PROJECT TITLE:	SHD at Central Mental Hospital, Dundrum, Dublin 14
CLIENT:	Dundrum Central SHD
DOCUMENT TITLE:	Energy & Sustainability Report
DOCUMENT NUMBER:	D20004-EDC-XX-XX-RP-K-0001

Rev.	Status	Date	Originator	Checker	Approved By
01	For Planning	10/12/2021	T. McDonnell	R. O'Farrell	R. O'Farrell
02	For Planning	08/03/2022	T. McDonnell	R. O'Farrell	R. O'Farrell
03	**For Planning**	**16/03/2022**	**T. McDonnell**	**R. O'Farrell**	**R. O'Farrell**

TABLE OF CONTENTS

1 INTRODUCTION ... 5
1.1 Proposed Development ... 5
2 TGD PART L – THE REQUIREMENTS ... 7
2.1 Dwellings ... 7
2.2 Buildings other than Dwellings ... 7
3 THE ENERGY HIERARCHY PLAN ... 8
3.1 Be Mean – Use Less Energy ... 9
3.1.1 High Performance U-Values ... 9
3.1.2 Air Tightness ... 9
3.1.3 Thermal Transmittance ... 10
3.2 Be Clean – Consume Energy Efficiently ... 10
3.2.1 Ventilation System ... 10
3.2.2 Space Heating & Domestic Hot Water ... 11
3.2.3 Lighting ... 13
3.2.4 Electric Vehicle Charging ... 13
3.3 Be Green – Use Renewable Technologies ... 13
3.3.1 Renewable Energy from Heat Pumps ... 13
3.3.2 Solar Photovoltaics ... 13
4 DEVELOPING THE ENERGY PERFORMANCE STRATEGY ... 15
4.1 Home Performance Index (HPI) ... 15
4.2 Carbon Designer Tool for Ireland (OneClick LCA) ... 16
4.3 DEAP (Dwellings) ... 16
4.4 Dynamic Energy Modelling ... 16
4.4.1 Overheating Risk/ Thermal Comfort Assessment ... 16
4.4.2 Internal Daylight, Sunlight & Overshadowing ... 17
5 CONCLUSION ... 18
6 APPENDIX A – HPI CERTIFICATION REVIEW ... 19

LIST OF FIGURES

Figure 1: Proposed Site Layout 6
Figure 2: The Energy Hierarchy Plan 8
Figure 3: Typical Air Leakage Paths 10
Figure 4: Mechanical Ventilation System 11
Figure 5: Centralised/ Communal Heating System 12
Figure 6: Air Source Heat Pump Diagram 12
Figure 7: Solar PV Diagram (Domestic) 14
Figure 8: HPI compared to other standards 15
Figure 9: Factors Influencing Thermal Comfort 16
Figure 10: Daylight, Sunlight, Overshadowing Model Image from GIA No: 17967 17

LIST OF TABLES

Table 1: Proposed Building Fabric Performance 9

1 INTRODUCTION

The intention of this report is to identify energy efficiency measures associated with the design, construction and building services of the proposed SHD at Central Mental Hospital located in Dundrum, Dublin 14. The proposed development will consist of residential and commercial aspects (full description in section 1.1).

Extensive works were carried out early in the design stages to develop a sustainability strategy which can be carried through to completion. As part of this sustainability strategy, the development is targeting a minimum BER A3 for all residential buildings. This onerous target will contribute to the development's reduction in energy consumption, carbon emissions and the end users' operational costs. The residential aspects of the proposed development will with TGD Part L 2021 (dwellings), while the commercial aspects will comply with TGD Part L 2021 (Buildings other than dwellings).

1.1 Proposed Development

The Land Development Agency intend to apply to An Bord Pleanála (the Board) for a 10 year permission for a Strategic Housing Development with a total application site area of c.9.6 ha, on lands at the Central Mental Hospital, Dundrum Road, Dundrum, Dublin 14.

The development will consist of the demolition of existing structures (3,736 sq m), including:

- Single storey Former swimming pool / sports hall and admissions unit (2,750 sq m);
- Two storey redbrick building (305 sq m);
- Temporary structures including single storey portacabins (677 sq m);
- Removal of security fence at Dundrum Road entrance;
- Demolition of element of Gatelodge (4 sq m).

The development will also consist of alterations and partial demolition of the perimeter wall, including:

- Removal of section of perimeter wall adjacent to Rosemount Green (south);
- Formation of a new opening in perimeter wall at Annaville Grove to provide a pedestrian and cyclist access and associated gate;
- Removal of section of perimeter wall at the existing Dundrum Road access;
- Alterations and removal of sections of wall adjacent to Dundrum Road, including the provision of a new vehicular, cyclist and pedestrian access;
- Alterations and removal of section of perimeter wall adjacent to Mulvey Park to provide a pedestrian and cyclist access; and
- Removal of walls adjacent to Main Hospital Building.

The development with a total gross floor area of c. 106,770 sq m (c. 106,692 sq m excluding retained existing buildings), will consist of 977 no. residential units comprising:

- 940 no. apartments (consisting of 53 no. studio units; 423 no. one bedroom units; 37 no. two bedroom (3 person) units; 317 no. two bedroom (4 person) units; and 110 no. 3 bedroom units) arranged in 9 blocks (Blocks 02-10) ranging between 2 and 6 storeys (excluding plant) in height, together with private (balconies and private terraces) and communal amenity open space provision and ancillary residential facilities;
- 17 no. duplex apartments (consisting of 3 no. 2 bedroom units and 14 no. 3 bedrooms units located at Block 02, 08 and 09), together with private balconies and terraces.
- 20 no. two and three storey houses (consisting of 7 no. three bedroom units and 13 no. 4 bedrooms units) and private rear gardens located at Block 02, 08 and 09).

The development will also consist of 3,889 sq m of non-residential uses, comprising:

- Change of use and renovation of existing single storey Gate Lodge building to provide a café unit (78 sq m);
- 1 no restaurant unit (307 sq m) located at ground floor level at Block 03;
- 6 no. retail units (1,112 sq m) located at ground floor level at Blocks 03, 06 and 07;
- 1 no. medical unit (245 sq m) located at ground floor level at Block 02;
- A new childcare facility (463 sq m) and associated outdoor play area located at ground floor level at Block 10; and
- A new community centre facility, including a multi-purpose hall, changing rooms, meeting rooms, storage and associated facilities (1,684 sq m) located at ground and first floor level at Block 06.

The development will also consist of the provision of public open space and related play areas; hard and soft landscaping including internal roads, pathways and boundary treatments, wetland feature, car parking (547 no. spaces in total, including car sharing and accessible spaces); motorcycle parking; electric vehicle charging points; bicycle parking (long and short stay spaces including stands); ESB substations, piped infrastructural services and connections; plant (including external plant for district heating and pumping station); waste management provision; SuDS measures; sustainability measures (including green roofs and solar panels); signage; public lighting; any making good works to perimeter wall and all site development and excavation works above and below ground.

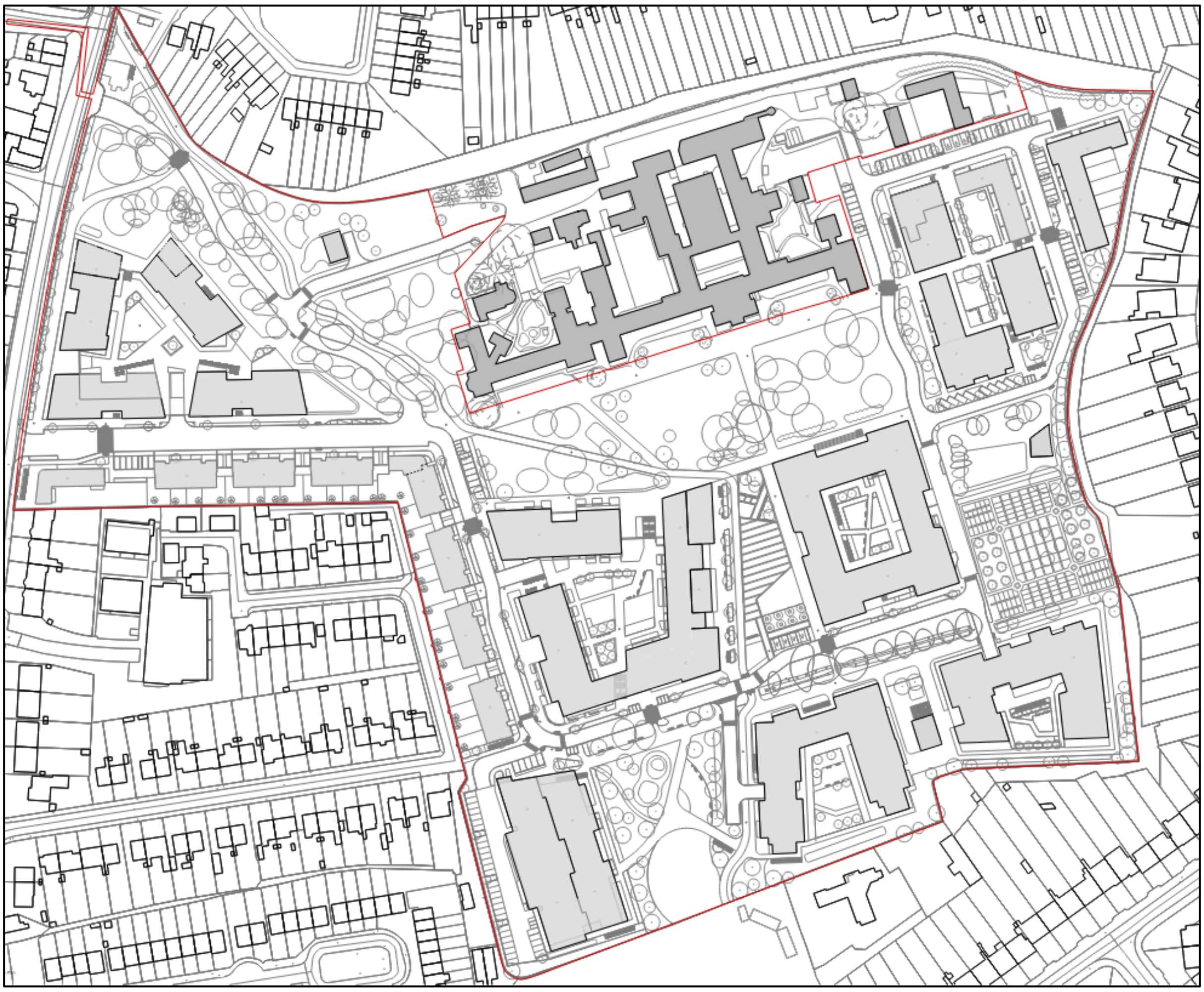

Figure 1: Proposed Site Layout

2 TGD PART L – THE REQUIREMENTS

Technical Guidance Document Part L (Conservation of Fuel and Energy) of the Building Regulations sets the energy and carbon performance requirements to achieve Nearly Zero Energy Buildings performance as required by the EU Energy performance in Buildings Directive 2010/31/EU of 19 May 2010 and amending directive 2018/844 of May 2018.

2.1 Dwellings

TGD Part L 2021 Conservation of Fuel and Energy – Dwellings, states the following requirement for new dwellings, *"A building shall be designed and constructed so as to ensure that the energy performance of the building is such as to limit the amount of energy required for the operation of the building and the amount of carbon dioxide (CO2) emissions associated with this energy use insofar as is reasonably practicable"*. This requirement is met by the following.

a) Providing that the energy performance of the building is such as to limit the calculated primary energy consumption and related carbon dioxide (CO2) to that of a nearly zero energy building within the meaning of the Directive insofar as is reasonably practicable, when both energy consumption and carbon dioxide (CO2) emissions are calculated using the Dwelling Energy Assessment Procedure (DEAP) published by Sustainable Energy Authority of Ireland.
b) Limiting the heat loss and, where appropriate, availing of heat gain through the fabric of the building.
c) Providing and commissioning energy efficient space and water heating systems with efficient heat sources, effective controls, and self-regulating devices.
d) Providing that all oil and gas fired boilers shall meet a minimum seasonal efficiency of 90 %.
e) Providing to the dwelling owner 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.
f) Ensuring that for a new multi-unit building the installation of ducting infrastructure, namely conduits for electric cables, for every parking space to enable the installation of recharging points for electric vehicles, where:
    i. the car park is located inside the building; or
    ii. the car park is physically adjacent to the building; and
g) Ensuring that for a new dwelling house with a car parking space located within the curtilage of the dwelling house, the provision of appropriate electric vehicle recharging infrastructure to enable the installation of a recharging point for electric vehicles.

2.2 Buildings other than Dwellings

TGD Part L 2021 Conservation of Fuel and Energy – Buildings other than Dwellings, states the following requirement for new dwellings, *"A building shall be designed and constructed so as to ensure that the energy performance of the building is such as to limit the amount of energy required for the operation of the building and the amount of carbon dioxide (CO2) emissions associated with this energy use insofar as is reasonably practicable"*. This requirement is met by the following.

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.
b) Providing that, the 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; and
i) Providing to the building owner 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.

Plus, Regulation 5 requirements.

a) A new building shall, where technically and economically feasible, be equipped with self-regulating devices for the separate regulation of the temperature in each room or, where justified, in a designated heated zone of the building unit.
b) A new building, which has more than 10 car parking spaces, shall have installed at least one recharging point and ducting infrastructure (consisting of conduits for electric cables) for at least one in every 5 car parking spaces to enable the subsequent installation of recharging points for electric vehicles.

3 THE ENERGY HIERARCHY PLAN

The energy hierarchy plan aims to reduce energy before it can be consumed. This can be achieved by implementing passive design strategies across the development, like maximising the building fabric performance, building orientation, HVAC, and Lighting.

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

- **BE MEAN** - The first step of this plan is the most important, its aim is to first reduce energy demand by improving the building's thermal envelope, increasing air tightness, improving thermal transmittance, and applying passive design techniques.
- **BE CLEAN** - The second step is to utilise energy in the most efficient way through the selection and installation of energy efficient plant and equipment.
- **BE GREEN** - The final step is to introduce energy from renewable sources to reduce the burden on fossil fuels.

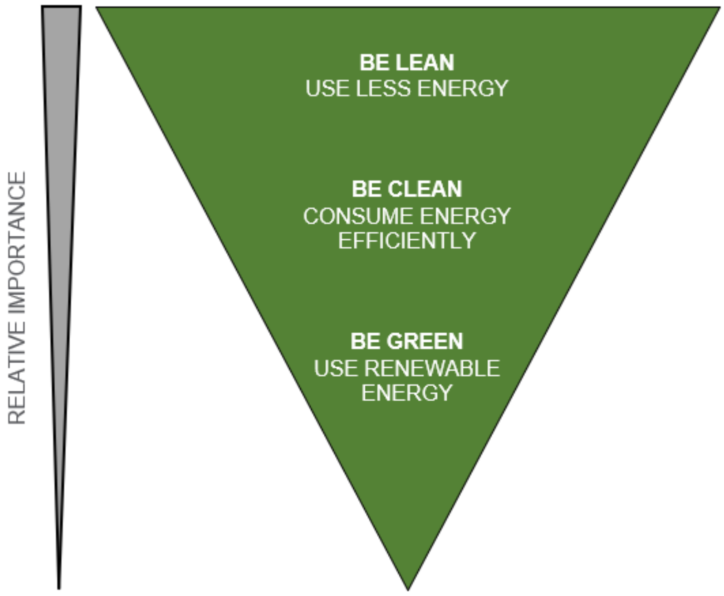

Figure 2: The Energy Hierarchy Plan

3.1 Be Mean – Use Less Energy

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.

3.1.1 High Performance U-Values

To limit heat loss through the façade, careful consideration will be shown when designing the external envelope. 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 maximum average elemental U-values from Part L 2021 (NZEB) are outlined in Table 1 below.

Table 1: Proposed Building Fabric Performance

Fabric Element	TGD Part L (2021) Maximum Average Elemental U-value ($W/m^2.K$)	Proposed Elemental U-value ($W/m^2.K$)
Ground floor	U-Value = 0.18	U-Value = 0.18
Exposed floor	U-Value = 0.18	U-Value = 0.18
Wall (External)	U-Value = 0.18	U-Value = 0.18
Roof (pitched)	U-Value = 0.16	U-Value = 0.16
Flat roof	U-Value = 0.20	U-Value = 0.20
Windows and glazed doors	U-Value = 01.40	[1]Total system u-value: 1.10W/m2K for windows, and 1.40W.m2k for sliding doors
Opaque doors u-value	U-Value = 01.40	U-Value = 1.40
Thermal bridging factor	0.08 W/m2k	0.08 W/m2k
Internal heat capacity	NA	Medium light
Air permeability	5m3/(hr.m2) @50pa	3m3/(hr.m2) @50pa or 0.15 ach

Note 1: Targeting Home Performance Index (HPI) credit HW4.1: Winter Comfort – Radiant Asymmetry. Refer to Section 4.1 and Appendix A of this report.

3.1.2 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.

Under the Part L 2021 (Domestic) the minimum air permeability performance of not greater than 5 m3/hr/m2 @ 50 Pa. It is intended that the residential development will target an air permeability rate of 3 $m^3/hr/m^2$ @ 50 Pa. By reducing the number of infiltration/ external air changes per hour, the buildings energy demand and carbon emissions will reduce as the buildings ability to retain conditioned thermal energy has increased i.e., the space heating system will not be required as often.

Common areas where air infiltration occurs in buildings can be seen in figure 3 below.

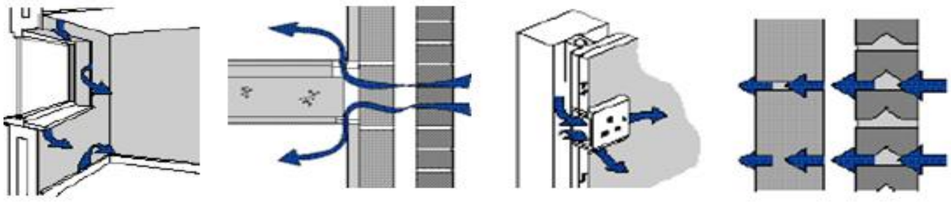

Figure 3: Typical Air Leakage Paths

3.1.3 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. It is intended to target a Thermal Bridging Factor of 0.08 W/m2k as per TGD Part L 2021 Accredited Construction details.

Figure 4 below shows thermal images of typical building details where a thermal bridge has occurred.

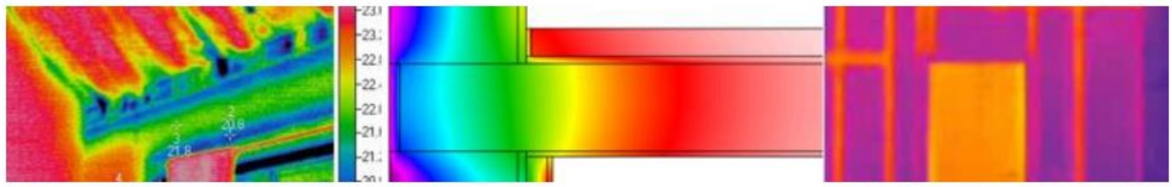

Figure 4: Typical Thermal Bridging Details

3.2 Be Clean – Consume Energy Efficiently

To maximise the effectiveness of enhancing the building fabric, it is important to utilize energy efficient system to further reduce the energy consumption, carbon production and annual running costs, while maximising the occupancy thermal comfort and wellbeing.

A centralised communal heating scheme has been proposed to meet the space heating and domestic hot water for the development, excluding the town houses. An air to water heat pump has been proposed to meet the space heating and domestic hot water requirements for town houses. Continuous mechanical extract ventilation is proposed for all dwellings/apartments.

3.2.1 Ventilation System

To reduce heat loss through the building fabric, a continuous whole-house extract ventilation system has been proposed. By implementing this system, it mitigates the requirement for open vents, flues, and intermittent fans in the building envelope. It will increase the thermal comfort of the building and ensure adequate fresh air is being supplied.

The system will be selected in the detailed design stage; however, it is proposed to have a specific fan power of not more than 0.36 W/l/s in dwellings.

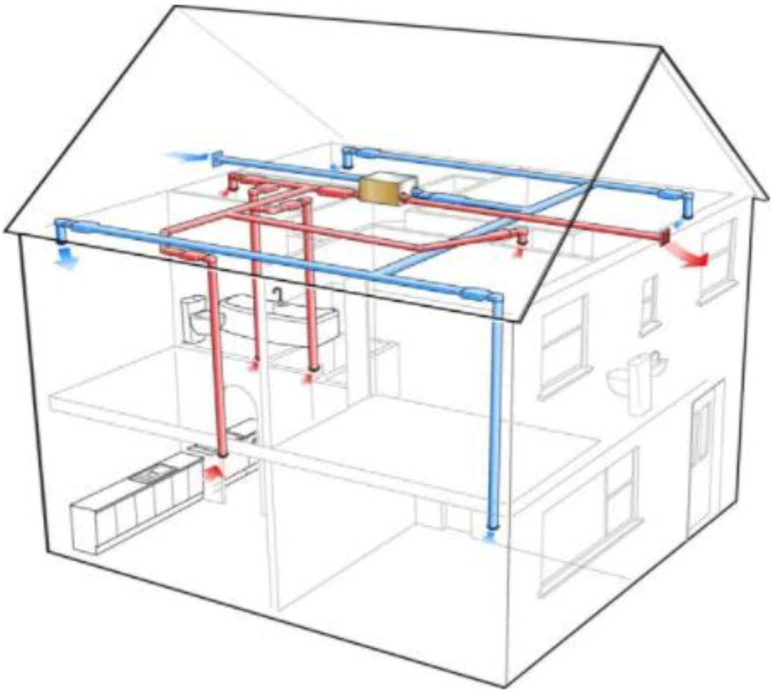

Figure 4: Mechanical Ventilation System

3.2.2 Space Heating & Domestic Hot Water

3.2.2.1 Centralised/ Communal Heating Scheme

A centralised/ communal heating scheme is proposed to meet the space heating and domestic hot water requirement for the development, excluding the town houses. The centralised heating scheme is intended to be made up of air-water heat pump(s) with a gas boiler top up if required.

The heat network will be heated by the air-water heat pumps in a centralised location. Hot water is distributed through a heat network, providing space heating and domestic hot water for the complete development. A Heat Interface Unit (HIU) is located within each dwelling, within this unit a plate heat exchanger transfers the heat from the heat network to the dwellings internal space and domestic hot water system. A management company or a third party ESCO company will bill individually for heat consumed.

This system has many advantages for the development.

- It can provide Part L compliance and meet renewable targets from a centralised location.
- Most system maintenance can be carried out without access to the individual apartments (some maintenance will be required for HIUs).
- Reduces space requirement for plant within the units when compared to individual heating systems.
- Space heating can also be met in common areas by the communal heating system removing the requirement for additional HVAC system and reducing maintenance.
- Future proofs the development as it allows for other renewable gases such as green hydrogen to be used in the future, with minimal changes to the heat network.

Figure 5 below provides and example of a communal heating system.

Figure 5: Centralised/ Communal Heating System

3.2.2.2 Air-Water Heat Pump

An air-water heat pump has been proposed for the town houses, this was selected over the centralised communal heating scheme to reduce the network distribution losses across they system and reduce energy consumption within the town houses.

This system will play a major role in reducing energy consumption, carbon emissions and annual running costs. Air source heat pumps convert energy from the air to provide heat and hot water for dwellings. They are powered by electricity and are highly efficient. The air source heat pump is located outside in the open air, and it uses a fan to draw air across it. 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 as useful heat within the dwelling.

The air-water heat pump will be selected in the detailed design stage; however, it is intended not to have a space heating seasonal efficiency of less than 450% and water heating efficiency of less than 230% in dwellings.

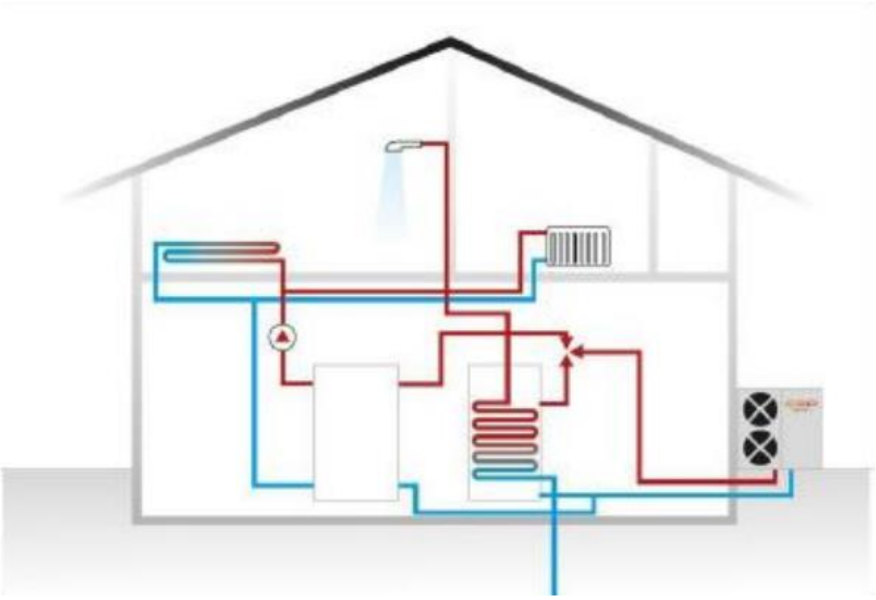

Figure 6: Air Source Heat Pump Diagram

3.2.3 Lighting

The Lighting design intent is to introduce artificial lighting in all applicable areas. Energy efficient light fittings will be installed throughout.

3.2.4 Electric Vehicle Charging

It is intended to provide up to 10% of all public parking spaces with electric vehicle charging facilities. Ducting infrastructure (electrical conduits) are intended to be provide to all public car parking spaces, where.

i. the car park is located inside the building; or
ii. the car park is physically adjacent to the building.

It is also proposed for a new dwelling house with a car parking space located within the curtilage of that dwelling, the provision of appropriate electric vehicle recharging infrastructure will be included for future private electric vehicle charging.

3.3 Be Green – Use Renewable Technologies

The following renewable technologies will be considered for implementation, in so far as is practical and feasibly possible.

3.3.1 Renewable Energy from Heat Pumps

The main source of renewable energy for this development will be produced by Heat Pumps. The centralised communal heating scheme is proposed the generate heat through air to water heat pumps. This is intended to provide sufficient renewable energy contribution to meet the TGD Part L renewable energy requirements. The townhouses are also intended meet their renewable energy requirements though individual air to water heat pumps.

A heat pump provides renewable (thermal) energy through their operational efficiencies. They can produce 4.5 – 5 times the amount of energy that is put into the system, reducing the demand and energy requirements substantially.

3.3.2 Solar Photovoltaics

Photovoltaic (PV) are proposed for areas that require an additional renewable energy contribution to meet TGD Part L.

PV panels convert the solar radiation into electricity, which can be connected to the mains supply of a dwelling. Panels are typically arranged in arrays on a building roof, with the produced electricity fed directly into the building.

Figure 6 below shows a diagram of how a PV system works in a dwelling application. The sun (1) provides solar radiation through sunlight that hits the PV cells (2), converting the solar energy into DC electricity. DC electricity passes through an inverter (3) which converts the electricity to AC making it ready to use. The current is then fed through a meter (4) before passing through the consumer unit. The dwelling will automatically use the PVs energy to power appliances (5), any electricity that is not used can be exported back to the national grid (6).

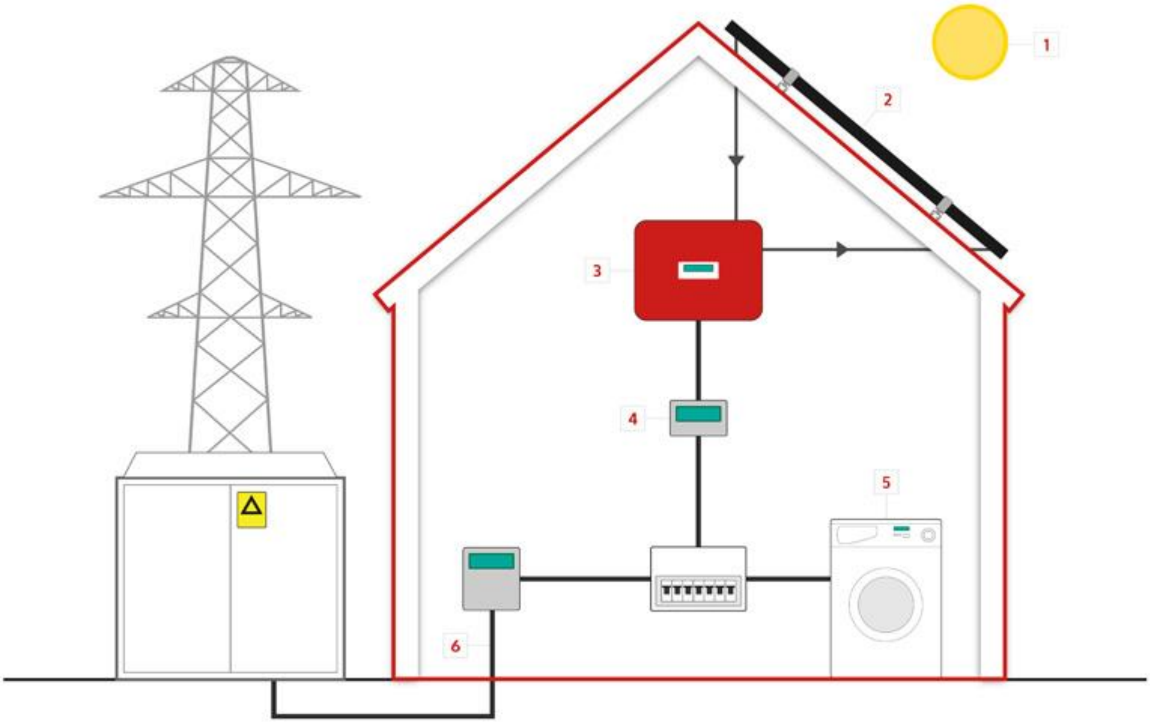

Figure 7: Solar PV Diagram (Domestic)

4 DEVELOPING THE ENERGY PERFORMANCE STRATEGY

Extensive works have been conducted in the early design stage to provide a coordinated energy strategy for the development. The proposed strategy will help to reduce energy consumption, carbon emissions and annual running costs throughout the development.

The works included investigating independently validated sustainability assessment methodologies, such as the Home Performance Index (HPI), IGBC Carbon Designer tool for Ireland, "OneClick LCA", and preforming several DEAP calculations to improve building fabric and HVAC systems.

Dynamic Thermal Energy Modelling will be used as the design progresses to enhance thermal comfort and wellbeing throughout the development. It is intended to perform overheating risk, and internal daylight assessments in the detailed design phase.

4.1 Home Performance Index (HPI)

HPI certification is an independently certified sustainability assessment methodology for Ireland. It is like certifications for commercial developments such as LEED and BREEAM, except that its specifically designed for residential developments and aligns to the Irish building regulation, EU Levels Framework, and international WELL certification for communities.

HPI is independently assessed and awards certificates with a rating for the standard of a homes design, construction, and environmental sustainability. This development will achieve HPI Certified as a minimum performance. Figure 8 below shows how the HPI compares with other standards, frameworks, and systems for green buildings.

	HPI	BREEAM	LEED	EDGE	nZEB	Passivhaus	LEVEL(s)*
Energy Efficiency Energy use + CO_2 emissions	Fully considered	Fully considered	Fully considered	Fully considered	Fully considered	Fully considered	Fully considered
Energy Savings	Fully considered	Fully considered	Fully considered	Fully considered	Fully considered	Fully considered	Fully considered
Indoor Air Quality Ventilation, VoCs, Radon	Fully considered	Fully considered	Fully considered	Not considered	Partially considered	Partially considered	Fully considered
Water Efficiency Water quality + Testing	Fully considered	Fully considered	Fully considered	Fully considered	Partially considered	Not considered	Fully considered
Daylight Levels Health + Wellbeing	Fully considered	Fully considered	Fully considered	Not considered	Not considered	Partially considered	Fully considered
Acoustic Comfort Wellbeing + Comfort	Fully considered	Fully considered	Fully considered	Not considered	Not considered	Not considered	Fully considered
Embodied Carbon	Fully considered	Fully considered	Fully considered	Fully considered	Not considered	Not considered	Fully considered
Improving Biodiversity	Fully considered	Fully considered	Fully considered	Not considered	Not considered	Not considered	Partially considered
Universal Design Lifetime Homes	Fully considered	Fully considered	Not considered	Not considered	Not considered	Not considered	Partially considered
Connected Location Transport links, facilities, amenities	Fully considered	Fully considered	Fully considered	Not considered	Not considered	Not considered	Not considered
Lifecycle Analysis	Fully considered	Fully considered	Fully considered	Not considered	Not considered	Not considered	Fully considered
Circular Economy Design for reuse	Fully considered	Fully considered	Fully considered	Not considered	Not considered	Not considered	Fully considered
Nationally Adapted Data fed back into national policy	Fully considered	Not considered	Not considered	Not considered	Not considered	Not considered	Partially considered

Fully considered Partially considered Not considered

** An EU framework from the European Commission. More information at https://ec.europa.eu/environment/topics/circular-economy/levels_en*

Figure 8: HPI compared to other standards

4.2 Carbon Designer Tool for Ireland (OneClick LCA)

The recently announced Carbon Designer Tool for Ireland is being considered for this development. The Irish Green Building Council developed the Carbon Designer for Ireland tool, and OneClick LCA, with support from the Land Development Agency (LDA) and the Environmental Protection Agency (EPA).

The Carbon Designer Tool for Ireland will be used to inform material specification and construction methods during design development and delivery phases to reduce embodied energy and whole life carbon impacts of the development.

4.3 DEAP (Dwellings)

DEAP calculations were performed on several dwelling types to ensure compliance with Part L and to enhance the overall building fabric and HAVC systems as reasonably as possible. The enhancements include.

- Improving building fabric performances for windows from what is required by TGD Part L (2021),
- Improving building air permeability to a maximum of 3 m3/hr/m2, from 5 m3/hr.m2 as required by TGD Part L (2021),
- Limiting heat loss through chimneys, open flues, and intermittent fans by implementing a whole-house extract system with a specific fan power no greater than 0.36 W/l/s,
- Enhancing the space heating and domestic hot water system by implementing a centralised heating scheme for the complete development, and air-water heat pumps for the townhouses, which reduces cost for tenants/ building owners and increases renewable energy generation.
- Solar photovoltaic will also be used, where required, to further increase the renewable energy generation and decrease grid supplied electricity.

4.4 Dynamic Energy Modelling

4.4.1 Overheating Risk/ Thermal Comfort Assessment

It is intended to preform dynamic thermal modelling during early detailed design, using the building energy simulation software, IESVE, to analyse selected worst case dwellings for overheating risk, and to propose design changes to mitigate that risk, if required. CIBSE TM 59 sets the design performance guidelines for overheating risk in residential building. Figure 9 below represents the factors which affect Thermal Comfort.

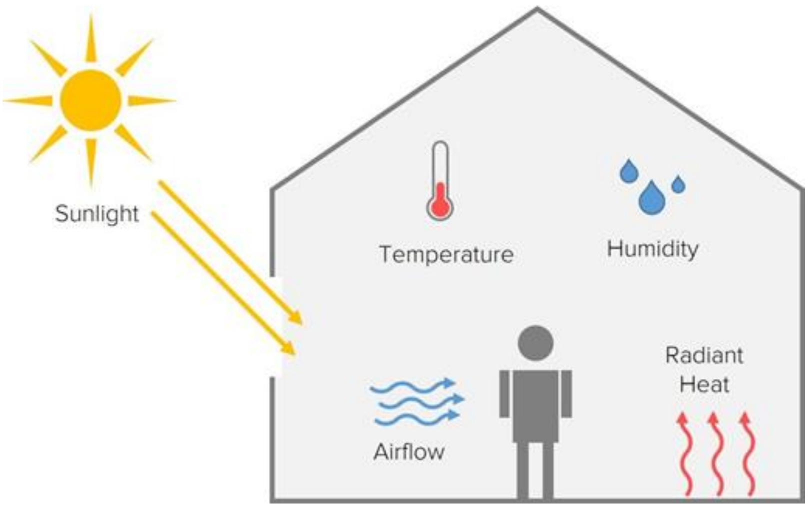

Figure 9: Factors Influencing Thermal Comfort

To further mitigate the risk of overheating, the development will meet HPI credit *HW4.2: Winter Comfort – Radiant Asymmetry*. This is based on minimising the temperature diffference between radiant surfaces and ambiant temperatures within a room. Glazing is now the main surface where significant temperature difference can occur in cold weather. This leads to precieved discomfort particularly when sitting near a window with poorer thermal performance. To mitigate this risk, it is proposed to improve the window thermal performance to achieve total system u-value of 1.10 W/m2k, and 1.40 W/m2k for sliding doors.

4.4.2 Internal Daylight, Sunlight & Overshadowing

Extensive works have been carried out to between Reddy A+U and GIA Chartered Surveyors to ensure the development will perform as well as possible regarding the availability of daylight and sunlight. The works included assessing internal daylight levels, sunlight availability, daylight availability and overshadowing on external amenity spaces.

GIA Chartered Surveyors stated within report GIA No: 17967, *"The achieved levels of daylight and sunlight are overall excellent for a scheme of this nature. As such, we consider that the scheme offers future residents' acceptable levels of daylight and sunlight amenity"*

For further information, please refer to GIA No: 17967 *"Daylight & Sunlight, Internal daylight, sunlight and overshadowing report, Dundrum Central SHD"*, created by GIA Chartered Surveyors on 01 March 2022. Submitted as part of this application.

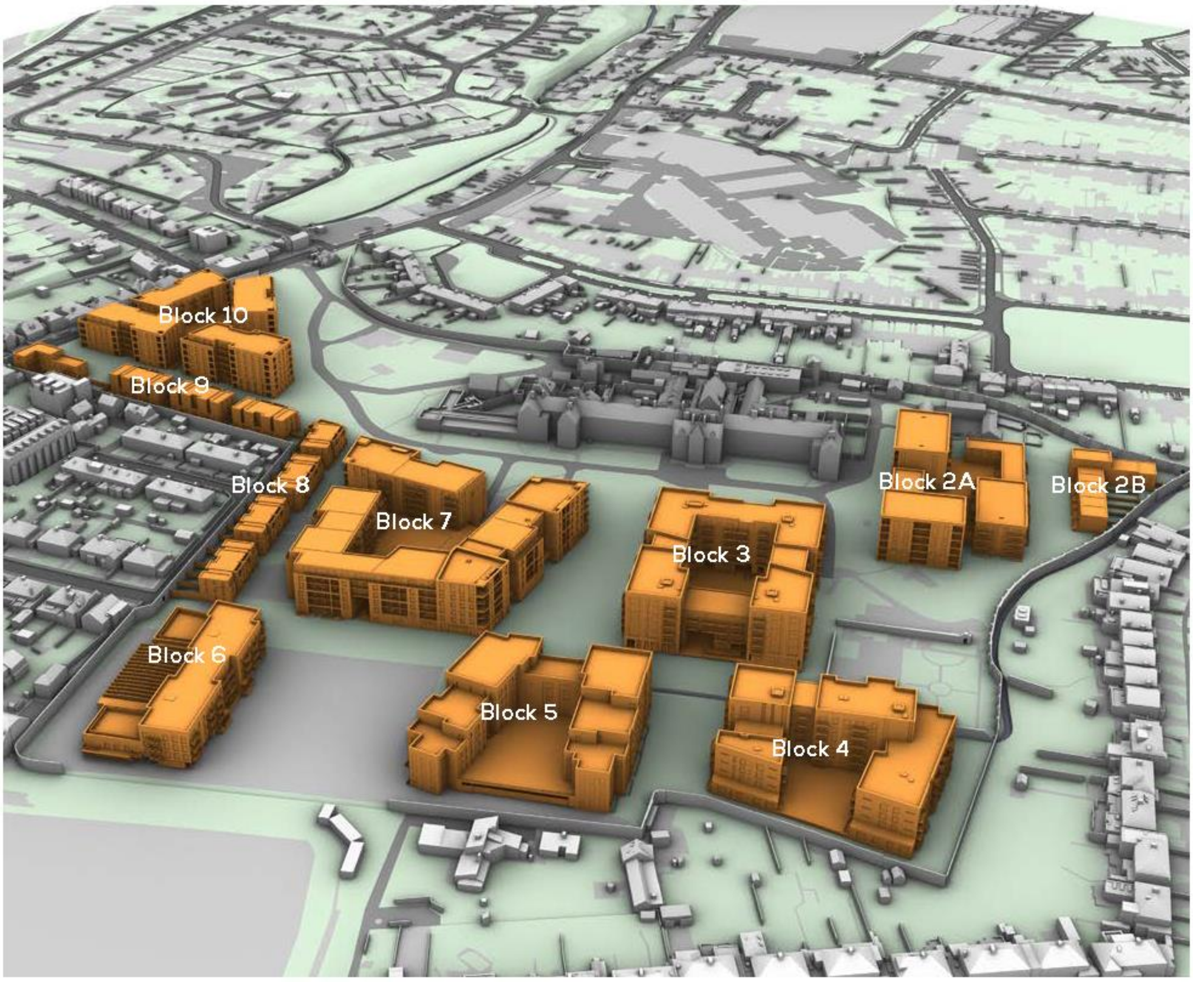

Figure 10: Daylight, Sunlight, Overshadowing Model Image from GIA No: 17967

5 CONCLUSION

A holistic sustainable approach has been adopted by the design team for the proposed development. Through detailed design, several sustainability and efficiency features have been considered throughout.

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

Be Mean

- Improving external window performances u-values from what is required by TGD Part L (2021),
- Improving building air permeability to a maximum of 3 m3/hr/m2, from 5 m3/hr.m2 as required by TGD Part L (2021),
- Limiting heat loss through chimneys, open flues, and intermittent fans by implementing a whole-house extract system with an intended specific fan power no greater than 0.36 W/l/s,

Be Clean

- Limiting heat loss through chimneys, open flues, and intermittent fans by implementing a whole-house extract system with an intended specific fan power no greater than 0.36 W/l/s,
- Enhancing the space heating and domestic hot water system by implementing a centralised heating scheme for the complete development served by air to water heat pumps, and individual air-water heat pumps for the townhouses, which reduces cost for tenants/ building owners and increases renewable energy generation.
- Low energy lighting design will be utilised to further reduce energy consumption and increase occupant thermal comfort.

Be Green

Several sustainable design features have been considered within the design to achieve the sustainability targets of the proposed refurbishment. These include:

- Utilising a centralised communal heating scheme served by air to water heat pumps to provide a renewable energy contribution to the development.
- Solar PV will be considered where required.

Home Performance Index (HPI)

This development is targeting HPI Certified as a minimum. All mandatory requirements will be fulfilled. In particular, EC1.0 – Net space heat demand requirements and QA 2.0 – Thermal Bridging calculations (non-default). Please refer to Appendix A for further information and assumptions made.

6 APPENDIX A – HPI CERTIFICATION REVIEW

HPI Certification Review

Project – Dundrum Central Project, Dublin 14

Client
LDA
Michael Goan
mgoan@lda.ie

Architects
Reddy Architects

19 Mountjoy Square, Dublin 1
www.igbc.ie, hpi@igbc.ie
01 681 5843

Summary

The following exercise is based on information from the Dundrum Central Project website - https://dundrumcentral.ie/

A list of assumptions are set out on the following page that form the basis of the exercise.

2

Assumptions for baseline certification (Highlighted in Table below)

- Reasonable levels of Water efficiency – 95l/person/day
- Low levels of ecology introduced through trees and bird boxes
- Embodied Carbon Calculation carried out
- C+D Waste is planned, tracked and reported
- FSC timber, Low VOC and EPD products chosen
- Low levels of universal design are incorporated
- Handover pack is provided to tenants in line with HPI requirements

All mandatory HPI requirements are fulfilled in particular EC1.0 - Net Space Heat Demand Requirements and QA 2.0 - Thermal Bridging Calculations (No default)

3

Category	Code	Credit	Y	?	N
Envrionment	EN 1.0	LAND USE	2		1
	EN 2.0	RESIDENTIAL DENSITY	6		
	EN 3.0	SURFACE WATER RUN-OFF	2	1	
	EN 4.1	INTERNAL WATER USE	4	3	
	EN 4.2	EXTERNAL WATER USE	0	1	
	EN 5.0	ECOLOGY	2	4	
	EN 6.1	ENERGY IN USE	4	4	
	EN 6.2	CARBON IN USE	4	4	
	EN 7.0	EMBODIED IMPACT OF HOMES	7	7	
	EN 8.1	WASTE MANAGEMENT DURING CONSTRUCTION	6		
	EN 8.2	ORGANIC AND RECYCLED WASTE MANAGEMENT	3		
	EN 9.0	PROCUREMENT OF TIMBER	3		
	EN 10.0	ENVIRONMENTAL PRODUCT DECLARATION	4		
	EN 11.0	TRANSPORT IMPACT	6	4	1
	EN 12.0	DWELLING SIZE ADJUSTMENT FACTOR	0		

Category	Code	Credit	Y	?	N
Health and Wellbeing	HW 1.0	INDOOR AIR QUALITY - VENTILATION*	4	4	
	HW 2.0	DAYLIGHTING*	2	4	
	HW 3.1	AIRBORNE SOUND INSULATION - WALLS		2	
	HW 3.2	AIRBORNE SOUND INSULATION - FLOORS		2	
	HW 3.3	IMPACT SOUND INSULATION - FLOORS		2	
	HW 3.4	INTERNAL SOURCES		2	
	HW 4.1	SUMMER COMFORT - RISK OF OVERHEATING		4	
	HW 4.2	WINTER COMFORT - RADIANT SYMMETRY		1	
	HW 5.0	LOW VOC SPECIFICATION AND TESTING	1	2	
	HW 6.0	RADON - MEASURED LEVELS		2	
	HW 7.0	DRINKING WATER QUALITY		1	
	HW 8.0	WALKABLE NEIGHBOURHOOD	8		1

Category	Code	Credit	Y	?	N
Economic	EC 1.0	NET SPACE HEAT DEMAND*	2	6	
	EC 2.0	ENERGY COSTS	2	4	
	EC 3.0	TRANSPORT COSTS	6	1	1
	EC 4.0	UNIVERSAL DESIGN	2	2	
	EC 5.0	SMART MONITORING OF ENERGY, HEAT AND WATER		4	
	EC 6.0	ENERGY LABELLED GOODS		4	
	EC 7.0	FLOOD RISK	4		

Category	Code	Credit	Y	?	N
Quality & Assurance	QA 1.0	QUALITY OF THE BUILDING SHELL - AIR INFILTRATION		6	
	QA 2.0	QUALITY OF THE BUILDING SHELL - THERMAL BRIDGING	2	4	
	QA 3.0	QUALITY OF OVERSIGHT AND TESTING	4		
	QA 4.0	CONSTRUCTION TEAM SKILLS*		4	
	QA 5.1	DESIGN TEAM SKILLS*	1	3	
	QA 5.2	DESIGN TEAM PLANNING			1
	QA 6.0	COMMISSIONING OF SERVICES		4	
	QA 7.0	POST OCCUPANCY EVALUATION		4	
	QA 8.0	CONSUMER INFORMATION AND AFTERCARE	2	2	
		Total Score	93.0	102.0	5

Category	Code	Credit	
Location	SL 1.1 - 1.4	Options for Transportation	Accessed within the categories above
	SL 2.1 - 2.9	Access to Amenities	

Total Score	46.5
Rating	-

Certification 45%
Gold 65%

4

Additional Items for Gold Certification (Highlighted in Table below)

- Increased levels of water efficiency below 80l/person/day
- Enhanced Landscaping and ecology proposal
- Additional Embodied Carbon optimisation at pre planning stage
- Reduced car parking provision at less than 1 / 4 units and 1 bike parking space / bedroom
- Internal Sources of noise comply with requirements exceeding Part E
- Risk of overheating is avoided passively
- Additional Radon measurement post occupancy
- Improved levels of universal design
- Construction team incorporates Considerate Constructors Scheme, and upskilling of staff for NZEB
- Independent commissioning of heat pumps, PV and ventilation system on completion and after 12 months
- Energy is assessed after 12 months and shared with IGBC

Mandatory requirement for Gold certification is zero on-site fossil fuel consumption and air tightness below 2 $(m^3/hr)/m^2$

5

			Y	?	N
Envrionment	EN 1.0	LAND USE	2		1
	EN 2.0	RESIDENTIAL DENSITY	6		
	EN 3.0	SURFACE WATER RUN-OFF	2	1	
	EN 4.1	INTERNAL WATER USE	7		
	EN 4.2	EXTERNAL WATER USE	0	1	
	EN 5.0	ECOLOGY	6		
	EN 6.1	ENERGY IN USE	4	4	
	EN 6.2	CARBON IN USE	4	4	
	EN 7.0	EMBODIED IMPACT OF HOMES	10	4	
	EN 8.1	WASTE MANAGEMENT DURING CONSTRUCTION	6		
	EN 8.2	ORGANIC AND RECYCLED WASTE MANAGEMENT	3		
	EN 9.0	PROCUREMENT OF TIMBER	3		
	EN 10.0	ENVIRONMENTAL PRODUCT DECLARATION	4		
	EN 11.0	TRANSPORT IMPACT	10		1
	EN 12.0	DWELLING SIZE ADJUSTMENT FACTOR	0		

			Y	?	N
Health and Wellbeing	HW 1.0	INDOOR AIR QUALITY - VENTILATION*	4	4	
	HW 2.0	DAYLIGHTING*	2	4	
	HW 3.1	AIRBORNE SOUND INSULATION - WALLS	2		
	HW 3.2	AIRBORNE SOUND INSULATION - FLOORS	2		
	HW 3.3	IMPACT SOUND INSULATION - FLOORS	2		
	HW 3.4	INTERNAL SOURCES	2		
	HW 4.1	SUMMER COMFORT - RISK OF OVERHEATING	3	1	
	HW 4.2	WINTER COMFORT - RADIANT SYMMETRY		1	
	HW 5.0	LOW VOC SPECIFICATION AND TESTING	1	2	
	HW 6.0	RADON - MEASURED LEVELS	2		
	HW 7.0	DRINKING WATER QUALITY		1	
	HW 8.0	WALKABLE NEIGHBOURHOOD	8		1

IGBC
IRISH GREEN BUILDING COUNCIL

			Y	?	N
Economic	EC 1.0	NET SPACE HEAT DEMAND*	2	6	
	EC 2.0	ENERGY COSTS	2	4	
	EC 3.0	TRANSPORT COSTS	6	1	1
	EC 4.0	UNIVERSAL DESIGN	3	1	
	EC 5.0	SMART MONITORING OF ENERGY, HEAT AND WATER		4	
	EC 6.0	ENERGY LABELLED GOODS		4	
	EC 7.0	FLOOD RISK	4		
Quality & Assurance	QA 1.0	QUALITY OF THE BUILDING SHELL - AIR INFILTRATION		6	
	QA 2.0	QUALITY OF THE BUILDING SHELL - THERMAL BRIDGING	2	4	
	QA 3.0	QUALITY OF OVERSIGHT AND TESTING	4		
	QA 4.0	CONSTRUCTION TEAM SKILLS*	4		
	QA 5.1	DESIGN TEAM SKILLS*	2	2	
	QA 5.2	DESIGN TEAM PLANNING			1
	QA 6.0	COMMISSIONING OF SERVICES	4		
	QA 7.0	POST OCCUPANCY EVALUATION	2	2	
	QA 8.0	CONSUMER INFORMATION AND AFTERCARE	2	2	
		Total Score	132.0	63.0	5

Location	SL 1.1 - 1.4	Options for Transportation	Accessed within the categories above
	SL 2.1 - 2.9	Access to Amenities	

Total Score	66
Rating	-

Certification 45%
Gold 65%

6

EDC

PROGRESSIVE ENGINEERING