Renaissance Engineering

Mechanical & Electrical Consulting Engineers

Company No: 515 676
Vat No: IE 984 245 6U
info@reneng.ie
renaissanceengineering.ie

Energy & Sustainability (Climate Action) Report for Large-Scale Residential Development

Ballycullen, Firhouse, Dublin 24

11 September 2024

Ireland
2nd Floor, 67-70 Meath Street
Dublin 8, Ireland, D08 YCK4
+353 (0) 1 675 0850

United Kingdom
Rodney Chambers, 40 Rodney Street
Liverpool, L1 9AA
+44 (0) 330 0591

Contents

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 the policies and objectives of the South Dublin County Council Development Plan, hereafter referred to as the CDP. The purpose of this statement is further to demonstrate how low carbon energy and heating solutions have been considered as part of the overall design and planning of the proposed development. Having regard to the above, the statement, prepared by a certified engineer, shall address:

- *the technical, environmental and economic feasibility of on-site renewable energy generation including solar PV and small scale wind power;*
- *the technical, environmental and economic feasibility of at a minimum, the following high-efficiency alternative energy supply and heating systems:*
  - *decentralised energy supply systems based on energy from renewable and waste heat sources;*
  - *co-generation (combined heat and power);*
  - *district or block heating or cooling, particularly where it is based entirely or partially on energy from renewable and waste heat sources;*
  - *heat pumps;*
  - *include an assessment of embodied energy impacts.*

Description of Development

The proposed development consists of 523 no. residential units comprised of 253 no. 2, 3 & 4 bed detached, semi-detached and terraced houses, 208 no. 1, 2 & 3 bed duplex units in 20 no. 2 & 3 storey blocks, and 62 no. 1, 2 & 3 bed apartments in 4 no. 3 & 3-4 storey blocks, along with a 2-storey childcare facility of c. 457sq.m.

Private amenity space for the residential units is provided in the form of rear gardens for houses and ground floor terraces / upper floor balconies for apartments and duplex units. The proposed development provides for c. 7.38Ha of public open space and c.4,797 sq.m of communal open space associated with proposed residential units.

Vehicular access to the development will be via 4 no. access points, as follows: (i) from the west of the site via 2 no. accesses located off Bohernabreena Road, (ii) from the north of the site via 1 no. access at Dodderbrook Place, and (iii) from Oldcourt Road (the R113) to the east, via adjoining residential development. The proposed development includes for pedestrian and cyclist connections and accesses to adjoining lands to the north, east and west, and includes for cycling and pedestrian routes and infrastructure throughout the development.

The proposed development also includes the demolition of existing buildings / structures on the site (c.3,800sq.m), hard & soft landscaping, boundary treatments, SuDs features, drainage infrastructure, services infrastructure, bin stores, bicycle stores, car parking (including EV parking facilities), bicycle parking, public lighting etc. and all associated site development works.

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 rating 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.

2.1 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.

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.

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.

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.

3. Energy Efficient & Sustainable Technologies Considered

The following renewable energy systems were considered for this development in terms of capital costs, energy performance, maintenance requirements & Part L Compliance.

- Solar PV
- Small scale wind power
- Decentralised energy supply systems based on energy from renewable and waste heat sources;
- Co-generation (combined heat and power);
- District or block heating or cooling, particularly where it is based entirely or partially on energy from renewable and waste heat sources;
- Heat pumps;

In compliance with this, the report evaluates the following on-site renewable energy generation systems:

- Solar photovoltaic panels (3.1.1)
- Small-scale wind power (3.1.2)

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
- Exhaust Air Heat Pump

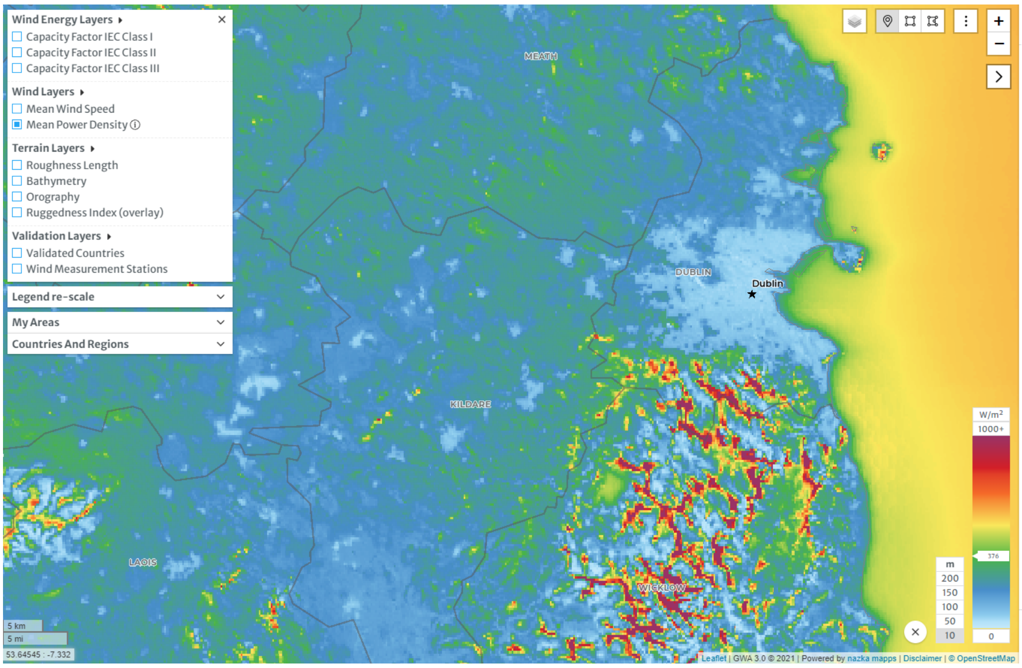
3.1 Description of Systems and Technical and Environmental Feasibility

3.1.1 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.

3.1.2 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.



3.1.3 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 and housing 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 externally, including on a balcony in cases of apartments or duplexes which do not have a private garden.

3.1.4 Centralised Systems – Block Heating with Cogeneration (Combined Heat and Power/CHP) and District Heating

The typical system considered here consists of a centralised plant room, 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 dwelling via a piping network and is controlled via a heat interface unit located within each dwelling. 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 of apartment buildings 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.
- Although there is great potential for district heating to meet Dublin's heating needs, with it estimated to be capable of providing 87% of all heating requirements,
- 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. Although Oldcourt is generally located in an urban environment, it is not densely populated, being located on the outskirts of the Dublin urban area and backing onto the Dublin mountains and as a result has fewer hospitals, nursing homes, hotels and high-density accommodation than other areas of the city which may be prioritised for district heating schemes.
- As we are not aware of any planned district heating schemes intended to serve the Oldcourt area and since for the density and suitability reasons above we consider it less likely to be a priority target for development of future schemes, alternative high-efficiency means of heating the planned development are preferred.

3.1.5 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. 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 dwelling as no need for additional hot press to house cylinder. Excellent ventilation throughout dwelling 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 management company metering or billing.
- May have insufficient capacity or power for larger dwellings such as 3-4 bedroom houses

3.2 Cost Analysis/Economic Feasibility

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

Description	1 bed apartment	2 bed duplex	3 bed house
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. 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	*Not suitable*

The proposal for a centralised system is the most expensive option and coupled with the disadvantages outlined above this is not considered to be a viable option for the development.

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.

3.3 Energy Analysis

The remaining 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 house.

Description	Proposed System		
	Hot water heat pump + electric heating + MVHR	Air Sourced HP	Boiler & PV
BER Rating	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.

3.4 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:

- Solar photovoltaic panels
- Air to Water Heat Pump with External Condenser
- Exhaust Air Heat Pump (apartments only)

Broadly speaking, the two latter 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.

4. Recommendation / Proposed Systems & Building Fabric

The air source heat pump system has been chosen as the preferred option because it:

- Complies with all applicable energy legislation as demonstrated within Section 3 above
- Is all-electric and thus avoids fossil-fuel-at-point-of-use
- Requires minimal central plant and site ducting as with district energy schemes and is thus compatible with the design for individual dwellings
- Is cost-effective to install
- It is simple to use and therefore suitable operationally for residents

To this end, a system comprising the following main components will be installed in each dwelling to cater for all hot water, space heating and ventilation requirements:

- Outdoor heat pump fan unit
- 200 litre hot water heat pump cylinder
- Steel panel radiators
- The system shall provide individual time and temperature control over heating and hot water.
- Ducted centralised continuous mechanical extract ventilation (CMEV) system in accordance with Technical Guidance Document F (2019).

Alternatively, for smaller apartments an exhaust air heat pump system as detailed above, which complies with the requirements of Part L and achieves NZEB BER, may be utilised. PV panels will additionally be provided where necessary to meet compliance with NZEB requirements.

Other building energy specification details include:

- Use of A-rated low energy LED lamps throughout.
- Air tightness values and building fabric details shall be as outlined in 1.8 above.
- Solar PV will be installed to ensure landlord spaces comply with Part L requirements for EPC, CPC and RER

Signed:

Barry Stenson BA, BAI, MSc, MIEI

Senior Mechanical Engineer
Renaissance Engineering

5. Appendix A / Schedule of Proposed Systems & Building Fabric

Item	**Specification**	
Primary Heat Source	Air-source heat pump (e.g. Joule Samsung 5 or 8kW as appropriate or equal approved)	Exhaust air heat pump (e.g. Joule Modulair All-E or equal approved)
Secondary Systems	None	
Chimneys	None	
Heating element	Steel radiators	
Central Heating Pump	None	
Heating controls	Individual time and temperature zone control (A minimum of 2 heating zones & 1 hot water zone)	
Hot Water Storage Tank	200 litre hot water storage cylinder (Joule Cyclone or equal approved)	
Lighting	All lamps must be A-Rated low energy type.	
Ventilation	Centralised continuous mechanical extract ventilation via dedicated system	Centralised continuous mechanical extract ventilation via exhaust air heat pump action
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	