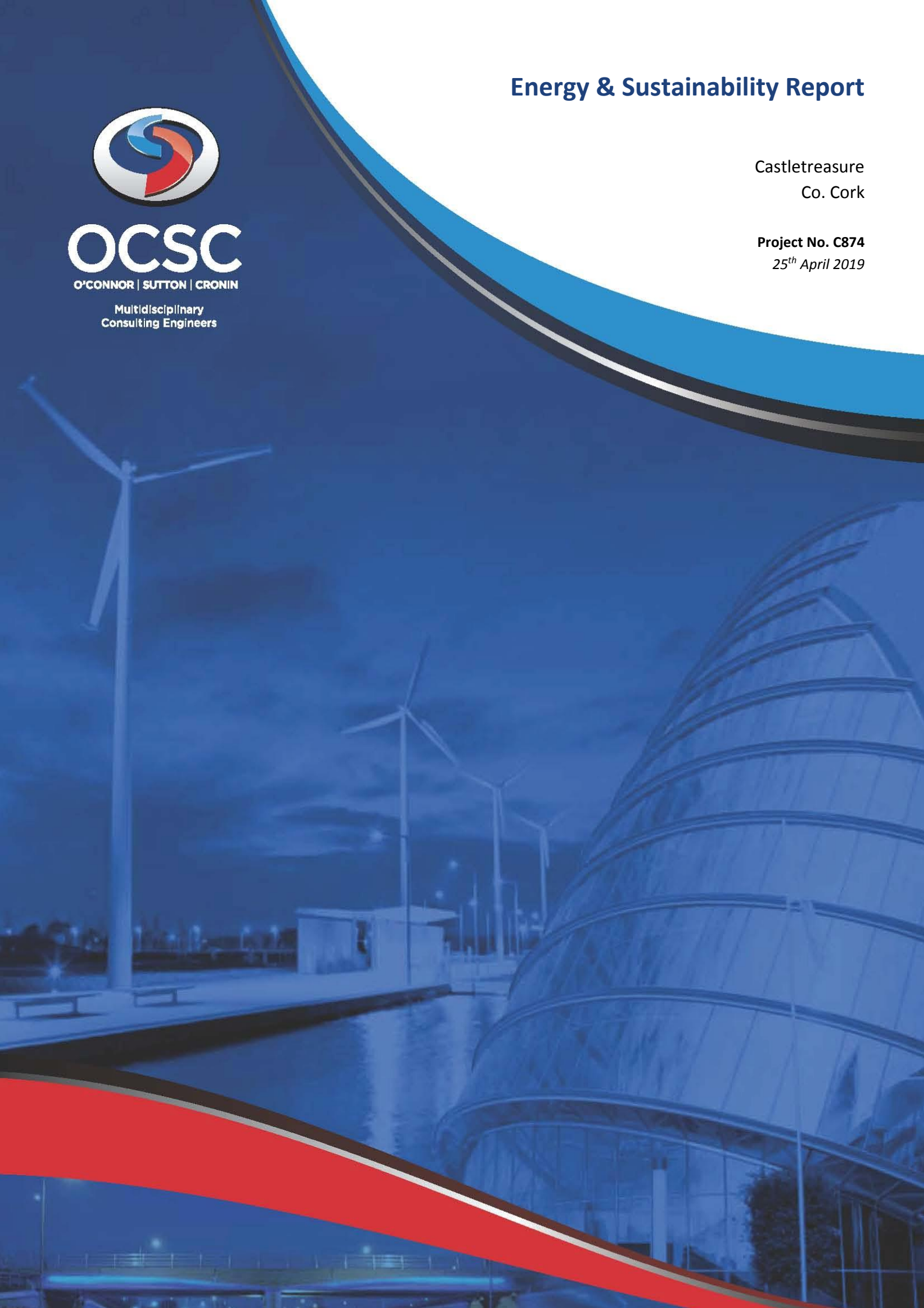
Energy & Sustainability Report

Castletreasure
Co. Cork

Project No. C874
25th April 2019

OCSC
O'CONNOR | SUTTON | CRONIN
Multidisciplinary
Consulting Engineers



Energy & Sustainability Report

NOTICE

OCSC Job No.: C874	Project Code	Originator Code	Zone Code	Level Code	File Type	Role Type	Number Series	Status/ Suitability Code	Revision
	C874	OCSC	XX	XX	RP	YS	0001	S4	P06

Rev.	Status	Authors	Checked	Authorised	Issue Date
6	Final	DM	MT	DO'C	25/04/2019
5	For Comment	DM	MT	DO'C	16/04/2019
4	For Comment	DM	MT	DO'C	09/04/2019
3	For Comment	DM	MT	DO'C	29/03/2019
2	For Comment	DM	MT	DO'C	22/03/2019
1	For Comment	DM	DO'C	DB	08/02/2019

ENERGY & SUSTAINABILITY REPOT

1. INTRODUCTION

The intention of this report is to identify the energy efficiency measures associated with the design, construction, ongoing management and maintenance of the proposed development at Castletreasure, Co. Cork.

The proposed development will comply with Part L (2019). As part of the development's efforts to further reduce energy consumption, the project is targeting an A2/A3 BER (Building Energy Rating) throughout. Extensive work has been carried out to develop a balanced design approach to achieve these onerous targets with a number of sustainable features being incorporated into the design from the early stages.

Target Energy Performance		
Standard/Rating	**Mandatory**	**Target**
Part L	**Yes**	**Part L (2019)**
BER	**Yes**	**A2/A3**

Table 1: Energy Performance Target

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

2. SITE DESCRIPTION

The proposed strategic housing development will consist of the construction of a strategic housing development comprising 472 residential units, a crèche and all associated ancillary development works. The proposed 472 no. residential units are broken down as follows:

- 234 no. semi-detached and terraced houses comprising 67 no. 4 bed units and 167 no. 3 bed units;
- 93 no. duplexes/apartments and 145 no. apartments (in Blocks A, B, C & D) comprising 76 no. 1 bed units, 123 no. 2 bed units and 39 no. 3 bed units.

The development also includes a number of play areas, active amenity spaces and circa 4.4 hectares of landscaped parkland which runs northwest to southeast through the site. A section of the Ballybrack Greenway is also provided within the parkland which will connect to the existing Cork County Council cycle network at the site's western boundary via the existing Irish Water Pumping Station compound, and to the future expansion of the Greenway towards Maryborough at the site's eastern boundary.

Primary access to the proposed development will be from a new signalised junction on to Carr's Hill/Carrigaline Road (R609), which will also serve a 24 classroom Primary School (permitted under Cork County Council planning application ref. 18/5369 / An Bord Pleanala, ref. ABP-302924-18) and which is located on land within the ownership of the applicant. Upgrades are also proposed to the Carr's Hill/Carrigaline Road (R609) including road widening, traffic calming and footpath connections. A second access point and footpath connections will be provided onto the Carr's Hill/Carrigaline Road (R609) (serving 98 apartments in Blocks B, C & D only) and access will also be provided via the adjoining Temple Grove residential area.

Provision is also made for the diversion of the existing 300mm Irish Water watermain, the construction of an underground wastewater pumping station and rising main to serve Apartment Blocks B, C and D, and all other associated ancillary site development works including ground works and retaining structures, foul drainage, stormwater drainage, water supply, 7 no. electrical substation kiosks, service ducting and cabling, boundary treatments, access roads including a vehicular and pedestrian bridge over the Moneygurney Stream, gateway treatment/signage on the Carr's Hill/Carrigaline Road (R609), bicycle and car parking and landscaping. A temporary single storey marketing suite, adjoining the Carr's Hill/Carrigaline Road (R609), and signage (including hoarding) will be provided during the construction phases.

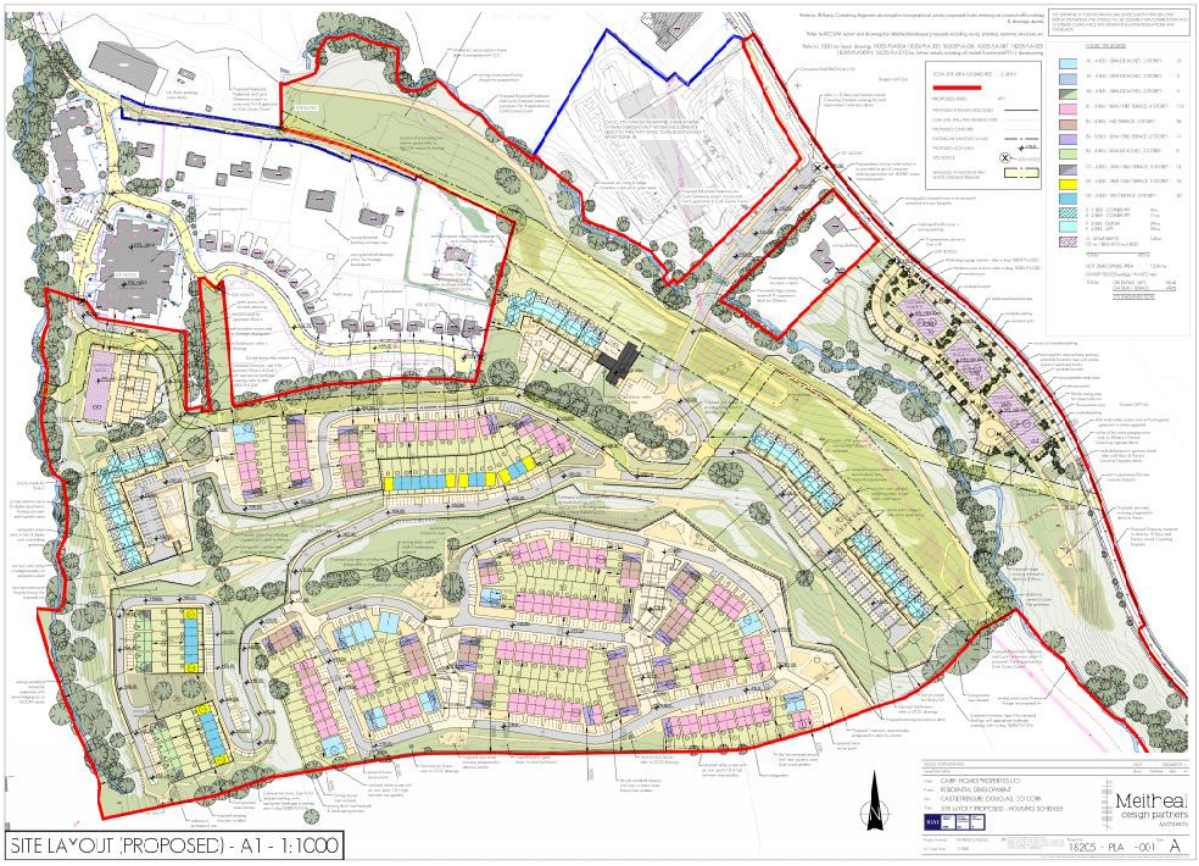


Figure 1: Site Location Plan

3. PART L BUILDING REGULATIONS

3.1. PART L (2019)

The proposed new Part L (2019) of the Technical Guidance Document has currently been issued in draft format by the Minister for Housing, Planning and Local Government and is yet to be finalised. This document is due to be the new standard for dwellings constructed from November 2019.

The Part L (2019) 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".*

Renewable Energy Ratio (RER):

For the proposed Part L (2019) NZEB requirements, a Renewable Energy Ratio (RER) is to replace the current Part L (2011) renewable requirements. A RER of 20% is currently being proposed, however, this is yet to be finalised by the Dept. of Housing, Planning & Local Government.

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;
- Wind Power;
- Solar Thermal System;
- CHP Units (Combined Heat & Power);
- Biomass Systems (using Biofuels);
- Heat Pumps (Minimum COP of 2.5).

To demonstrate that an acceptable primary energy consumption rate has been achieved, the calculated Energy Performance Coefficient (EPC) of the dwelling being assessed should be no greater than the Maximum Permitted Energy Performance Coefficient (MPEPC).

The MPEPC is 0.3 (NZEB compliant – subject to final confirmation)

To demonstrate that an acceptable CO2 emission rate has been achieved, the calculated Carbon Performance Coefficient (CPC) of the dwelling being assessed should be no greater than the Maximum Permitted Carbon Performance Coefficient (MPCPC).

The MPCPC is 0.35 (NZEB compliant – subject to final confirmation)

3.2. PROPOSED TRANSITIONAL ARRANGEMENTS:

As it stands, the proposed new Part L (2019) standard is due to come into effect with the following transitional arrangements **(to be confirmed)**:

- Part L 2011 will cease to have effect from November 2019.
- However, the 2011 document may continue to be used in the case of:
    - Where work has started on or before October 2019, or
    - Where planning approval has been applied for on or before October 2019 and substantial work** has been completed by mid-2020.

** "Substantial work" means that:

- For houses, the structure of external walls (up to wall-plate) has been erected.
- For apartments, the structure of the roof deck has been completed.

Due to the timeline for completion, the proposed development will be targeting compliance under Part L (2019).

4. BUILDING ENERGY RATING (BER)

As of 1st July 2009, all newly built domestic buildings and existing buildings that are for sale or rent require a BER (Building Energy Rating) certificate. The Castletreasure development is targeting an A2/A3 BER.

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 variables 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)
- Lighting systems (how efficient is the lighting)

The variables 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.

5. COMPLIANCE WITH PART F OF BUILDING REGULATIONS

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 Document's (TGD).

The proposed version of TGD Part F (2019) 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.*

In relation to F1, the proposed design for the houses and apartments will comply with the requirements.
In relation to F2, all roof systems throughout will be effectively ventilated in order to avoid condensation.

6. 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.

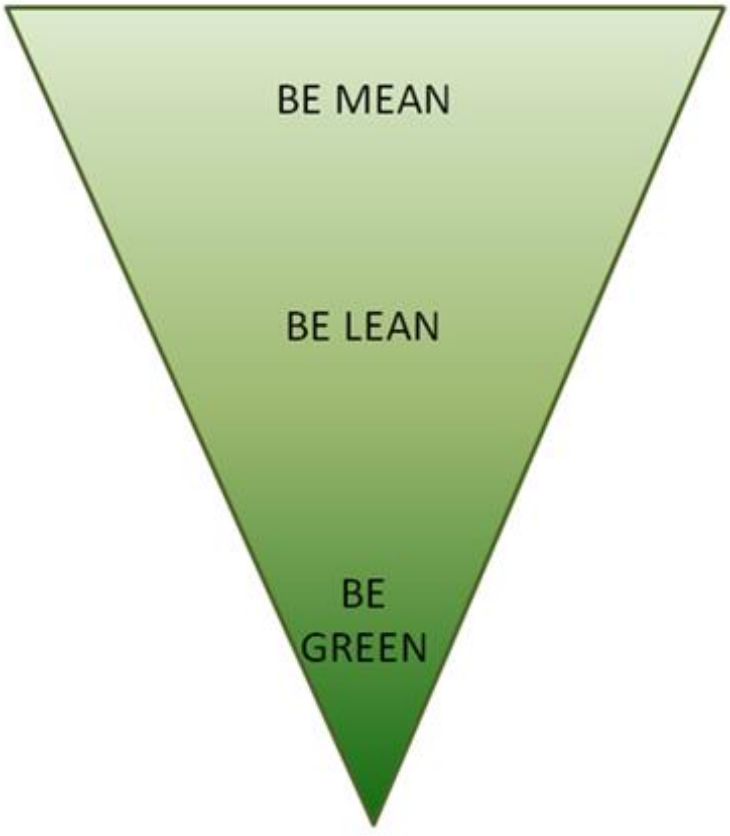


Figure 2: Energy Hierarchy Plan

6.1. 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
- Improved thermal transmittance and thermal bridging design
- Passive design measures

6.1.1. HIGH PERFORMANCE U-VALUES

To limit the heat loss through the façade, careful consideration must be demonstrated 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 target average elemental U-Values for the new build elements are set out in Table 2 and demonstrates how the proposed development will comply with Part L (2019) performance requirements.

6.1.2. 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 Part L (2019), a performance level of 5 $m^3/hr/m^2$ @ 50 Pa represents a reasonable upper limit for air permeability.

It is intended the proposed development will target an air permeability rate of 3 $m^3/hr/m^2$ @ 50 Pa.

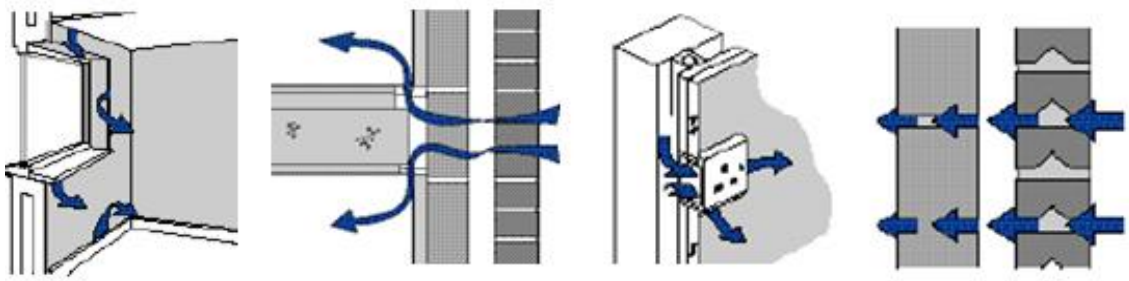


Figure 3: Typical Air Leakage Paths

For the new build elements, products installed will be factory tested and certified before reaching site. Elements of the façade will be installed and tested to ensure the proposed façade system achieves the design target.

Information on air tightness testing requirements are summarised in Appendix A.

6.1.3. 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 development will be designed to achieve low thermal bridging values where possible. For more information relating to thermal bridges, please follow the guidance in Appendix B of this report. A Y value of ≤0.05 W/m^2.k must be achieved, in accordance with Part L (2019) stipulations.

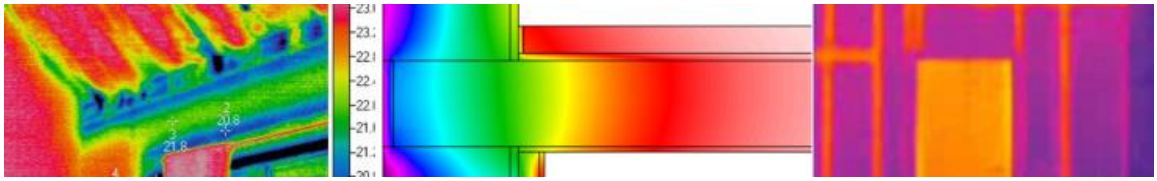


Figure 4: Typical Thermal Bridging Details

6.1.4. PASSIVE DESIGN

The proposed Castletreasure development has been evaluated and analysed with respect to Daylight/ Sunlight, in order to determine the following:

- The expected daylight levels within the living and bedroom areas of each house type and selected apartments, to give an indication of the expected daylight levels throughout the proposed development.
- The quality of amenity space being provided as part of the development, in relation to sunlight.
- Any potential overshadowing impact the proposed development may have on properties adjacent to the site.

The calculations and methodology used are in accordance with BRE Guidelines for daylight and sunlight and based on the British Research Establishments "Site Layout Planning for Daylight and Sunlight: A Good Practice Guide" by PJ Littlefair, 2011 Second Edition.

6.2. 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.

6.2.1. LOW ENERGY PLANT

To improve the building's overall energy efficiency, all HVAC plant has been selected based on performance and energy efficiency.

Space Heating: It is proposed to satisfy the space heating requirements of the development through one or a combination of the following options:

- Electric heating;
- Natural gas boiler;
- Air source heat pump.

Domestic Hot Water: It is proposed to satisfy the domestic hot water requirements of the development through one or a combination of the following options:

- DHW heat pump;
- Natural gas boiler;
- Air source heat pump.

Ventilation: Mechanical ventilation with heat recovery (MVHR) will be supplied to each apartment and house. The proposed strategy extracts the moist, stale and polluted internal air from wet rooms of the home such as bathrooms, utility rooms and kitchens. This air is passed over a heat exchange cell which recovers and retains the heat that would otherwise be lost from the extracted air. This heat is then transferred to incoming fresh, filtered air that the unit resupplies back into habitable rooms such as bedrooms and living rooms, resulting in minimal heat losses and a more comfortable indoor environment.

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.

6.2.2. LIGHTING

The design intent for internal lighting design is to introduce high efficiency LED artificial lighting to all applicable areas.

The design of the building façade has been significantly influenced to maximise potential levels of natural daylight within occupied zones, while reducing the impact of unnecessary solar gains.

6.2.3. ONGOING MONITORING AND CONTROLS

Apartments:

A BEMS (Building Energy Management System) system is to be installed to monitor the use of all major systems in the building, including:

- Space heating
- Space cooling
- Water consumption

The BEMS system is a graphical interface which allows the facilities/building manager to monitor and control all systems throughout the building. The development manager can view operational temperatures for the heating and cooling systems to ensure they are operating at maximum efficiency.

Houses:

Independent control systems are to be installed to monitor and control the use of all major systems in the building, including;

- Space heating;
- Water consumption.

Independent control of systems is to be installed to monitor the use of all space heating in the dwelling. This includes time and temperature zone control, one thermostat per zone, bedroom heating and living heating and domestic hot water controls in all units.

6.3. STEP 3 (BE GREEN) – USE OF LOW OR ZERO CARBON (LZC) TECHNOLOGY

Air-Source Heat Pumps and Solar Photovoltaics (PV) are currently being considered for use within the Castletreasure development and are deemed renewable energy technologies under Part L (2019). Integration of these technologies will help meet the Part L and BER targets.

6.3.1. AIR SOURCE HEAT PUMP

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.

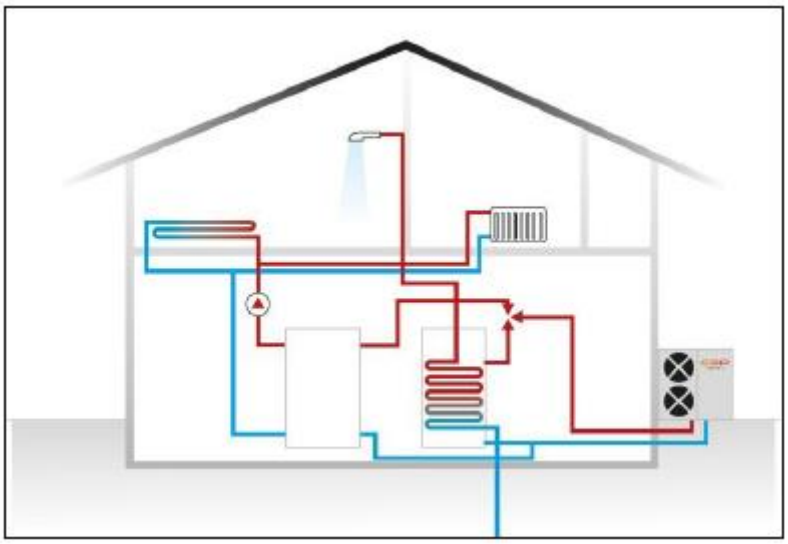


Figure 5: Example Diagram of Air Source Heat Pump Layout

6.3.2. SOLAR PHOTOVOLTAICS

Photovoltaic (PV) panels convert the solar radiation into electricity, which can be connected to the mains supply of a building. Rooftop solar PV is being considered for incorporation into the proposed Castletreasure development.

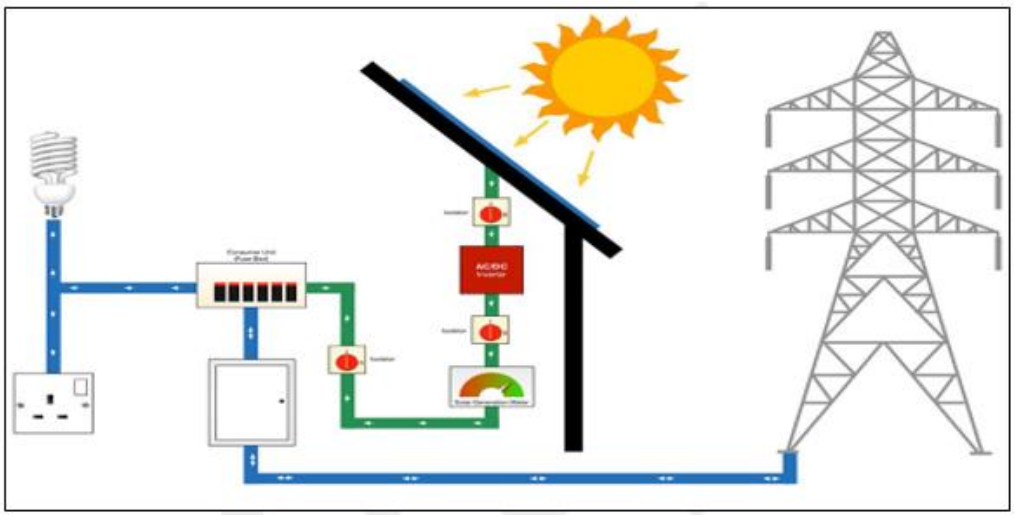


Figure 6: Example Diagram of Solar PV Layout

7. PROPOSED PART L SPECIFICATION SUMMARY

The energy strategy for the proposed Castletreasure development is summarised as follows:

- High thermal envelope performance throughout;
- Reduced air permeability with 'Best Practice' façade design;
- Energy efficient production of hot water for space heating and domestic hot water;
- All lighting installed will be energy efficient;
- High efficiency ventilation system - Mechanical Ventilation with Heat Recovery (MVHR);
- Provision for renewable technologies – the option of Solar PV Panels or Air Source Heat Pumps (ASHP).

Table 2 summarises the energy strategy options being considered for the proposed Castletreasure development.

Description	**Option 1** **Electric Heating & Air Source Heat Pump for DHW** **-Proposed Part L (2019)-**	**Option 2** **Gas Boiler & PV** **-Proposed Part L (2019)-**	**Option 3** **Air Source Heat Pump** **-Proposed Part L (2019)-**
Element Performance			
Thermal Element	**Proposed U-Value (W/m².K)**	**Proposed U-Value (W/m².K)**	**Proposed U-Value (W/m².K)**
External walls	0.18	0.18	0.18
Roof	0.16	0.16	0.16
Floor	0.18	0.18	0.18
Windows	1.4 (Double)*	1.4 (Double)*	1.4 (Double)*
Glazing g-value	0.7	0.7	0.7
Air Permeability			
m³/hr/m²@50Pa	3	3	3
Thermal Bridging			
W/m².K	0.05	0.05	0.05
Ventilation, Space heating & Domestic hot water			
Ventilation	Mechanical Ventilation with Heat Recovery (MVHR)	Mechanical Ventilation with Heat Recovery (MVHR)	Mechanical Ventilation with Heat Recovery (MVHR)
Space Heating	Electric Panel Heaters	High Efficiency Gas Boiler	High Efficiency Air Source Heat Pump (ASHP)
Domestic Hot Water	Air Source Heat Pump (ASHP)	High Efficiency Gas Boiler	High Efficiency Air Source Heat Pump (ASHP)
BE GREEN – Renewables			
Renewables	Provided by Solar PV panels & ASHP Approx. 3/4 no. Solar PV panels	Provided by Solar PV panels Approx. 6 no. Solar PV panels	Provided by Air Source Heat Pump (ASHP) & Solar PV panels Approx. 1 no. Solar PV panel
RESULTS - Carbon Emission Reductions			
Renewable Energy Contribution Achieved	**Yes**	**Yes**	**Yes**
EPC	**Compliant**	**Compliant**	**Compliant**
Building Energy Rating (BER)	A2/A3	A2/A3	A2/A3
Compliance with Part L (2019) Requirements	**Yes**	**Yes**	**Yes**

Table 2: Proposed Performance Specification for the Castletreasure Development

*1.4 W/m²K acceptable throughout development pending final confirmation from Dept of Housing, Planning and Local Government)

8. KEY SUSTAINABLE FEATURES

Key sustainability features for the Castletreasure development are available through transportation, use of water efficient fixtures, consideration for materials and resources and improved indoor environmental quality for the building occupants.

8.1. LOCATION AND TRANSPORTATION

Developing in an area that has a strong primary and secondary road network allows residents the opportunity to travel to and from the site with ease. The development is accessible by the N28 primary road nearby, together with the numerous intersecting secondary road also allows residents accessibility to the development by bicycle.

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 in commercial buildings, 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. 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

The proposed development will comply with Part L (2019), as well as achieving an A2/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 central plant will be specified 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

- High efficiency Air-Source Heat Pumps, and rooftop Solar Photovoltaics are being considered for use within the development.

This report confirms that if the strategy is adopted as suggested and properly implemented, then all houses and apartments and dwellings within the Castletreasure development will comply with Part L 2019 (Conservation of Fuel and Energy) of the Technical Guidance Documents and will also achieve a targeted BER rating of A2/A3 throughout.

APPENDIX A

Air Permeability testing

An air pressure test is to be carried out on each residential unit. The target to be achieved is 3 $m^3/hr/m^2$@50Pa under test conditions.

The procedure for testing is specified in I.S. EN 13829: 2000 "Thermal performance of buildings: determination of air permeability of buildings: fan pressurization method".

The tests should be carried out by a person certified by an independent third party to carry out this work, e.g. National Standards Authority of Ireland certified or equivalent. The test report should contain at least the information specified in Section 7 of I.S. EN 13829.

APPENDIX B

Thermal Bridging Calculations

Thermal bridging calculations must be carried out on all details provided within the Façade tender package. All calculations must be carried out in line with ISO 10211:2007 "Thermal bridges in building construction -- Heat flows and surface temperatures -- Detailed calculations"

All calculations must be carried out by a registered assessor listed under the NSAI Thermal Modelling scheme. The link for the approved modelers is shown below:

https://www.nsai.ie/certification/agrement-certification/thermal-modellers-scheme

Before any detail is accepted the output report for the proposed detail must be submitted as part of the technical submittal process and the NSAI registered assessor must provide the following reports:

- Psi output report from the certified modelling software (Psi-Therm or equivalent)
- Frsi output report from the certified modelling software (Psi-Therm or equivalent)

OCSC

O'CONNOR | SUTTON | CRONIN

Multidisciplinary
Consulting Engineers

9 Prussia Street
Dublin 7
Ireland

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

Dublin | London | Abu Dhabi | Belfast | Cork | Galway | Glasgow | Libya | Poland | Romania | Russia