Parkgate Street Development

Co. Dublin

Energy Analysis Report

IN2 Project No. D1861

Revision History

Date	Revision	Description
14.06.21	02	Planning Issue

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 Parkgate St, Co. Dublin. Block A of the development, which this report describes, consists of approximately 197 no. residential 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. This Report refers specifically to Parkate Tower Block A.

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 Parkgate Street residential development. As demonstrated in section 4, the proposed heating strategy to utilise Air Source Heat Pumps and Boilers for Parkgate Street will achieve NZEB compliance and would be suitable options for this development.

Section 4 outlines the mechanical and electrical installations information used for the energy analysis undertaken for the Parkgate Street residential 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 2019, 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.

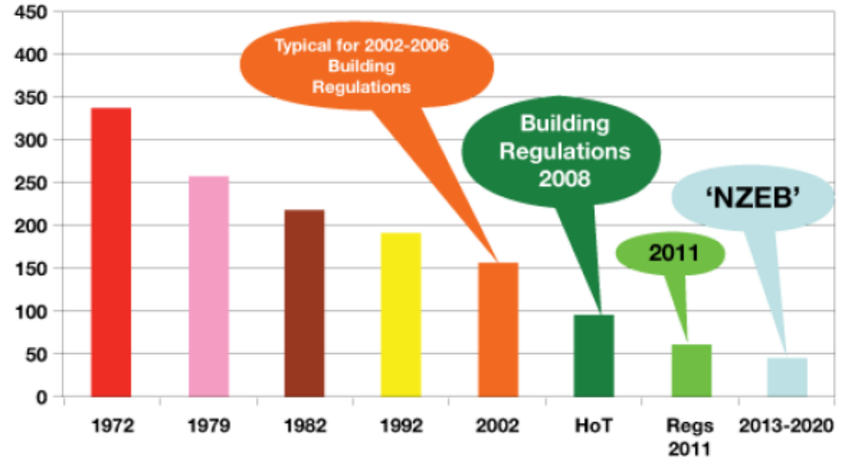

Figure 2.1.1: Primary Energy Consumption in Irish Housing 1972-2020

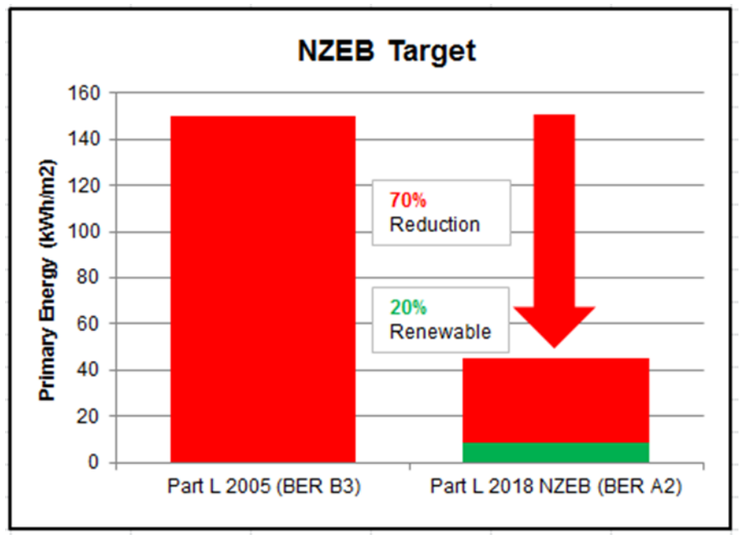

Figure 2.1.2: NZEB Targets

2.2 Part L 2019

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/m^2.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 (100m2, local gas-fired boiler) compliant to NZEB / Part L 2019. 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 2019:

<u>Thermal Transmittance (U-Values)</u>

- Roofs: 0.16 W/ m^{2}K
- External Walls: 0.18 W/ m^{2}K
- Ground/ Exposed Floors: 0.18 W/ m^{2}K
- Windows/ Doors/ Rooflights: 1.40 W/ m^{2}K

<u>Air Permeability</u>

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

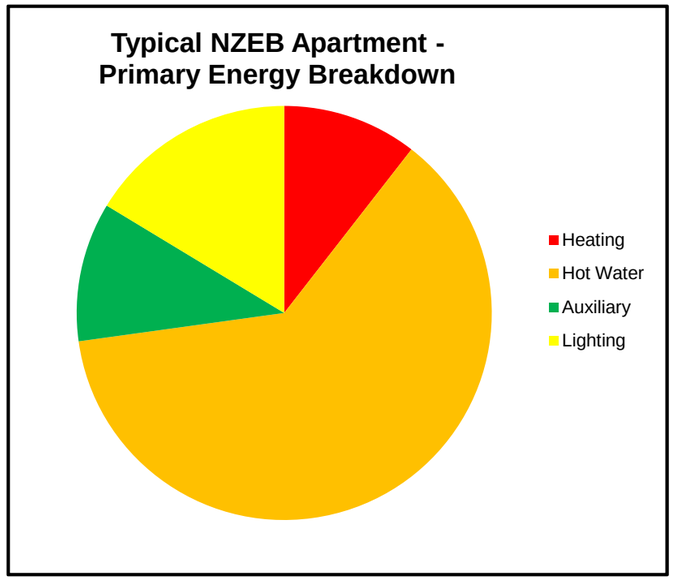

Figure 2.2.1: Typical Residential Primary Energy Breakdown

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 2019:

- 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

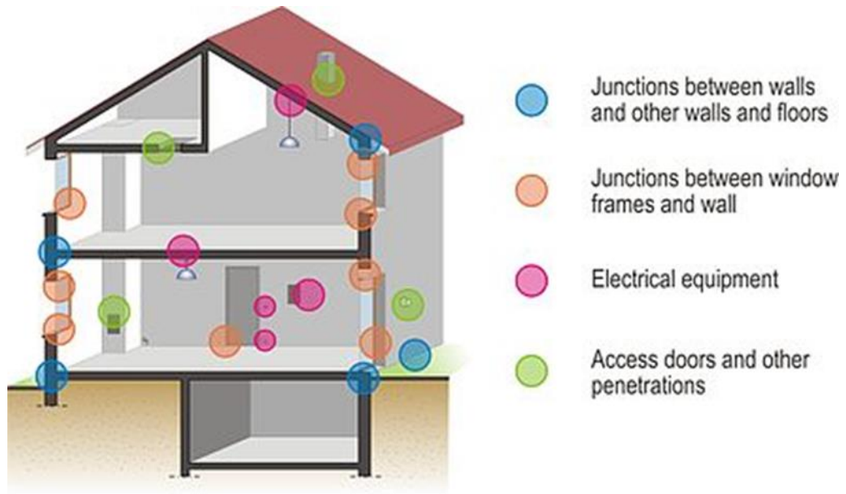

Figure 2.2.2: Common areas of air leakage

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: 2.08
- 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 2019 PEF is based on the average of the projected Electrical grid efficiency over the next 10years.

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

- Electricity: 409 gCO2/kWh
- Natural Gas: 203 gCO2/kWh

The Carbon Factors associated with Electricity have fallen by approximately 26% 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.

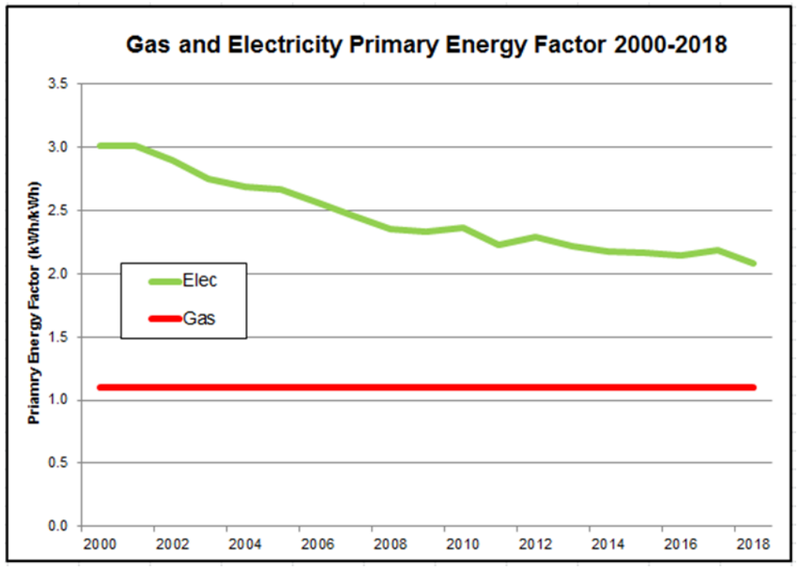

Figure 2.3.1: Primary Energy Factors for Gas and Electricity 2000-2018

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 2019 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.

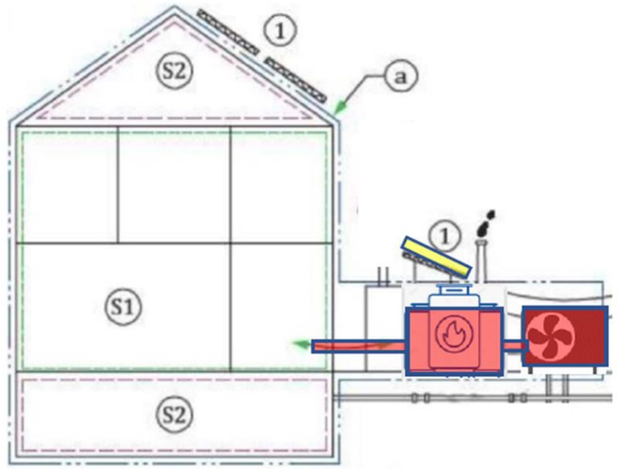

Figure 2.4.1: Centralised Boilers/ASHP with PV array (if required) to Landlord Areas

De-centralised Exhaust Air Heat Pump:

In cases where an Exhaust Air Heat Pump (EAHP) is provided but is insufficient to meet the total renewable contribution for the apartment it serves; compliance may be achieved by supplementing this system with PV.

In contrast to the centralised option, the de-centralised option will not provide the landlord areas with any renewable contribution as the system is designed only to serve the apartment it sits in. The landlord areas will therefore require separate renewable technology. This is typically achieved with a PV panel array.

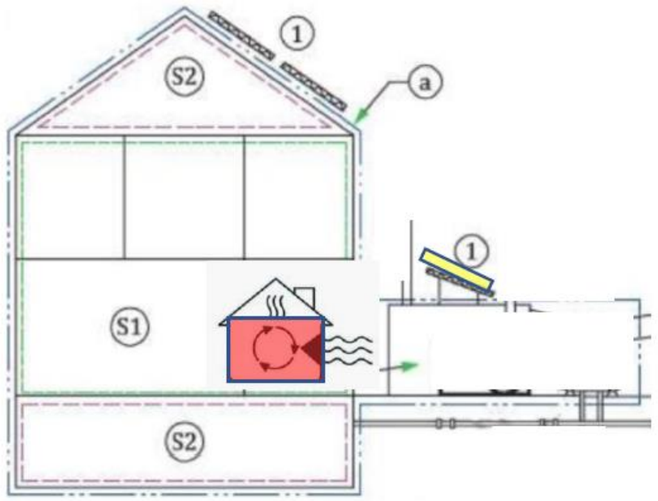

Figure 2.4.2: Centralised Boilers/ASHP with PV array (if required) to Landlord Areas

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 Anerobic 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 2019 delivered 36% 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 Centralised Air Source Heat Pump and Boiler System

To achieve NZEB and Part L compliance, the most suitable solution for the Park gate Street Development is the centralised air source heat pump and boiler system. The proposed system will consist of both an air source heat pump and floor mounted cascade boiler arrangement, which will be located at the ground floor and basement level plant areas. From a centralised plant location, district heating pipework shall serve each of the residential units.

This is a centralised solution in which each 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.

This solution relies on the Cascade Boiler and Air Source Heat Pumps working to provide a primary system with a supply temperature of 65°C and a return temperature of 35°C. The 65°C supply is pumped around the building from the main plant room to each apartments 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°C wherever it is needed.

Cold water storage would be located centrally at basement level and pressure boosted to all apartments to eliminate noisy pumps and failure points within residential areas.

Figure 3.1.1: ASHP's, Boilers & HIU's

4.0 Energy Analysis

To determine Part L compliance, a detailed energy analysis was completed for the different Parkgate Street 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 2019 Regulations	Targeted
Roof	0.16 W/m^{2}k	0.15 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	0.18 W/m^{2}k – where applicable
Windows/Doors/Rooflights	1.4 W/m^{2}k	1.2 W/m^{2}k
Heat Transmission Coefficient	0.08 W/m^{2}k (ACD's)	0.08 W/m2k

Table 4.1.1: Building Construction & U-Values

Glazing Parameters	
Total Solar Heat Transmittance	0.63
Framing Factor	0.70
Overshadowing	Very little

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
Thermal Bridging (Heat Transmission Coefficient)	0.08 W/m2K

Table 4.1.3: Miscellaneous Building Parameters

4.2 Tower (Block A) - Studio Apartment Mechanical & Electrical Installations

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

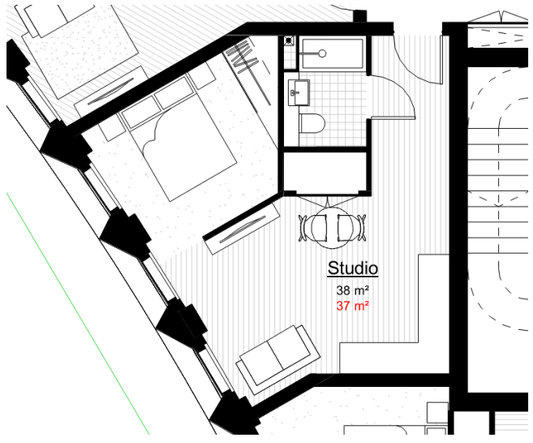

Figure 4.2.1: Typical Studio Apartment

4.2.1 Part L Compliance

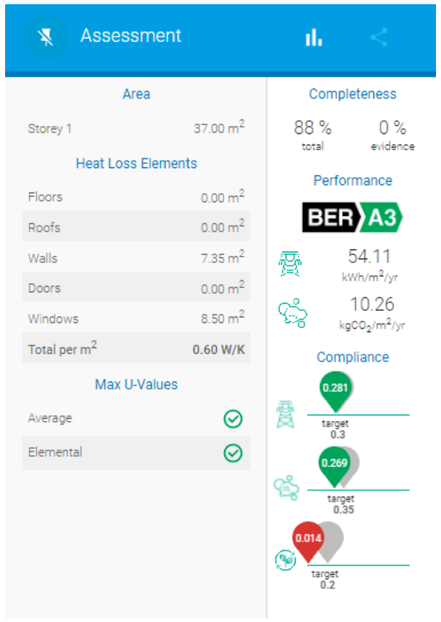

Figure 4.2.2: Part L Compliance – Primary Energy Breakdown

Figure 4.2.2 above, indicates confirmation of compliance to Part-L for a typical apartment of this type on the tenth floor of the Tower Block A, **without the need for PV panels to the residental unit**, 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 2019 Building regulaitons regulations for the Parkgate St. 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	417.52	
Total renewables primary energy from DEAP software	22.71	
Total Primary Energy from DEAP software	1601.00	
Adjusted Renewable Energy Ratio to be attached to compliance report	**0.22**	

Figure 4.2.3 –Adjusted RER

The results as averaged for the entire block we will achieve cfull compliance (see in section 4.6 below), without the need for supplementary PV.

4.3 Tower (Block A) - 1-Bed Apartment Mechanical & Electrical Installations

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

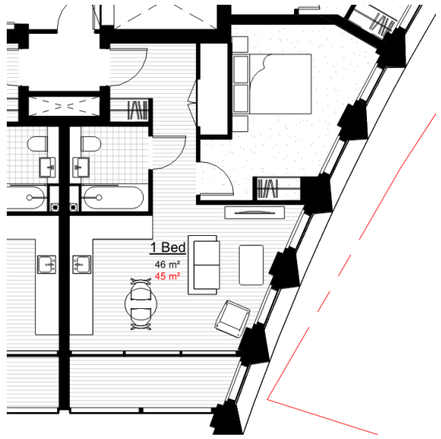

Figure 4.3.1 – Typica 1 Bed Apartment

4.3.1 Part L Compliance

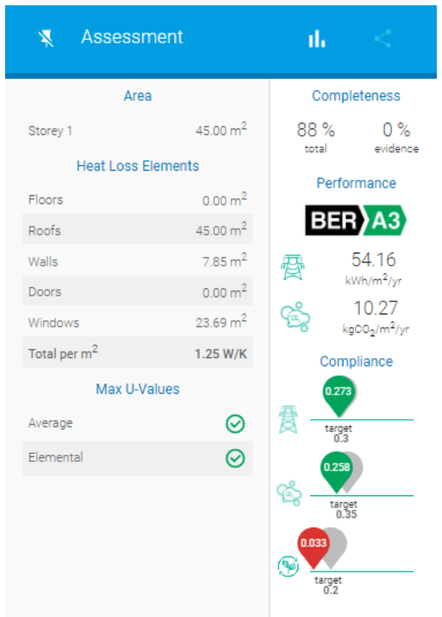

Figure 4.3.2: Part L Compliance – Primary Energy Breakdown

Figure 4.3.2 above, indicates confirmation of compliance to Part-L for a typical apartment of this type on the tenth floor of the Tower Block A, **without the need for PV panels to the residental unit**, 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 4.3.3 shows that a centralised system, as designed, complies with the regulations for the Parkgate St. 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	424.11		
Total renewables primary energy from DEAP software	30.15		
Total Primary Energy from DEAP software	1772.20		
Adjusted Renewable Energy Ratio to be attached to compliance report	**0.21**		

Figure 4.3.3 – Adjusted RER

The results as averaged for the entire block we will achieve cfull compliance (see in section 4.6 below), without the need for supplementary PV.

4.4 Tower (Block A) - 2-Bed Apartment Mechanical & Electrical Installations

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

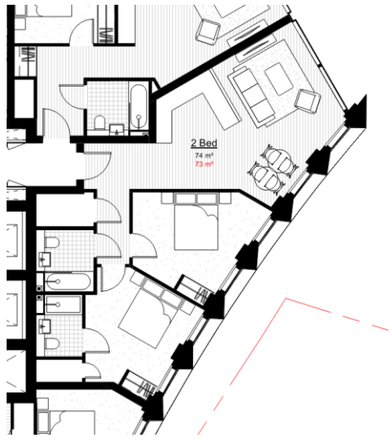

Figure 4.4.1 – Typical 2 Bed Appartment

4.4.1 Part L Compliance

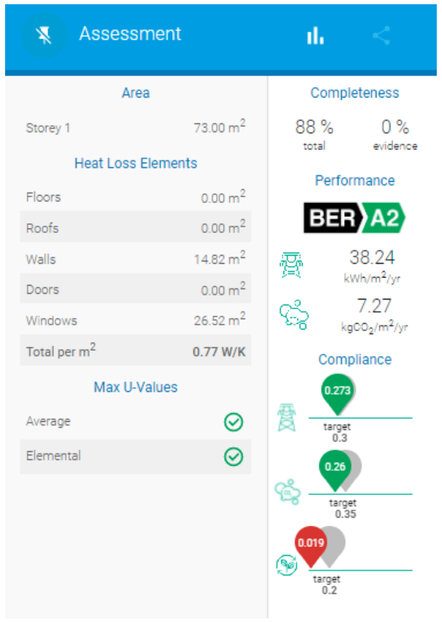

Figure 4.4.2: Part L Compliance – Primary Energy Breakdown

Figure 4.4.2 above, indicates confirmation of compliance to Part-L for a typical apartment of this type on the tenth floor of the Tower Block A, **without the need for PV panels to the residental unit**, 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 4.4.3 shows that a centralised system, as designed, complies with the regulations for the Parkgate St. 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	424.11		
Total renewables primary energy from DEAP software	30.15		
Total Primary Energy from DEAP software	1772.20		
Adjusted Renewable Energy Ratio to be attached to compliance report	**0.21**		

Figure 4.4.3 – Adjusted RER

The results as averaged for the entire block we will achieve cfull compliance (see in section 4.6 below), without the need for supplementary PV.

4.5 Tower (Block A) - 3-Bed Apartment Mechanical & Electrical Installations

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

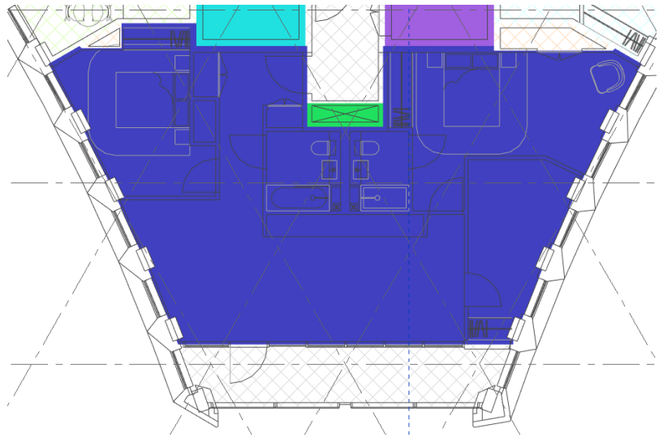

Figure 4.5.1 – 3 Bed Appartment on 27th Floor

4.5.1 Part L Compliance

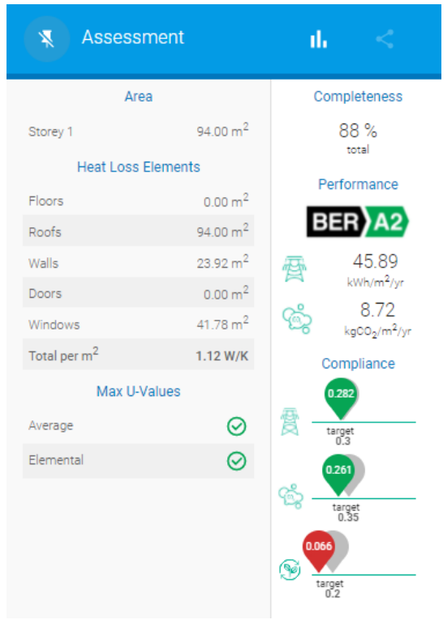

Figure 4.5.2: Part L Compliance – Primary Energy Breakdown

Figure 4.4.2 above, indicates confirmation of compliance to Part-L for a typical apartment of this type on the twenty seventh floor of the Tower Block A, **without the need for PV panels to the residental unit**, with the following parameters achieved:

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

From figure 4.5.2, it is clear that the renewable energy ratio, RER, shown is not sufficient to meet the requirement within DEAP 4.2.1, for this single apartment. 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 4.5.3 shows the final adjusted RER value for this apartment.

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	565.79
Total renewables primary energy from DEAP software	283.17
Total Primary Energy from DEAP software	4318.04
Adjusted Renewable Energy Ratio to be attached to compliance report	**0.17**

Figure 4.5.3 – Adjusted RER

However, the results as averaged for the entire block we will achieve full compliance (see in section 4.6 below).

4.6 Development Averaging

> Where a building contains more than one dwelling (e.g. a terrace of houses or a block of apartments) it is acceptable to show that either every individual dwelling has an EPC ≤ 0.30, a CPC ≤ 0.35 and an RER ≥ 0.20, or that for all the dwellings in the building the average EPC ≤ 0.30, the average CPC ≤ 0.35 and the average RER ≥ 0.20. The average EPC, CPC and RER are calculated by multiplying the EPC, CPC and RER calculated for each dwelling by its floor area, adding the results together (separately) and dividing by the total floor area of the building. Calculation of the average EPC and CPC should exclude any common parts, but calculation of the average RER should include any common parts.

The block A averaged results are as follows below.

- Block A

Average EPC	Average CPC	Average RER
0.2848	0.2718	0.2026

As can be seen from the above results, the Parkgate St. Tower (Block A) passes all criteria to comply with NZEB, **without the need for PV panels** to the residential units.

4.7 Non Domestic Areas

Amenity and commercial units shall be provided with the following PV panels (located on Block C roof and connected directly to the associated space), to ensure overall building compliance.

The PV allowance below were calculated using sBEM methodology

Block A							
Building Space			Photovoltaic Provision				Heating System
Ref	Description	Floor Area (m^2)	PV (No.)	PV (kW)	PV (^2)	PV (%)	
Block A	Restaurant	174	8	2.32	12.8	7.4%	Central FCU-ASHP(67%) + PV
Block A	Mezzanine	128	6	1.74	9.6	7.5%	Central FCU-ASHP(67%) + PV
Block A	Level 28 Amenity	145	7	2.03	11.2	7.7%	Central FCU-ASHP(67%) + PV
Block A	Cinema Room	45	2	0.58	3.2	7.1%	Central FCU-ASHP(67%) + PV
Total		492	23	6.67	36.8	7.5%	

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