DUBLIN SCHOOL OF ARCHITECTURE
DT774 POSTGRADUATE CERTIFICATE IN DIGITAL ANALYSIS & ENERGY RETROFIT
Unit 8, St. Laurence's Terrace, Mullingar, Co. Westmeath - Brian Collentine C98036238

DEVELOPMENT:

The development is a social housing project strategically located in the heart of the vibrant town of Mullingar. The client is Westmeath County Council who will be the long-term owner of the development.

CLIENT OBJECTIVES:

The client had specific design objectives which required to be achieved as follows:

1. The client wished the development to comply with NZEB STANDARDS.
2. The client required LIMITED USER INTERACTION with systems as best as possible.
3. The client wished to incorporate an ARRAY OF NEW TECHNOLOGIES to trial new concepts for future social housing projects.
4. The client wished to use a TRADITIONAL FORM CONSTRUCTION.

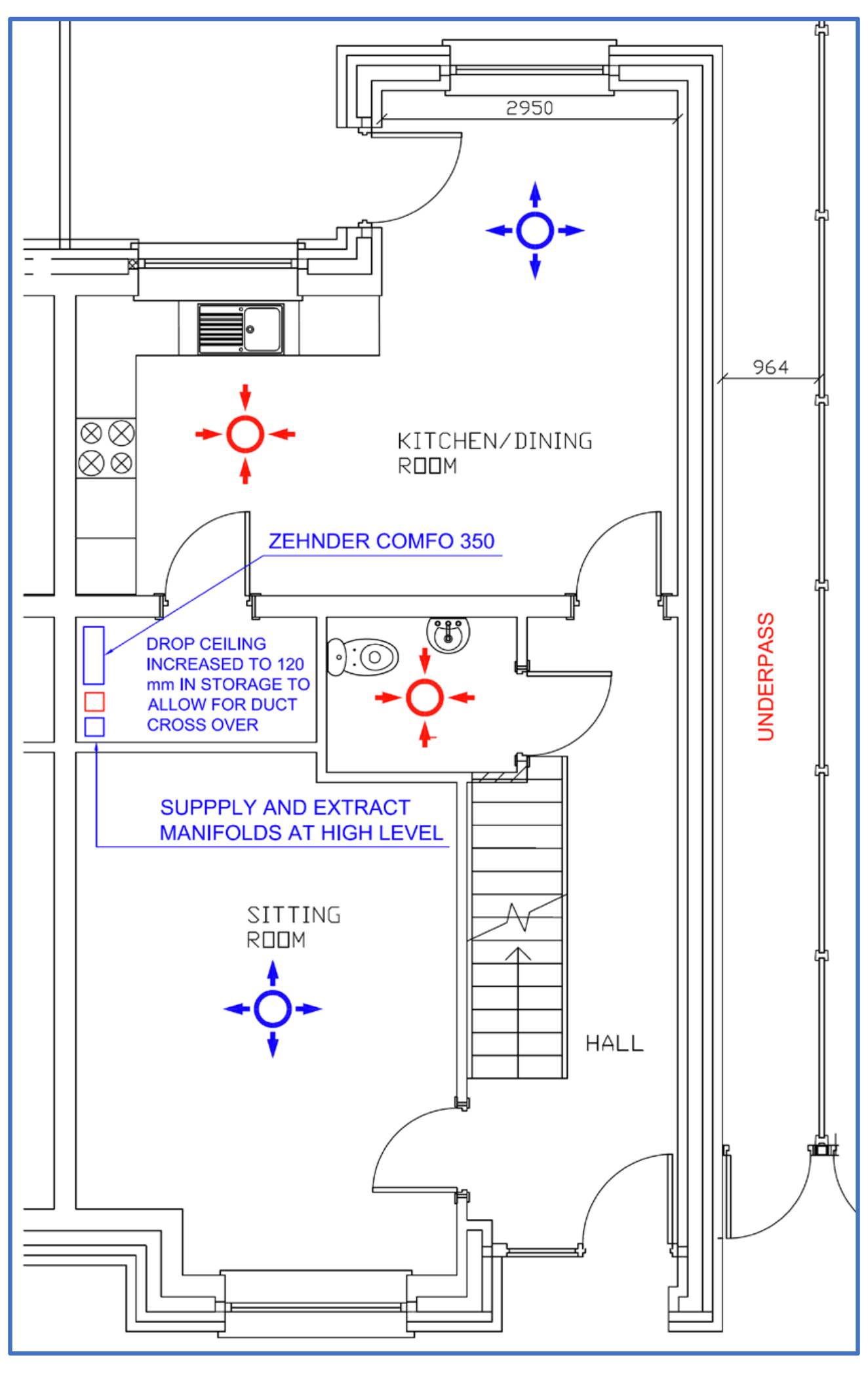
NZEB TARGET:
30 KWh/m2/yr with 35 KWh/m2.yr of on-site renewables

DESIGN APPROACH:

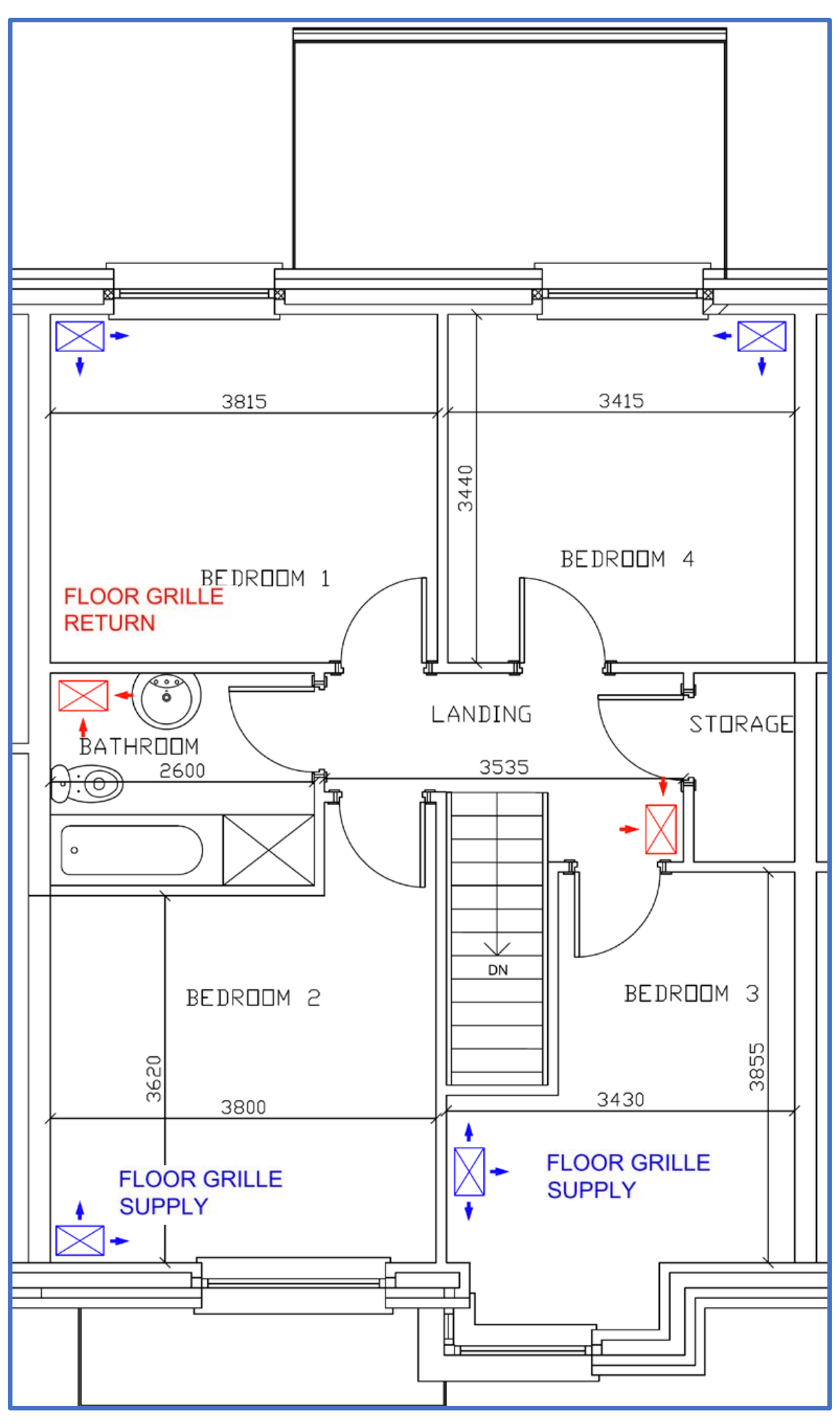
- STEP 1 – CONCEPT DESIGN
- STEP 2 – OUTLINE DESIGN
- STEP 3 – DETAILED DESIGN
- STEP 4 – SERVICES
- STEP 5 – COSTING
- STEP 6 – HPI INDEX
- STEP 7 – HYGROTHERMAL
- STEP 8 - OVERHEATING

SITE LAYOUT

MVHR SUPPLY
MVHR RETURN



GROUND (SCALE- 1:50)



FIRST (SCALE 1:50)

STEP 1 : PATH TO NZEB (CONCEPT DESIGNS OPTIONS)

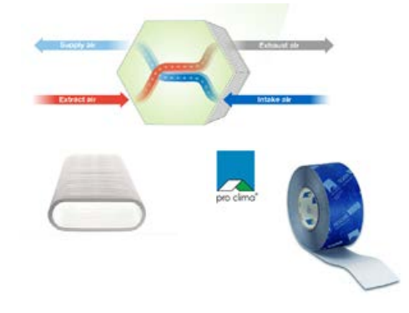
	Part L Compliance Options		NZEB Options				
Reference:	Part L - Option 1 (Gas Boiler)	Part L _ Option 2 (Heat Pump)	Option 3 - NZEB	Option 4 - NZEB	Option 5 - NZEB	Option 6 - NZEB	Option 7 - NZEB
Summary of Proposed Provision	Gas Boiler, Natural Ventilation, Triple Glazing, Calculated Thermal Bridging Calculated, Solar Water Heating	Heat Pump, Natural Ventilation, Double Glazing, Default Thermal Bridging(0.15)	Heat Pump, Natural Ventilation, Triple Glazing, Calculated Thermal Bridging(0.08[illegible]6); Solar Water Heating = 3.2 m2; PV (3.[illegible]8 m2 panel (2 no. [illegible]50 KWp)	Electricity , Triple Glazing, Calculated Thermal Bridging Calculated; Solar Water Heating; PV; MVHR - Zehnder; Enhanced U Values; Instantaneous Waste Heat Recovery;	Power Factor @ 1.8; Electricity , Triple Glazing, Calculated Thermal Bridging Calculated; Solar Water Heating ; MVHR - 204 x 60 rectangular duct; Enhanced U Values	Gas Boiler , Triple Glazing, Thermal Bridging Calculated; Solar Water Heating; MVHR - 204 x 60 rectangular duct; Enhanced U Values	Oil Boiler , Triple Glazing, Calculated Thermal Bridging Calculated; Solar Water Heating ;PV; MVHR - 204 x 60 rectangular duct; Enhanced U Values
Comments	Preferred Part L Compliance Selection	Preferred Part L Compliance Selection	Maximum of 3[illegible] kWh/m2 exceeded for this option.	Preferred NZEB selection based on cost optimal analysis	Reduced electricity factor in future will aid NZEB Design	Roof area not significant enough in area for this option for PV and Solar	Roof area not significant enough in area for this option for PV and Solar

1. TRADITIONAL FORM
2. ARRAY OF TECHNOLGIES
3. LIMITED USER INTERACTION

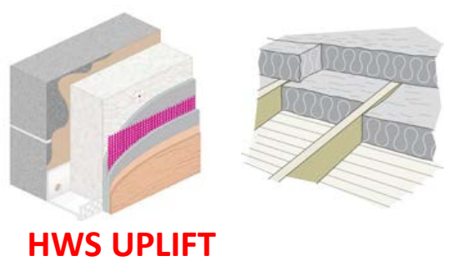
DESIGN DRIVER: OPTION 4 DELIVERED CLIENT OBJECTIVES 1-4

UPLIFTS

MECH. VENTILATION & AIR TIGHTNESS UPLIFT



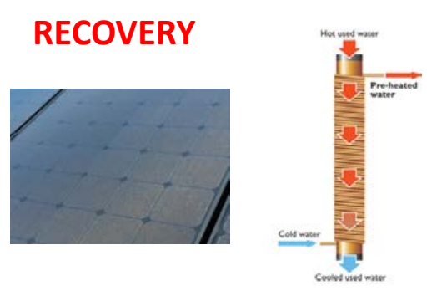
FABRIC UPLIFT
- EXTERNAL INSULATION
- IMPROVED THERMAL BRIDGE
- IMPROVED GROUND AND ROOF INSULATION



HWS UPLIFT
- ADDITIONAL SOLAR PANEL
- LARGER STORAGE VOLUME

IMPROVED SYSTEM EFFICIENCY

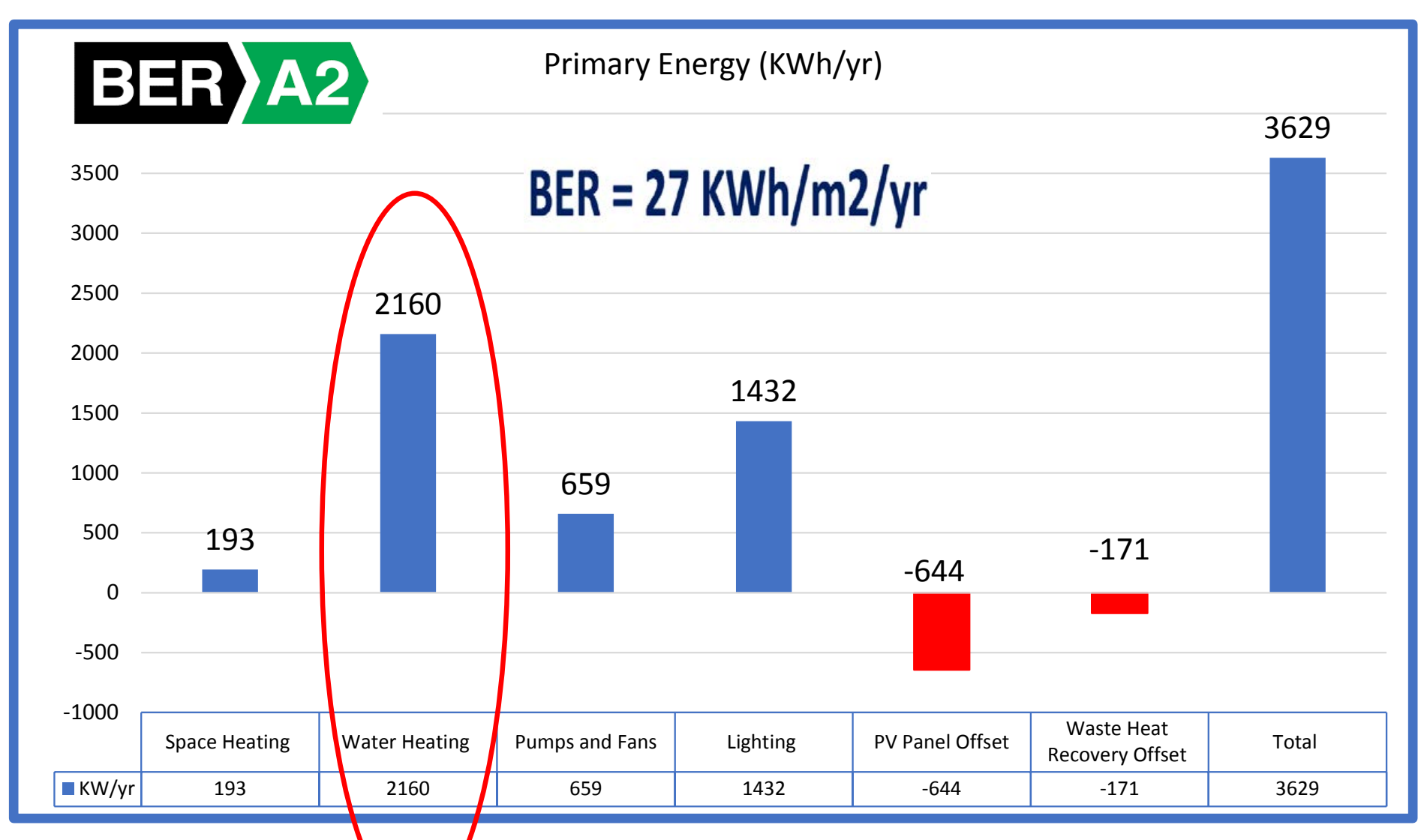
NEW TECHNOLOGIES
- PV PANELS
- INSTANTANEOUS WASTE WATER HEAT RECOVERY



STEP 2: OUTLINE SPECIFICATION (PART L AND NZEB)

Reference:	Part L - Option 1 (Gas Boiler)	Notes:	Option 4 - NZEB	Notes:
Dimensions				
Ground Floor Area (m^2)	63.06		66.63	
Ground Floor Height	2.45		2.44	
First Floor Area (m^2)	69.84		59.38	
First Floor Height	2.76	Average height calculated	2.70	
Living Area (m^2)	18.74	Living Room	126.01	
Total Floor Area (m^2)	132.90		20.10	
Living Area Percentage	0.14		15.95	
Ventilation				
Number of Chimneys	0	No Chimney	0	No Chimney
Number of Open Flues	0		0	
Number of Fans and Vents	3	Kitchen Extract; 2 bathroom extracts	1	Kitchen Extract Only
Draught Lobby	No		No	
Air Permeability Test (Q50)	3	Q50/20 = 0.15	1.5	Q50/20 = 0.075
Ventilation Method	Natural Ventilation	Natural ventilation with adjustable closing	MVHR	n = 3; 88% Heat Exchanger; 0.71 W/(l.s)
Building Elements				
Ground Floor (W/m^2K)	0.178		0.107	200 mm Xtratherm
Passage Way Floor to First Floor (W/m2K)	0.189		0.141	150 mm Xtratherm with concrete ceiling tile
Roofs (W/m^2K)	0.148		0.109	400 mm fibreglass
External Walls (W/m^2K)	0.18		0.109	150 mm Xtratherm Fullfill (OK with brick as agrement certificate) and 70 mm webertherm MFD
Doors (W/m^2K)	1.4		1.4	
Window- U-Value (W/m^2K)	0.74	Triple Glazed Unit (Ref:Futureproof Window) 4-20-4-20-4	0.74	Triple Glazed Unit (Ref:Futureproof Window) 4-20-4-20-4
Window- Solar Transmittance (G perp)	0.61		0.61	
Thermal bridging Factor (W/m^2k)	0.0816	Calculated Thermal Bridging Factor	0.0127	Calculated & Modelled Thermal Bridging Factor
Water Heating				
Cylinder volume (L)	385 L	Solar Heating System with 3.2 m2 of Kingspan Type Panel	500 L	Solar Heating System with 6.4 m2 of Kingspan Type Panel
Declared loss Factor (kWh/day)	Default		Default	
Cylinder Stat	Yes		Yes	
Separate Time Control of HW	Yes		Yes	
Primary Circuit Loss	Insulated and Cylinder Stat		Insulated and Cylinder Stat	
Lighting and Internal gains				
% of low energy fixed Lighting	100		100	
Net Space Heat Demand				
Thermal Mass Category	High	Calculated	High	
Distribution system loss and gains				
Heating System Control Category	Time and Temp		Time and Temp	
Heating System Responsiveness	Radiators		Radiators	
Central Heating Pump number	1		1	
Central Heating Pump Consumption	130		130	
Gas Boiler Flue Fan	1		1	
Energy Requirement-Space Heating				
Main Space Heating	Gas Boiler		Electricity	
Efficiency of Main Heating (%)	0.913		100.00	
Efficiency Adjustment Factor	1.02	with weather compensator	1.0	
Secondary Heating	None		None	
Efficiency of Secondary Heating (%)	---		---	
Energy Requirement-Water Heating				
Water Heating	Gas Boiler		Electricity	
Efficiency of Water Heating (%)	91.30		100.00	
Efficiency Adjustment Factor	1.02		1.0	
Energy Requirement-Renewable and Energy Saving Technologies				
Number of PV panels	0		2	Northwest Facing
Part L Total Contribution (Electrical kWh/y)	0.00		294	
Heat Pump Tool/Other Total (Thermal kWh/y)	0		155	Instantaneous Waste Heat Recovery System
Results				
Energy Label	A3		A2	
Energy Value ($kWh/m^2/yr$)	55		27	
CO_2 Emissions Indictor	10.54		5.62	
CPC	0.393		0.196	
EPC	0.363		0.194	
Part L renewable Contribution (kWh/m^2y)	12.2		21.8	

RESULTS SUMMARY



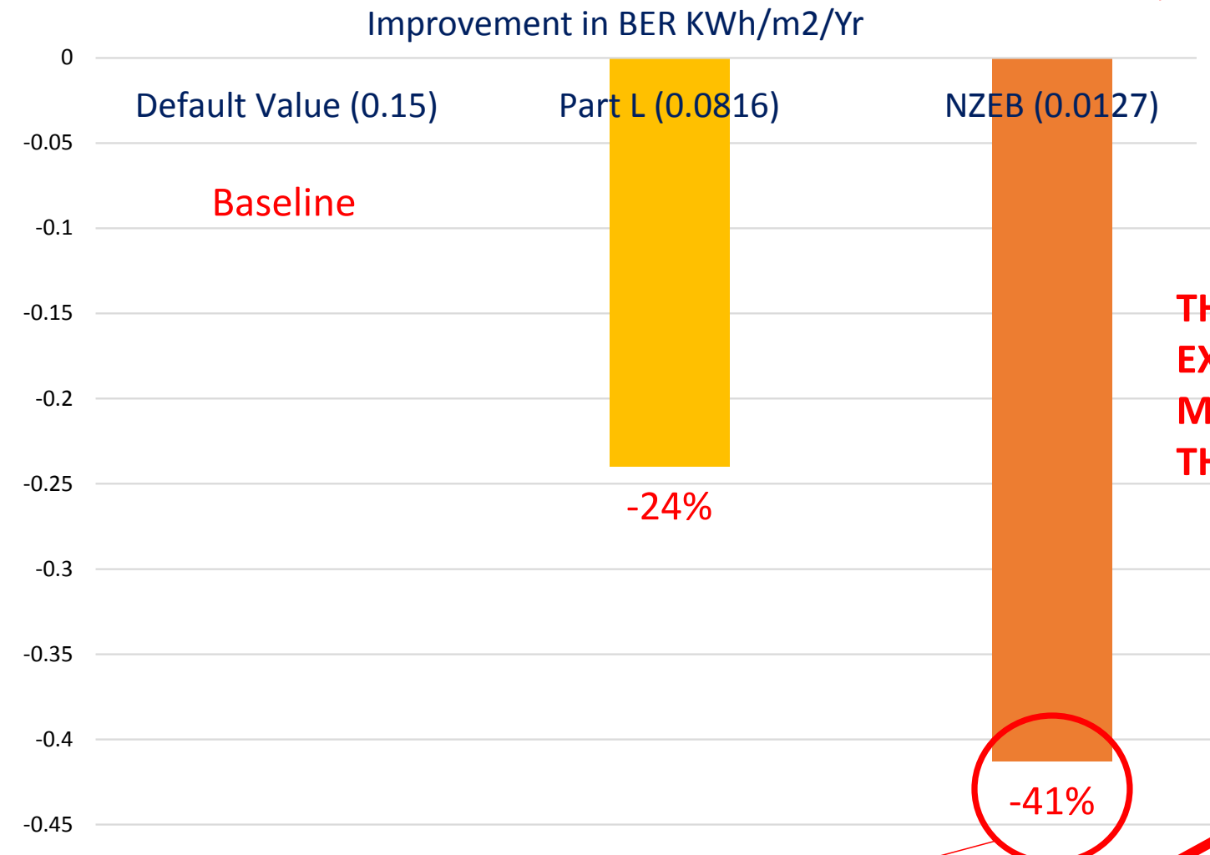
	Space Heating	Water Heating	Pumps and Fans	Lighting	PV Panel Offset	Waste Heat Recovery Offset	Total
KW/yr	193	2160	659	1432	-644	-171	3629

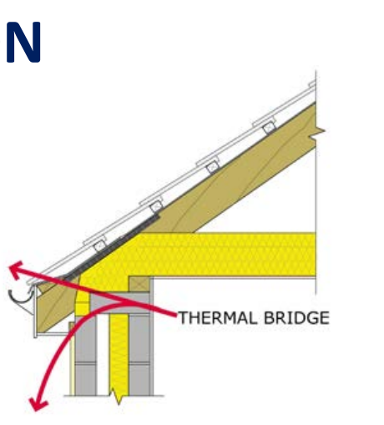
HOT WATER - PRIMARY ENERGY LOAD

STEP 3: DETAILED DESIGN AND SPECIFICATION

THERMAL BRIDGING

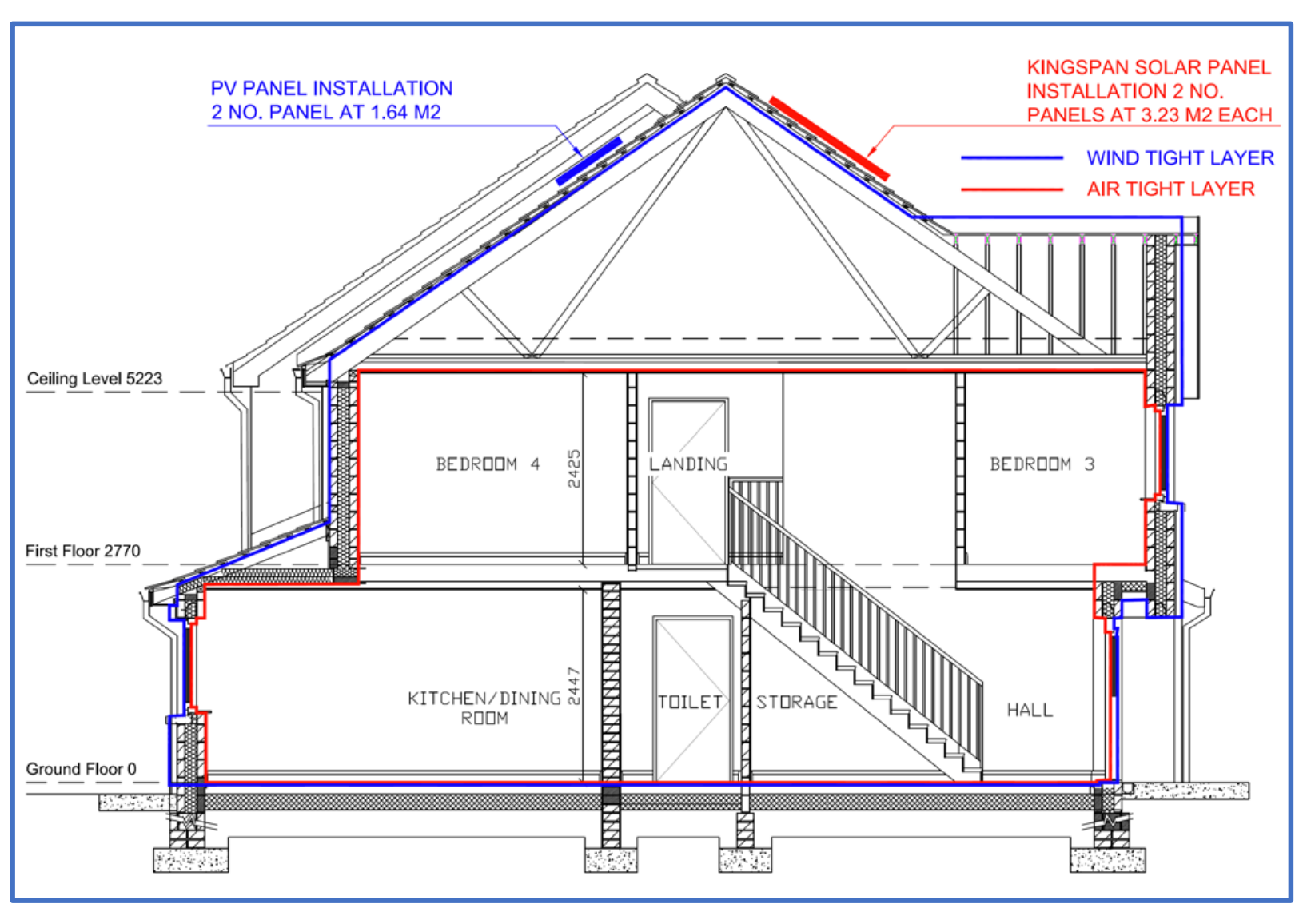
KEY DRIVER OF NZEB COMPLIANCE



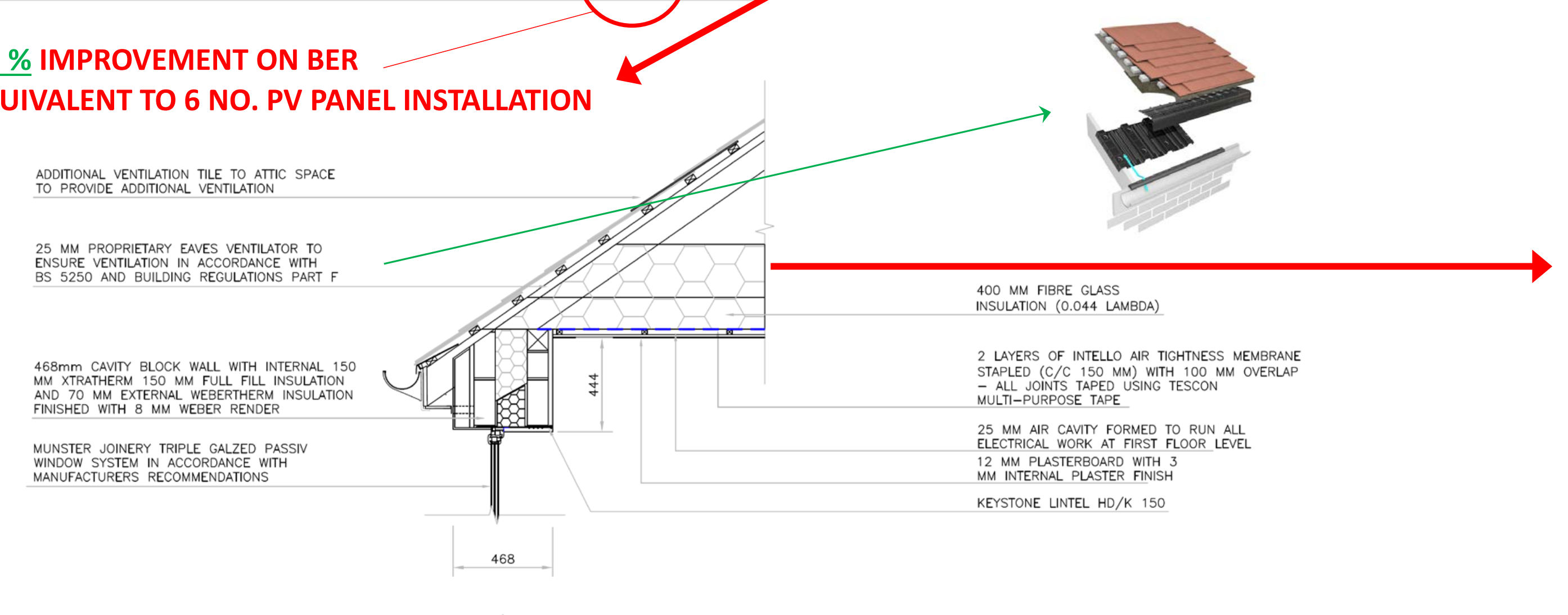


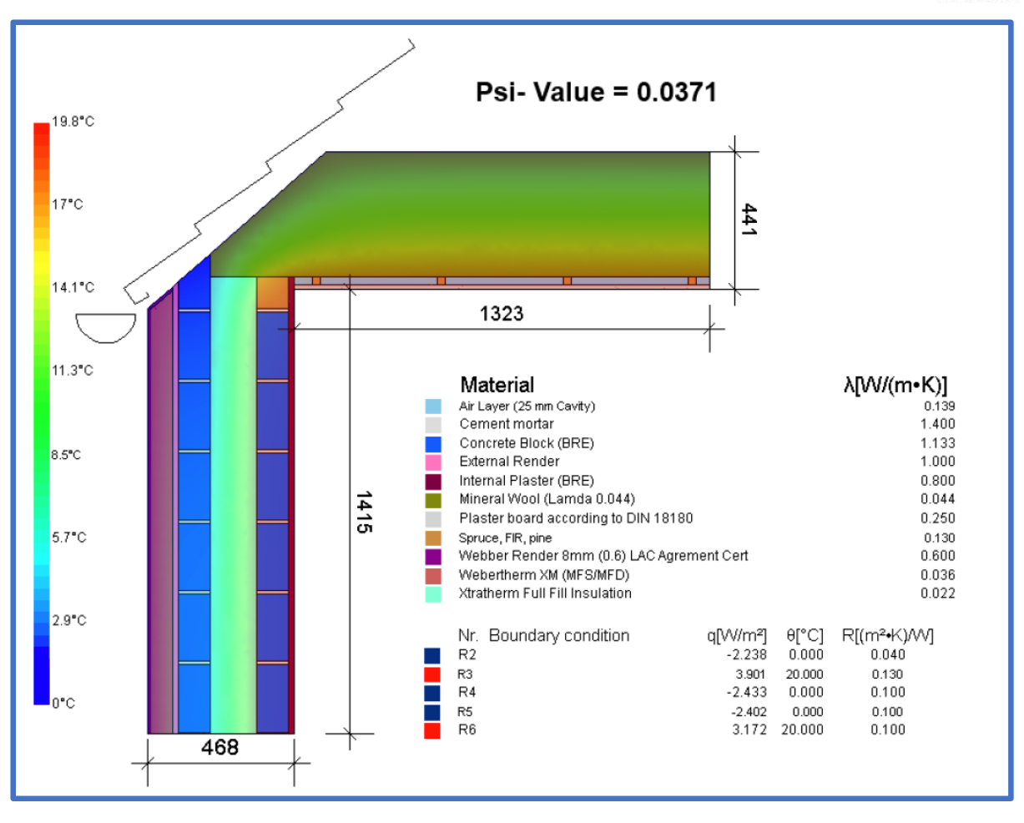
THERMOBLOCK, EXTERNAL INSULATION & MODELLING DRIVER OF THERMAL BRIDGING

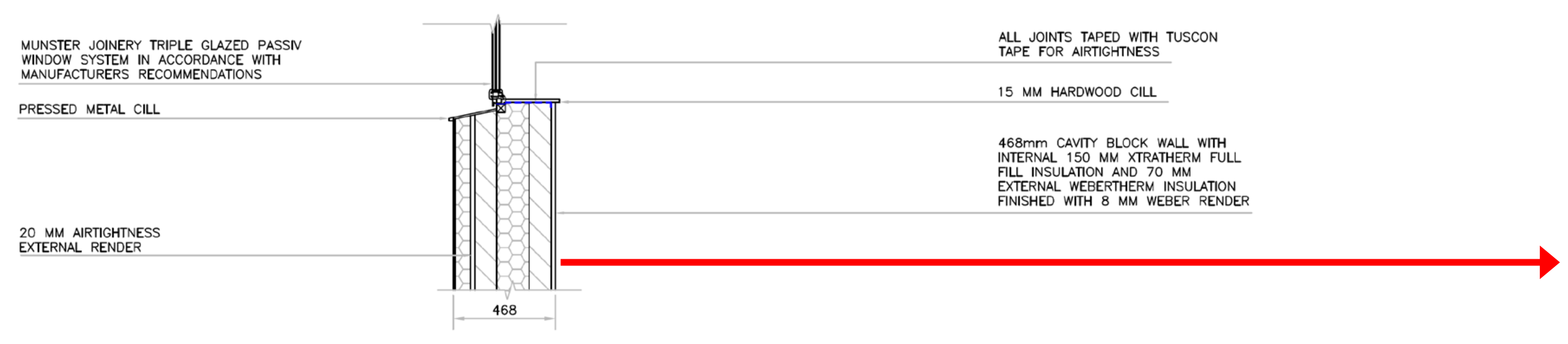
41 % IMPROVEMENT ON BER EQUIVALENT TO 6 NO. PV PANEL INSTALLATION

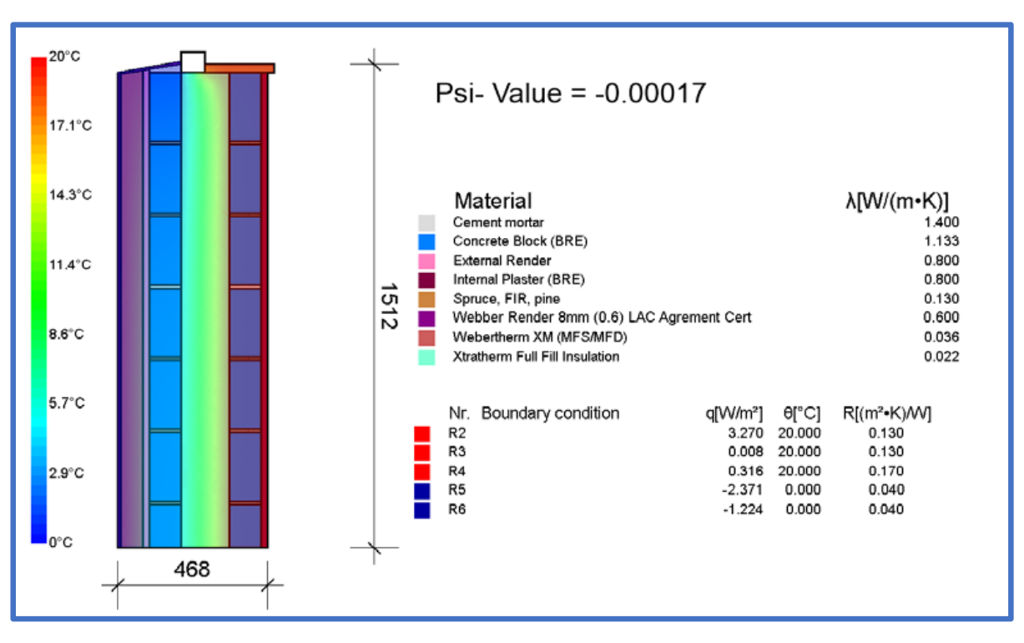


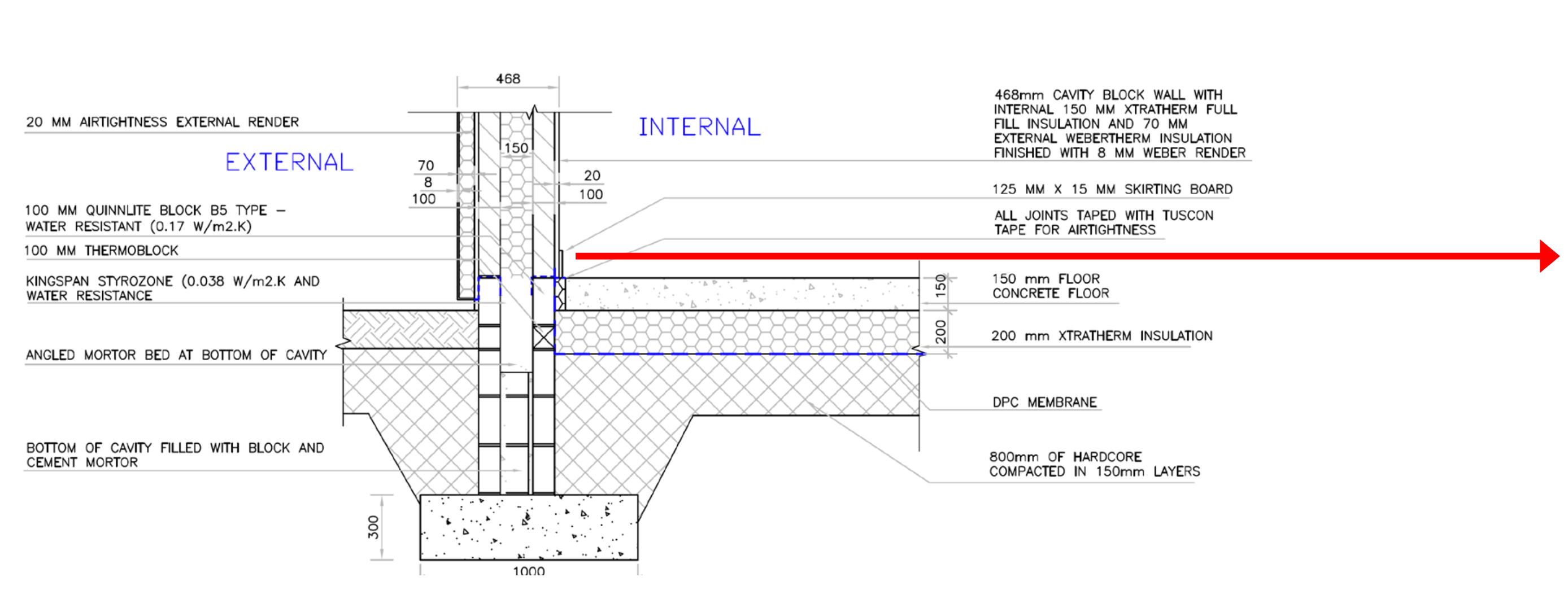
SECTION DRAWING

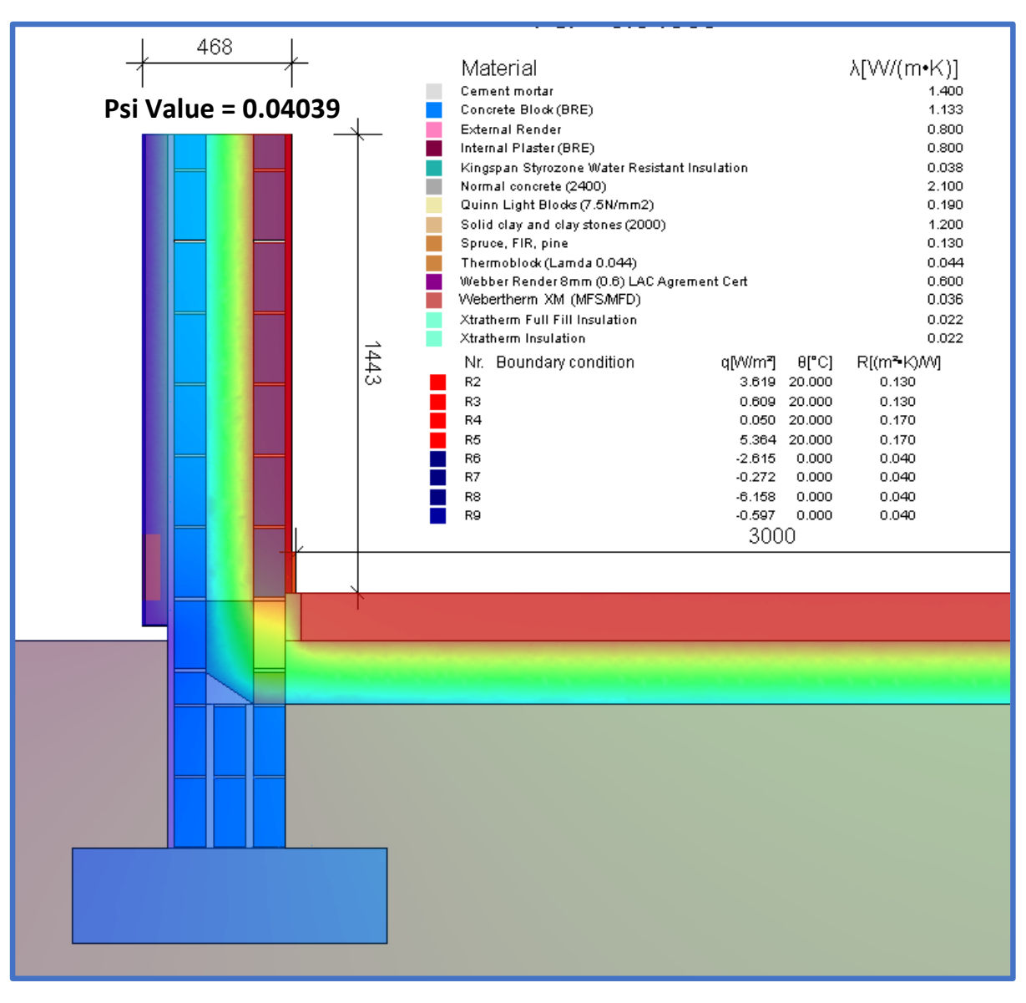




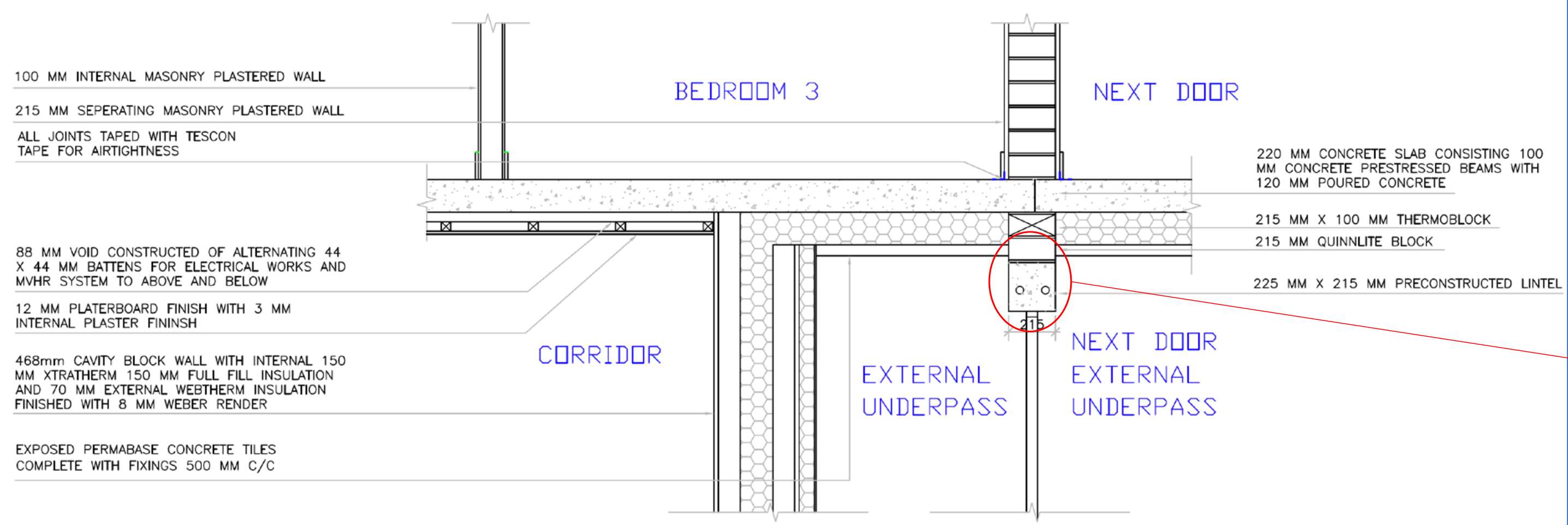


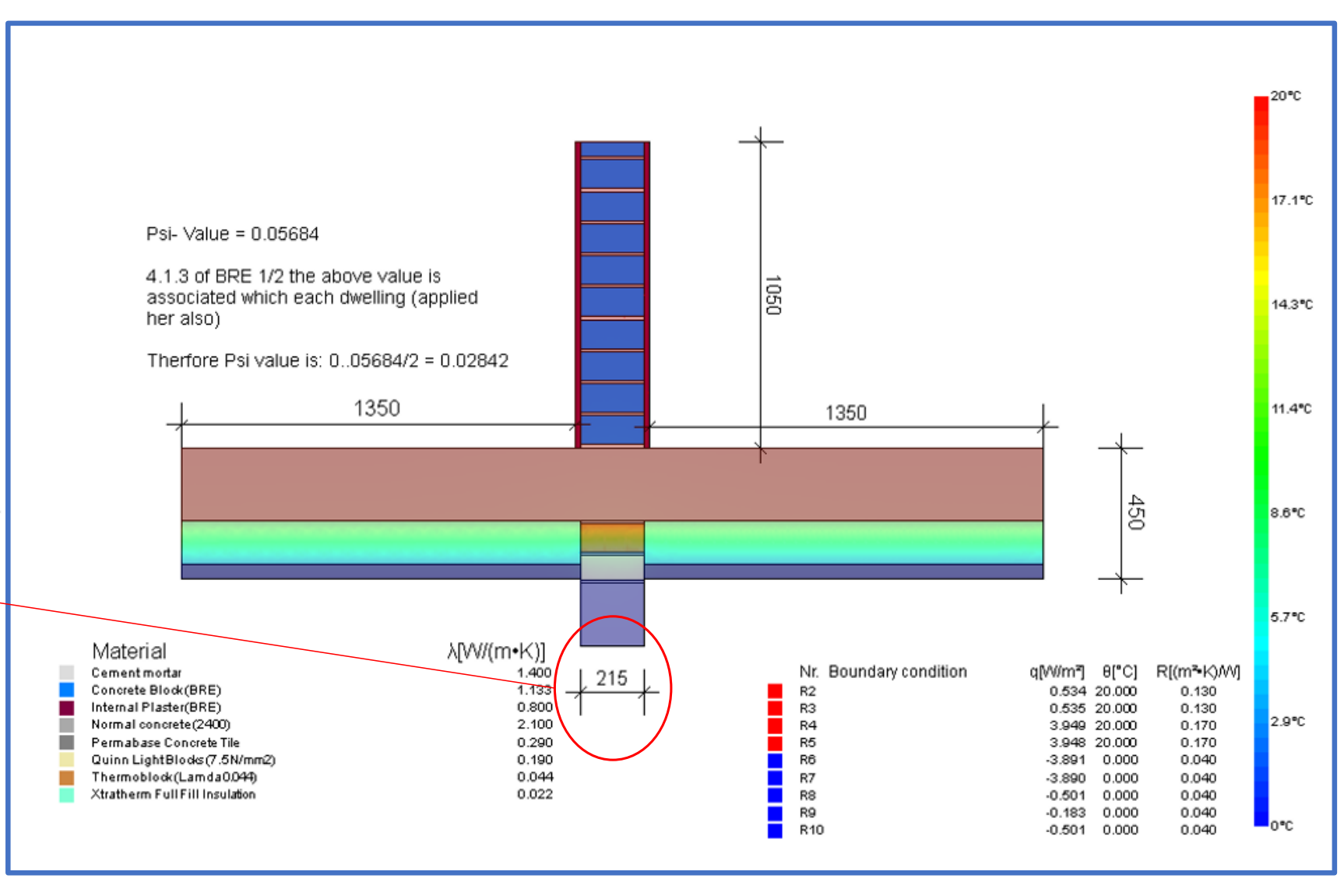






LONGITUDINAL SECTION OF EXTENRAL FAÇADE COMPLETE WITH ASSOCIATED THERMAL BRIDGE MODEL (BOTH AT SCALE 1:20)





UNDERPASS SECTION WITH ASSOCIATED THERMAL BRIDGE MODEL (BOTH AT SCALE 1:20)

THERMAL BRIDGING HEATLOSS REDUCED BY 85%

THERMAL BRIDGING SUMMARY

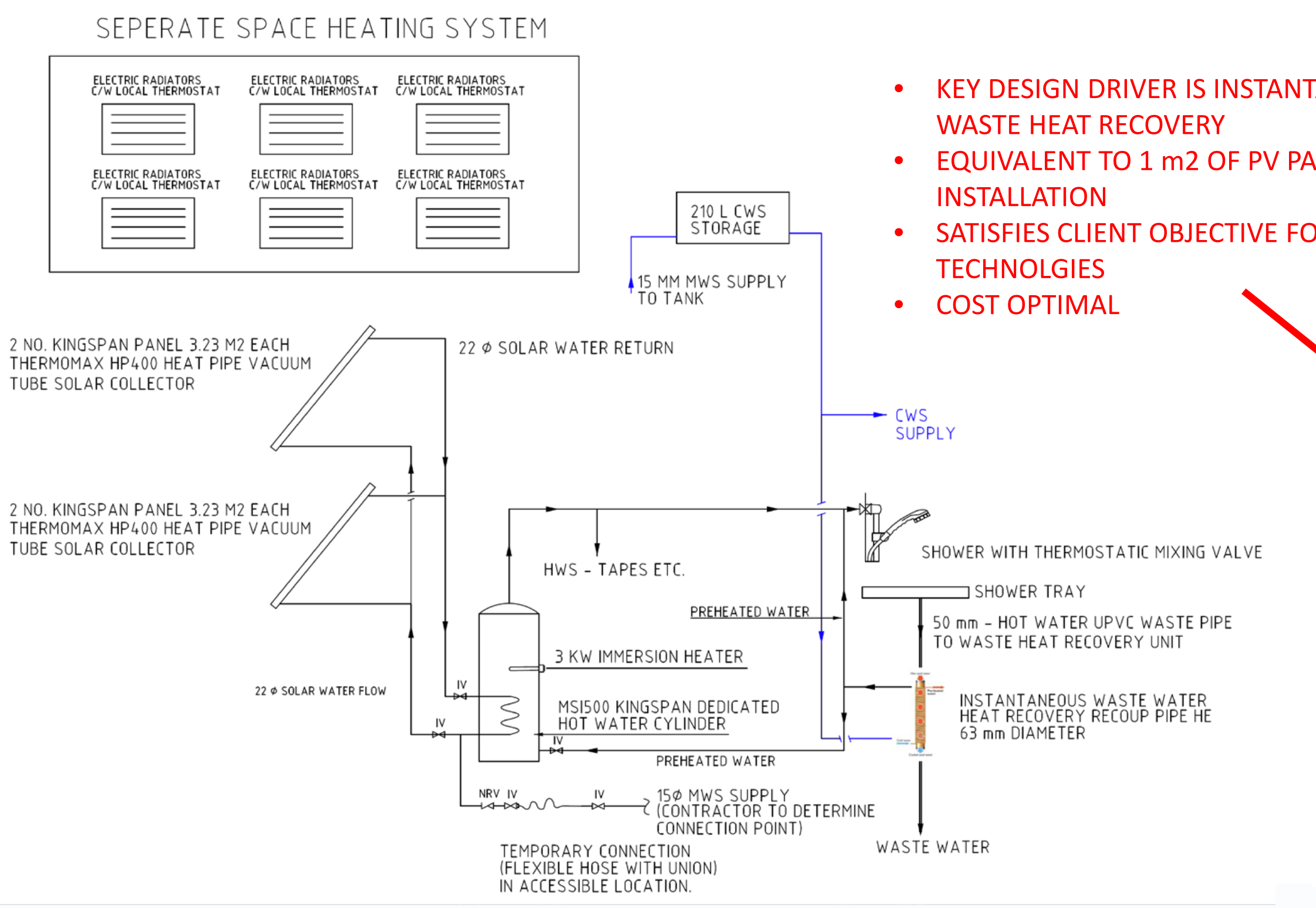
Ref:	Accredited Detail Reference and Junction Detail Description	Length	Accredited Detail Value	Enhanced Insulation and Thermally Modelled
1	1.02b: Ground Floor - Insulation below slab plus lightweight block - Floor Junction	26.300	0.0610	**0.04039**
2	1.06.1: Masonry Solid Separating Wall (plan) - To Adjacent Units	15.940	0.0660	**-0.00285**
3	1.09/1.10: Eaves – Unventilated/Ventilated attic - Junction of Eaves	16.380	0.0300	**0.03710**
4	1.04: Concrete Intermediate Floor within a dwelling - First Floor	34.500	0.0390	**-0.00493**
5	1.27.1: Corner - Corner Detail	14.120	0.0320	**0.01313**
6	1.27.2: Inverted corner - Inverted Corner Detail	10.420	-0.0530	**-0.09397**
7	1.07: Masonry Partition Wall - Masonry Wall to External	10.420	0.0000	**0.00000**
8	1.23.1: Ope - Pre-stressed concrete lintels - Window Heads (except first floor bay window)	14.480	0.0040	**0.00536**
9	1.22: Ope - Perforated steel lintel (stainless steel) - First Floor Window Head (Steel Lintel)	1.513	0.1380	**-0.01670**
10	1.24: Ope - Jamb with closer block - Side Jambs	25.718	0.0260	**0.01052**
11	1.26: Ope - Concrete Forward Sill - Sills Throughout	13.233	0.0060	**-0.00017**
12	G.01.2: Masonry Separating (solid) Wall Section to Attic	18.400	0.4880	**0.03400**
13	G.05.1: Solid Masonry Separating Wall through ground floor	9.130	0.2400	**0.24000**
14	1.27.2: Inverted corner - Underpass Inverted Corner detail	9.400	-0.0530	**-0.09397**
15	G.01.2: Masonry Separating (solid) Wall Head - Underpass Section	9.400	0.4580	**0.02842**
Total W/K			**20.3850**	**3.1819**
Total Envelope Area containing Thermal Bridges (m^2):			**249.85**	
Calculating Y Factor for Thermal Bridging [W/m^2K]:			**0.0816**	**0.0127**

PART L COMPLIANCE ACHIEVED

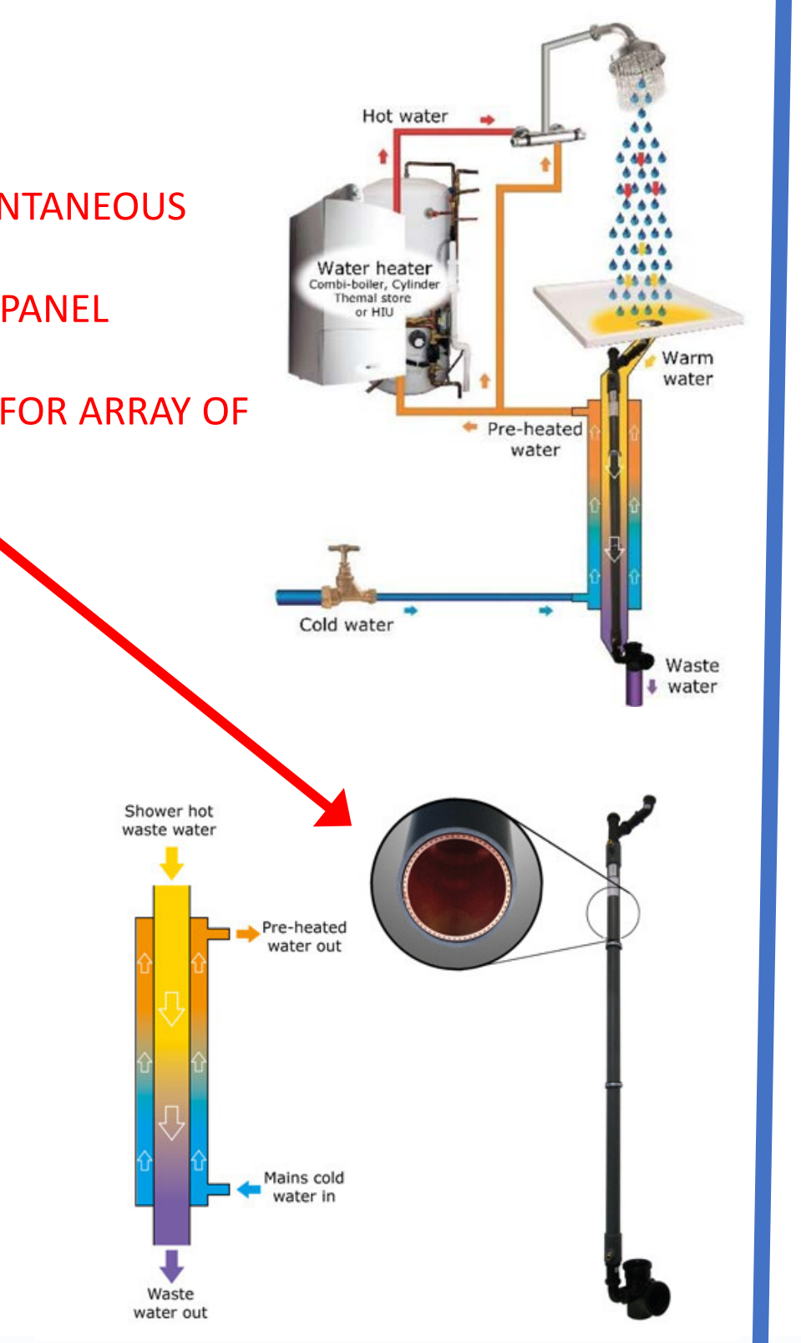
Frsi COMPLIANCE SCHEDULE

Ref:	Accredited Detail Reference and Junction Detail Description	Frsi Values
1	1.02b: Ground Floor - Insulation below slab plus lightweight block - Floor Junction	**0.93**
2	1.06.1: Masonry Solid Separating Wall (plan) - To Adjacent Units	**0.97**
3	1.09/1.10: Eaves – Unventilated/Ventilated attic - Junction of Eaves	**0.92**
4	1.04: Concrete Intermediate Floor within a dwelling - First Floor	**0.97**
5	1.27.1: Corner - Corner Detail	**0.95**
8	1.23.1: Ope - Pre-stressed concrete lintels - Window Heads (except first floor bay window)	**0.95**
9	1.22: Ope - Perforated steel lintel (stainless steel) - First Floor Window Head (Steel Lintel)	**0.97**
10	1.24: Ope - Jamb with closer block - Side Jambs	**0.89**
11	1.26: Ope - Concrete Forward Sill - Sills Throughout	**0.94**
12	G.01.2: Masonry Separating (solid) Wall Section to Attic	**0.95**
14	1.27.2: Inverted corner - Underpass Inverted Corner detail	**0.95**
15	G.01.2: Masonry Separating (solid) Wall Head - Underpass Section	**0.96**

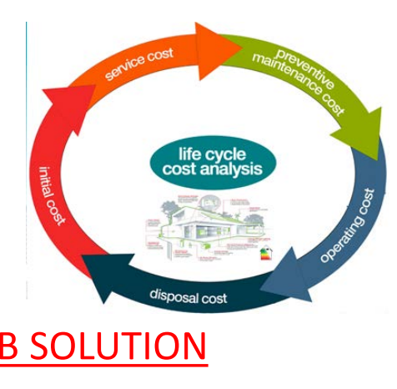
STEP 4: SERVICES STRATEGY



- KEY DESIGN DRIVER IS INSTANTANEOUS WASTE HEAT RECOVERY
- EQUIVALENT TO 1 m2 OF PV PANEL INSTALLATION
- SATISFIES CLIENT OBJECTIVE FOR ARRAY OF TECHNOLGIES
- COST OPTIMAL



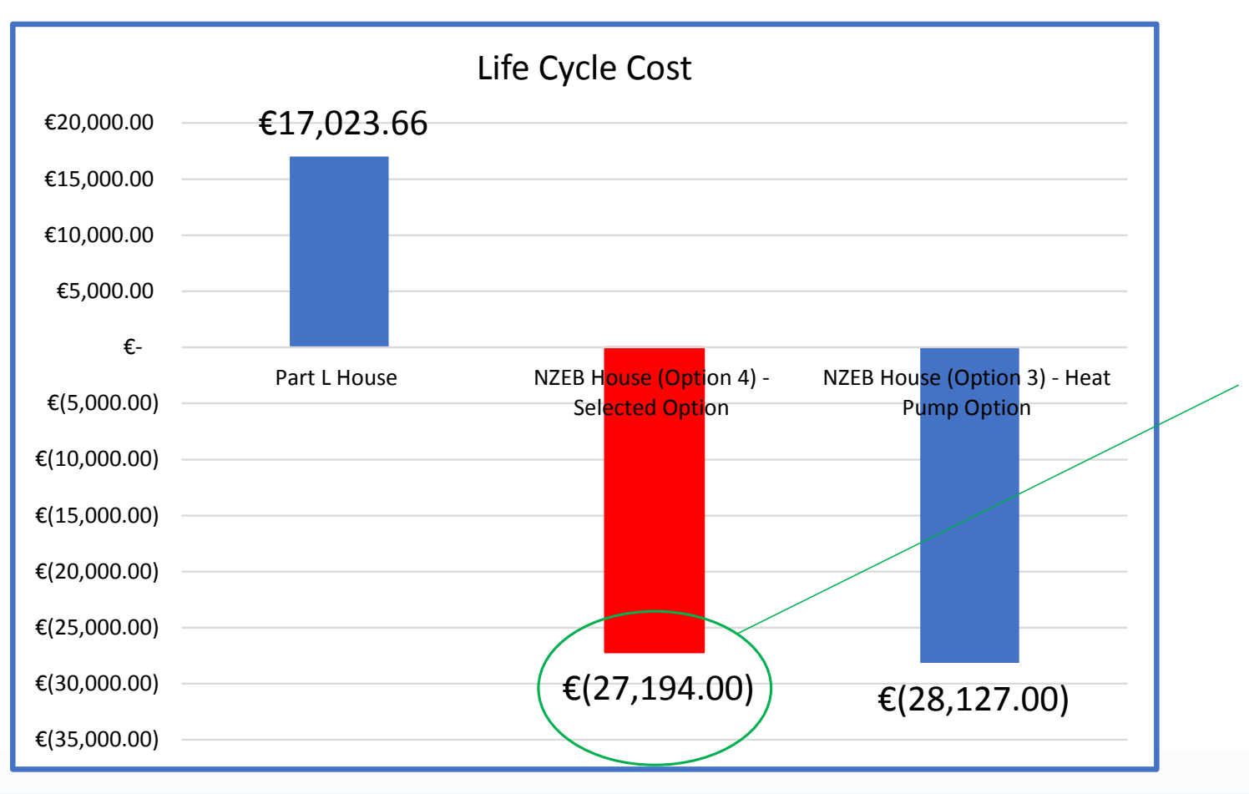
STEP 5: COST OPTIMAL STUDY



- PART L - COST OPTIMAL
- SELECTED NZEB OPTION AS MOST COST OPTIMAL NZEB SOLUTION
- GOVERNMENT POLICY CHANGE NEEDED

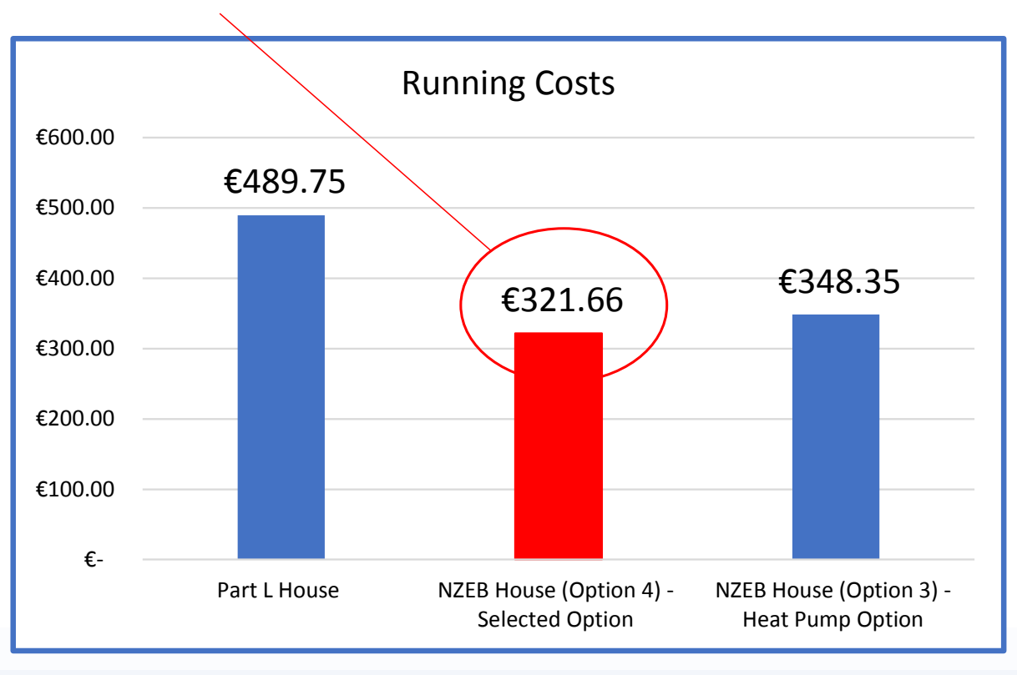
Government Policy Change Needed:

The cost analysis concluded particularly for retrofit there needs to be significant government investment via grants to meet the energy performance targets set out by the EU. The market itself is not a big enough driver. Also, a stimulant is required for landlord accommodation to drive energy projects within the landlord sector. The landlords themselves need to see a return on projects not just the occupants.



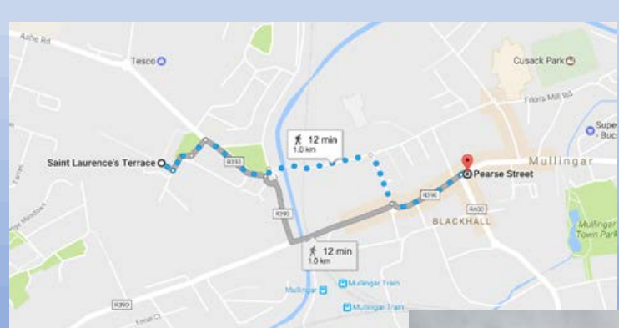
NZEB SELECTION MORE COST OPTIMAL THEN HEAT PUMP SOLUTION

NZEB HOUSE LOWEST RUNNING COSTS

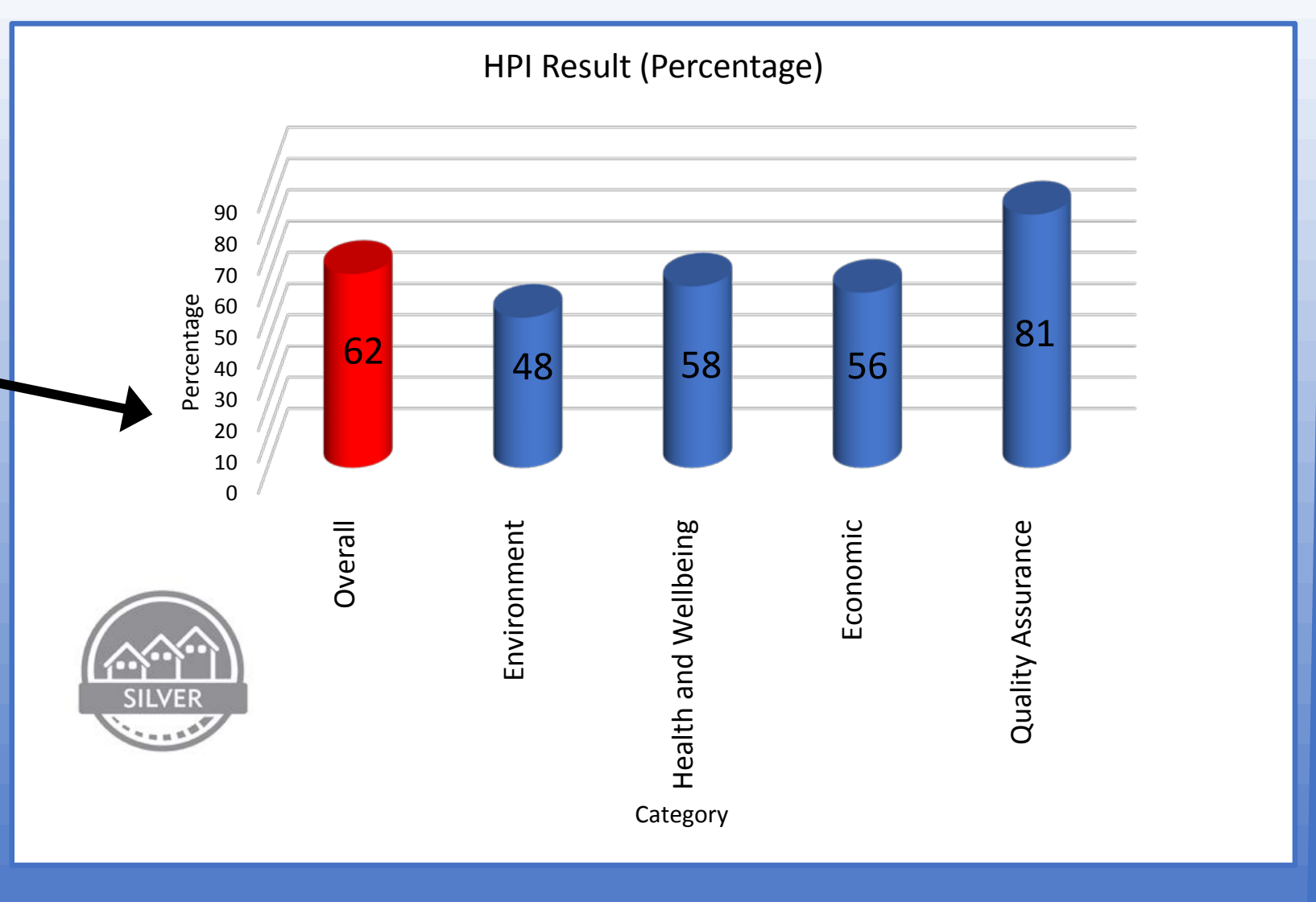


STEP 6: HPI CERTIFICATION

Certification to ***SILVER STANDARD***



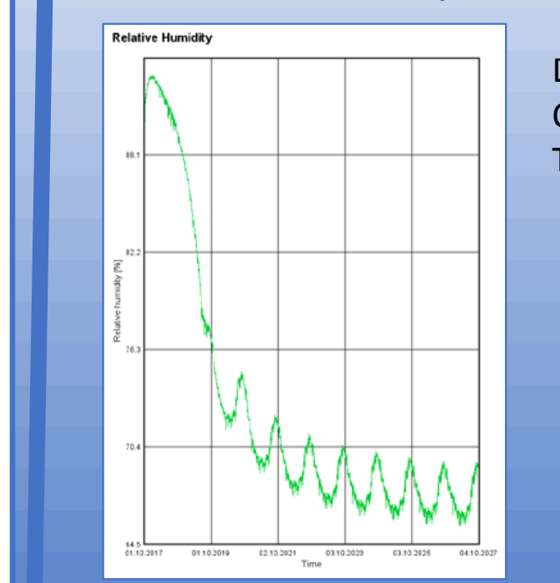
KEY DRIVERS: LOCATION AND QUALITY ASSURANCE



STEP 7: HYGROTHERMAL VERIFICATION

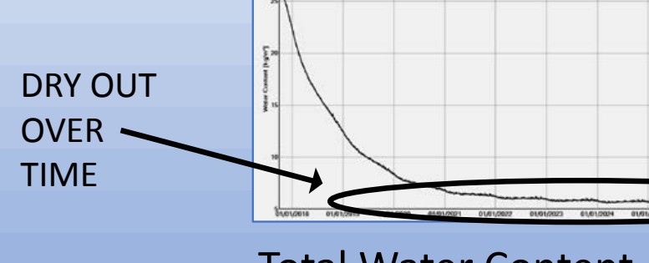
LOW RISK of Interstitial Condensation

External Wall Analysis

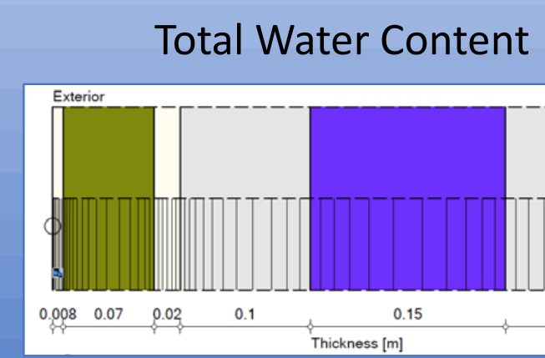


Relative Humidity

DRY OUT OVER TIME



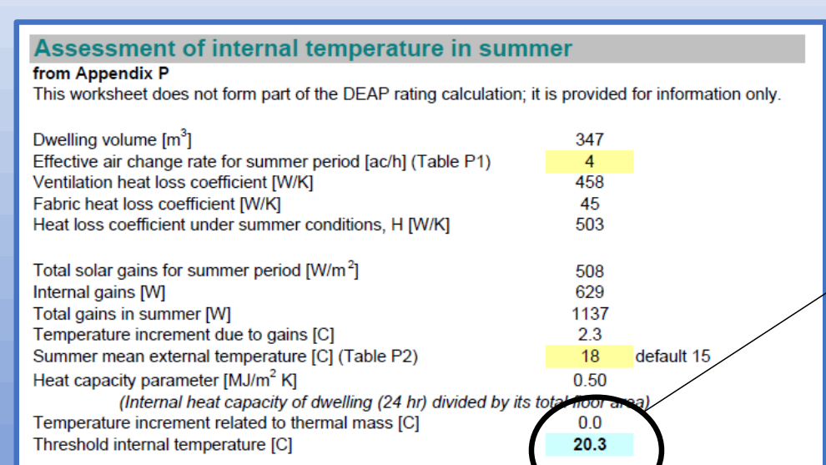
Total Water Content



Construction Layers

STEP 8: OVERHEATING RISK VERIFICATION

LOW RISK of overheating with Cross Ventilation Provided



Assessment of internal temperature in summer
from Appendix P
This worksheet does not form part of the DEAP rating calculation; it is provided for information only.

Dwelling volume [m^3]	347	
Effective air change rate for summer period [ac/h] (Table P1)	4	
Ventilation heat loss coefficient [W/K]	458	
Fabric heat loss coefficient [W/K]	45	
Heat loss coefficient under summer conditions, H [W/K]	503	
Total solar gains for summer period [W/m^2]	508	
Internal gains [W]	629	
Total gains in summer [W]	1137	
Temperature increment due to gains [C]	2.3	
Summer mean external temperature [C] (Table P2)	18	default 15
Heat capacity parameter [MJ/m^2 K]	0.50	
(Internal heat capacity of dwelling (24 hr) divided by its total floor area)		
Temperature increment related to thermal mass [C]	0.0	
Threshold internal temperature [C]	20.3	

MAX. TEMP = 20.3 C