IN2
ENGINEERING DESIGN PARTNERSHIP

D1723
Hamilton Gardens
Carnlough Road,
Cabra, Dublin 7

Energy Analysis Report

Seven Cabra Real Estate Ltd

18th October 2019

Rev02

CONTENTS

1.0 EXECUTIVE SUMMARY

This report summarises the Energy Analysis undertaken for the proposed development at Carnlough Road, Cabra, Dublin 7. The development will consist of the construction of 485 no. residential units (484 no. apartments and 1 no. house) comprising of 33no. studios, 137 no. 1 bed, 271 no. 2 bed and 43 no. 3 bed units and a neighbourhood centre comprising of 3 no. retail / café / restaurant units including a convenience supermarket with ancillary off licence (1627.0sq.m.- Unit 2), Unit 1 (120.6 sq.m.), Unit 3 (230.0 sq.m.), 1 no. gym unit (617.9 sq.m.), community centre (382.2 sq.m.), creche (351.9 sq.m.) and 403 no. car parking spaces (375 no at basement level (305 no. to serve the residential units and 70 no. to serve the retail units) and 28 no. at surface level (20 no. to serve the residential units and 8 no. to serve the retail units) and 488 no. bicycle parking spaces (368 no. at basement level and 120 no. at surface level)

Energy analysis has been undertaken in order to demonstrate compliance to Building Regulations Technical Guidance Document (TGD) Part L 2019 and Section 3.0 outlines the requirements to ensure compliance: outlining the overarching EU Directive for Near Zero Energy Buildings (NZEB) and how this is implemented in Ireland and detailing associated requirements within Part L 2017. The report then examines the methodology in terms of Primary Energy, Renewable Technologies and options between Centralised and Decentralised plant, illustrating how electrically based technologies (Air Source Heat Pumps, Photovoltaic panels etc.) are increasingly favoured within Part L and associated Building Energy Rating (BER) calculations techniques within the approved software Dwelling Energy Assessment Procedure (DEAP), in comparison to gas based technologies such as CHP.

This DEAP software was used to undertake energy analysis for Part L and BER for all Apartments and a representational apartment within the development (2 Bed, 87m^2) is assessed in detail, with Section 4.0 detailing the assumptions made in terms of Building Construction, Mechanical and Electrical Systems and Renewable Technologies, before confirmation of compliance is confirmed in terms of Primary Energy, Carbon Emissions and Renewable Energy Ratio.

The analysis determined that the following energy and servicing strategy should enable compliance to Part L 2019/ NZEB and that an A2 BER be obtainable:

- Improvements to building thermal transmittance (U-Values), air permeability and thermal bridging with respect to Part L defaults.
- Centralised Heating and Hot Water Plant arrangement (with Heat Interface Units (HIU's) to each apartment).
- Air Source Heat Pumps (ASHP's) delivering 33% of annual heating and hot water, with back-up natural gas fired condensing boilers.
- Local Heat Recovery Ventilation (HRV) Units to each apartment.
- Photovoltaic (PV) array for electricity generation, centralised to connect to Landlord systems. Minimum required 0.5 PV panels per apartment (330 W peak/ 1.68m^2 each).

The detailed DEAP report for the selected Apartment unit, compiling all assumptions and calculations undertaken within the software, is included as in Appendix A, with all results determined for Block A summarised in Appendix B. Finally, the new DEAP methodology (Version 4) includes an allowance for maximum water consumption (125 l/person.day) and associated calculation is included in Appendix C.

2.0 DEVELOPMENT OVERVIEW

Figure 2.1 – Site Overview

Cabra Residential is a residentially zoned brownfield site (9.6ha) at Carnlough Road in Dublin 7. The site is situated on the corner of Carnlough Road and Faussagh Avenue within the urban context as illustrated above in Figure 2.1.

APARTMENT BREAKDOWN		
TOTAL NUMBER OF APARTMENTS:	484	Mix: 33xStudio; 137x1-bed; 257x2-bed; 14x2-bed Duplex; 43x3-bed
		RESIDENTIAL MIX PERCENTAGES: STUDIO=6.8%, 1 BED=28.3%, 2 BED=53.1%, 2 BED DUPLEX=2.9%, 3 Bed=8.9%

Figure 2.2 – Schedule of Accommodation

The proposed development will consist of 485No Residential units; comprising of a mix of studios, 1-3 bed apartments and 1 house as outlined in Figure 2.2 above, which range in size between 40 and 110m^2 approx.

3.0 BUILDING REGULATIONS

3.1 NZEB

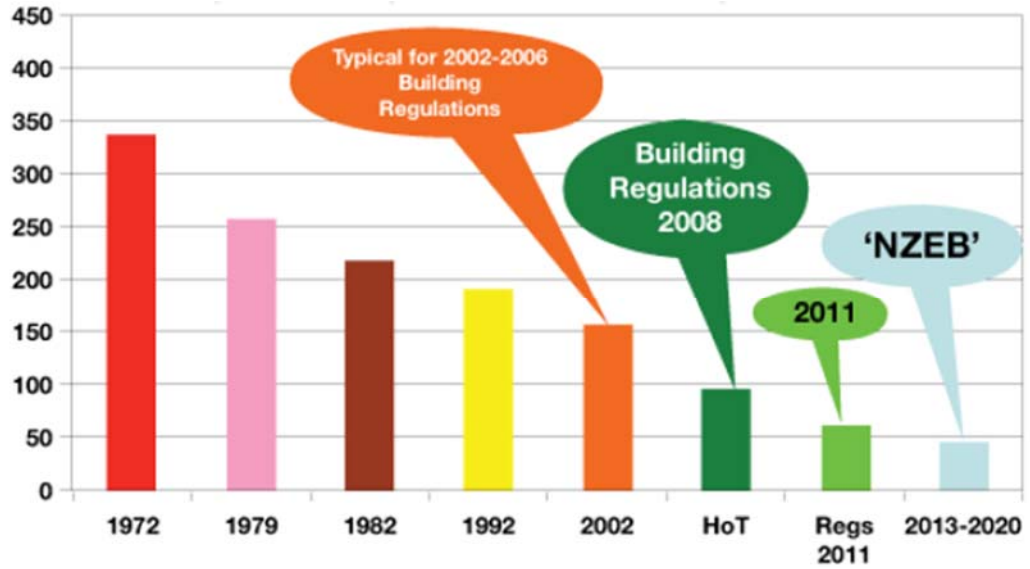

Figure 3.1.1 – Primary Energy Consumption in Irish Housing 1972-2020

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 3.1.1 above 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.

3.0 BUILDING REGULATIONS

3.1 NZEB (Cont'd)

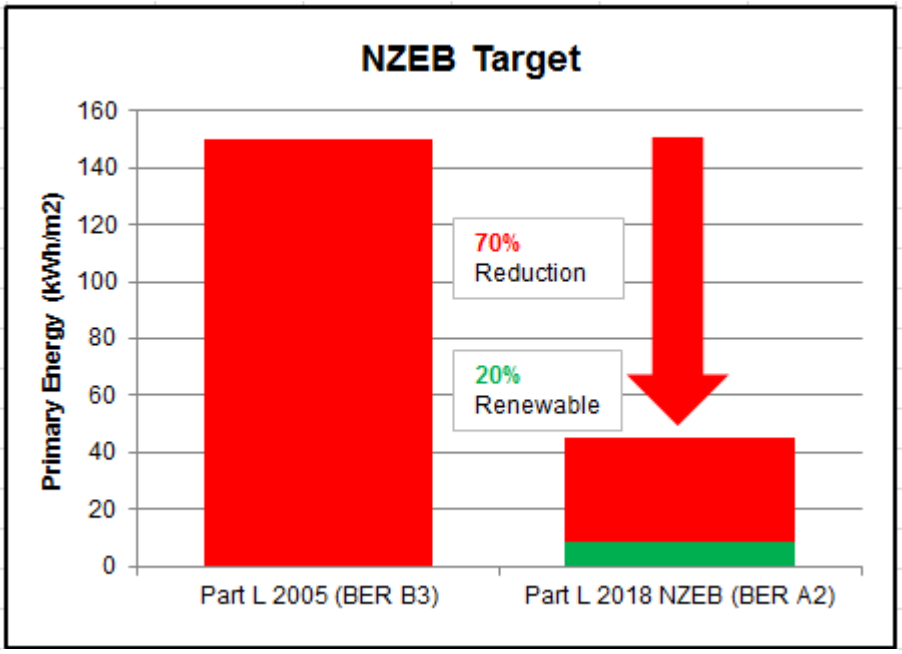

Figure 3.1.2 - NZEB Targets

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 3.1.2 above 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 for NZEB compliance.

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

3.0 BUILDING REGULATIONS

3.2 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 version 4.2, 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.

In summary, to ensure NZEB compliance, 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

In addition, minimum Fabric Performance is defined as follows in Part L 2019:

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

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

<u>Air Permeability</u>

- Maximum Air Leakage: 5 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, all apartments in Block A were assessed, with an average determined.

3.0 BUILDING REGULATIONS

3.3 Primary Energy

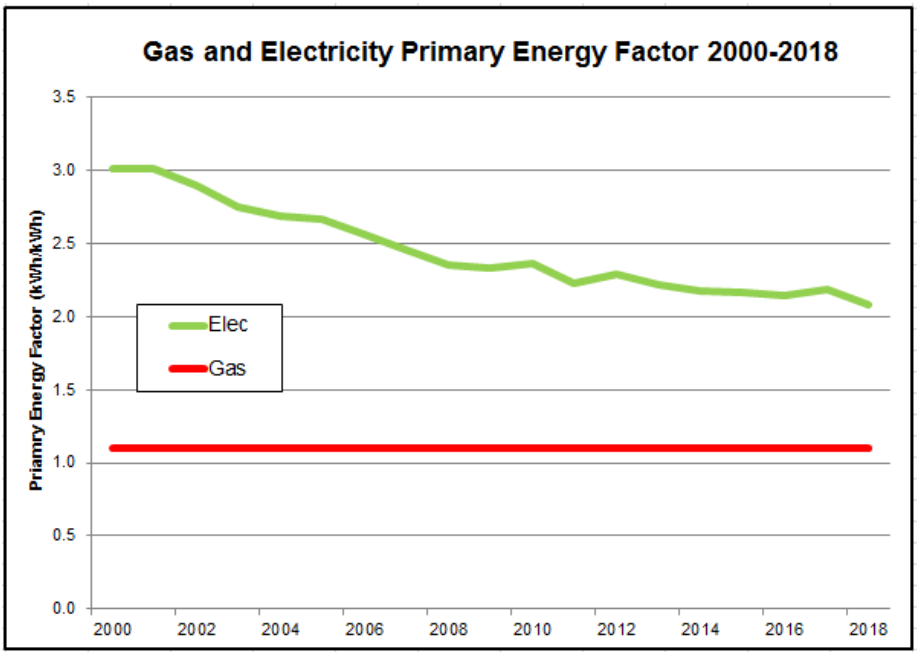

Figure 3.3 -Primary Energy Factors for Gas and Electricity 2000-2018

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/ 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 3.3 above, 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).

3.0 BUILDING REGULATIONS

3.4 Renewable Technologies

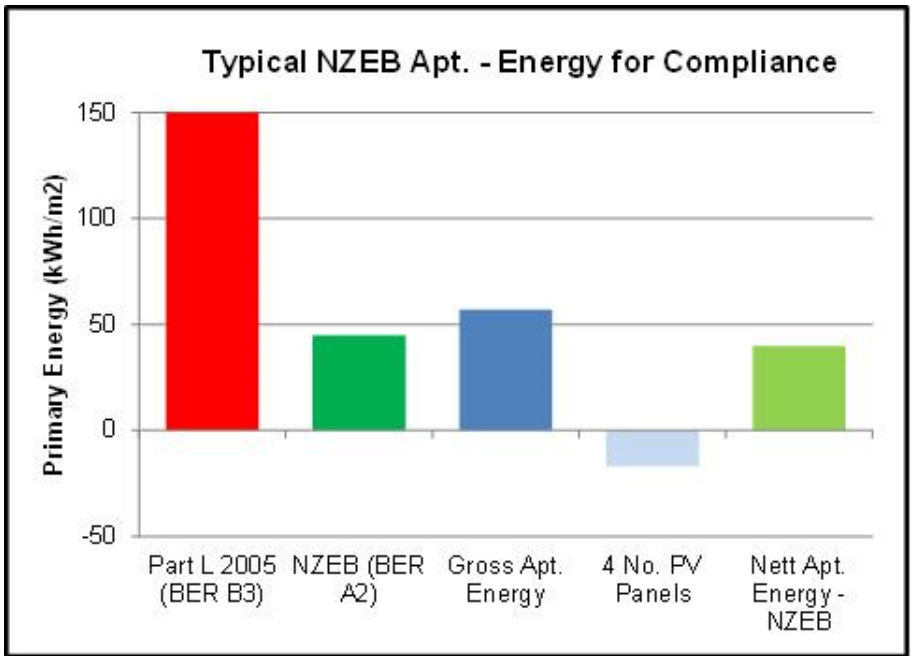

Figure 3.4 -EPC Compliance for Typical Apartment

In addition to improving heating energy related aspects, renewable technologies can be utilised to significantly reduce Primary Energy requirements (in addition to ensuring the renewable energy percentage is achieved). Figure 3.2.2 above indicates how, for a typical apartment (notional 100m^2) 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 3.5 below).

- 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.

- 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).

3.0 BUILDING REGULATIONS

3.5 Centralised -v- Decentralised Plant

3.5.1 Decentralised Plant

Decentralised plant would involve each apartment being provided with individual heating units (generally wall-mounted condensing gas fired boiler or floor-standing air source heat pump) and hot/ cold water storage in "hot press" area, in a conventional manner.

Figure 3.5.1 – Decentralised Plant Components: Boiler, Calorifier and PV panel

In addition, localised Heat Recovery Ventilation (HRV) units would be provided (typically located in store areas within apartments). Each individual apartment would also have its own separate ESB meter, located in a Ground Floor switchroom.

Pros

- All apartments would have autonomous services provision, with only utilities of ESB, gas and mains water being outside direct responsibility of individual units.

Cons

- Reduced space availability within apartments due to provisions for boiler/ heat pump, hot and cold water storage.
- Localised gas boilers would require individual flues to each apartment unit, with associated vents for combustion air.
- Gas boilers would require pipework to be routed throughout development incurring additional venting/ fire compartmentation.
- Localised storage tanks result in low pressure availability for hot and cold water; unless localised pumps installed which require more space and have inherent noise impact to individual apartments.
- No potential for CHP to provide renewable energy requirements.

Decentralised Plant arrangement is most cost-effective and suitable for smaller apartment developments (less than 50 units), or where management of centralised energy systems is not viable.

3.0 BUILDING REGULATIONS

3.5 Centralised -v- Decentralised Plant

3.5.2 Centralised Plant

This option would consist of a centralised plant area with modulating gas-fired condensing boilers, (potential for) CHP and/ or ASHP and centralised cold water storage. Apartments would be provided with an individual Heat Interface Unit (HIU) to provide domestic hot water and heating; a small encased unit with piped manifold arrangement, typically wall mounted within Utility room space.

Figure 3.5.2 - Centralised Plant Components: Modulating Boiler Plant, CHP and HIU

Individual ESB meters (in switchroom/ sub-station arrangement), would still be retained for each apartment.

Pros

- Increased physical space available within apartments due to absence of boiler/ heat pump/ hot and cold water storage/ heat recovery ventilation unit.
- Single point of maintenance for development at central plantrooms.
- Flue requirements and associated vents for combustion localised to central plant boilers and CHP only, as opposed to throughout individual units.
- Avoids routing gas pipework through apartment complex with associated venting/ fire compartmentation.
- Centralised nature allows future connection of renewable technologies as and when they become viable.
- Entire hot and cold water system may be pressurised.
- Potential for CHP to provide “free” hot water to apartments throughout the year; subject to extent of Landlord electrical load requirements.

Cons

- Requires management of heating and hot water distribution with billing through either metering or fixed service charge.

Larger apartment developments (50 units +) are best suited to Centralised Plant configurations, with higher cost-effectiveness due to economies of scale.

4.0 ENERGY ANALYSIS

4.1 Building Construction

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)

- External Walls: 0.17 W/m^{2}K
- Roofs: 0.15 W/m^{2}K
- Ground/ Exposed Floors: 0.11 W/m^{2}K
- Windows: 1.2 W/m^{2}K
- Doors: 1.5 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: 0.05 W/m^{2}K
  In accordance with Acceptable Construction Details (ACD's).

4.0 ENERGY ANALYSIS

4.2 Mechanical and Electrical Systems

The following low-energy systems have been selected for the mechanical and electrical installations, comprising of heat generators, heating and hot water systems, ventilation and lighting:

Primary Heat Generator

- **Type:** **Air Source Heat Pumps (Centralised)**
- Model: DAIKIN
- Number: 2
- Nominal Capacity: 63 kW
- Fuel: Electricity
- Percentage of HTG & HWS delivered: 33%

Secondary Heat Generator

- **Type:** **Modulating Condensing Boilers**
- Fuel: Natural Gas
- Operational Flow Temperature: 65ºC
- Seasonal Efficiency: 95%
- Percentage of HTG & HWS delivered: 67%

Heating Installations

- **Type:** **Centralised**
- Distribution: Heat Interface Units
- Heat Emitter: Radiators

Hot Water Installations

- **Type:** **Centralised**
- Water Use Target: 125 l/person.day
- Bath: Yes
- Shower: 6 l/min (flow restrictor)

Ventilation

- **Type:** **Heat Recovery Ventilation**
- Model: Vent Axia Kinetic E
- No. Wet Rooms: K+2
- Heat Recovery Efficiency: 80%
- Specific Fan Power: 0.5 W/l.s

Lighting

- Lamp Type: LED
- Luminaire Efficacy: 91 lm/W
- Total Installed Load: 119 W

4.0 ENERGY ANALYSIS

4.3 Renewable Technologies

Air Source Heat Pump

- 2 no. 63 kW Nominal size

Photovoltaics

- Building Energy Contribution: 100 kWh/apartment
- Primary Energy Contribution: 208 kWh/apartment
- No. PV panels: 0.5 per apartment

4.0 ENERGY ANALYSIS

4.4 Part L NZEB Compliance

Check conformity with MPEPC, MPCPC and RER requirements in TGD L			
Relevant for new-build.			
	Primary energy	CO2 emissions	Renewable
	[kWh/y]	[kg/y]	Energy Ratio
Totals for reference dwelling	12,791	2,588	
	EPC	CPC	RER
Performance coefficients	0.281	0.264	0.94
Maximum permitted	0.300	0.350	0.20
	Complies	Complies	Complies

Figure 4.4.2 – Part L Compliance – Primary Energy Breakdown

Figure 4.4 above indicates confirmation of compliance to NZEB, with the following parameters achieved:

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

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APPENDIX A – DEAP REPORT

DEAP Report

DEAP Workbook: Aligned to DEAP software version 3.2 plus inclusion of Part L 2019 requirements, incorporating NZEB

Inputs and results, with selected intermediate results shown in *italics*

Details not applicable for this dwelling are grayed out.

Print out 'Proj' worksheet separately if required.

Dwelling dimensions — **TGD L version** 2019

	Area [m^2]	Height [m]
Ground floor	87	2.5
First floor	0	0.0
Second floor	0	0.0
Third and other floors	0	0.0
Total floor area [m^2]	87	
Dwelling volume [m^3]	218	
Living area [m^2]	33.0	

Ventilation

Number of chimneys	0	
Number of open flues	0	
Number of intermittent fans and passive vents	1	
Number of flueless gas fires	0	
Is there a draught lobby on main entrance?	Yes	
Number of storeys in the dwelling	1	
Has an air permeability test been carried out?	Yes	1

If no Not applicable

If yes :

Air permeability [m3/h.m2 at 50 Pa]	3

End if

Number of sides sheltered	2	
Ventilation method	Balanced whole-house mechanical ventilation with heat recovery	6
Effective air change rate [ac/h]	0.27	
Ventilation heat loss [W/K]	19	
Permeability test carried out and meets guidelines in TGD L?	Complies	

For mechanical ventilation, other than positive input ventilation from loft: :

Is measured "PCDB" data available?	Yes
Manufacturer and model	0
Specific fan power [W/(l/s)]	0.5
Heat exchanger efficiency [%]	80

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Windows											
Orientation			East/West	South	North	SE/SW	South	North	North	North	Horizontal
Orientation ID			3	5	1	4	5	1	1	1	6
Area [m^2]			15.7	0	0	0	0	0	0	0	0
U-value [W/m^2 K]			1.20	1.20	1.20	0.00	0.00	0.00	0.00	0.00	0.00
Is U-value a manufacturer's certified value?			Yes	Yes	Yes	-	-	-	-	-	-
If yes:											
	Manufacturer and model		-	-	-	-	-	-	-	-	-
	Solar energy transmittance		0.6	0.6	0.6	-	-	-	-	-	-
End if											
Correction for roof window and/or metal frame if applicable (Table 6a, notes 1 and 2).											
			0	0	0	0	0	0	0	0	0
Overshading ID			2	2	2	0	0	0	0	0	0
Frame factor (Table 6c) [-]			0.70	0.70	0.70	0.00	0.00	0.00	0.00	0.00	0.00
Window type ID			7	7	7	0	0	0	0	0	0

Fabric						
Exposed element type	Area	U-value	*AU*	Comment (optional)	Element type	
	[m^2]	[W/m^2 K]	*[W/K]*		(for assessing TGD L conformity)	
Windows/rooflights	15.7	1.1	18.0	-		
Doors	0.0	1.5	0.0	-		
Floor	87.0	0.1	9.6	-	No underfloor heating	
Floor (type 2)	0.0	0.0	0.0	-	No underfloor heating	
Floor (type 3)	0.0	0.0	0.0	-	No underfloor heating	
Walls	13.6	0.2	2.3	-	Wall relevant for TGD L fabric compliance ch	
Walls (type 2)	0.0	0.0	0.0	-	Wall relevant for TGD L fabric compliance ch	
Walls (type 3)	0.0	0.0	0.0	-	Wall relevant for TGD L fabric compliance ch	
Walls (type 4)	0.0	0.0	0.0	-	Wall relevant for TGD L fabric compliance ch	
Walls (type 5)	0.0	0.0	0.0	-	Wall relevant for TGD L fabric compliance ch	
Roof	0.0	0.0	0.0	-	Pitched roof - Insulation at ceiling	
Roof (type 2)	0.0	0.0	0.0	-	Pitched roof - Insulation at ceiling	
Roof (type 3)	0.0	0.0	0.0	-	Pitched roof - Insulation at ceiling	
Roof (type 4)	0.0	0.0	0.0	-	Pitched roof - Insulation at ceiling	
Roof (type 5)	0.0	0.0	0.0	-	Pitched roof - Insulation at ceiling	
Total area of elements [m^2]	116.30					
Heat loss via plane elements [W/K]			30			
Factor for thermal bridging [W/m^2 K]			0.05			
Fabric heat loss [W/K]			36			
Dwelling heat loss coefficient [W/K]			55			
Heat loss parameter, HLP [W/K m^2]			0.63			

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Water heating											
Are there distribution losses?			Yes								
Distribution loss [kWh/y]			257								
Are there storage losses?			Yes	1							
If yes	:										
	Water storage volume [litres]					4					
	Is manufacturer's declared loss factor available?					Yes	1				
	If yes	:									
		Manufacturer and model name				-					
		Manufacturer's declared loss factor [kWh/day]				0.364					
	If no	Not applicable									
	End if										
	Temperature factor unadjusted (Table 2)				1						
	Temperature factor multiplier (from Table 2 notes)				1						
End if											
Is there a solar water heating system?					No	0					
If yes	Not applicable										
							Solar fraction [%]		0		
End if											
Primary circuit loss [kWh/y] (Table 3)							0				
Additional loss for combi boiler [kWh/y] (Table 3a)							0				
Electricity consumption of electric keep-hot facility of combi boiler [kWh/y] (Table 4f)							0				
Is supplementary electric immersion heating is used in summer?							No				
Output from main water heater [kWh/y]					1843						
Output from supplementary heater [kWh/y]					0						
Heat gains from water heating system [W]					77						
Is hot water storage indoors or in group heating scheme?					Yes						

Lighting											
Annual energy used for lighting, EL [kWh/y]					198						
Internal gains											
Net internal gains [W]					392						
Heat use											
Living area fraction [-]				0.38							
Thermal mass category of dwelling				Medium							
Heat use [kWh/y]				645							
Space heating											
Control and responsiveness											
Temperature adjustment (Table 4e), where appropriate [C]					0						
Heating system control category (Table 4e)					2						
Heating system responsiveness category (Table 4a or 4d)					1						
Pumps/fans						Enter number present	If present, is boiler controlled by room thermostat?		If present, inside dwelling?		
Central heating pump (supplying hot water to radiators or underfloor system)						0		-			
Oil boiler - pump (supplying oil to boiler and flue fan)						0		-	-		
Gas boiler - flue fan (if fan assisted flue)						0					
Is there a warm air heating system present?					No						
Emission efficiency											
Is main heat emission system within an envelope element? (e.g. underfloor heating in ground floor)								-	0		
If yes, U-value of envelope element [W/m^2 K]								0			
Type of main heating system				Group / community heating scheme			2				
Energy requirements - individual heating systems					Not applicable						

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Energy requirements - group/community heating scheme :											
Secondary space heating											
Fraction of heat use from secondary / supplementary system (use value from Table 7, Table 10 or Appendix F)											0
Generation efficiency of secondary / supplementary heating system [%] (use value from Table 4a or Appendix E)											0
Main (group heating) system											
Is charging based on heat consumed?								Yes			
Distribution loss factor [-] (Table 9)								1.05			
Fraction of heat from CHP unit or fraction of heat recoverd from power station								0			
Boilers											
	(If the fraction of heat from boilers is zero, this section is irrelevant).										
	Heat source type		Fuel					Efficiency [%]	Percent of heat [%]		
	Central Boiler		mains gas					95	67		
	Central Boiler		wood pellets - bulk supply, for main htg					0	0		
	Heat Pump		electricity					0	33		
	Heat Pump		electricity					0	0		
	Solar heating system								0		
CHP or waste heat from power stations											
	(If the fraction of heat from CHP/waste heat is zero, this section is irrelevant).										
	System type					District Heating				2	
	If CHP										
		Electrical efficiency of CHP unit (e.g. 0.3) from operational records or the CHP design specification [-									1
		Heat efficiency of CHP unit (e.g. 0.5) from operational records or the CHP design specification [-]									1
		Fuel type				mains gas					
	If Waste Heat										
		Renewable Primary Energy Factor				0					
		Non Renewable Primary Energy Factor				0					
		CO2 Emission Factor				0					
Fuel data			Fuel								
Space heating - secondary			-								
Photovoltaics/ Wind Turbine			-100	kWh/yr							
Solar			0	kWh/yr							
								Primary	CO2		Delivered
Renewable and energy-saving technologies								energy	factor		energy
Type 1	Description		-					factor [-]	[kg/kWh]		[kWh/y]
	Energy produced or saved							0.00	0.000		0
	Energy consumed							0.00	0.000		0
Type 2	Description		-								
	Energy produced or saved							0.00	0.000		0
	Energy consumed							0.00	0.000		0
Type 3	Description		-								
	Energy produced or saved							0.00	0.000		0
	Energy consumed							0.00	0.000		0

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Results													
				Delivered energy	Primary energy	CO_2 emissions							
				[kWh/y]	[kWh/y]	[kg/y]							
Space heating - main				739	877	165							
Space heating - secondary				0	0	0							
Water heating - main				1,843	2,189	412							
Water heating - supplementary				0	0	0							
Pumps, fans				158	330	65							
Energy for lighting				198	412	81							
Renewable and energy-saving technologies													
CHP input (individual heating systems only)				0	0	0							
CHP electrical output (individual heating syst				0	0	0							
Photovoltaic/ Wind Turbine				100	-208	-41							
Type 1	-			0	0	0							
Type 2	-			0	0	0							
Type 3	-			0	0	0							
Total				3,039	3,600	682							
per m^2 floor area				34.9	41.4	7.8							
Building Energy Rating [kWh/m^2 y]					41	A2							
Check conformity with MPEPC and MPCPC requirements in TGD L							***2019***						
			Max permitted										
EPC		0.281	0.30	Complies									
CPC		0.264	0.35	Complies									
RER		0.939	0.20	Complies									

IN2 ENGINEERING DESIGN PARTNERSHIP

APPENDIX B - SUMMARY OF BLOCK A DEAP RESULTS

Floor	Type	Area (m^2)	EPC
First Floor	A1	87	0.281
First Floor	A2	81	0.277
First Floor	A3	116.3	0.307
First Floor	A4	103	0.281
First Floor	A5	61	0.256
First Floor	A6	98	0.270
First Floor	A7	120	0.280
First Floor	A8	123	0.274
Second Floor	A1	87	0.285
Second Floor	A2	81	0.281
Second Floor	A16	123	0.311
Second Floor	A4	103	0.276
Second Floor	A5	61	0.264
Second Floor	A6	98	0.279
Second Floor	A7	120	0.277
Second Floor	A8	123	0.278
Second Floor	A9	91.5	0.279
Second Floor	A10	91.2	0.281
Second Floor	A12/A14	59.5	0.274
Second Floor	A15	88.4	0.285
Second Floor	A13	89.4	0.284
Second Floor	A12/14	59.5	0.274
Second Floor	A15	91	0.284
Second Floor	A13	89.4	0.284
Second Floor	A12/14	59.5	0.274
Second Floor	A15	91	0.284
Second Floor	A13	89.4	0.284
Second Floor	A12/14	59.5	0.274
Second Floor	A15	91	0.284
Third Floor	A1	87	0.285
Third Floor	A2	81	0.281
Third Floor	A16	123	0.311
Third Floor (Top Floor)	A4	103	0.308
Third Floor (Top Floor)	A5	61	0.277
Third Floor (Top Floor)	A6	98	0.298
Third Floor (Top Floor)	A7	120	0.306
Third Floor (Top Floor)	A8	123	0.304
Third Floor	A9	91.5	0.279
Third Floor	A10	91.2	0.281
Third Floor	A12/A14	59.5	0.274
Third Floor	A15	88.4	0.285
Third Floor	A13	89.4	0.284
Third Floor	A12/14	59.5	0.274
Third Floor	A15	91	0.284
Third Floor	A13	89.4	0.284
Third Floor	A12/14	59.5	0.274
Third Floor	A15	91	0.284
Third Floor	A13	89.4	0.284
Third Floor	A12/14	59.5	0.274
Third Floor	A15	91	0.284
Fourth Floor	A1	87	0.285
Fourth Floor	A2	81	0.281
Fourth Floor	A16	123	0.311
Fourth Floor (Top Floor)	A9	91.5	0.296
Fourth Floor (Top Floor)	A10	91.2	0.301
Fourth Floor (Top Floor)	A12/A14	59.5	0.295
Fourth Floor (Top Floor)	A15	88.4	0.312
Fourth Floor (Top Floor)	A13	89.4	0.307
Fourth Floor (Top Floor)	A12/14	59.5	0.295
Fourth Floor (Top Floor)	A15	91	0.312
Fourth Floor (Top Floor)	A13	89.4	0.307
Fourth Floor (Top Floor)	A12/14	59.5	0.295
Fourth Floor (Top Floor)	A15	91	0.312
Fourth Floor (Top Floor)	A13	89.4	0.307
Fourth Floor (Top Floor)	A12/14	59.5	0.295
Fourth Floor (Top Floor)	A15	91	0.312
Fifth Floor	A1	87	0.285
Fifth Floor	A2	81	0.281
Fifth Floor	A16	123	0.311
Sixth Floor (Top Floor)	A1	87	0.308
Sixth Floor	A2	81	0.281
Sixth Floor	A16	123	0.311
Seventh Floor (Top Floor)	A2	81	0.302
Seventh Floor (Top Floor)	A16	123	0.343
AVERAGE			**0.289**

APPENDIX C - TOTAL WATER CONSUMPTION CALCULATION

D1723 Cabra Residential

You are within your target maximum consumption of potable water (125 litres per person per day).

Total water consumption from your calculation	**101.61**	litres per person per day
Total including external water use (17.K Compliance [Building Regulations Part G])	**106.61**	litres per person per day

This calculator is intended to inform design choices by demonstrating the likely impact of specification changes on total water consumption. Results can only be used to demonstrate compliance with Building Regulations when the calculations have been verified by a Building Control Officer.

Calculation summary

Installation type	Unit of measure	Capacity / flow rate	Use factor	Fixed use	Litres / person / day
WCs (single flush)	Flush volume (litres)		4.42	0	26.52
WCs (dual flush)	Average effective flushing volume (litres)	6			
Taps (excl. kitchen/utility room)	Flow rate (litres / minute)	6	1.58	1.58	11.06
Bath (shower also present)	Capacity to overflow (litres)	120	0.11	0	13.2
Shower (bath also present)	Flow rate (litres / minute)	6	4.37	0	26.22
Kitchen/utility room sink taps	Flow rate (litres / minute)	6	0.44	10.36	13
Washing machine	Litres / kg dry load	8.17	2.1	0	17.16
Dishwasher	Litres / place setting	1.25	3.6	0	4.5
Waste disposal unit	Litres / use	☐	3.08	0	
Water softener	Litres / person / day	☐	1	0	
Contribution from Grey Water					undefined
Contribution from Rain Water					undefined
				Normalisation factor	∑ × 0.91