Energy & Sustainability Report

Holy Cross College SHD

Project No. H634
8th July 2021

O'CONNOR | SUTTON | CRONIN
Multidisciplinary Consulting Engineers

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DOCUMENT CONTROL & HISTORY

OCSC Job No.: H634	Project Code	Originator Code	Zone Code	Level Code	File Type	Role Type	Number Series	Status/ Suitability Code	Revision
	H634	OCSC	XX	XX	RP	YS	0001	S4	P08

Rev.	Status	Authors	Checked	Authorised	Issue Date
8	For Planning	JS	PF	ST	08/07/2021
7	Final Draft for Planning	JS	DOC	ST	14/05/2021
6	Draft For Planning	JS	DOC	ST	11/05/2021
5	Draft for Planning	JS	DOC	ST	23/04/2021
4	Draft for Planning	JS	DOC	ST	08/04/2021
3	For Planning Pre-App	JS	DOC	ST	06/11/2020
2	Draft for Planning	JS	DOC	ST	28/08/2020
1	Draft for Planning	JS	DOC	ST	28/08/2020

EXECUTIVE SUMMARY

This document provides an overview of how the project intends to integrate sustainability as a key strategy into the building's design. The report focuses on the performance targets required by the Building Regulations Part L – Conservation of Fuel and Energy and what energy measures are needed to ensure compliance. Furthermore, a Building Energy Rating (BER) of A2/A3 has been targeted throughout.

The following document sets out the energy design approach that requires the design to initially focus on an energy demand reduction. This will primarily be through passive strategies such an energy efficient envelope which in turn reduces the demand relating to items such as HVAC and renewable energy systems. This initial approach in reducing the energy demand significantly aids the project in obtaining the desired energy goals while reducing running costs. Performance criteria relating to the development's building envelope are set out within the document.

The energy systems design must also focus on specifying energy efficient equipment to ensure the day to day running of the energy systems are optimised to further enhance energy savings and the related energy cost. Specifications relating to efficient heating, cooling, lighting and auxiliary equipment are also set out in this document.

This report confirms that if the energy and sustainability strategy is successfully implemented, the proposed development will achieve all energy and sustainability targets.

ENERGY & SUSTAINABILITY REPORT

INDEX **PAGE NO.**

1. INTRODUCTION

The purpose of this report is to identify the energy efficiency measures associated with the design, construction, ongoing management and maintenance of the proposed development located on the Clonliffe Road, Dublin 3 and Drumcondra Road Lower, Drumcondra, Dublin 9.

The proposed development will comply with Part L 2019 (NZEB) for residential and Part L 2017 (NZEB) for non-residential. As part of the development’s efforts to further reduce energy consumption, the project is targeting an A2/A3 BER (Building Energy Rating).

Extensive work has been carried out to develop a balanced design approach to achieve the energy efficiency targets with a number of sustainable features being incorporated into the design from the early stages.

Energy Performance Targets		
Standard / Rating	**Mandatory**	**Target**
Part L Residential	Yes	2019 (NZEB)
Part L Non-residential	Yes	2017 (NZEB)
BER Residential	Yes	A2/A3
BER Non-residential	Yes	A3

Table 1 – Energy Performance Targets

The following sections identify a range of energy efficient measures that have been considered for the proposed development.

2. PROPOSED DEVELOPMENT

The development will consist of the construction of a Build To Rent residential development set out in 12 no. blocks, ranging in height from 2 to 18 storeys, to accommodate 1614 no. apartments including a retail unit, a café unit, a crèche, and residential tenant amenity spaces. The development will include a single level basement under Blocks B2, B3 & C1, a single level basement under Block D2 and a podium level and single level basement under Block A1 to accommodate car parking spaces, bicycle parking, storage, services and plant areas. To facilitate the proposed development the scheme will involve the demolition of a number of existing structures on the site.

The proposed development sits as part of a wider Site Masterplan for the entire Holy Cross College lands which includes a permitted hotel development and future proposed GAA pitches and clubhouse.

The site contains a number of Protected Structures including The Seminary Building, Holy Cross Chapel, South Link Building, The Assembly Hall and The Ambulatory. The application proposes the renovation and extension of the Seminary Building to accommodate residential units and the renovation of the existing Holy Cross Chapel and Assembly Hall buildings for use as residential tenant amenity. The wider Holy Cross College lands also includes Protected Structures including The Red House and the Archbishop’s House (no works are proposed to these Structures).

The residential buildings are arranged around a number of proposed public open spaces and routes throughout the site with extensive landscaping and tree planting proposed. Communal amenity spaces will be located adjacent to residential buildings and at roof level throughout the scheme. To facilitate the proposed development the scheme will involve the removal of some existing trees on the site.

The site is proposed to be accessed by vehicles, cyclists and pedestrians from a widened entrance on Clonliffe Road, at the junction with Jones’s Road and through the opening up of an unused access point on Drumcondra Road Lower at the junction with Hollybank Rd. An additional cyclist and pedestrian access is proposed through an existing access point on Holy Cross Avenue. Access from the Clonliffe Road entrance will also facilitate vehicular access to future proposed GAA pitches and clubhouse to the north of the site and to a permitted hotel on Clonliffe Road.

The proposed application includes all site landscaping works, green roofs, boundary treatments, PV panels at roof level, ESB Substations, lighting, servicing and utilities, signage, and associated and ancillary works, including site development works above and below ground.

Figure 1 – Site Plan

3. PART L CONSERVATION OF FUEL & ENERGY - DWELLINGS

3.1. PART L 2019 (NZEB)

Part L 2019 (NZEB) of the Technical Guidance Document has been issued by the Minister for Housing, Planning, Community and Local Government. This document is the new standard for dwellings constructed from November 2019.

The Part L 2019 (NZEB) regulations set energy performance requirements to achieve Nearly Zero Energy Buildings performance as required by Article 4 (1) of the Directive for new buildings.

The definition of Nearly Zero Energy Buildings is defined as:

"'Nearly zero-energy building' means a building that has a very high energy performance, as defined in 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".

For the Part L 2019 (NZEB) requirements, a Renewable Energy Ratio (RER) is to replace the Part L 2011 renewable requirements. A RER of 20% (ratio of total primary energy generated from renewable energy resources to total primary energy consumption) is required to achieve compliance.

In line with the requirements detailed within the Technical Guidance Document, renewable energy technologies are defined as technologies that derive their energy directly from a renewable energy source, such as:

- Solar Photo-Voltaic Systems;
- Solar Thermal System;
- CHP Units (Combined Heat & Power);
- Heat Pumps (Minimum Coefficient of Performance of 2.5).

4. PART L CONSERVATION OF FUEL & ENERGY - BUILDINGS OTHER THAN DWELLINGS

4.1. LOCATION OF NON-RESIDENTIAL DEVELOPMENT

The non-residential aspects of the development will consist of residential tenant amenity spaces, a crèche, retail unit and a café.

4.2. PART L 2017 (NZEB)

The Part L 2017 (NZEB) building regulations is the new standard for all buildings other than dwellings constructed after 1st January 2019. The Part L 2017 (NZEB) regulations set energy performance requirements to achieve Nearly Zero Energy Buildings performance as required by Article 4 (1) of the Directive for new buildings. The definition of Nearly Zero Energy Buildings is defined as:

"Nearly zero-energy building' means a building that has a very high energy performance, as defined in Annex 1. The nearly zero or very low amount of energy required should be covered to a significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby".

For new buildings other than dwellings, the Part L 2017 (NZEB) requirements shall be met by:

a) providing that the energy performance of the building is such as to limit the calculated primary energy consumption and related Carbon Dioxide (CO2) emissions to a Nearly Zero Energy Building level insofar as is reasonably practicable, when both energy consumption and Carbon Dioxide emissions are calculated using the Non-domestic Energy Assessment Procedure (NEAP) published by Sustainable Energy Authority of Ireland. To demonstrate that an acceptable primary energy consumption rate has been achieved, the calculated Energy Performance Coefficient (EPC) of the building being assessed should be no greater than the Maximum Permitted Energy Performance Coefficient (MPEPC) which is equal to 1.0. To demonstrate that an acceptable CO2 emission rate has been achieved, the calculated Carbon Performance Coefficient (CPC) of the building being assessed should be no greater than the Maximum Permitted Carbon Performance Coefficient (MPCPC) which is equal to 1.15.

b) providing that, the nearly zero or very low amount of energy required is covered to a very significant extent by energy from renewable sources produced on-site or nearby;

c) limiting the heat loss and, where appropriate, availing of the heat gains through the fabric of the building;
d) providing and commissioning energy efficient space heating and cooling systems, heating and cooling equipment, water heating systems, and ventilation systems, with effective controls;
e) ensuring that the building is appropriately designed to limit need for cooling and, where air-conditioning or mechanical ventilation is installed, that installed systems are energy efficient, appropriately sized and adequately controlled;
f) limiting the heat loss from pipes, ducts and vessels used for the transport or storage of heated water or air;
g) limiting the heat gains by chilled water and refrigerant vessels, and by pipes and ducts that serve air conditioning systems;
h) providing energy efficient artificial lighting systems and adequate control of these systems;
i) providing to the building owner or occupants sufficient information about the building, the fixed building services, controls and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and energy than is reasonable.

Renewable Energy Ratio (RER):

This is the most significant change introduced as part of the Part L 2017 (NZEB) regulations for non-residential buildings. Some of the main performance requirements are as follows:

- The new regulations will require a significant level of energy provision be provided onsite or nearby by renewable energy technologies, e.g. solar energy (thermal and photovoltaic), air and exhaust air source heat pumps, combined heat and power, biomass boiler, etc.
- The current NZEB definition does not allow the renewable requirement to be met though the purchase of off-site green electricity.
- There are two routes in achieving compliance with the renewable target:
  - Route 1 = If the Part L compliance is achieved with no tolerance (0% margin), 20% of the building's energy use must be provided by onsite / near site renewable technologies.
  - Route 2 = If the Part L compliance is achieved with a minimum of 10% margin, then 10% of the building's energy use must be provided by onsite / near site renewable technologies. To achieve the 10% margin, the building envelope, lighting and M&E specification will likely have to be improved above minimum requirements.

5. PART F VENTILATION

This report is primarily focused around achieving compliance with Part L of the building regulations, but in doing so, the ventilation systems proposed must also comply with Part F (Ventilation) of the Technical Guidance Documents (TGD).

The TGD Part F 2019 document revolves around two requirements as outlined below:

Means of ventilation.

- *F1 – Adequate and effective means of ventilation shall be provided for people in buildings. This shall be achieved by:*

a) Limiting the moisture content of the air within the building so that it does not contribute to condensation and mould growth, and

b) Limiting the concentration of harmful pollutants in the air within the building.

Condensation in roofs.

- *F2 - Adequate provision shall be made to prevent excessive condensation in the floor or in a roof void above an insulated ceiling.*

The proposed development will be designed to achieve compliance with Part F of the building regulations.

6. BUILDING ENERGY RATING (BER)

As of 1st July 2009, all newly built domestic and non-domestic buildings and existing buildings that are for sale or rent require a BER (Building Energy Rating) certificate.

The actual building energy rating is based on the primary energy used for one year and is classified on a scale of A1 to G with A1 being the most energy efficient. It also provides the anticipated carbon emissions for a year of occupation based on the type of fuel that the building systems use. The following determines the extent of primary energy consumption within the building:

- Building type (office, retail, etc.);
- Building orientation;
- Thermal envelope (insulation levels of the façade, roofs, ground floor etc);
- Air permeability (how much air infiltrates into the building through the façade);
- Heating systems (what type of plant is used and how efficient it is);
- Cooling systems (what type of plant is used and how efficient it is);
- Ventilation (what form of ventilation is used - natural ventilation, mixed mode mechanical ventilation);
- Fan and pump efficiency (how efficient are the pumps and fans);
- Domestic hot water generation (what type of plant is used and how efficient it is); and
- Lighting systems (how efficient is the lighting).

The areas identified above will be described within this report and categorised under three main headings through "The Energy Hierarchy Plan". i.e. Be Mean, Be Lean, Be Green.

7. THE ENERGY HIERARCHY PLAN

Through the specification of an energy efficient façade and HVAC systems, the energy consumption of a building will be reduced compared to a set baseline. This ensures the environmental and economic impact of the operation of the building is reduced.

The key steps in the Energy Hierarchy Plan are outlined as follows:

1. The key philosophy of this plan is to first reduce energy demand by improving the building's thermal envelope, increasing air tightness, improving thermal transmittance and applying passive design techniques.

2. The second step is to utilise energy in the most efficient way through the selection and installation of energy efficient plant and equipment.

3. The final step is to introduce energy from renewable sources to reduce the burden on fossil fuels.

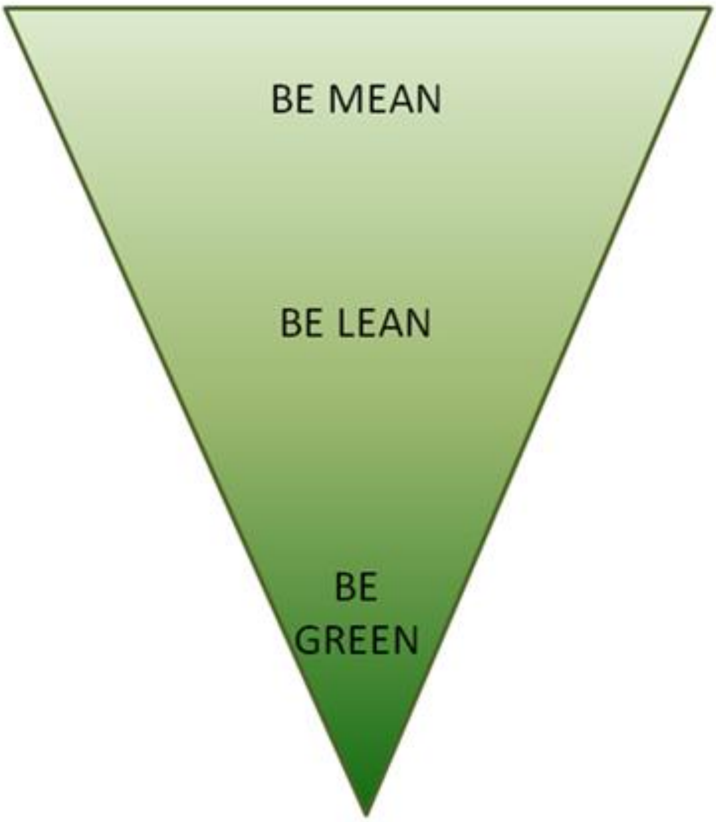


Figure 2 – Energy Hierarchy Plan

7.1. STEP 1 (BE MEAN) – USE LESS RESOURCES

The following measures will be implemented to reduce the energy consumption of the proposed development:

- High performance U-values;
- Improved air tightness; and
- Improved thermal transmittance and thermal bridging design.

7.1.1. HIGH PERFORMANCE U-VALUES

To limit the heat loss through the façade, careful consideration must be shown when designing the external façade. The specification of the insulation utilised, and the continuity of insulation are crucial. Insulation slows the rate at which heat is lost to the outdoors. Heat flows in three ways: by conduction, convection and radiation.

The targeted maximum average elemental U-Values for both the residential and non-residential aspects of the proposed development are outlined in Table 2 and Table 3 below.

Fabric Element	Proposed Development Maximum Average Elemental U-value ($W/m^2.K$)
External Walls	0.18
Flat Roof	0.18
Ground Contact & Exposed Floor	0.18
External Windows & Doors	1.40

Table 2 – Residential Building Envelope Thermal Performance Targets

Fabric Element	Proposed Development Maximum Average Elemental U-value ($W/m^2.K$)
External Walls	0.20
Flat Roof	0.18
Ground Contact & Exposed Floor	0.20 (0.15 if underfloor heating installed)
External Windows & Doors	1.40

Table 3 – Non-residential Building Envelope Thermal Performance Targets

7.1.2. AIR TIGHTNESS

One major contributing factor to unnecessary heat loss is infiltration. Infiltration is the air leakage of external air into a building due to the pressure difference associated with internal and external temperatures.

It is intended that the residential and non-residential development will both target an air permeability rate of 3 $m^3/hr/m^2$ @ 50 Pa.

Figure 3 – Air Tightness Testing

7.1.3. THERMAL TRANSMITTANCE

Thermal bridges occur where the insulation layer is penetrated by a material with a relatively high thermal conductivity and at interfaces between building elements where there is a discontinuity in the insulation. The residential and non-residential development will be designed to achieve low thermal bridging values throughout. A Y value of ≤ 0.08 W/m^2K is being targeted for the residential development to comply with Part L 2019 (NZEB) requirements.

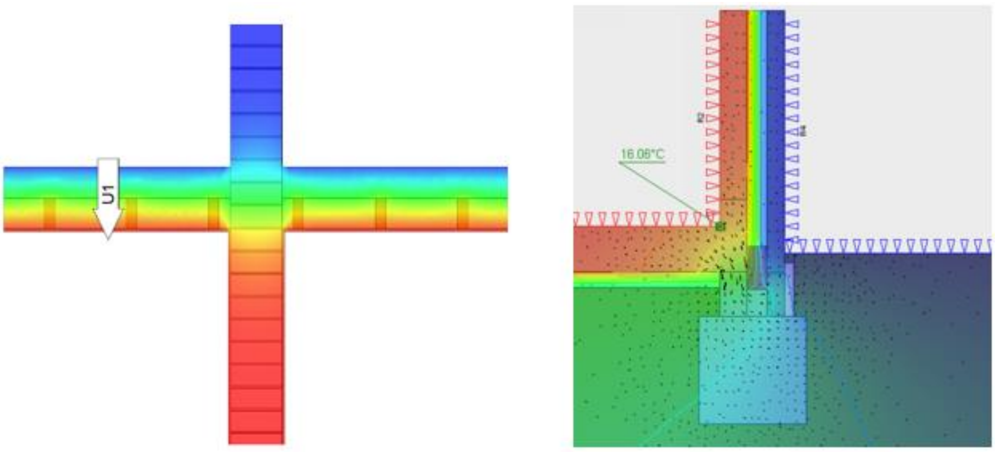


Figure 4 – Thermal Bridge Assessment

7.1.4. OVERHEATING ANALYSIS

Due to factors such as climate change, population increase and construction of high-rise buildings there has been an increase in high internal temperatures. Overheating of buildings can be extremely uncomfortable for the occupant and can ultimately lead to costly mitigation measures.

Residential:

The proposed residential development will be evaluated and analysed with respect to overheating as outlined in Part L 2019 (NZEB) and CIBSE TM59 (Design Methodology for the Assessment of Overheating Risk in Homes).

Non-residential:

The proposed non-residential development will be evaluated and analysed with respect to overheating as outlined in Part L 2017 (NZEB) and CIBSE TM52 (Limits of Thermal Comfort: Avoiding Overheating in European Buildings).

7.1.5. PASSIVE DESIGN

The proposed façade has been designed to limit the effects of unnecessary solar gains during the summer-time period. The design intent is to provide local shading utilising for the building structure which allows glazing areas to be maximised, where required.

This balance of shading and maximised glazing areas provides both enjoyable and interesting living spaces, full of natural light and without undue solar gains in summertime. The shading coefficient of the glazing units has also been optimised to limit unnecessary solar gains, while allowing as much natural daylight to enter the living space as possible.

7.2. STEP 2 (BE LEAN) – USE RESOURCES EFFICIENTLY

To maximise the effectiveness of changes to the construction, it is important to use the energy sources within the building as efficiently as possible.

7.2.1. LOW ENERGY PLANT - RESIDENTIAL

To improve the overall energy efficiency of the residential aspect of the development, plant is to be selected based on performance and energy efficiency.

Space Heating: The plant options for space heating are:

- Electric Panel Heaters, or
- Air Source Heat Pumps (ASHP)

Domestic Hot Water: The plant options for domestic hot water are:

- Air Source Heat Pumps (ASHP), or
- Electric immersion heaters

Ventilation: The plant options for ventilation are:

- Mechanical Ventilation and Heat Recovery, or
- Mechanical Extract Ventilation

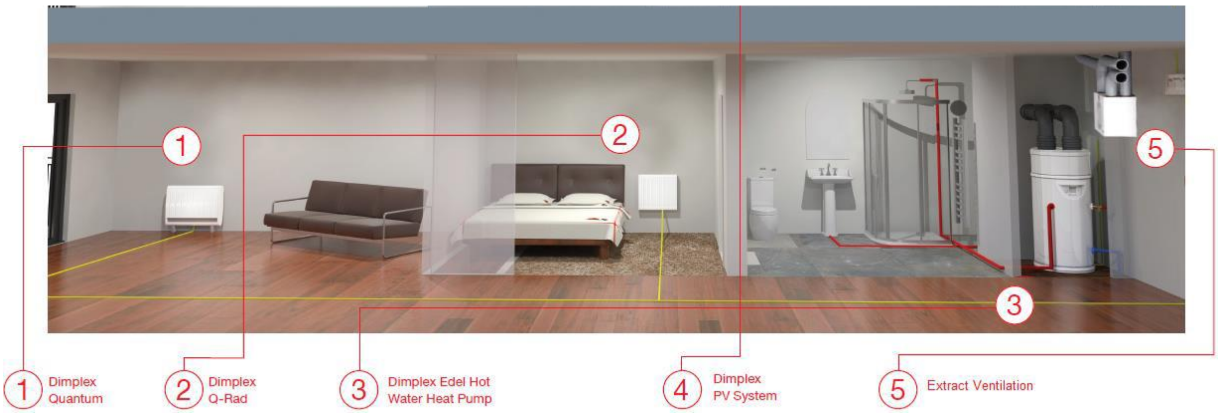


Figure 5 – Typical Air-Source Heat Pump with electric panel heaters arrangement

7.2.2. LOW ENERGY PLANT - NON-RESIDENTIAL

To improve the overall energy efficiency of the non-residential aspect of the development, plant is to be selected based on performance and energy efficiency.

Space Heating: The plant options for space heating are:

- Air Source Heat Pumps (ASHP), or
- Electric Panel Heaters

Domestic Hot Water: The plant options for domestic hot water are:

- Air Source Heat Pumps (ASHP), or
- Electric instantaneous water heaters

Space Cooling: The plant options for space cooling are:

- Natural ventilation where possible, and/or
- Variable Refrigerant Flow (VRF) Heat Pumps, or
- Air Source Heat Pumps (ASHP)

Ventilation: The proposed ventilation strategy for the building will be natural ventilation where possible and/or mechanical ventilation. The mechanical ventilation system will be a high efficiency, variable speed drive system that also incorporates heat recovery and CO_2 control.

Variable Speed Drives (VSDs): Variable speed drive motors are to be fitted to all fans and pumps servicing all HVAC systems. Standard fans and pumps operate at a constant speed to meet maximum demand even though only half the building may be occupied. VSDs have the ability to ramp up or down depending on the load requirements, making this the most efficient auxiliary system to install.

7.2.3. LIGHTING

The design intent for internal lighting design is to introduce artificial lighting in all applicable areas. Energy efficient light fittings will be installed throughout. The design of the building façade also allows high levels of natural daylight to enter into occupied zones.

7.2.4. ONGOING MONITORING

A BEMS (Building Energy Management System) is to be installed to monitor the use of all major systems in the building. The BEMS is a graphical interface that allows the facilities/building manager to monitor and control all systems throughout the building.

7.3. STEP 3 (BE GREEN) – USE OF RENEWABLE TECHNOLOGIES

The following renewable technologies are being considered for implementation in the proposed development.

7.3.1. AIR SOURCE HEAT PUMP

Air source heat pumps convert energy from the air to provide hot water for buildings. They are powered by electricity and are highly efficient. The air source heat pump proposed for use pulls in external air via insulated ductwork. This air then flows over a heat exchanger, which contains a refrigerant liquid. An evaporator uses the latent heat from the air to heat the refrigerant sufficiently until it boils and turns to a gas. This gas is then compressed which causes a significant rise in temperature. An additional heat exchanger removes the heat from the refrigerant which can then be used to heat water within the dwelling.

Figure 6– Typical Air-Source Heat Pump with electric panel heaters arrangement

7.3.2. SOLAR PHOTOVOLTAICS

Photovoltaic (PV) Panels convert the solar radiation into electricity. The panels are placed on the roof and are most efficient with an incline angle of 30˚. Panels are typically arranged in arrays on building roofs, with the produced electricity fed either directly into the apartment or into the landlord's supply.

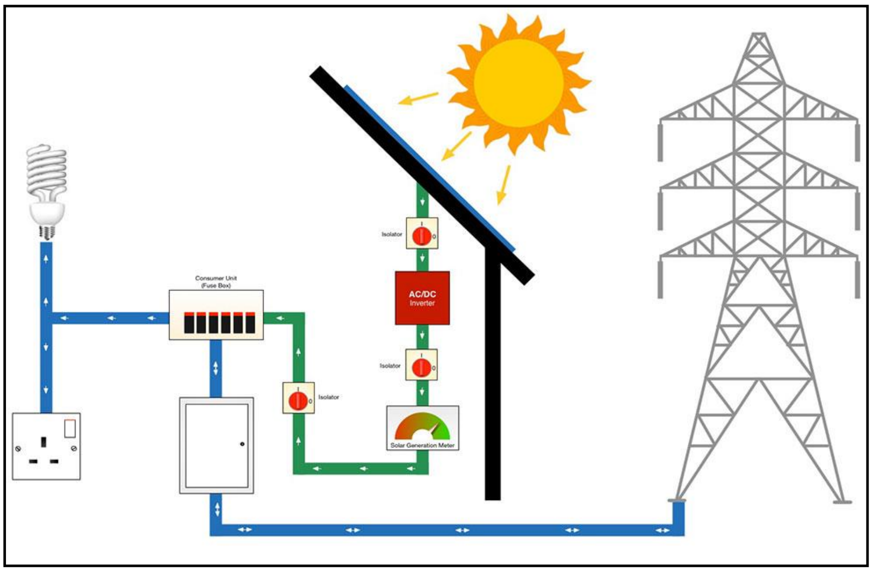
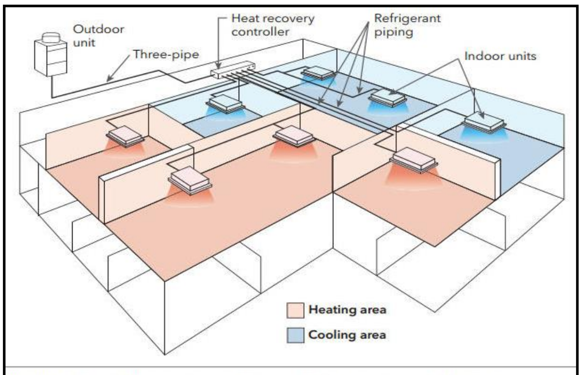


Figure 7 – Solar PV Diagram

7.3.3. VRF HEAT PUMPS

Variable Refrigerant Flow systems utilise heat pumps in order to provide space heating as well as space cooling. These systems are capable of serving multiple zones with different heating and cooling requirements and they can modulate their output according to zone requirements, increasing system efficiencies and reducing the energy demand of these systems.



Variable refrigerant flow systems can deliver cooling to some zones and heating to others, with no reheat needed (an air-source system is shown here).

Figure 8 – Typical VRF Schematic Diagram

8. KEY SUSTAINABLE FEATURES

The location of the proposed development provides availability to alternative modes of transportation, use of water efficient fixtures, consideration for materials and resources and indoor environmental quality for the building occupants.

8.1. LOCATION AND TRANSPORTATION

The proposed development will offer occupants travelling to and from the building alternative modes of transport other than the need to rely on a car. Developing in an area that has strong public transport nodes offers users the opportunity to travel to and from the site using alternative modes of transport. The following figures identify the local Dublin bus stops, train stations, bicycle lanes and local car sharing locations and their proximity to the proposed development.

Figure 9 – Local Train and Dublin Bus Stops

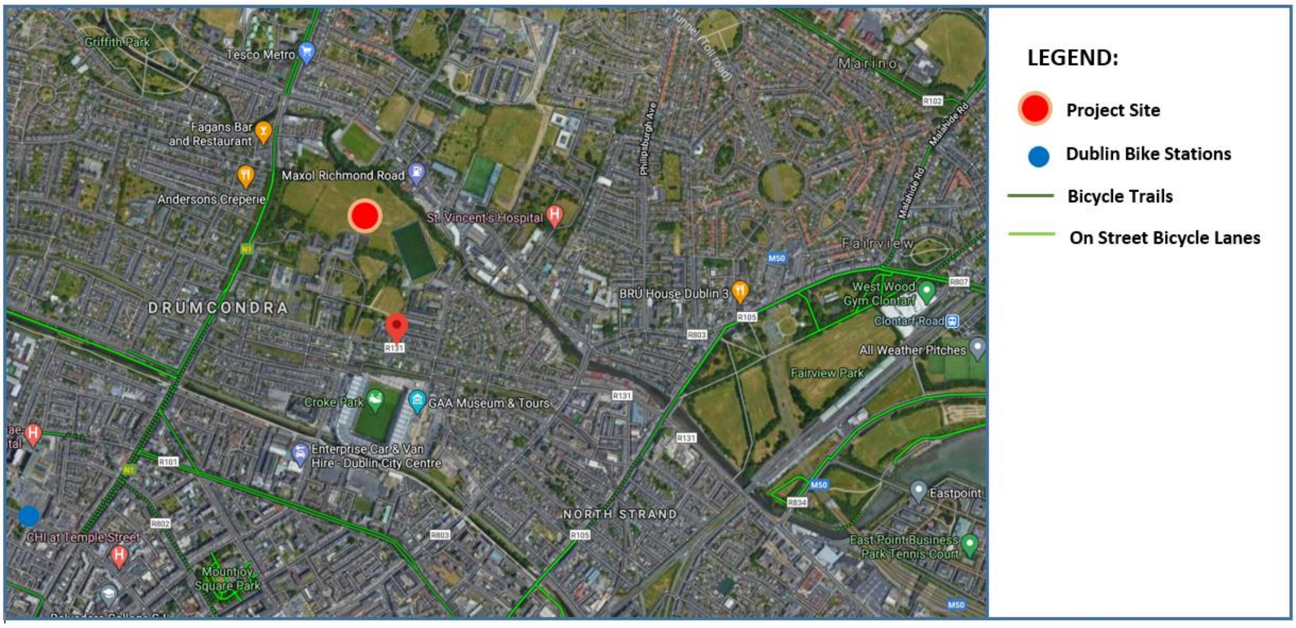


Figure 10 – Local Bicycle Lanes and Dublin Bike Stations

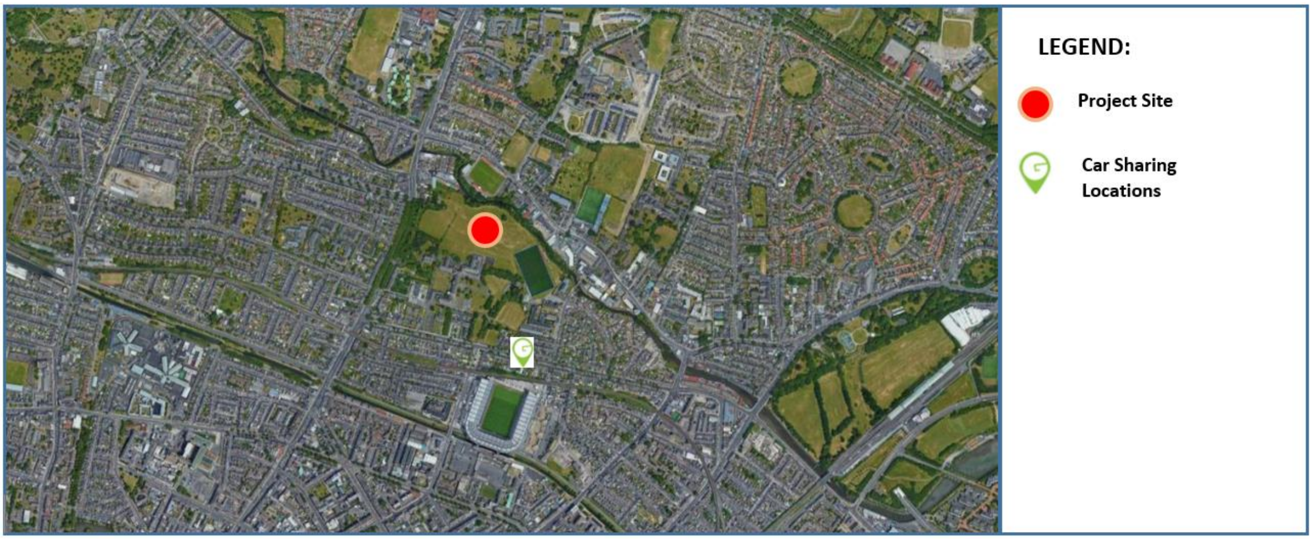


Figure 11 – Local Car Sharing Locations

8.2. COMMISSIONING

To ensure efficient operation of the building all systems will be commissioned. Commissioning of a building's systems ensures that the sustainable energy-design can be fully realised, with fewer operational issues during the building's lifetime. Building users' productivity improves and operational costs decrease also.

8.3. MATERIALS AND RESOURCES

The building will be designed and operated with the aim of a reduction in waste generation through construction and operation. Where possible waste streams will be separated on site and recycled or re-used. Where possible local materials will be specified, and in addition materials that contain recycled content will be considered as preferable.

8.4. WATER EFFICIENCY

With increasing costs associated with potable water use, the proposed development will incorporate measures to reduce water usage through the appropriate selection of low consumption sanitary fittings, leak detection systems and water monitoring facilities.

8.5. BICYCLE FACILITIES

Cycling offers a sustainable alternative to personal vehicle use, which reduces gas and particulate emissions, noise pollution and also congestion in busy urban areas. The proposed development will provide private bicycle spaces for tenants/occupants.

8.6. INDOOR ENVIRONMENTAL QUALITY

As part of the sustainable design strategy, consideration of occupants and staff will be an integral part of the design process. As the productivity and well-being of building users depends strongly on the quality of the indoor environment, the following aspects will be addressed:

- Adequate ventilation and filtration;
- Low-emitting materials; and
- Natural daylight and views to the external environment.

9. CONCLUSION

A holistic sustainable approach been adopted by the design team for the proposed development located on the Clonliffe Road, Dublin 3 and Drumcondra Road Lower, Dublin 9. Through detailed design, a number of sustainability and efficiency features have been considered throughout.

The proposed residential development will comply with Part L 2019 (NZEB), as well as targeting an A2/A3 BER, while the proposed non-residential development will comply with Part L 2017 (NZEB), as well as targeting an A3 BER.

The optimised approach is based on the Energy Hierarchy Plan - Be Mean, Be Lean, Be Green.

Be Mean

- The façade performance specification has been optimised to limit heat loss, improve air tightness and thermal transmittance and to maximise natural daylight.

Be Lean

- High efficiency equipment will be specified where applicable to take advantage of the optimised façade design measures that have been introduced.
- A low energy lighting design will be utilised to further reduce energy consumption and increase occupant thermal comfort.

Be Green

- Renewable energy technologies such as Air Source Heat Pumps, VRF Heat Pumps and Solar PV will be considered for implementation.

A number of sustainable design features have been considered within the design to achieve the sustainability targets of the proposed development. These include:

- The proximity of the development to public transportation networks;
- Water efficiency measures such as low consumption sanitary fittings; and
- Improved indoor environmental quality.

This report confirms that if the energy and sustainability strategy is successfully implemented, the proposed development will satisfy all Part L and BER requirements.

OCSC

O'CONNOR | SUTTON | CRONIN

Multidisciplinary
Consulting Engineers

9 Prussia Street
Dublin 7
Ireland

T | +353 (0)1 8682000
F | +353 (0)1 8682100
W | www.ocsc.ie