project consultants to review which future refrigerants will considered as part of the future projects ensure the lowest GWP. Future possibilities are as follows:

Hydrofluorocarbons (HFCs), and hydrocarbons (HCs) are more prevalent, each offering different benefits and challenges in terms of efficiency, environmental impact, and safety. R32 is a good example, offering a trifecta of benefits: enhanced efficiency, reduced GWP, and recyclability.

Hydrofluoroolefins (HFOs) are emerging as frontrunners in the race for sustainable refrigerants. These compounds, often blended with other substances, boast a much lower global warming potential than traditional HFCs. R454B, commonly known as Opteon™ XL41, is also emerging as a pivotal refrigerant in the HVAC industry, with a lower Global Warming Potential (GWP) alternative to the widely used R410A.

Natural refrigerants are the real game-changers. Substances like CO2 (R744), ammonia (R717), and hydrocarbons such as propane (R290) and isobutane (R600a) are making waves in the industry. Their minimal GWP makes them standout candidates for future HVAC systems.

To meet the current – and future – F-gas requirements, some safety challenges will need to be overcome. The downside to lowering the GWP of a gas tends to be the increasing flammability or related issues. All 'flammable' refrigerants (with flammability classification of 2L, 2 or 3) will not ignite if the refrigerant concentration in room air stays below the lower flammability limit (LFL).

BS EN 378 Refrigerating systems and heat pumps – safety and environmental requirements sets limiting refrigeration concentrations that are deemed safe for applications in buildings. The standard relates the size of an occupied space with the amount of refrigerant (contained in pipework, fittings and components) allowed within that space, and also sets requirements for any leak detection devices.

- All cooling systems and AC systems must have an EER and COP of at least 3.9 and preferably > 4.0.

- Many HCFC based refrigerant's are now restricted or banned outright , ie R22, R-123, R-401A, R-401B, R-402A, R-402B, R407A, R407C, R-409A and R-416AR12, R22, R134.

- Refurbishment's of buildings must include for the legally required legitimate costs of collecting, removing, and legal disposal of these gases and installation of new refrigerants with lower global warming potential (GWP)

- Acceptable new refrigerant mixes are included in the table below:

Type	Refrigerant	GWP	Toxicity and flammability classification
HFO	R1234yf	<1	A2L
HFO	R1234ze	1	A2L
HC (natural)	R290 (propane)	3	A3
HFC	R32	675	A2L
HFC	R410A	2,088	A1
HFC	R454A	238	A2L
HFC	R454B	466	A2L
HFC	R454C	148	A2L
HFC	R513A	631	A1
(natural)	R717 (ammonia)	0	B2L
(natural)	R718 (water)	0	A1
(natural)	R744 (CO_2)	1	A1

Toxicity and flammability classification: A= lower toxicity, B= higher toxicity; 1 = no flame propagation; 2L = lower flammability; 3 = higher flammability (See BS ISO 817[7] for full definitions). Grey shading indicates those refrigerants with GWP<150
Table 2: Refrigerants commonly employed in building services systems

3.11 Building Management Software (BMS)systems.

The University of Galway have a very sophisticated BMS system which serves the main campus and some of the remote system. The current BMS system is Cylon system and NIAGRA digital platform of monitoring and recording, which can be accessed from fixed and mobile platforms via campus LAN and fibre optic networks. Install screens to visualise energy use to users, encouraging behaviour change.

The BMS server and hardware HUBS are located in BSE Supervisors office and in Aras Moyola currently, a project is currently underway and will be completed by the end of 2024 to move to the cloud based system.

All temp, humidity, pressure sensors shall be compatible with the Cylon system (ie UC32.net and UCC4.net application compatible).

All building utility meters and heat meters shall be picked up on the BMS system and shall record daily, weekly and monthly consumption in easily accessed graphics files, refer to the controls specialist during tender design.

BMS system shall be configured to severe weather/frost protection as follows;

- When external temperature falls to 2.5^{o}C, all external LPHW pumps, and AHU/FCU coil supply pumps will be automatically started to circulate water. At this time all AHU supply and return fans will be automatically interlocked off.

- When external temperature falls to 1^{o}C, all internal LPHW pumps, and AHU/FCU coil supply pumps will be automatically started to circulate water through coils etc.

- If internal plant room space temperature falls to -1^{o}C, all heating plant (boilers) will be energised and automatically started and will run until citrcuit temperatures reach their programmed set point s (eg 80^{o}C on main gas boiler flow temps).

All water Booster sets, Fill sets, and pressure sets will have an automatic cut off switch in the event that water pressure suddenly drops by 0.8Bar. A low pressure alarm shall light on the BMS and an audible alarm (90dB) will be activated. Manual intervention shall be required to reset system.

BMS Technical

When integrating or backing up sites onto the campus BMS network the following should be noted;

-The WN3000.ini file must NOT be altered or overwritten in any way under any circumstances. At present, such changes will affect approx 50% of the entire campus BMS network.

The site numbers in the cylon controllers being added to the system must match the site number as per the campus configuration file.

- Existing site numbers in the campus configuration file must NOT be altered or duplicated.

- The graphics resolution and layout must not be altered on the front end PC's.

All changes to layouts must be approved by Services Engineer, University of Galway.

New buildings shall be added to the overall BMS, eg not as a separate satellite BMS site.

3.12 LPHW/HPHW

Heating system flues shall not be carried though the building internally but should exit the building envelope at 1.5meters above ridgeline as soon as practicable.

Foul, surface water and rainwater drainage pipes shall not be carried through a plant room where possible, and certainly not through or near electrical panels, substations, transformers, switches etc..

The requirement for DHWS in buildings during Summer, must not require the LPHW systems to operate during summer season – during summer Solar thermal or timed electric immersions shall be used to heat the small volumes of water required in most buildings.

Flue dilution fans, where required, shall not be wired so as to act as master to burners, eg the flue dilution fan should be wired to activate when the burner activates (on receipt of a low voltage signal from BeMS) and they must cease to operate within 5 mins of the burner shutting off.

Cooling via AHU shall be provided where necessary via free ambient air cooling, DX air cooled refridgeration or by air cooled compressor driven chillers producing chilled water in the larger installations.

4.0 BUILDING ELEMENTS

4.1 Windows

Windows hall be double or triple glazing low energy glass, and in areas of large solar gain, suncool or other glass shall be used to minimise solar gains .

An element of solar shading/brise soleil can also be incorporated into new glazing systems in areas susceptible to large solar gains (eg south facing elevations with >30% glazing in wall area.

4.2 Walls,

Walls shall have u-values of at least 25% better than current standards specification/planning regulations demand (Part M), so as to minimise heat loss through the fabric elements.

4.3 Roofs

Roofs shall have u-values of at least 25% better than current standards specification/planning regulations demand (Part M), so as to minimise heat loss through the fabric elements.

4.4 Floors

Floors shall have u-values of at least 25% better than current standards specification/planning regulations demand (Part M), so as to minimise heat loss through the fabric elements.

4.5 Thermal Insulation

Thermal insulation standards shall be as outlined in this technical guidance document, whilst ensuring that the overall Maximum Permitted Energy Performance Coefficient (MPEPC) and Maximum Permitted Carbon Performance Coefficient (MPCPC) are achieved. Insulation shall be installed so as to result in a U Value 25% greater than that demanded for insulation materials under current Building regulations.

4.6 Glazing

Glazing shall be chosen having regard to the orientation of the building – eg if solar shading is required for a space because it is predominantly south facing and open plan, then overhang, brise soleil or low energy tinted glazing with the ability to reduce the solar gain shall be investigated. However this may affect external appearance of building dramatically.

4.7 MATERIALS

Materials shall be selected and all building elements designed to ensure that the building and all components are durable and low maintenance and do not present a hazard to the health and safety of the users.

In accordance with Part D of the Building Regulations all works shall be carried out with proper materials and in a workmanlike manner. “Proper materials” means materials which are fit for the use for which they are intended and for the conditions in which they are to be used, and includes materials which:

(a) Bear a CE Marking in accordance with the provisions of the Construction Products Regulation;

(b) Comply with an appropriate harmonised standard or European Technical Assessment in accordance with the provisions of the Construction Products Regulation;

Or

(c) Comply with an appropriate Irish Standard or Irish Agrément Certificate or with an alternative national technical specification of any State which is a contracting party to the Agreement on the European Economic Area, which provides in use an equivalent level of safety and suitability.

5.0 WATER / WATER CONSERVATION

The University of Galway have set targets as part of the Climate Action Roadmap to 2030 to reduce water consumption on campus by 20%. This includes reduces plastic consumption on campus and therefore the implementation of drinking water fountains internally and externally.

Potable and Drinking water shall be separated from Fire Mains/fire fighting water to maintain clean water and drinking water to EU/WHO standards and also to preserve water volumes and pressure for both potable requirements and fire fighting requirements.

Water conservation features shall be maximised where possible including the reuse and recycling of rain water and grey water for use in flushing toilets in the building – this requires a quantity of stored water fed from coarse filtered recycled water and backed up with fresh water, for use in flushing toilets.

A decision on whether rain water harvesting or low volume appliances or both, are to be employed must be made at start of project. Where the majority of the water used in the Water closets is from recycled rainwater, it is acceptable to reduce the cost and number of low water use fittings, controls and appliances. Water closets will be fitted with option of half and full flush. Full flush will be limited to 7 litres water maximum. Water closets should be supplied from rain water tank where RWH systems are provided.

Urinals will be fitted with flushes via 2 methods:

- if rainwater harvesting is included – urinal will be flushed via infra red activation only, eg before and after use. Rinse volume shall be 0.5 -1.0 litre per rinse.

-If only potable water is being used, then a waterless urinal (using Microbiological agents) is to be used, with 4 timed flushes per 18 daytime/evening hours.

Designers shall ensure that water-saving devices in laboratories, kitchens, workshops and WC facilities across the campus e.g. low flow taps, dual flush WC's, time control on urinal flushes and showers and low flow shower heads.

Flowrates for each of the various outlets and appliances shall be as follows in litres per second:

- Drinking water outlets 0.072 l/s (fills a 300ml cup in 4 seconds)
- Staff room & catering outlets 0.1 l/s.
- Blended supply to wash hand basins 0.033 l/s (cold water supply at 0.011 and hot water supply at 0.022 l/s).

Flow rates for non-potable supply to a WC cistern shall be based on a maximum fill time of 1 minute. For a 4 litre flush this equates to a flowrate of 0.067l/s.

Wash hand basins will be activated by infra red activation only with extra long life batteries fitted to sensor tap controls.

6.0 Laboratory equipment and commissioning

The consulting engineer shall ensure that all design solutions for laboratires are designed to be energy efficient, most of the University of Galway are now members of the Green Lab verification network.

Green lab asks the users of labs to rethink the 'way things have always been done' to identify new approaches that also reduce the environmental impact of their work. This new way of thinking changes the culture in the lab from 'follow the protocol' to 'does this make sense/is there a better, more sustainable approach?' People who participate in our programs are often inspired to implement changes in their personal lives as well, thus creating a culture of sustainability in all aspects of our lives.

Therefore the designers shall ensure that the following guides are followed and consulted with the Energy Team and the relevant school of science or engineering. Where a project is a refurbishment project the users must remove all the existing equipment and have it disposed off in accordance with manufacturers guidelines.

Lab equipment shall be A rated for energy consumption and efficiency or other equivalent energy rating system.

Fume hoods should be equipped with sash controls (presence sensors) to reduce extracted air volumes to reduce loss of warm air and reduced fan energy consumption.

Laboratory waste pipes that are likely to contain strong acids, bases, oxidisers, flammables or corrosives shall be piped in Vulcathene™ or some other chemical resistant pipework which is equal and approved by University of Galway.

Chemical waste dilution traps made of chemical resistant glass and Vulcathene™ may be required in some instances where large volumes of highly corrosive materials are being disposed down the sinks.

Lighting in laboratories shall be considered in terms of switching and controls.

Cold Storage

ULT freezers expel a lot of heat and, as such, the rooms in which they are held can heat up very quickly if not well ventilated. As the room becomes hotter the strain on the ULT freezers' compressors increases, which increases energy consumption and the likelihood of failure (risking potentially irreplaceable biological samples). Currently some freezers are located in facilities which have poor natural ventilation, resulting in excessive energy requirements to maintain the appropriate room temperature with fans and air conditioning, and excessive strain and energy consumption of the ULT freezers.

The design of facilities to house scientific cold storage equipment can be a major influence on the energy consumption of that equipment and also the energy consumption of building ventilation and cooling services. A well-designed facility will provide more favourable ambient conditions and put less strain upon the components of individual ULTs, reducing risk of failure and associated risk of damage to samples and other freezer contents.

Facilities with good natural ventilation, such as the facility at the Roslin Institute, maintain lower room temperatures with very low fan and air conditioning energy consumption. This has a positive compounding effect of lower ULT freezer energy consumption and reduced strain on the compressors, reducing the risk of failure and sample losses.

The term "ULT freezer" refers to specialist laboratory Ultra Low Temperature freezers designed to operate at temperatures between -50 and -90^{o}C. Commonly ULT freezers are held at a set point temperature of -80^{o}C, leading to them also being known as "minus eighties".

Industry and the educational sector are implementing the reduction from -80^{o}C to -70^{o}C, the units are working on new procedures to reduce the temperature profiles.

7.0 ELECTRICAL works

The University of Galway has 4 distinct areas, Nuns Island, South Campus, North Campus and Dangan, in these areas we are restricted to electrical supply to the campus. The designer shall discuss with the Energy team to asses the extent of available electrical supply before the project begins as it may not be feasible.

The electrical consultants shall ensure that electrical systems are designed and installed to be flexible to allow for safe zoning and switching off. The sub boards shall be fitted with meters to monitor the consumption in each area.

Electrical supply shall conform to all National Rules for Electrical Installations I.S. 10101:2019..

Protection devices, earthing and bonding shall conform to the highest international standards at all times.

Motor power, Chiller, AC units & Fan power must be minimised by choice of highly energy efficient motors and fans.

Standard 6-8 person lifts shall be fitted 6 x10watt LEDs, backed up with 180minute battery pack. Lifts shall use low energy motors (n=93%+) with energy recovery mechanism.

8.0 Lighting Installation

Lighting internally and externally is the highest visible energy source on either a new building or an existing space to be refurbished. The University of Galway have carried out numerous energy project upgrades for replacement of fluorescent fittings to LED, we have installed over 6500 LED fittings.

Good quality lighting is lighting that allows you to see what you need to see quickly and easily and does not cause visual discomfort. It does raise the human spirit. The effect of lighting on vision is the most obvious impact of light on humans. With light we can see, without light we cannot. The visual system is an image processing system.

Lighting comes at a cost, both financial and environmental. The financial cost involves first costs, the cost of the electricity consumed and disposal costs. The environmental cost takes three forms: the consequences of generating the electricity required to power lighting, the chemical pollution upon disposal and the presence of light pollution at night. Lighting is a major user of electrical energy.

The purpose of this document is to highlight to the designers and the contractors the simplicity of lighting design for the university campus, unnecessary lighting will not be acceptable as part of the solution for the campus.

European lighting regulations. The most recent pivotal shift for the lighting industry was the EU's adoption of 12 regulations, under the RoHS Directive, to ban the sales of toxic fluorescent lamps from September 1st 2023. This is part of the EU's commitment to reduce emissions by at least 55% by 2030. This ban means that any T5/T8 bulbs that break or reach end-of-life cannot be replaced.

8.1 Verification of Refurbishment lighting project.

Users of this guide shall ensure that when refurbishing a space and lighting is to be upgraded that they link in with the electrical supervisor and carry out a pre-electrical load and after the replacement what the revised load is. Photographic evidence must be gathered, and this will then be recorded on the ISO50001:2018 dashboard as a saving.

8.2 Internal Lighting Installation

The designer shall note that all Lighting in University of Galway both internal and external must be LED Lighting, it is also a requirement that lighting be installed for function and easily accessible.

8.2.1 How much lighting do I need?

Detailed design guidance is available in the SLL Code for Lighting. Specific requirements will be based on the tasks being undertaken. Typical illuminance levels are from 100 – 1000 lux.

8.2.2 How the building itself influences lighting

Aspects of the work environment that need to be considered are:

- level of natural light;
- interior design;
- working conditions.

8.2.3 Level of natural light

Most people prefer to work in natural daylight, therefore it is important to make full use of it. Daylight by itself does not usually provide sufficient illuminance throughout the whole working area or for the entire working day; in most circumstances sufficient and suitable lighting can be provided by a combination of natural and artificial lighting. However, some workplaces have no natural light owing to architectural layout and, in these cases, suitable artificial lighting needs to be present so that work can be done safely and efficiently.

Natural light on its own, or combined with artificial lighting, can be a source of glare and/or reflections. Where it is not possible to adjust the position or location of the display screen or work station, adjusting the illuminance in the workplace may solve the problem. If not, anti-glare screens for VDUs may be used as a last resort.

8.2.4 Interior design

Constraints imposed by the layout of the workplace may result in the employer choosing a particular lighting design. For example, an open-plan office with large windows will have different lighting requirements to small individual offices with few windows.

Furniture and equipment in an open-plan office may cause excessive differences in the illuminance between areas.

Lighting design needs to allow for this, especially in areas where illuminance may be insufficient to carry out a task safely.

The choice of colour in a room is also important because dark surfaces reflect very little light. Light reflected off the walls is usually distributed more evenly than direct lighting. It can soften shadows and will tend to reduce the effects of any veiling reflections and glare.

8.2.5 Working conditions

It is important that an employer considers the working conditions in which lighting is used. Conditions which create dusty, flammable or explosive atmospheres may require a lighting design that protects against dust ingress, is robustly constructed and does not ignite. Care must also be taken to keep away any objects (for example curtains and shelves) that may be damaged by lamps that operate at high temperatures (for example tungsten halogen).

8.2.6 Daylight

Daylight is the only freely available light source and yet all too often it is overlooked; well controlled daylight can provide a space with the best possible lighting effect, superb colour rendering, great user comfort and with zero cost or CO_2 emissions.

8.3 University of Galway Lighting internal conditions

The designer must highlight were specialist decorative lighting or scene lighting is proposed, this will be considered by University of Galway. Lighting of shadow gaps, picture frame lighting will not be considered.

The LED lighting shall meet the following performance specification in accordance with CIBSE Lighting guide latest standard for new buildings and refurbished buildings.

Light fittings to be retrofitted the designer shall include embodied carbon calculations for this project.

Light Source	LED
Colour Rendering Index	>80
Colour Temperature	4000k
Minimum Luminaire Efficacy	125 lm/W
Median Useful Life (IEC 62717) Ta 25oC (50,000 hrs)	L80 B50
Minimum Driver Lifetime (Max ambient temp 35oC)	50,000hrs
MacAdam Step	3
UGR	<19

Internal natural lighting gains from sunlight will be included in lighting plan – where the external wall to internal wall exceeds 3 meters, lighting controls will be used to incorporate lux sensors to independently control the bank of lights in the 3 meter space from the external walls, particularly in foyers, reception areas, corridors, collision spaces, large offices and spaces.

These sensors must be set to achieve a light level of 450lux minimum and 600lux maximum for occupants.

8.4 LIGHTING CONTROLS

The University of Galway does not consider the use of Digital lighting control systems beneficial to the project but will consider proposal for specialist rooms ie boardrooms, lecture halls etc.

All lighting installations operating in conjunction with automatic dimming to “Off” lighting controls and absence detection must have manual “On/Off/ dimming” switching arrangements via push type retractable light switches.

Lighting control shall be by mixtures of high quality Presence PIR sensors, preferably low microwave type shall be used in large areas such as corridors, labs, post grad suites, computer labs and lecture theatres. In areas with natural light Lux/Photocell sensors shall be used.

Lighting circuits shall be wired so the PIR/photocell is the master switch calling lights on and off. In the case of PIR the sensor would switch off lights after 5 minutes of non activity/movement.

Lighting controls such as photocells will be used to switch off lighting when not required eg once natural light supplies >500 lux in classrooms the photocell should switch off its bank of lights.

In high ceiling rooms, walls and ceilings shall be painted white or off white where possible in order to maximise the reflectance of light; and lights shall be suspended with steel wires.

Low wattage (<10W) LED Task lighting shall be used in places such as libraries and labs to maximise personal comfort while minimising energy waste through inefficient lighting design and placement and light loss off walls and ceilings through reflectance.

In long corridors and foyers etc, photocells should be located at 10 meter centres in the middle of walkways with an acuity angle of detection of 60-85 degrees.

Lights must be accessible from scaffold or ladder. It is recommended that this type of lighting shall be avoided as this adds cost to maintenance and little benefit, wall uplighters should be considered.

Where fittings are mounted at heights greater than 3 meters, the fittings shall be capable of being lowered for relamping via motor or winch, or alternatively the design team must include for supply of a boom/lift/machine for accessing & maintenance and cleaning of lights.

All lighting shall be high energy efficient, this includes functional and feature lighting.

The lamps and fittings shall be recyclable under the WEEE and RoHWS waste directives.

IP65 rated fittings & diffusers where wet, moist or humid conditions pertain.

8.5 External lighting.

The electrical consultant engineer and designers shall refrain from excessive external lighting or building uplighting, external lighting shall be functional only and be restrictive to avoid nuisance to the campus neighbours.

Downlighters only to be used for street lighting and car parks – no sky lighting or light scatter allowed, especially in the SAC area in Dangan and main campus. (SAC =Special area of conservation)

First preference lights are LED lamps

Lifetime for lamps must be 30,000 hours minimum.

Uplighters are only allowed in specific instances eg to allow feature lighting on historic buildings eg Quadrangle, or recessed low wattage LED uplighters illuminating paths.

Lighting controls will be high quality photocells will be used to switch off lighting when not required and set to switch off at 25-30lux

8.6 Emergency lighting

All emergency lighting whether PIN spots, EXIT signs, external emergency bulkheads must be all LED. Batteries must be energy efficient.

8.7 Light samples.

The electrical consultant shall ensure as part of the technical specifications the electrical contractor must provide a working sample of all the light fittings for the project. The fittings must be installed in the proposed ceiling in the areas.

It is preferred that fittings are all from the same manufacturer and parts, replacements are all easily accessed by the University of Galway.

9.0 COMMISSIONING

All M& E items must be balanced, commissioned and signed off by qualified personnel.

All commissioning and balancing record sheets shall be furnished to Service Engineer with all other Safety file documentation incl drawings and plant schedules, plant OEM maintenance routines etc.

At the 6 + 12 month point after handover/occupation and before end of defects liability period, the measured energy profiles for the building shall be analysed to determine if the building performs to its intended brief.

10.0 TRIPLE E REGISTER

The Triple E Products Register is a benchmark register of best in class energy efficient products. The European Union (Energy Efficient Public Procurement) Regulations 2011, SI 151 of 2011, state “a public body shall only procure equipment or vehicles which are (a) listed on the Register or (b) satisfy the published SEAI energy efficiency criteria for the equipment or vehicle concerned, and the public body shall specify this requirement in any documentation describing its procurement requirements”.

Where applicable the Building Services Consulting Engineer shall ensure that all products or equipment included in mechanical and electrical tender documentation and installed in schools are listed on the Sustainable Energy Authority Ireland’s (SEAI) Triple E lists of energy efficient equipment or are compatible with the criteria of the Triple E evaluation scheme.

11.0 RENEWABLES

The government Climate action plan and the University of Galway have actioned that we will install new renewable technologies to address climate change and reduce greenhouse gas emissions.

Part L of the Building Regulations 2017 requires that 20% of the energy used by a building is produced from on-site renewable energy sources. It allows this figure to be reduced to 10% where the energy performance of the building model is 10% or better than that of the reference building in Building Regulations Part L 2017.

In terms of buildings it is more cost effective to reduce the energy use to this point and provide a 10% renewable contribution rather than to provide the 20% renewable contribution. Note also requirements with regard to SBEM and calculating the renewable energy generation on site ie CHP units.

Thus where the Energy Performance Coefficient (EPC) of 0.9 and a Carbon Performance Coefficient (CPC) of 1.04 is achieved a Renewable Energy Ratio (RER) of 0.10 represents a very significant level of energy provision from renewable energy technologies.

11.1 SOLAR PHOTOVOLTAICS (PV)

The University of Galway have invested in the installation of over 750kw of Solar PV to help reduce the electricity yield from the grid. It proposes as part of the future electrification of the campus to install a 1MW Solar PV farm to the Dangan campus zone.

The design of the PV system must be considered from project inception in relation to the overall project, roof design and materials. It is important that a balance is struck between the various elements such as angle of roof, planning requirements, roof build up and costs when developing the building design and deviation from this ideal maybe required.

The designers shall consult with the Planning authority and ensure we can install the Solar PV installation.

Key components for the project include:

- Solar Panel selection
- Roof support structure and snow/wind loading
- Invertor controller
- Cabling and string sizes
- G10 location and linking with ESB
- Controls link to the University of Galway BMS network
- Ease of cleaning of the panels after completion.
- Maintenance and procedures for safety reasons.

The specialist shall issue a full designer report as part of the submission document for stage 2.

In new projects the consultants shall liaise with the structural engineers for the fixing methods.

In existing roof schemes, the consultants shall consider the roof type, fire rating and fixing details.

The technology with Solar PV technology is evolving all the time, suppliers and consultants must advise the University of Galway of the new technology whether is roof panels, vertical wall panels, mirrored panels inserted into facades.

11.2 BIOMASS HEATING.

The University of Galway have two Biomass Heating systems installed on campus, the first is a 200kw system installed feeding the Quadrangle building and the second is the 1MW system installed in Alice Perry for the future District heating scheme.

It is envisaged that no further Biomass systems will be installed on campus.

11.3 GEOTHERMAL HEATING SYSTEMS

The University of Galway have two Geothermal heating systems installed on campus:

System 1 – 4no 100m borehole closed loop connected to 30kw heat pump feeding the underfloor heating in the Alice Perry Building.

System 2 – 18no 150m boreholes closed loop connected to 2 heat pumps and 2000 litre buffer vessel. Heating is then pumped through underground pipes approximately 200m to the Kingfisher swimming pool.

The university of Galway wish to include Geothermal as option for new construction on campus, the system can be vertical borehole or horizontal collectors.

Discussions between the Energy team and the consultants will ascertain the suitability for the specific project.

11.4 COMBINED HEAT AND POWER UNITS.

The University of Galway will cease to use Combined Heat and Power units as they are deemed expensive to run and have high maintenance costs.

11.5 AIR TO WATER HEAT PUMP UNITS.

The University of Galway have actioned to remove all fossil fuel from the campus and therefore have proposed to carry out the replacement of existing heating systems with new Air to Water heat pump packaged systems.

Systems will vary as follows:

- Low Temperature heat pumps for LTHW heating systems which excluded hot water.
- Medium temperature heat pump systems with some hot water
- High temperature heat pump systems for systems serving over 70 degrees water for LTHW/HTHW
- Heat pumps for water heating only.

The design engineers shall propose systems to the Energy team for consideration and a review will take place of sample type units and suitability for the project.

Design of new heating systems – the consultant shall ensure project boundaries around the heating system, buffer vessel and heating source.

Consideration for electrical load and controls must be considered at early design stage.

11.6 DISTRICT HEATING SYSTEMS

The government climate action roadmap considers district heating systems as a future technology for public sector bodies. The University of Galway have proposed a new district heating system for the North campus and it is proposed to have the project completed by 2028.

The university Energy team will review future possibilities.

11.7 FUTURE TECHNOLOGIES

Renewable technologies are developing at pace, offshore wind, tidal, wind turbine. The university is land locked for some of these technologies on our Galway campus but possible sites remote may consider these technologies.

New developments in Hydrogen and batteries may be considered for project on campus and may feature in future drafts of this document.

11.8 EV PARKING

The University of Galway has invested in the installation of a new EV network, in compliance with the government guidance new buildings must include for EV parking locations.

It is proposed to install future high speed charging stations for the public.

All vehicles used by the University of Galway will be electric due to the phasing out of fossil fuels.

11.9 THERMAL SURVEY

A thermal building survey is a non-invasive way, under the right conditions, and using thermal imaging cameras, to identify thermal anomalies in the structure of a building. FLIR (Forward Looking InfraRed) cameras convert infrared radiation into imagery that shows the distribution of temperatures across the image. All bodies with a temperature above Absolute Zero (-273°C) emit electromagnetic radiation, a thermographic survey carried out using a thermal imaging camera can detect infrared radiation invisible to the human eye.

The Building Services Engineer shall include for a carrying out a Thermal imaging survey of the building before and after if existing and after if a new building.

Once the surveyor is appointed the Energy team and engineer shall agree on the type of thermal building survey, then you have to agree on a date. In Galway this can be a difficult task with the unpredictable weather that we have. You will have been informed of the conditions required for your inspection, and then we have to see the external conditions align to make the survey happen.

As an example for a standard internal/external domestic property survey, we would require

- 10° minimum temperature difference from inside to out
- Large items of furniture moved away from external walls during the heating of the property
- Wind Speed at less than 5 m/s
- External Building Envelope dry (ideally no rain in the previous 24 hrs)
- Internal Ambient air temperature within 10° a minimum of 24 hours (ideally up to 72 hours)
- Open all internal doors
- Take down heavy curtains during the heating of the property
- Close all external windows and doors

Upon completion the specialist shall issue a detailed report to the project engineer and if an excessive number of defects are found then once the defects are fixed a new survey must be carried out.

11.10 AIRTIGHTNESS TEST REQUIREMENTS

Building Performance and Compliance Testing

The Airtightness specification for all new buildings and refurbishments is to be less than 3.0 m3/h/m2 of measured envelope area at a test pressure of 50Pa.

The required level of air permeability for the whole building must be clearly detailed within the specification, in units of m3/hr.m2 @ 50 Pa. The main contractor's responsibility for achieving the required level of specification should be clearly stated.

The requirement to test the building at a suitable point in the programme by a competent specialist should be the responsibility of the contractor and included within the works requirements.

An example of competence would be a contractor fully accredited by INAB (Irish National Accreditation Board) or UKAS (United Kingdom Accreditation Service) Accredited calibration laboratory to ISO 17025 for airtightness testing of commercial buildings in accordance with

- CIBSE TM23: 2000 'Testing buildings for air leakage',
- IS EN ISO 9972 2017 'Determination of air permeability of buildings, fan pressurisation method' ATTMA TS1 'Measuring air permeability of building envelopes'
- DoES Building preparation as detailed below.
- Non Accredited test Certificates will not be accepted by the DoES.
- Measured envelope area shall be taken as the area of surfaces that make up the air seal boundary of the building.
- External envelope area = Detailed envelope area calculation as per
- ATTMA TS1.
- Contractor to provide Detailed envelope area and red-line drawings of measured area for agreement no less than three weeks before the date of air testing.

The test must be programmed for a weekday and should be carried out at least three weeks prior to the planned completion date to allow remedial works and re-testing to be completed before handover if necessary. Sufficient notice must be provided to allow witnessing of the test by the Design Team and Employer's Representative.

- The airtightness testing specialist must not have any involvement with the supply and/or installation of any specialist products or involved commercially or financially with any of the specialist products installed on any buildings. If the airtightness specialist is involved with any contract works within the building this is a conflict of interest and the test certificate will be deemed invalid.
- The project manager on the main contract team is to ensure a copy of the "airtightness compliance is issued as part of the handover documentation.

- The test and recording equipment including the fan test rig and manometers must have a valid calibration certificate that is less than 12 months old on date of test.
- The contractor shall liaise with the local fire brigade to ensure that they are aware of the smoke tests and to avoid unnecessary call outs. Call out costs shall be the responsibility of the contractor if incurred and this shall be stated in the works requirements.
- The testing contractor shall designate a single person to supervise all aspects of measurements with regard to air tightness at a particular building. The designated person shall liaise with Employer's Representative and the Buildings and Estates team until the results are provided to the Employer's Representative. The supervisor shall inspect the building and ensure that all necessary provisions are made for temporary sealing up of openings where permitted by the standard.

Building Airtightness Testing Specialist

- The airtightness works will be carried out by a recognised building airtightness specialist accredited by INAB (Irish National Accreditation Board) or UKAS (United Kingdom Accreditation Service) accredited calibration laboratory to ISO 17025 as a testing laboratory for large commercial buildings. Their appointment will be approved by the Architect/Design Team.
- The specialist company must demonstrate prior experience of works on projects of similar size and complexity. The Design Team and Contractor are to ensure that a copy of the specialists INAB/ UKAS accreditation certificate is submitted to the Employer's Representative for approval before the airtightness specialist is appointed.

For suitable specialists refer to: www.inab.ie; and www.ukas.com.

Compliance Testing

SAMPLE ROOM TEST DURING CONSTRUCTION

While this test is good practice, it is at the discretion of the Contractor and should comprise one pressure test followed by a smoke test on the external envelope during construction. It is not possible to run a complete airtightness test on a single room as there will be no air seal boundary between the room and adjacent internal spaces, however the sample room test will give an early indication of weaknesses that may be replicated throughout the building.

This pressure test should be a positive test, pressurising the room from one door opening. Air intake/leaks along the external wall, floor and service points can be established thereby facilitating improved sealing techniques as the project is progressing. This test should be considered at a very early stage in the project and preferably witnessed by the Employer's Representative.

WHOLE BUILDING ACCREDITED AIRTIGHTNESS TEST

A preliminary site meeting must be held with the approved accredited specialist at the start of the project to discuss airtightness detailing, approach, programme and testing schedule.

Following this a detailed envelope area calculation shall be undertaken and issued to the Design Team before test date.

To ensure the building is properly prepared for the test, a pre-test site inspection by the Accredited Airtightness testing company must be undertaken 2-3 weeks prior to the final test date.

This final test will comprise an accredited airtightness test as detailed above with subsequent smoke tests should the specification requirements not be reached.

All further airtightness tests and smoke tests required to bring the building up to the required airtightness to be at the contractor's expense.

Building Preparation for Test

The building preparation works are not to be carried out by the airtightness testing specialist as it is deemed a conflict of interest. Preparation work is the full responsibility of the contractor.

Before the final testing the contractor should ensure the following attendances and preparations are complete.

Contractor to provide an estimate of measured area and the capacity of the proposed test rig for review by Employer's Representative no less than one week before the date of air testing.

- All external windows, trickle vents, smoke vents and doors must be closed and not artificially sealed with tape.
- If there are hit and miss vents for ventilation purposes, they have to be installed for the test and closed, they should not be artificially sealed with tape.
- All internal doors must be wedged open.
- All drainage traps must be filled with water. If traps have not been fitted then drainage pipes must be sealed with tape.
- All heating and mechanical ventilation systems must be turned off and intake/exhaust louvers closed up with plywood/ MDF board and sealed with tape/polythene or similar. This is most effectively achieved by sealing the intake and exhaust louvers for each system.
- Any combustion appliances within the airtight building envelope should be turned off and their flues sealed including fume cupboards.
- The ground floor internal and external area within 5 metres of the fan equipment/doorway must be level, clean and clear of all loose material with vehicular access to entrance doorway area.
- The vent at the top of the lift shaft where applicable must be closed but not artificially sealed with tape.
- The contractor must ensure that no external doors/windows/trickle vents are opened for the duration of the test.
- Some temporary minor carpentry works may be required to the doorway in which the fan equipment is mounted to accommodate the fan equipment.
- Notices must be posted at all entry and exit points to the building; ''AIRTIGHTNESS TEST IN PROGRESS DO NOT OPEN''.
- Suspended floor tiles and ceiling tiles (where applicable) around the perimeter of the building are to be removed for the test
- The contractor shall advise the Design Team of the proposed test date one month prior to the test date; weekend days may not be acceptable. An agreed date should be sought to enable the Employer's Representative to be present during the test, and to inspect any defects.
- Note that the air test can only be carried out during appropriate weather conditions (particularly wind speeds that must be less than 5 metres/second during the test), contractor to check weather forecast on the day before the test is due and confirm that local forecasted conditions are appropriate.

12.0 Seasonal commissioning philosophy

M&E services and BEMS on all new or refurbished buildings should be seasonally commissioned on a quarterly basis following handover. The rationale behind the University's approach to seasonal commissioning is set out in the CIBSE Guide for Commissioning of Systems.

It is essential that accurate and comprehensive metering and sub-metering data is available through the PME metering system.

The BEMS should be fully functional with all necessary sensors, drivers and other devices logged at appropriate intervals with plots available.

Seasonal commissioning should start no earlier than six months after practical completion to ensure that all the main snag items are cleared, that all meters are connected and reading correctly, and that the building has had a chance to settle in.

After this there should be four quarterly visits over the next 12 months, covering a period of no less than 18 months following practical completion.

Seasonal commissioning should generally follow the requirements of the BSRIA BG 44 guide.

The building's in-use energy should also be collected from the metering system and compared against the design model.

The seasonal commissioning should be led and chaired by the Project Manager and include the appropriate team members. As a minimum this should be the MEP contractor, BEMS contractor, Estates M&E Engineers and the Building Manager.

Following each visit a full and detailed report of the commissioning activities undertaken and the analysis of the energy usage of the building should be presented to the Estates Team and Building Users along with recommendations for adjustments to make the systems more energy efficient.

13.0 HANDOVER

All new builds/refurbishments will not be deemed complete until all as built P&IDs, O&M manuals and associated documentation are handed over to the Buildings and Estates office, even if Practical Completion stage (PC) has been reached.

In addition, M&E systems must be walked down and snagged by the Contractor and Design team. Any changes, discrepancies must be noted and redlined on the as built drawings and added to main snagging list. Through document control, a new set of as built drawings shall be promptly issued with corrections.

It is essential that the Estates Services M&E team are engaged with in good time to ensure a smooth handover of the project.

Asset data should be provided to the M&E team so that it can be recorded in the University's maintenance databases. Mechanical asset information should be provided by the project team in a format that enables upload onto the University's Flexs system, and electrical information to the Flex database.

Contractors should assist the Estates maintenance team in identifying and tagging all the installed assets. On refurbishment projects, they should provide a list of all assets removed along with their identification numbers.

The O&M information, drawings and all test certificates should be available at handover to ensure that Estates Services staff can commence maintenance from day one along with full training for the operation and maintenance of the installed services. The Estates M&E handover checklist should be completed before systems can be accepted for handover.

As-fitted drawings provided as part of the O&M documentation should be provided in both PDF and DWG formats.

Glossary

Abbreviation	Item
AHU	Air handling unit
BMS	Building management system
BSE	Buildings Services Engineer
CHP	Combined heat & power
CHWS	Chilled water services
CO2	Carbon dioxide
COP	Coefficient of power
DHWS	Domestic hot water services
FCU	Flow control unit
HDPE	High density polyethylene
HVAC	Heating, ventilation, air conditioning
iSBEM	Simplified building energy method
LTHW	Low temperature hot water
MCC	Motor control center
MTHW	Medium temperature hot water
WHO	Word Health Organisation
VSD	Variable speed drive