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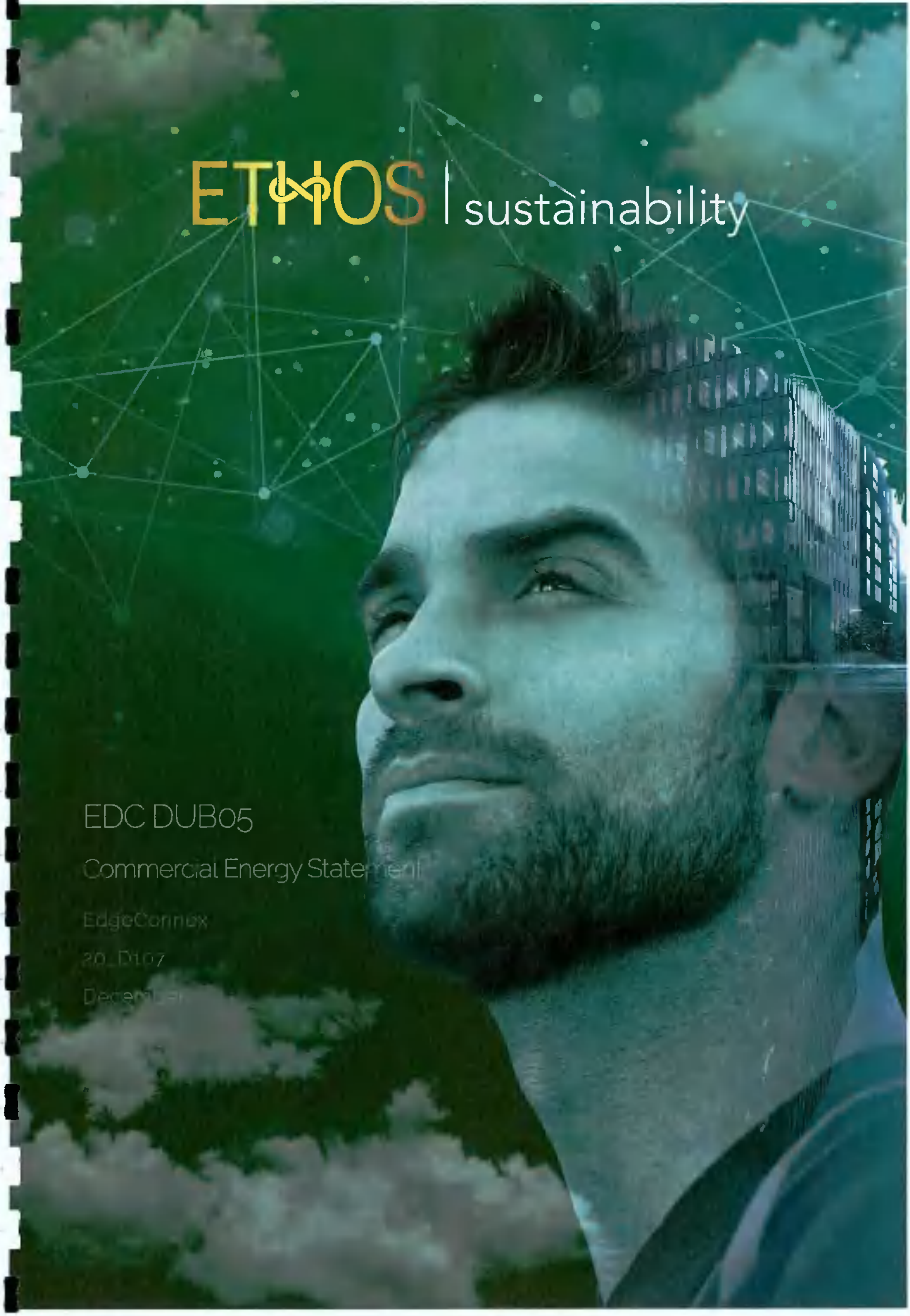

EDC DUB05

Commercial Energy Statement

EdgeConnex

20_D107

December

EDC DUB05

Commercial Energy Statement

EdgeConnex

20_D107

CURRENT ISSUE			
Issue No		Issue Date	8th December 2021
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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 Datacentre 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 NZEB, Part L 2021 requirements for energy performance and greenhouse gas emissions.

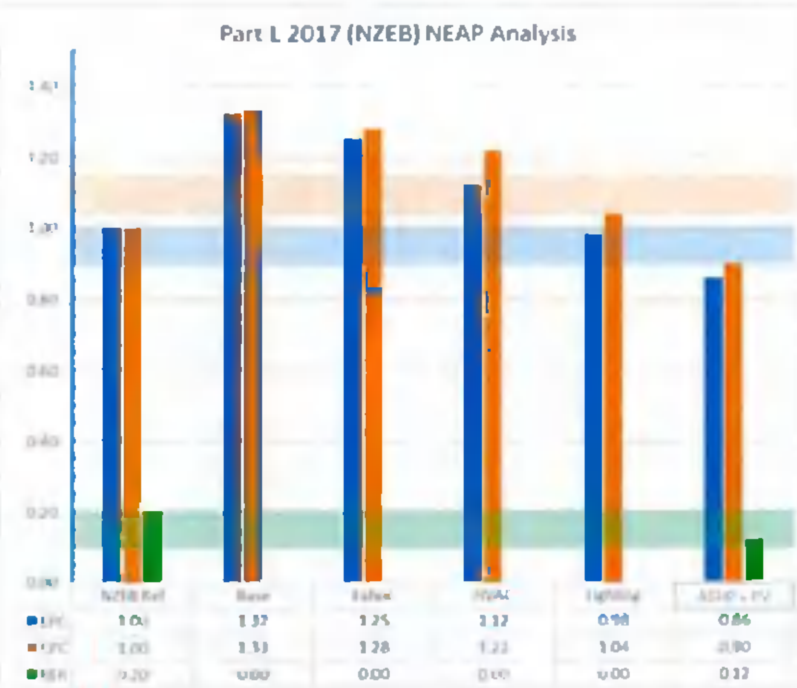

Figure 1: Indicative EPC, CPC and RER for typical design measures

Sustainable design features of these units include enhanced building fabric performance, high efficiency HVAC systems and high efficacy lighting with occupancy and daylight control where applicable. Renewable technologies including both heat pumps and photovoltaic panels are proposed. Subject to a detailed design assessment with final construction details a final BER assessment will be completed.

The proposed development target BER rating of "A3" has been assessed using the SBEM interface VE Compliance 7.0.13.0 in the IES software version 2019.3.2.0 which demonstrates Part L compliance in accordance with NEAP. (BERs could change in the future with updates to software due to improvements in methodology and revised Electricity Primary Energy Factor)

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Contents

1. Introduction

This report prepared by Ethos Engineering demonstrates how the energy performance and the sustainability of construction of the proposed datacentre of the EdgeConnex will meet or exceed legislative/planning requirements. This report is to form part of the planning submission documentation to the South Dublin City Council (SDCC).

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 2021 - Buildings other than Dwellings'.

The proposed design must comply with national building regulations for energy performance and carbon dioxide (CO2) emissions set out in 'Technical Guidance Document Part L - Conservation of Fuel and Energy 2021 - 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).

Located in Newcastle Road, Lucan, Co.Dublin, the development is subject to the planning requirements set out in the South Dublin City 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 will be 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

Construction of two single storey data centres with associated office and service areas; and three gas powered generation plant buildings with an overall gross floor area of 24,624sq.m that will comprise of the following:

Demolition of abandoned single storey dwelling, remaining agricultural shed and derelict former farm building; Construction of 2 single storey data centres (12,797sq.m), both with associated plant at roof level, with 24 standby diesel generators with associated flues (each 25m high) that will be attached to a single storey goods receiving area/store and a single storey office area (2,404sq.m) located to the west of the data centres as well as associated water tower and sprinkler tank and other services; Amendments to the internal access road and omission of access to loading bay permitted under SDCC planning Ref. SD19A/0042/ABP Ref. PL06S.305948 that include the relocation of permitted, and new, internal security gates, and new internal access roads to serve the proposed development that will provide access to 39 new car parking spaces (including 4 electric and 2 disabled spaces) and sheltered bicycle parking to serve the new data centres;

The development will also include the phased development of 3 two storey gas powered generation plants (9,286sq.m) within three individual buildings and ancillary development to provide power to facilitate the development of the overall site to be located within the south-west part of the overall site. Gas plant 1 (3,045sq.m) will contain 20 generator units (18+2) with associated flues (each 25m high) will facilitate, once operational the decommissioning of the temporary Gas Powered Generation Plant within its open compound as granted under SDCC Planning Ref. SD19A/0042/ABP Ref. PL06S.305948.

Gas plant 2 (3,045sq.m) will contain 20 generator units (18+2) with associated flues (each 25m high), and, Gas plant 3 (3,196sq.m) will contain 21 generator units (19+2) with associated flues (each 25m high).

These plants will be built to provide power to each data centre, if and, when required. The gas plants will be required as back up power generation once the permitted power connection via the permitted substation is achieved; New attenuation pond to the north of the site; Green walls are proposed on the southern elevation of each power plant, as well as to the northern elevation of the generator compound of the data centres, and enclosing the water tower/pump room compound, and a new hedgerow is proposed linking east and west of the site; Proposed above ground gas installation compound to contain single storey kiosk (93sq.m) and boiler room (44sq.m).

The development will also include ancillary site works, connections to existing infrastructural services as well as fencing and signage. The development will include minor modifications to the permitted landscaping to the west of the site as granted under SDCC planning Ref. SD19A/0042/ABP Ref. PL06S 305948. The site will remain enclosed by landscaping to all boundaries. The development will be accessed off the R120 via the permitted access granted under SDCC planning Ref. SD19A/0042/ABP Ref. PL06S.305948. An EPA-Industrial Emissions (IE) licence will be applied for to facilitate the operation of the gas powered generation plant. An Environment Impact Assessment Report (EIAR) has been submitted with this application. All on a site of 22.1hectares.

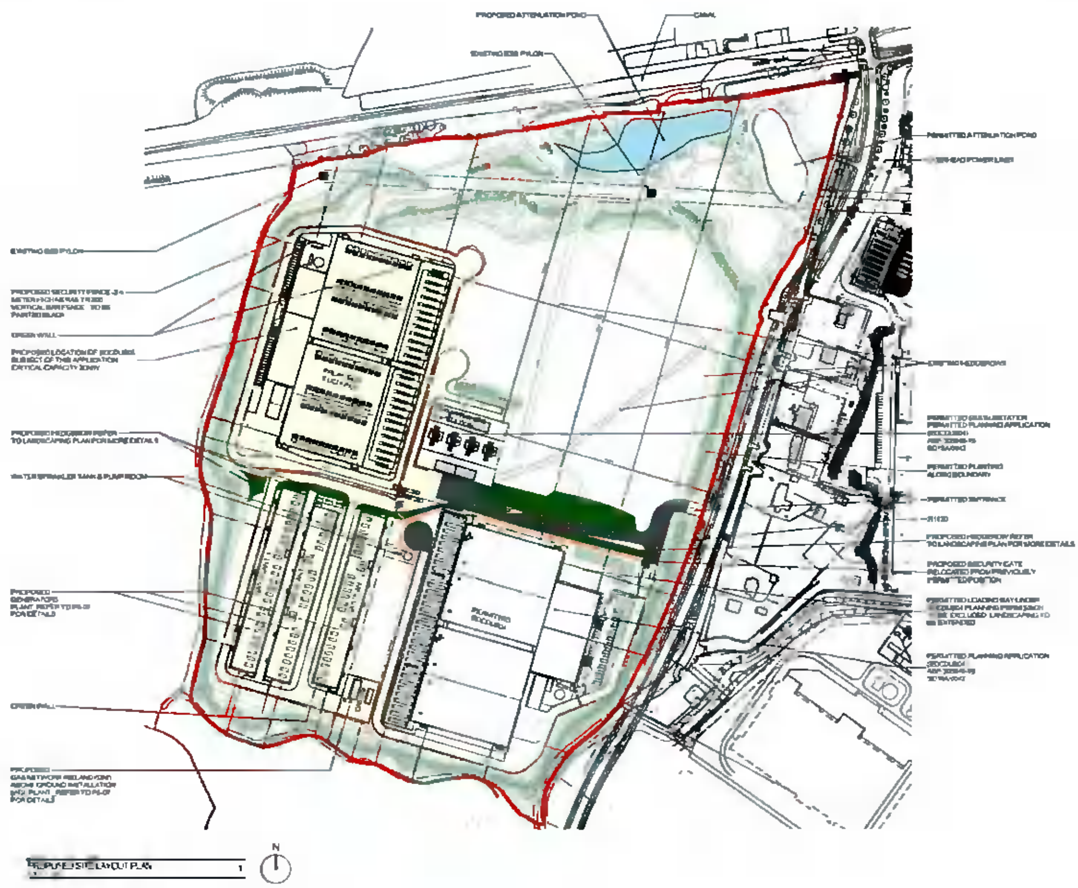


Figure 2: Proposed site layout

2. Legislative/Planning Requirements

2.1. Part L/ Nearly Zero Energy Buildings (NZEB)

The European Energy Performance of Buildings Directive Recast (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.

'Nearly Zero – Energy Buildings' means a building that has a very high energy performance, Annex 1 of the Directive and in which "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".

The European Commission issued recommendations on 29th July 2016 (EU 2016/1318) on guidelines for the promotion of nearly zero-energy buildings and best practices to ensure that, by 2020, all new buildings are nearly zero-energy buildings.

Specifically, for the Oceanic zone which applies to Ireland the guidance proposes the following recommendation.

- Offices: 40-55 kWh/(m².y) of net primary energy with, typically, 85-100 kWh/(m².y) of primary energy use covered by 45 kWh/(m².y) of on-site renewable sources.

A combination of some of the following likely needed to achieve a 60% improvement.

- Building insulation levels will be greatly improved
- Glazing ratios may need to be considered
- Insulation value of the glazing itself will be considerably improved
- Airtightness standards will be introduced including mandatory airtightness test on every building
- Enhanced calculation of linear thermal bridging probably required particularly for the 60% improvement
- The use of renewables and free cooling will be required
- The use of solar shading will need to be considered
- Renewables will need to cover a substantial part of energy use
- Much more efficient lighting and services will be needed

Article 9(1) of the EPBD requires Member States to ensure that by the relevant dates, 'all new buildings are NZEBs'. As a result, citizens buying newly constructed buildings or apartments in 2021 would expect the market to have evolved in line with these targets, and buildings to be NZEBs.

The construction sector shows that the timing of the end of construction or completion of a building might be uncertain and may suffer delays. Member States would need to factor in the period of validity of building permits, the length of construction and completion of building works and the targets in Article 9(1) of the EPBD to avoid falling short of the obligation to ensure that 'by January 2021 all new buildings are NZEBs'.

2.2. South Dublin City Development Plan 2016-2022

The energy strategy will consider the following council policies and objectives as outlined in the South Dublin County Development Plan 2016-2022.

ENERGY (E) Policy 1 - Responding to European and National Energy Policy & Legislation

It is the **policy** of South Dublin County Council:

- To respond to the European and National Energy Programme through the County Development Plan – with policies and objectives that promote energy conservation, increased efficiency and the growth of locally based renewable energy alternatives, in an environmentally acceptable and sustainable manner.

ENERGY (E) Policy 2 - South Dublin Spatial Energy Demand Analysis

It is the **policy** of South Dublin County Council:

- To implement the recommendations of the South Dublin Spatial Energy Demand Analysis (SEDA) in conjunction with all relevant stakeholders, promoting energy efficiency and renewable energy measures across the County.

E2 Objective 1:

- To develop planning policies and objectives in relation to energy planning on a spatial understanding of the existing and future energy demands of the County.

E2 Objective 2:

- To seek to reduce reliance on fossil fuels in the County by reducing the energy demand of existing buildings, in particular residential dwellings.

E2 Objective 3:

- To promote the generation and supply of low carbon and renewable energy alternatives, having regard to the opportunities offered by the settlement hierarchy of the County and the built environment.

E2 Objective 4:

- To support the recording and monitoring of renewable energy potential in the County in partnership with other stakeholders including the Sustainable Energy Authority of Ireland (SEAI) and City of Dublin Energy Management Agency (CODEMA).

E2 Objective 5:

- To ensure that the recommendations of the South Dublin Spatial Energy Demand Analysis (SEDA) are carried out in accordance with environmental safeguards and the protection of natural or built heritage features, biodiversity and views and prospects.

E2 Objective 6:

- To require, where feasibly practical and viable, the provision of PV solar panels in new public buildings (e.g. Council buildings, school buildings, hospitals, health centres, community centres, sports facilities, libraries, Garda stations etc.), for electricity generation/storage and/or water heating so as to reduce energy costs, minimise carbon emissions and reduce our dependence on imported fossil fuels.

E2 Objective 7:

- To require, where feasibly practical and viable, the provision of PV solar panels in new housing and apartment builds, for electricity generation/storage and/or water heating, so as to reduce the long term energy/heating costs of residents living in such dwellings, to minimise carbon emissions and to reduce Ireland's dependency on imported energy derived from fossil fuels.

E2 Objective 8:

- To require, where feasibly practical and viable, the provision of green roofs for all new public buildings (Council buildings, school buildings, hospitals, community centres, sports facilities, libraries, Garda stations etc.), to assist in flood alleviation, insulation and improved biodiversity, and to actively promote these measures where appropriate in new commercial and industrial buildings.

ENERGY (E) Policy 3 - Energy Performance in Existing Buildings

It is the **policy** of South Dublin County Council:

- To promote high levels of energy conservation, energy efficiency and the use of renewable energy sources in existing buildings.

E3 Objective 1:
- To ensure that medium to large scale residential and commercial developments are designed to take account of the impacts of climate change, including the installation of rainwater harvesting systems and that energy efficiency and renewable energy measures are incorporated in accordance with national building regulations, policy and guidelines.

ENERGY (E) Policy 4 - Energy Performance in New Buildings

It is the **policy** of South Dublin County Council:

- To ensure that new development is designed to take account of the impacts of climate change, and that energy efficiency and renewable energy measures are considered in accordance with national building regulations, policy and guidelines.

E4 Objective 1:
- To ensure that medium to large scale residential and commercial developments are designed to take account of the impacts of climate change, including the installation of rainwater harvesting systems, and that energy efficiency and renewable energy measures are incorporated in accordance with national building regulations, policy and guidelines.

E4 Objective 2:
- To support the passive house standard or equivalent for all new build in the County.

ENERGY (E) Policy 5 - Waste Heat Recovery & Utilisation

It is the **policy** of South Dublin County Council:

- To promote the development of waste heat technologies and the utilisation and sharing of waste heat in new or extended industrial and commercial developments, where the processes associated with the primary operation on site generates waste heat.

E5 Objective 1:
- To promote the development of waste heat technologies and the utilisation and sharing of waste heat, in new or extended industrial and commercial developments, where the processes associated with the primary operation on site generates waste heat.

E5 Objective 2:
- To promote the development of local energy partnerships among businesses in the County.

E5 Objective 3:
- To promote increased energy self-sufficiency across business sectors.

ENERGY (E) Policy 6 - Low Carbon District Heating Networks

It is the **policy** of South Dublin County Council:

(a) To support the development of low carbon district heating networks across the County based on technologies such as combined heat and power (CHP), large scale heat pumps, and renewable energy opportunities including geothermal energy, energy from waste, biomass and bio-gas.

(b) To support the development of both deep and shallow geothermal energy sources throughout the County. Deep geothermal projects are particularly suited to areas demonstrating high heat densities.

E6 Objective 1

- To prioritise the development of low carbon district heating networks in Low Carbon District Heating Areas of Potential.

E6 Objective 2:

- To future proof the built environment in Low Carbon District Heating Areas of Potential to aid the future realisation of local energy networks and a move towards de-centralised energy systems.

E6 Objective 3:

- To ensure that all development proposals in Low Carbon District Heating Areas of Potential carry out an Energy Analysis and explore the potential for the development of low carbon district heating networks.

E6 Objective 4:

- To support deep and shallow geothermal projects at appropriate locations across South Dublin County and in accordance with the South Dublin Spatial Energy Demand Analysis (SEDA).

ENERGY (E) Policy 7 – Solar

It is the **policy** of South Dublin County Council:

- To promote the development of solar energy infrastructure in the County, in particular for on-site energy use, including solar PV, solar thermal and seasonal storage technologies. Such projects will be considered subject to environmental safeguards and the protection of natural or built heritage features, biodiversity and views and prospects.

E7 Objective 1:

- To encourage and support the development of solar energy infrastructure for on-site energy use, including solar PV, solar thermal and seasonal storage technologies.

E7 Objective 2:

- To encourage and support the development of solar energy infrastructure for local distribution, including solar PV, solar thermal and seasonal storage technologies.

ENERGY (E) Policy 8 - Small Scale Hydro-Electricity Projects

It is the **policy** of South Dublin County Council:

- To encourage the roll-out of small scale hydroelectric projects on the rivers, watercourses, dams and weirs across the County, where they do not impact negatively on freshwater species (including protected aquatic species), birds and mammals, biodiversity and natural or built heritage features.

E8 Objective 1

- To support the roll-out of small scale hydroelectric projects on the rivers, watercourses, dams and weirs across the County, where projects do not impact negatively on freshwater species (including protected aquatic species), birds and mammals, biodiversity and natural or built heritage features.

ENERGY (E) Policy 9 - Wind Energy

It is the **policy** of South Dublin County Council:

- It is the policy of the Council to restrict large scale wind energy infrastructure in the rural hinterland and mountain areas of the County, to protect the overriding visual and environmental value of these landscapes.

E9 Objective 1:

- To restrict large scale wind energy infrastructure from rural and mountain areas of the County.

ENERGY (E) Policy 10 - Small to Medium Scale Wind Energy Schemes

It is the **policy** of South Dublin County Council:

- It is the policy of the Council to encourage small to medium scale wind energy developments within industrial or business parks, and support small community-based proposals in urban areas provided they do not negatively impact upon the environmental quality, and visual or residential amenities of the area.

ENERGY (E) Policy 11 - Service Providers and Energy Facilities

It is the **policy** of South Dublin County Council

- It is the policy of the Council to ensure that the provision of energy facilities is undertaken in association with the appropriate service providers and operators, including ESB Networks, Eirgrid and Gas Networks Ireland. The Council will facilitate the sustainable expansion of existing and future network requirements, in order to ensure satisfactory levels of supply and to minimise constraints for development.

E11 Objective 1:
- To work in conjunction with EirGrid to prioritise the undergrounding of the 220kv power line between Foxborough and the County boundary, including in the Balgaddy and Ronanstown areas.

HOUSING (H) Policy 6 - Sustainable Communities

It is the **policy** of South Dublin County Council:

To support the development of sustainable communities and to ensure that new housing development is carried out in accordance with Government policy in relation to the development of housing and residential communities.

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

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.

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

3. Energy Strategy Methodology

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

- Achieve (as a minimum) Building Regulations (Part L) 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; to achieve a BER of A rating building (VE Compliance 7.0.12.0 or iSBEM V5.5.h).
- Consider the potential to make use of decentralised and/or renewable energy resources
- Maximise energy performance points achieved if Sustainability Accreditation Scheme is pursued

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:

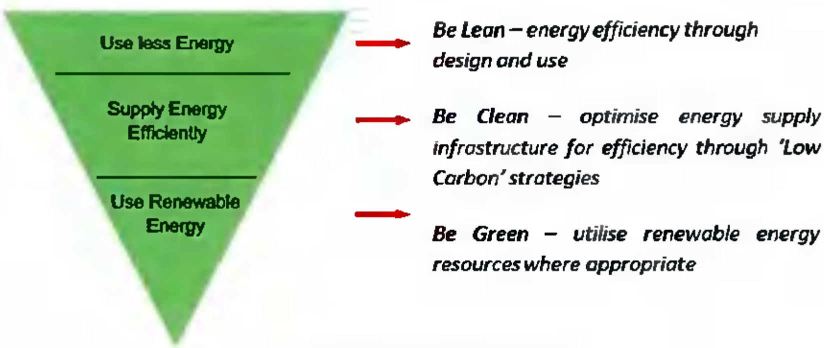


Figure 3: Energy Hierarchy

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 2021, 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 i.e. (heat pump)

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.

The proposed development has been assessed using the SBEM interface in the IES software which demonstrates Part L compliance in accordance with NEAP. SBEM inputs are detailed in Appendix 1 of this report.

3.4. Application of Part L to Industrial / Datahall Buildings in Campus setting

The application of Building Regulations Part L 2021 to industrial / warehouse / datahall buildings requires a nuanced approach.

There are a number of documents which should be considered, and which provide guidance in relation to the application of the regulation as follows:

- TGD Part L 2021 Conservation of Fuel and Energy
- SEAI NEAP Survey Guide
- TGF Part F 2019 Ventilation

3.4.1. TGD Part F 2019 Ventilation

TGD Part F Ventilation defines what is an 'occupiable space' in a building:

Occupiable room: A room in a building other than a dwelling, occupied as an office, workroom, classroom, hotel bedroom or similar room but does not include a bathroom, sanitary accommodation, utility room or rooms or spaces used solely or principally for circulation, building services, plant or storage purposes.

The Admin Office in this building is an 'occupiable space' and because of this, it is expected to be heated and would therefore trigger the application Part L 2021. NEAP modelling would include this space. Even if heating was removed completely, the NEAP modelling guidance requires that a 'default' system be modelled as a worst case.

Part L provides guidance in relation to industrial buildings in section 0.1.4.3.

3.4.2. TGD Part L 2021 – Unheated Buildings

0.1.1.4 The guidance given in this Technical Guidance Document applies to buildings designed to be heated to temperatures appropriate for ***human occupancy****. Less demanding standards could represent reasonable provision in those buildings or* ***parts of buildings*** *with a low level of heating or where heating provision is not intended.*

Low level of heating is considered to be where there is an installed heating capacity of less than 10W/m² and zones are not designed to be heated to temperatures appropriate for human occupancy. This includes buildings where ***heating and cooling systems are not provided****, or are provided to only heat or cool a localized area rather than the entire enclosed volume of the space concerned e.g. localized radiant heaters at a workstation in a generally unheated space. A low level of heating can also be considered to apply where spaces are heated to a level substantially less than those normally provided for human comfort e.g to protect a warehouse from condensation or frost. In these situations all fixed building services should meet the guidance for heating systems in section 1.4 or 2.2. Fabric should have a U value appropriate for the heating system provided and in no case greater than 0.7 W/(m²K) for opaque fabric.*

If a part of a building with low energy demand is partitioned off e.g. a ***heated office in an unheated warehouse then the fabric of the heated partitioned area should meet the guidance for fabric from sections 1.3 or 2.1.*** *Where the occupancy level or level of heating required when in use cannot be established at construction stage, the building should be treated as fully heated and the provisions of Part L applied accordingly. It should be noted that the provisions of Part L apply where a material change of use occurs and such a change of use may require specific construction measures to comply with Part L These measures may prove more costly than if carried out at the time of initial construction*

In all cases the energy consumption, Carbon Dioxide emissions and energy from renewable sources for new buildings should be modelled in NEAP.

This outcome of the above paragraph is that the whole building -- Admin Office + Datahall – is modelled in NEAP, even though the warehouse can be considered as an unheated space. Other unheated spaces onsite such as Generator Plant space and any substations are also included in NEAP modelling.

3.4.3. TGD Part L 2021 – Specialist Process

0.1.1.5 The guidance provided in this document for space heating, cooling, ***lighting*** *and ventilation systems are appropriate for typical conditioned spaces intended 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 Energy Performance Coefficient (EPC), Carbon Performance Coefficient (CPC) and Renewable Energy Ratio (RER) calculations use the NEAP activities database for occupancy, heating, cooling, ventilation, air conditioning, lighting, equipment parameters and profiles.

*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.*

The NEAP methodology sets out the procedures to reflect specialist processes when calculating the Energy Performance Coefficient, Carbon Performance Coefficient and Renewable Energy Ratio.

It should be noted from the above that even where parts of the building have specialist process areas, that the lighting associated with this still needs to be considered and regulated by Part L. While there are specialist process areas in this building, however, the NEAP modelling of the datahall area will include the lighting in this space. Gas Generator Plant space and any other substation plant space lighting is also included.

3.4.4. TGD Part L 2021 – Campus Developments

1.2.2 Where a building or campus contains more than one new building, reasonable provision would be to show that:

- every individual new building should meet the minimum provision from renewable energy technologies specified in paragraph 1.2.1 above; or
- the average contribution of renewable technologies to each new building other than a dwelling in the development or campus should meet that minimum level of provision.

This allows for the option of achieving compliance on a campus basis, i.e., all units can be modelled as one for Part L Compliance. Renewables could feasible be installed on certain buildings in the development which would allow other buildings achieve compliance. However, the current approach is for standalone building unit compliance.

3.4.5. Industrial Building

Ethos considers this building as 'industrial' as per the definition below from the Planning and Development Regulations:

"industrial building" means a structure (not being a shop, or a structure in or adjacent to and belonging to a quarry or mine) used for the carrying on of any industrial process;

"light industrial building" means an industrial building in which the processes carried on or the plant or machinery installed are such as could be carried on or installed in any residential area without detriment to the amenity of that area by reason of noise, vibration, smell, fumes, smoke, soot, ash, dust or grit;

"industrial process" means any process which is carried on in the course of trade or business, other than agriculture, and which is-

(a) for or incidental to the making of any article or part of an article, or

(b) for or incidental to the altering, repairing, ornamenting, finishing, cleaning, washing, packing, canning, adapting for sale, breaking up or demolition of any article, including the getting, dressing or treatment of minerals,

and for the purposes of this paragraph, "article" includes-

(i) a vehicle, aircraft, ship or vessel, or

(ii) a sound recording, film, broadcast, cable programme, publication and computer program or other original database;

4. Be Lean: Demand Reduction

4.1. Passive Solar Design

Passive solar design is of upmost importance in large commercial buildings where cooling constitutes a significant portion of the energy demand. Minimising unnecessary/unwanted solar gains is one of the most effective ways to reduce cooling energy requirements. The building will be designed in line with section 1.3.5 of Part L 2021 "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.

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 2021 "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 naturally ventilated spaces. A thermal comfort analysis for proposed naturally ventilated design will be carried out to demonstrate compliance with CIBSE TM52 as per solar part L report.

To achieve the criteria set out in sections 1.3.5 and 1.3.6 of Part L 2021 it is recommended that a glazing G-value of 30% as outlined with blinds as per the solar Part L report is specified while glazing VLT (Visible Light Transmittance) should be kept above 70%. 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.

The proposed façade design minimises solar heat gain via a combination of glazing specification, spandrel panels and local shading fins on the East, South and West façades. The proposed façade design was developed over an iterative process of verification against the Part L criteria in IES.

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 2021. Table 1, lists the targeted U-values of the proposed design.

Table 1: Fabric U Values to meet Part L 2021

Building Element	U-value (W/m²K)
Roof (Office Area)	0.20
Roof (Warehouse)	0.20
Wall Cladding – Office - External (Inclusive of all cladding/rainscreen systems)	0.21
Wall Cladding –Warehouse – External (Inclusive of all cladding/rainscreen systems)	0.21
Semi exposed Wall from Office to adjoining Unheated Warehouse	0.21
Floor – Ground Contact – Office area [1]	0.21
Floor – Ground Contact – Warehouse	0.21
Curtain Wall - Glazed curtainwall screen	1.40
External windows	1.40
External personnel doors[2]	1.40
Warehouse Dock Door	1.50

[1] Semi-exposed floor/ceiling over unheated spaces such as plant areas, ESB substations, etc. must be insulated. **N.B.** The ESB will not permit insulation in the substation. Dropped slab required or else secondary slab to be installed over sub. "Nothing, other than painted concrete allowed in substation".

[2] A high-usage entrance door, as defined in Part L 2021, may achieve a relaxed U-value of 3.0W/m²K. High-usage entrance doors should be equipped with automatic closers and be protected by a lobby.

*Maximum elemental U-value detailed in Table 1 of Part L 2021
**As per the preliminary Solar Gain Assessment Result

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 2021 requires an air permeability level no greater than 5m³/m²/hr @50Pa for new buildings. The design intent will be to achieve an air permeability of **3m³/m²/hr @50Pa** for the admin office area which represents a reasonable upper limit of air tightness.

Air Tightness in the warehouse to be carried out under 'Special Case Building' criteria under the ATTMA guidelines. The building will be inspected & letter of compliance issued for air permeability of less than **5m³/hr/m²@50Pa**.

4.2.2. Thermal Bridging

To avoid excessive heat losses and the risk of local condensation problems, reasonable care should be taken 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. In general, thermal bridges should not pose a risk of surface or interstitial condensation which can lead to mould growth.

The key factor used in assessing the risk of mould growth or surface condensation in the vicinity of thermal bridges is the temperature factor (fRsi). To limit the risk of surface condensation or mould growth, fRsi should be greater than or equal to a critical value (fCRsi); dependent upon the internal and external environments and applies generally to the whole of the internal surface.

Additional heat loss associated with thermal bridges is accounted for in calculating energy use and CO_2 emissions using the NEAP methodology via linear thermal transmittance (ψ, Psi-value). See

Appendix D of Part L 2021 for further information in relation to thermal bridging and its effect on building heat loss and how this is taken account of in NEAP calculations.

4.3. High Efficiency HVAC System

Full mechanical Heating, Ventilation and Air Conditioning (HVAC) systems will be utilised in this building 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 not classed as a 'renewable' source of energy despite the use of heat pump technology but 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.

4.3.2. AHUs with 2 stage heat recovery

The admin office area in these Industrial / Warehouse units will be provided with fresh outdoor air via a Dedicated Outdoor Air System (DOAS). This Air Handling Unit (AHU) will have two stage heat recovery using a thermal wheel and an integrated heat pump.

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 AHU will combine thermal wheel technology with an air-to-air packaged heat pump. This means that levels of heat recovery within the AHU have removed any need for heating or cooling coils and reduces the capacity of the central plant by a significant margin. The integrated Air to Air heat pumps achieve very high SCOP and SEER efficiencies due to the almost constant temperature of the tempered air after the thermal wheel.

4.3.3. Domestic Hot Water (DHW) Production

An air to water heat pump system e.g. Mitsubishi Ecodan type system will provide domestic hot water via a dedicated calorfier. The hot water will be plumbed to the sanitary ware and will include a secondary hot water return pump. The efficiency of the system proposed will be certified to EN16147.

4.3.4. Specific Fan Power Reduction

All ductwork will be adequately sized and service routes optimised to minimise fan power requirements. All SFPs will comply with Part L 2021.

4.3.5. 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.

4.3.6. 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 and in accordance with Appendix G TGD Part L 2021. 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.

4.3.7. Air Conditioning 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.

4.3.8. 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. 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 3 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 0.05W/m².

The lighting system will have provision for metering with a warning for 'out of range' values.

Table 2: Lighting Power Densities and Control

Element	lumen per circuit Watt	Control	Parasitic Load (W/m²)
Data hall	133	PIRs in all applicable zones	0.05
Staircore areas	130		
Circulation & Storage areas	129		
Toilets & Showers areas	110		
Office Areas	124		

4.4.2. 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.

5. Be Clean: Reduce On-Site Fossil Fuel Reliance

With the greening of the ESB grid with increased levels of wind farm connectivity, the use of electricity as a fuel source for heating and cooling the building was examined, along with other options to reduce the reliance on fossil fuel use on-site.

The use of biofuel Combined Heat and Power was examined. Biogas would need to be used in order for both heat and power to be accounted for in the RER. The availability of biogas is limited currently, and would require bulk storage on site, which is not preferred due to increased risk of accidents on site.

There is no availability for connection to a district heating system currently, so this option is discounted.

The use of the multi-pipe heat pump provides the opportunity to provide all heating and cooling efficiently using electricity. This reduces the reliance on fossil fuels, and is a 'green' technology under the TGD Part L 2021, listed as one renewable energy option to meet the requirements of NZEB.

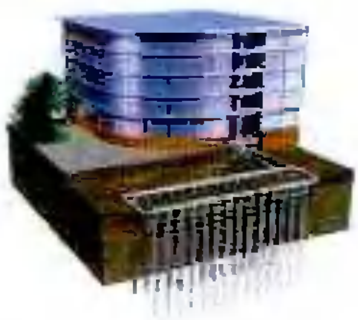
6. Be Green: Low or Zero Carbon Technologies

Following a low or zero carbon (LZC) technologies feasibility study it has been concluded that none of the LZC technologies considered were applicable or suitable to the proposed development.

Following a Low or Zero Carbon (LZC) technologies feasibility study, it has been concluded that 4-pipe heat pump chillers and solar Photovoltaic (PV) are the most suitable renewable energy technologies to the proposed development.

Table 3: LZC Feasibility

Technology	Feasibility H	M	L	Comments
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 roof plant area required restricts the potential area for a significant PV installation. The 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 would be considered feasible due to the low DHW demand for offices. Solar thermal systems typically have a payback greater than 10 years and also require regular maintenance. Additionally, they would not be compatible 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.
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. Additionally, capital costs are high and ideally, there should be a good balance between heating and cooling loads to allow for high COPs and reasonable capital payback. While a well-designed GSHP system operating under favourable conditions can achieve better efficiencies than an ASHP system, the capital cost difference may still outweigh potential energy savings.

Technology	Feasibility H	Feasibility M	Feasibility L	Comments
Multi-Pipe 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. A VRF heat pump in heating mode is operating as an ASHP, thus heating from a VRF heat pump system contributes towards meeting the RER requirement under Part L 2021. An ASHP will also provide LPHW heating and also Domestic Hot Water to office areas.

7. NEAP Calculation

A number of NEAP calculations have been carried out based on the adopted energy hierarchy in order to demonstrate compliance with Part L and to guide the design towards achieving the targeted BER certification.

In order to establish a reference point by which to measure the improvement of proposed design measures, a base case scenario was first assessed. The base case scenario uses the same building geometry with building fabric and M&E services meeting the minimum requirements stated by Part L.

8. Sustainability of Design and Construction

The proposed development will meet the highest standards of sustainable design and construction solutions were possible. During design and construction, the following sustainability considerations will be inherently addressed 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

APPENDIX 1: SBEM INPUTS

The NEAP calculations are based on the following inputs:

- **Office Building Fabric Performance**
  - External Wall U-value = 0.21 W/m²K
  - Internal Partition to WH = 0.21 W/m²K
  - Ground/Exposed Floor U-value = 0.21 W/m²K
  - Flat Roof U-value = 0.20 W/m²K
  - Glazing U-value = 1.40 W/m²K
  - Glazing G-value Office = 0.32 (32%)
- **Office Building Air permeability** = 4.0 m³/m²/hr at 50 Pa
- **Warehouse Building Fabric Performance**
  - External Wall U-value = 0.21 W/m²K
  - Ground/Exposed Floor U-value = 0.21 W/m²K
  - Flat Roof U-value = 0.20 W/m²K
- **Warehouse Building Air permeability** = 5.0 m³/m²/hr at 50 Pa
- **Thermal Bridging** = Default (see table 2)
- **Ventilation Office area**
  - HRU-01 SFP = 1.30 W/l/s
  - HRU-02 SFP = 1.70 W/l/s
  - HRU-03 SFP = 1.80 W/l/s
  - HRU-04 SFP = 1.30 W/l/s
  - Heat Exchanger Efficiency = 80%
  - Heat Exchanger Efficiency = 82%
  - Extract rate Toilets/Changing = As per Mechanical Specification
- **HVAC system in Office area (VRF)**
  - Air conditioned via VRF PURY-P750YSNW-A1
  - SCOP Heating = 6.31 (Part L)
  - SEER Cooling = 10.36 (Part L)
- **HVAC system in SER (VRF)**
  - Air conditioned via VRF PUZ-ZM71VHA
  - SCOP Heating = 4.30 (Part L)
  - SEER Cooling = 6.80 (Part L)
- **HVAC system in ECX (VRF)**
  - Air conditioned via VRF PUZ-ZM140VKA
  - SCOP Heating = 4.60 (Part L)
  - SEER Cooling = 7.00 (Part L)
- **HVAC system in WCs/ Service Corridor**
  - LPHW SUZ-SWM80VA
  - SCOP Heating = 3.275
- **Domestic Hot Water Heating**
  - DHW = Heat Pump
  - SCOP Heating = 3.7
    - Storage volume = 300L
    - Storage losses = 0.00870
- **Lighting**
  - Office building = As per design
  - Warehouse = As per design

- Sub metering of major M&E systems = Yes
- M&E metering warns "out of range" values = No
- Lighting systems have provision for metering = Yes
- Lighting metering warns "out of range" values = No (Monitoring & Targeting system)
- Power Factor correction = Yes (>0.95)

- **Photovoltaic** **= 30 kWp**

APPENDIX 2: ABBREVIATION

- 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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