IN2
ENGINEERING DESIGN PARTNERSHIP

D1861 - Parkgate Street Blocks B1 & C
42A Parkgate Street,
Dublin 8

Energy Analysis Report Planning
05/12/2024

CONTENTS

1.0 EXECUTIVE SUMMARY

This report outlines the current building regulations framework and the requirement to achieve a Nearly Zero Energy Building (NZEB) for all new developments. The NZEB standard is demonstrated using the Dwelling Energy Assessment Procedure (DEAP) software. The principal energy use associated with residential developments as assessed under DEAP is the domestic hot water to showers, sinks, basins etc. which accounts for over half of the total annual energy consumption for an apartment.

Energy consumption is not the same as energy produced however, this is due to the inefficiencies associated with generation and transmission of electricity. The DEAP software therefore analyses Primary Energy use which is a measure of the total energy required to deliver the energy consumed. This multiplier factor in Ireland is 1.75 for electricity and 1.1 for Natural Gas.

NZEB includes a requirement for on-site renewable technology, considered suitable for Parkgate Street are Heat Pumps and PV panels each of which are examined in detail.

The table below summarises the results of our proposed heating strategy which could be considered suitable for the Parkgate Street development Blocks B & C.

Although all options perform well with low associated CO_2 emissions, the decentralised solution is the optimal solution.

	Heating Strategy	Approximate PV panels Required for NZEB	Annual CO_2 Emissions Per Apartment
	Decentralised system with local Exhaust Air Heat Pumps (EAHP) and electric radiators.	0.0	650 kg

Project Description

Ruirside Developments Limited is seeking planning permission with a life of 8 years for Large-Scale Residential Development, at a site (c. 0.82 ha), at No. 42A Parkgate Street, Dublin 8. This is a brownfield site of former Parkgate Printing Works, now known as Parkgate House, with Protected Structures on site including (a) riverside stone wall; (b) turret; (c) square tower; and (d) stone arch. The proposed development adjoins consented development within the same application site boundary, including LRD6042/23 (Block B2 – 40no. apartments, café/restaurant unit (236 sq. m) and community/cultural space (c. 52 sq. m)) and SHD-310567-21 (Block A – 198no. apartments and restaurant/café (c.187 sq. m)). The proposed development comprises mixed use residential, community and commercial redevelopment (c. 25,777 sq. m gross floor area), accommodated in 2no. blocks (Block B1 and Block C) ranging in height from 8 to 13 storeys with basement and under croft, and including: 316no. apartments (178no. 1-bed units and 138no. 2-bed units), with associated private balconies on all building elevations and communal roof terraces at Levels 07, 08, 09 and 12; ancillary internal residents' amenity facilities (c.226 sq. m); multi-functional space accommodating co-working/cultural/community/exhibition uses available for public hire (c.496 sq. m); ground level retail (c.147 sq. m); and all associated and ancillary demolition, conservation, landscaping and site development works.

2.0 BUILDING REGULATIONS

2.1 NZEB

Building energy has been long understood as contributing a major component of greenhouse gas emissions which 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." Figure 2.1.1 illustrates comparative Primary Energy (see Section 3.3) for Dwellings in Ireland from 1970's through to NZEB,

The EU Energy Performance of Buildings Directive set out the target that all *new* developments should be Nearly Zero-Energy Buildings (NZEB) by the end of 2020, with the intention having been that all public buildings be in accordance with this by the end of 2018.

A Nearly-Zero Energy Building is defined 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"; the latter understood to refer to district heating systems and centralised plant arrangements.

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 was 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

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 be achieving a B3 BER, in comparison to A2/A3 for NZEB compliance.

These NZEB targets have been now incorporated within the Technical Guidance Document (TGD) Part L 2019, as discussed below.

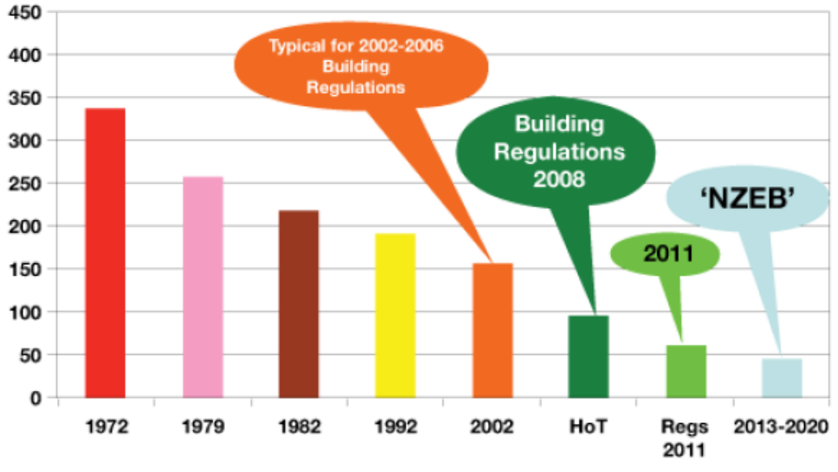


Figure 2.1.1 - Primary Energy Consumption in Irish Housing 1972-2020

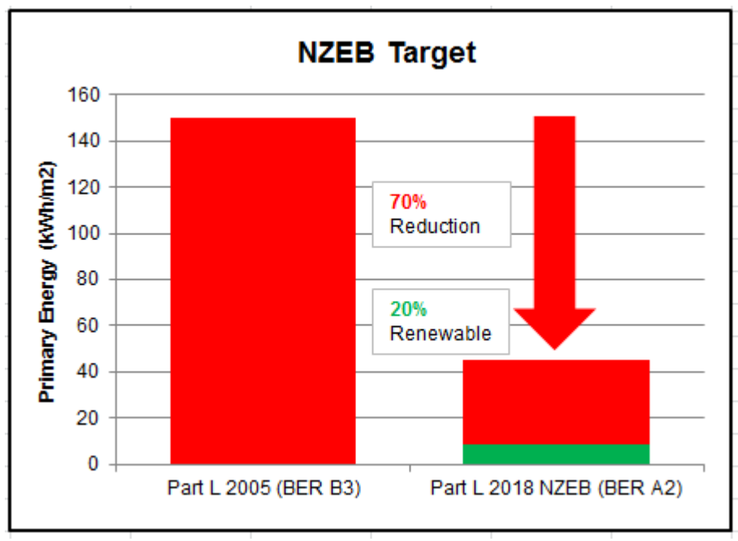


Figure 2.1.2 - NZEB Targets

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 can 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) for the following usages, known as "regulated loads":

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

It may be noted therefore that considerable energy usages within dwellings; particularly equipment associated with cooking, washing etc. are excluded from DEAP analysis and associated Part L Compliance/ BER calculations. These energy usages, known as "unregulated loads", are deemed to be associated with *operational* usage, as opposed to the building's fabric and services performance.

Figure 2.2 indicates an energy breakdown for a typical apartment (100m^2, local gas-fired boiler) compliant to NZEB/ Part L 2018. It can be seen that Hot Water Energy consumption pre-dominates, with Heating Energy considerably lower; reflective of the extensive improvement in insulation/ air permeability/ thermal bridging/ glazing/ heating system efficiency etc. through successive Building Regulations improvements.

However, 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.

In addition, minimum Fabric Performance is defined as follows 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

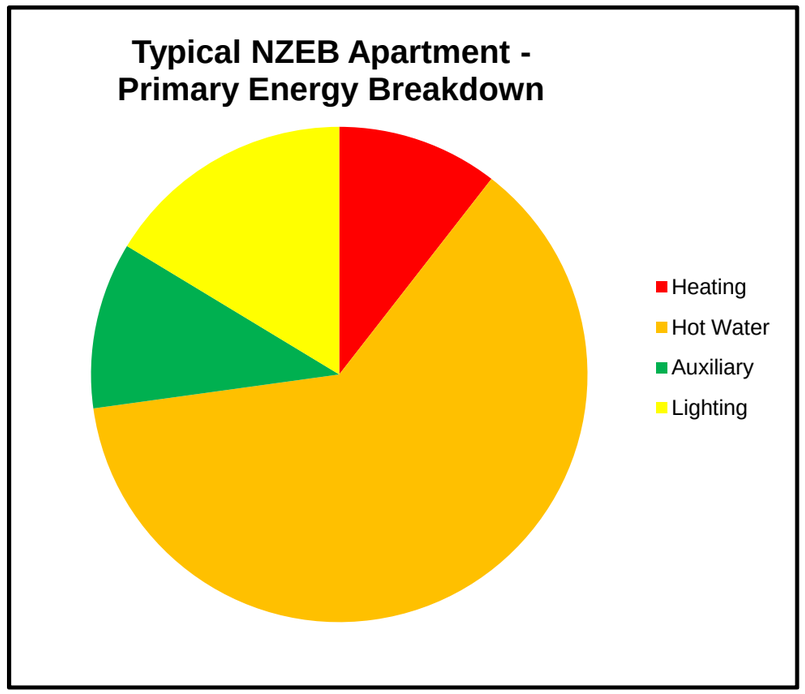


Figure 2.2 -Energy Breakdown

2.2 Part L 2019 (Cont'd)

Air Permeability

- Maximum Air Leakage: 3 $m^3/hr.m^2$ @ 50Pa

In terms of apartments or other terraced residential buildings, Part L allows that the 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 (i.e. 70% reduction in Primary Energy against Part L 2005 benchmark)
- Carbon Performance Coefficient (CPC): 0.35 or lower
- Renewable Energy Ratio (RER): 0.20

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: 1.75
- Natural Gas/ LPG/ Oil/ Biomass: 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 a LPHW radiator. However, as can be seen from Figure 2.3, 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).

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

- Electricity: 330.4 gCO_2/kWh
- Natural Gas: 203 gCO_2/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.

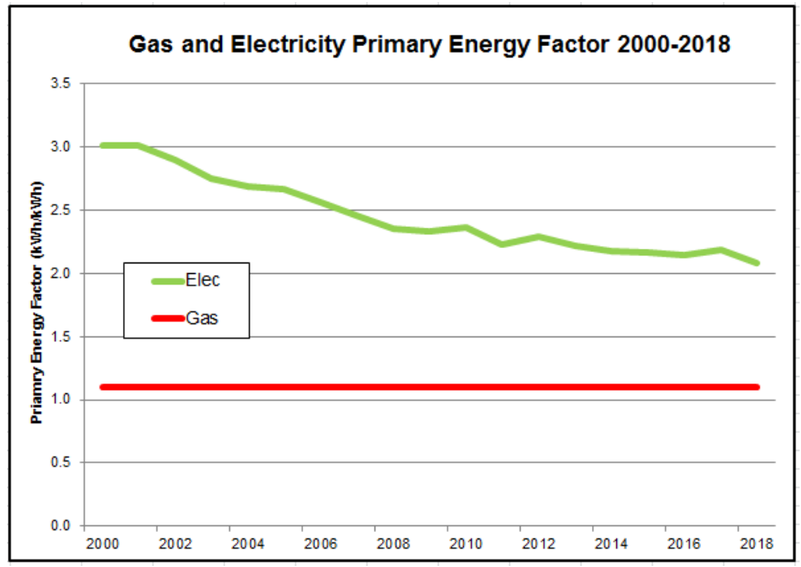


Figure 2.3 -Primary Energy Factors for Gas and Electricity 2000-2018

2.4 Renewable Technologies

In addition to improving heating energy related aspects, renewable technologies can be utilised to significantly reduce Primary Energy requirements (in addition to ensuring the RER renewable energy percentage is achieved). Figure 2.2.2 indicates how, for a typical apartment (notional 100m², gas boiler plant) designed to ensure NZEB compliance, 4 no. (250W) PV panels 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 types, the most effective for integration within apartment design to ensure compliance to 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 below). The project will target Heat Pump efficiencies (seasonal CoP) of 450%.

  All three options considered for the Parkgate Street development rely on Air Source Heat Pump technology. Both decentralised solutions include heat pumps within the apartment while the centralised option includes a basement level heat pump with boiler back up.

- Combined Heat and Power (CHP)

  Offsets Primary Energy associated with Hot Water (and potentially some Heating) where used in conjunction with centralised plant/ district heating. Viable for larger (300+ unit) apartment developments where larger, higher efficiency units can be deployed.

  May also be considered in tandem with a central air source heat pump where the electricity generated by the CHP powers the heat pump delivering further savings. This strategy, although complex to implement, delivers lower running costs than a central heat pump only option.

- 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).

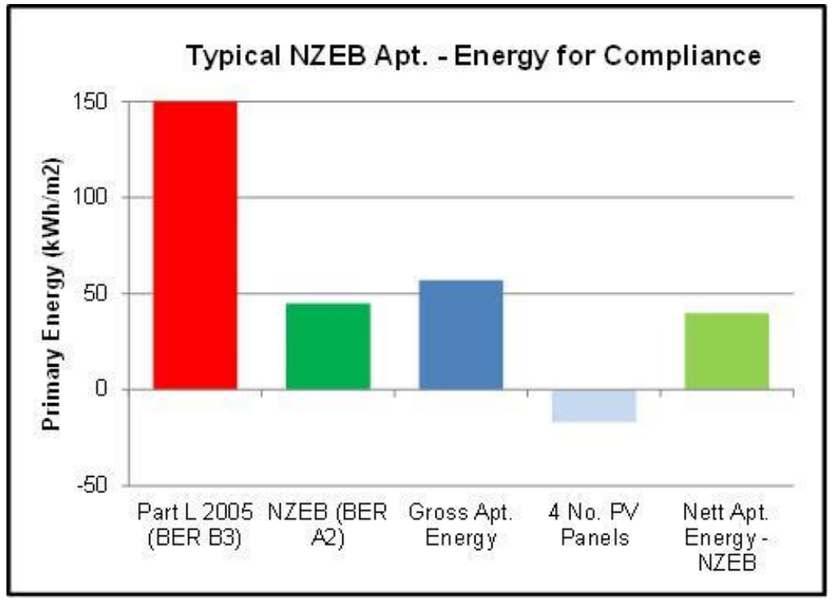


Figure 2.4 -EPC Compliance for Typical Apartment

3.0 ENERGY ANALYSIS

We have completed detailed analysis based on the proposed heating strategy for the Parkgate Street residential elements. The detailed results of this analysis are contained within the attached appendices. 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.

3.1 Building Construction

A full floor of the tower building and a west and an east facing apartment from blocks B1/B2 were selected for the purposes of analysis with a small element of exposed floor and roof allowed for 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:

Thermal Transmittance (U-Values)

- Roofs: 0.12 W/m^{2}K
- External Walls: 0.18 W/m^{2}K
- Ground/ Exposed Floors: 0.12 W/m^{2}K
- Windows/ Doors/ Rooflights: 1.40 W/m^{2}K

Glazing Parameters

- Total Solar Heat Transmittance: 0.60
- Framing Factor: 0.70
- Overshadowing: Average

Air Permeability

- Air Leakage: 3.0 m^3/hr.m^2 @ 50 Pa

Thermal Bridging

- Heat Transmission Coefficient: 0.08 W/m^{2}K (standard construction details)

Domestic Potable Water Services and Lighting

- Shower Flowrate: 6 l/min
- Water usage: 125l/person/day
- Lighting: 100% LED

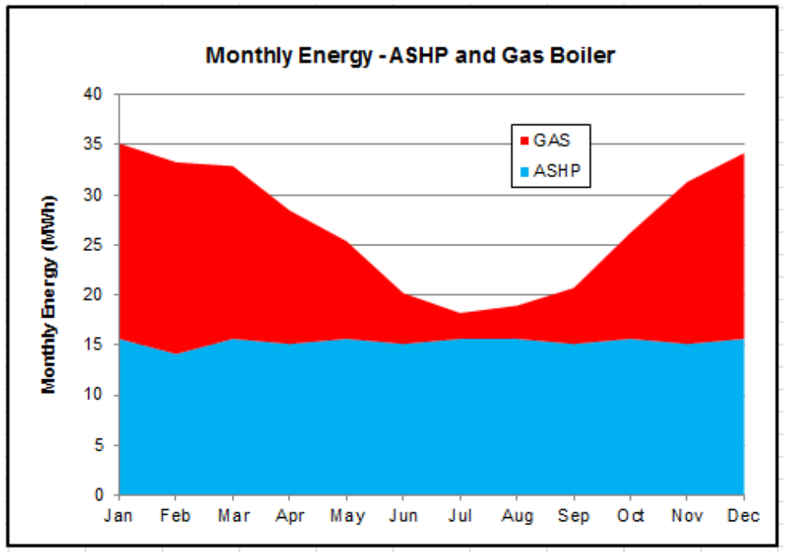


Figure 3.2 - Extent of Heating and Hot Water delivered by ASHP and Gas Boiler

4.0 HEATING STRATEGY

4.1 Decentralised Ducted Air Source Heat Pump Option

This decentralised solution would include a 200L hot water cylinder with an integral air source heat pump for every apartment. Air would be ducted to and from the façade to the heat pump where the heat extracted from the air would be used to heat hot water for shower, basins etc. This solution does not allow for wet radiators. The heating to the apartments would instead be provided by electric radiators. This system is less efficient than the exhaust air heat pump version as the heating does not benefit from the heat pump Co-efficient of Performance (COP).

A ducted heat recovery ventilation unit would be provided to each apartment to maintain air quality while minimising heat losses associated with air infiltration. This would require a second set of intake and exhaust ducts from the building façade

The heat pump is electric therefore the only bills to the tenant would be for electricity.

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

The heat pump capacity is relativley low requiring an electric heating element to supplement the heat pump during periods of heavy duty.

Sustainability

Under the DEAP methodology for Parkgate Street this system will require approx. 60No. PV panels for the Blcok B&C development.

The CO_2 emissions associated with the heating, hot water, ventilation and lighting for a typical Parkgate Street apartment averages **1,300kg/year**.

Figure 4.2 – Decentralised Ducted Air Source Heat Pump & PVs

Key Figures (per Apartment)

- PV requirement: **Approx. 60No. panel for Blocks B & C**
- Annual CO_2 emissions: **1,300kg**

Pro's

- Low capital cost solution
- Sustainable efficient solution – low CO_2 emissions
- No energy manager required – only bill to tenant is for electricity

Con's

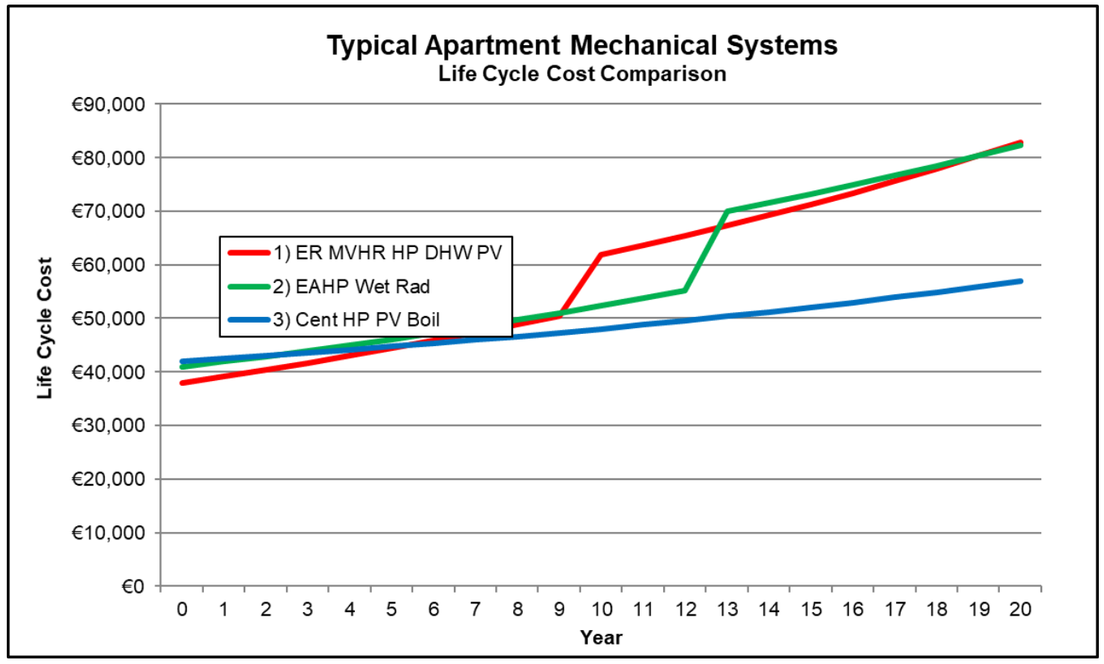
- Relatively low life expectancy – 12 years
- Unproven technology – possible reliability issues
- Inflexible – no potential to add new sustainable technology in future

5.0 CONCLUSION

All options considered for Parkgate Street will achieve NZEB compliance and would be suitable options for this development**.** All options considered rely on Heat Pump technology which uses the energy released from a phase change of the refrigerant to deliver more heating energy than **input** to the system**.** The application of this technology for each solution results in variable CO_2 emissions and running costs for each as outlined below:

Exhaust Air Heat Pump with Electric Rads for space heating.

This system combines the efficiency of a heat pump with the practicality of local hot water storage. It is one of the best options for meeting ZNEB requirements on renewable technologies and energy efficiency.



5.1 PV Requirements for Apartments and Landlord spaces.

Commercial/Landlord spaces shall be provided with the following PV panels (located on Block B&C roofs and connected directly to the associated space), to ensure overall building compliance.

The PV allowance below for the landlord spaces was calculated using sBEM methodology. We have allowed for 1 PV panel per apartment for this stage of the project.

Block B & C						
Building Space			Photovoltaic Provision			
Ref	Description	No. of Apts	PV (No.)	PV (kW)	PV (m²)	PV (%)
Block B	Apartments	137	137	54.8	219.2	-
Block C	Apartments	179	179	71.6	286.4	-
Landlord/Commercial Spaces						
Ref	Description	Floor Area (m²)	PV (No.)	PV (kW)	PV (^2)	PV (%)
Landlord/Commercial	Landlord Spaces	3430	65	26	103	3
Total			381	152.4	608.6	-

6.0 Appendix A: DEAP Results for typical Apartment types

6.1 Block B & C - Typical 1 Bed Apartment

The following sub section details the DEAP analysis for the below apartment.

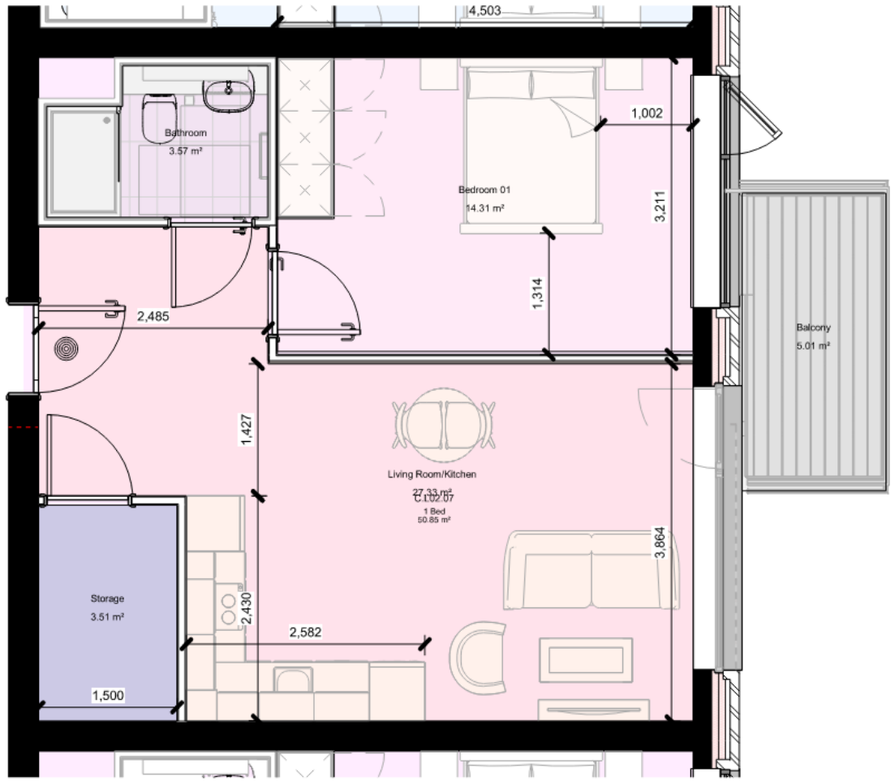


Figure 7.1.1 - Typical 1 Bed Apartment

7.2 Part L Compliance.

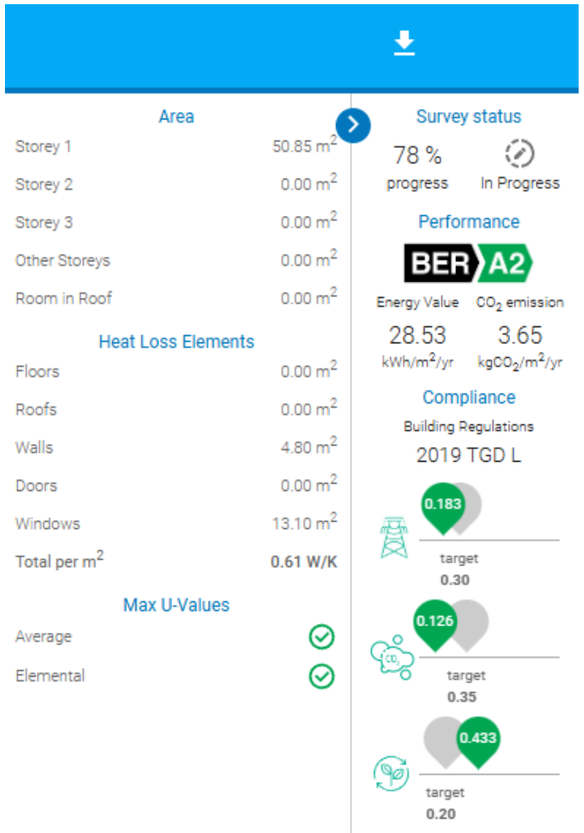


Figure 7.1.2 - Typical 1 Bed Apartment Compliance

Figure 7.1.2 above, indicates confirmation of compliance to Part-L for one of the typical 1 bed apartments in block B&C with the following parameters achieved:

- Energy Performance Coefficient (EPC) < 0.30
- Carbon Performance Coefficient (CPC) < 0.35
- Renewable Energy Ratio (RER) > 0.20

6.2 Block B & C - Typical 2 Bed Apartment (Type G)

The following sub section details the DEAP analysis for the below apartment.

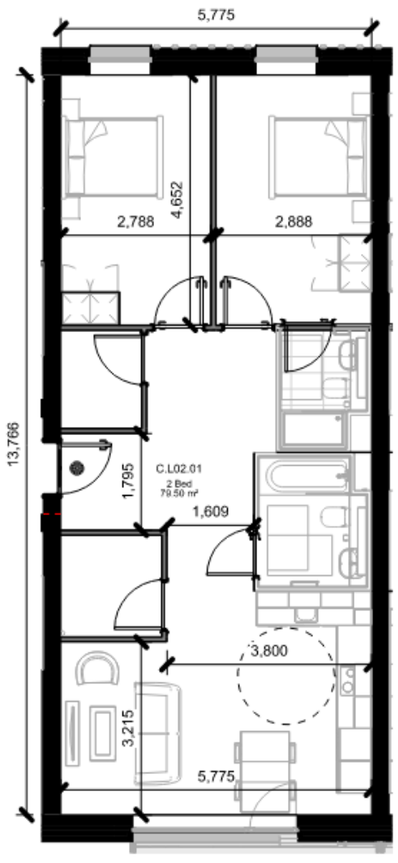


Figure 7.2.1 - Typical 2 Bed Apartment (Type G)

7.2 Part L Compliance.

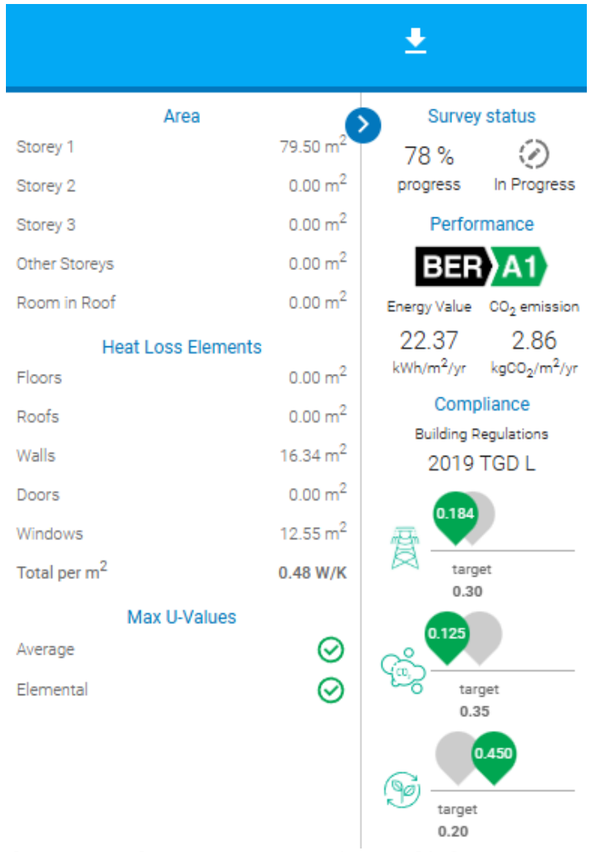


Figure 7.2.2 - Typical 2 Bed Apartment (Type G) Compliance

Figure 7.2.2 above, indicates confirmation of compliance to Part-L for one of the typical 2 bed apartments in block B&C, with the following parameters achieved:

- Energy Performance Coefficient (EPC) < 0.30
- Carbon Performance Coefficient (CPC) < 0.35
- Renewable Energy Ratio (RER) > 0.20

6.3 Block B & C - Typical 2 Bed Apartment (Top Floor)

The following sub section details the DEAP analysis for the below apartment.

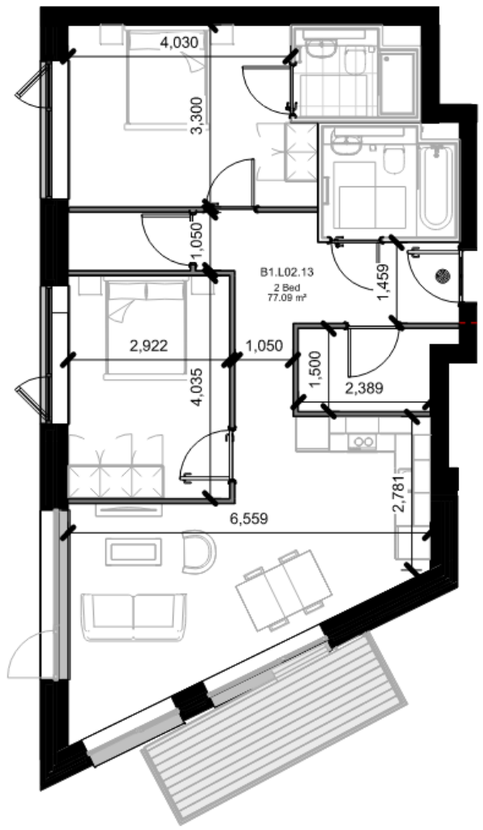


Figure 7.3.1 - Typical 2 Bed Apartment (Top Floor)

7.2 Part L Compliance.

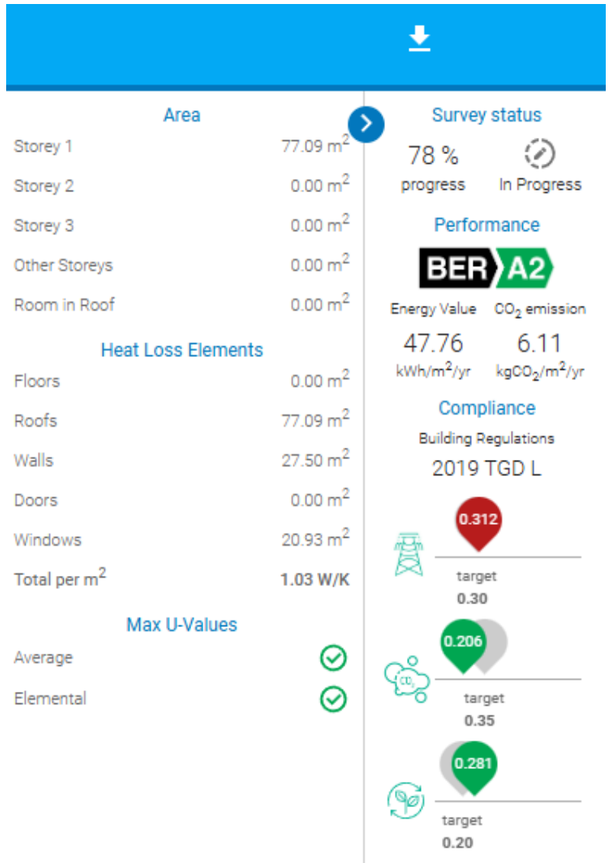


Figure 7.3.2 - Typical 2 Bed Apartment (Top Floor) Compliance

Figure 7.3.2 above, indicates non-compliance to Part-L for one of the criteria, for a typical 2 bed apartment at roof level in block B&C, **without the addition of PV panels to the residential unit**, with the following parameters achieved:

- Carbon Performance Coefficient (CPC) < 0.35
- Renewable Energy Ratio (RER) > 0.20

However, we can see the EPC does not achieve a rating of <0.3.

With the addition of 1No. 300W solar PV panel to the apartment we can achieve the below parameters. All areas are then compliant and receive a significant increase in ratings.