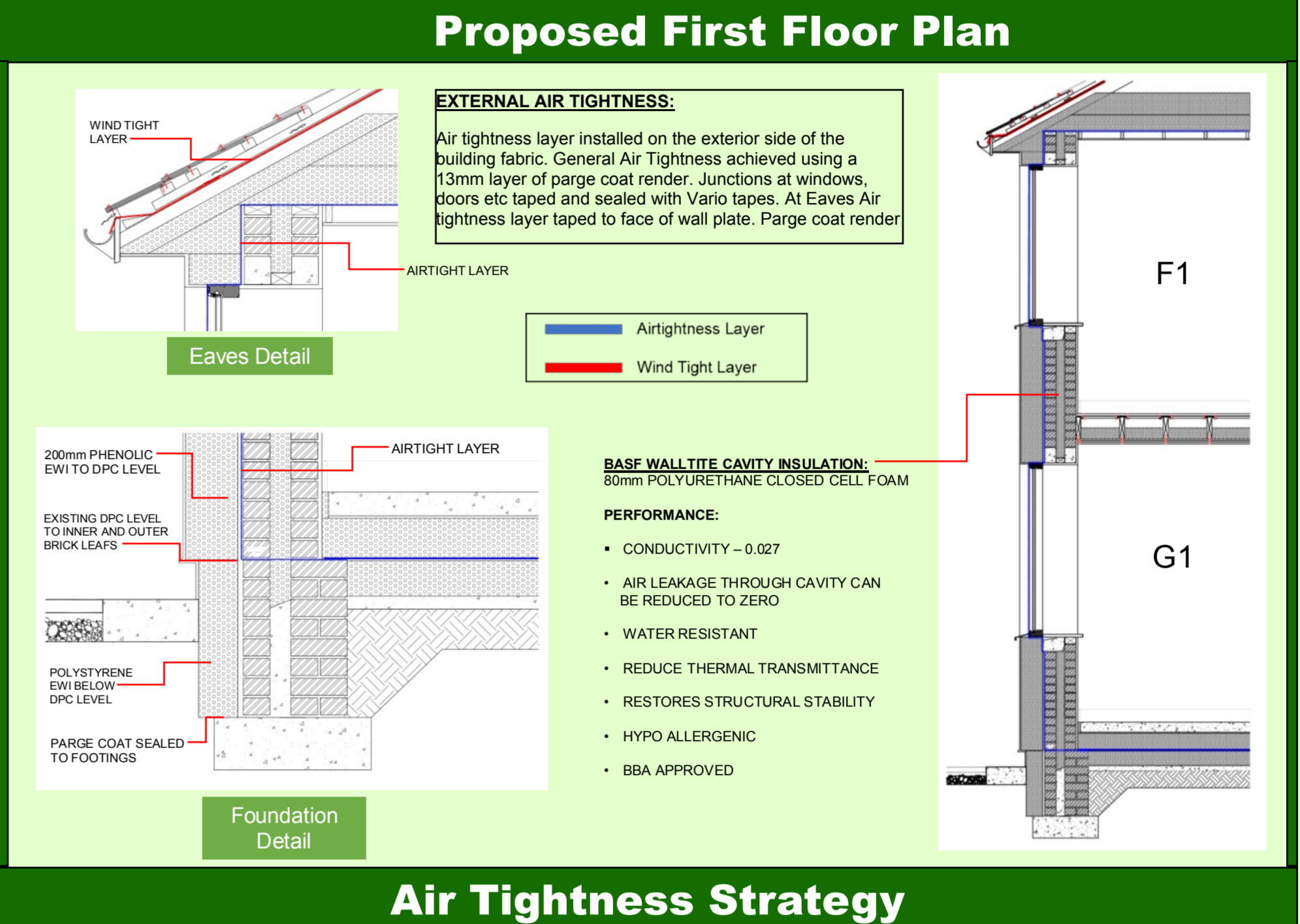


PROPOSED nZEB RETROFIT DESIGN



Proposed Southeast Elevation

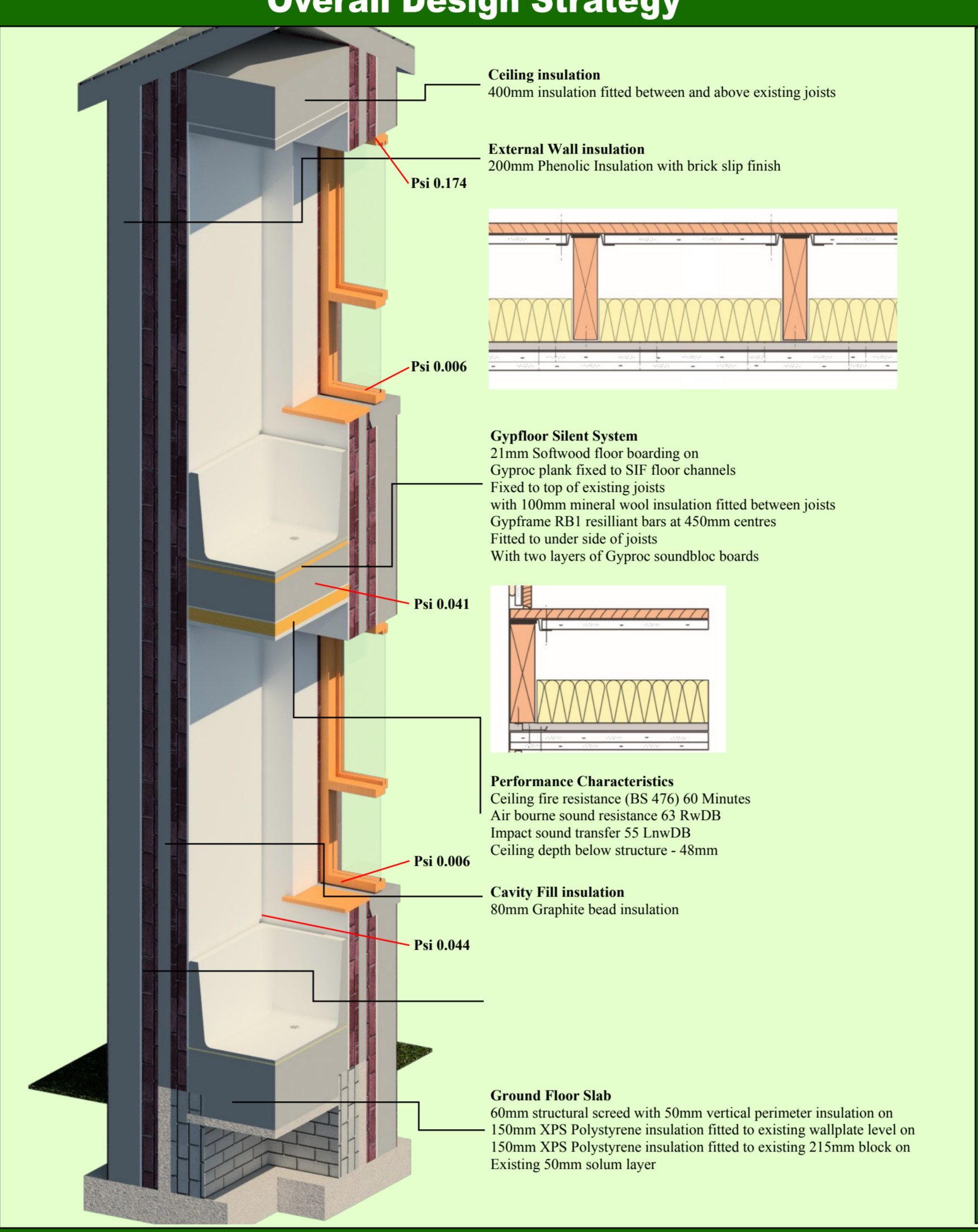
The overall design approach is to uncouple the Apartments reliance on fossil fuels by switching to 100% Electricity fuel supply for Space and water heating. This is achieved with the use of high efficiency farbo xana plus electric heaters and instantaneous point of use water heaters. The Buildings fabric performance for the enclosing elements is upgraded reducing the space heat requirement to a minimum. An Air Tightness target of 1.0 Air change per hour has been set and will be achieved with an external air tightness layer. Ventilation is upgraded using an Aereco whole house extract ventilation system with automatic humidity sensors and VOC activation. Space and Water heating is provided by a 100% electric system comprising of high efficiency farbo xana plus electric heaters and instantaneous point of use water heaters.



Apartment F1 - 73 Sq.m.

The overall design strategy for apartment F1 is to firstly upgrade the fabric performance for the enclosing elements reducing the space heat requirement to a minimum. An Air Tightness target of 1.0 Air change per hour has been set and will be achieved with an external air tightness layer. Ventilation is upgraded using an Aereco demand control ventilation system with automatic humidity sensors and VOC activation. Space and Water heating is provided by a 100% electric system comprising of high efficiency farbo xana plus electric heaters and instantaneous point of use water heaters.

Upgrade Measure	Details	DEAP Before Upgrade	DEAP After Upgrade	Energy Reduction
Replace existing suspended timber floor with highly insulated concrete floor	Improvement in U-value from 1.19 W/m2K to 0.28 W/m2K and improvement in floor area	329	315	14 kWh/m2y
Upgrade existing un-insulated 100mm gypcrete floor with 200mm mineral wool insulation and 100mm concrete screed	Improvement in U-value from 1.72 W/m2K to 0.18 W/m2K and improvement in floor area	315	215	100 kWh/m2y
Upgrade existing un-insulated 100mm gypcrete floor with 200mm mineral wool insulation and 100mm concrete screed	Improvement in U-value from 1.72 W/m2K to 0.18 W/m2K and improvement in floor area	215	191	24 kWh/m2y
Replace existing glazed windows and doors with triple glazed windows and doors	Improvement in U-value from 4.80 W/m2K to 0.85 W/m2K	191	153	38 kWh/m2y
Air Tightness improvement	Target value of 1.0 Ach	153	125	28 kWh/m2y
Space & Water heating upgrade	All Electric System including electric heaters & instantaneous point of use water heaters	125	141	-16 kWh/m2y
Installation of PV panels	2 x 4kW PV panels	141	77	64 kWh/m2y
Fit 100% low energy bulbs	100% L.E. bulbs	77	70	7 kWh/m2y
Revised Y Factor	Y Factor from 0.15 to 0.08 (ACD)	70	55	15 kWh/m2y
Ventilation Upgrade	New Aereco DCV	55	45	10 kWh/m2y



Apartment G1 - 72 Sq.m.

The overall design strategy for apartment G1 is to firstly upgrade the fabric performance for the enclosing elements reducing the space heat requirement to a minimum. An Air Tightness target of 1.0 Air change per hour has been set and will be achieved with an external air tightness layer. Ventilation is upgraded using an Aereco demand control ventilation system with automatic humidity sensors and VOC activation. Space and Water heating is provided by a 100% electric system comprising of high efficiency farbo xana plus electric heaters and instantaneous point of use water heaters.

Upgrade Measure	Details	DEAP Before Upgrade	DEAP After Upgrade	Energy Reduction
Replace existing suspended timber floor with highly insulated concrete floor	Improvement in U-value from 1.19 W/m2K to 0.28 W/m2K and improvement in floor area	208	243	35 kWh/m2y
Upgrade existing un-insulated 100mm gypcrete floor with 200mm mineral wool insulation and 100mm concrete screed	Improvement in U-value from 1.72 W/m2K to 0.18 W/m2K and improvement in floor area	243	173	70 kWh/m2y
Upgrade existing un-insulated 100mm gypcrete floor with 200mm mineral wool insulation and 100mm concrete screed	Improvement in U-value from 1.72 W/m2K to 0.18 W/m2K and improvement in floor area	173	138	35 kWh/m2y
Replace existing glazed windows and doors with triple glazed windows and doors	Improvement in U-value from 4.80 W/m2K to 0.85 W/m2K	138	114	24 kWh/m2y
Air Tightness improvement	Target value of 1.0 Ach	114	106	8 kWh/m2y
Space & Water heating upgrade	All Electric System including electric heaters & instantaneous point of use water heaters	106	137	-31 kWh/m2y
Installation of PV panels	2 x 4kW PV panels	137	77	60 kWh/m2y
Fit 100% low energy bulbs	100% L.E. bulbs	77	73	4 kWh/m2y
Revised Y Factor	Y Factor from 0.15 to 0.08 (ACD)	73	54	19 kWh/m2y
Ventilation Upgrade	New Aereco DCV	54	44	10 kWh/m2y

DEAP Analysis - Apartment F1

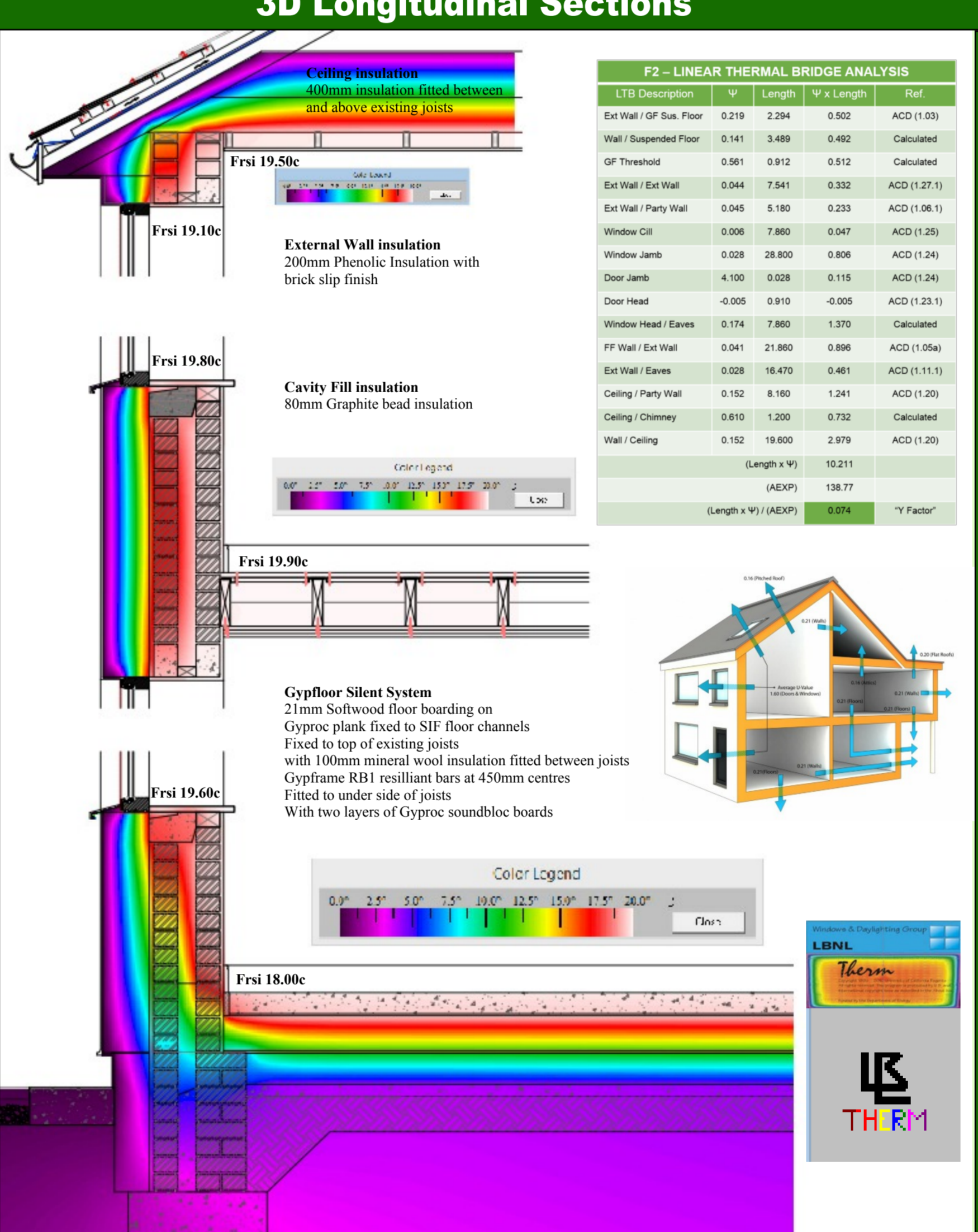
BASELINE DEAP ANALYSIS									
Delivered Energy Total - kWh/y	Delivered Energy Per M ² - kWh/M ² y	Primary Energy Total - kWh/y	Primary Energy Per M ² - kWh/M ² y	CO ₂ Emissions kg/y	CO ₂ Emissions Per M ² - kg/M ² y	BER Rating	kWh/M ² y	EPC	CPC
19513	265.4	22508	329.16	4215	61.64	E1	329	1.951	1.763

nZEB DEAP ANALYSIS									
Delivered Energy Total - kWh/y	Delivered Energy Per M ² - kWh/M ² y	Primary Energy Total - kWh/y	Primary Energy Per M ² - kWh/M ² y	CO ₂ Emissions kg/y	CO ₂ Emissions Per M ² - kg/M ² y	BER Rating	kWh/M ² y	EPC	CPC
1322	18.1	3239	44.25	734	10.02	A2	44	0.261	0.282

F1 - PRIMARY ENERGY BALANCE

F1 nZEB Retrofit from Baseline Data

Floor Area: 73.00 Sq.m
Primary Energy: 44 kWh/m²y
CO₂: 10.02 kg/m²y
BER Rating: **A2 BER**
EPC (Max 0.400): 0.261
CPC (Max 0.460): 0.282



DEAP Analysis - Apartment G1

BASELINE DEAP ANALYSIS									
Delivered Energy Total - kWh/y	Delivered Energy Per M ² - kWh/M ² y	Primary Energy Total - kWh/y	Primary Energy Per M ² - kWh/M ² y	CO ₂ Emissions kg/y	CO ₂ Emissions Per M ² - kg/M ² y	BER Rating	kWh/M ² y	EPC	CPC
16147	226.3	18745	257.54	3517	55.83	D2	298	1.74	1.578

nZEB DEAP ANALYSIS									
Delivered Energy Total - kWh/y	Delivered Energy Per M ² - kWh/M ² y	Primary Energy Total - kWh/y	Primary Energy Per M ² - kWh/M ² y	CO ₂ Emissions kg/y	CO ₂ Emissions Per M ² - kg/M ² y	BER Rating	kWh/M ² y	EPC	CPC
1163	17.2	2850	42.22	646	9.56	A2	42	0.248	0.269

G1 - PRIMARY ENERGY BALANCE

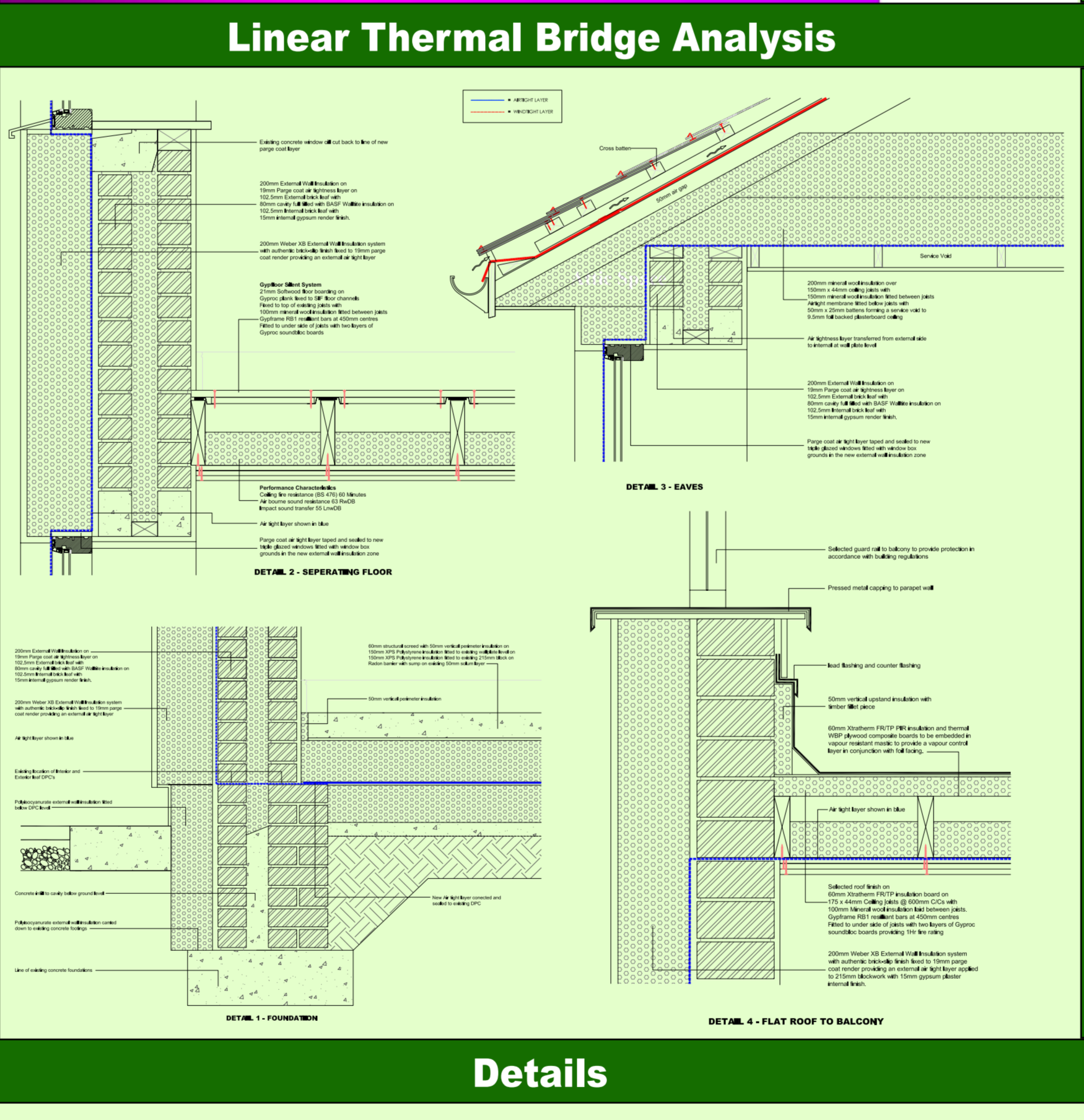
G1 nZEB Retrofit from Baseline Data

Floor Area: 72.00 Sq.m
Primary Energy: 44 kWh/m²y
CO₂: 9.94 kg/m²y
BER Rating: **A2 BER**
EPC (Max 0.400): 0.265
CPC (Max 0.460): 0.288

Apartment F2 - 68 Sq.m.

Apartment F2 has recently been upgraded by BRE Scotland improving the DEAP rating from a baseline rating of E1 with a primary energy of 329 kWh/m²y to a current rating of A2 with a primary energy of 49 kWh/m²y. To achieve nZEB the apartments primary energy is required to be 45 kWh/m²y or less, as the property is so close to its desired energy target then using calculated values for DEAP instead of default values will suffice. However some upgrades like air tightness have been proposed as they will cost effectively improve the property. As a result two PV panels fitted during the BRE upgrade can be deducted to apartment G2.

Upgrade Measure	Details	DEAP Before Upgrade	DEAP After Upgrade	Energy Reduction
Replace existing suspended timber floor with highly insulated concrete floor	Improvement in U-value from 1.19 W/m2K to 0.28 W/m2K and improvement in floor area	48	46	2 kWh/m2y
Upgrade existing un-insulated 100mm gypcrete floor with 200mm mineral wool insulation and 100mm concrete screed	Improvement in U-value from 1.72 W/m2K to 0.18 W/m2K and improvement in floor area	46	39	7 kWh/m2y
Air Tightness improvement	Target value of 0.5 Ach	39	35	4 kWh/m2y
Revised Y Factor	Improvement from 0.15 to 0.074	35	33	2 kWh/m2y
Water Cylinder (loss reduced)	Manufacturers declared losses	33	28	5 kWh/m2y
Insulated Doors for Windows & Doors	New Frames (Double 0.85 & Door 0.80)	28	23	5 kWh/m2y
Duration of PV panels to Apt G2	2 x PV panels = 0.544 kw	23	42	19 kWh/m2y



DEAP Analysis - Apartment G2

BASELINE DEAP ANALYSIS									
Delivered Energy Total - kWh/y	Delivered Energy Per M ² - kWh/M ² y	Primary Energy Total - kWh/y	Primary Energy Per M ² - kWh/M ² y	CO ₂ Emissions kg/y	CO ₂ Emissions Per M ² - kg/M ² y	BER Rating	kWh/M ² y	EPC	CPC
16147	226.3	18745	257.54	3517	55.83	D2	298	1.74	1.578

BRE UPGRADE									
Delivered Energy Total - kWh/y	Delivered Energy Per M ² - kWh/M ² y	Primary Energy Total - kWh/y	Primary Energy Per M ² - kWh/M ² y	CO ₂ Emissions kg/y	CO ₂ Emissions Per M ² - kg/M ² y	BER Rating	kWh/M ² y	EPC	CPC
1344	19.9	3294	45.8	746	11.05	A2	49	0.291	0.316

nZEB DEAP ANALYSIS									
Delivered Energy Total - kWh/y	Delivered Energy Per M ² - kWh/M ² y	Primary Energy Total - kWh/y	Primary Energy Per M ² - kWh/M ² y	CO ₂ Emissions kg/y	CO ₂ Emissions Per M ² - kg/M ² y	BER Rating	kWh/M ² y	EPC	CPC
4850	60.1	11883	196.35	2692	44.48	C2	196	1.147	1.247

nZEB DEAP ANALYSIS									
Delivered Energy Total - kWh/y	Delivered Energy Per M ² - kWh/M ² y	Primary Energy Total - kWh/y	Primary Energy Per M ² - kWh/M ² y	CO ₂ Emissions kg/y	CO ₂ Emissions Per M ² - kg/M ² y	BER Rating	kWh/M ² y	EPC	CPC
1074	17.7	2631	43.47	596	9.85	A2	43	0.249	0.27

G2 - PRIMARY ENERGY BALANCE

G2 nZEB Retrofit from BRE Upgrade Data

Floor Area: 61.00 Sq.m
Primary Energy: 43 kWh/m²y
CO₂: 9.85 kg/m²y
BER Rating: **A2 BER**
EPC (Max 0.400): 0.249
CPC (Max 0.460): 0.270

DEAP Analysis - Apartment F2

BASELINE DEAP ANALYSIS									
Delivered Energy Total - kWh/y	Delivered Energy Per M ² - kWh/M ² y	Primary Energy Total - kWh/y	Primary Energy Per M ² - kWh/M ² y	CO ₂ Emissions kg/y	CO ₂ Emissions Per M ² - kg/M ² y	BER Rating	kWh/M ² y	EPC	CPC
19513	285.4	22508	329.16	4215	61.64	E1	329	1.951	1.763

BRE UPGRADE									
Delivered Energy Total - kWh/y	Delivered Energy Per M ² - kWh/M ² y	Primary Energy Total - kWh/y	Primary Energy Per M ² - kWh/M ² y	CO ₂ Emissions kg/y	CO ₂ Emissions Per M ² - kg/M ² y	BER Rating	kWh/M ² y	EPC	CPC
1344	19.9	3294	45.8	746	11.05	A2	49	0.291	0.316

nZEB DEAP ANALYSIS									
Delivered Energy Total - kWh/y	Delivered Energy Per M ² - kWh/M ² y	Primary Energy Total - kWh/y	Primary Energy Per M ² - kWh/M ² y	CO ₂ Emissions kg/y	CO ₂ Emissions Per M ² - kg/M ² y	BER Rating	kWh/M ² y	EPC	CPC
1163	17.2	2850	42.22	646	9.56	A2	42	0.248	0.269

F2 - PRIMARY ENERGY BALANCE

F2 nZEB Retrofit from BRE Upgrade Data

Floor Area: 68.00 Sq.m
Primary Energy: 42 kWh/m²y
CO₂: 9.56 kg/m²y
BER Rating: **A2 BER**
EPC (Max 0.400): 0.248
CPC (Max 0.460): 0.269

