Rathdown Road
Student Accommodation

Energy Statement

18_D075 Rathdown Road Student Accommodation

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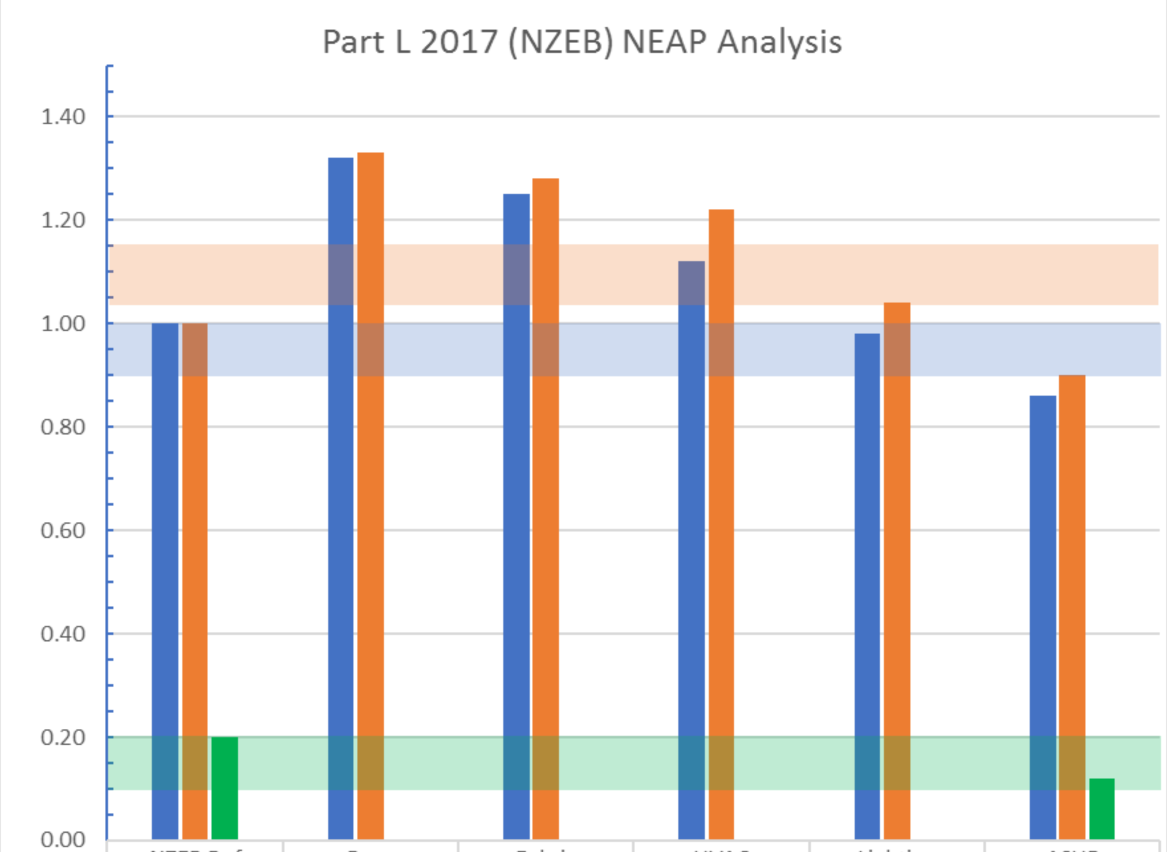
Executive Summary

This report prepared by Ethos Engineering demonstrates how the energy performance and the sustainability of construction of the proposed Rathdown Road student accommodation development meets or exceeds legislative/planning requirements.

The energy strategy has been approached in a holistic manner using the energy hierarchy "Be Lean, Be Clean, Be Green" in order to comply with Part L 2017 requirements for energy performance and greenhouse gas emissions.



	NZEB Ref	Base	Fabric	HVAC	Lighting	ASHP
EPC	1.00	1.32	1.25	1.12	0.98	0.86
CPC	1.00	1.33	1.28	1.22	1.04	0.90
RER	0.20	0.00	0.00	0.00	0.00	0.12

Figure 5: EPC, CPC and RER for proposed design measures

Sustainable design features of the Rathdown Road student accommodation include enhanced building fabric performance, high efficiency HVAC systems and high efficacy lighting with occupancy and daylight control where applicable.

The proposed energy strategy as detailed in this report will be compliant with the requirements of Part L 2017 and will achieve a BER certification of 'A3' or greater.

Table of Contents

1. Introduction

This report prepared by Ethos Engineering demonstrates how the energy performance and the sustainability of construction of the proposed Rathdown Road Student Accommodation development will meet or exceed legislative/planning requirements. This report is to form part of the planning submission documentation to the Dublin City Council (DCC).

The proposed design must comply with national building regulations for energy performance and carbon dioxide (CO_2) emissions set out in 'Technical Guidance Document Part L - Conservation of Fuel and Energy 2017 - Buildings other than Dwellings'.

Additionally, a provisional Building Energy Rating (BER) must also be produced in line with the EU Directive on Energy Performance in Buildings (EPBD). While the project is not targeting any specific BER certification, an 'A3' BER or higher is likely, due to the NZEB performance required under Part L 2017.

Located in the Phibsborough, the development is subject to the planning requirements set out in the DCC Development Plan 2016-2022.

In order to meet the legislative and planning requirements the overall energy strategy of the proposed design has been approached in a holistic manner using the adopted energy hierarchy "Be Lean, Be Clean, Be Green". Energy performance has been assessed in accordance with the Non-Domestic Energy Assessment Procedure (NEAP) methodology to demonstrate the systematic improvement in energy performance.

Assessments carried out in this report are based on latest floor plans and elevations received from the architect and all design parameter figures and assumptions stated are based on the current preliminary design received from the design team; these are subject to change during detailed design.

1.1. Site and Development Summary

The proposed site is located at Rathdown Rd, Dublin 7 opposite the Grangegorman luas stop. The proposed development consists of 261 bedrooms, with a range of 4, 6, 7 & 8 bed clusters over a site area of 4010m² and reaching up to 6 storeys in height.

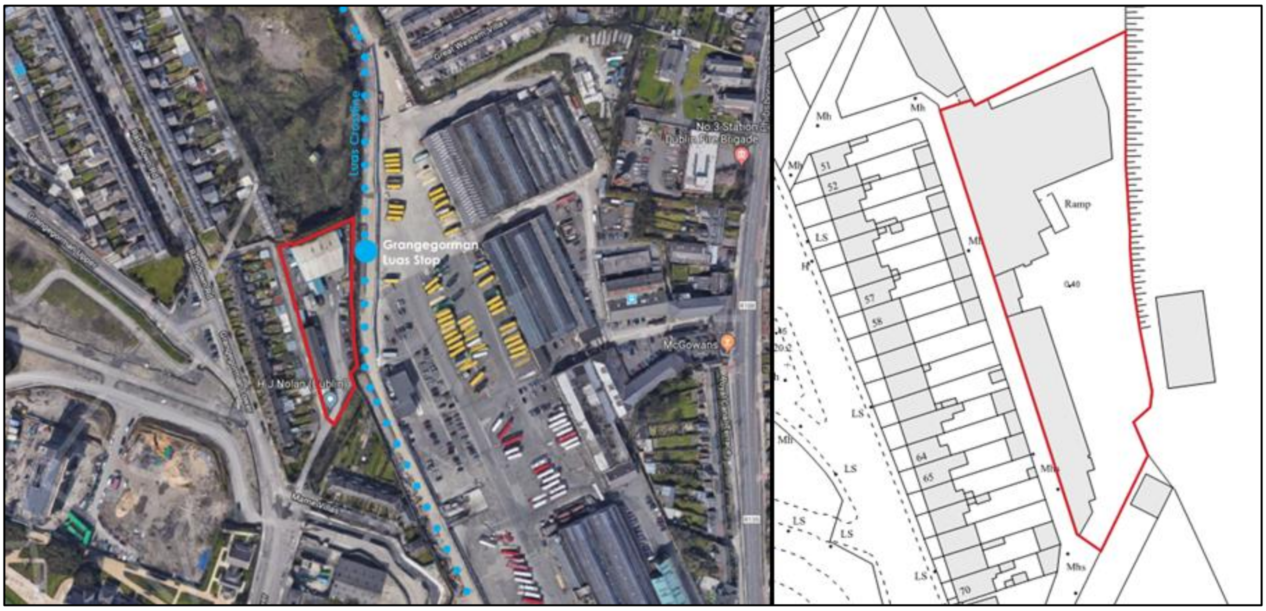


Figure 1: Aerial (left) and site plan (right) view of Rathdown Rd Student Accommodation development

2. Legislative/Planning Requirements

The proposed development is subject to compliance with;

- Nation legislation to meet the requirements of the EU Directive on Energy Performance in Buildings (EPBD) – Part L
- Local planning requirements as determined by the local authority

2.1. EU Legislative Initiatives

The Directive on Energy Performance in Buildings (EPBD), adopted in 2002, primarily affects energy use and efficiency in the building sector in the EU. Ireland transposed the EPBD through the Energy Performance of Buildings Regulations 2003 (S.I. 666 of 2006) which provided for the Building Energy Rating (BER) system to be administered and enforced by the Sustainable Energy Authority of Ireland (SEAI).

The Recast EPBD, adopted in May 2010, states that reduction of energy consumption and the use of energy from renewable sources in the buildings sector constitute important measures needed to reduce the EU's energy dependency and greenhouse-gas emissions. The directive aims to have the energy performance of buildings calculated on the basis of a cost-optimal methodology. Member states may set minimum requirements for the energy performance of buildings.

The recast EPBD requires Ireland to ensure, among other obligations, that:

- Building energy ratings are included in all advertisements for the sale or lease of buildings;
- Display Energy Certificates (DECs) are displayed in public and privately owned buildings frequently visited by the public;
- Heating and air-conditioning systems are inspected;
- Consumers are advised on the optimal use of appliances, their operation and replacement;
- Energy Performance Certificates and inspection reports are of a good quality, prepared by suitable qualified persons acting in an independent manner, and are underpinned by a robust regime of verification; and
- A national plan is developed to increase the number of low or nearly zero energy buildings (NZEB), with the public sector leading by example.

The directive was transposed by the European Union (Energy Performance of Buildings) Regulations 2012 (S.I. 243 2012).

Part 2 of the EPBD deals with Alternative Energy Systems and applies to the design of any large new building, where a planning application is made, or a planning notice is published, on or after 1st of January 2007. This calls for a report into the economic feasibility of installing alternative energy systems to be carried out during the design of the building. Systems considered as alternative energy systems are as follows:

- Decentralised energy supply systems based on energy from renewables
- Cogeneration i.e. Combined heat and power systems
- District or block heating or cooling, if available, particularly where it is based entirely or partially on energy from renewable sources
- Heat pumps

The EPBD requires all new buildings to be Nearly Zero Energy Buildings (NZEB) by 31st December 2020 and all buildings acquired by public bodies by 31st December 2018; defining NZEB as:

"A building that has a very high energy performance, as determined in accordance with Annex 1. 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,"

2.2. Part L 2017 (NZEB)

'Technical Guidance Document Part L – Conservation of Fuel and Energy 2017 - Buildings other than Dwellings' (referred to in this document as 'Part L 2017') stipulates requirements on, minimum fabric and air permeability requirements, maximum energy use and carbon dioxide (CO_2) emissions and renewable energy requirements as calculated using the NEAP (Non-Domestic Energy Assessment Procedure) methodology.

Part L 2017 defines how buildings in Ireland will meet "Nearly Zero Energy Building" (NZEB) performance as required by the Energy Performance of Buildings Directive (EPBD). NZEB is not separate to the building regulations, it is merely a term used to define the targeted performance of new building regulations; i.e. buildings compliant with the requirements of Part L 2017 will be "NZEB".

Part L 2017 is the nation legislation to meet the requirements of the EPBD and compliance is compulsory for all new buildings other than dwellings from 31st December 2020. Part L 2008 ceases to have effect from 31st December 2018. The transition period from Part L 2008 to Part L 2017 is illustrated in figure 2.

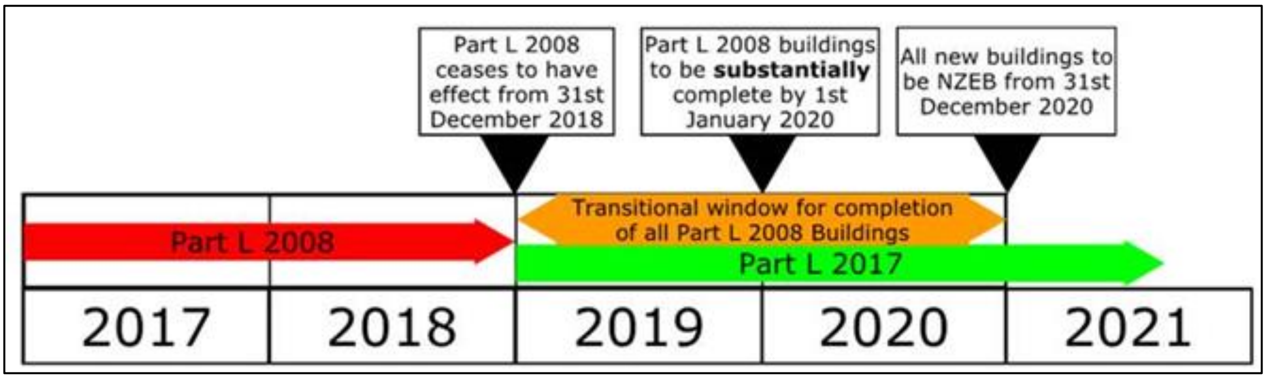


Figure 2: Part L transitional period

Under Part L 2017, an NZEB Reference building has been specified which defines the 'Maximum Permitted Energy Performance Coefficient' (MPEPC) and 'Maximum Permitted Carbon Performance Coefficient' (MPCPC).

Additionally, Part L 2017 introduces the requirement to meet a significant portion of the buildings primary energy use from renewables; the "Renewable Energy Ratio" (RER).

2.3. Dublin City Development Plan 2016-2022

The development is subject to the Dublin City Development Plan 2016-2022. The following council policies have been considered as part of the proposed Energy strategy:

Student Accommodation

It is the **policy** of Dublin City Council:

- QH31: To support the provision of high-quality, professionally managed and purpose built third-level student accommodation on campuses or in appropriate locations close to the main campus, in the inner city or adjacent to high-quality public transport corridors and cycle routes, in a manner which respects the residential amenity and character of the surrounding area, in order to support the knowledge economy. Proposals for student accommodation shall comply with the 'Guidelines for Student Accommodation' contained in the development standards.

Climate Change

It is the **policy** of Dublin City Council:

- CC1: To prioritise measures to address climate change by way of both effective mitigation and adaptation responses in accordance with available guidance and best practice.
- CC2: To mitigate the impacts of climate change through the implementation of policies that reduce energy consumption, reduce energy loss/wastage, and support the supply of energy from renewable sources.

It is an **objective** of Dublin City Council:

- CCO1: To implement the 'National Climate Change Adaptation Framework' (2012) by adopting a Climate Change Action Plan for Dublin City which will assist towards meeting National and EU targets. This will be adopted by end of 2018.
- CCO2: To support the implementation of the forthcoming 'Climate Change Strategy for Dublin and Climate Change Action Plan for Dublin City.
- CCO3: To support the implementation of the national level 'Strategy for Renewable Energy 2012-2020' and the related National Renewable Energy Action Plan (NREAP) and National Energy Efficiency Action Plan (NEEAP)
- CCO4: To support the implementation of the 'Dublin City Sustainable Energy Action Plan 2010-2020' and any replacement plan made during the term of this Development Plan.

Sustainable Energy / Renewable Energy

It is the **policy** of Dublin City Council:

- CCO5: To support and collaborate on initiatives aimed at achieving more sustainable energy use, particularly in relation to the residential, commercial and transport sectors.
- CCO6: To promote the concept of carbon-neutral sustainable communities throughout the city and to seek to initiate and support carbon neutral demonstration projects in conjunction with local communities.
- CCO7: To actively promote and facilitate the growth of the new emerging green industries to contribute both to the reduction of the city's energy consumption levels and to the role of the city as a leader in environmental sustainability.
- CCO8: In conjunction with Codema, to complete a comprehensive spatial energy demand analysis to help align the future energy demands of the city with sustainable energy solutions
- CCO9: To encourage the production of energy from renewable sources, such as from BioEnergy, Solar Energy, Hydro Energy, Wave/Tidal Energy, Geothermal, Wind Energy, Combined Heat and Power (CHP), Heat Energy Distribution such as District Heating/Cooling Systems, and any other renewable energy sources, subject to normal planning considerations, including in particular, the potential impact on areas of environmental sensitivity including Natura 2000 sites
- CCO10: To support renewable energy pilot projects which aim to incorporate renewable energy into schemes where feasible
- CCO11: To support and seek that the review of the National Building Regulations be expedited with a view to ensuring that they meet or exceed the passive house standard or equivalent, with

particular regard to energy performance and other sustainability considerations, to alleviate poverty and reduce carbon reduction targets

Sustainable Building Design/Quality

It is the **policy** of Dublin City Council:

- QH12: To promote more sustainable development through energy end-use efficiency, increasing the use of renewable energy, and improved energy performance of all new development throughout the city by requiring planning applications to be supported by information indicating how the proposal has been designed in accordance with the development standards set out in the development plan.

Energy Efficiency and the Built Environment

It is the **policy** of Dublin City Council:

- CC3: To promote energy efficiency, energy conservation, and the increased use of renewable energy in existing and new developments.
- CC4: To encourage building layout and design which maximises daylight, natural ventilation, active transport and public transport use.

It is an **objective** of Dublin City Council:

- CCO12: To ensure high standards of energy efficiency in existing and new developments in line with good architectural conservation practice and to promote energy efficiency and conservation in the design and development of all new buildings in the city, encouraging improved environmental performance of building stock.
- CCO13: To support and encourage pilot schemes which promote innovative ways to incorporate energy efficiency into new developments.

3. Energy Strategy Methodology

The aspirations of the developer can be summed up as follows:

- Achieve (as a minimum) Building Regulations (Part L 2017) compliance
- Achieve a BER of A3 or better
- Consider the potential to make use of decentralised and/or renewable energy resources

3.1. Energy Hierarchy

In order to achieve these objectives, the following energy hierarchy (referred to as "Be Lean, Be Clean & Be Green") was used to identify and prioritise effective means of reducing carbon emissions:

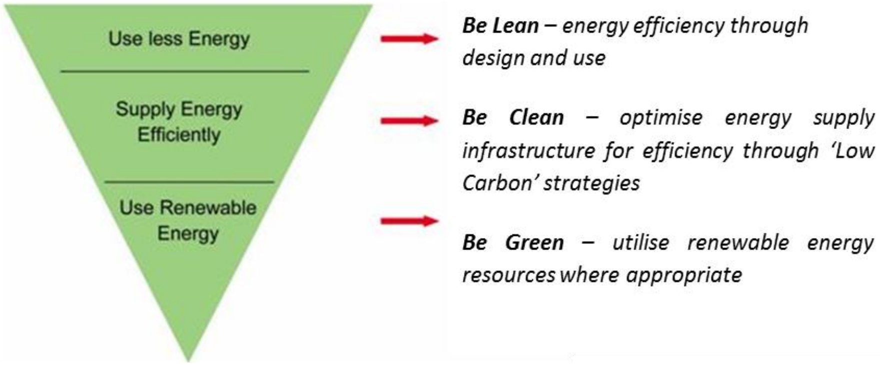


Figure 3: Energy Hierarchy

Ethos Engineering considers this hierarchy - a hierarchy proposed and/or endorsed internationally by many local authorities - to be well considered and an appropriate set of principles to adhere to in tackling climate change. In adopting the hierarchy, the primary energy use and CO_2 emissions reduction at each stage are maximised before strategies at the next stage are considered.

3.2. NEAP

The primary energy consumption and carbon dioxide (CO_2) emissions of the proposed development, including the services design, will be calculated using the NEAP (Non Domestic Energy Assessment Procedure) methodology. The NEAP methodology sets out the procedures to reflect specialist processes when calculating the 'Energy Performance Coefficient' (EPC), 'Carbon Performance Coefficient' (CPC) and 'Renewable Energy Ratio' (RER).

Under Part L 2017, an NZEB Reference building has been specified which defines the 'Maximum Permitted Energy Performance Coefficient' (MPEPC) and 'Maximum Permitted Carbon Performance Coefficient' (MPCPC). The Reference building is a high-performance building based on the same geometry as the actual design with 20% of its primary energy use met by renewables (PV).

In order to demonstrate that an acceptable primary energy consumption rate has been achieved, the calculated EPC will be no greater than the MPEPC of 1.0. Similarly, to demonstrate that an acceptable CO_2 emission rate has been achieved, the calculated CPC will be no greater than the MPCPC of 1.15.

The RER requires that 20% of the building primary energy use is met via renewable energy technologies. However, for higher performing buildings that achieve EPCs and CPCs $\leq$ 0.9 and 1.04 respectively, the RER is reduced to 10%.

3.3. SBEM

The Simplified Building Energy Model (SBEM) is a calculation engine designed for the purpose of indicating compliance with building regulations Part L in regards primary energy usage from buildings other than dwellings. SBEM has certain limitations and is explicitly for benchmarking purposes; not a design tool.

Integrated Environmental Solutions (IES) Virtual Environment (VE) software provides an SBEM interface. IES VE version 6.1 has been used for the Part L and BER assessments conducted in this report. Detailed 3D model was constructed based on latest floor plans and elevations received from the architect and all building fabric and M&E inputs (detailed later in this report) are based on the current preliminary design received from the design team; these are subject to change during detailed design.

The proposed development will be assessed using the SBEM interface in the IES software which demonstrates Part L compliance in accordance with NEAP.

Currently the updated SBEM software (version 5.3.ar/IE1.0.) for demonstrating compliance with Part L 2017 has not been released. Thus, the energy strategy can only be definitively determined when approved building energy modelling software is made available; which has been indicated might be the end of 2018.

The 'Interim Nearly Zero Energy Building Performance Specification' for new buildings owned and occupied by Public Authorities was launched in January 2017. It is intended that this methodology will allow designers to adapt the existing SBEM software to assess compliance with Part L 2017. This has been used to assess the current proposed design.

4. Be Lean: Demand Reduction

4.1. Passive Solar Design and Natural Ventilation

The building design is such that Natural Ventilation (NV) will be feasible in the majority of occupied spaces to adequately manage internal temperatures and occupant thermal comfort. Bedrooms and Kitchen/Living areas will be designed to have openable window sections and purge ventilation louvres which will allow for NV.

Passive solar design to minimise unnecessary/unwanted solar gains is one of the most effective ways to reduce/negate cooling requirements. The building will be designed in line with section 1.3.5 of Part L 2017 "Limiting the effects of solar gain in summer" which requires that;

- Buildings should be designed and constructed so that:
  - those occupied spaces that rely on natural ventilation do not risk unacceptable levels of thermal discomfort due to overheating caused by solar gain, and
  - those spaces that incorporate mechanical ventilation or cooling do not require excessive plant capacity to maintain the desired space conditions.
- For the purposes of Part L, reasonable provision for limiting solar gain through the building fabric would be demonstrated by showing that for each space in the building that is either occupied or mechanically cooled, the solar gains through the glazing aggregated over the period from **April to September** inclusive are no greater than would occur through one of the following glazing systems with a defined total solar energy transmittance (g-value) calculated according to I.S. EN 410: 2011.
  - For side lit spaces, an east-facing façade with full width glazing to a height of 1.0m. having a framing factor of 10% and a G-value of 0.68.
  - For top lit spaces, a horizontal roof of the same total area that is 10% glazed (based on internal roof area) with roof lights having a 25%framing factor and a G-value of 0.68.

For side lit space in Dublin this methodology corresponds to a 213.45kW of solar gain per linear length of façade; aggregated over the period from April to September. This is subject to change following the official release of SBEM version 5.3.ar/IE1.0.

Meeting the solar gain criteria in Section 1.3.5 is not an assessment of the internal comfort condition of the building as many other factors have a bearing on comfort e.g. internal heat gains, occupancy level, thermal capacity and ventilation. For this reason, Section 1.3.6 of Part L 2017 "Limiting Overheating" recommends that the design should comply with the thermal comfort criteria set out in CIBSE TM52 to ensure overheating is avoided for normally occupied NV spaces. A thermal comfort analysis for the proposed NV design has been carried out to demonstrate compliance with CIBSE TM52 and is detail in a separate report.

To achieve the criteria set out in sections 1.3.5 and 1.3.6 of Part L 2017 it is recommended that a glazing G-value of 40% is specified while glazing VLT (Visible Light Transmittance) should be kept above 60%. This is to ensure that the reduction in solar heat gain has a minimal impact on daylight entering occupied spaces; as the design intent is to achieve adequate daylighting in perimeter zones. Thus, electric lighting will be a supplementary lighting source, reducing both the electricity demand for lighting and the associated internal heat gain from lighting, which further reduces the risk of overheating.

Large purge ventilators have also been incorporated in the window design which allows for a large free area for rapid ventilation. These purge ventilators are located behind a louvre system and will allow the window located behind it to be opened by up to 90° without any risk to safety or security. This strategy has been proven to prevent overheating on other student accommodation schemes and offers improved performance when compared to a restricted window opening.

4.2. Building Fabric

The new development will be designed and constructed to limit heat loss and where appropriate, limit heat gains through the fabric of the building. In order to limit the heat loss through the building fabric the thermal insulation for each of the plane elements of the development will meet or exceed the minimum area weighted average elemental U-values as specified in Part L 2017. Table 1, lists the targeted U-values for the proposed design.

Table 1: Fabric U Values for the student accommodation development

Fabric Element	Proposed	Part L 2017	NZEB Ref Building
	Area Weighted Elemental U-value (W/m^2.K)		
Flat Roof	0.15	0.20	0.20
External Wall	0.20	0.21	0.21
Ground/Exposed Floor	0.20	0.21	0.21
Window	1.20	1.60	1.60
Curtain Walling	-	1.80	-
	Glazing Properties		
G-value (EN410)	0.40	0.72	0.40
Light Transmittance (VLT)	71%	76%	71%

4.2.1. Building Envelope Air Permeability

In addition to fabric heat loss/gain, reasonable care will be taken during the design and construction to limit the air permeability (or Infiltration). High levels of infiltration can contribute to uncontrolled ventilation. Part L 2017 requires an air permeability level no greater than 5m^3/m^2/hr @50Pa for new buildings. The design intent will be to achieve an air permeability of 3m^3/m^2/hr @50Pa which represents a reasonable upper limit of air tightness.

4.2.2. Thermal Bridging

To avoid excessive heat losses and local condensation problems, consideration will be given to ensure continuity of insulation and to limit local thermal bridging, e.g. around windows, doors and other wall openings, at junctions between elements and other locations. Heat loss associated with thermal bridges is taken into account in calculating energy use and CO_2 emissions using the NEAP methodology.

Acceptable Construction Details will be adopted for all key junctions where appropriate (i.e. typical/standard junctions). For all bespoke key junctions certified details which have been certified by a third party certification body will be used. The default values for thermal bridging in accordance with Appendix D of TGD - Part L 2017, will be used or the certified details for any bespoke key junctions.

4.3. High Efficiency HVAC System

4.3.1. High Efficiency and Condensing Gas Boilers

Use of Condensing Boilers achieves higher efficiencies than standard boilers when condensing temperatures are achieved by utilising latent heat from the combustion gases which is normally wasted. The design will be assessing the use of condensing gas boilers for low return temperature loads, 100% resilience load and peak lopping load.

A cascade arrangement of boilers is recommended which will allow for very low modulation ranges. An example of a cascaded boiler system is the Remeha Quinta Pro Plus. This can achieve up to 48% lower carbon emissions and fuel savings than typical ‘best practice’ systems, delivering an overall system efficiency of 98.1% GCV at 50/30°C. By incorporating Passive Flue Gas Heat Recovery technology, the Quinta Eco Plus recovers normally wasted energy equivalent to around 15% of the gross input energy. The full time condensing environment is irrespective of primary circuit temperatures, making it the perfect solution for a wide range of commercial heating requirements.

4.3.2. Central Heating using water: Convectors

The heating system proposed for this building will utilise low temperature hot water (LTHW) to transfer heat energy throughout the development. LTHW will be generated centrally and distributed to each cluster using the principles of a heat network. Each cluster will have a Heat Interface Unit (HIU) which will transfer heat from the primary LTHW loop to a secondary loop to supply the cluster using a high efficiency heat exchanger. These units are the size of a typical boiler and can be located such that maintenance can be easily carried out by the engineer. Maintenance requirements will be less than with a typical boiler as the unit only contains a heat exchanger, circulating pumps and mixing valves. Another advantage of the units are that they generate Domestic Hot Water instantaneously with no storage cylinder required. This significantly reduces the risk of legionnaire's disease.

4.3.3. Specific Fan Power Reduction

All ductwork will be adequately sized and service routes optimised so as to minimise fan power requirements. All SFPs will be in compliance with Part L 2017.

4.3.4. Variable Speed Pumps and Ventilation Fans

All pumps and fans will be specified with variable speed drives and constant pressure control. This means that these items of mechanical plant will run at partial load most of the year rather than at the peak design load. This has obvious energy savings. Pumps will comply with the Energy related Products (ErP) Directive. All electric drives will be classed as IE3 'Premium efficiency' under EN60034-30:2009 which is a legal requirement since 1st January 2017.

4.3.5. Insulation of Hot Water Storage Vessels, Pipes and Ducts

All hot water storage vessels, pipes and ducts (where applicable) will be insulated to prevent heat loss. Adequate insulation of hot water storage vessels will be achieved by the use of a storage vessel with factory applied insulation tested to BS 1566, part 1:2002 Appendix B. Water pipes and storage vessels in unheated areas will be insulated for the purpose of protecting against freezing. Technical Guidance Document G and Risk report BR 262, Thermal insulation avoiding risks, published by the BRE will be followed.

4.3.6. Heating System Zone Control Strategy

The heating system will be zoned and sub circuited to allow for areas that are not in use to be turned off. The systems will be zoned to allow defined areas work outside normal hours and will have time scheduling on the intelligent control system.

4.3.7. Metering and Sub Metering

Metering is an effective way to raise awareness of energy use and to bring about behavioural change by the building owners and occupiers. Sub metering of all major HVAC energy uses will be integrated with the Building Management System (BMS). Metering will include automatic monitoring and targeting with alarms for out of range values.

4.4. High Efficiency Electrical Systems

4.4.1. Small Power Items and Site Wide Energy Efficiency Drive

All small power items will be reviewed for increased energy efficiency. Feature lighting if installed will be designed for improved energy efficiency or removed completely. Sub metering of electricity will be installed across the site and a site Energy Manager should be tasked with monitoring out-of-range values so that any increased energy consumption due to faults can be investigated and remedied.

4.4.2. Low Energy White Goods

White goods include fridge/freezers, microwave ovens, and dishwashers. These items are responsible for a significant proportion of energy use in student accommodation buildings. White goods are now provided with a certified energy label. These are rate A+, A, B and C with C being the least efficient. Data supplied by the Energy Advice Centre suggests that using A rather than C rated white goods would reduce electrical energy consumption by 800kWh/year/unit. It is the design intent that all white goods provided will be rated at the highest energy rating available.

4.4.3. Low Energy Lighting Solutions

Energy efficient lighting should maximise the use of natural daylight, avoid unnecessarily high illuminance, incorporate the most efficient luminaires, control gear and include effective lighting controls. These good practice design principles will be followed during the detailed design stage of the proposed development.

LED lighting will be considered for all building areas as the most energy efficient and practical solution, offering the lowest achievable Lighting Power Density (LPD). Table 2 indicates the LPDs that will be targeted by the design. PIR occupancy control will be used for lighting in areas that will have intermittent occupancy. Daylight sensors will be applied to perimeter zones with high lux levels and generous glazing e.g. Reception. All lighting control will target a parasitic energy demand no greater than $0.1W/m^2$.

Table 2: Lighting Power Densities and Control

Element	LPD (W/m^2 per 100lux)	Control	Parasitic Load (W/m^2)
Bedroom	2.4	Manual On / Off	0.1
Ensuite	3.2	Man On – Auto Off	
Reception	2.2	Auto On – Auto Off	
Corridors/Circulation	2.8	Auto On – Auto Off	
Kitchen/Living area	2.2	Man On – Auto Off	
Common/Study Room	2.2	Auto On – Auto Off	
Office area	2.2	Man On – Auto Off	
Laundry/Storage	2.2	Auto On – Auto Off	
Plant	2.4	Manual On / Off	

4.4.4. Power Factor Correction

Most electrical equipment creates an inductive load on the supply which requires a magnetic field to operate, and when this magnetic field is created, the electricity current will lag the electricity voltage, i.e. the current will not be in phase with the voltage. Power Factor Correction compensates for the lagging current by applying a leading current, reducing the power factor to close to unity. Power factor correction >0.95 will be installed on the incoming electricity supply.

4.5. Building User Guide

After the completion of the proposed student accommodation the end user(s) will be provided with sufficient information about the building, its installed services and their maintenance requirements so that the student accommodation can be operated in such a manner as to use no more fuel and energy than is reasonable. Facilities management evidence shows that many new buildings lose up to 30% of their energy efficiency in the first year due mainly to a lack of understanding by the users/occupants on its M&E systems and their operation.

5. Be Clean: Heating Infrastructure including CHP

There is currently no district heating and cooling network existing or proposed in the vicinity of the site which the proposed building could utilise.

Combined heat and power (CHP), also known as co-generation, is the simultaneous generation of both useable heat and electrical power from the same source. CHP systems can be used in applications where there is a significant year-round demand for heating in addition to the electricity generated. Typically, in order for CHP engines to be economic they must run for between 4,500 and 5,000 hours per annum therefore are usually sized on or below the base loads.

There are site opportunities for the implementation of CHP due in part to the large number of bedrooms which will generate a constant year-round Domestic Hot Water (DHW) demand. CIBSE guidance indicates that a student accommodation building would consume 70 litres of DHW per day per bedroom.

However, Part L 2017 (NZEB) guidance no longer deems heat from CHP to be renewable, with only electricity accounting towards the RER. Biogas would need to be used in order for both heat and power to be accounted for in the RER. Thus, the use of CHP has been discounted as part of the energy strategy.

6. Be Green: Low or Zero Carbon Technologies

Following a low or zero carbon (LZC) technologies feasibility study it has been concluded that Air Source Heat Pumps (ASHP) and solar Photovoltaic (PV) are the only renewable energy technologies applicable or suitable to the proposed development. The current energy strategy aims to meet the Part L 2017 RER through ASHP alone, with PV added if needed in order to meet the RER.

Table 4: LZC Feasibility

Technology	Feasibility			Comments
	H	M	L	
Micro Wind 			✓	Micro wind turbines can be fitted to the roof of a building but would contribute a negligible amount of energy to the development. Due to the urban nature of the site, these have been deemed unviable for this site. Vertical axis wind turbines may be more suited to this building, but there would be the obvious aesthetic and potential noise issues.
Wind Power 			✓	Mast-mounted wind turbines can be located in an open area away from obstructions such as buildings and tall trees. Due to the urban location of the site, and its location close to other tall buildings it is deemed that a large wind turbine installation is not feasible.
Solar PV - Roof mounted 		✓		Photovoltaic (PV) Cell technology involves the conversion of the sun's energy into electricity. PV panels can be discrete roof-mounted units or embedded in conventional windows, skylights, atrium glazing, façade cladding etc. The proposed green/sedum roof area (70%) and roof plant area required leaves little potential area for a feasible PV installation. Area availability and feasibility will be considered further at detailed design stage.
Solar hot water systems 		✓		Active solar hot water technology uses the sun's thermal radiation energy to heat fluid through a collector in an active process. Solar thermal could be considered feasible due to the forecast DHW demand. Solar thermal systems typically have a payback greater than 10 years and also require regular maintenance. Additionally, they would compete with the preferred ASHP solution. For these reasons, solar thermal has been discounted as an option.

Technology	Feasibility			Comments
	H	M	L	
Biomass Heating 			✓	Biomass boilers work on the principle that the combustion of wood chip or pellets can create heat for space heating and hot water loads. This technology requires space allowance in a boiler room, access for delivery trucks, a thermal accumulator tank and considerable space for fuel storage of wood chips or pellets. The system also requires regular maintenance to remove ash etc. The use of biomass calls for a continuous local supply of suitable fuel to be truly sustainable. Concerns exist over the level of NOx and particulate emissions from biomass boiler installations, particularly in urban areas. Moreover, such a system is most suitable as an alternative to oil or solid fuels where natural gas is not available. The high efficiency of the proposed condensing gas boiler system means biomass boilers are not a feasible option for the development.
Ground source heat pump (GSHP) Closed loop 			✓	GSHP technologies exploit seasonal temperature differences between ground and air temperatures to provide heating in the winter and cooling in the summer. GSHP systems are most efficient when delivering low temperature heat and high temperature cooling, suitable for underfloor heating or chilled beams. Additionally, there should be a good balance between heating and cooling loads to allow for high COPs and reasonable capital payback. Site restrictions would require the use of vertical boreholes as opposed to horizontal ground loops, increasing the capital cost of any GSHP system. GSHP technology would need further investigation during detailed design and would depend on a favourable ground Thermal Response Test. A well designed GSHP system operating under favourable conditions can achieve better efficiencies than the proposed ASHP system. However, the heating only nature of the building and the capital cost difference leads to an unacceptable payback period.

Technology	Feasibility H	Feasibility M	Feasibility L	Comments
Air source heat pump (ASHP) 	✓			ASHP technologies exploit seasonal temperature differences between external air and refrigerant temperatures to provide heating in the winter and cooling in the summer. ASHP systems use more electricity to run the heat pump when compared to GSHP, but as most of the energy is taken from the air, they produce less greenhouse gas than conventional heating systems over the heating season. Their COP can reduce to below 2.0 when outside air temperatures are ≤0°C and they can require additional energy for a defrost cycle. Additionally, they require access to outdoor air and need to be located either at ground or roof level. ASHP offer an alternative to fossil fuel gas boilers and may contribute towards reaching Part L 2017 RER. It is proposed that ASHPs be used in conjunction with the gas fired boiler LPHW heating loop.
Exhaust Air Heat Pump (EAHP) 			✓	A centralised exhaust air heat pump (EAHP) can be used on a centralised WC/ensuite extract to provide heat contribution for DHW production. EAHPs have a high COP of 3.9 due to the high extract air temperature of around 20°C which is constant all year, guaranteeing high seasonal efficiency. There are number of variants of EAHP systems from small scale domestic type units to commercial scale units. With the EAHP, the extract air temperature is reduced from 20°C to 2°C. Recovering up to 90% of thermal energy that would otherwise be wasted to produce hot water to meet DHW and/or space heating demands. Due to the modular nature of the proposed design with individual extract fans per unit, it is not viable to incorporate an EAHP system.

7. NEAP Calculation

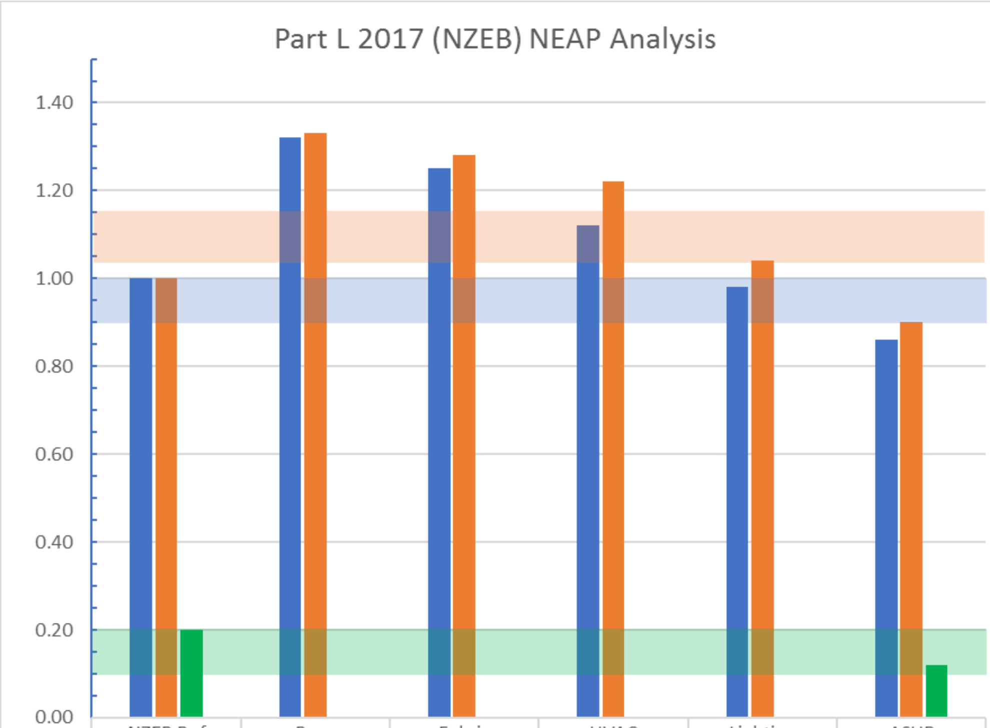
NEAP calculations will be carried out to guide the design towards achieving NZEB performance and demonstrate compliance with the requirements of Part L 2017.

As stated in section 3.3, the updated SBEM software for demonstrating compliance with Part L 2017 has currently not been released. Thus, the energy strategy can only be definitively determined when approved building energy modelling software is made available; which has been indicated might be the end of 2018.

The 'Interim Nearly Zero Energy Building Performance Specification' was launched in January 2017. It is intended that this methodology will allow designers to adapt the existing SBEM software to assess compliance with Part L 2017. This will be used to assess the current proposed design. In line with this methodology the NZEB Reference building is modelled to determine the MPEPC and MPCPC.

Additionally, in order to establish a reference point by which to measure the improvement of proposed design measures, a basecase scenario is first assessed. The basecase scenario uses the same building geometry with building fabric and M&E services meeting the allowable minimum "backstop" specifications stated by Part L 2017.

Figure 5 is representative of the performance improvements for the proposed design measures. Actual performance in accordance with Part L 2017 (NZEB) can't be confirmed until approved building energy modelling software is made available.



	NZEB Ref	Base	Fabric	HVAC	Lighting	ASHP
EPC	1.00	1.32	1.25	1.12	0.98	0.86
CPC	1.00	1.33	1.28	1.22	1.04	0.90
RER	0.20	0.00	0.00	0.00	0.00	0.12

Figure 5: EPC, CPC and RER results for proposed design measures

N.B. It should be noted that the basecase scenario exceeds the MPEPC/MPCPC and so is not Part L 2017 compliant; this highlights how the application of allowable minimum specifications is not sufficient to achieve overall compliance. These backstop values are intended to restrain the design within acceptable limits while also allowing for a degree of design flexibility.

7.1. NEAP Inputs

Below is an input summary for the NEAP calculations. These are provisional inputs and subject to change during detailed design.

- Building Fabric Performance
  - External Wall U-value = 0.18 W/m²K
  - Ground/Exposed Floor U-value = 0.15 W/m²K
  - Flat Roof U-value = 0.15 W/m²K
  - Glazing U-value = 1.4 W/m²K
  - Glazing G-value = 0.4 (40%)
- Air permeability = 3.0 m³/m²/hr at 50 Pa

- Ventilation
  - Extract rate Toilets/Changing = 6 ACH
  - Extract SFP = 0.5 W/l/s
  - Fan remote from zone = Yes

- Central heating system in building
  - Central heating using gas fired boilers and ASHPs supplying Heat Interface Units (HIUs) serving clusters of rooms
    - Boiler seasonal efficiency = 95%
    - Variable speed pumping = Yes
    - ASHP SCOP (Heating) = 4.5

- Domestic Hot Water Heating
  - Serviced via central heating system
    - Storage volume = 5,000ltr
    - Storage losses = 0.004kWh/(ltr*24hr)
    - Secondary circ. losses = 8.7W/m
    - Secondary circ. Pump Power = 0.2kW

- Lighting – See Table 2 in Section 4
- Sub metering of major M&E systems = Yes
- Lighting systems have provision for metering = No
- Lighting metering warns "out of range" values = No
- Power Factor correction = Yes (>0.95)

8. Sustainability

The proposed development will meet the highest standards of sustainable design and construction in line with all applicable regulations and planning requirements. Where feasible the development will aspire to exceed these requirements. In line with the Dublin City Development Plan 2016-2022 the following sustainability considerations will be inherently addressed during design and construction to ensure the overall development;

- Makes most efficient use of land and existing buildings
- Reduces carbon dioxide and other emissions that contribute to climate change
- Is designed for flexible use throughout its lifetime
- Minimises energy use, including by passive solar design, natural ventilation, and vegetation (green roofs etc.) on buildings
- Minimises energy use, including passive solar design and natural ventilation
- Supplies energy efficiently and incorporates decentralised energy systems such as District Heating and uses renewable energy where feasible
- Manages flood risk, including application of sustainable drainage systems (SuDS) and flood resilient design for infrastructure and property
- Reduces air and water pollution
- Is comfortable and secure for its users
- Conserves and enhances the natural environment, particularly in relation to biodiversity, and enables ready access to open spaces
- Avoids the creation of adverse local climatic conditions
- Promotes sustainable waste behaviour
- Reduces adverse noise impacts internally and externally

9. Abbreviations

- BER Building Energy Rating
- BRIRL Building Regulations Part L Ireland
- CHP Combined Heat & Power
- CPC Carbon Performance Coefficient
- DEC Display Energy Certificate
- EPBD Energy Performance in Buildings
- EPC Energy Performance Coefficient
- EU European Union
- IES Integrated Environmental Solutions
- LZC Low to Zero Carbon (technology)
- MPCPC Maximum Permitted Carbon Performance Coefficient
- MPEPC Maximum Permitted Energy Performance Coefficient
- NEAP Non-domestic Energy Assessment Procedure
- NZEB Nearly Zero Energy Building
- SBEM Simplified Building Energy Model
- SEAI Sustainable Energy Authority of Ireland
- SEER Seasonal Energy Efficiency Ratio
- SFP Specific Fan Power

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ISO 9001:2008 EQA QUALITY ASSURED COMPANY

ISO 14001:2004 EQA ENVIRONMENTAL APPROVED SYSTEM

OHSAS 18001:2007 EQA OCCUPATIONAL, HEALTH & SAFETY APPROVED SYSTEM