

Emmet Rd. Development

Co. Dublin

Energy Analysis Report
IN2 Project No. D2030

Revision History

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Registered Office: Unit E, Mount Pleasant Business Park, Upper Mount Pleasant Avenue, Dublin 6

Company Registration No.: 466565

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1.0 Executive Summary

The proposed development is located at Emmet Rd, Inchicore, Dublin 8. The development, which this report describes, consists of 578 no. apartments, a library/community building, supermarket, creche as well as 5 no. retail/commercial units and 2 no. cafe units.

This report outlines the current building regulations framework and the requirement to achieve Nearly Zero Energy Building (NZEB) standard for all new developments. The report describes how the NZEB standard is demonstrated using the SEAI approved Dwelling Energy Assessment Procedure (DEAP) software.

Section 2 provides a brief overview of Building Regulations, Renewable Technologies as well as defining Primary Energy.

Section 3 includes a descriptive summary of the proposed heating system strategy for the Emmet Rd. development. As demonstrated in section 4, the proposed heating strategy to utilise Air Source Heat Pumps for Emmet Rd. will achieve NZEB compliance and would be a suitable options for this development.

Section 4 outlines the mechanical and electrical installations information used for the energy analysis undertaken for the Emmet Rd. development to determine Part L compliance. This includes recommendations for the minimum fabric and design parameters necessary to achieve compliance.

2.0 Building Regulations

2.1 NZEB

Building energy has long been understood as contributing a major component of greenhouse gas emissions. This was acknowledged within the 2030 Communication published by the European Commission (2014) which stated that “the majority of the energy-saving potential (for the EU) is in the building sector”

The 2010 EU Energy Performance of Buildings Directive (EPBD) sets out the target that all new developments should be Nearly Zero-Energy Buildings (NZEB) by the end of 2020. A Nearly-Zero Energy Building is defined in the Directive as having “very high energy performance”, with Article 2 of the EPBD outlining that “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”.

Interpretation and implantation of these statements within the directive are at the discretion of each EU Member State in accordance with their “National, Regional or Local considerations” and thus the definition of NZEB itself varies greatly between different countries.

For new dwellings in Ireland, NZEB has been defined as being (primarily) associated with demonstrating the following characteristics are achieved:

- Primary Energy/ Carbon Emissions: 70% reduction against Part L 2005
- Renewable Energy: 20% of this Primary Energy required

These NZEB targets have been now incorporated within the current Technical Guidance Document (TGD) Part L 2021, as discussed in section 2.2.

Figure 2.1.1 illustrates comparative Primary Energy consumption for Dwellings in Ireland from the 1970’s through to current NZEB standards. It may seem that continued improvements in Primary Energy consumption over the past 20years have been maintained by the ongoing revisions to the building regulations.

Figure 2.1.2 illustrates the NZEB targets for Primary Energy (and Carbon Emissions) and Renewable Energy. The Part L 2005 benchmark could be expected to achieve a B3 BER, in comparison to A2 for NZEB compliance.

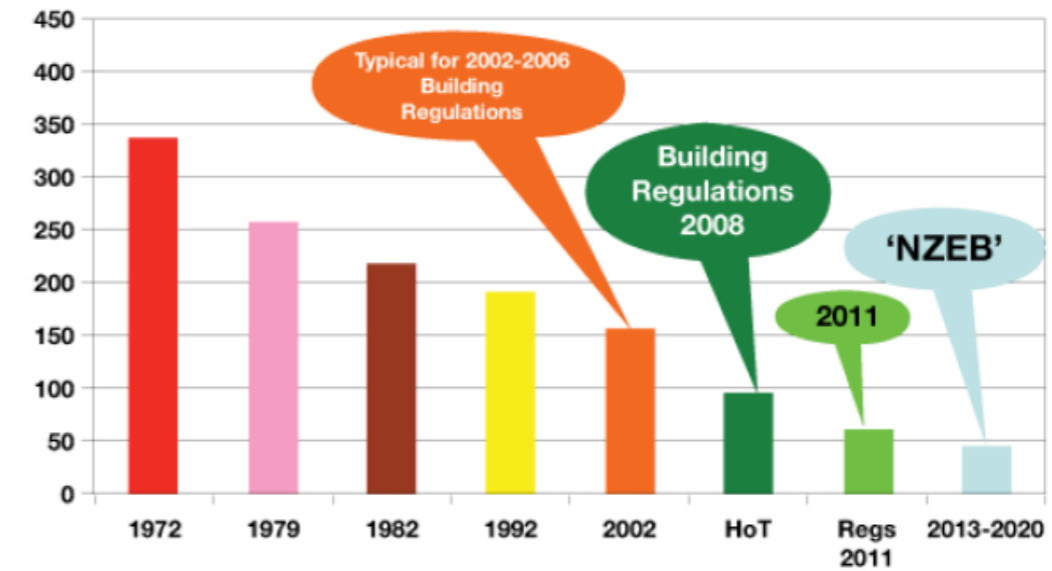


Figure 2.1.1: Primary Energy Consumption in Irish Housing 1972-2020

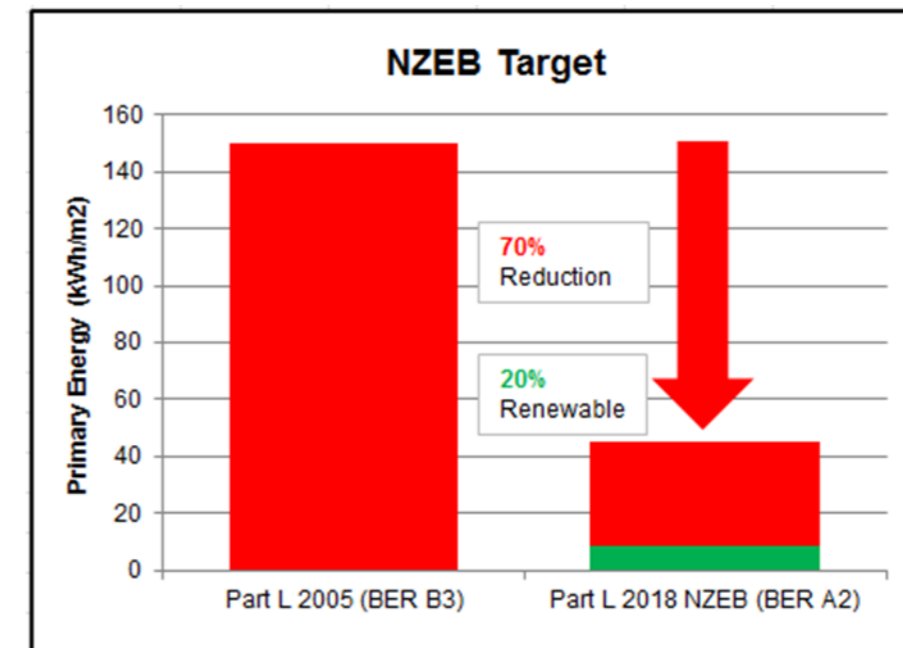


Figure 2.1.2: NZEB Targets

2.2 Part L 2021

Technical Guidance Document (TGD) Part L Conservation of Fuel and Energy – Dwellings outlines how compliance to this element of the Building Regulations may be demonstrated through the utilisation of the Dwelling Energy Assessment Procedure (DEAP) software, which analyses comparative energy usage for a particular residence.

The energy assessment is determined annually on a floor area basis (kWh/m².ann) under the following headings, known as “regulated loads”:

- Heating
- Hot Water
- Auxiliary (Fans, Pumps and Controls)
- Lighting

It should be noted that significant energy loads within dwellings; particularly equipment associated with cooking, washing etc. are excluded from DEAP analysis and associated Part L Compliance/ BER calculations. These energy loads, known as “unregulated loads” are deemed to be associated with operational usage which is not consistent across all dwellings, as opposed to the building’s fabric and services performance.

Figure 2.2.1 indicates an energy breakdown for a typical apartment (circa 100m²) compliant to NZEB / Part L 2021. It can be seen that Hot Water Energy consumption pre-dominates accounting for over half of the primary energy consumed, with Heating Energy considerably lower. This is reflective of the extensive improvements to insulation/air permeability / thermal bridging/glazing / heating system efficiency etc., through successive Building Regulation revisions over recent years.

As both Hot Water and Lighting Energy consumption are effectively fixed within the calculation methodology (as based on standardised databases of hot water usage etc.), further improvements to Heating related items (insulation etc.) are generally required to ensure overall compliance can be achieved.

The following minimum Fabric Performance targets are defined in Part L 2021:

Thermal Transmittance (U-Values)

- Roofs: 0.16 W/ m²K
- External Walls: 0.18 W/ m²K
- Ground/ Exposed Floors: 0.18 W/ m²K
- Windows/ Doors/ Rooflights: 1.40 W/ m²K

Air Permeability

- Maximum Air Leakage: 3 m³/hr.m² @ 50Pa

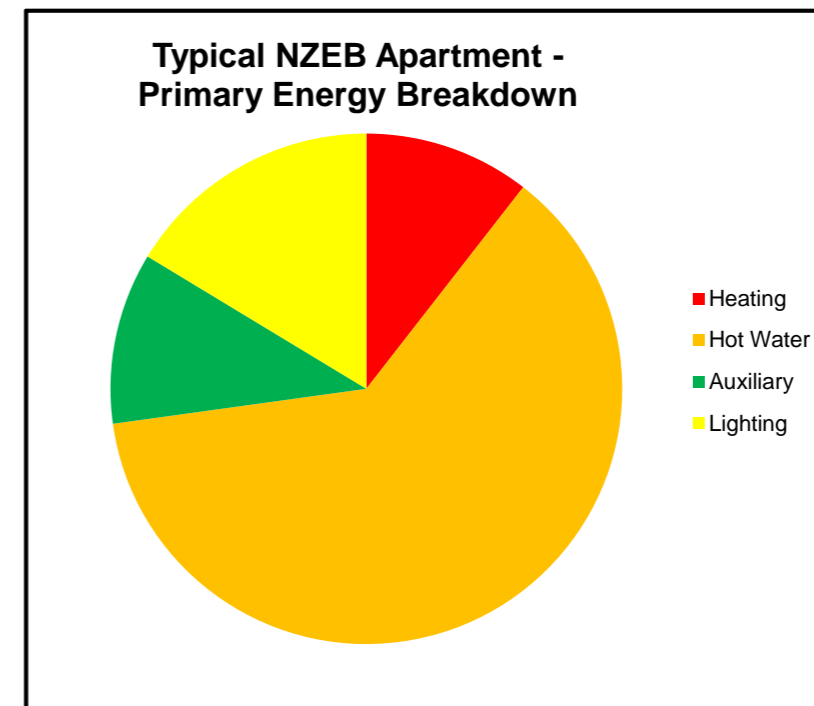


Figure 2.2.1: Typical Residential Primary Energy Breakdown

The Part L regulations specify that for apartments or other terraced residential buildings compliance can be demonstrated based on the average of all dwellings for each of the parameters associated with Part L, namely Primary Energy (EPC), Carbon Emissions (CPC) and Renewable Energy (RER). Therefore, for the purposes of analysis, an apartment representative of the average attributes of the dwellings has been selected.

In summary, DEAP analysis must demonstrate the following to ensure compliance to Part L 2021:

- Energy Performance Coefficient (EPC): 0.30 or lower
(ie. 70% reduction in Primary Energy against Part L 2005 benchmark)
- Carbon Performance Coefficient (CPC): 0.35 or lower
- Renewable Energy Ratio (RER): 0.20

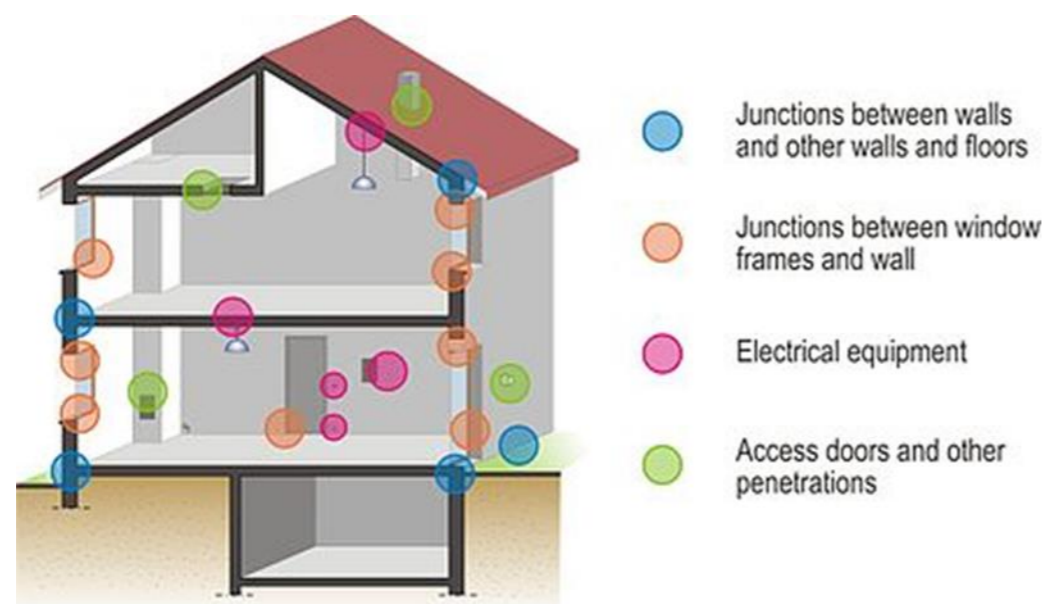


Figure 2.2.2: Common areas of air leakage

2.3 Primary Energy

In assessing energy performance for dwellings, Part L (and BER) utilises Primary Energy as a means of comparative analysis. This relates to the energy at source as required for the dwelling, as opposed to that consumed within the actual building. For example, electrical Primary Energy relates to that required for both generation (based on average of power plant fuels and efficiencies) and transmission for electricity through the ESB grid.

Primary Energy Factor (PEF) conversions for main fuel types are as follows:

- Electricity: 1.83 (2.08 as included in DEAP software)
- Natural Gas: 1.10

It can be seen from the above that the Primary Energy conversion for Electricity is twice that of Natural Gas (as well as other fossil fuels and biomass); therefore, a direct electric heater would consume double the Primary Energy of an LPHW radiator. However, as can be seen from Figure 2.3.1, the underlying trend over time has been that the Primary Energy of electricity with respect to Natural Gas (and other fuels) has been reducing (due to the increased “greening” of the ESB grid with Wind and Solar renewables and more efficient plant operation), with the following impacts in terms of technologies and associated Part L compliance, as PEF for electricity reduces.

- Heat Pump, both Air Source and Geothermal, are becoming increasingly viable.
- Natural Gas Combined Heat and Power (CHP) is becoming less viable.
- Larger Photovoltaic (PV) arrays required to offset electricity usage (albeit offset by increases in PV efficiency for equivalent array sizes).

As the efficiency of the Electrical grid continues to improve the current Part L 2021 PEF is based on the average of the projected Electrical grid efficiency over the next 10 years.

The associated Carbon Factors for main fuel types in Ireland are as follows:

- Electricity: 346 gCO₂/kWh
- Natural Gas: 203 gCO₂/kWh

The Carbon Factors associated with electricity have fallen by approximately 45% in Ireland over recent years (from 635 gCO₂/kWh in 2005) as renewable technologies are

added to the grid however the reliance on natural gas, peat and coal ensures electricity remains a relatively significant source of carbon emissions.

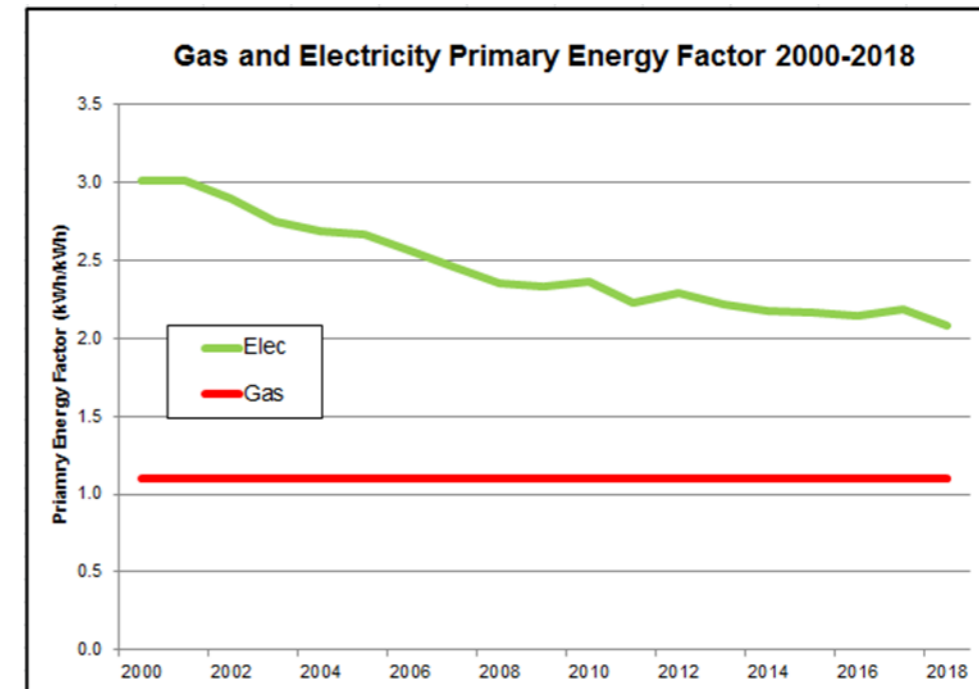


Figure 2.3.1: Primary Energy Factors for Gas and Electricity 2000-2018

2.4 Renewable Technologies

In addition to improving heating energy efficiency, renewable technologies can be utilised to significantly reduce Primary Energy requirements (while ensuring the RER renewable energy percentage is also achieved). Figure 2.4.1 indicates how, for a typical apartment (notional 100m², gas boiler plant) designed to ensure NZEB compliance, 4no. PV panels (250W each) would offset the excess energy within the gross consumption. This extent of renewable energy must be at least 20% of the overall Primary Energy (RER =0.20+).

With regards to renewable energy technology solutions, the most suitable options for apartment design, ensuring compliance with Part L in a cost-effective manner, are as follows:

- Air Source Heat Pumps (ASHP)

Reduces Primary Energy associated with both Heating and Hot Water compared to gas boilers. Can be implemented on either a centralised or decentralised basis (see Section 2.5). Typically Heat Pump efficiencies (seasonal CoP) of 450% are available.

A centralised solution would include a large commercial heat pump sized to provide the base heating load and supplemented with gas boilers. A decentralised solution would include Air Source Heat Pump technology located in each apartment.

- Photovoltaics (PV)

Offsets Primary Energy associated with Electricity. Most cost-effective where installed as part of Centralised plant arrangement, with single array interlinked to Landlord electricity supply (as opposed to individual units).

The centralised and de-centralised portions of this section explain the current method in dealing with the renewable contribution to each apartment and landlord area for both a centralised system and a decentralised system.

Centralised Air source Heat Pump & Boilers:

In this configuration, the heat from the Air Source Heat Pump (ASHP) contributes renewable energy to both the apartment and the landlord areas. If this contribution is insufficient, a small Landlord PV array may be included to increase the renewable energy contribution.

Current Part L 2021 regulations require a Renewable Energy Ratio (RER) of 20% for each apartment. The landlord areas (separately assessed as a commercial building) must also be served by a renewable technology to be deemed compliant.

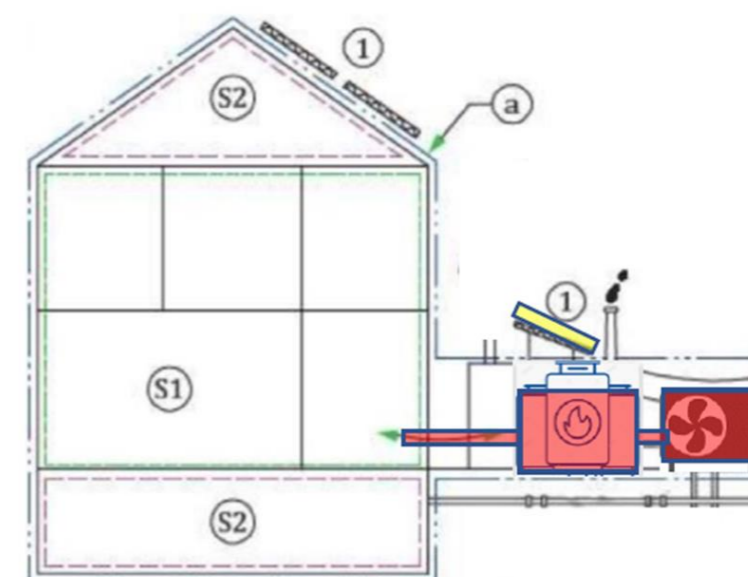


Figure 2.4.1: Centralised Boilers/ASHP with PV array (if required) to Landlord Areas

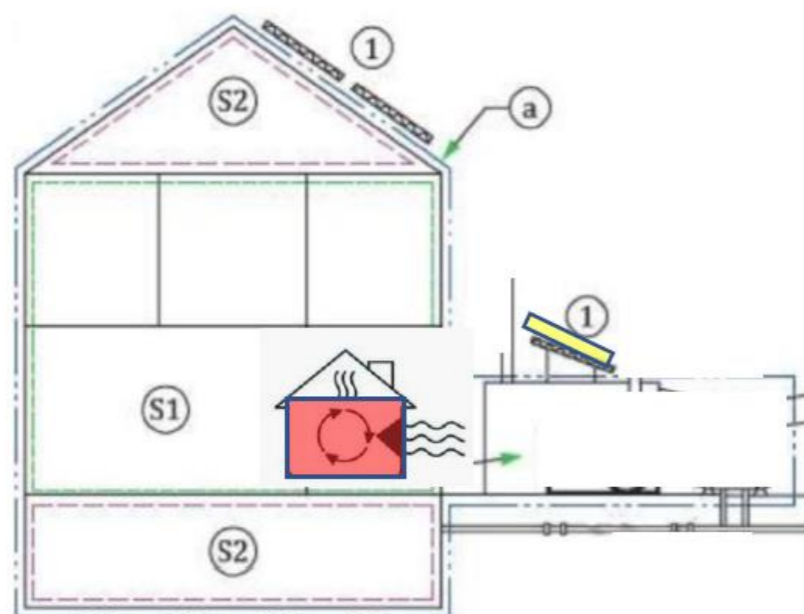


Figure 2.4.2: Centralised Boilers/ASHP with PV array (if required) to Landlord Areas

2.5 Route to Net Zero Carbon

As outlined in section 2.3 the building regulations in Ireland assess both primary energy consumption and carbon intensity. The carbon intensity that is applied for electricity within the DEAP methodology is the grid average. There is therefore no benefit to the NZEB calculation for changing to a renewable electricity supplier. This approach was taken by the SEAI in developing the regulations to ensure that buildings would be designed to prioritise reducing primary energy consumption regardless of the energy source.

Although sourcing renewable energy providers will not affect the results of the NZEB calculations this approach should still be considered as best practice.

Renewable Gas

An EU commissioned report has found Ireland has the highest potential for Renewable Gas production per capita in Europe. This is based on Anaerobic Digestion technology which generates biogas from grass or manure.

Renewable gas is currently projected to make up 12% of the gas grid by 2030 however renewable gas is not currently widely available to customers.

Renewable Electricity

Ireland in 2020 delivered 40% of electricity from renewable sources. This is due to continue to rise in the coming years with Eirgrid reporting a target of 60%-70% renewable electricity by 2030 dependant on consumption patterns.

Renewable electricity is widely commercially available and should be considered when choosing an energy supplier for the development.

3.0 Proposed Heating Strategy Plant

3.1 Centralized Air Source Heat Pump System

To achieve NZEB and Part L compliance, a suitable solution for the Emmet Rd. Development is the centralised air source heat pump system. The proposed system will consist of an arrangement of air source heat pumps, which will be located at roof level.

From this centralised plant location, district heating pipework shall serve the entire site, both residential & commercial blocks.

This is a centralised solution in which each residential apartment is provided with a Heat Interface Unit (HIU) which will provide both the hot water and heating demand for the apartment via an inbuilt plate heat exchanger.

Similarly, commercial units shall be provided with local Plate heat exchangers to meet the associated thermal load of the building/block.

This solution relies on the Air Source Heat Pumps working to provide a primary system with a supply temperature of 65°C and a return temperature of 35°C.

For the residential elements, the 65°C supply is pumped around the site from the main plant to each apartment HIU. At this point some of the heated water will bypass the internal plate heat exchanger in the HIU and go directly to the apartment's radiators for heating. Some of the water will also pass through the heat exchanger for the Domestic Hot Water (DHW) as there is demand. This DHW will be supplied at 45-50°C wherever it is needed.

For the commercial elements, the 65°C supply is pumped around the site from the main plant to each commercial / community building. At this the heated water will be passed through a local Plate Heat Exchanger. This will hydraulically separate the commercial / community systems from the main site heating system, while still maintaining the thermal delivery.

Cold water storage serving the entire site will be located centrally at basement level and pressure boosted to all buildings to eliminate noisy pumps and failure points within local blocks.



Figure 3.1.1: ASHP's & HIU's

4.0 Energy Analysis

To determine Part L compliance, a detailed energy analysis was completed for the different Emmet Rd. development apartment types. The analysis was completed using the building control approved Dwelling Energy Assessment Procedure (DEAP) software administered by Sustainable Energy Authority Ireland (SEAI) of behalf of the Department of Housing, Planning and Local Government.

4.1 Building Construction

Sample apartments within the development were taken based on worst-case scenarios ie; dual aspect, north-facing glazing, sheltered on only one side etc. These apartments were selected for the purposes of analysis with a minimal level of exposed floor and roof allowed to simulate the whole block average. The following building performance was assumed for analysis in terms of Thermal Transmittance, Glazing Parameters, Air Permeability and Thermal Bridging, respectively:

Building Construction and U-Values		
Element Type	Part-L 2021 Regulations	Targeted
Roof	0.16 W/m ² k	0.12 W/m ² k
External Wall	0.18 W/m ² k	0.18 W/m ² k
Ground/Exposed Floors	0.18 W/m ² k	0.12 W/m ² k – where applicable
Windows/Doors/Rooflights	1.4 W/m ² k	1.4 W/m ² k
Heat Transmission Coefficient	0.08 W/m ² k (ACD's)	0.15 W/m ² k (default value)

Table 4.1.1: Building Construction & U-Values

Glazing Parameters	
Total Solar Heat Transmittance	0.6
Framing Factor	0.70
Overshadowing	Average

Table 4.1.2: Glazing Parameters

Miscellaneous Building Parameters	
Element	Value Targeted
Shower Flow Rates	6 l/min
Water Usage	125 l/person/day
Lighting	100% LED
Air Permeability Rate (Air Leakage)	3m ³ /h/m ² @ 50Pa

Table 4.1.3: Miscellaneous Building Parameters

4.2 Commercial / Community Buildings Part-L RER contribution

The Part-L Renewable Energy contribution is achieved with the use of centralized Air Source heat pumps, delivering 100% of the required thermal load of unit/block.

4.3 Typical Studio Apartment Mechanical & Electrical Installations

The following sub-sections detail the DEAP analysis for the below apartment.

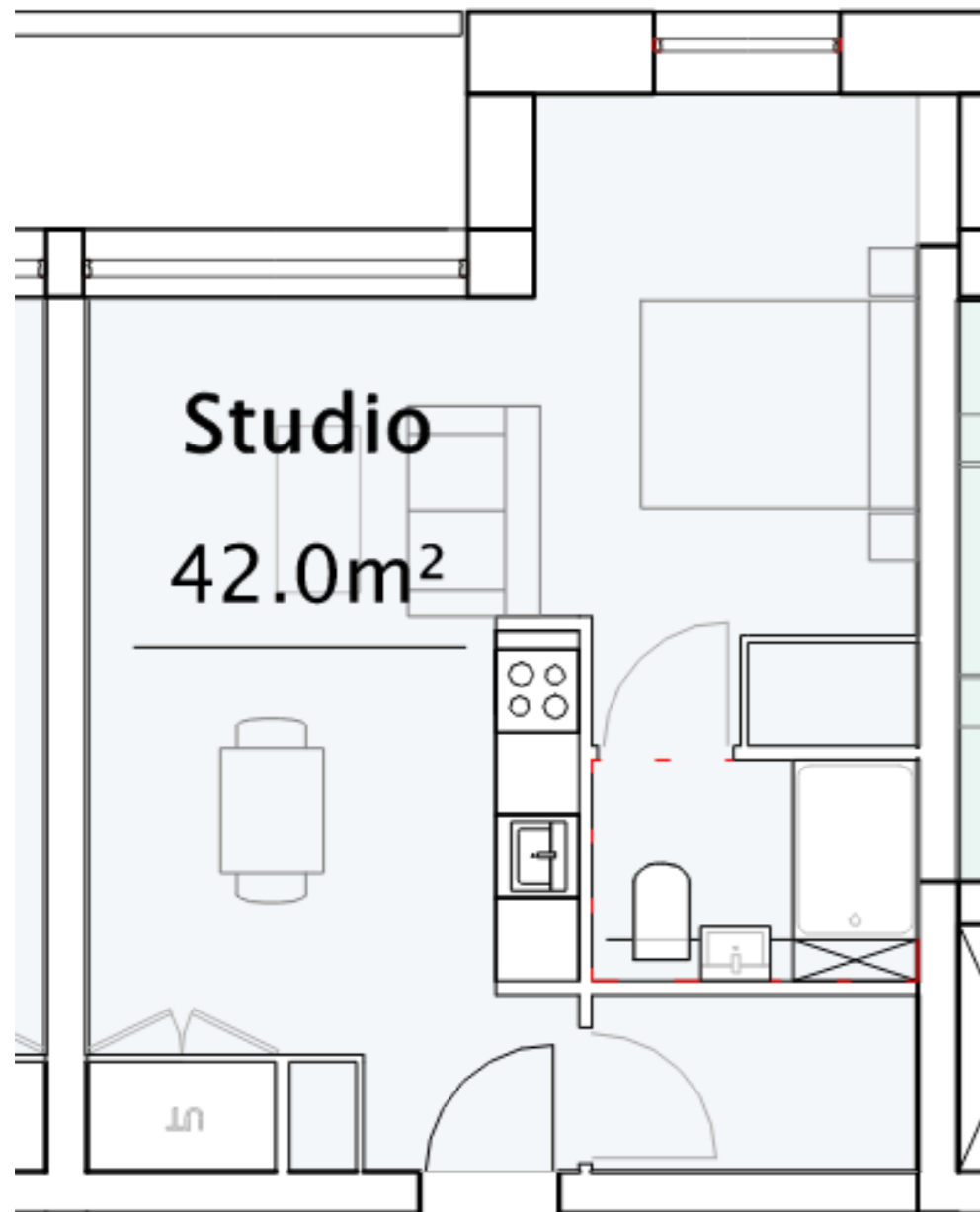


Figure 4.2.1: Typical Studio Apartment

4.3.1 Part L Compliance

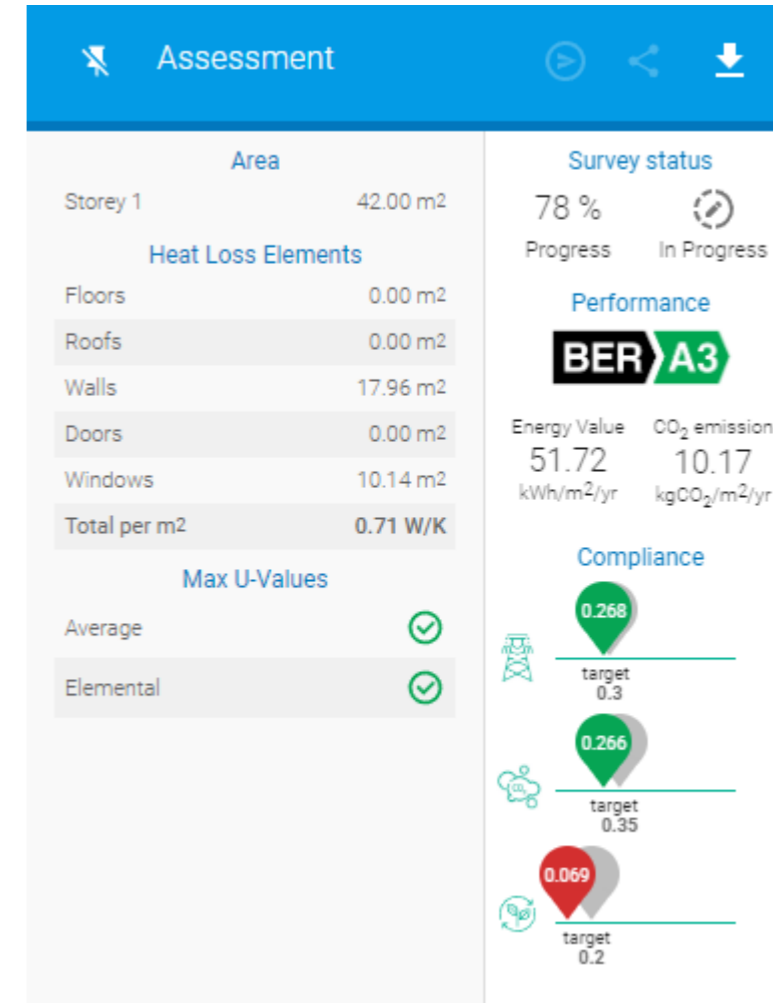


Figure 4.2.2: Part L Compliance – Primary Energy Breakdown

Figure 4.2.2 above, indicates confirmation of compliance to Part-L for one of the Studio apartments on the 3rd floor of the development, with the following parameters achieved:

- Energy Performance Coefficient (EPC) < 0.30
- Carbon Performance Coefficient (CPC) < 0.35

From figure 4.2.2, it is clear that the renewable energy ratio, RER, shown is not sufficient to meet the requirement within DEAP 4.2.1. The RER requirement is as per the value indicated below:

- Renewable Energy Ratio (RER) > 0.20

The SEAI have released a new heat pump calculator which considers heat pumps used within group schemes. Based on inputs from both DEAP and the overall design of the system, an adjusted RER is generated and is shown in Figure 4.2.3.

Figure 4.2.2 & 4.2.3 shows that a centralised system, as designed, complies with the NZEB & the Part L 2021 Building regulations for the Emmet Rd. Development.

RESULTS: Part L compliance Renewable Energy Ratio (RER) Adjustment. Applies to New final and New provisional assessments only. BER Assessor must advise the client of any adjustment to RER, and attach details of adjusted RER to Part L compliance report. This section is completed AFTER the above heat pump calculation results are entered in DEAP software.	
Total renewable contribution adjustment	1258.54
Total renewables primary energy from DEAP software	239.98
Total Primary Energy from DEAP software	3499.94
Adjusted Renewable Energy Ratio to be attached to compliance report	<u>0.31</u>

Figure 4.2.3 –Adjusted RER

4.4 Typical 1-Bed Apartment Mechanical & Electrical Installations

The following sub-sections detail the DEAP analysis for the below apartment.

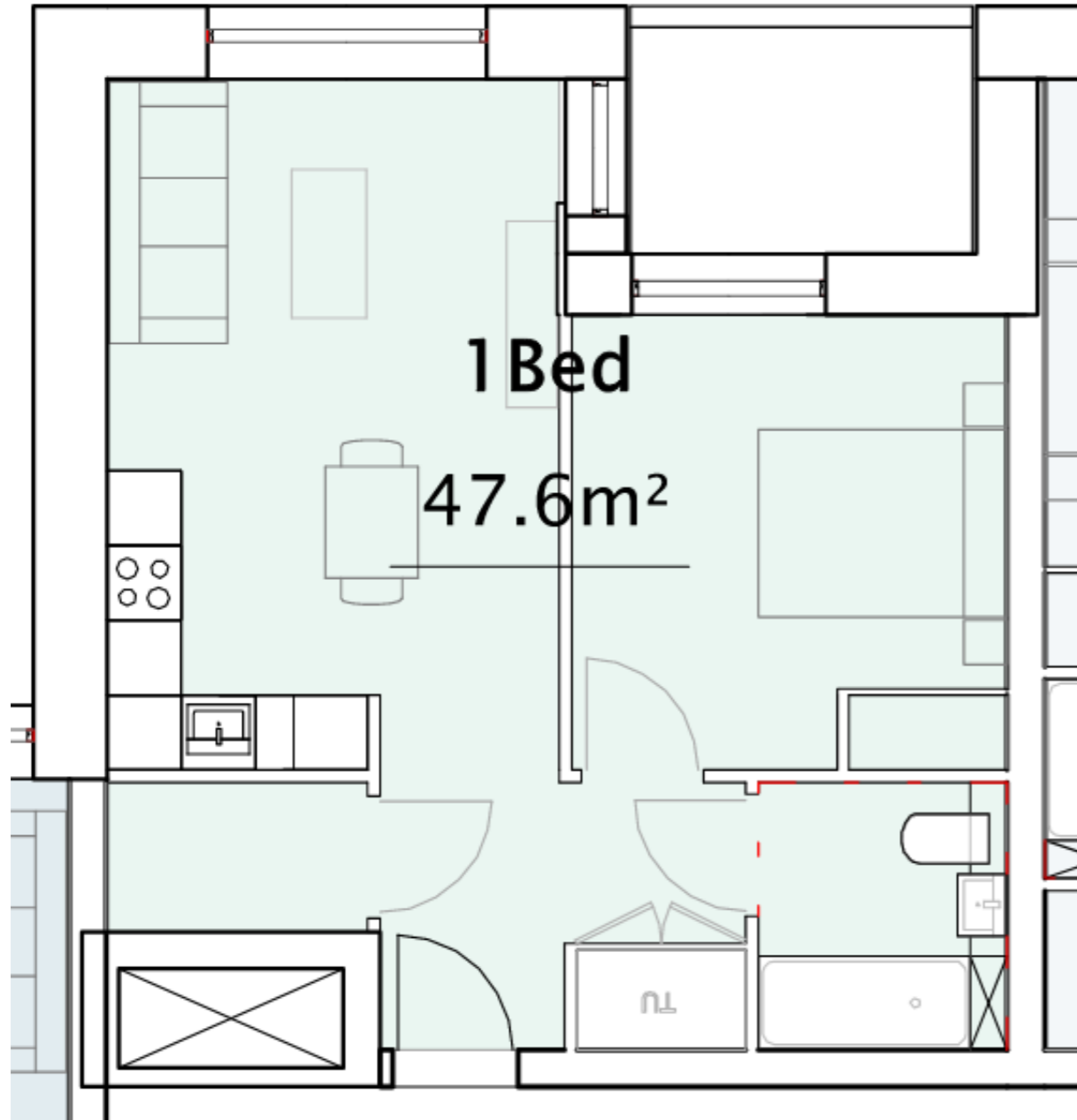


Figure 4.3.1 – Typical 1 Bed Apartment

4.4.1 Part L Compliance

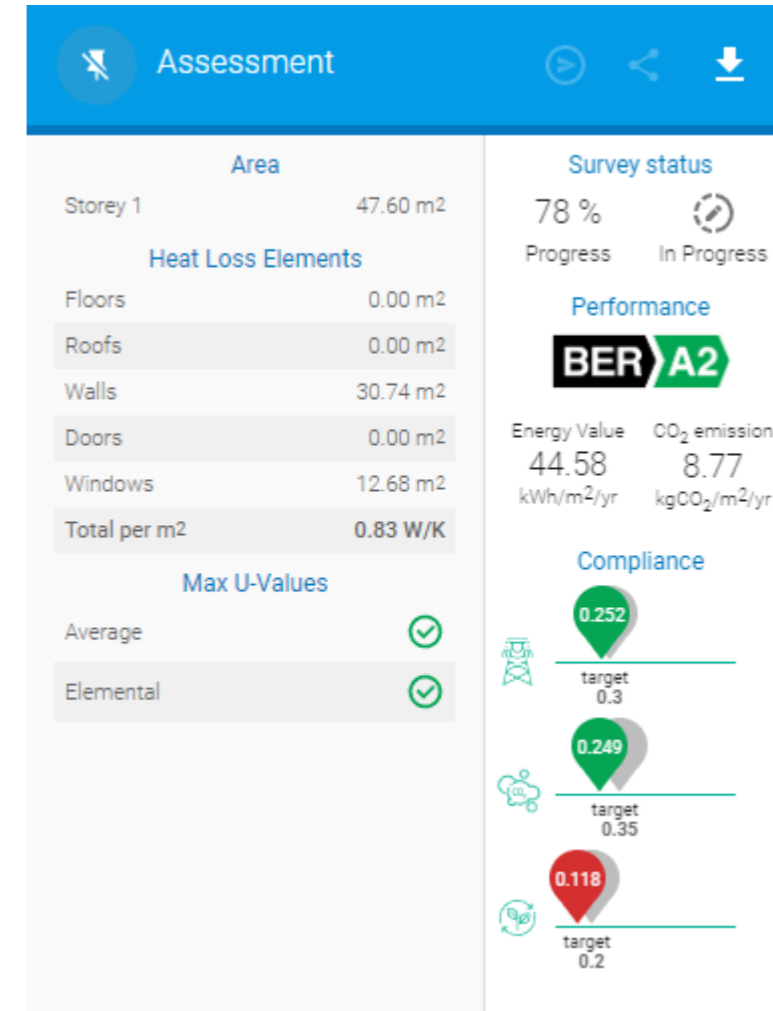


Figure 4.3.2: Part L Compliance – Primary Energy Breakdown

Figure 4.3.2 above, indicates confirmation of compliance to Part-L for one of the 1 Bed apartments on the 3rd floor of the development, with the following parameters achieved:

- Energy Performance Coefficient (EPC) < 0.30
- Carbon Performance Coefficient (CPC) < 0.35

From figure 4.3.2, it is clear that the renewable energy ratio, RER, shown is not sufficient to meet the requirement within DEAP 4.2.1. The RER requirement is as per the value indicated below:

- Renewable Energy Ratio (RER) > 0.20

The SEAI have released a new heat pump calculator which considers heat pumps used within group schemes. Based on inputs from both DEAP and the overall design of the system, an adjusted RER is generated and is shown in Figure 4.3.3.

Figure 4.3.2 & 4.3.3 shows that a centralised system, as designed, complies with the NZEB & the Part L 2021 Building regulations for the Emmet Rd. Development.

RESULTS: Part L compliance Renewable Energy Ratio (RER) Adjustment. Applies to New final and New provisional assessments only. BER Assessor must advise the client of any adjustment to RER, and attach details of adjusted RER to Part L compliance report. This section is completed AFTER the above heat pump calculation results are entered in DEAP software.	
Total renewable contribution adjustment	1063.41
Total renewables primary energy from DEAP software	410.99
Total Primary Energy from DEAP software	3495.13
Adjusted Renewable Energy Ratio to be attached to compliance report	<u>0.32</u>

Figure 4.3.3 – Adjusted RER

4.5 Typical 2-Bed Apartment Mechanical & Electrical Installations

The following sub-sections detail the DEAP analysis for the below apartment.

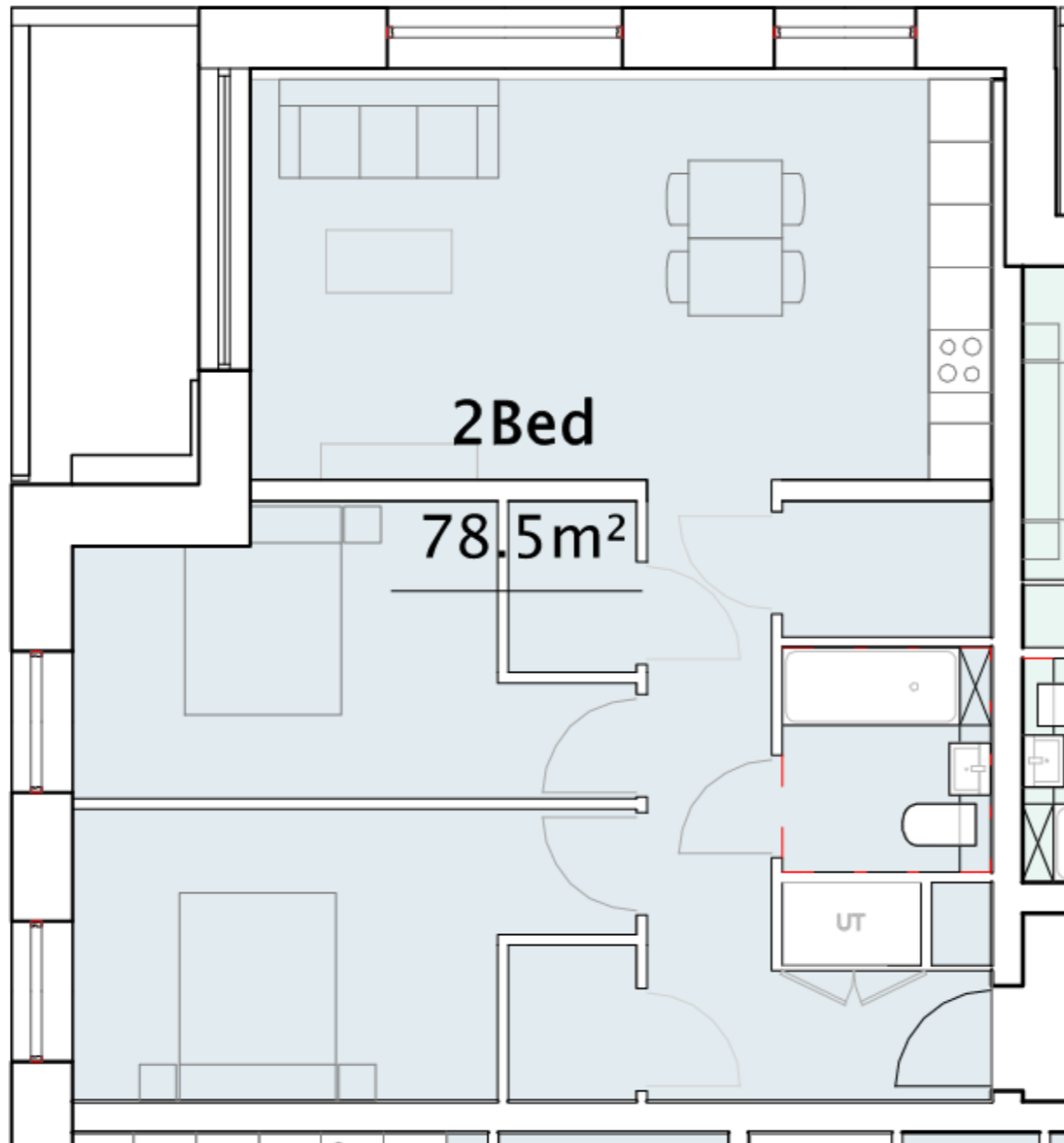


Figure 4.4.1 – Typical 2 Bed Apartment

4.5.1 Part L Compliance

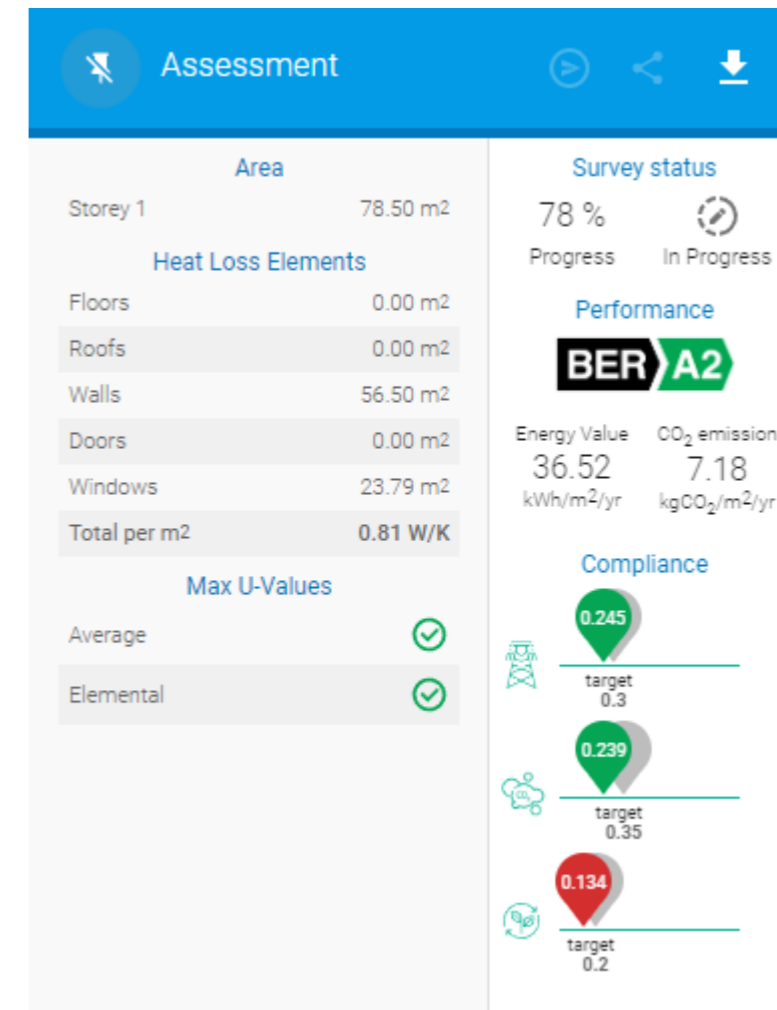


Figure 4.4.2: Part L Compliance – Primary Energy Breakdown

Figure 4.4.2 above, indicates confirmation of compliance to Part-L for one of the 2 Bed apartments on the 3rd floor of the development, with the following parameters achieved:

- Energy Performance Coefficient (EPC) < 0.30
- Carbon Performance Coefficient (CPC) < 0.35

From figure 4.4.2, it is clear that the renewable energy ratio, RER, shown is not sufficient to meet the requirement within DEAP 4.2.1. The RER requirement is as per the value indicated below:

- Renewable Energy Ratio (RER) > 0.20

The SEAI have released a new heat pump calculator which considers heat pumps used within group schemes. Based on inputs from both DEAP and the overall design of the system, an adjusted RER is generated and is shown in Figure 4.4.3.

Figure 4.4.2 & 4.4.3 shows that a centralised system, as designed, complies with the NZEB & the Part L 2021 Building regulations for the Emmet Rd. Development.

RESULTS: Part L compliance Renewable Energy Ratio (RER) Adjustment. Applies to New final and New provisional assessments only. BER Assessor must advise the client of any adjustment to RER, and attach details of adjusted RER to Part L compliance report. This section is completed AFTER the above heat pump calculation results are entered in DEAP software.	
Total renewable contribution adjustment	1320.41
Total renewables primary energy from DEAP software	627.90
Total Primary Energy from DEAP software	4679.70
Adjusted Renewable Energy Ratio to be attached to compliance report	<u>0.32</u>

Figure 4.4.3 – Adjusted RER

4.6 Typical 3-Bed Apartment Mechanical & Electrical Installations

The following sub-sections detail the DEAP analysis for the below apartment.

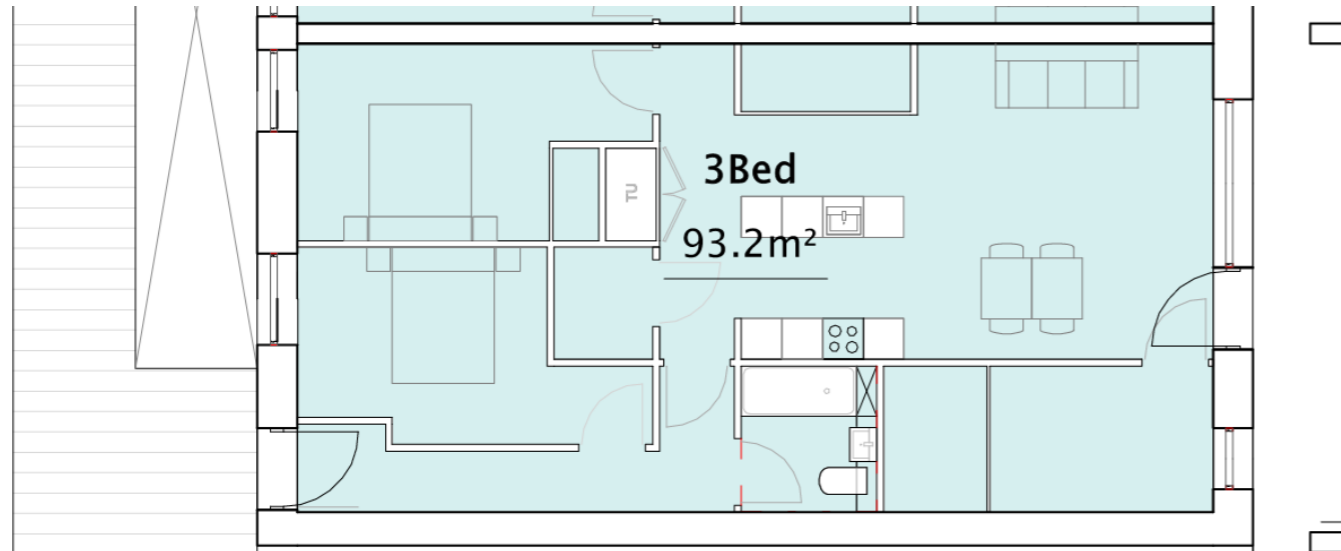


Figure 4.5.1 – Typical 3 Bed Apartment

4.6.1 Part L Compliance

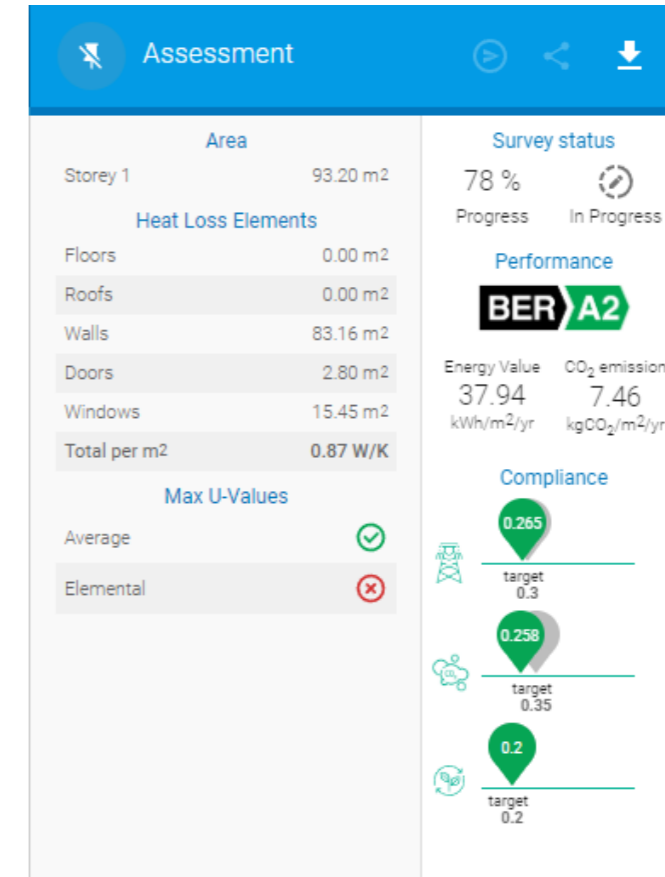


Figure 4.5.2: Part L Compliance – Primary Energy Breakdown

Figure 4.5.2 above, indicates confirmation of compliance to Part-L for one of the 3 Bed apartments on the 3rd floor of the development, with the following parameters achieved:

- Energy Performance Coefficient (EPC) < 0.30
- Carbon Performance Coefficient (CPC) < 0.35

From figure 4.5.2, we can see that this apartment does pass the required RER, to meet the requirement within DEAP 4.2.1, however we still need to use the heat pump calculator to get the adjusted RER as heat pumps are used. The RER requirement is as per the value indicated below:

- Renewable Energy Ratio (RER) > 0.20

The SEAI have released a new heat pump calculator which considers heat pumps used within group schemes. Based on inputs from both DEAP and the overall design of the system, an adjusted RER is generated and is shown in Figure 4.5.3.

Figure 4.5.2 & 4.5.3 shows that a centralised system, as designed, complies with the NZEB & the Part L 2021 Building regulations for the Emmet Rd. Development.

RESULTS: Part L compliance Renewable Energy Ratio (RER) Adjustment. Applies to New final and New provisional assessments only. BER Assessor must advise the client of any adjustment to RER, and attach details of adjusted RER to Part L compliance report. This section is completed AFTER the above heat pump calculation results are entered in DEAP software.	
Total renewable contribution adjustment	1394.04
Total renewables primary energy from DEAP software	1198.96
Total Primary Energy from DEAP software	5993.22
Adjusted Renewable Energy Ratio to be attached to compliance report	<u>0.35</u>

Figure 4.5.3 – Adjusted RER

5.0 Climate Action and Energy Statement

The fifth assessment report by the Intergovernmental Panel on Climate Change (IPCC) in 2014 confirmed that warming of the atmosphere and ocean system is happening and that there is clear human influence on the climate.

Whilst climate change is a global scale problem requiring a multi-faceted international response, the overall challenge for Ireland is to develop and improve its inter-disciplinary approach. The EU has committed to cut greenhouse gas emissions by at least 55% by 2030.

Based on the EU approach, the framework requests local authorities to prepare and publish local adaptation plans which will complement mitigation actions and reduce our vulnerability to the negative impacts of climate change.

The Climate Action and Low Carbon Development Bill 2015 was passed in December 2015 and requires the preparation of a new national mitigation plan and an adaptation framework. The 2015 Act was subsequently amended by the Climate Action and Low Carbon Development (Amendment) Act 2021.

The Dublin City Council Climate Action Plan 2019 - 2024 was adopted in response to this and sets out policies and objectives to achieve a 20% reduction of energy use for the whole city and for a 33% reduction for the Council's own energy by 2020, along with 20% of energy to come from renewable sources, with the EU Mayors Adapt Initiative agreeing to reduce carbon dioxide emissions by at least 40% by 2030. The plan includes adaptation measures to reduce our vulnerability to the negative impacts of climate change and mitigating actions to reduce emissions of the greenhouse gases that are driving climate change.

As key strategies it sets out to increase the share of renewable energy generation to reduce energy consumption and find alternative, non-polluting, and renewable sources for energy provision, and improve energy efficiency in the built environment, reducing energy demand and energy wastage/loss in order to reduce CO₂ contributions.

Design and layout of schemes optimised by maximising benefits from energy efficient passive measures such as natural ventilation and lighting and reduction of cooling requirement through control of excessive solar gain is encouraged.

In the previous section we illustrate how NZEB/Part L 2021 performance can be achieved. The above also complies with the requirements of Dublin City Council Climate Action Plan 2019 - 2024 for energy reduction, carbon reduction and renewable energy usage would be met.

5.1 Climate Mitigation Actions

The Emmet Rd developed has been designed to promote low carbon technologies, by utilising Heat Pump technology to meet the thermal load for the entire development. This will also allow for the complete elimination of Fossil Fuels from the site, while maximising operational efficiencies.

The development has been designed to maximise natural daylight, natural ventilation, please refer to Sunlight / Daylighting study report for full details.

The development is situated in close proximity to multiple public transport routes.

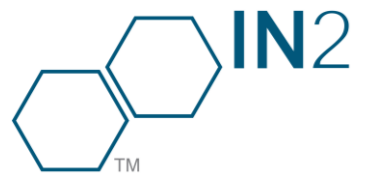
As mentioned, the use of a centralised Heat pump for the sole means of thermal generation will result in an extremely high efficient renewable means of satisfying the developments heating & hot water needs.

The centralised heat pump technology is considered a renewable technology and as such provide the full NZEB Renewable Energy Contribution for the entire site.

The centralised heating strategy will also ensure site remains "district Heating enabled", and will be capable of importing heating energy from external 3rd party District heating schemes.

5.2 Resilience to Climate Change

The proposed development have been designed to be resilient to climate change. The proposed measures include the use of Green Roofs to reduce internal overheating and the urban heat island effect and help to mitigate peak surface water run offs during heavy rain fall for full details please refer to SuDS proposals in civil engineering reports;



IN2 Engineering Design

Unit E&F

Mount Pleasant Business Park

Upper Mount Pleasant Avenue

Dublin 6

(01) 496 0900

info@in2.ie