Appendix B - Environmental Services

IN2
ENGINEERING DESIGN PARTNERSHIP

D1815 Trinity Wharf Mixed Use Development
Wexford Town
Co. Wexford

Comhairle Contae Loch Garman
Wexford County Council

Environmental Analysis Report
Planning stage

IN2 Project No. D1815
17/01/2019
REV02

DOCUMENT REGISTER

Rev	Status	Date	Comment
00	Draft	23rd November 2018	DRAFT Issued for Comment
01	Issue	29th November 2018	Issued for Planning
02	Issue	17th January 2019	Issued for Planning

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1.0 EXECUTIVE SUMMARY

This report compiles the environmental analysis undertaken for the proposed Mixed-Use Development at Trinity Wharf, Wexford Town. The analysis contained within the report is based on the drawings as issued by Scott Tallon Walker Architects between the 10th October and 13th November 2018.

The energy analysis in particular assessed the individual buildings as proposed within the development and determined an environmental and servicing strategy for each to ensure compliance to Technical Guidance Document Part L 2017 of the Building Regulations. These Regulations have been released to ensure new buildings are designed in accordance with the Near Zero Energy Building (NZEB) Directive, which is described in detail in Section 2.0.

Dynamic simulation models were created for each of the buildings to enable energy analysis, accounting for climate, site location, building materials and constructions, fenestration and shading, HVAC systems, occupant profiles and behaviour (opening and closing windows and blinds etc.).

The energy analysis inputs and results are described for each individual building through Sections 3.0- 8.0. In each case, a servicing strategy is described and the renewable technology required to ensure NZEB compliance is detailed. Photovoltaic (PV) panels for electricity generation were found to be the most applicable renewable technology for the majority of the building types (often supplementing Air Source Heat Pumps); with the notable exception of the Hotel, where the high hot water energy consumption (bedroom showers and restaurant/ bar requirements) rendered a Combined Heat and Power (CHP) unit to be the most appropriate.

In addition to energy performance, comfort analysis has been undertaken for the buildings. In particular, the offices have been designed to allow a flexibility of use: that they could be either air conditioned (4-pipe Fan Coil Unit) or naturally ventilated as preferred by the relevant future Developer.

Finally, a LEED Pre-Assessment has been undertaken for the proposed office developments. It was determined that a “Gold” Accreditation could be achievable for the offices, due to a combination of reusing brownfield site, environmental considerations, transport links and NZEB low energy performance.

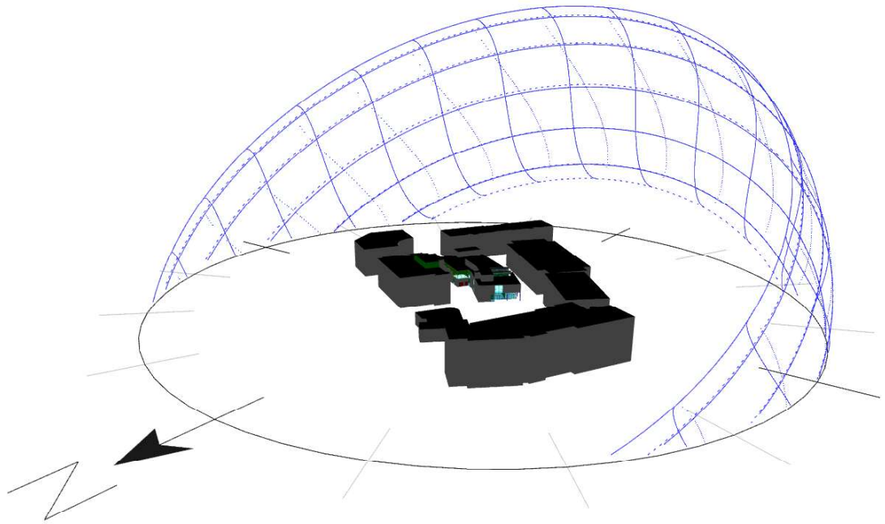


Fig 1.1 – Dynamic Simulation Model: Overall Site Development

2.0 BUILDING REGULATIONS COMPLIANCE

2.1 NZEB METHODOLOGY

The EU Energy Performance of Buildings Directive (EPBD) requires that all new developments be designed to be Near-Zero Energy Buildings (NZEB) from 2020.

This directive has been interpreted for Ireland as requiring both a substantial reduction in Primary Energy (of the order of 50-60% below the Part L 2008 benchmark), with significant proportion of that (10-20% of energy) being provided by Renewable Energy sources "either on-site or nearby (i.e. energy from district heating systems etc.)".

The NZEB methodology involves comparing the "Actual Building" as proposed against a "Reference Building".

The NZEB "Reference Building" has been defined in the SEAI's "Interim NZEB Performance Specification" document and is (essentially) a building of the same form and geometry as the "Actual" with 40% glazing and 10% framing factor applied to walls of each orientation and building insulation levels, mechanical/ electrical systems and renewable energy contribution in accordance with Appendix C of the Part L Technical Guidance Document.

Figure 2.1 illustrates the energy performance required to demonstrate compliance for Part L 2017: In addition to meeting the overall Primary Energy NZEB performance (which is 50-60% lower than Part L 2008 benchmark) , the Renewable Energy Ratio (RER) contribution must be either 20%; or, if an additional 10% reduction in overall Primary Energy against the benchmark is achieved, the RER contribution may be reduced to 10%.

In order to demonstrate NZEB compliance and determine BER performance Dynamic Simulation Modelling was utilised (Tas software). This involved creating a representative model of the Building including the building's orientation, fenestration, materials and internal conditions (occupancy etc) and simulating this against historic climatic data.

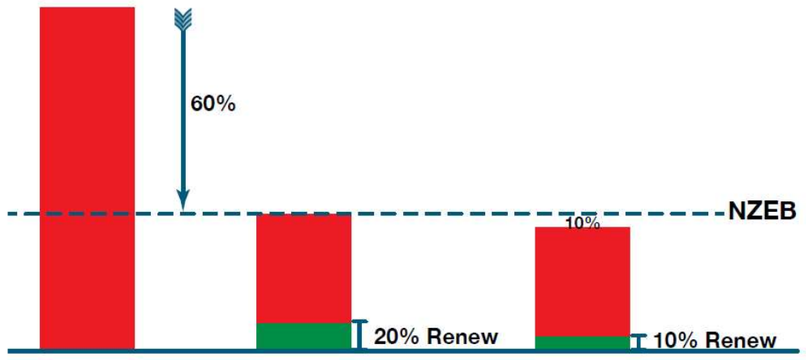


Figure 2.1 - NZEB Requirements

2.0 BUILDING REGULATIONS COMPLIANCE

2.1 NZEB METHODOLOGY (Cont'd)

The predicted annual building energy is then separately calculated for each "Reference", "Notional" and "Actual" Buildings for:

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

Each building energy type (heating, hot water, etc.) is then converted to Primary Energy (an indication of energy usage at source) utilising the factors in Figure 2.2.

Primary Energy accounts for inefficiencies in fuel generation and transportation; hence electricity usage is penalised approximately twice that of gas/ oil, etc. Also, as comparison is solely based on *Primary Energy* and Biomass is deemed equivalent to Natural Gas in Primary Energy, the use of this low-carbon fuel would not assist improvement in results in the current methodology. The NZEB specification includes a reduction in Electrical primary energy and CO_2 due to the increase in renewables in use for electricity generation.

The calculated primary energy consumption of the "Actual Building" is divided by that of the NZEB "Reference Building", the result being the Energy Performance Coefficient (EPC) of the "Actual Building".

The Renewable Energy Ratio (RER) is calculated by dividing the renewable energy contribution as a proportion of overall Primary Energy provided.

To demonstrate that an acceptable Primary Energy consumption rate has been achieved, the calculated EPC of the building being assessed should be no greater than the Maximum Permitted Energy Performance Coefficient (MPEPC) as defined within Part L 2017 as illustrated in Figure 2.3:

Each building was therefore analysed to ensure compliance can be achieved, by minimising Primary Energy for heating, hot water, cooling, auxiliary and lighting systems and applying the most appropriate renewable technology accordingly.

Primary Energy Factors		
Gas / Oil / Biomass	1.1	kWh_P/kWh_B
Electricity	2.08	kWh_P/kWh_B

Carbon Emissions		
Gas	0.203	$kgCO_2/kWh_B$
LPG	0.232	$kgCO_2/kWh_B$
Oil	0.272	$kgCO_2/kWh_B$
Biomass	0.025	$kgCO_2/kWh_B$
Electricity	0.409	$kgCO_2/kWh_B$

Figure 2.2 - Primary Energy and Carbon Emission Factors

- Maximum EPC: 1.0/ Minimum RER: 0.20
- Maximum EPC: 0.9/ Minimum RER: 0.10

Figure 2.3 - Part L 2017 Compliance

2.0 BUILDING REGULATIONS COMPLIANCE

2.2 BER METHODOLOGY

The methodology for BER is similar to that of NZEB, however, the benchmark utilised (The "Notional Building") differs slightly in that it is assumed to be naturally ventilated throughout, irrespective of systems used within the proposed building.

Similarly, the calculated primary energy of the "Actual Building" is divided by that of the "Notional Building" for which the BER is determined. A value of 1.0 is indicative of the B3/ C1 range, with an A rated building demonstrating at least 50% reduction in primary energy below this "Notional Building" benchmark.

New buildings designed to be compliant to Part L 2017 NZEB Building Regulations may be expected to achieve BER's in the range of A2- A3; depending on building application and HVAC systems utilised.

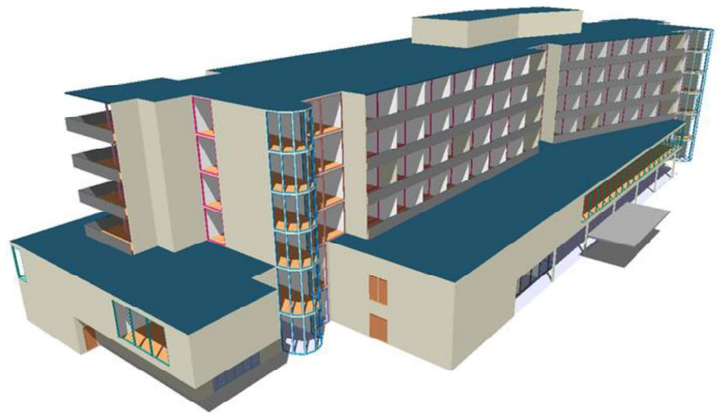


Figure 2.4- Dynamic Simulation Model of Hotel

IN2
ENGINEERING DESIGN PARTNERSHIP

3.0 HOTEL

3.1 SERVICES STRATEGY

The proposed servicing strategy for the Hotel buildings comprises of the following systems: -

- Heating is proposed to public areas and bedrooms using Variable Refrigerant Flow (VRF) air source heat pumps.
- Heating will be provided to other areas with condensing natural gas boiler and radiator system.
- Hot water is proposed to be heated primarily by natural gas fired 100 kW_E (with heat to power ratio of 1.3) Combined Heat and Power Plant (CHP) with insulated storage tanks incorporated in the system.
- Cooling will be provided by air source heat pumps and chillers for ventilation cooling / dehumidification.
- Ventilation will be provided by mechanical ventilation with heat recovery to all public and back of house areas.
- Constant air volume mechanical ventilation is proposed for kitchen areas with dedicated exhaust.
- Centralised extract ventilation will be provided to ensuite bathrooms.
- Natural ventilation will be used to ventilate bedrooms and circulation areas.
- Lighting will be provided by high efficiency LED luminaires in conjunction with occupancy control and photocell dimming controls
- Renewable energy contribution will be provided through the use of Combined Heat and Power plant (CHP) for hot water consumption.

It is anticipated that plant will be provided at both ground floor and at roof level as indicated in Figures 3.3 and 3.4

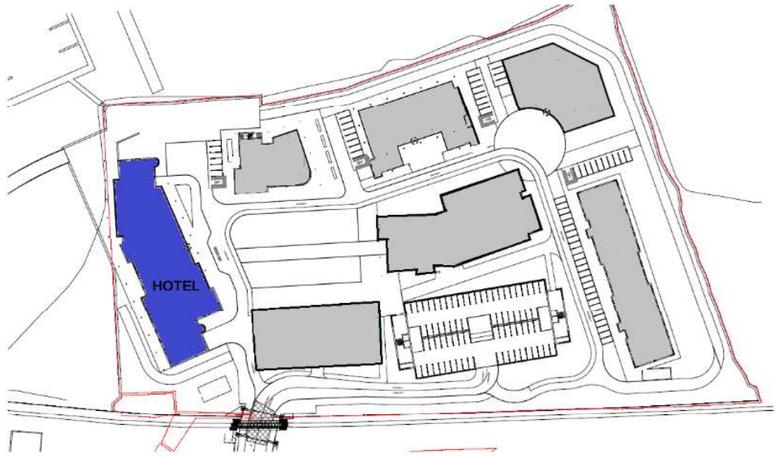


Figure 3.1 – Site Key Plan Indicating the Hotel Building Location

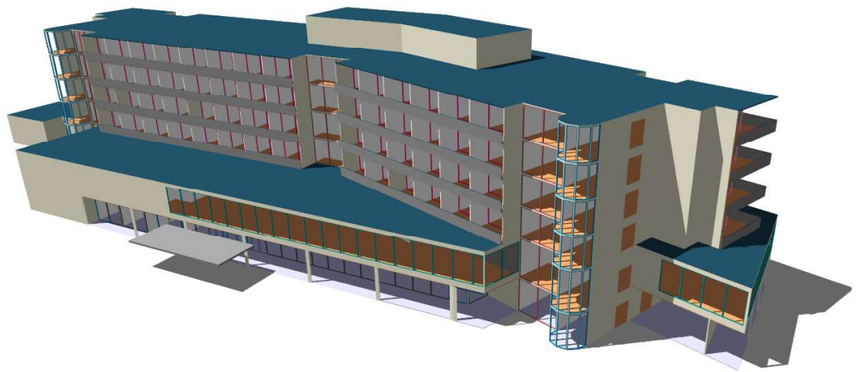


Figure 3.2 - Dynamic Simulation model of the Hotel Building

IN2
ENGINEERING DESIGN PARTNERSHIP

3.0 HOTEL

3.1 SERVICES STRATEGY (Cont'd)

The plant at ground level comprises of the following: -

- Hot, cold and mains water storage and booster sets
- Boiler plant/ ancillaries
- Combined Heat and Power (CHP)

Figure 3.3 illustrates the proposed layout with allocated plant space 3m high. The CHP unit will be accommodated within a dedicated plant room to enable acoustic separation.

Plant at roof comprises of: -

- Air Handling Units (AHU's)
- VRF condensers
- Centralised extract fans.

Figure 3.4 illustrates our proposed roof plant layout. The proposed plant compound would be entirely open to above and consist of 3m high louvred screening enclosing all plant items to ensure they are not visible.

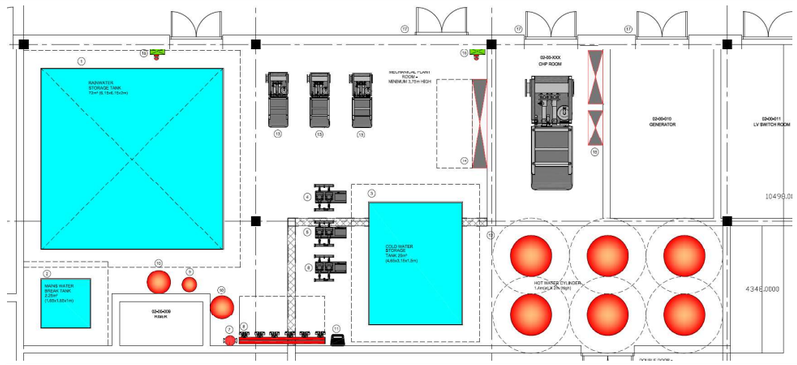


Figure 3.3 - Proposed Hotel Ground Floor Plant Area

SCHEDULE OF TRINITY WHARF HOTEL PLANT EQUIPMENT

ITEM No.	DESCRIPTION
01	RAINWATER (RWS) TANK - 72,000L
02	MAINS WATER (MWS) TANK - 2,250L
03	COLD WATER (CWS) TANK - 20,000L
04	RAINWATER DUTY/STANDBY BOOSTER SET
05	MAINS WATER DUTY/STANDBY BOOSTER SET
06	COLD WATER DUTY/STANDBY BOOSTER SET
07	LOW LOSS HEADER
08	HEATING CIRCUITS HEADER - PRIMARY PUMPS
09	EXPANSION VESSEL - 500mmØ
10	EXPANSION VESSELS - 700mmØ
11	PRESSURISATION UNIT / DEGASSER
12	6NO. HOT WATER CYLINDERS - TOTAL STORAGE 14,000L
13	3NO. GAS FIRED BOILERS - 300kW
14	MCC PANEL
15	100kW CHP UNIT
16	GAS DETECTION PANEL
17	FULLY LOUVERED ACCESS DOORS, MINIMUM 1.0m² FREE AREA FOR COMBUSTION/PLANTROOM VENTILATION AIR

NOTE: 600mm WIDE X 2,000mm HIGH ACCESS ROUTE AND 1,100mm WIDE KNEELING ACCESS TO ALL PLANT REQUIRED IN ACCORDANCE WITH TGD PART F-VENTILATION OF THE BUILDING REGULATIONS.

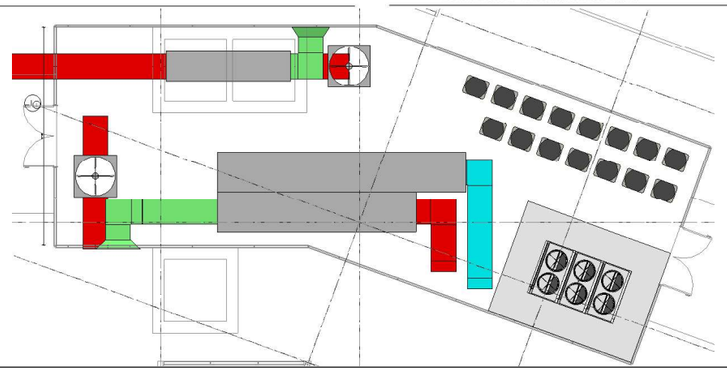
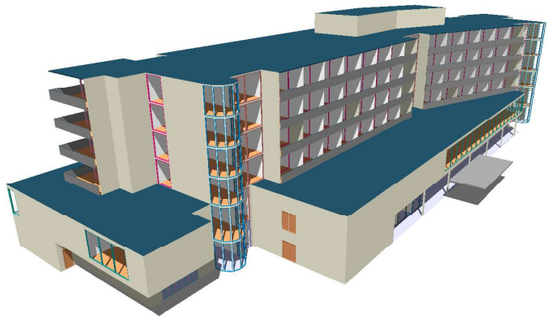


Figure 3.4 - Proposed Hotel Roof Level Plant Area

3.0 HOTEL (Cont'd)

3.2 BUILDING AND HVAC ASSUMPTIONS



Building Fabric			
Element	U-Value W/m²K	General Fabric Details	
External Walls	0.18	Air Permeability m³/hr.m²	3
Roof	0.15	Glazing g-Value General	39%
Floor	0.15	Glazing Light Transmittance	79%
Exposed Floor	0.15	External Shading Transmittance[1]	26%
Glazing - (Centrepane)	1.1		

Please Note: - Assumed U-Values to be achieved inclusive of thermal bridging
[1]External Shading to stair cores

Heating System			
Heating to Bedrooms and Public Areas (VRF)			
Fuel	Electrical	Air Source Heat Pump SEER	500%
Heating Water Pumps	NA	Distribution System Efficiency	NA
Heating to Other Spaces (Radiators)			
Fuel	Natural Gas	Boiler Seasonal Efficiency	95%
Heating Water Pumps	Variable Speed	Distribution System Efficiency	95%

Hot Water System			
Fuel	Natural Gas	Seasonal Efficiency	95%
		Distribution System Efficiency	95%

Cooling			
Fuel	Electrical	Air Source Heat Pump SEER	400%
Chilled Water Pumps	NA	Distribution System Efficiency	NA

HVAC System			
Public Areas			
Variable Refrigerant Flow and Mechanical Ventilation (VRF.+MV):	Supply Air Fan Specific Fan Power (W/l.s)		1.2
	Extract Fan Specific Fan Power (W/l.s)		0.5
	Heat Recovery Efficiency	Plate Heat Exchanger	70%
	CO_2 Sensor		
Bedrooms			
Variable Refrigerant Flow and Natural Ventilation (VRF.+NV)			
Back of House Areas and Large Toilets			
Heat Recovery Ventilation (HRV)	Supply Air Fan Specific Fan Power (W/l.s)		1.2
	Extract Fan Specific Fan Power (W/l.s)		0.5
	Heat Recovery Efficiency	Plate Heat Exchanger	70%
	CO_2 Sensor		
Kitchen			
Constant Air Volume (CAV) Mechanical Ventilation	Supply Air Fan Specific Fan Power (W/l.s)		1.2
	Extract Fan Specific Fan Power (W/l.s)		0.5
Stores, Small Toilets and Ensuite			
Extract Ventilation (Ex)	Extract Fan Specific Fan Power (W/l.s)		0.5

Lighting			
Space Type	Presence Detection Switching	Daylight Control	Lighting Power (W/m^2 per 100 Lux)
Back of House	Manual on / Auto off	Photocell Dimming (as required)	1.5
Toilets	Auto on / Auto off	NA	1.5
Bedrooms	Manual on / Auto off	NA	1.5
Public Areas	Manual on / Auto off	Photocell Dimming	1.5

Controls	
Automatic monitoring and targeting with alarms for out of range values	Yes
Power factor correction to achieve a whole building power factor of at least	>95%

Renewable Technology			
System	Combined Heat and Power (CHP)	Renewable Yield	
Size (Electrical Output)	100kW(e)	Overall Efficiency	84.9%
Heat to power ratio	1.3	Proportion of annual demand supplied by CHP Plant	71%

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3.0 HOTEL (Cont'd)

3.3 BER and NZEB RESULTS

Figure 3.5 indicates how an A3 building energy rating was determined for the proposed Hotel building design, for which the following may be noted:

- The improved building fabric performance reduces Heating Energy demand.
- The use of the high efficiency heat pump generation plant was predicted to provide a considerable reduction to building energy consumption for both heating and cooling.
- The improved efficiency of LED lighting combined with photocell-based lighting control to public areas has significantly reduced the energy demand for lighting.
- The renewable contribution from the Combined Heat and Power Plant (CHP) installation was predicted to provide the RER requirement further reducing the overall energy demand.
- The overall energy improvement for the building was determined to achieve a reduction of 65% below Notional benchmark, which equates to an A3 BER rating as indicated.

NZEB analysis was undertaken for the building with Part L Compliance determined as illustrated in Figure 3.6.

For the Hotel building the renewable energy contribution from the 100 kW(e) Combined Heat and Power plant (CHP) is providing the RER requirement to achieve NZEB, by delivering approximately 70% of estimated annual domestic hot water consumption.

Energy Type	HTG - Gas	HTG - Elec	HWS	CLG	AUX	LTG	PV	GAS	ELEC	TOTAL
Notional	89.15	0.00	157.92	1.86	3.10	39.19	0.00	271.78	91.83	363.61
Actual	26.6	2.6	120.8	3.2	3.8	10.0	-35.6	162.15	-33.5	128.6
BER			A3						EPC	0.35

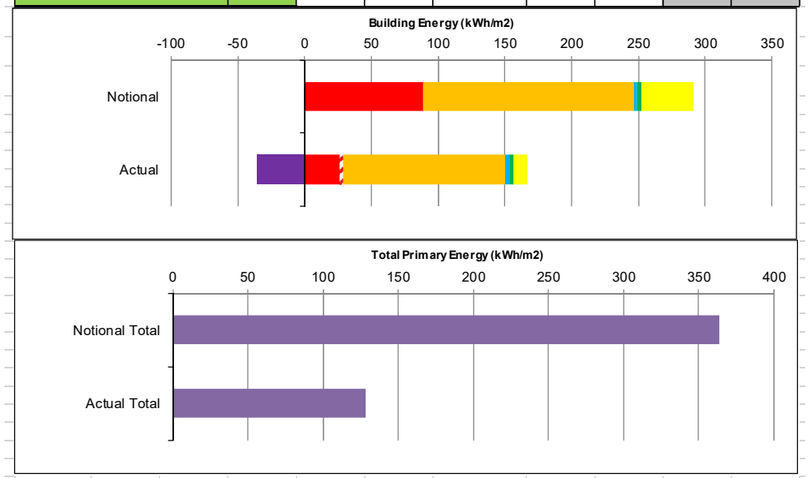


Figure 3.5 - Predicted BER Results for the Hotel Building

Results		
EPC	0.88	Compliant
CPC	0.86	Compliant
RER	0.23	Compliant

Figure 3.6 - Hotel Building - NZEB Compliance

IN2
ENGINEERING DESIGN PARTNERSHIP

4.0 CULTURAL CENTRE

4.1 SERVICES STRATEGY

The proposed servicing strategy for the Cultural Centre building comprises of the following systems: -

- Heating and hot water will be provided to all areas with condensing natural gas boilers with ventilation systems to conference room and a radiator system to other areas.
- Cooling will be provided by air cooled chiller.
- Mechanical Ventilation with cooling and plate heat exchanger for heat recovery will be provided to the conference room, stage area and exhibition spaces.
- Mechanical Ventilation with heat recovery will be provided to changing rooms and staff areas.
- Constant air volume mechanical ventilation is proposed for kitchen areas with dedicated exhaust.
- Localised individual extract will be provided to toilet blocks.
- Natural ventilation will be used to ventilate studios, exhibition space, office and back of house areas.
- Lighting will be provided by high efficiency LED luminaires with occupancy control and photocell dimming controls
- Renewable energy contribution will be provided by photovoltaic (PV) solar panels.

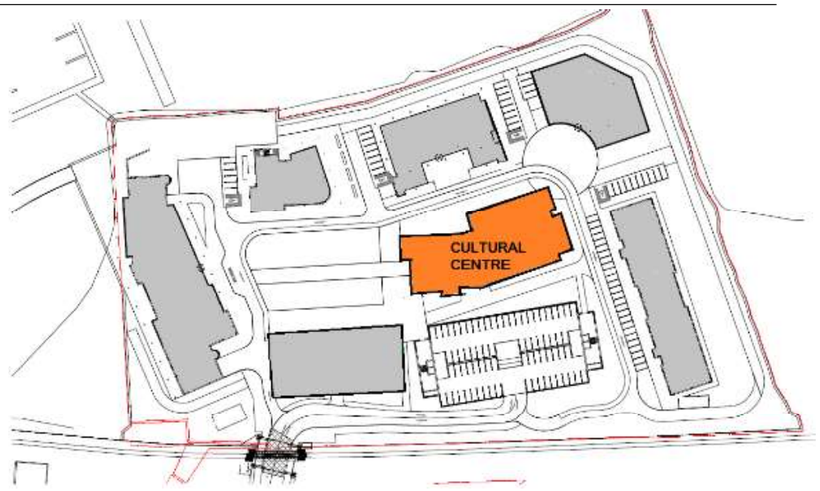


Figure 4.1 – Site Key Plan Indicating the Cultural Centre Building Location

Figure 4.2 - Dynamic Simulation Model of the Cultural Centre Building

4.0 CULTURAL CENTRE (Cont'd)

4.1 SERVICES STRATEGY (Cont'd)

Figure 4.3 illustrates the proposed roof plant layout. The allocated plant space would be within a 3.6 m high enclosed space with louvered walls and comprises of: -

- Hot, cold and mains water storage and booster sets
- Natural Gas Boiler plant and ancillaries
- Air Handling Units
- Centralised extract fans
- Chiller Unit (external compound)
- Photovoltaic (PV) Panels (external)

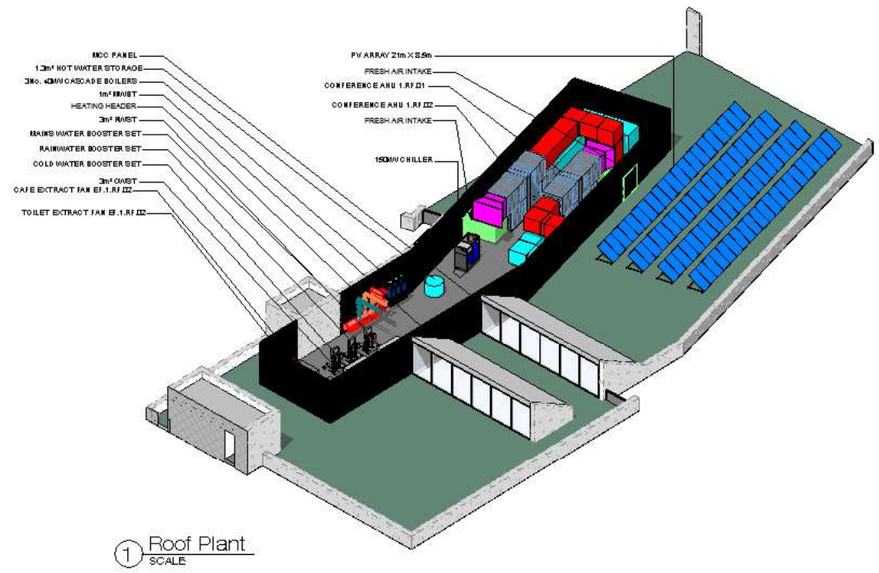


Figure 4.3 - Proposed Cultural Centre Roof Level Plant Compound

IN2 ENGINEERING DESIGN PARTNERSHIP

4.0 CULTURAL CENTRE (Cont'd)

4.2 BUILDING AND HVAC ASSUMPTIONS

Building Fabric

Element	U-Value W/m²K	General Fabric Details	
External Walls	0.18	Air Permeability m³/hr m²	3
Roof	0.15	Glazing g-Value General	39%
Floor	0.15	Glazing Light Transmittance	79%
Exposed Floor	0.15		
Glazing - (Centrepane)	1.1		

Please Note: - Assumed U-Values to be achieved inclusive of thermal bridging

Heating System

Heating to All Areas (Radiators)			
Fuel	Natural Gas	Boiler Seasonal Efficiency	95%
Heating Water Pumps	Variable Speed	Distribution System Efficiency	95%
Heating to Other Spaces			
Fuel	None	Boiler Seasonal Efficiency	
Heating Water Pumps		Distribution System Efficiency	

Hot Water System

Fuel	Natural Gas	Seasonal Efficiency	95%
		Distribution System Efficiency	95%

Cooling

Fuel	Electrical	Chiller SEER	300%
Chilled Water Pumps	NA	Distribution System Efficiency	NA

HVAC System

Conference Room and Stage		
Mechanical Ventilation and Cooling (MV.+C)	Central Supply Air Fan Specific Fan Power (W/l.s)	2.5
	Central Extract Fan Specific Fan Power (W/l.s)	0.9
	Heat Recovery Efficiency | Plate Heat Exchanger	70%
	CO_2 Sensor	
Exhibition Areas		
Fancoil Units and Mechanical Ventilation (FCU.+MV)	Fresh Air Fan Specific Fan Power (W/l.s)	0.8
	Terminal Fan Specific Fan Power (W/l.s)	0.3
	Extract Fan Specific Fan Power (W/l.s)	0.5
	Terminal Unit Fan Air Changes Per Hour (ACH)	5
Changing and Staff Areas		
Heat Recovery Ventilation (HRV)	Supply Air Fan Specific Fan Power (W/l.s)	0.8
	Extract Fan Specific Fan Power (W/l.s)	0.5
	Heat Recovery Efficiency | Plate Heat Exchanger	70%
	CO_2 Sensor	
Kitchen		
Constant Air Volume (CAV) Mechanical Ventilation	Supply Air Fan Specific Fan Power (W/l.s)	1.2
	Extract Fan Specific Fan Power (W/l.s)	0.5
Stores, Small Toilets and Ensuite		
Extract Ventilation (Ex)	Extract Fan Specific Fan Power (W/l.s)	0.5
Offices and Backroom Areas		
Natural Ventilation) (NV)		

Lighting

Space Type	Presence Detection Switching	Daylight Control	Lighting Power (W/m² per 100 Lux)
Back of House	Manual on / Auto off	Photocell Dimming (as required)	1.5
Toilets	Auto on / Auto off	NA	1.5
Bedrooms	Manual on / Auto off	NA	1.5
Public Areas	Manual on / Auto off	Photocell Dimming	1.5

Controls

Automatic monitoring and targeting with alarms for out of range values	Yes
Power factor correction to achieve a whole building power factor of at least	>95%

Renewable Technology

System	Approximate Area of PV (m²)	Renewable Yield	
		MWh/ann	kWh/m².ann
Photovoltaic Solar Panel	140	18.8	6

IN2 ENGINEERING DESIGN PARTNERSHIP

4.0 CULTURAL CENTRE (Cont'd)

4.3 BER and NZEB RESULTS

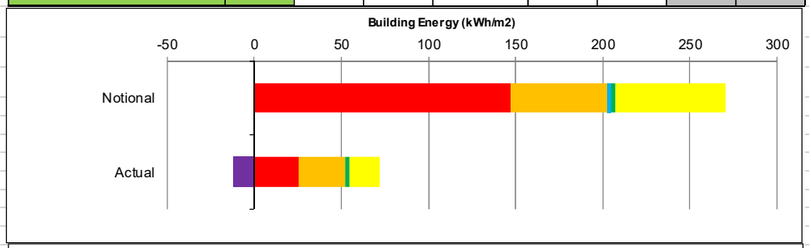
Figure 4.5 indicates how an A2 building energy rating was determined for the proposed Cultural Centre building design, for which the following may be noted:

- The improved building fabric performance significantly reduces Heating Energy demand.
- The use of the high efficiency natural gas boiler plant was predicted to provide a further reduction to building energy demand for space and water heating.
- The improved efficiency of Lighting combined with improved lighting control has significantly reduced the energy demand for lighting.
- The renewable contribution from the Photovoltaic solar panels (PV) was predicted to provide the RER requirement for NZEB further reducing the overall energy demand.
- The overall energy improvement for the building was determined to achieve a reduction of 80% below Notional benchmark, which equates to an A2 BER rating as indicated.

NZEB analysis was undertaken for the building with Part L Compliance determined as illustrated in Figure 4.5.

For this project the renewable energy contribution from the 140 m² Photovoltaic Solar panel (PV) array is providing the RER requirement.

Energy Type	HTG - Gas	HTG - Elec	HWS	CLG	AUX	LTG	PV	GAS	ELEC	TOTAL
Notional	147.16	0.00	55.98	1.51	2.61	63.08	0.00	223.45	139.78	363.23
Actual	25.4	0.0	26.5	0.0	2.6	17.5	-12.5	57.12	15.7	72.9
BER			A2						EPC	0.20



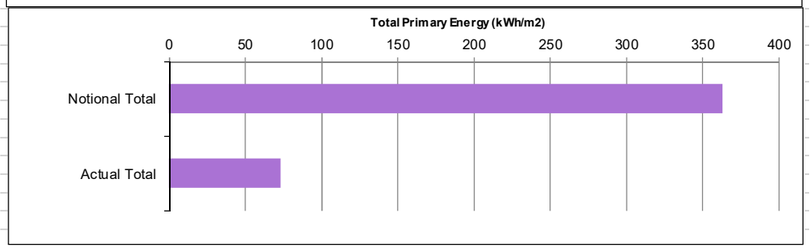


Figure 4.4 - Predicted BER Results for the Cultural Centre Building

EPC	0.86	Compliant
CPC	0.86	Compliant
RER	0.13	Compliant

Figure 4.5 - Cultural Centre Building - NZEB Compliance

IN2 ENGINEERING DESIGN PARTNERSHIP

CAFÉ, RETAIL AND RESTAURANT

5.1 SERVICES STRATEGY

The proposed servicing strategy for the Café and Restaurant buildings comprise of the following systems: -

- Heating will be provided to all areas with a highly efficient natural gas boiler and radiator system.
- Hot water is proposed to be heated indirectly from natural gas boiler with insulated storage calorifiers.
- It is envisaged that cooling will not be provided to the restaurant or café.
- A natural ventilation strategy is proposed for ventilation of café and restaurant areas.
- Constant air volume mechanical ventilation is proposed for kitchen and servery areas with dedicated exhaust fans
- Localised extract ventilation is proposed for toilets.
- Lighting will be provided by highly efficient LED luminaires with occupancy control and photocell dimming controls
- Renewable energy contribution will be provided by 150 m² photovoltaic (PV) solar panels.
- Retail Space to be provided as shell and core, with 15m² photovoltaic array to meet envisaged NZEB requirement in accordance with guidance within Part L 2017

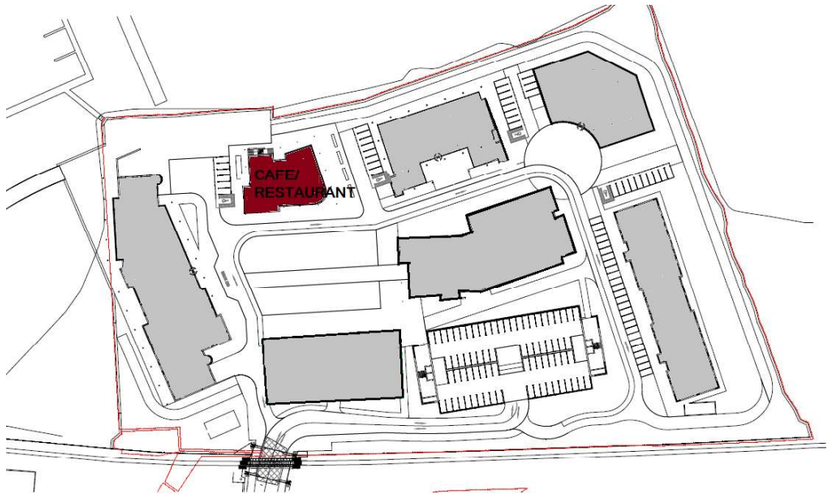


Figure 5.1 - Site Key Plan Indicating the Café, Retail and Restaurant Building Location

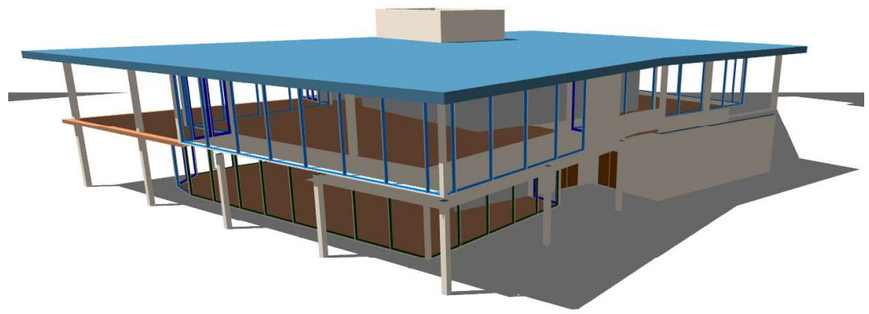


Figure 5.2 - Dynamic Simulation model of the Café, Retail and Restaurant Building

IN2
ENGINEERING DESIGN PARTNERSHIP

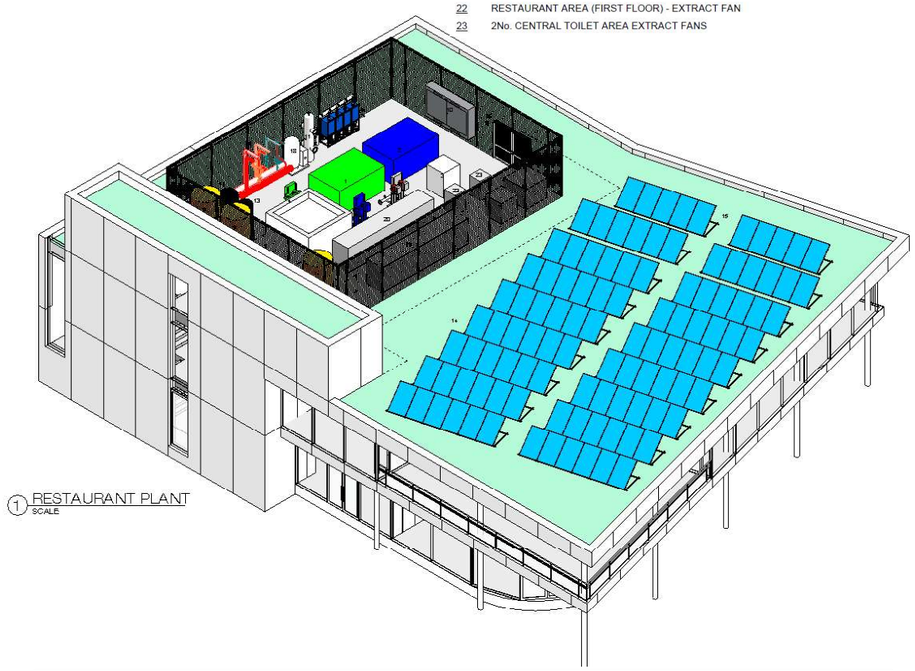
5.0 CAFÉ, RETAIL AND RESTAURANT (Cont'd)

5.1 SERVICES STRATEGY (Cont'd)

Figure 5.3 illustrates the proposed roof plant layout. The allocated plant space would be within a 3 m high enclosed space with louvered walls and comprises of:

- Hot, cold and mains water storage and booster sets
- Natural Gas Boiler plant and ancillaries
- Air Handling Units
- Centralised extract fans
- Photovoltaic (PV) Panels (external)

PLANT LEGEND	
1	RAINWATER STORAGE (RWS) TANK - 9,000L
2	COLD WATER STORAGE (CWS) TANK - 9,000L
3	MAINS WATER BREAK TANK (MWBT) TANK - 1,500L
4	RAINWATER DUTY/STANDBY BOOSTER PUMP
5	COLD WATER DUTY/STANDBY BOOSTER PUMP
6	MAINS WATER BOOSTER PUMP
7	4No. 40kW CASCADE BOILERS
8	HEATING CIRCUITS HEADER - PRIMARY PUMPS
9	3No. 3.5m³ HOT WATER STORAGE
10	MCC PANEL
11	LOW LOSS HEADER
12	EXPANSION VESSEL - 1,000mmø
13	EXPANSION VESSEL - 800mmø
14	150m² PV PANEL ARRAY - RESTAURANT
15	15m² PV PANEL ARRAY - RETAIL
16	GAS DETECTION PANEL
17	FULLY LOUVRE'D ACCESS DOORS, MINIMUM 1.0m² FREE AREA FOR COMBUSTION/PLANTROOM AND VENTILATION AIR
18	PRESSURISATION UNIT
19	CAFÉ AREA (GROUND FLOOR) - AIR HANDLING UNIT
20	RESTAURANT AREA (FIRST FLOOR) - AIR HANDLING UNIT
21	CAFÉ AREA (GROUND FLOOR) - EXTRACT FAN
22	RESTAURANT AREA (FIRST FLOOR) - EXTRACT FAN
23	2No. CENTRAL TOILET AREA EXTRACT FANS



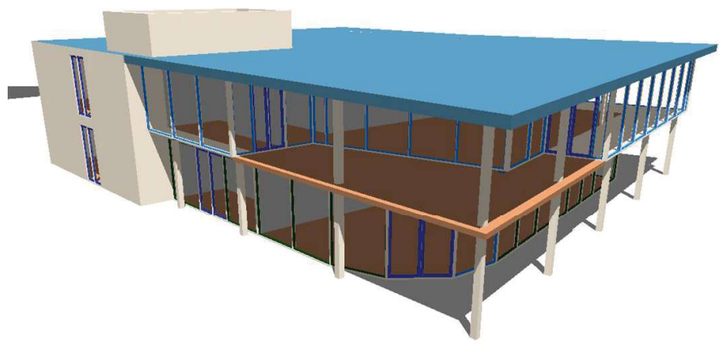
1 RESTAURANT PLANT
SCALE

Figure 5.3 - Proposed Café, Retail and Restaurant Roof Level Plant Area

IN2 ENGINEERING DESIGN PARTNERSHIP

5.0 CAFÉ / RETAIL AND RESTAURANT (Cont'd)

5.2 BUILDING AND HVAC ASSUMPTIONS



Building Fabric

Element	U-Value W/m²K	General Fabric Details	
External Walls	0.18	Air Permeability m³/hr. m²	3
Roof	0.15	Glazing g-Value General	39%
Floor	0.15	Glazing Light Transmittance	79%
Exposed Floor	0.15		
Glazing – (Centrepane)	1.1		

Please Note: - Assumed U-Values to be achieved inclusive of thermal bridging

Heating System

Heating to All Areas (Radiators)			
Fuel	Natural Gas	Boiler Seasonal Efficiency	95%
Heating Water Pumps	Variable Speed	Distribution System Efficiency	95%
Heating to Other Spaces			
Fuel	None	Boiler Seasonal Efficiency	
Heating Water Pumps		Distribution System Efficiency	

Hot Water System

Fuel	Natural Gas	Seasonal Efficiency	95%
		Distribution System Efficiency	95%

Cooling

Fuel	NA	Chiller SEER	NA
Chilled Water Pumps	NA	Distribution System Efficiency	NA

HVAC System

Kitchen and Servery		
Mechanical Ventilation Supply and Extract (MV)	Central Supply Air Fan Specific Fan Power (W/l.s)	1.2
	Central Extract Fan Specific Fan Power (W/l.s)	0.5
	Heat Recovery Efficiency None	NA
	Terminal Fan Specific Fan Power (W/l.s)	0.4
	Terminal Fan Air Changes Per Hour (ACH)	8
	CO_2 Sensor	
Café, Retail, Restaurant and Backroom Areas		
Natural Ventilation) (NV)		
Main Toilets Kitchen and Servery		
Constant Air Volume (CAV) Mechanical Ventilation	Supply Air Fan Specific Fan Power (W/l.s)	1.2
	Extract Fan Specific Fan Power (W/l.s)	0.5
Stores, Small Toilets		
Extract Ventilation (Ex)	Extract Fan Specific Fan Power (W/l.s)	0.5

Lighting

Space Type	Presence Detection Switching	Daylight Control	Lighting Power (W/m² per 100 Lux)
Back of House	Manual on / Auto off	Photocell Dimming (as required)	1.5
Toilets	Auto on / Auto off	NA	1.5
Bedrooms	Manual on / Auto off	NA	1.5
Public Areas	Manual on / Auto off	Photocell Dimming	1.5

Controls

Automatic monitoring and targeting with alarms for out of range values	Yes
Power factor correction to achieve a whole building power factor of at least	>95%

Renewable Technology

System		Photovoltaic Solar Panels (PV)	
Unit	Approximate Area of PV (m²)	Renewable Yield	
		MWh/ann	kWh/m².ann
Café / Restaurant	150	18.0	15.7
Retail Unit	15	1.5	21.0

IN2 ENGINEERING DESIGN PARTNERSHIP

5.0 CAFÉ, RETAIL AND RESTAURANT (Cont'd)

5.3 BER and NZEB RESULTS

Figure 5.4 indicates how an A2 building energy rating was determined for the proposed Café and Restaurant building design, for which the following may be noted:

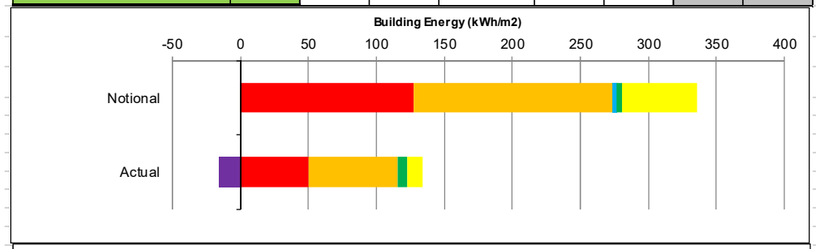
- The improved building fabric performance significantly reduces Heating Energy demand.
- The use of the high efficiency natural gas boiler plant was predicted to provide a further reduction to building energy demand for space and water heating.
- The improved efficiency of Lighting combined with improved lighting control has significantly reduced the energy demand for lighting.
- The renewable contribution from the Photovoltaic solar panels (PV) was predicted to provide the RER requirement further reducing the overall energy demand.
- The overall energy improvement for the building was determined to achieve a reduction of 71% below Notional benchmark, which equates to an A2 BER rating as indicated.

NZEB analysis was undertaken for the building with Part L Compliance determined as illustrated in Figure 5.5.

-

For this project the renewable energy contribution from Photovoltaic Solar panel (PV) array is providing the RER requirement, with150m²/ 15m² array sizes for Restaurant/ Café and Retail respectively.

Energy Type	HTG - Gas	HTG - Elec	HWS	CLG	AUX	LTG	PV	GAS	ELEC	TOTAL
Notional	127.3		146.1	3.6	3.5	55.4	0.0	300.7	168.6	469.2
Actual	50.3		65.7	0.0	7.2	11.2	-15.7	127.6	7.3	134.9
BER			A2						EPC	0.29



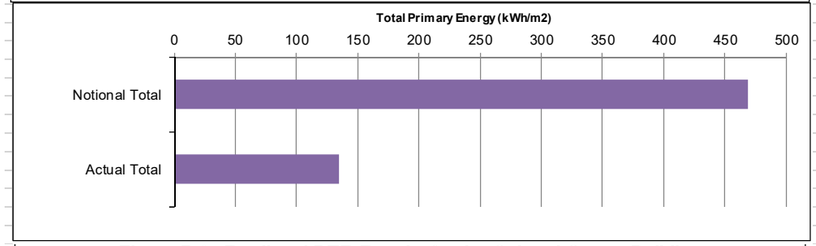


Figure 5.4 - Predicted BER Results for the Cultural Centre Building

Results		
EPC	0.88	Compliant
CPC	0.88	Compliant
RER	0.19	Compliant

Figure 5.5 - Café, Retail and Restaurant Building - NZEB Compliance

IN2 ENGINEERING DESIGN PARTNERSHIP

6.0 OFFICE BLOCKS A, B AND C

6.1 SERVICES STRATEGY

The proposed servicing strategy for the Office buildings comprise of the following systems: -

- Heating will be provided to office areas with 4-pipe fan coil units with a condensing natural gas boiler and radiator system to ancillary areas.
- Hot water is proposed to be heated by a highly efficient natural gas boiler and insulated storage system
- Cooling will be provided by air cooled chillers.
- Ventilation will be provided to all office areas by mechanical ventilation with heat recovery using fan coil units for temperature control.
- Constant air volume mechanical ventilation is proposed for toilets.
- Localised individual extract will be provided to small individual toilets and storage areas.
- Natural ventilation will be used to ventilate core areas.
- Lighting will be provided by high efficiency LED luminaires with occupancy control and photocell dimming controls
- Renewable energy contribution will be provided by Photovoltaic (PV) solar panels ranging between 100 – 120m² for each of the three office blocks.

Plant space allocation has been provided at both ground floor and at roof level as indicated in figures 6.3 and 6.4. This space allocation has been based on providing a 4-pipe Fancoil Unit HVAC solution for the offices. However, the offices have also been designed to ensure they could ensure adequate comfort based on a naturally ventilated strategy. This strategy would utilise a combination of the narrow plan building configuration, façade performance (external shading and solar glazing) in conjunction with ventilation opening sections (combined of manual and motorised) integrated in the façade design. Therefore, the offices have been designed to enable full flexibility of environmental strategy; either to be air conditioned (4-pipe Fancoil units) or naturally ventilated: the latter of which would obviate the requirement for plant area at ground floor level (circa 100m² lettable area).

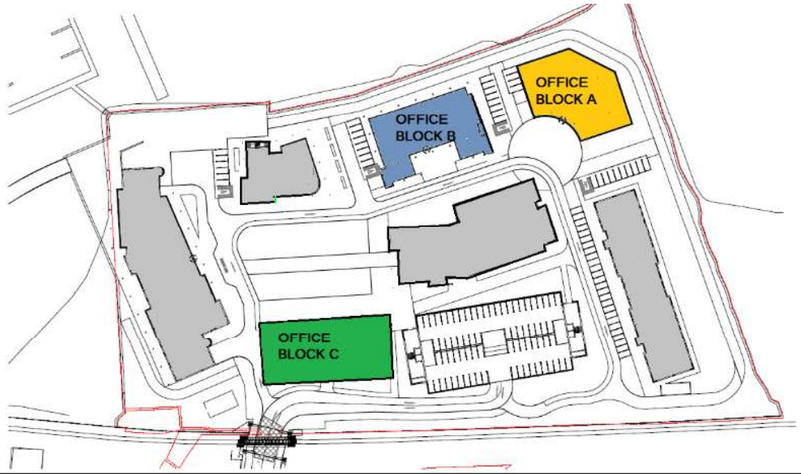


Figure 6.1 - Site Key Plan Indicating the Office Building Locations

Figure 6.2 - Dynamic Simulation model of Office Building A

IN2
ENGINEERING DESIGN PARTNERSHIP

6.0 OFFICE BLOCKS A, B AND C (Cont'd)

6.1 SERVICES STRATEGY

The plant at ground level is based on a 4-pipe Fancoil Unit option and comprises of the following: -

- Hot, cold and mains water storage and booster sets
- Natural Gas Boiler plant and ancillaries

Figure 6.3 illustrates the proposed layout.

Plant at roof comprises of: -

- Air handling units
- Chillers Units
- Centralised extract fans
- Photo Voltaic (PV) Panel Array (external)

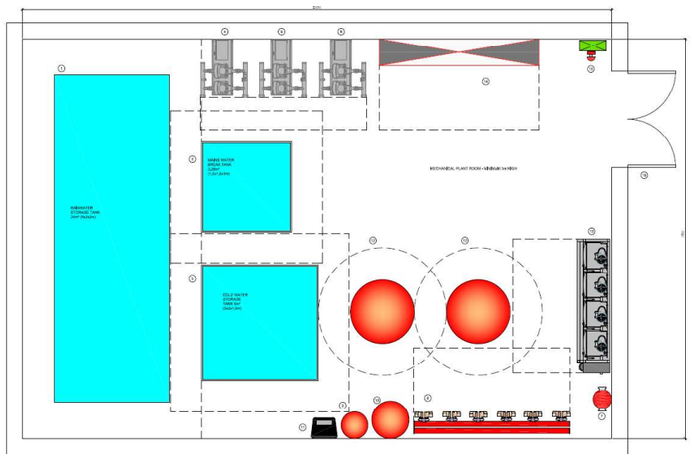


Figure 6.3 - Typical Office Building Ground Floor Plant Area

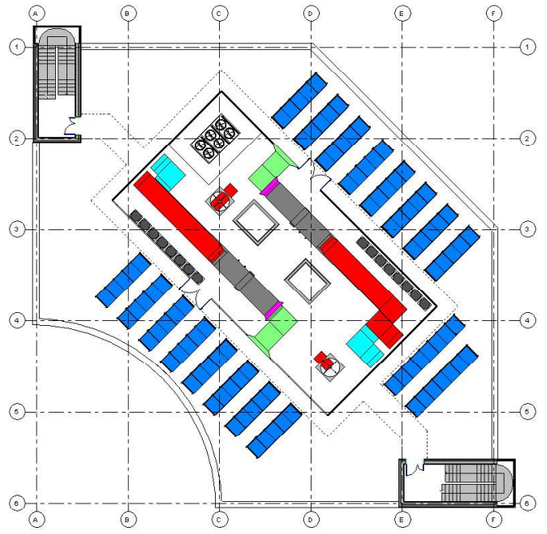


Figure 6.4 - Office Building A Roof Level Plant Compound

IN2
ENGINEERING DESIGN PARTNERSHIP

6.0 OFFICE BLOCKS A, B AND C (Cont'd)

6.1 SERVICES STRATEGY

Figure 6.4 to 6.6 illustrate the proposed roof plant layouts for each office building. The proposed plant compounds are entirely open and consist of 3m high louvred screening enclosing all plant items.
The Photovoltaic (PV) array will be located on each roof outside the compound.

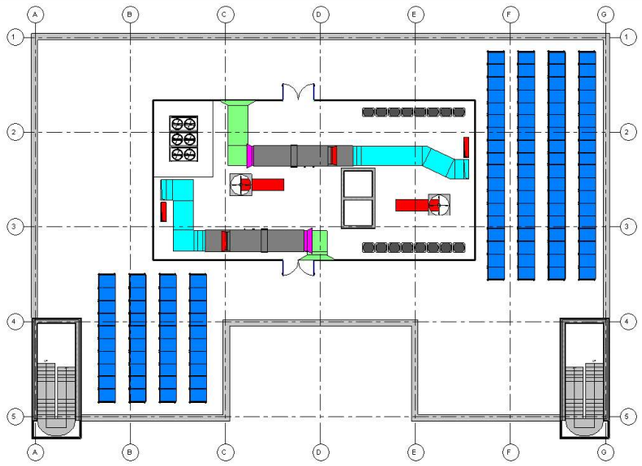


Figure 6.5 - Office Building B Roof Level Plant Compound

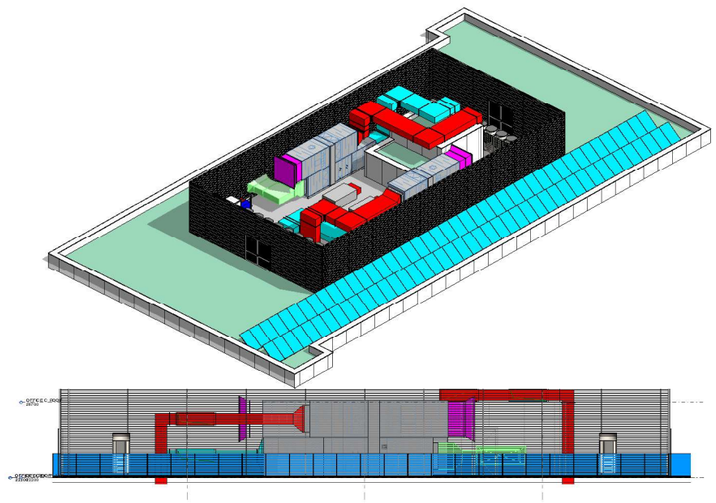
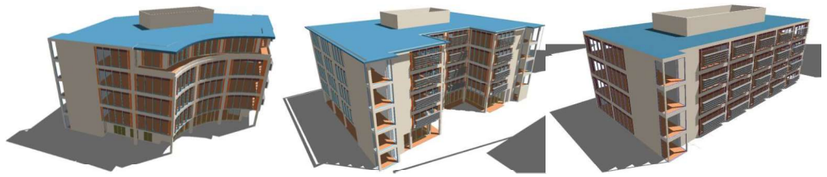


Figure 6.6 - Office Building C Roof Level Plant Compound

IN2 ENGINEERING DESIGN PARTNERSHIP

6.0 OFFICE BLOCKS A, B AND C (Cont'd)

6.2 BUILDING AND HVAC ASSUMPTIONS



Building Fabric Option

Element	U-Value W/m²K	General Fabric Details	
External Walls	0.18	Air Permeability m³/hr m²	3
Roof	0.15	Glazing g-Value General	39%
Floor	0.15	Glazing Light Transmittance	79%
Exposed Floor	0.15	External Shading to South and West	
Glazing - (Centrepane)	1.1	5 No. fixed horizontal blades,0.55 m deep, between 1.05 and 2.45 above floor level	

Please Note: - Assumed U-Values to be achieved inclusive of thermal bridging

Heating System

Heating to All Areas (Radiators)			
Fuel	Natural Gas	Boiler Seasonal Efficiency	95%
Heating Water Pumps	Variable Speed	Distribution System Efficiency	95%
Heating to Other Spaces			
Fuel	None	Boiler Seasonal Efficiency	
Heating Water Pumps		Distribution System Efficiency	

Hot Water System

Fuel	Natural Gas	Seasonal Efficiency	95%
		Distribution System Efficiency	95%

Cooling

Fuel	Electricity	Chiller SEER	300%
Chilled Water Pumps	Variable	Distribution System Efficiency	95%

HVAC System

Offices		
Fan Coil Units and Cooling (FCU + C)	Supply Air Fan Specific Fan Power (W/l.s)	1.3
	Extract Fan Specific Fan Power (W/l.s)	0.5
	Heat Recovery Efficiency Plate Heat Exchanger	70%
	Terminal Fan Specific Fan Power (W/l.s)	0.3
	Terminal Fan Air Changes Per Hour (ACH)	8
	CO_2 Sensor	
Circulation Areas		
Natural Ventilation) (NV)		
Main Toilets		
Constant Air Volume (CAV) Mechanical Ventilation	Supply Air Fan Specific Fan Power (W/l.s)	1.2
	Extract Fan Specific Fan Power (W/l.s)	0.5
Stores, Small Toilets		
Extract Ventilation (Ex)	Extract Fan Specific Fan Power (W/l.s)	0.5

Lighting

Space Type	Presence Detection Switching	Daylight Control	Lighting Power (W/m² per 100 Lux)
Back of House	Manual on / Auto off	Photocell Dimming (as required)	1.5
Toilets	Auto on / Auto off	NA	1.5
Bedrooms	Manual on / Auto off	NA	1.5
Public Areas	Manual on / Auto off	Photocell Dimming	1.5

Controls

Automatic monitoring and targeting with alarms for out of range values	Yes
Power factor correction to achieve a whole building power factor of at least	>95%

Renewable Technology

System		Photovoltaic Solar Panels (PV)	
Unit	Approximate Area of PV (m²)	Renewable Yield	
		MWh/ann.	kWh/m².ann
Office Block A	110	13.2	2.54
Office Block B	120	14.4	2.48
Office Block C	100	11.9	2.5

IN2 ENGINEERING DESIGN PARTNERSHIP

6.0 OFFICE BLOCKS A, B AND C (Cont'd)

6.3 BER and NZEB RESULTS

Figure 6.7 indicates how an A3 building energy rating was determined for the proposed Office building designs, for which the following may be noted:

- The improved building fabric performance significantly reduces Heating Energy demand.
- The use of the high efficiency natural gas boiler plant was predicted to provide a further reduction to building energy demand for space and water heating.
- The improved efficiency of lighting combined with improved lighting control has significantly reduced the energy demand for lighting.
- The renewable contribution from the photovoltaic solar panels (PV) was predicted to provide the RER requirement further reducing the overall energy demand.
- The overall energy improvement for the building was determined to achieve a reduction of 66% below Notional benchmark, which equates to an A3 BER rating as indicated.

NZEB analysis was undertaken for the building with Part L Compliance determined as illustrated in Figure 6.8.

For each office building the renewable energy contribution from Photovoltaic Solar panel (PV) array is providing the RER requirement, ranging between 100 and 120m² array sizes for each office building.

Energy Type	HTG - Gas	HWS	CLG	AUX	LTG	PV	GAS	ELEC	TOTAL
Notional	28.3	8.3	5.9	1.8	48.1	0.0	40.3	150.6	190.9
Actual	12.8	3.9	3.8	9.3	7.4	-3.5	18.4	45.8	64.2
BER		A3						EPC	0.34

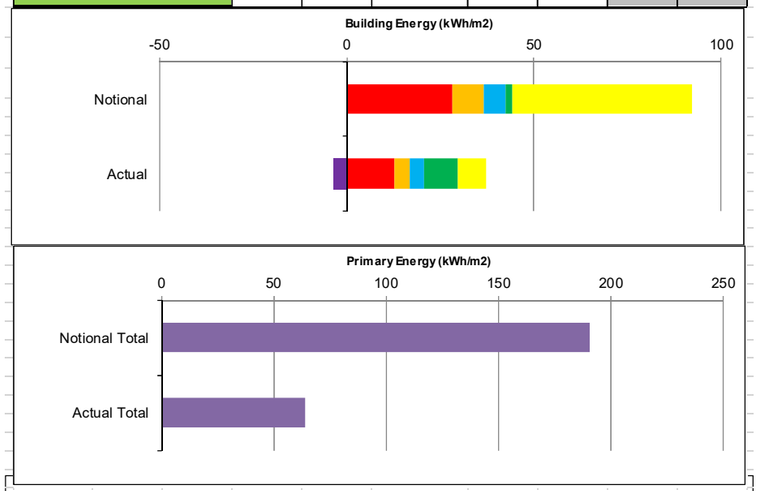


Figure 6.7 - Predicted BER Results for Office Buildings A, B and C

Results		
EPC	0.76	Compliant
CPC	0.75	Compliant
RER	0.12	Compliant

Figure 6.8 - Office Blocks A, B and C - NZEB Compliance

IN2
ENGINEERING DESIGN PARTNERSHIP

7.0 RESIDENTIAL APARTMENT BUILDING

7.1 SERVICES STRATEGY

The proposed low energy and servicing strategy for the Apartment building comprise of the following systems: -

- Improved Building Fabric and glazing Thermal Transmittance (U-Value) performance
- Reduced Air permeability
- Thermal Bridging to Accredited Construction Details (ACD)
- Heat Recovery Ventilation (HRV) to each apartment (individual system)
- Natural Ventilation to Landlord areas
- Centralised heating and hot water provided by Air Source Heat Pumps (ASHP) with back-up natural gas fired boilers, via heat interface units HIU's)
- Air Source heat pumps predicted to provide 55% of annual heating and hot water demand
- 100% Low Energy Lighting
- Renewable technologies – Air Source Heat Pumps for heating and hot water supplemented with landlord photovoltaic (PV) Array instillation, with 1 No. PV panel per apartment (60 No. Total / 100m² approx.)

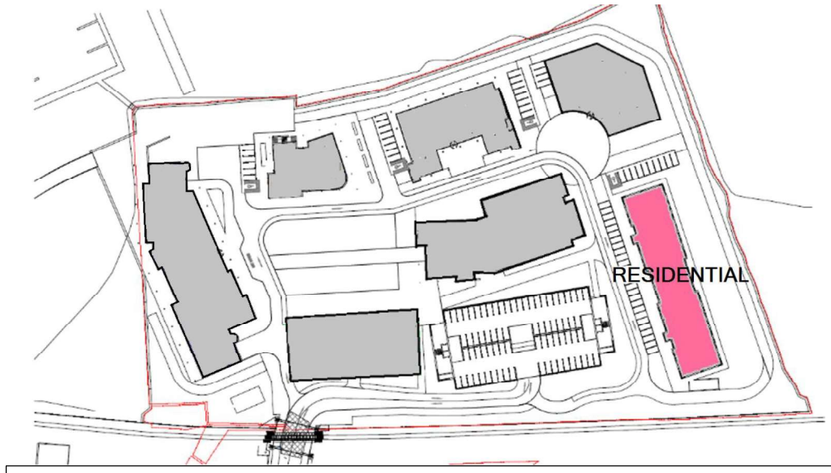


Figure 7.1 - Site Key Plan Indicating the Residential Building Locations

Figure 7.2 - Image of the Residential Building

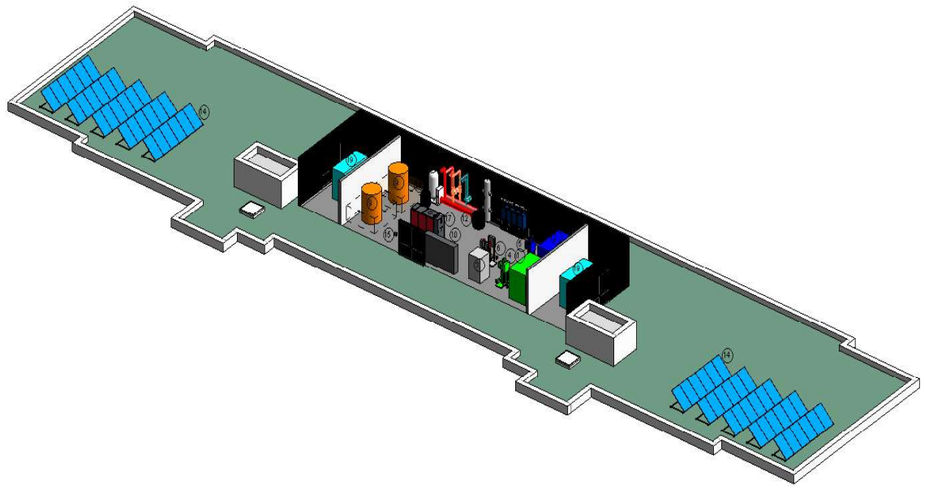
IN2
ENGINEERING DESIGN PARTNERSHIP

7.0 RESIDENTIAL APARTMENT BUILDING

7.1 SERVICES STRATEGY

Figure 7.3 illustrates the proposed roof plant layout. The proposed plant compound is entirely open and consist of 3m high louvred screening enclosing all plant items and comprises of: -

- Cold and mains water storage and booster sets
- Natural gas boiler plant and ancillaries
- Air handling units
- Air source heat pumps
- The photovoltaic panels (PV) will be located on the roof outside the compound.



1 RAINWATER STORAGE (RWS) TANK - 7,500L
2 COLD WATER STORAGE (CWS) TANK - 7,500L
3 MAINS WATER BREAK TANK (MWBT) TANK - 1,500L
4 RAINWATER DUTY/STANDBY BOOSTER PUMP
5 COLD WATER DUTY/STANDBY BOOSTER PUMP
6 MAINS WATER BOOSTER PUMP
7 4No. 40kW CASCADE BOILERS
8 HEATING CIRCUITS HEADER - PRIMARY PUMPS
9 2No. 4m³ HOT WATER STORAGE
10 MCC PANEL
11 LOW LOSS HEADER
12 EXPANSION VESSEL - 1,000mmø
13 EXPANSION VESSEL - 800mmø
14 96m² PV PANEL ARRAY
15 GAS DETECTION PANEL
16 FULLY LOUVRE'D ACCESS DOORS, MINIMUM 1.0m² FREE AREA FOR COMBUSTION/PLANTROOM AND VENTILATION AIR
17 CHP UNIT
EXTERNAL DIMENSIONS: 3m(L) X 1.2m(W) X 2m(H)
18 PRESSURISATION UNIT
19 2No. 50kW AIR SOURCE HEAT PUMPS - EXTERNAL DIMENSIONS: 3m(L) X 1.2m(W) X 2m(H) EACH TO BE CONTAINED WITHIN LOUVRE'D ENCLOSURE

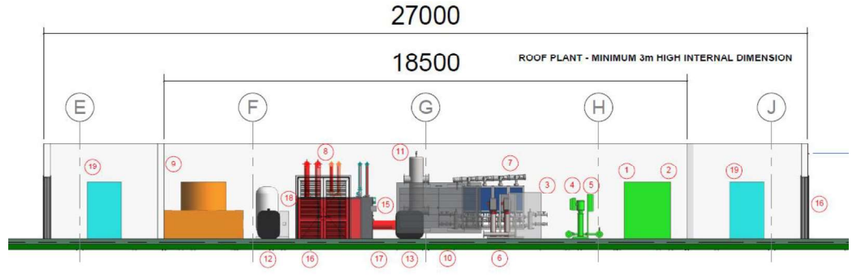


Figure 7.3 - Apartment Building Roof Level Plant Compound

IN2 ENGINEERING DESIGN PARTNERSHIP

7.0 RESIDENTIAL APARTMENT BUILDING (Cont'd)

7.2 BUILDING AND HVAC ASSUMPTIONS

Building Fabric Option

Element	U-Value W/m²K	General Fabric Details	
External Walls	0.15	Air Permeability m³/hr m²	2
Roof	0.15	Glazing g-Value General	72%
Floor	0.12	Glazing Light Transmittance	70%
Exposed Floor	0.12		
Glazing - (Centrepane)	1.2		
Thermal Bridging	0.08		

Centralised Heating System

Heating to Apartment air source heat pumps with back up natural gas boilers			
Fuel	Electric	ASHP Seasonal Energy Efficiency	315%
Heating Water Pumps	N/A	Distribution System Efficiency	N/A
Heating to Other Spaces (Landlord)			
Fuel	Natural Gas	Boiler Seasonal Efficiency	95%
Heating Water Pumps	Variable Speed	Distribution System Efficiency	95%

Centralised Hot Water System
Air Source Heat Pumps with Back up Natural Gas Boilers

Fuel	Natural Gas	Boiler Seasonal Efficiency	315%
	N/A	Distribution System Efficiency	95%
Centralised Hot Water Energy Split %			
Air Source Heat Pump	55%	Natural Gas Boiler	45%

Ventilation System

Apartments		
Local Heat Recovery Ventilation (HRV) Units	Supply Air Fan Specific Fan Power (W/l.s)	0.25
	Extract Fan Specific Fan Power (W/l.s)	0.25
	Heat Recovery Efficiency — Plate Heat Exchanger	80%
Circulation Areas		
Natural Ventilation) (NV)		

Lighting

100% Low Energy	All Areas

Controls

Time and Temperature Control	Yes

Renewable Technology

System	Photovoltaic Solar Panels (PV)		
Residential	Approximate Area of PV (m²)	Renewable Yield	
		MWh/ann.	kWh/m².ann
Apartment Building	100	12	1.92
`Each Apartment	1.6	0.2	1.92

IN2 ENGINEERING DESIGN PARTNERSHIP

7.0 RESIDENTIAL APARTMENT BUILDING (Cont'd)

7.3 BER and NZEB RESULTS

The apartments were assessed for BER and NZEB/Part L 2017 Dwellings compliance utilising Dwelling Energy Assessment Procedure (DEAP) software.

Figure 7.3 indicates how an A2 building energy rating was determined for the proposed apartment building design, for which the following may be noted:

- Improvement to building fabric and glazing thermal transmittance, thermal bridging and air permeability reduce heating energy demand.
- Use of Air Source Heat Pumps (ASHP) significantly reduces heating and hot water energy consumption due to high seasonal efficiency of performance
- Provision of centralised heating systems provides efficiency of performance, reducing energy consumption.
- ASHP supplemented by Landlord 100m² PV array equivalent to 1 No. panel per apartment, to ensure reduction in Primary energy (70% below Part L 2005) and renewable contribution (10kWh/m² thermal equivalent) in accordance with Part L 2017 – Dwellings.

The overall energy improvement for the building was determined to achieve an A2 BER Rating and is NZEB /Part L Compliant determined as illustrated in Figure 7.3.

For each apartment the renewable energy contribution from photovoltaic Solar panel (PV) array of approximately 100m², combined with the renewable energy provided by the Air source heat pump is providing the RER requirement.

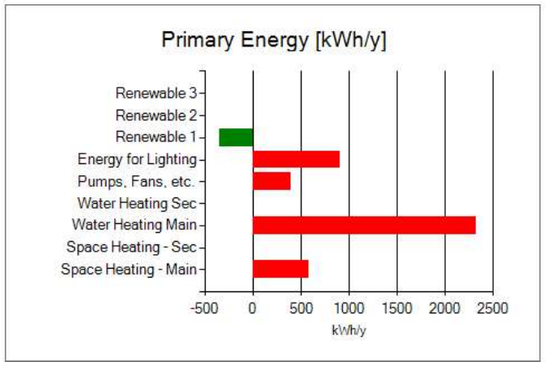
Conformity with primary energy use and CO2 emissions limitation requirement

	Performance coefficient			
CPC	0.280	MPCPC	0.46	✔
EPC	0.298	MPEPC	0.4	✔

Conformity with renewable energy technologies requirement - group schemes

	Total contribution kWh/y	Part L renewables contribution kWh/m²y
Renewable main heat source	0	0
Renewable heat source 2	287.21	2.93
Renewable heat source 3	0	0
Group solar water system	0	0
Individual solar water system	0	0
Secondary space heating system - renewable	0	0
Contribution from CHP	0	0
PV	170.00	1.73
Air SourceHeat Pump	278.94	2.85
Not Entered	0.00	0
Total thermal	566.15	5.78
Total electrical	170.00	1.73
Total thermal equivalent	991.15	10.11

✔



Results

Energy Rating: **A2**

Energy Value: **39.45** [kWh/m²/yr]

CO_2 Emissions Indicator: **7.55** [kgCO_2 /m²/yr]

Figure 7.3 - Apartment Building A2 BER Rating and NZEB Compliance

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ENGINEERING DESIGN PARTNERSHIP

8.0 LEED SUSTAINABILITY

Leadership in Energy and Environmental Design (LEED) is a rating system devised by the United States Green Building Council (USGBC) to evaluate the environmental performance of buildings and encourage market transformation towards sustainable design. A project then receives one of four LEED ratings levels based on credits achieving an allocated number of points: **Certified**: 40 to 49 points, **Silver**: 50 to 59 points, **Gold**: 60 to 79 points, **Platinum**: 80 to 110.

The credit categories and their weightings are shown in Fig. 8.1. The single largest point allocation relates to Energy and Atmosphere (33 credits equating to 30%) including 18 credits (maximum) available for Optimize Energy Performance as noted in section 3.0 above. The environmental strategy and services design for the office accommodation on Trinity Wharf is predicted to achieve all 18 of these points.

The aspiration would be to achieve a rating of **LEED Gold** for the Trinity Wharf scheme. It should be noted that achieving LEED Gold on a project requires an integrated approach from the entire design team, stakeholders and contracting team requiring cognisance and commitment from the outset of the project and is not something that can be achieved by the design team in isolation.

In order to assist understanding around the assessment , a **"Road Map to LEED Gold"** document set should be produced in tandem with the tender documentation to give direction on how to fulfil the LEED Gold goal through the construction and handover project stages.

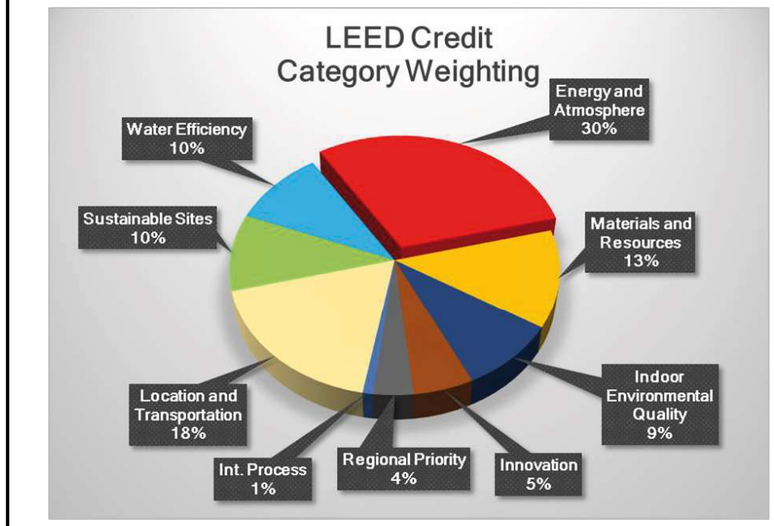

Fig. 8.1 - LEED Credit Make-up

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8.0 LEED SUSTAINABILITY (Cont'd)

LEED and The Design

An initial design workshop, or LEED "charrette", was carried out to agree potential credits to be targeted to ensure the target LEED Gold rating could be achieved. Fig 8.2 illustrates the target credit breakdown for achieving this Gold Rating. Credits were divided into 3 categories, readily achievable, potentially achievable, and not achievable.

The charrette identified a target of 62 points as readily achievable and thus the Gold rating was deemed to be a viable target to realise. The design team will be integrating these LEED credit requirements into the building through the design process.

There is risk associated with missing targeted credits and a "buffer" of only 2 credits would not be considered sufficient. Therefore, it would be important for the design team to identify other credits that have not been currently considered.

Road Map to LEED Gold

The road map will provide direction to achieving these 62 LEED points, achieving a low-level LEED Gold score.

Points can only be verified after prescriptive credit documentation has been provided. So, whilst it is envisioned that the pre-tender stage documents will include compliant design to allow the project to achieve circa 53 points, the remainder (approximately 10) required to achieve targeted Gold rating will require implementation and verification through construction / handover stages and these will be identified within the "Road Map to LEED Gold" documentation. This documentation will also include confirmation on those credits achieved by end of pre-tender stage.

The current targeted score is 62 (achieved from 28 credits) and therefore in excess of minimum Gold rating requirement of 60 points. As project constraints may render some of these credits unachievable, further credits will be highlighted for potential targeting should they be required. This target score will be continuously updated as the project information is verified.

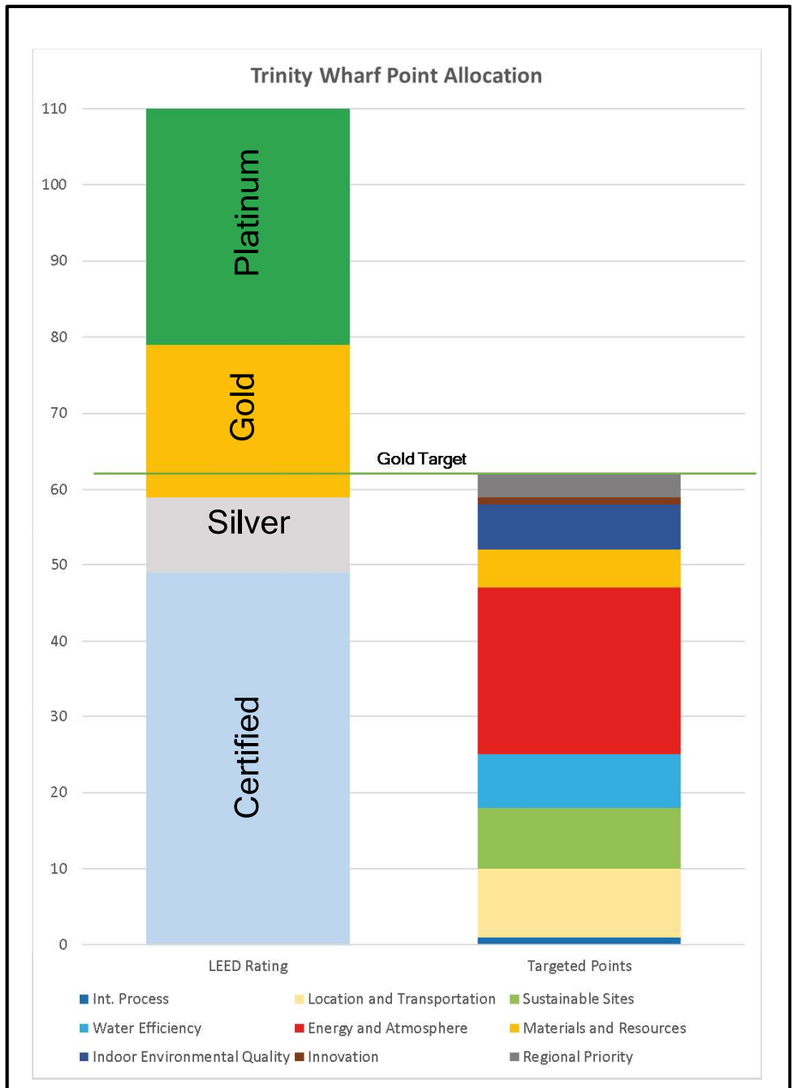

Fig. 8.2 - Trinity Wharf LEED Targeted Point Allocation

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ENGINEERING DESIGN PARTNERSHIP

8.0 LEED SUSTAINABILITY (Cont'd)

LEED and the Owner

The commitment to achieving LEED Gold extends to the building owner with certain credits requiring owner buy in. These credits requirements include:

Prerequisites

- Building-level water metering sharing commitment.
- Production of owner's project requirement document for fundamental commissioning.
- Building-level energy metering commitment.

The "Road Map to LEED Gold" documentation will clearly identify the end user / owner commitment requirements through construction and handover stages should the LEED Gold rating be pursued.

LEED v4 for BD+C: Core and Shell
Project Checklist

Y	?	N			
1			Credit	Integrative Process	1
9	2	9		**Location and Transportation**	20
2			Credit	Sensitive Land Protection	2
3			Credit	High Priority Site	3
2	2	2	Credit	Surrounding Density and Diverse Uses	6
		6	Credit	Access to Quality Transit	6
		1	Credit	Bicycle Facilities	1
1			Credit	Reduced Parking Footprint	1
1			Credit	Green Vehicles	1
8	2	1		**Sustainable Sites**	11
Y			Prereq	Construction Activity Pollution Prevention	Required
1			Credit	Site Assessment	1
	2		Credit	Site Development - Protect or Restore Habitat	2
1			Credit	Open Space	1
2		1	Credit	Rainwater Management	3
2			Credit	Heat Island Reduction	2
1			Credit	Light Pollution Reduction	1
1			Credit	Tenant Design and Construction Guidelines	1
7	2	2		**Water Efficiency**	11
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
2			Credit	Outdoor Water Use Reduction	2
4	2		Credit	Indoor Water Use Reduction	6
		2	Credit	Cooling Tower Water Use	2
1			Credit	Water Metering	1
22	1	10		**Energy and Atmosphere**	33
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
		6	Credit	Enhanced Commissioning	6
18			Credit	Optimize Energy Performance	18
1			Credit	Advanced Energy Metering	1
		2	Credit	Demand Response	2
3			Credit	Renewable Energy Production	3
	1		Credit	Enhanced Refrigerant Management	1
		2	Credit	Green Power and Carbon Offsets	2
5	6	3		**Materials and Resources**	14
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
	3	3	Credit	Building Life-Cycle Impact Reduction	6
2			Credit	Building Product Disclosure and Optimization - Environmental ProductDeclarations	2
1	1		Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
	2		Credit	Building Product Disclosure and Optimization - Material Ingredients	2
2			Credit	Construction and Demolition Waste Management	2
6	4	0		**Indoor Environmental Quality**	10
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
2			Credit	Enhanced Indoor Air Quality Strategies	2
	3		Credit	Low-Emitting Materials	3
1			Credit	Construction Indoor Air Quality Management Plan	1
3			Credit	Daylight	3
	1		Credit	Quality Views	1
1	5	0		**Innovation**	6
	5		Credit	Innovation	5
1			Credit	LEED Accredited Professional	1
3	0	1		**Regional Priority**	4
1			Credit	Green Vehicles	1
1			Credit	Rainwater management	1
1			Credit	Light Pollution Reduction	1
		1	Credit	Regional Priority: Specific Credit	1
62	23	25		**TOTALS** Possible Points:	110

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

Fig. 8.3 - Trinity Wharf LEED Targeted Credits