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MULTIDISCIPLINARY CONSULTING ENGINEERS

S1071: SCHOOL SITE AT KILCARBERY

ENERGY & SUSTAINABILITY REPORT

For

South Dublin County Council

18 December 2023

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1 EXECUTIVE SUMMARY

This document provides an overview of how the project intends to integrate sustainability as a key strategy into the development'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 as an energy efficient envelope, which in turn reduces the demands 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 this 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 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 residential development at the School Site at Kilcarbery will achieve all energy and sustainability targets.

2 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 residential development at Upper Nangor Rd, Kilcarbery Grange, Dublin 22.

The proposed development will comply with Part L 2022 (Dwellings). As part of the development's efforts to further reduce energy consumption, the project is targeting a minimum A3 BER (Building Energy Rating) across the development.

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.

Table 1: Energy Performance Targets

Standard / Rating	Mandatory	Target
Part L Residential	Yes	2022 (NZEB)
BER Residential	Yes	A2/A3

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

3 PROPOSED DEVELOPMENT

The proposal has been prepared on behalf of South Dublin County Council as a Part 8 application for a residential development, consisting of 88 residential units on undeveloped lands measuring c. 2.04 hectares adjoining the Upper Nangor Rd, Kilcarbery Grange, Dublin 22.

The proposed development consists of a mix of 88 units consisting of a variety of house and duplex types. The units proposed include 44 no. 3bed 2 storey houses, 8 no. 4 bed 2 storeys houses, 36 no. duplex units (varying from 1 to 3 beds) within 3 storey duplex blocks. The development includes 100 no. surface car park spaces and 110 no. bicycle parking spaces, above ground sustainable urban drainage measures, an ESB kiosk, Irish Water below-ground foul pumping station, proposed new roads, footpath and cycle-paths (including works to provide a cycle-path along a portion of the Upper Nangor Rd), public open space areas, landscape works, bin/bicycle stores and all associated ancillary site development works.

Figure 1: Proposed site plan

4 PART L CONSERVATION OF FUEL & ENERGY- DWELLINGS

4.1 PART L 2022 (DWELLINGS)

Part L 2022 (Dwellings) of the Technical Guidance Document has been issued by the Minister for Housing, Local Government and Heritage. This document is the new standard for dwellings constructed after 25th October 2022.

The Part L 2022 (Dwellings) 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".*

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 COP of 2.5).

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 (residential, 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.

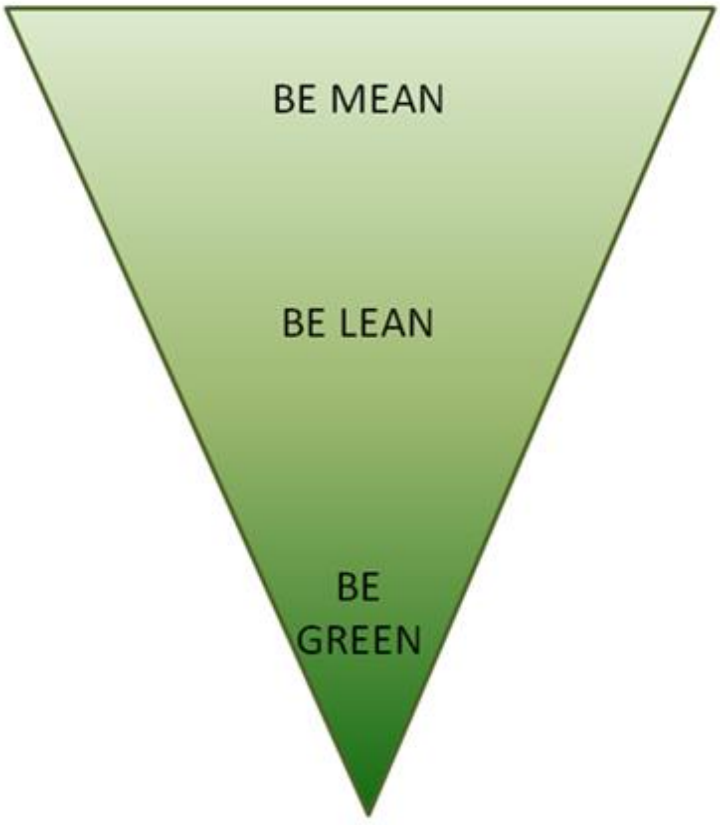

Figure 2: Energy Hierarchy Plan

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 the proposed development are outlined in Table 2 below.

Table 2: Residential Building Envelope Thermal Performance Targets

Fabric Element	School Site at Kilcarbery Maximum Average Elemental U-value ($W/m^2.K$)
External Walls	0.18
Flat Roof	0.18
Pitched Roof	0.16
Ground Contact & Exposed Floor	0.18 (0.15 if underfloor heating installed)
External Windows, Roof-lights & Doors	1.40

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 development will target an air permeability rate of ≤ 3 m³/hr/m² @50 Pa.

Figure 3: Air tightness testing examples

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 proposed development will be designed to achieve low thermal bridging values throughout.

A Y value of ≤ 0.08 W/m^2.K is being targeted for the development, in accordance with Part L (2022) – Dwellings requirements. The risks relating to mould growth/ condensation risks will also be assessed, in accordance with Part L (2022) – Dwellings.

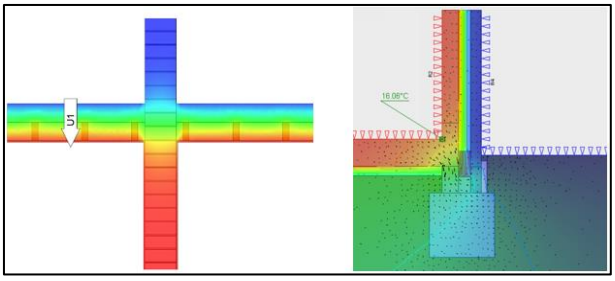

Figure 4: Thermal Bridge Assessment Examples

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.

The proposed development will be evaluated and analysed with respect to overheating as outlined in Part L 2022 (Dwellings) and CIBSE TM59 (Design Methodology for the Assessment of Overheating Risk in Homes).

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 development as efficiently as possible.

7.2.1 LOW ENERGY PLANT - RESIDENTIAL

To improve the overall energy efficiency 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
- Exhaust Air Heat Pumps (EAHP)

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

- Air Source Heat Pumps (ASHP), or
- Exhaust Air Heat Pumps (EAHP)

Ventilation: The plant options for ventilation are:

- Whole House Extract Ventilation, or
- Mechanical Extract Ventilation via the EAHP

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.

7.2.2 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 developments façades also allows high levels of natural daylight to enter into occupied zones.

7.2.3 ONGOING MONITORING

A BEMS (Building Energy Management System) system is to be installed to monitor the use of all major systems in the building. The BEMS system 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 residential development at School Site at Kilcarbery.

7.3.1 AIR SOURCE HEAT PUMP - RESIDENTIAL

Air source heat pumps convert energy from the air to provide heat and hot water for buildings. 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 a building.

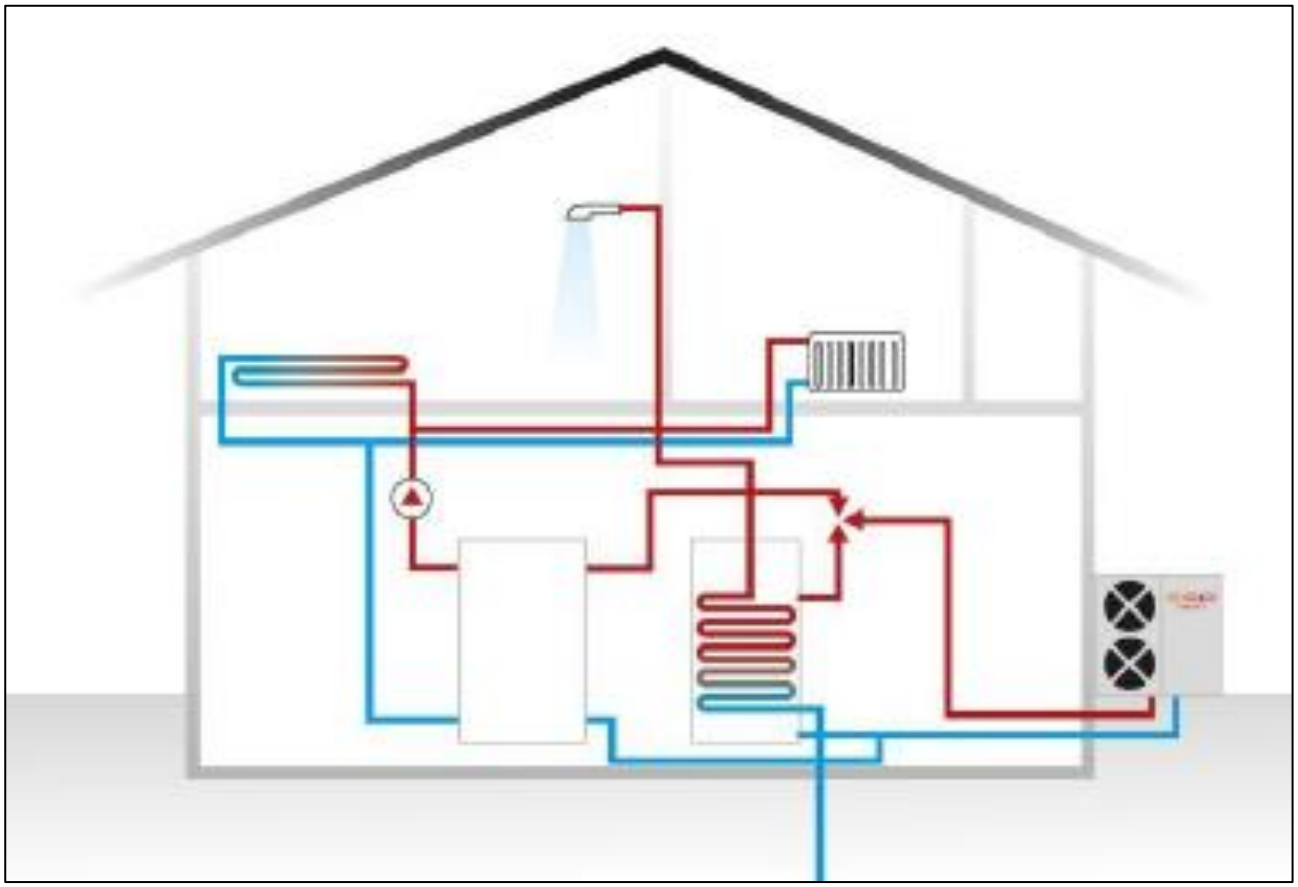

Figure 5: Air-Source Heat Pump Diagram

7.3.2 EXHAUST AIR HEAT PUMP

Exhaust air heat pumps collect warm air as it leaves a building via the ventilation system and then reuse the heat that would otherwise be lost to the outside to heat fresh air coming into the building or to heat water. Exhaust air heat pumps operate on a similar basis to other heat pumps such as air source heat pumps and ground source heat pumps and are suitable for providing hot water and heating for buildings such as houses, apartments or flats.

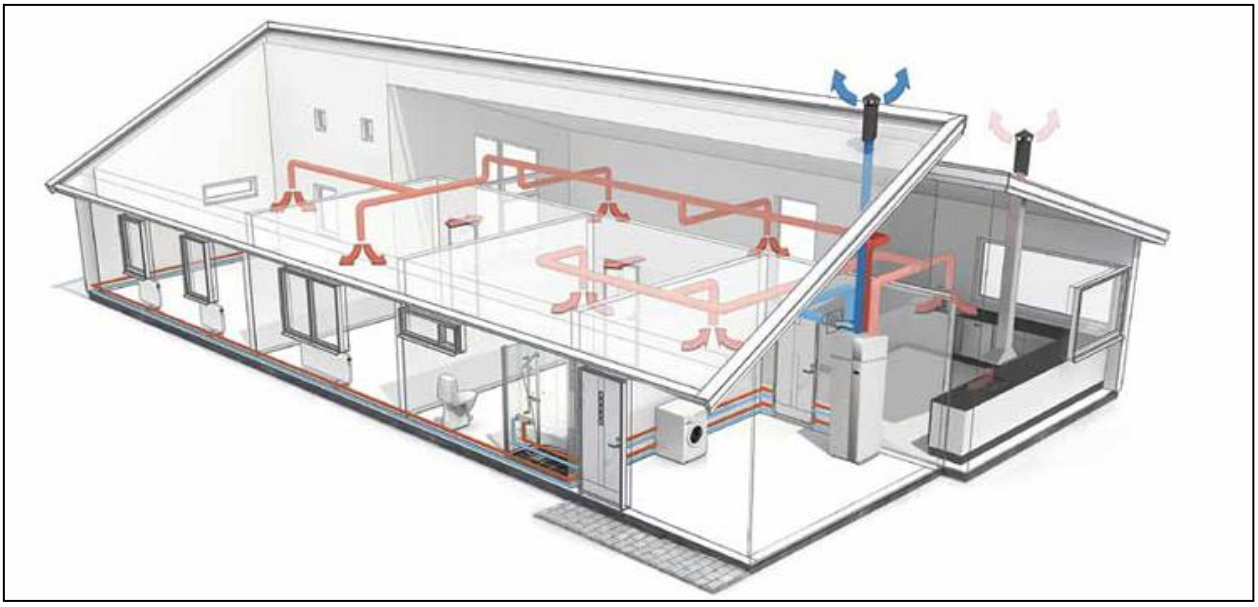

Figure 6: Example Diagram of Typical Exhaust Air Heat Pump Layout

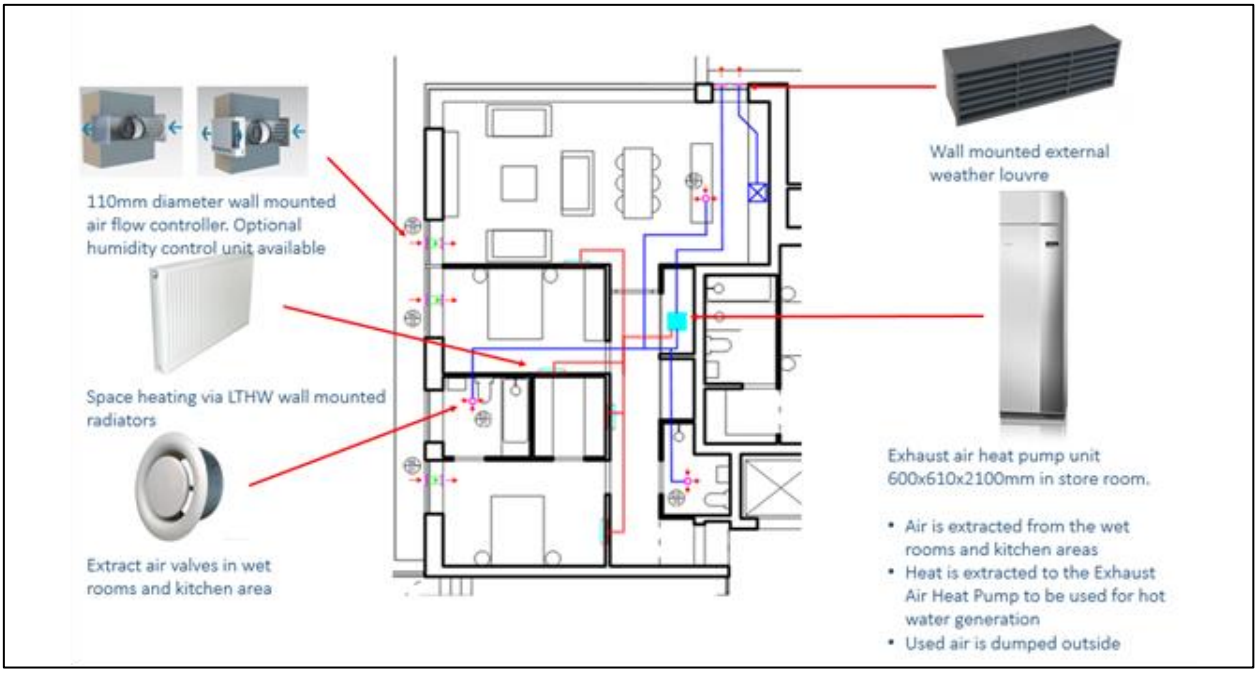

Figure 7: Example Diagram of Typical Exhaust Air Heat Pump Layout

8 KEY SUSTAINABLE FEATURES

The location of the proposed residential development at the School Site at Kilcarbery 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 development 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, bicycle lanes and local car sharing locations and their proximity to the proposed development.

Bus:

Figure 8: Local Dublin Bus Stops

Dublin Bikes/Trails:

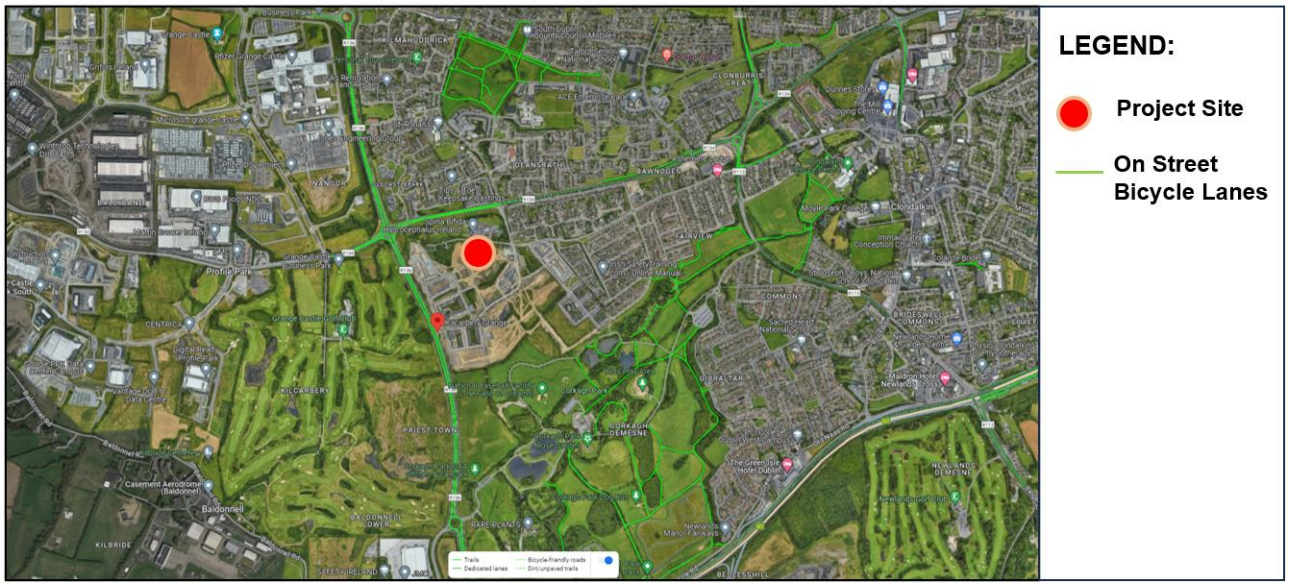

Figure 9: Local Bicycle Lanes

Go-Car:

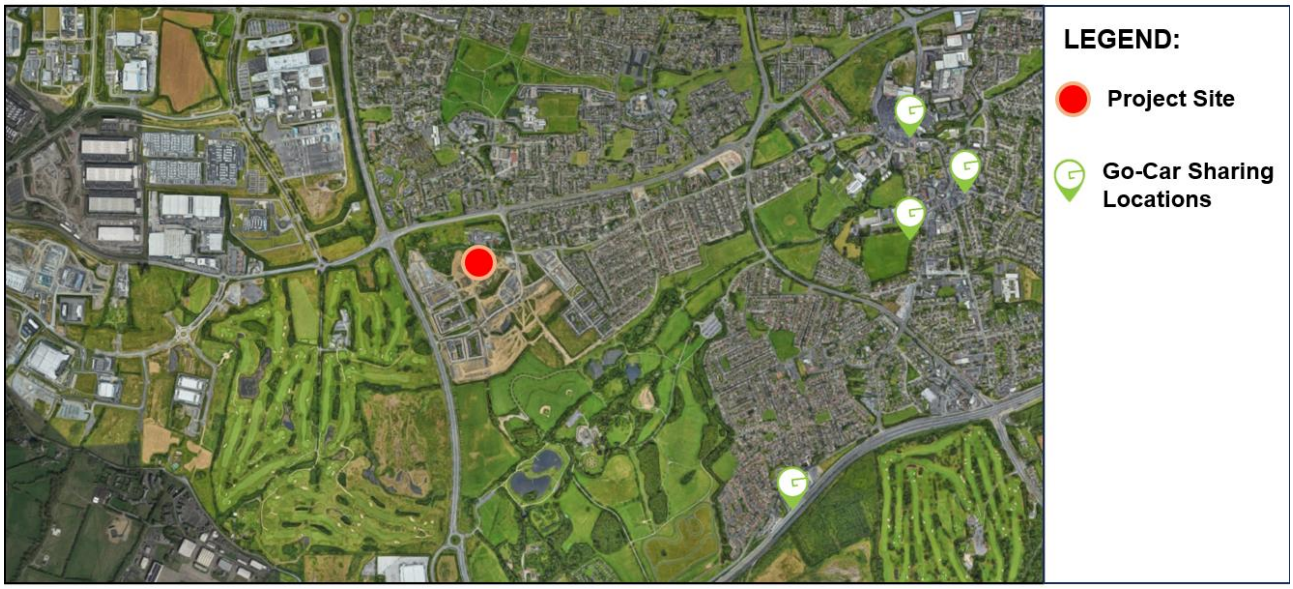

Figure 10: Local Car Sharing Locations

8.2 COMMISSIONING

To ensure efficient operation of the development, all systems will be commissioned. Commissioning of a developments 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 development 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.

8.7 ELECTRIC VEHICLE CHARGING

As part of the sustainable design strategy, the development shall provide the following provisions relating to electric vehicle charging:

- The proposed development will have 10% of E.V car spaces installed at construction and 'infrastructure' to allow 100% future installation of recharging points.

9 CONCLUSION

A holistic sustainable approach been adopted by the design team for the proposed residential development at the School Site at Kilcarbery. Through detailed design, a number of sustainability and efficiency features have been considered throughout.

The proposed residential development will comply with Part L 2022 (Dwellings), as well as targeting 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 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

- Renewable energy technologies such as Air Source Heat Pumps (ASHP) and Exhaust Air Heat Pumps (EAHP) 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 residential development at the School Site at Kilcarbery will satisfy all Part L and BER requirements.

10 VERIFICATION

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