Castleforbes Development

Commercial Energy Statement

20_D003 Castleforbes Residential

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ethos ENGINEERING

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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 Castleforbes 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.

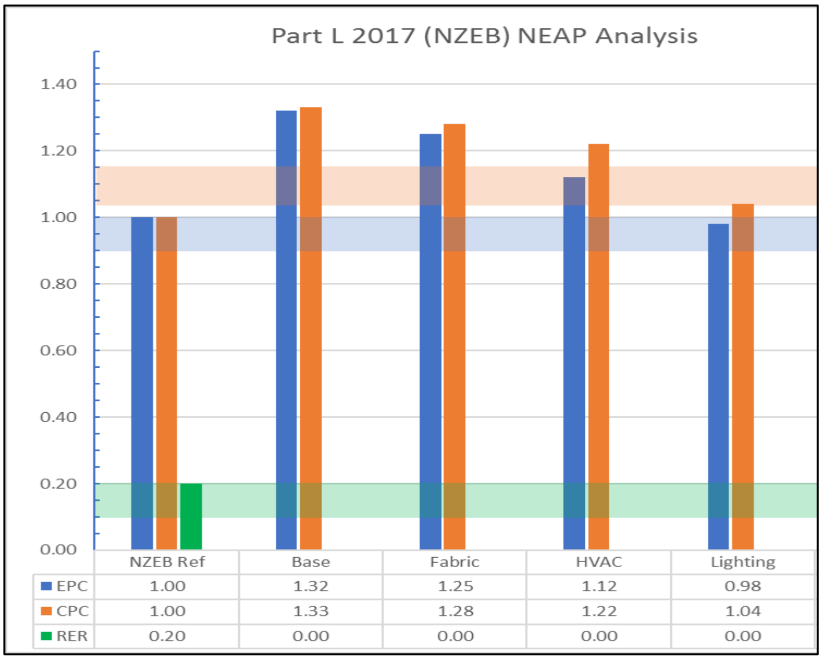

Figure 1: EPC, CPC NZEB strategy

Sustainable design features of the Castleforbes commercial areas include enhanced building fabric performance, high efficiency HVAC systems including heat pumps and high efficacy lighting with occupancy and daylight control where applicable.

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1. Introduction

This report prepared by Ethos Engineering demonstrates how the energy performance and the sustainability of construction of the proposed Castleforbes 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 scheme consists of a mix of uses comprising of Creche, Restaurant, Retail and Residential. **This report deals with commercial areas only**. Please refer to Castleforbes Residential Energy Statement for details of energy strategy for apartments.

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'.

Located at the address Castleforbes Road, East Road, East Wall, Co.Dublin, the development is subject to the planning requirements applicable to the Dublin City Council 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 development will consist of the demolition of all structures on the site and the construction of a mixed use residential development set out in 9 no. blocks, ranging in height from 1 to 18 storeys, above part basement/upper ground level, to accommodate 702 no. build to rent residential units, retail/café/restaurant units, cultural building, creche and residential tenant amenity.

The site will accommodate car parking spaces, bicycle parking, storage, services and plant areas. The residential buildings are arranged around a central open space (at ground level) and raised residential courtyards at upper ground level over part basement level. Ground floor level uses located onto Sheriff Street and into the central open space include a cultural building, retail/restaurant/cafe units, and tenant amenity space. Two vehicular access points are proposed along Sheriff Street, and the part basement car parking is split into two areas accordingly, accommodating bicycle parking spaces, car parking spaces, plant, storage areas and other associated facilities. The main pedestrian access is located centrally along Sheriff Street with additional access points from East Rd and from the eastern end of Sheriff Street. The application also includes for a pocket park on the corner of Sheriff Street Upper and East Rd to be provided as a temporary development prior to additional future development on this part of the site. A detailed development description is set out in the Statutory Notices.

Figure 2 Castleforbes Proposed Development

2. Legislative/Planning Requirements

The proposed development is subject to compliance with;

- National 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".

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).

2.2.1. Assessment of Common areas

Part L 2017 provides clarification on the treatment of communal spaces within Residential buildings.

"This TGD L for Buildings other than Dwellings should be used for guidance for those parts of the building which are not a dwelling such as common areas and in the case of mixed use developments, the commercial or retail space."

This means that any common areas need to be assessed through NEAP following the same methodology used to assess commercial areas.

Part L 2017 Section 0.1.2.4 sets out the following in relation to achieving the RER:

"In the case of the Renewable Energy Ratio (RER) the renewables provision should be calculated separately for these common areas.

Where there are both common areas and individual units in a building, reasonable provision would be to show that the average contribution of renewable technologies to all areas meets the minimum level of renewable provision to the individual units and common areas combined. In this case a proportion of renewables should be provided to each area and individual unit in the building."

The above means that an excess can be provided from the residential renewable component in the case that the RER cannot be met by the unit serving the common areas alone. This may be the case when there is little or no demand for DHW as the demand for heat is low in communal circulation spaces. This, however, should only be a consideration if it is found that the RER cannot be met directly in the first place. It is our intention for the communal areas to achieve standalone Part L compliance and this will be achieved through use of a heat pump boiler, VRF system for any amenity spaces and energy efficient lighting in all zones. A dedicated renewable technology will be provided to these spaces. Should the RER fall short of the target set out in Part L 2017, it is anticipated that this shortfall can be met with excess renewable generated for the apartments. Thus, allowing the building as a whole to achieve Part L compliance.

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:

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.

Electric Vehicles and e-bikes

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

- CCO14 To support the Government's target of having 40% of electricity consumption generated from renewable energy sources by the year 2020.
- CCO15 (as amended by Variation 7): To facilitate the provision of electricity charging infrastructure for electric vehicles in all new development and in the public realm.
- CC016 (as inserted by Variation 7): All new parking for new (or extensions to) housing, apartments and places of employment that provide car parking shall be electric charge enabled. Dublin City Council shall work closely with the ESB and other stakeholders to increase the number of EV charge points across the city. All new (or upgraded) commercially operated car parking developments shall be required to provide a minimum of 50% of spaces with EV charging facilities.

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
- Further reduce, as far as is feasible and reasonable, the primary energy consumption and CO_2 emissions of the proposed development through design measures;
- 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:

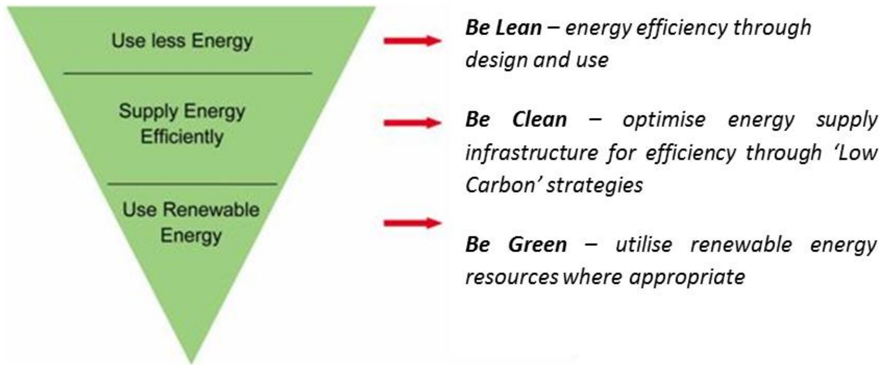


Figure 3: Energy Hierarchy

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 ≤ 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 with regard to 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 and has been used for the Part L and BER assessments conducted in this report. A 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.

3.3.1. Occupied Space

For the purpose of this specific guidance, an occupied space means a space that is intended to be occupied by the same person for a substantial part of the day. This excludes circulation spaces and other areas of transient occupancy such as toilets and spaces not intended for occupation e.g. display windows. Retail areas will include large Display windows.

3.3.2. Display windows

Display glazing is defined in Part L Section 1.3.2.6 as follows: "A display window is an area of glazing, including glazed doors, intended for the display of products or services on sale within the building, positioned at the external perimeter of the building, at an access level and immediately adjacent to a pedestrian thoroughfare. Glazing that extends to a height of more than 4m above such an access level, or incorporates a fixed or opening light of less than $2m^2$, should not be considered part of a display window except:

- where the size of individual products on display require a greater height of glazing
- where changes to the façade requiring planning (including glazing) require a greater height of glazing, e.g. to fit in with surrounding buildings or to match the character of the existing façade.

Therefore, it can be concluded that Retail areas would not generally be deemed to be occupied and display windows are exempt from the requirements of Part L section 1.3.5. Glazing with a high light transmittance will be used for ease of product viewing. However, a more detailed analysis will be conducted during detailed design when Part L 2017 Compliance software will be available. Some solar control may be required in order to achieve EPC requirements for NZEB

3.4. Shell & Core

Part L 2017 makes specific requirements in relation to Shell and Core buildings and when renewables should be installed. Ideally these should be installed with primary heating and cooling plant or with utility connections;

"For shell and core buildings the specification used for the NEAP calculation should be compatible with the intended building end use and servicing strategy. The renewables required should be installed at an early stage in the construction process that ensures that the building will meet the renewables provision for the whole building when completed and prior to occupation of any part of the building. Where practical renewable systems should be installed on the shell and core building with the utility connections or with the primary heating and cooling services for the building."

There is now a new two stage process for demonstrating compliance with Part L for Shell & Core or Grey box units. For demonstrating compliance at practical completion, a provisional BER is created for the shell & core or Grey box unit using an assumed fit-out. This BER will have a water mark across it stating 'Shell & Core'. The Fit-Out M&E consultant will then carry out the Final BER on the fully fitted out unit using the actual installed layouts and M&E services. It is anticipated that both steps will be auditable by SEAI.

"Where a shell has a fit out completed on all or part of the building through the provision or extension of any of the fixed services for heating, hot water, air-conditioning or mechanical ventilation then the Maximum Permitted Energy Performance Coefficient (MPEPC), Maximum Permitted Carbon

Performance Coefficient (MPCPC) and Renewable Energy Ratio (RER) should be based on the building shell as constructed and the fixed building services as actually installed.

3.5. Specialist Process

Part L 2017 provides clarification with regard to specialist processes and process loads and whether these loads should be included in Part L compliance calculations. Part L is only concerned with energy used for space heating, cooling, lighting and ventilation systems appropriate for human occupancy.

"Where a building has specialist processes, alternative operational procedures or ventilation requirements other than those required for human occupancy different performance specifications may be appropriate.

In the context of this section "specialist processes" can be taken to include any activity or operational profile where the resulting need for heating, hot water, ventilation or air conditioning is significantly different to that required for human occupancy.

The Renewable Energy Ratio calculation should exclude the heating, ventilation and air conditioning system demands determined by specialist process requirements, together with the plant capacity, or proportion of the plant capacity, provided to service specialist processes."

In the context of a retail environment, refrigeration plant required for chilled / cold storage of food would there be excluded from any calculations for example. Similarly, car park ventilation systems would not be included in the Renewable Energy Ratio calculation.

4. Be Lean: Demand Reduction

4.1. Passive Solar Design

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.

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 28% 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.

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 commercial 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	0.18	0.21	0.21
Ground/Exposed Floor	0.15	0.21	0.21
Window	1.2	1.60	1.60
Curtain Walling & Rooflights	1.4	1.80	-
	Glazing Properties		
G-value (EN410)	0.46	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

Full mechanical Heating, Ventilation and Air Conditioning (HVAC) systems will be utilised in these buildings due to the high occupancy level and deep floor plates which means that a natural ventilation strategy is not feasible. However, the mechanical HVAC strategy is to minimise energy associated with space conditioning through the use of high efficiency systems, heat recovery and the efficient control of both ventilation rates and of heating and / or cooling supply.

4.3.1. VRF System

Variable Refrigerant Flow (VRF) or Variable Refrigerant Volume (VRV) (depending on manufacturer) is an air source heat pump that increases operational efficiency by modulation of cooling capacity at room/zone level. The basic idea is that a large outdoor unit serves multiple indoor units connected by refrigerant pipework. Each indoor unit controls its refrigerant supply to match the demand of the space it serves. The outdoor unit also varies its output to match the communal demands of all the indoor units served by it. Thus, at any point in a system there will be a variable volume of refrigerant flowing.

The most sophisticated VRF systems can have indoor units, served by a single outdoor unit, in both heating and cooling modes simultaneously. This mixed mode operation leads to energy savings as both ends of the thermodynamic cycle are delivering useful heat exchange. It should be noted that this perfect balance of heating and cooling demand is unlikely to occur for many hours each year, but whenever mixed mode is used, energy is saved. Where deep floor plans are present, it is possible that internal units could be in cooling mode and perimeter units in heating mode which would allow for mixed mode operation and very high COPs. Units are now available to deliver heat removed from space cooling into hot water for domestic hot water.

VRF/VRV systems are deemed to a 'renewable' source of energy as they use of heat pump technology and this can be linked to other renewable sources of energy such as water based geothermal, solar thermal or solar PV. Typical VRF manufacturers state a cooling SEER of 6.0-8.0 and a heating Seasonal COP of 5.0-6.0 when installed in an office environment located in Ireland.

A Hybrid VRF (HVRF) system that combines the benefits of VRF with the flexibility and reduced refrigerant volume of a FCU system may also be considered as the HVAC design develops.

4.3.2. 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.

4.3.3. 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. IE4 'Super Premium efficiency' motors will be considered during detailed design and may be used if they are deemed to be technically, functionally and economically feasible.

4.3.4. 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.

4.3.5. 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.

4.3.6. 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. All individual units will have dedicated utility supplied electricity meters. As regards landlord areas metering should be specified on all major loads and sub-mains cabling.

4.3.7. Heat Recovery Thermal Wheels

Thermal wheel technology offers heat recovery between two air streams. A thermal wheel, also known as a 'rotary' or 'regenerative' heat exchanger, is a system of heat transfer which involves a single rotating wheel with high thermal capacity located within the supply and exhaust air streams of an Air Handling Unit (AHU). Its rotation allows the recovery of sensible and latent energy from air that would otherwise be lost to the atmosphere. This energy is used to pre-heat (or cool) the incoming fresh air.

This development will take the heat recovery thermal wheel technology a step further by gaining further heat recovery using an integrated heat pump. These AHUs combine thermal wheel technology with an air-to-air packaged heat pump. This means that levels of heat recovery within the AHU has removed any need for heating or cooling coils and reduces the capacity of the central plant by a significant margin.

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 commercial 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 relevant perimeter zones. All lighting control will target a parasitic energy demand no greater than $0.1W/m^2$.

Table 3: Lighting Power Densities and Control

Element	LPD (W/m^2 per 100lux)	Control	Parasitic Load (W/m^2)
Corridors, Stores, etc.	3.0	Auto On – Auto Off	0.1

Note: See NEAP inputs for further lighting design

4.4.4. Display Lighting

Effective display lighting ensures that merchandise, exhibits and the internal environment can be clearly seen in an aesthetically pleasing manner with the maximum visual impact. Every business or organisation has different lighting requirements. Aside from essential health and safety functions, lighting is also imperative in creating appropriate comfort conditions and ambience.

The use of lighting with good colour rendering is essential in helping to generate sales, particularly in fashion retail, where the customer must be able to see the actual colour of the goods. Good colour rendering is also critical in food retailing, where the goods must look appealing. The lighting designer should take care in selecting lamps to give the most appropriate colour rendering for the application.

Improving the efficiency of display lighting will lead to cost and energy savings. It will also reduce maintenance costs, improve lighting distribution and control, increase staff and customer satisfaction, reduce heat gain (leading to a reduction in cooling demand) and help organisations comply with legislation. Under the regulations, the definition of display lighting refers to lighting intended to highlight exhibits or merchandise and lighting used in spaces for public entertainment. The exception is special process lighting such as that used in theatre spotlights, photographic studio lighting, illuminated signs and portable lighting. Other decorative elements such as illuminated fountains, chandeliers and all forms of emergency escape lighting are also exempt.

Shop windows use a lot of display lighting and may use up to 192.72 kWh/m^2/year if the window faces a public road, and 96.8kWh/m^2/year if the window is in a shopping centre that is closed during the night.

Reasonable provision would be to demonstrate that the installed capacity of display lighting averaged over the building, has an initial (100-hour) efficacy of at least 22 lumens per circuit-watt (this figure includes power consumed by ballasts or transformers). For compliance we recommend that Display lighting is LED in most cases. Requirements such as this will be captured in a tenant lease agreement in order to ensure that the final fit-out also complies Part L 2017.

4.4.5. 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 commercial the end user(s) will be provided with sufficient information about the building, its installed services and their maintenance requirements so that the commercial 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

The site does not fall within reach of the Dublin District Heating System (DDHS).

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.

Opportunities for the implementation of CHP are limited in retail and commercial areas due to the relatively low demand for Domestic Hot Water.

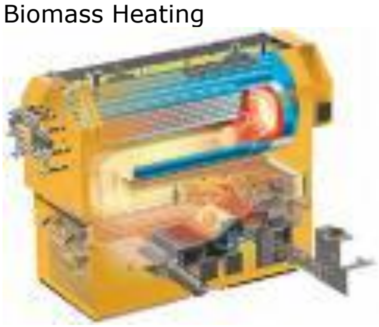
However, Part L 2017 (NZEB) guidance no longer deems heat from CHP to be renewable, with only electricity accounting towards the RER. Biogas would need to be used in order for both heat and power to be accounted for in the RER. Thus, the use of CHP has been discounted as part of the energy strategy for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

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. 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 capital cost difference leads to an unacceptable payback period.

<table>
<tr><th rowspan="2">Technology</th><th colspan="3">Feasibility</th><th rowspan="2">Comments</th></tr>
<tr><th>H</th><th>M</th><th>L</th></tr>
<tr><td>Air source heat pump (ASHP)
</td><td>✓</td><td></td><td></td><td>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.</td></tr>
<tr><td>Exhaust Air Heat Pump (EAHP)
</td><td>✓</td><td></td><td></td><td>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.

EAHP have not been considered for use in commercial areas.</td></tr>
</table>

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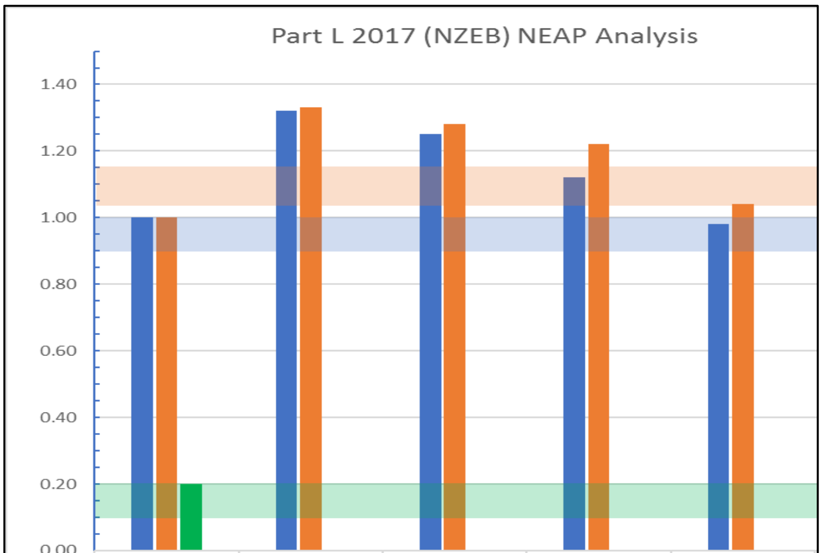
7. NEAP Calculation

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

Figure 5 is representative of the performance improvements for the proposed design measures.



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

Figure 5: EPC, CPC results for proposed design measures

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 = 1.2 W/m²K
  - Curtain Wall U-value = 1.4 W/m²K
  - Glazing G-value = 0.46 (46%)*
- Air permeability = 3.0 m³/m²/hr at 50 Pa

- Ventilation
  - Lossnay Heat Recovery Unit = 1.5 W/l/s
  - Heat Exchanger Efficiency = 80%
  - Extract rate Toilets/Changing = 10 ACH
  - Extract SFP = 0.5 W/l/s
  - Fan remote from zone = Yes

- HVAC system in Restaurant / Cultural Centre / Retail / Gym / Crèche
  - VRF from central AHU
  - VRF SEER = 9.68
  - VRF SCOP = 4.30

- **HVAC system in common corridors
  - ASHP SCOP = 4.05

- Domestic Hot Water Heating
  - ASHP SCOP = 3.975

- Lighting
  - Cultural Centre = 2.0 W/m²/100lux (500lux)
    - PIRs in all zones
    - Photoelectric dimming in all perimeter zones

  - Retail = 1.7 W/m²/100lux (500lux)
    - PIRs in all zones
    - Photoelectric dimming in all perimeter zones

  - Crèche / Gym = 2.0 W/m²/100lux (300lux)
    - PIRs in all zones
    - Photoelectric dimming in all perimeter zones
  - Restaurant = 2.0 W/m²/100lux (200lux)
    - PIRs in all zones
    - Photoelectric dimming in all perimeter zones

  - All other areas (Communal areas) = 3.0 W/m²/100lux (100lux)
    - PIRs in all applicable zones

- Display Lighting = 22 lumens per circuit watt
- Sub metering of major M&E systems = Yes
- Sub metering warn "out of range" = Yes
- Power Factor correction = Yes (>0.95)

- *****Based on the Solar Gain Assessment results. g_{tot} is the overall combined g value of both glazing and shading devices*
- ***Heat to be provided to common areas subject to part L assessment*
- ****Energy Monitoring and Targeting system (M&T)*

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

Appendix 1: BRIRL Compliance Report

BRIRL Output Document

Compliance Assessment with the Building Regulations (Ireland) TGD-Part L 2017

This report demonstrates compliance with specific aspects of Part L of the Building Regulations. Compliance with all aspects of Part L is a legal requirement. Demonstration of how compliance with every aspect is achieved may be sought from the Building Control Authority.

Communal areas

Date: Mon Sep 07 17:36:04 2020

Administrative information

Building Details

Address: Address 1, Address 2, Address 3, Address 4, Co. Carlow, Eircode

NEAP

Calculation engine: SBEMIE

Calculation engine version: v5.5.h.2

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: 7.0.12

BRIRL compliance check version: v5.5.h.2

Client Details

Name: Name

Telephone number: Phone

Address: Street Address, Co. Carlow, Eircode

Energy Assessor Details

Name: Name

Telephone number: Phone

Email: you@yourISP

Address: Street Address, Co. Carlow, Eircode

Primary Energy Consumption, CO2 Emissions, and Renewable Energy Ratio

The compliance criteria in the TGD-L have been met.

Calculated CO2 emission rate from Reference building	8.2 kgCO2/m2.annum
Calculated CO2 emission rate from Actual building	7.5 kgCO2/m2.annum
Carbon Performance Coefficient (CPC)	**0.92**
Maximum Permitted Carbon Performance Coefficient (MPCPC)	**1.15**
Calculated primary energy consumption rate from Reference building	42.9 kWh/m2.annum
Calculated primary energy consumption rate from Actual building	38.2 kWh/m2.annum
Energy Performance Coefficient (EPC)	**0.89**
Maximum Permitted Energy Performance Coefficient (MPEPC)	**1**
Renewable Energy Ratio (RER)	**0.12**
Minimum Renewable Energy Ratio	**0.1**

Heat Transmission through Building Fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Limit}$	$U_{i\text{-}Calc}$	Surface with maximum U-value*
Walls**	0.21	0.13	0.6	1.4	1L0000CE_W2_O4
Floors (ground and exposed)	0.21	0.15	0.6	0.15	1L000003_F
Pitched roofs	0.16	-	0.3	-	"No heat loss pitched roofs"
Flat roofs	0.2	0.15	0.3	0.15	1L000003_C
Windows, roof windows, and rooflights	1.6	1.33	3	1.4	1L0000CE_W2_O0
Personnel doors	1.6	-	3	-	"No ext. personnel doors"
Vehicle access & similar large doors	1.5	-	3	-	"No ext. vehicle access doors"
High usage entrance doors	3	-	3	-	"No ext. high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m2K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m2K)]
$U_{i\text{-}Limit}$ = Limiting individual element U-values [W/(m2K)]
$U_{i\text{-}Calc}$ = Calculated individual element U-values [W/(m2K)]

* There might be more than one surface with the maximum U-value. ** Automatic U-value check by the tool does not apply to curtain walls whose area-weighted average and individual limiting standards are 1.8 and 3 W/m2K, respectively.

Air Permeability	Upper Limit	This Building's Value
m3/(h.m2) at 50 Pa	5	3

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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