Energy Statement

Glenamuck North (Northern Site), Kilternan, Dublin 18

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Comments

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Content

1. Introduction

This Energy Statement has been prepared by Waterman Moylan as part of the planning documentation for a proposed residential development at Glenamuck North, Kilternan, Dublin 18.

Durkan Carrickmines Developments Limited intend to apply for permission for a Large-Scale Residential Development at a site in the townland of Glenamuck North, Kilternan, Dublin 18. The site is generally bounded by: the Glenamuck District Distributor Road to the south, which is recently constructed (to be known as the Kilternan Road); agricultural land to the west; De La Salle Palmerstown Football Club and the future Jamestown Park to the north; and Bective Rangers Football Club to the east.

Road works are proposed to the approved Glenamuck District Roads Scheme (ACP Ref. HA06D.303945) to provide access to the development from the Kilternan Road which will include any necessary tie-ins to the existing footpath and cycle track.

The development will principally consist of the construction of a creche (c. 571 sq m) and 219 No. residential units comprising 69 No. houses (51 No. 3 -bed units and 18 No. 4-bed units), 108 No. apartments (38 No. 1-bed units, 31 No. 2-bed units and 39 No. 3-bed units) and 42 No. duplexes (11 No. 1-bed units, 9 No. 2-bed units, and 22 No. 3-bed units). The proposed development will range in height from 2 No. to 4 No. storeys.

The development also provides: car, bicycle and motorcycle parking; bin storage; ancillary storage; private balconies, terraces and gardens; hard and soft landscaping; boundary treatments; lighting; substations; and all other associated site works above and below ground.

This report identifies the energy standards with which the proposed development will have to comply and also sets out the overall strategy that will be adopted to achieve these energy efficiency targets.

The dwellings will be required to minimise overall energy use and to incorporate an adequate proportion of renewable energy in accordance with Building Regulations Part L 2022, Conservation of Energy & Fuel (hereinafter referred to as "*Part L 2022 Dwellings*").

2. Building Regulations Part L 2022 Dwellings

Compliance with Building Regulations *Part L 2022 Dwellings* is broken down into six distinct categories, known as Regulation 8; parts (a) to (f).

A summary of each of these parts as listed in Technical Guidance Document L 2011 is provided below together with a description of what is required to demonstrate compliance and suggested routes to meeting the required standards.

2.1 Regulation 8 Part (a)

The regulation requires that:

> *Providing that the energy performance of the building is such as to limit the calculated primary energy consumption and related carbon dioxide (CO2) to that of a nearly zero energy building within the meaning of the Directive insofar as is reasonably*

Part (a) is the overarching compliance target which stipulates the required overall reduction in energy consumption and carbon emissions for new dwellings.

This requires that the energy consumption and carbon emissions of every dwelling is assessed using the DEAP software and that reductions of 70% in energy consumption and 65% in carbon emissions are achieved. The baseline against which this reduction is to be measured is considered to be a dwelling which is constructed to perfectly comply with the 2005 version of Building Regulations Part L.

The ratio of the energy consumed by the proposed dwelling to a similar dwelling constructed to 2005 energy efficiency standards is referred to as the “Energy Performance Co-efficient”

2.2 Regulation 8 Part (b)

The regulation requires that:

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

This requires that the all new dwellings are provided with a renewable energy source. The regulations state that 20% of the total energy consumed within the dwelling must be provided from renewable thermal sources (solar thermal, biomass, heat pumps) or renewable electrical sources (Photovoltaic, Micro-wind).

In practical terms, for a multiple unit development, this requirement is usually met by incorporating PV panels at roof level, incorporating air source heat pump technology or by adding an element of biomass or micro-CHP to a district heating scheme.

Where CHP is included, the renewable energy is considered to be the waste heat which is generated as a by-product of the electricity produced. Specific calculation methods are set out within TGD *Part L 2022 Dwellings* which detail how compliance should be demonstrated.

2.3 Regulation 8 Part (c)

The regulation requires that:

> *Limiting heat loss and, where appropriate, availing of heat gain through the fabric of the building;*

This requires that the fabric of the building is designed to minimise heat loss from the building and that the air permeability of the structure limits the unwanted passage of air into the building.

Typical compliant U-Values are as follows.

Pitched roof	0.16 W/m^{2}K
Flat roof	0.20 W/m^{2}K
Walls	0.18 W/m^{2}K
Floor	0.18 W/m^{2}K
Windows	1.4 W/m^{2}K

The u-values of individual elements can be relaxed if required provided that compensatory measures are taken on other elements and that the overall area weighted u-value for the entire dwelling is the same as it would have been if all individual elements had complied.

The thermal bridging details of junctions in the envelope of the building (floor-wall; wall-window; wall-roof, etc) must also be designed and constructed in accordance with the guidance set out in Limiting Thermal Bridging and Air Infiltration – Acceptable Construction Details

Every dwelling must also be subjected to an air pressure test to determine the air tightness. All dwellings must achieve and air tightness of less than 5m^3/m^2/hour when tested at 50 Pascals.

2.4 Regulation 8 Parts (d & e)

The regulation requires that:

> *Providing and commissioning energy efficient space and water heating systems with efficient heat sources and effective controls;*
>
> *Providing that all oil and gas fired boilers shall meet a minimum seasonal efficiency of 90%;*

These require that gas or oil-fired boilers are at least 90% efficient and that heating controls allow independent time control of the heating (2 zones for dwellings larger than 100m^2) and hot water. Heating in each zone should also be controlled by room thermostats (in the case of heating) and cylinder stats (in the case of hot water).

2.5 Regulation 8 Parts (f)

The regulation requires that:

> *Providing to the dwelling owner sufficient information about the building, the fixed building services and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and energy than is reasonable.*

This requires that information is provided to the dwelling owner which relates to the effective and efficient operation of the systems installed in that dwelling. Instructions on how to control the heating & hot water systems based on time and temperature requirements.

2.6 Requirements for Common Areas

Section 0.1.2.3 requires that:

> *Where a new dwelling forms part of a larger building, the guidance in this document applies to the individual dwelling, and the relevant guidance in Technical Guidance Document L - Conservation of Fuel and Energy – Buildings other than dwellings applies to the non-dwelling parts of the building such as common areas (including duplex landlord areas), and in the case of mixed-use developments, the commercial or retail space.*

This requires that the common areas of the duplex blocks are design to meet *Part L 2022 BOTD*

for Buildings Other Than Dwellings and will require that a portion of the energy demand for the common areas is met by a renewable energy source.

2.7 S.I No 393 of 2022 - Regulation 5 Part (e)

The regulation requires that:

> *For a new building (containing one, or more than one, dwelling), where there are more than 10 car parking spaces, ducting infrastructure, consisting of conduits for electric cables, should be provided for every parking space, to enable the subsequent installation of recharging points for electric vehicles where:*
>
> > *• the car park is located inside the building, e.g. a basement car park; or*
> >
> > *• the car park is physically adjacent to the building, i.e. the car park is within the curtilage of the site.*

This requires that ducting provision for the future installation of car charging point be made in all carparks with more than 10 parking spaces associated with multi-unit residential buildings.

3. Building Regulations Part L 2022 (Building Other than Dwellings)

Compliance with Building Regulations *Part L 2022 BOTD* is broken down into seven distinct categories, known as Regulation L5 parts (a) to (i).

A summary of each of these parts as listed in Technical Guidance Document L 2022 BOTD is provided below together with a description of what is required to demonstrate compliance and suggested routes to meeting the required standards.

3.1 Regulation L5 Parts (a)

The regulation requires that:

> *(a) providing that the energy performance of the building is such as to limit the calculated primary energy consumption and related Carbon Dioxide (CO2) emissions to a Nearly Zero Energy Building level insofar as is reasonably practicable, when both energy consumption and Carbon Dioxide emissions are calculated using the Non-domestic Energy Assessment Procedure (NEAP) published by Sustainable Energy Authority of Ireland;*

Part (a) is the overarching compliance target which stipulates the required overall reduction in energy consumption and carbon emissions for new commercial buildings.

This requires that the energy consumption and carbon emissions of every building is assessed using the SBEM software and that the energy consumption and carbon emissions associated with the building being assessed are in line with the required standards.

3.2 Regulation L5 Parts (b)

The regulation requires that:

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

This requires that Renewable Energy Technologies are provided. This to be reflected by Renewable Energy Ratio (RER) which is the ratio of the primary energy from renewable energy sources to total primary energy as defined and calculated in NEAP. RER for commercial buildings is as follows

- Where the MPEPC of 1.0 and MPCPC of 1.15 is achieved an RER of 0.20
- Where an EPC of 0.9 and a CPC of 1.04 is achieved an RER of 0.10

3.3 Regulation L5 Parts (c)

The regulation requires that:

> *limiting the heat loss and, where appropriate, availing of the heat gains through the fabric of the building.*

This requires that the fabric of the building is designed to minimise heat loss from the building and that the air permeability of the structure limits the unwanted passage of air into the building.

Typical compliant U-Values are as follows.

Pitched roof	0.16 W/m^{2}K

Flat roof	0.20 W/m^{2}K
Walls	0.21 W/m^{2}K
Floor	0.21 W/m^{2}K
Windows	1.6 W/m^{2}K

The u-values of individual elements can be relaxed if required provided that compensatory measures are taken on other elements and that the overall area weighted u-value for the entire building is the same as it would have been if all individual elements had complied.

The thermal bridging details of junctions in the envelope of the building (floor-wall; wall-window; wall-roof, etc) must also be designed and constructed in accordance with Acceptable Construction Details and/or certified details for all key junctions.

Building must also be subjected to an air pressure test to determine the air tightness and must achieve an air tightness of less than 5m^3/m^2/hour when tested at 50 Pascals.

3.4 Regulation L5 Parts (d)

The regulation requires that:

> *providing and commissioning energy efficient space heating and cooling systems, heating and cooling equipment, water heating systems, and ventilation systems, with effective controls.*

This requires that heat- generators should be designed and installed so that they operate efficiently over the range of loading likely to be encountered. This means that gas or oil-fired boilers are at least 86% efficient for output less than 70kW and 93% efficient for output over 70kW. Space and water heating systems should be effectively controlled so as to limit energy use by these systems.

Additionally, buildings should be designed and constructed in such way that there is no requirement for excessive installed capacity of Air Conditioning and Mechanical Ventilation for cooling purposes and the ventilating and cooling systems installed are energy efficient and are capable of being controlled to achieve optimum energy efficiency.

3.5 Regulation L5 Parts (e)

The regulation requires that:

> *ensuring that the building is appropriately designed to limit need for cooling and, where air-conditioning or mechanical ventilation is installed, that installed systems are energy efficient, appropriately sized and adequately controlled.*

This requires that the glazed elements of the proposed building are design to limit solar gain to acceptable levels. Design approaches that are often adopted to address this requirement include reducing total glazing areas, introducing internal or external shading devices, or using specifically selected solar control glazing to reduce the solar gain.

3.6 Regulation L5 Parts (f)

The regulation requires that:

> *limiting the heat loss from pipes, ducts and vessels used for the transport or storage of heated water or air.*

This requires that hot water storage vessels, pipes, and ducts associated with the provision of heating and hot water in a building should be insulated to limit heat loss, except where the heat flow through the wall of the pipe, duct, or vessel is always useful in conditioning the surrounding space.

3.7 Regulation L5 Parts (g)

The regulation requires that:

> *limiting the heat gains by chilled water and refrigerant vessels, and by pipes and ducts that serve air conditioning systems.*

This requires that storage vessels for chilled water and refrigerant, and pipes and ducts that serve air-conditioning systems should be insulated to limit heat gain from the surrounding environment.

3.8 Regulation L5 Parts (h)

The regulation requires that:

> *providing energy efficient artificial lighting systems and adequate control of these systems.*

This requires that artificial lighting systems shall be designed and controlled so as to ensure the efficient use of energy for this purpose. Lighting controls should encourage the maximum use of daylight and help avoiding unnecessary artificial lighting.

3.9 Regulation L5 Parts (i)

The regulation requires that:

> *providing to the building owner or occupants sufficient information about the building, the fixed building services, controls, and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and energy than is reasonable.*

This requires that information is provided to the dwelling owner which relates to the effective and efficient operation of the systems installed in that house. Instructions on how to control the heating & hot water systems based on time and temperature requirements.

3.10 S.I No 393 of 2022 - Regulation 5 Part (e)

The regulation requires that:

> *A building which has more than 10 car parking spaces, that is (i) new, or (ii) undergoing major renovation, shall have installed at least one recharging point and ducting infrastructure (consisting of conduits for electric cables) for at least one in every 5 car parking spaces*

This requires that at least one functioning charging point be provided for carparks with more than 10 parking spaces and that a ducting provision be made for the future installation of additional charging points for one in every 5 spaces.

4. Building Fabric

Before considering efficient building services or renewable energy systems, the form and fabric of a building must be assessed and optimised so as to reduce the energy demand for heating, lighting and ventilation. Target performance levels have been identified by the design team and are presented below.

4.1 Elemental U-Values

The U-Value of a building element is a measure of the amount of heat energy that will pass through the constituent element of the building envelope. Increasing the insulation levels in each element will reduce the heat lost during the heating season and this in turn will reduce the consumption of fuel and the associated carbon emissions and operating costs.

It is the intention of the design team to exceed the requirements of the building regulations. Target U-Values are identified below.

U-Values	**Range of Target Values Proposed**	**Part L 2022 (Dwellings) Compliant Values**
Floor	0.10 to 0.18 W/m^{2}K	0.18W/m^{2}K
Roof (Flat)	0.12 to 0.20 W/m^{2}K	0.20 W/m^{2}K
Roof (Pitched)	0.10 to 0.16 W/m^{2}K	0.16 W/m^{2}K
Walls	0.10 to 0.18 W/m^{2}K	0.18 W/m^{2}K
Windows	0.9 to 1.4 W/m^{2}K	1.4W/m^{2}K

4.2 Air Permeability

A major consideration in reducing the heat losses in a building is the air infiltration. This essentially relates to the ingress of cold outdoor air into the building and the corresponding displacement of the heated internal air. This incoming cold air must be heated if comfort conditions are to be maintained. In a traditionally constructed building, infiltration can account for 30 to 40 percent of the total heat loss, however construction standards continue to improve in this area.

With good design and strict on-site control of building techniques, infiltration losses can be significantly reduced, resulting in equivalent savings in energy consumption, emissions and running costs.

In order to ensure that a sufficient level of air tightness is achieved, air permeability testing will be specified in tender documents, with the responsibility being placed on the main contractor to carry out testing and achieve the targets identified in the tender documents.

A design air permeability target of **3 m^3/m^2/hr** has been identified for the houses and duplexes on the site.

The air permeability testing will be carried out in accordance with BS EN 13829:2001 ‘Determination of air permeability of buildings, fan pressurisation method’ and CIBSE TM23: 2000 ‘Testing buildings for air leakage”

4.3 Thermal Bridging

Thermal bridges occur at junctions between planar elements of the building fabric and are typically defined as areas where heat can escape the building fabric due to a lack of continuity of the insulation in the adjoin elements.

Careful design and detailing of the manner in which insulation is installed at these junctions can reduce the rate at which the heat escapes. Standard good practice details are available and are known as Acceptable Construction Details (ACDs). Adherence to these details is known to reduce the rate at which heat is lost.

The rate at which heat is lost is quantified by the Thermal Bridging Factor of the dwelling and measured in W/m2K. The Thermal Bridging Factor is used in the overall dwelling Part L calculation, this value can be entered in three different ways:

0.15W/m^2K	Used where the ACDs are not adhered to
0.08W/m^2K	Used where the ACDs are fully adhered to
< 0.08 W/m^2K	Used where the thermal details are thermally modelled and considered to perform better than the ACDs

It is intended that the ACDs will be adhered where suitable benchmarks exist, and that thermal modelling will be carried out for any non-standard junction details within proposed development and that the resultant Thermal Bridging Factor will be less than 0.08W/m2K for houses.

Confirmation will be required from the Architect and/or Contractor that all key junctions in the scheme have been designed and constructed in accordance with the ACDs.

They will require the following:

- List of thermal bridging junctions in the building, noting all key junctions
- Plan, elevation and section drawings identifying all key junctions and the ACD that are designed and constructed in accordance with signed details sheets of all ACDs used.

5. Heat Sources & Renewable Energy Options & Proposals

All new dwellings must meet overall energy performance levels (as defined by the Energy Performance Coefficient - EPC) and must have a portion of their annual energy demand provided by renewable energy sources.

The renewable energy source can be thermal energy such as solar thermal collection, biomass boilers or heat pumps or it can be electrical energy as generated by photovoltaic solar panels or wind turbines. The minimum renewable energy contributions defined in *Part L 2022 Dwellings* Part (b) is 20% of the total energy consumption for the dwelling.

Two main fuel sources are generally available for developments of this nature, natural gas and electricity. Each present distinct options for compliance with the new standards. Solutions involving gas as the primary fuel source will typically include a solar technology such as PV panels to meet the renewable energy requirements while solutions relying on electricity will include heat pump technology.

The options presented in Sections 5.1 to 5.3 below set out three possible means of complying with *Part L 2022 Dwellings* for the houses, duplexes and apartments. Each is based on the building fabric performance levels identified in Table 1 in Section 3.

The final selection and combination of technologies will most likely be selected from these options based on a more in-depth technical and financial appraisal of the technologies which will be carried out during detailed design.

5.1 Houses & Duplexes Option 1 - Air Source Heat Pumps

Air source heat pumps (ASHPs) utilise grid supplied electricity to extract thermal energy from a heat source, in this case, the external ambient air. While the electricity consumed is obviously not renewable energy, the efficiency at which a heat pump operates allows a significant portion of the heat delivered to be considered as renewable energy. The amount of heat considered to be renewable is determined by the efficiency of the heat pump and the “primary energy conversion factor” for grid supplied electricity. Typically, approximately 40% to 50% of the heat supplied is considered to be renewable energy.

Air source heat pumps require an indoor and an outdoor component. The outdoor unit is the evaporator which extracts the thermal energy from the ambient air while the indoor unit typically includes the heating buffer tanks and the hot water cylinder for the dwelling. The outdoor unit is typically located in the back garden of a dwelling.

In recent years, the design of ASHPs has improved bringing about higher efficiencies and reduced costs. This, in turn, has led to an increase use of this technology in large scale housing developments. Certified seasonal efficiencies of some models can exceed 500% meaning that the use of this technology can easily deliver compliance with *Part L 2022 Dwellings*.

5.2 Duplexes & Apartments Option 2 - Electric Heaters, Exhaust Air Hot Water Heat Pumps & PV

This approach includes the provision of electric storage and/or convector heaters in the living & sleeping areas to meet all of the space heating requirements with electric towel rads provided in main bathrooms and en-suites.

The hot water demand is met by an exhaust air hot water heat pump which utilise grid supplied electricity to extract thermal energy from a heat source, in this case, the internal air within the houses and duplexes. The internal air is extracted from kitchens and wet rooms and is drawn into the heat pump via ductwork in

the ceiling void. The heat pump extracts heat from this air before expelling it from the duplexes & apartments.

There is no requirement for a separate Mechanical Extract Ventilation (MEV) systems when an exhaust air heat pump is used as the heat pump draws the air from all wet rooms in the same manner as an MEV system would. The fan will run continuously to ensure that the minimum ventilation rates are maintained and the supply air to the dwelling is provided through trickle vents in each habitable room.

PV panels are also then needed to improve the overall renewable energy contribution and improve the overall energy performance of the dwellings.

5.3 Apartments Option 3 - Exhaust Air Heat Pumps

Exhaust Air heat pumps (EAHPs) operate in a very similar manner to the more conventional air source heat pumps and utilise grid supplied electricity to extract thermal energy from a heat source, in this case, the internal air within the apartment. The internal air is extracted from kitchens and wet rooms and is drawn into the heat pump via ductwork in the ceiling void. The heat pump extracts heat from this air before expelling it from the apartment.

As noted in Section 4.2 above, the electricity consumed is not renewable energy but the efficiency at which a heat pump operates allows a significant portion of the heat delivered to the dwelling be considered as renewable.

There are a number of manufacturers offering products of this type and the certified seasonal efficiencies of some models can exceed 450% in heating mode and 170% to 190% in hot water mode. These efficiencies can deliver Part L 2022 compliance in most circumstances but in some instances may need supplementary PV panels in order to meet the required energy targets.

There is no requirement for a separate Mechanical Extract Ventilation (MEV) systems when an exhaust air heat pump is used as the heat pump draws the air from all wet rooms in the same manner as an MEV system would. The fan will run continuously to ensure that the minimum ventilation rates are maintained and the supply air to the dwelling is provided through trickle vents in each habitable room.

6. Heat Sources & Renewable Energy Options – Creche

All new commercial buildings (Buildings Other Than Dwellings) must meet the overall energy performance standards and have a have a portion of their annual energy demand provided by renewable energy sources as set out in Part L 2022 Dwellings. This can be thermal energy such as ***solar thermal collection***, ***biomass boilers*** or ***heat pumps*** or it can be electrical energy as generated by ***photovoltaic solar panels*** or ***wind turbines.***

The minimum renewable energy contributions for a development of this nature is defined in *Part L 2022 BOTD* L5 Part (b) and is measured by the Renewable Energy Ratio (RER). This is the ratio of the primary energy from renewable energy sources to total primary energy demands of the building. Depending on the overall performance of the building, as measured by the EPC and CPC the required renewable energy contribution is either 20% or 10%

In order to determine the most efficient and effective means of complying with the requirements of Part L 2022 BOTD Part (b) a detailed assessment of the various renewable energy systems available will be conducted during the design stage using the SBEM calculation methodology.

There is a wide variety of possible solutions for heating, cooling and ventilation of non-domestic buildings which can be tailored to suit the proposed uses of the spaces and to meet the occupancy needs. Some spaces may require mechanical ventilations systems or comfort cooling to meet the required internal comforts levels, while others may simply need heating and natural ventilation. Hot water demands in non-domestic buildings also vary considerably depending on building use.

As part of the detailed design process, an SBEM analysis will be carried out to assess the proposed design solutions for compliance with the requirements of *Part L 2022 BOTD*. Typical design solutions that will be assessed will include the following:

- Water based heating systems incorporating air source heat pumps or condensing gas boilers
- Natural ventilation where possible
- Mechanical ventilation systems incorporating heat recovery and/or heat pump technology
- Comfort cooling where required with invertor driven, R32 air conditioning technology
- LED lighting with occupancy and daylight controls
- Solar renewable energy systems (photovoltaic or solar thermal) if required to meet renewable contribution energy targets

7. Electric Vehicle Charging

All new commercial buildings (residential and non-residential) must make a provision for charging electric vehicles. This applies where more than 10 parking spaces are provided.

For residential buildings, the regulations state that future provision, in the form of cable ducting and capacity on distribution boards and meters etc. be made for all parking spaces associated with multi-unit developments with more than 10 parking spaces.

Electric Vehicle (EV) charging points are provided in accordance with Section 12.4.11 (Electrically Operated Vehicles) of the Dún Laoghaire-Rathdown County Development Plan 2022-2028 which states the following:

"Residential multi-unit developments both new buildings and buildings undergoing major renovations (with private car spaces including visitor car parking spaces) - a minimum of one car parking space per five car parking spaces should be equipped with one fully functional EV. Charging Point. Ducting for every parking space shall also be provided."

The proposed multi-unit residential development includes a total of 179 no. off-curtilage car parking spaces. Future provision for all spaces will be required and 20% of spaces will incorporate EV charging points. Since the development will also include Part M compliant accessible spaces, the location of the charging point will be such that it can serve one accessible parking space and one standard parking space.

Therefore, 36 no. of the residential car parking spaces are required to be equipped with EV charging points. Additional ducting will be provided to allow for retrospective installation of additional charging points. In-curtilage car parking spaces can readily be made EV charging point equipped. The location of EV charging point-equipped car parking spaces and the car parking allocation is shown on MCORM site plan layout.

8. Proposed Solutions and Conclusions

This evaluation considered several different energy systems evaluating both central and individual plant for both heating and renewable energy systems. The recommendations produced from this evaluation are shown below. All of which provide low carbon, low energy heating solutions.

The preceding sections of this report set out the regulatory requirements with which the scheme will have to comply while identifying a number of technologies and design approaches that may be utilised to achieve compliance.

The building fabric standards and the technology solutions discussed will all be assessed in greater detail during the detailed design stage of the project. A cost benefit analysis of all these available solutions will be carried out to determine the correct balance between an efficient building envelope and the most appropriate combination of technology and renewable energy systems.

The proposed approach to achieving Part L Compliance will be based on a combination of the solutions below once a detailed analysis has been completed at detailed design stage. A final decision will be made once capital costs, renewable targets and regulation compliance have all been compared to find the most appropriate solution.

8.1 Energy in Use Measures (Residential)

- Meet or exceed minimum U-Value standards identified in *Part L 2022 Dwellings.*
- Achieve air tightness standards of 3m^3/m^2/hr.
- Ensure thermal bridging details are designed to achieve thermal bridging factors of 0.08W/m^2K or less.
- Provide an appropriate combination of technologies to ensure energy consumption is in line with *Part L 2022 Dwellings* requirements. This will include individual plant in each house (air source heat pumps or electric heaters and hot water exhaust air heat pumps).
- Install centralised mechanical ventilation systems to ensure adequate ventilation rates are achieved in the dwelling which maximising the benefits of the airtight construction.

8.2 Energy in Use Measures (Creche)

The most likely overall solution that will be implemented will include the following measures

- Meet or exceed minimum U-Value standards
- Achieve air tightness standards of 5 m^3/m^2/hr
- Provide an air source heat pump and/or PV panels to meet Part L renewable contribution requirements

8.3 Energy in Use Measures (Landlord Areas)

The most likely overall solution that will be implemented will include the following measures:

- Meet or exceed minimum U-Value standards.
- Achieve air tightness standards of 5 m^3/m^2/hr.

- Provide PV panels to meet Part L renewable contribution requirements (no. of panels will depend on size and if corridor is heated or unheated corridor) (unheated corridor typically 10-15 PV panels).

UK and Ireland Office Locations