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Energy Efficiency and Climate Change Adaptation Design Statement
Large-Scale Residential Development
at Belgard Square East, Belgard Road and Old Blessington Road, Tallaght, Dublin 24

17 November 2025 Rev. P02

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1. Introduction

1.1 Purpose of the Report

Climate change has emerged as one of the most pressing global challenges of our time, with its far-reaching impacts affecting ecosystems, economies, and societies worldwide.

The scientific consensus on climate change, driven by the accumulation of greenhouse gases in the Earth's atmosphere, has triggered growing concern among citizens, scientists, and policymakers. This heightened awareness stems from the escalating frequency of extreme weather events, rising sea levels, disruptions in agriculture, and threats to biodiversity.

Ireland, like many nations, faces unique climate-related challenges, including vulnerable coastal areas, agricultural dependencies, and emissions reduction targets. Concurrently, the European Union has made it a top priority to lead global efforts in combating climate change.

This report has been prepared by Renaissance Engineering in response to Item 12.10.1 of the issued South Dublin County Council (SDCC) Development Plan request that "Development proposals for medium to large scale residential and commercial developments in excess of 10 residential units and / or 1,000 sq m of commercial floor space should be accompanied by an Energy Efficiency and Climate Change Adaptation Design Statement.

This sub-section 12.10.1 of the South Dublin County Development Plan, hereafter referred to as the SDCDP, states that the statement should include:

- *How any on-site demolition, construction and long-term management of the development will be catered for;*
- *How energy and climate change adaptation considerations have been inherently addressed in the design and planning of the scheme.*

The purpose of this statement is to demonstrate how low carbon energy and heating solutions, as well as demolition and adaptation strategies have been considered as part of the overall design and planning of the proposed development.

1.2 Description of Development

Midsal Homes Limited intends to apply for permission for a Large-Scale Residential Development (LRD) at a site of approximately 1.19 Ha at Belgard Square East, Belgard Road and Old Blessington Road, Tallaght, Dublin 24. The main development site (approximately 0.91 Ha) is generally bound: to the north by Old Blessington Road; to the east by Belgard Road (R113); to the south by McDonald's Restaurant property (D24 HW74); and to the west by Belgard Square East. The site also includes parts of the carriageways and verges of Belgard Square East, Belgard Road and Old Blessington Road (approximately 0.28 Ha) for the provision of landscaping, 2 No. pedestrian crossings, accesses/junctions, minor road and footpath works, cycle infrastructure and water services infrastructure.

The proposed development principally comprises: the demolition and removal of existing boundary walls and railings on the main development site's eastern, western and northern sides; and the construction of a mixed-use development in 2 No. blocks (Block A to the south and Block B to the north) with a gross foor area of 23,540 sq m (excluding basement of 275 sq m) and ranging in height from 1 No. to 7 No. storeys (with mezzanine level) over basement.

The development includes a total of 199 No. residential dwellings (6 No. studios, 47 No. 1-bed, 98 No. 2-bed and 48 No. 3-bed) in the 2 No. blocks, with Block A comprising 49 No. 'senior living' apartment units and Block B comprising 150 No. 'standard' apartment units. The development also includes 2,123 sq m of non-residential floor space, with the following uses proposed: 4 No. retail units (totalling 331 sq m); 4 No. class 1 / class 2 commercial units (totalling 387 sq m); a bicycle sales and repair shop (81 sq m); an of-licence (64 sq m); a bar (151 sq m); a café (87 sq m); a medical centre (210 sq m); a dental practice (72 sq m); a pharmacy (195 sq m); a beauty/health salon (195 sq m); and a crèche (350 sq m) with external play area.

The development also comprises: an undercroft car park accessed via a new entrance/exit at Belgard Square East which provides 58 No. car parking spaces; a gated service lane to the south of Block A, with entrances/exits of Belgard Square East and Belgard Road; 2 No. pedestrian/cycle crossings, at Belgard Square East and Belgard Road; continuation of the northbound cycle lane from Belgard Road onto Old Blessington Road; alteration to the median and northbound right turn at Belgard Road onto Abberley Square; cycle parking; internal communal amenity spaces for the senior living units; hard and soft landscaping, including public open space, communal amenity space and incidental spaces; private amenity spaces (as balconies and terraces facing all directions); boundary treatments; 2 No. sub-stations; plant/operational rooms; bin stores; public lighting; blue roofs; rooftop PV arrays; lift overruns and rooftop opening vents atop both blocks; 4 No. 0.3 m diameter microwave link dishes mounted on 2 No. steel support poles afxed to the Block B lift overrun, all enclosed in radio-friendly GRP shrouds; and all associated works above and below ground.

2. Summary of Relevant Applicable Legislation

The Energy Performance in Buildings Directive (EPBD)

The EPBD was first published in 2002 (2002/91/EC) (the "EPB Directive") and has been revised as follows:

- the EPBD was recast in 2010 (2010/31/EU) (the "EPB Recast Directive")
- a revised version of the EPBD was published in 2018 (2018/844/EU) (the "EPB 2018 Directive")

The EPB Recast Directive stipulated that all new buildings must be Nearly Zero Energy Buildings by the 31st of December 2020 and all buildings acquired by public bodies by 31st December 2018.

The definition for Nearly Zero Energy Buildings (NZEB) in the EPB Recast Directive is "a very high energy performance, as determined in accordance with 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".

On 14 March 2023, the European Parliament adopted draft amendments to the proposed revisions of the EPD Recast Directive. The key revisions to the EPD Recast Directive include:

- All new buildings to be zero emission from 1 January 2028; and
- New buildings occupied, operated or owned by public authorities to be zero emission by 1 January 2026. This is an enhancement on Nearly Zero Emission Building ("NZEB") obligations introduced in 2018 (enacted in Ireland in 2019). NZEB requirements typically equate to an A3 BER for commercial buildings and A2 for residential with a percentage of energy needs to be derived from on site or nearby renewables.

Technical Guidance Document Part L – Conservation of Fuel and Energy

This EPD Directive was adopted into Irish law as a Regulation in 2006 (S.I. No.666 of 2006) and recast in 2012 (S.I.243 of 2012), effective from 9 January 2013.

The regulations transpose Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings (recast), as amended by Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018.

Each member government has discretion in how the standard is applied nationally, and to comply with the NZEB requirement, the Irish government has issued the revised Building Regulations, with the current iterations:

1. Technical Guidance Document Part L – Conservation of Fuel and Energy - Dwellings (2022)
2. Technical Guidance Document Part L – Conservation of Fuel and Energy – Buildings other than Dwellings (2022)

Part L – Dwellings stipulates requirements in the following areas (applicable to new dwellings):

- Limitation of Primary Energy Use and CO_2 Emissions.
- Renewable Energy Technologies.
- Building Fabric.
- Building Services.
- Construction quality and commissioning of services.

For new buildings, it is calculated that NZEB corresponds to equivalent to a 25% improvement in energy performance on the 2011 Building Regulations and have a renewable energy ratio (RER)of 20%.

In order to demonstrate that an acceptable primary energy consumption rate has been achieved for NZEB, the ratio between the calculated Energy Performance Coefficient (EPC) should not be greater than the Maximum Permitted Energy Performance Coefficient (MPEPC), with a value of 0.30. Similarly, the ratio between the calculated Carbon Performance Coefficient (CPC) should not be greater than the Maximum Permitted Carbon Performance Coefficient (MPCPC), with a value of 0.35.

The EPC, CPC and RER are evaluated using the Domestic Energy Assessment Procedure for the dwellings in this project.

Building Energy Rating

The introduction of the Building Energy Rating system for evaluating the energy performance of all buildings has led to an increased focus on the energy usage of developments currently being constructed.

This report outlines the Energy Analysis and Part L Compliance undertaken for the proposed Residential Development. Comparative results including BER output for competing systems are outlined in later sections.

The design shall place high emphasis on the Mechanical and Electrical services. All works shall be in full compliance with all current statutory regulations, Irish and British standards and be fully compliant with the requirements of Part L.

The 2030 Climate and Energy Framework:

The 2030 Climate and Energy Framework is a key element of the European Union's commitment to addressing climate change. It includes specific targets for emissions reduction, renewable energy, and energy efficiency by 2030.

Key targets encompass a reduction of at least 40% in greenhouse gas emissions compared to 1990 levels, a binding target of at least 32% for renewable energy in the EU's energy mix, and a binding energy efficiency improvement goal of at least 32.5%.

This framework acts as a blueprint for EU member states to shape their national energy and climate policies, emphasizing collective action to mitigate climate change.

The European Green Deal:

The European Green Deal is the EU's roadmap for achieving carbon neutrality by 2050. It encompasses a wide range of initiatives, policies, and legislation to transform Europe into the world's first climate-neutral continent.

Key aspects of the Green Deal include the Just Transition Fund to support regions heavily impacted by the transition, the Farm to Fork Strategy to promote sustainable agriculture, and the Renovation Wave to enhance energy efficiency in buildings.

The Green Deal represents the EU's comprehensive approach to addressing climate change while promoting economic growth, social fairness, and environmental sustainability.

The EU Biodiversity Strategy:

The EU Biodiversity Strategy is a critical component of the European Green Deal, aiming to halt the loss of biodiversity and restore ecosystems by 2030.

This strategy outlines specific targets, such as protecting 30% of the EU's land and sea areas and restoring degraded ecosystems, including forests, wetlands, and rivers.

By addressing the interconnectedness of climate change and biodiversity loss, the EU strives to create a more resilient and sustainable environment.

2023 Climate Action Plan:

The 2023 Climate Action Plan is a significant milestone in Ireland's efforts to combat climate change, driven by the Climate Action and Low Carbon Development (Amendment) Act 2021.

The plan sets out legally binding objectives and actions to reduce greenhouse gas emissions in line with Ireland's climate commitments, including an ambitious target of a 51% reduction in emissions by 2030.

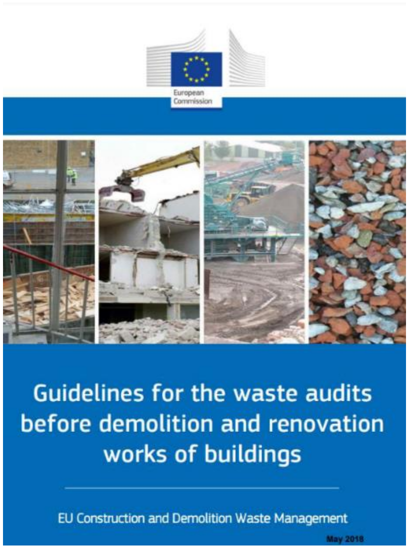
Specific measures include increasing renewable energy capacity, enhancing energy efficiency in homes and businesses, and transitioning to electric vehicles to reduce emissions from the transport sector.

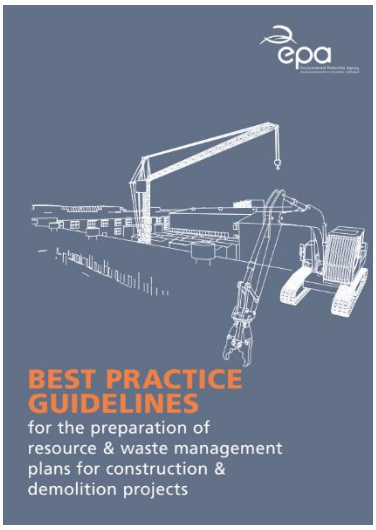
This plan underscores Ireland's commitment to aligning its national policies with European and international climate goals, contributing to the broader effort to mitigate the impacts of climate change.

3. Demolition Considerations

The author of this report, the client and the design team are aware that from a sustainability point of view the starting point shall always be to reuse and repurpose existing buildings rather than to seek to demolish them. The proposal is therefore to retain as much as possible of the existing structures, especially where these are of some merit and of historical interest. Existing building materials should be incorporated and utilised in the new design proposals where feasible and a clear strategy for the reuse and disposal of the materials should be included where demolition is proposed.

The following documents were reviewed while preparing this section of the Energy Efficiency and Climate Change Adaptation Design Statement.





As part of the proposed development of the site, the design team have identified the elements and structures on the site as below:

- The existing paved yard slab
- The existing perimeter boundary, consisting of a mixture of half-height block wall and steel fencing

The site is derelict and has no evidence of ever serving as a residential property. There are no buildings on the site at present and therefore demolition works are limited to the boundary treatments. Please refer to Donnelly-Turpin architectural documents for further details on the existing structures.

The details of the demolition is further set out in section 8 “Demolition Procedures” of the Resource & Waste Management Plan and section 3.1 “Demolition Phase” of the Construction Environmental Management Plan by AWN Consulting Engineers.

2D and 3D aerial views of the site are shown below, with the approximate site boundaries shown adjacent.

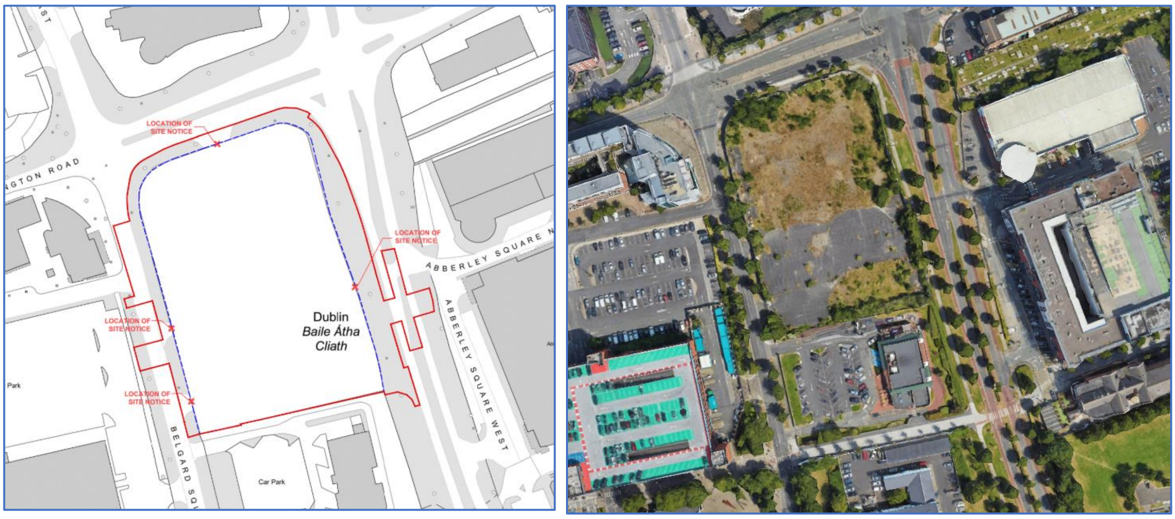


Figure 1: 2D Aerial Site Layout showing yard area with slab and walls as per above text.

Figure 2: Isometric Aerial Site Layout showing yard area with slab and walls as per above text.

The existing empty and derelict yard contributes no aesthetic or heritage value to the area and demolishing the existing boundary structures will not subtract in any tangible way from the area. The limited demolition of these boundary walls is proposed to be carried out in such a way as to salvage a portion of materials as reasonably practical for reuse and recycling. The methodology will be agreed between the contractor and the design team.

Both the client and the design team are acutely aware that, in terms of embodied carbon, the most eco-friendly choice typically involves reusing and repurposing existing buildings. After thorough consideration, some demolition work is deemed necessary for the following reasons.

1. The removal of existing paving and boundary walls will allow the new development to encompass the entire site, ensuring an efficient use of space. Therefore, for the overall benefit of the project, some demolition is deemed necessary.
2. While recognizing the heightened embodied carbon associated with demolishing structures, both the client and the design team are conscious of the opportunities to mitigate this impact. Crushed rubble from the site can be reclaimed to create recycled aggregate. Considering the embodied carbon perspective and the alignment with EU Taxonomy requirements, it is a specific client objective to minimize, recover, and recycle wherever feasible, thereby enhancing the circular economy not only of this project but also of other endeavors benefiting from these salvaged materials.

While all steps feasible will be taken to reuse as much materials as possible, it is clear that the site contains minimal existing structures and this development will thus by default perform well in avoiding significant demolition waste.

4. Construction, Energy and Climate Change Considerations – Building Fabric

Building Regulations Part L outlines the acceptable levels of provisions necessary to ensure that heat loss through the fabric of a building is minimised. Guidance is given on three main issues:

- Insulation levels to be achieved by the plane fabric elements.
- Thermal bridging.
- Limitations of air permeability.

4.1 Fabric Insulation

The new development will be designed and constructed to limit heat loss and where appropriate, limit heat gains through the fabric of the building. In order to limit the heat loss through the building fabric the thermal insulation for each of the plane elements of the development will meet or exceed the area weighted average elemental U-Values as specified in Part L.

The area of openings will not be reduced below that required for the provision of adequate daylight, in accordance with daylight provision guidance of BS 8206-2:2008 Code of Practice for daylight and CIBSE Lighting Guide LG 10.

4.2 Thermal Bridging

To avoid excessive heat losses and local condensation problems, consideration will be given to ensure continuity of insulation and to limit local thermal bridging, e.g. around windows, doors and other wall openings, at junctions between elements and other locations. Heat loss associated with thermal bridges is considered in calculating primary energy use and CO_2 emissions using DEAP methodologies.

Acceptable Construction Details will be adopted for all key junctions where appropriate (i.e. typical/standard junctions). For all bespoke key junctions, certified details which have been certified by a third-party certification body will be used.

The default values for thermal bridging as set out in table D2, Appendix D of TGD – Part L, will be used or the certified details for any bespoke key junctions.

4.3 Air Permeability

In addition to fabric heat loss, reasonable care will be taken during the design and construction to limit the air permeability (Infiltration). High levels of infiltration can contribute to uncontrolled ventilation. Part L requires an air permeability level no greater than $5m^3/h/m^2$ at 50 Pascals for NZEB.

Where lower levels of air permeability are achieved, it is important that purpose provided ventilation is maintained. The design intent will be to achieve an air permeability of $3m^3/h/m^2$ @ 50Pa (TBC) which represents a reasonable upper limit of air tightness.

5. Construction, Energy and Climate Change Considerations – Building Services

The following on-site renewable energy generation systems were considered for this development in terms of capital costs, energy performance, maintenance requirements & Part L Compliance:

- Solar photovoltaic panels
- Small-scale wind power

Further, the report assesses and compares:

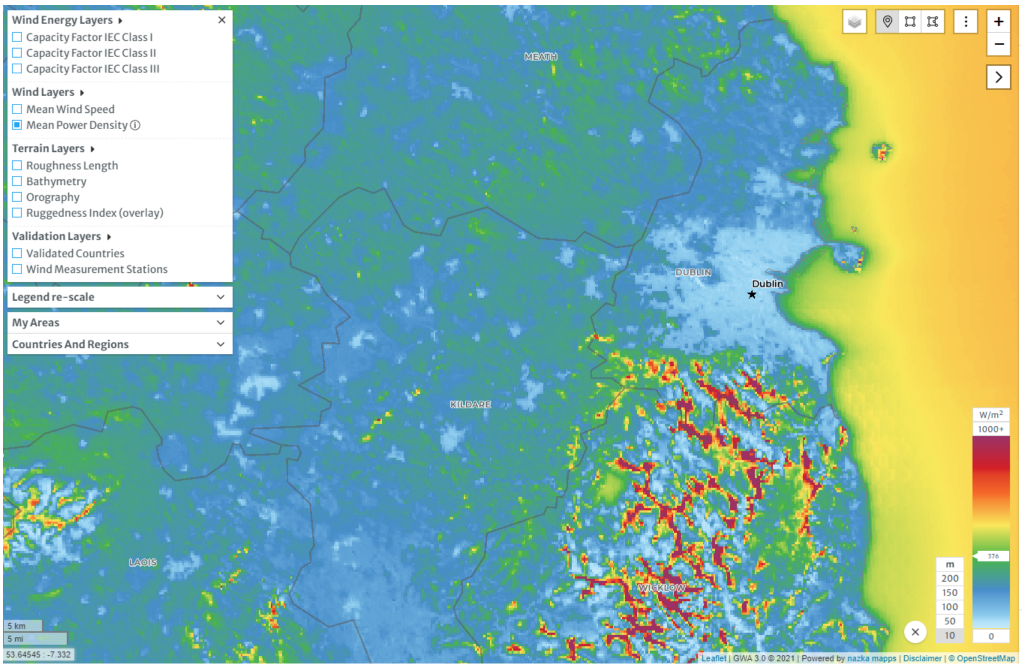
- Centralised Systems – Block Heating with Cogeneration (Combined Heat and Power/CHP) and District Heating
- Air to Water Heat Pump with External Condenser on Balcony
- Exhaust Air Heat Pump

5.1 Solar photovoltaic panels (PV)

- Solar Photovoltaic Panels – once installed – provide free electricity for decades.
- Predictable – unlike wind power, annual solar irradiation can be estimated using historical weather data.
- Tried and tested, proven technology. There are systems installed in the 1980's, still operating today.
- Long performance warranties on Solar PV panels – generally 25 years as standard
- Life expectancy of PV panels is greater than 30 years.
- No moving parts – minimal maintenance or servicing.
- Versatile – multiple methods of roof and ground installation – as well as car ports, awnings, facades, etc.
- Economical – prices of PV panels have fallen by 40% since 2014.
- Efficient – PV panel outputs have more than doubled since 2010, and the physical sizes of 60 cell panels have not changed.
- Responsible – PV panel manufacturers invest in low carbon manufacturing techniques and offsetting and commit to recycling products at end-of-life.
- PV panels help homes and businesses reduce their carbon footprint.
- PV panels are an investment, and future-proof homes and businesses from rising electricity prices.
- Sell electricity back to the grid – business users can sell their excess electricity back to the grid.
- Solar PV systems can be coupled with battery technology to store electricity for night-time usage.
- Solar power improves grid security – it is more efficient to use electricity on the same site where it is produced, if more PV systems are installed then the grid can better cope with peak daytime demands.
- Solar photovoltaic can be particularly useful for provision of renewable component in areas with minimal heating or hot water requirement, such as with apartment common landlord areas, as it supplies a purely electrical output and is fully scalable.

5.2 Small-scale wind power

- Small-scale wind power in urban centres is a relatively under-developed market sector.
- Efficient harnessing of wind power in an urban environment requires wind-sensitive urban planning and design – unlike in a wide open marine or rural landscape, the wind direction and speed within areas of dense urban population is highly variable, turbulent and unpredictable due to the presence of obstacles preventing laminar flow.
- Dublin's location at the North-South centre on Ireland's Eastern seaboard places it in the range of lowest wind mean power density, containing 10-50W/m^2, as per the excerpt below from Globalwindatlas.info
- It is our experience that for aesthetics reasons and the avoidance of visual clutter in an urban environment, local authorities specify/condition the omission of plant above parapet level on developments such as this.
- It is noted also that the presence of local wildlife in the area, such as bats, may be served better with an alternative strategy for renewable energy generation with potentially less risk of disturbance, such as solar PV as per previous section.
- While wind is an important resource on a national scale and forms a crucial element of Ireland's National Climate Action Plan, it is deemed that the technology, infrastructure and wider urban planning are yet to reach a stage where it is a viable renewable strategy for small-scale developments such as this.



5.3 Air Source Heat Pump

This system consists of an external air to water heat pump which uses a refrigerant cycle to extract energy from the external air and convert it to high grade heat for use in space heating and hot water systems. Advantages of this type of system are as follows:

- System will achieve an A2-A3 rated dwelling without the addition of another renewable source.
- One standalone system so reduced installation cost.
- Suited for apartment developments as there is a standalone system per dwelling and no centralised plant. This reduces management fees for developer.
- Can be supplied with a factory pre-plumbed & pre-wired cylinder which simplifies installation and eradicates potential installer error.
- Due to simplified design a standard domestic plumber can install. No specialised heat pump engineer needed.
- Compliance can be met with or without heat recovery ventilation.
- South orientation is not a factor when meeting compliance. This can be the case if using solar as your renewable source.
- Adequate roof area is not always available for a solar installation.
- The heat pump only gives you hot water when it’s needed. Solar thermal gives you hot water when sun is available.
- The system works on a lower operating temperature therefore drastically reduced running costs are achieved.
- Throughout the year, the heat pump will run at efficiencies of 250-450% depending on ambient temperature.
- The system works best in conjunction with underfloor heating and aluminium radiators but can also be installed with suitably sized steel radiators.

The only drawback with this type of system is that the heat pump needs to be located on an external balcony. The units are not the most aesthetically pleasing and may not suit some developments.

5.4 Centralised Systems –Cogeneration (Combined Heat and Power and District Heating)

The first system considered here consists of a centralised plant room typically, using a combination of condensing boilers alongside a renewable technology such as air sourced or geothermal heat pumps.

Combined Heat & Power (CHP) units can also be utilised as part of a centralised system. Low pressure hot water is distributed to each apartment via a piping network and is controlled via a heat interface unit located within each apartment.

District heating systems deliver heat for both space heating and water heating needs to buildings through a network of insulated pipes. Heat is produced centrally in large plants and delivered through the district heating network. The usage is transferred to each user via a Heat Interface Unit and then metered.

South Dublin City Council has launched the Tallaght District Heating Scheme. This scheme will supply low cost heat with a low carbon footprint to the area. The system will harness waste heat from a local data centre.

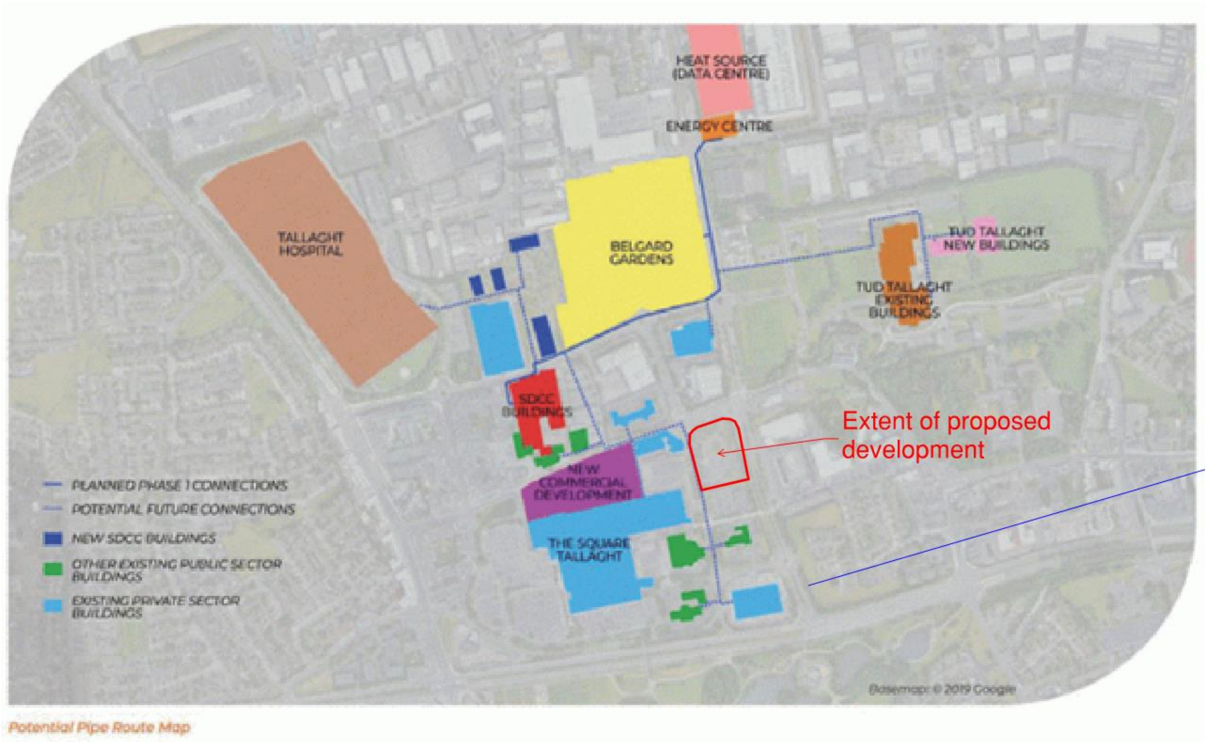
District heating systems offer advantages in terms of higher energy efficiencies, reduced consumption of energy resources and are fully compatible with European and National policies and objectives for carbon dioxide reduction, energy efficiency, security of energy supply, sustainability and competitiveness. District heating can also offer capital cost savings and reduced operating and maintenance costs to commercial and residential customers.

Advantages/Disadvantages of this type of system are as follows:

- In theory the energy supply company ESCO can operate at a profit by buying fuel in bulk and selling to end user at a higher rate. In practice it is difficult to achieve and there are a lot of pitfalls.
- Efficiency of central plant is poor due to circulation losses. Typically 65%.
  Landlord is responsible for collecting payment from each tenant and needs to set up an energy supply company.
- Expensive installation with centralised plant and pipework distribution network.
  Additional professional fees associated with design of centralised system.
  Large gas connection required.
- Metering and billing system required.
- Central heating plant still needs to be supplemented with a renewable or high-efficiency technology such as air or geothermal heat pumps or a CHP plant.
- Construction of plant room & associated civil works need to be considered.
  Overheating can occur in landlord areas as hot water circulation is required 24/7 to serve instantaneous hot water demand in each apartment.
- Maintenance requirement for central plant can be very costly.
- Similar issues relate to district heating systems wherein efficiency savings availed of by reuse of waste process heat are offset by losses in transmission and risk of overheating if installed pipework does not meet levels required.
- In order for DH to be economically feasible, there needs to be a sufficient heat demand within a given area - the denser the heat demand, the shorter the pipelines required, which means lower investment costs, and lower operational costs through lower losses and lower pumping requirements. Hospitals, nursing homes and hotels are known to be ideal for district heating operation as they have long hours of space heating demand and large hot water demands.

The map below shows the phase 1 and future proposed route for the Tallaght district heating scheme pipework.

The outline of the proposed development is added in red. The Tallaght District Heating Scheme is not currently available to serve the site of the proposed development, though there is a strong likelihood that the pipe will be installed in future adjacent the proposed development on the Belgard Square East side.



Source: echo.ie

As part of the planning application preparation, Renaissance Engineering have met and consulted with Codema's District Heating Development Manager and reviewed the proposed future rollout of the district heating pipe for the scheme in the area. At present, there is no fixed date for when the district heating pipe (identified above as "potential future connections") will be available for connection to the proposed site at Belgard Square.

We note the guidance of the South Dublin County Council Development Plan Section 12.10.2 Low Carbon District Heating Networks, specifically:

"Development proposals for large scale residential, commercial or mixed use developments (100 + dwellings at a density of 50 dwelling per hectare (dph) or more and / or non-residential development of 10,000 sq m or over) in Tallaght, Clonburris / Grangecastle and Clondalkin which have been identifed as Areas of Potential for Low Carbon District Heating should support the delivery of District Heating Proposals and … Where a District Heating scheme has not been confirmed new development should be designed so that it can connect into such a scheme when one is delivered."

And the recommendations within the Tallaght Local Area Plan, given that *"All major developments within the Plan area will be encouraged to incorporate space to be safeguarded for future pipework/pipe run, energy centres of other infrastructure."*

To this end, the viability of designing the development so that it can connect into a district heating scheme when one is delivered has been investigated as part of this Energy and Climate Design Statement. Renaissance Engineering is currently consulting on a 3rd Generation District Heat Network in Liverpool consisting of 540 No. apartments, 7,000m^2 of commercial space, a 180-bed hotel and a 200-bed aparthotel under development for future connection and have adapted our experience to consider similar for the development at Belgard.

As per the development description, the project consists of:

- 6no studios (estimated 45m2 from types B-SA)
- 47no 1bed (estimated 50m2 from types B-1A)
- 98no 2-bed (estimated 80m2 from types B-2A, B-2B)
- 48no 3-bed (estimated 100m2 from types B-3A, B-3B)
- 2,123 sq m of non-residential floor space

Based on typical modelled values for similar high-density Nearly Zero Energy Building (nZEB) constructions, an average heat load of 35W/m2 is estimated.

Space Type	**High-level Area Estimate (m^2)**
Studios	6 x 45 = 270
1bed	47 x 50 = 2,350
2-bed	98 x 80 = 7,840
3-bed	48 x 100 = 4,800
Total heated area (residential)	15,260
Total estimated heating capacity (residential)	534.1kW

Space Type	**High-level Area Estimate (m^2)**
Non-residential	2,123
Total heated area (non-residential)	2,123
Total estimated heating capacity (non-residential)	74.3kW

From the high-level estimations above, it is calculated using a flow temperature of 70°C and return of 50°C as per the Tallaght DHS, that pipe sizes between 100mm and 150mm diameter would need to serve the development from the district heating scheme.

If the scheme opts to utilise a connection to the future Tallaght District Heating Scheme at Belgard Square East, a potential suitable location for heating plant and connection to the system is the basement mechanical plantroom which will house some of the water storage for the development.

Pipes would be required to run a relatively short distance to connect to the system, from where they could enter the basement plantroom level at high level through the wall, subject to detailed design and coordination with other design disciplines.

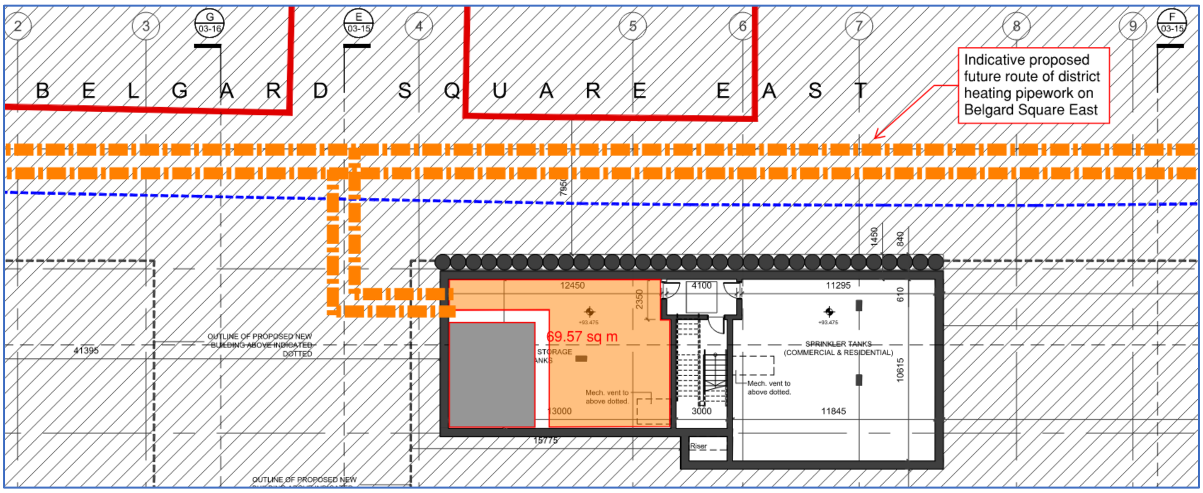
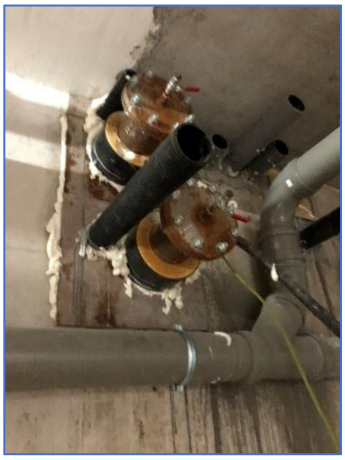
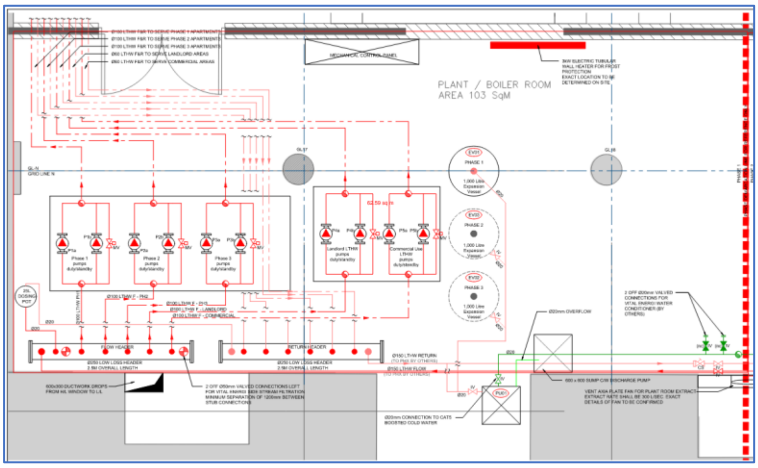
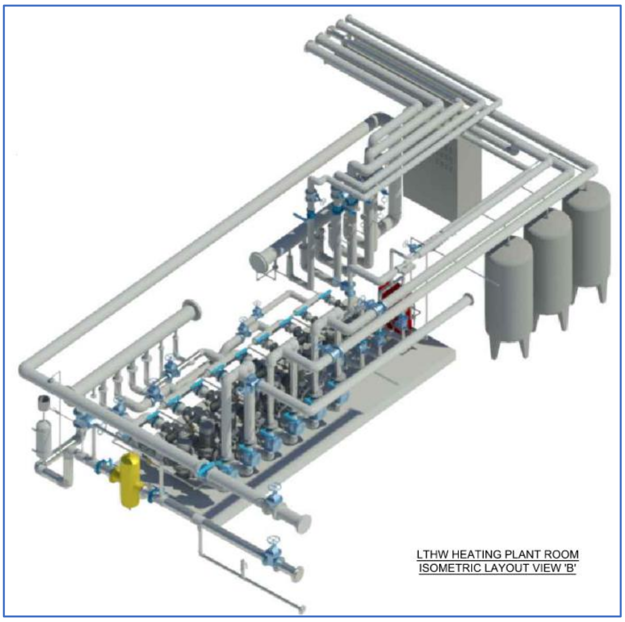


Image: Potential district heating scheme connection route (Drawing: Donnelly-Turpin Architects drawing 2424_P03_00 PROPOSED BASEMENT PLAN)

The basement plant room in question contains approximately 70m^2 of space which could be allocated to heating plant. While further detail design is required if connection of development to the scheme progresses, this area is consistent with space requirements for the plate heat exchangers, low-loss headers, expansion vessels and pipe, pump and control arrangement necessary for operation of such a system.





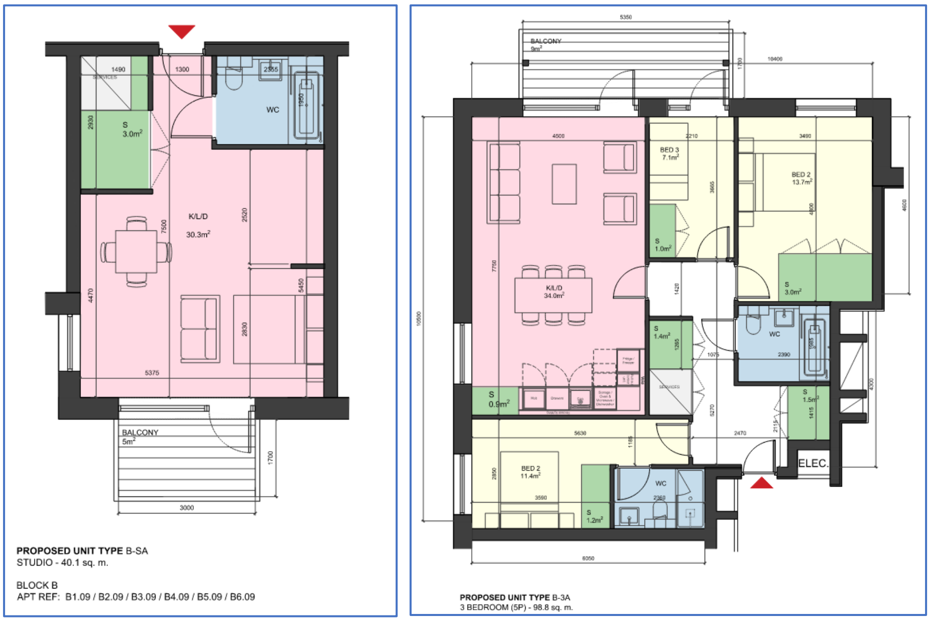


Images: Photographs and screenshots of existing district heating design work/installations on which Renaissance Engineering consulted, showing district heating scheme connection pipework entering plantroom and low-pressure hot water (LPHW) plantroom pipework and equipment modelling.

A review of the architectural design has been carried out to ensure that the development has been designed so that it is capable of potential connection into a district heating scheme when such a scheme is delivered. Floorplans have been reviewed to confirm sufficient space exists within the allocated mechanical risers for the decentralised heating distribution pipework alongside the boosted mains/cold water and sprinkler distribution pipework systems.

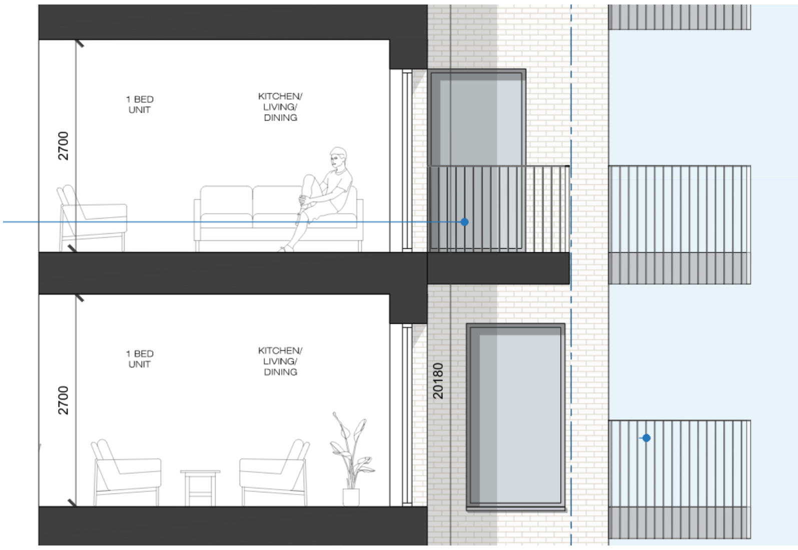
Source: Donnelly-Turpin Architects drawings

Further, apartment plant stores (“Services” coloured grey) primarily proposed as locations for domestic hot water cylinders provide sufficient space within the dwellings for decentralised hardware such as heat interface units.



Source: Donnelly-Turpin Architects drawings

A review has likewise been undertaken to ensure that the development ceiling voids are sufficient to house the necessary heating distribution pipework.



Source: Donnelly-Turpin Architects drawings

We note as a disadvantage of these systems historical issues of heat loss within circulation corridors as part of the pipework distribution network.

5.5 Exhaust Air Heat Pumps

An exhaust air heat pump extracts air via ventilation ducts positioned in the wet rooms of the house such as bathrooms, kitchens and utility rooms. On its way out of the house, heat is extracted from the old air and transferred into the heat pump's refrigerant circuit. The cooled air is then discharged. Meanwhile, the vapour compression cycle of the heat pump raises the temperature of the refrigerant and transfers the extracted heat into a water-based system that can either warm the domestic hot water or heat the building, or both. For the purpose of this analysis the NIBE Exhaust air heat pump has been considered. Advantages of this system are as follows:

- Efficiency of 570%. For every kW of electricity consumed 5.7kW of heat can be produced.
- Full part L Compliance in a single unit from one manufacturer that does, heating, hot water and ventilation.
- Integrated control system with large, easy to read multi-colour display.
- Easily connects to wireless network to provide remote access from mobile devices for control and monitoring of heating & hot water.
- Similar cost to boiler & PV but far more efficient and cost effective for end user.
- Simple clean installation with electrical connection. Stylish free-standing unit incorporated into kitchen design that fits in a 600 x 625mm space.
- More storage space in apartment as no need for additional hot press to house cylinder.
- Excellent ventilation throughout apartment to ensure no issues with condensation which can occur with modern airtight units.
- No requirement for solar, gas pipework, civil works or central plant.
  No requirement for metering or billing.

5.6 Cost Analysis/Economic Feasibility

The following capital costs per apartment type have been calculated for each proposed system.

Description	1 bed	2 bed	3 bed
1. PV Panels (alongside gas boiler)	€10,200.00	€11,800.00	€12,600.00
2. Air-to-Water Heat Pump	€9,600.00	€10,900.00	€11,800.00
3. Centralised System (CHP and boilers in absence of available district/waste heating scheme)	€12,000.00	€13,300.00	€14,100.00
4. NIBE Exhaust Air Heat Pump	€10,400.00	€11,700.00	€12,400.00
5. Hot water heat pump with electric heating and MVHR	€9,800.00	€10,950.00	

The exhaust air and air-to-water systems provide similar advantages and disadvantages. Air-sourced heat pumps are compared using technical energy performance assessment with options 1 and 5 in the next section.

5.7 Energy Analysis

The three systems have been analysed in terms of their energy performance and the results are outlined below. The calculations were carried out using the DEAP software for a typical 3-bedroom apartment.

Description	**Proposed System**		
	Hot water heat pump + electric heating + MVHR	**Air Sourced HP**	**Boiler & PV**
BER	A2	A2	A2
Energy Value kWh/m2/year	48.03	47.78	47.75
CO2 Emissions CO2/m2/year	9.45 kg	8.69 kg	8.67 kg
EPC (Max)	0.398 (0.40)	0.284 (0.30)	0.395 (0.40)
CPC (Max)	0.385 (0.460)	0.275(0.35)	0.353 (0.460)
Renewable Energy Contribution (Min) kWh/m2y	11.65 (10.0)	0.322 (0.2)	28.4 (10.0)
Part L Compliant	Yes	Yes	Yes

It can be seen from the above comparison that all three options are Part L compliant and achieve an A2 rating.

Space has been allocated on the roofs for solar photovoltaic to aid with the achievement of nearly-zero energy building compliance should another approach, such as connection to a district heating scheme, be required.

5.8 Embodied Energy Analysis

Typically, the mass of mechanical and electrical systems in a building (such as HVAC (Heating, Ventilation, and Air Conditioning), plumbing, electrical distribution, and fire suppression systems) is relatively small compared to the total mass of the structure itself. A generalised estimate based on comparable past projects worked on by Renaissance Engineering would be that mechanical and electrical services can account for around 5% of the total weight of a building of this type and scale.

Nonetheless, building service materials may consist primarily of high-embodied energy materials, particularly metals and plastics as emphasised in table below:

Material	Approximate Embodied Energy (kJ/kg)
Cement	2,700 to 3,800 kJ/kg.
Bricks	2,500 to 3,500 kJ/kg.
Sand	300 to 600 kJ/kg.
Aggregates	100 to 300 kJ/kg.
Stainless Steel	**25,000 to 30,000 kJ/kg.**
Lime	1,800 to 2,300 kJ/kg.
Hardwood	8,000 to 12,000 kJ/kg.
Particle Board	2,500 to 3,500 kJ/kg.
Glass	6,000 to 10,000 kJ/kg.
Aluminium	**60,000 to 240,000 kJ/kg (depending on production method)**
Marble	3,500 to 4,500 kJ/kg.
Ceramic Tiles	2,000 to 3,000 kJ/kg.
Paint	15,000 to 25,000 kJ/kg.
PVC (Polyvinyl Chloride)	**40,000 to 70,000 kJ/kg.**
HDPE (High-Density Polyethylene)	**80,000 to 120,000 kJ/kg.**
PEX (Cross-linked Polyethylene)	**15,000 to 40,000 kJ/kg**
Copper	**80,000 to 120,000 kJ/kg (depending on grade)**

The building service systems compared above, which are deemed compatible with and suitable for further investigation based on the project type, scope and location are highlighted again below:

- Air to Water Heat Pump with External Condenser on Balcony
- Exhaust Air Heat Pump
- Solar photovoltaic panels
- Centralised system with connection to district heating scheme

Broadly speaking, the two former systems have similar material installation requirements, while the third provides a separate service generating electricity but not (directly) space heating or hot water.

The embodied energies of solar panels are compared below:

Material	**Approximate Embodied Energy (kJ/kg)**
Monocrystalline silicon	300,000 to 600,000 kJ/kg
Polycrystalline silicon	150,000 to 250,000 kJ/kg

While the embodied energy of mono- and polycrystalline silicon appears high compared to other materials, solar PV panels have the advantage of generating renewable energy over their operational lifetime, which can offset their initial embodied energy investment and consideration of this life cycle and environmental benefits of solar energy generation remains crucial in assessing the overall sustainability of solar PV systems.

Selection of the centralised/district heating system option will result in a greater overall mass of material required as part of the installation due to the need for distribution pipework to connect all residences and areas to a remote plantroom as opposed to generation of heat at source using a heat pump or electricity to heat directly. The detailed comparison of embodied energy within the proprietary equipment used for one system versus another is highly complex and reliant on the provision of detailed material information from manufacturers which is not readily available. However, it can be estimated that the centralised/district heating system option will provide a reduction in the extent of electronic control systems, substituting as it does (for example) one heat interface unit for two or more pieces of electronically-controlled equipment within each dwelling.

6. Long-Term Management Considerations

A summary of measures incorporated into the development design, which consider the long-term operation of the building as it relates to energy efficiency and climate adaptation, are shown below.

Measure	Description	Benefit
Soft Landscape	Planting proposals have been formulated to complement the local setting. Native tree and plant species have been prioritised for planting while non-native species have also been selected for diversity, aesthetics and for their value as pollinator plants which attract and encourage insects and wildlife. Plant species have been selected so that irrigation will be not required for the soft landscape in normal circumstances.	Ecological enhancement of the local area and contributing to the wider environmental quality of the area. Reduction in the frequency of required soft landscape maintenance.
Site Layout	High quality landscape spaces - both hard surface (for cycle /car parking and pedestrian areas / pavements) and soft landscaping with grass, planting and trees.	Plenty of room for cyclists and pedestrians along with car spaces provides a good balance between pedestrians and car users. High amenity value for the residents, with local options to exercise, relax, play and simply 'be' outdoors in contact with nature and greenery, without the requirement for travel and associated emissions.
Maintenance & Management	Maintenance and management operations will follow sustainable practices, encouraging natural growth habits, and minimizing chemical inputs. Bark mulch / weed membrane used to suppress weeds, displacing chemical input. Good quality soil reduces need for additional chemical fertiliser.	Development material embodied emissions reduced.

Sustainability & Biodiversity	Sustainability aspects of the proposed development include the use of native species where possible across the site. The landscape spaces will be planted with a variety of species suited and adapted to the Irish climate, including a substantial proportion of native plants. Pollinator-friendly plants will also be included to enhance insect populations. By encouraging wildlife, this will improve local biodiversity and animate the amenity spaces and wider landscape. Planting will also provide a contact with nature in the urban environment for the residents, and will have strong aesthetic characteristics, including tactile and aromatic qualities. Other species have been carefully selected for compatibility with the use and size of available spaces which is an important factor in long term management. The overall objective is to enhance the biodiversity potential of the site in addition to providing seasonal interest and variety. Judiciously placed flowering shrub and groundcover planting have been included to further promote biodiversity (pollinator species attracting insects and birdlife) and interest, at both ground and roof levels, with green roofs or roof gardens also proposed. Materials are robust and will be sourced sustainably where feasible, with low-carbon products preferred.	Enhanced sustainability and biodiversity of long-term estate management.

BER Certificates	A Building Energy Rating (BER) certificate will be provided for each dwelling and property in the proposed development when complete, which will provide detail of the energy performance of the units. A BER is calculated through energy use for space and hot water heating, ventilation, and lighting and occupancy. It is proposed to target an NZEB rating for the apartments, equating to emissions of 8-10 kWh/m^2/yr of CO2. An A2 property can be expected to require 25-50 kWh/m^2/yr.	Achieving a high BER means a reduction in energy consumption and running costs.
Fabric Energy Efficiency.	The U-values being investigated will be in line with the requirements set out by the current regulatory requirements of the Technical Guidance Documents Part L, '*Conservation of Fuel andEnergyBuildingsotherthanDwellings'*. See below Table 1 of Part L, Building Regulations. Thermal bridging at junctions between construction elements and at other locations will be minimised in accordance Paragraphs 1.2.4.2 and 1.2.4.3 within the Technical Guidance Documents Part L.	Lower U-values and improved air tightness is being considered to help minimise heat losses through the building fabric, lower energy consumption and thus minimise carbon emissions to the environment.
Low-energy LED Lighting	Shall be designed and specified in accordance with the BER requirements in each unit and in the landlord areas in accordance with Part L.	Lower consumption of energy and therefore lower carbon emissions and energy bills. LED bulbs have long operational lives, facilitating ease of future operation.
Low-energy heating system	Heat pumps and district heating systems are under consideration as a heating source for the development.	Heat pumps operate with efficiencies >400%. District heating permits residents avail of locally-generated wate heat. Both provide significant benefits for the users and the global climate when compared with traditional local fossil-fuel-based installations.

Demand-controlled ventilation with potential use of heat recovery	Central extract and demand-controlled ventilation, plus systems with heat recovery will be considered to provide ventilation with low energy usage.	Central mechanical extract ventilation provides controlled ventilation as an improvement on traditional naturally ventilated "leaky" buildings. As part of a strategy to reduce airtightness, central extract systems may reduce heating costs from wind infiltration and provide maintenance savings through condensation prevention. Systems with heat recovery improve on this further by transfer of heat from outgoing to incoming air without direct mixing or contamination of the incoming airstream, reducing energy consumption needed to heat cold incoming air.
Operational Waste Management Plan	This application is accompanied by an Operational Waste Management Plan (OWMP). The OWMP has been developed in line with local authority requirements for waste minimization, recycling and re-use.	The report demonstrates how the development will take into account sustainable methods for waste and recycling management during its operation.
Storage of non-recyclable waste and recyclable household waste	Inclusion of a number of bin storage areas for each apartment. Domestic waste management strategy: Colour-based (e.g. Black, Brown and Green) bin distinction. Competitive tender for waste management collection.	Easily accessible by all residents and minimises potential littering of the scheme.
Composting	Addition of organic waste bins to be provided throughout the development	Helps to reduce the amount of waste going to landfill.

Natural Daylight	The design, separation distances and layout of the apartments have been optimised for the ingress of natural daylight/sunlight to the proposed dwellings to provide good levels of natural light.	Reduces reliance on artificial lighting thereby reducing costs. Sunlight and solar gain can also be a significant source of heat and reduce the need for active heat production.
Access to Public Transport	The project is situated close to the Luas line and is well-served by multiple public and private bus routes. A transport statement will be prepared as part of this submission detailing the various transport options available in the vicinity of the site.	The availability, proximity and ease of access to high quality public transport services contributes to reducing the reliance on the private motor vehicle for all journey types, with consequent benefits for the operational emissions of the scheme.
Bicycle Storage	The provision of private bicycle parking facilities for the apartments, together with abundant parking.	Accommodates the uptake of cycling and reducing the reliance on the private motor vehicle.
Residents' Manual	Resident instructions will be provided with operational documentation which will include: • Operation and maintenance manual – this will provide important information for the occupier on details of their rented property. • A Resident's Pack which will typically provide information on contact details such as emergency contact information, transport links in the area and a clear set of rules and regulations.	Residents are as informed how to operate their installed systems as effectively and efficiently as possible.

7. Climate Change Adaptation Considerations

Key Climate Risks in South Dublin:

- Flooding - increased heavy rainfall events and rising sea levels pose significant flood risks, particularly in urban areas.
- Rising temperatures - urban heat islands can exacerbate temperature increases, affecting living conditions.
- Extreme Weather Events - More frequent storms and high winds necessitate robust structural designs.

Adaptation Strategies:

- Flood Resilience:
    - Sustainable drainage systems (SuDS) – blue roofing and permeable pavements will assist with management of stormwater.
    - Elevated design – All dwellings shall be located at first floor or above.
- Heat Mitigation:
    - Blue roofing shall be incorporated on roofs to reduce heat absorption.
    - Architectural elements and landscaping will be used to provide natural shade.
    - Exterior finishes that reflect, rather than absorb, heat, will be used where possible.
    - Openable windows and balcony doors will be optimised to avoid overheating.
    - Mechanical ventilation systems will provide a reliable source of cooling independent of wind speeds.
- Energy Efficiency:
    - Renewable energy integration – solar PV panels and low-carbon heating systems will be installed to all units as required to achieve NZEB status.
    - Buildings will be highly-insulated and air-tight to reduce heating and cooling demands.
    - Intelligent equipment control and energy management systems, including time and temperature control of multiple heating and hot water zones in each dwelling, shall be used to optimize consumption.
- Storm Resilience:
    - Buildings shall be designed to endure high winds and 100-year storm or better levels of precipitation.
    - PV panels, other roof-mounted equipment and roofing itself shall be anchored and constructed to resist storm damage. In general, plant at roof level shall be avoided.
- Sustainable Transportation:
    - EV charging infrastructure shall be provided in accordance with SDCC and Part L requirements.
    - Bicycle Amenities including secure bicycle storage will be provided to encourage cycling.
    - The development benefits from high proximity to multiple public transport networks, including Luas and Dublin bus.

8. Recommendation / Proposed Systems & Building Fabric

With the current insulation levels associated with NZEB standards, amalgamated by the modern efficiencies and simplistic M&E designs associated with electric technologies, choosing an all-electric solution is more cost effective to install and operate for a large development predominantly comprised of residential units.

Renaissance Engineering is currently consulting on a 3rd Generation District Heat Network in Liverpool consisting of 540 No. apartments, 7,000m^2 of commercial space, a 180-bed hotel and a 200-bed aparthotel under development for future connection. The heating scheme operates at a flow and return temperature of 80°C and 60°C respectively, feeding each unit via a Heat Interface Unit or a heat exchanger. The heat consumed is metered and then distributed around each unit via a hydronic system and its associated ancillary equipment such as pumps and valves. These items will drastically increase the installation costs associated with the development as well as introduce additional complexity in the design and increase the maintenance costs pertinent to each unit in the development

As district heating schemes operate on the basis of ensuring hot water availability around the clock, high temperature water is continuously circulated throughout the extensive pipe network of the development. This results in thermal losses throughout the year, being predominantly higher during the summer months when the thermal demand is lower due to the lack of space heating requirements. There will also be losses through the pipework in the apartments as well as losses in the radiators' ability to dissipate heat. On the other hand, electrical radiators do not suffer the same compounded effect of losses from a hydronic system. Aided by their ability to reach temperature quickly, the 100% efficient electric radiators can modulate their output / turn on and off with ease and on short notice to ensure the radiators are active to combat the dwellings thermal losses. This characteristic enables the electric system of being cost effective to operate even though electricity rates are higher than natural gas prices.

Glen Dimplex have conducted an in-depth analysis comparing a 3rd generation centralised district heating scheme with an all-electric system. Their analysis is summarised in the tables below.

M&E Costs	70 Apartments	100 Apartments	190 Apartments
District Heating	€863,100	€1,189,684	€2,252,000
Dimplex e-heat	€455,000	€650,000	€1,235,000
Savings	**€408,100**	**€539,684**	**€1,017,000**

Table 1: Residential installation cost (Source: Glen Dimplex NZEB Solutions for Apartments)

Running Costs	70m^2 Ground Floor Apt.	50m^2 Middle Floor Apt.	100m^2 Top Floor Apt.
District Heating	€313.92	€170.64	€333.09
Dimplex e-heat	€248.78	€113.86	€233.40
Savings	**€65.14**	**€56.78**	**€99.69**

Table 2: Residential operating cost (Source: Glen Dimplex NZEB Solutions for Apartments)

Table 1 highlights savings obtainable by installing an all-electric system both in running cost and capital installation costs.

With a world evolving to becoming more electric and renewable dependent and as electricity prices continue to stabilise in the future with the rollout of wind generation farms across the country that will contribute to 40% of the demand on the grid, an all-electric development appeals to masses for being future proof.

The possibility of connecting the development to Tallaght's District Heating Scheme instead of an independent DHS is also being considered and provisions have been made within the project to maintain the possibility of this.

Based on the multiple benefits of such a system (continued improvements in renewable contribution to the national grid, reduced material mass, elimination of distribution losses causing overheating, competitive capital cost, etc) and the current progress of the Tallaght District Heating Scheme, an all-electric system is the default proposal for the development and is detailed below in the schedule of proposed systems. We recognise also the recommendations of South Dublin County Council in regard to leveraging the benefits of the district heating scheme and therefore seek to provide a development with the flexibility to be adapted to either approach, in line with the guidance within the South Dublin County Development Plan and the Tallaght Local Area Plan.

Appendix A / Schedule of Proposed Systems & Building Fabric

Item	Specification
Primary Heat Source	Dimplex Q-Rad
Secondary Systems	None
Chimneys	None
Heating element	Dimplex Q-Rad
Central Heating Pump	None
Heating controls	Individual time and temperature zone control (A minimum of two heating zones and one hot water zone)
Hot Water Storage Tank	Dimplex Edel 200 litre cylinder
Lighting	All lamps must be A-Rated low energy type.
Ventilation	Xpelair NA 180 mechanical ventilation with heat recovery (MVHR)
Air Tightness Results	Max. Result of air tightness test of 2.5 $m^3/m^2/hr$ @ 50 Pascals
Thermal Bridging Factor	0.08 W/m2K (All new construction details shall be in compliance with Acceptable Construction Details as set out in “Limiting Thermal Bridging & Air Infiltration – Acceptable Construction Details”)
Thermal Mass	Medium High
Floor	U-value 0.18 W/m2K or better
Flat Roof	U-value 0.20 W/m2K or better
Wall	U-value 0.18 W/m2K or better
Window, Glazed Doors	U-value 1.40 W/ m2K, Solar Trans – 0.63, Frame Factor – 0.7
Renewable Energy Production (landlord areas)	Mono/polycrystalline solar PV panels, quantity and specification determined at detail design stage